FEASIBILITY STUDY REPORT

FOR

FORMER NUHART PLASTIC MANUFACTURING SITE
280 FRANKLIN STREET
BROOKLYN, NEW YORK

NYSDEC SITE # 224136

PREPARED FOR

DUPONT STREET DEVELOPERS, LLC

PREPARED BY

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LIST OF ACRONYMS

Acronym	Definition
ARARs	Applicable or Relevant and Appropriate Requirements
AS	Air Sparging
AST	Aboveground Storage Tank
C&D	Construction & Demolition
CAMP	Community Air Monitoring Plan
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
CFR	Code of Federal Regulations
CHASP	Construction Health and Safety Plan
CO	Certificate of Occupancy
CVOC	Chlorinated Volatile Organic Compound
DEHP	bis(2-ethylhexyl) phthalate
DOP	di-n-octyl phthalate
EC	Engineering Control
EIMS	Electronic Information Management System
ELAP	Environmental Laboratory Accreditation Program
ERH	Electrical Resistivity Heating
ESA	Environmental Site Assessment
FDNY	New York City Fire Department
FPM	FPM Engineering Group, P.C.
FS	Feasibility Study
GPR	Ground Penetrating Radar
GRA	General Response Action
HASP	Health and Safety Plan
IBC	Intermediate Bulk Container
IC	Institutional Control
IDW	Investigation Derived Waste
IRM	Interim Remedial Measure
K	Hydraulic Conductivity
LNAPL	Light Non-Aqueous-Phase Liquid
MSL	Mean Sea Level
NYC DEP	New York City Department of Environmental Protection
NYCRR	New York Code of Rules and Regulations
NYC OER	New York City Office of Environmental Remediation
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSDOT	New York State Department of Transportation
OSHA	United States Occupational Health and Safety Administration

Acronym	Definition
PAHs	Polycyclic Aromatic Hydrocarbons
PBS	Petroleum Bulk Storage
PCBs	Polychlorinated Biphenyls
PE	Professional Engineer
PID	Photoionization Detector
PPE	Personal Protective Equipment
QEP	Qualified Environmental Professional
RAO	Remedial Action Objective
RAP	Remedial Action Plan
RCA	Recycled Concrete Aggregate
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROD	Record of Decision
ROI	Radius of Influence
RR	Restricted Residential
SCFM	Standard Cubic Feet per Minute
SCGs	Standards, Criteria and Guidance
SCOs	Soil Cleanup Objectives
SMP	Site Management Plan
SPDES	State Pollutant Discharge Elimination System
SSDS	Sub-Slab Depressurization System
SVE	Soil Vapor Extraction
SVI	Soil Vapor Intrusion
SVOCs	Semivolatile Organic Compounds
USCS	Unified Soil Classification System
USGS	United States Geological Survey
UST	Underground Storage Tank
UU	Unrestricted Use
TAGM	Technical Administrative Guidance Memorandum
TAL	Target Analyte List
TCE	Trichloroethylene
TCL	Target Compound List
VOCs	Volatile Organic Compounds

FEASIBILITY STUDY REPORT

Prepared for

Facility: Former NuHart Plastic Manufacturing Site
280 Franklin Street
Brooklyn, New York
NYSDEC Site # 224136

FPM File No: 1134g-14-07

CERTIFICATION

I KEVIN LOYST certify that I am currently a NYS registered professional engineer as defined in 6 NYCRR Part 375 and that this Feasibility Study (FS) was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10) and that all FS activities were performed in full accordance with any DER-approved work plans for such activities.

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SECTION 1.0
INTRODUCTION AND BACKGROUND INFORMATION

This Feasibility Study (FS) Report has been prepared by FPM Engineering Group, P.C. (FPM) for New York State Department of Environmental Conservation (NYSDEC) Inactive Hazardous Waste Disposal Site #224136, identified as the Former NuHart Plastic Manufacturing Site located at 280 Franklin Street, Brooklyn, New York (Site). This FS Report was prepared to evaluate potential remedial alternatives for the Site based on the results of the Remedial Investigation (RI) and other NYSDEC-approved investigations completed for the Site and offsite vicinity and includes recommendations for the preferred remedial alternative.

Site background information was obtained from the RI Report and previous Site-related documents and is presented in summary form herein. It should be noted that certain information presented in the RI Report required clarification. Additional investigations were also performed following the RI. These issues are addressed in Section 2.

1.1 Site Location and Description

The subject Site is identified as the Former NuHart Plastic Manufacturing Site located at 280 Franklin Street in the Greenpoint area of Brooklyn, New York 11222 and is owned by Dupont Street Developers LLC. The approximately one-acre Site (240 feet by 200 feet) is identified on the Brooklyn Borough tax map as Block 2487, and Lots 1, 10, 12, 72 and 78. The Site is comprised of the western portion of a vacant industrial building complex (the former NuHart Plastic manufacturing facility). A Site Location Map is provided as Figure 1.1.1.

The Site is located in a heavily-developed area of Brooklyn and is bordered to the north by Clay Street, to the west by Franklin Street, to the south by Dupont Street, and to the east by other portions of the former NuHart Plastic manufacturing facility, as shown on Figure 1.1.1. Across Clay Street to the north are commercial and industrial buildings. Across Franklin Street to the west is a New York City park (Greenpoint Playground). Across Dupont Street to the south are multi-family residences. Across the intersection of Franklin Street and Dupont Street to the southwest is a vacant property which may be redeveloped for use as a school.

The Site is entirely covered by a complex of industrial buildings that were constructed at different times. The Site is underlain by sub-grade footings, utility networks, closed underground storage tanks (USTs), and piping and trench systems. The USTs and trench systems were cleaned out and the USTs were closed in accordance with applicable regulations in 2006. The Site is serviced by the municipal water service and a municipal sewer system.

Former industrial operations at the Site has impacted onsite and offsite soil and groundwater with phthalates and lubricating oil (Hecla oil), most likely released from the tank and piping/trench systems. Phthalates and a phthalate/oil mixture are present in soil and as a light non-aqueous-phase liquid (LNAPL) plume floating on the groundwater surface. Dissolved groundwater contamination is generally limited to phthalates and localized impacts by chlorinated solvents. The chlorinated solvent release area appears to be in or near the northeastern portion of the Site.

The Site was entered into the NYSDEC Inactive Hazardous Waste Disposal Site Remedial Program in April 2009. Ongoing investigation and remediation activities are overseen by the NYSDEC and the New York State Department of Health (NYSDOH).

Figure 1.1.1
Site Area Map
280 Franklin Street, Brooklyn, NY

A NYSDEC petroleum spill (#0601852) has been reported for an offsite portion of the former NuHart Plastic manufacturing facility and is related to a release of petroleum from former fuel oil USTs. The spill area is located offsite to the east of the Site and is the subject of investigation and remedial activities separate and apart from the activities associated with the Site and discussed herein. Information from the spill site is considered herein as appropriate.

1.2 Site Environmental Setting

The Site environmental setting is described in detail in the RI Report (Ecosystems Strategies, Inc., July 30, 2015) and is summarized herein. Additional details are presented in Section 2.2.5. The Site is located in a relatively level urban setting with surface elevations ranging from 17 to 23 feet above mean sea level (MSL). The Site is situated on a regional north-northwest trending topographic ridge bounded by the East River to the west and Newtown Creek to the north and east. There is a gradual downward slope to the west-northwest, towards the confluence of the nearby East River and Newtown Creek.

The soil type at the Site is mapped as Urban Land, which is defined as areas that are more than 80 percent covered by buildings and pavements. The Site surface (which is entirely covered by building slabs) is underlain by historic fill in some areas to depths of nearly 20 feet.

Native materials are present beneath the historic fill and are identified as unconsolidated Upper Pleistocene glacial deposits by the U S Geological Survey (USGS Open-File Report 92-76, 1995). Onsite these deposits were described in the RI Report as sandy soil with some gravel to between 10 and 12 feet below grade, below which silt and clay intervals are present. The top of a nearly continuous thick clay layer is found between 8 and 23 feet below grade. This clay was not fully penetrated by any of the borings performed during the RI but was noted to extend to approximately 50 feet below grade in geotechnical borings performed onsite in 2014. The clay was noted to be absent in one geotechnical boring near the southwest corner of the Site.

The glacial deposits rest unconformably on top of Precambrian crystalline bedrock, the top of which is found at an approximate elevation of -50 feet MSL in the project vicinity (USGS Open-File Report 92-76, 1995). This published information is consistent with the onsite geotechnical borings, which encountered bedrock at approximately 60 feet below the Site surface. Bedrock was not encountered in any of the borings performed during the RI (maximum depth of 30 feet).

Groundwater beneath the Site is generally found within the fill or glacial deposits at a depth noted in the RI Report as 7 to 12 feet below grade, with the highest water table generally occurring during the winter. Groundwater flow is generally westerly to northwesterly, towards the East River (located approximately 450 feet west of the Site) and is somewhat tidally-influenced to the west and northwest of the Site.

1.3 Site History

The Site was initially developed in the 1800s and was used up to 1950 for manufacturing purposes, including metal-working and manufacture of light fixtures, soap, and water-proofing materials. From 1950 until 2004 the Site and associated manufacturing buildings to the east were used for production, storage, and shipping of plastic and vinyl products. Operations ceased in 2004 and the Site buildings have not been used since that time. Redevelopment of the Site and associated former NuHart buildings to the east is contemplated. Redevelopment of the Site is anticipated to include restricted residential and/or commercial uses.

The Site was investigated on several occasions between 2005 and 2015; the results of these investigations are summarized in Section 2.

Seventeen USTs and associated sub-grade pipe trenches were cleaned out and closed in place in 2006; this work was reported to the NYSDEC. The tanks include 8 USTs formerly containing plasticizers (phthalates) and 4 USTs containing "Super Hecla" oil (a heavy-weight machine lubricant) located onsite and 5 USTs (3 fuel oil tanks and 2 chemical tanks containing methyl tert-butyl ketone and acetone) located offsite to the east in the associated NuHart manufacturing buildings. Spill #0601852 was reported to the NYSDEC for a petroleum release associated with the fuel oil USTs.

Product (LNAPL) recovery efforts began in 2006 at the Site as an Interim Remedial Measure (IRM) and have continued to the present. Product is removed from several wells within and in proximity to the Site building and is transported for offsite disposal. Product recovery appears to be limited by its highly viscous nature.

Groundwater monitoring has been performed, generally for petroleum compounds and phthalates, although recent monitoring events have included chlorinated volatile organic compounds (VOCs).

The Site was entered into the NYS Inactive Hazardous Waste Disposal Site Remedial Program in April 2009. Investigation and remediation activities since that time have been overseen by the NYSDEC and NYSDOH. These activities have included completion of an Interim Investigation, an RI, and a Supplemental RI, IRM product monitoring and removal, groundwater monitoring, and additional delineation investigations. The results of the investigation activities are summarized in Section 2. This information was used to evaluate the feasibility of potential remedial measures described later in this report.

SECTION 2.0
SUMMARY OF NATURE AND EXTENT OF CONTAMINATION AND POTENTIAL EXPOSURES, ADDITIONAL INVESTIGATIONS

2.1 Nature and Extent of Contamination and Potential Exposures

The nature and extent of contamination associated with the Site were described in Section 3 of the RI Report and Section 4 of the Supplemental RI Report (FPM, October 2015) and are summarized below. Clarifying information has been added where needed to depict the nature and extent of Site-related impacts. Figures depicting the nature and extent of contaminants in onsite and offsite media were presented in the RI Report and are included in this section for reference.

A qualitative human health exposure assessment is included in Section 3.6 of the RI Report and additional information concerning potential exposure to Site-related contaminants is included in the Supplemental RI Report. Relevant information concerning potential exposure to Site-related contaminants is summarized in this section.

2.1.1 <u>Soil</u>

Soil results presented in the RI Report were compared to the Title 6 of the New York Codes, Rules and Regulations (6NYCRR) Subpart 375-6 Soil Cleanup Objectives (SCOs) for unrestricted use (UU) and for the lowest contemplated use of the property (restricted residential, or RR). These results are presented in Tables 3 through 9 in the RI Report. Key results are also summarized in Figures 6, 7 and 8 in the RI Report, copies of which are included in Appendix A.

➢ <u>VOCs</u>

Trichloroethylene (TCE) and related chlorinated solvents were detected at levels below the RR-SCOs, but above the UU-SCOs in a limited solvent “hot spot” area in the northeastern portion of the Site, as shown on Figure 6 in Appendix A. This “hot spot” extends slightly offsite beneath the sidewalk on the south side of Clay Street, but does not extend to the north side of Clay Street, to the east of the Site, or to the west of soil boring 3SB-5. The impacted soil has been identified only at depth (generally 10 to 25 feet bgs). Soil above 10 feet bgs did not exhibit detections of chlorinated solvent VOCs in excess of the UU-SCOs, with the only exception being soil in the 0 to 5-foot interval of onsite soil boring 2SB-2.

A limited number of other VOCs, (acetone, xylenes, and 1,2,4-trimethylbenzene) were found above the UU-SCOs, but below the RR-SCOs, in soil at other locations on the Site, as shown on Figure 6. Two acetone detections above the UU-SCOs and below the RR-SCOs were also noted beneath the former NuHart facility to the east of the Site and acetone was detected above the UU-SCO at one location beneath the sidewalk to the north of the Site.

➢ <u>SVOCs</u>

Semivolatile organic compound (SVOC) soil contamination (analyte levels above the RR-SCOs) onsite is limited to bis(2-ethylhexyl) phthalate (DEHP) and di-n-octyl phthalate (DOP) in soil located at and near the groundwater interface in the area where LNAPL product is present, as shown in Figure 8 in Appendix A.

Soil contamination associated with DEHP and/or DOP is found in offsite soil located at and near the groundwater interface in the area where LNAPL product is present, generally to the west and southwest of the Site, as shown in Figure 8. The interval of impacted soil is found only at depth (approximately 8 to 10 feet bgs). The phthalate concentrations were noted to exceed the SCOs protective of groundwater but did not exceed the RR-SCOs offsite except at limited locations where LNAPL is present or in close proximity to the affected soil.

➢ Metals

Several metals were detected in excess of the UU-SCOs in onsite soil, including chromium, copper, iron, lead, nickel, and/or selenium, as noted on Table 7 in the RI Report. These detections are very similar to those detected in offsite soil (chromium, iron, nickel, selenium, and/or zinc). None of the detections in onsite or offsite soil exceeded the RR-SCOs with the exception of iron. These detections are most likely related to materials in the historic fill and are characteristic of historic fill commonly found in the New York City metropolitan area. Neither the distribution of these detections, nor the levels of the detections, is indicative of a release of metals contaminants at the Site. It was noted that the iron detections may also result from natural background conditions as iron is commonly found at somewhat elevated levels in native soil in this area.

As these metals are not related to a release on the Site, specific measures to remediate metals in soil will not be considered in this FS. However, proper management of soil containing metals during remedial activities, and associated Health and Safety Plan (HASP) and Community Air Monitoring Plan (CAMP) monitoring, will be addressed.

➢ Discussion

Direct contact, ingestion and/or inhalation of airborne soil particles are the pathways by which humans may be exposed to soil. At present, the Site is fully covered by the Site building foundation and following the future redevelopment of the Site it is highly likely that the entire Site surface will continue to be covered with a building foundation and/or pavement. Therefore, there is no reasonable possibility for Site occupants, visitors or trespassers to be exposed to Site soil at present or following future redevelopment. Similarly, at present the offsite soil impacted by Site-related contaminants (phthalates and TCE and related chlorinated solvents) is covered by road or sidewalk pavement and found only at depth (8 feet bgs or deeper). This soil is anticipated to remain at depth and covered by pavement except during ground-intrusive activities. Therefore, there is no reasonable possibility for residents or visitors in offsite areas to be exposed to offsite soil at present or in the future.

It is possible that human contact with onsite and/or offsite soil could occur during ground-intrusive work or if dust containing the impacted soil is generated during intrusive activities that disturb soil. Ground-intrusive activities will be likely during remedial and redevelopment activities at the Site and may occur during construction activities in offsite areas. Site-related remedial activities are anticipated to be conducted under a HASP and a CAMP designed to monitor and control potential exposures to impacted soil. Therefore, human exposure to impacted soil is unlikely to occur during intrusive remedial or redevelopment activities conducted under a Site-specific HASP and CAMP. Potential measures to control exposures to offsite soil during construction activities will be addressed in this FS.

2.1.2 Groundwater

Groundwater results for dissolved constituents presented in the RI Report were compared to the NYSDEC's Class GA Ambient Water Quality Standards (Standards). These results are presented in

Tables 10 through 13 in the RI Report. Key groundwater results are also summarized in Figures 9 through 13 in the RI Report, copies of which are included in Appendix A.

- LNAPL Plume

Phthalates and lubricating oil (Hecla oil), most likely released from the Site's tank and piping/trench systems, are present as an LNAPL plume floating on the groundwater surface. The LNAPL plume is present beneath much of the Site, particularly in the western half of the Site where most of the phthalate and lubricating oil-related infrastructure was present, as shown on Figure 13 from the RI Report (Appendix A). The LNAPL plume extends offsite to the west and southwest, including beneath the east side of Franklin Street, the north side of Dupont Street, and across these streets somewhat to the northwest and southeast corners of the Franklin/Dupont intersection. LNAPL has also been found in one offsite well (MW-7) on the south side of Clay Street. LNAPL does not extend as far as the playground to the west of the Site, the vacant property to the southwest of the Site, or across Clay or Commercial Streets, based on repeated measurements in the offsite wells in these areas starting in 2006 and conducted on a monthly basis over the past four years. Additional information concerning the LNAPL properties and apparent thickness is presented in Section 2.2 below.

- VOCs

TCE and related chlorinated VOCs associated with the Site are present in groundwater beneath the northeastern portion of the Site and extend a short distance offsite to the north-northwest, as shown on Figure 10 from the RI Report (Appendix A). The highest concentrations of chlorinated VOCs are detected at onsite well MW-34 and offsite wells MW-8 and MW-40, located immediately north and east, respectively, of the apparent source area on the northeastern portion of the Site. Chlorinated VOC concentrations decrease significantly to the east, west, and south of these wells, with more moderate decreases noted to the northwest.

- SVOCs

Phthalates, including primarily DEHP and one detection of DOP, were detected above NYSDEC Standards in several wells generally located on the periphery of the area where LNAPL is present, including offsite wells to the east, south, and southwest of the Site, as shown on Figure 11 from the RI Report (Appendix A). DEHP was also detected in groundwater in three wells located offsite to the northeast, in proximity to the offsite portion of the former NuHart facility. Phthalates were not detected above the NYSDEC Standards in groundwater in wells located to the west or northwest of the Site.

- Metals

Several metals were detected in unfiltered groundwater samples in excess of the NYSDEC Standards, including sodium in all 16 samples (34.9 to 311 mg/l), iron (0.899 to 9.38 mg/l in 9 samples), and magnesium (39.4 to 80.1 mg/l in 5 samples). As noted in the RI Report, these detections may be related to suspended particulates in the unfiltered samples and/or ambient groundwater quality in the Site vicinity and do not indicate Site-related metals impacts to groundwater. Accordingly, remediation of metals in groundwater is not considered in this FS. It should be noted that the sodium levels in all of the samples exceed the NYSDEC's sodium Standard of 20 mg/l for fresh (Class GA) groundwater and likely result from the Site's proximity to nearby saltwater surface water bodies, as well as the Site's original near-shore location prior to filling and development.

➢ Discussion

Direct contact and/or ingestion are the primary pathways by which humans may be exposed to groundwater. The Site area is served by the public water supply and no private water supply wells are reported to exist in the vicinity of the Site. As noted above, the sodium content of the groundwater precludes use of the groundwater for potable water purposes unless desalinization is performed. As groundwater is saline and is not being used for drinking water or any other purpose at the Site or in nearby offsite areas, there is no reasonable possibility for Site occupants or visitors or area residents to be exposed to Site-related contaminants in groundwater.

It is possible that human contact with Site-related contaminants in groundwater could occur during ground-intrusive work that extends to the depth of the water table (generally 8 feet or more bgs) in the areas where such contaminants are present. Ground-intrusive activities that may extend to the groundwater will be likely during Site-related remedial activities and may occur during construction activities in onsite and offsite areas. The Site-related remedial activities and onsite construction activities are anticipated to be conducted under a HASP and a CAMP designed to monitor and control potential exposures to contaminated groundwater. Therefore, human exposure to impacted groundwater is unlikely to occur during intrusive remedial or construction activities. Potential measures to control exposures to offsite groundwater during construction activities will be addressed in this FS. It should be noted that groundwater conditions are anticipated to improve as a result of remedial activities for Site-related contamination. Therefore, over time the potential for exposure to Site-related contaminants in groundwater during ground-intrusive activities is likely to diminish.

2.1.3 Soil Vapor, Sub-Slab Soil Vapor and Indoor/Outdoor Air

Soil vapor impacted by TCE and related CVOCs is present beneath the northeastern portion of the Site building, with the greatest impacts coinciding with CVOC-impacted groundwater in this area. The impacts do not extend fully beneath the Site and are not found beneath the western or southern portions of the Site, as shown in Figure 3.2.4.1 in Appendix A.

CVOCs in soil vapor are present offsite in a limited area to the east and north of the Site, generally consistent with the CVOC distribution in groundwater. Site-related CVOC soil vapor impacts extend offsite to the east beneath a portion of the adjoining former NuHart facility, but do not extend to the east end of this building or to the vicinity of residential properties to the east of the Site.

Site-related CVOC soil vapor impacts extend to the north, across Clay Street, but do not extend as far northward as the north side of Commercial Street, as demonstrated by soil vapor data from Greenpoint Landing. In general, the impacts decrease to the east and west of the 3SB-1 location on the north side of Clay Street. The distribution of TCE on the north side of Clay Street east of 3SB-1 suggests that it is possible that there is an offsite TCE source (unrelated to the Site) on the north side of Clay Street.

Other VOCs were detected in soil vapor throughout the Site and vicinity at generally low levels consistent with typical urban settings with historic industrial uses. Some petroleum-related VOCs may be associated with the known petroleum spill located on the former NuHart facility just to the east of the Site and additional offsite petroleum vapor detections on the north side of Clay Street may be associated with an offsite source.

➢ Discussion

Potential exposure pathways for soil vapor include inhalation within buildings in which soil vapor intrusion (SVI) is occurring and inhalation of soil vapor that may be released during intrusive activities into materials containing VOCs. SVI exposures at the Site under current conditions are likely to be insignificant as the building is not occupied. A CAMP would be implemented at the Site (and, as required, at offsite areas) during intrusive remedial activities to monitor air quality and minimize potential exposures to vapors for both construction workers and the public.

Onsite remedial activities are anticipated to decrease the potential for SVI and redevelopment activities would, if necessary, include SVI mitigation measures to eliminate or significantly reduce the potential for SVI onsite. These mitigation measures are considered in this FS.

The offsite soil vapor sampling results suggest that SVI is a potential concern for offsite properties at 15 and 29 Clay Street. However, the potential for SVI at these properties cannot be confirmed unless access for SVI sampling is provided by the property owners. SVI may also present a concern at 48 Commercial Street if a building is constructed on this property in the future (the property presently does not include a building). Remedial activities to be conducted for the Site are likely to reduce the source of TCE and related CVOC vapors. Over time, source reduction is likely to reduce the potential for SVI in offsite buildings. Potential measures to control exposures to offsite soil vapor during construction activities and to address potential SVI into offsite buildings are addressed in this FS.

2.2 Additional Investigations

As discussed above, a plume consisting of phthalates and lubricating oil (Hecla oil) is present as an LNAPL floating on the groundwater surface. Investigations of the LNAPL have been performed to evaluate its properties and actual thickness in the formation. These investigations were performed to provide information for use in assessing potential remedial measures for the Site-related LNAPL. The investigation results were previously reported to the NYSDEC (FPM, February 23, 2015 and FPM, May 28, 2015) and are summarized in Sections 2.2.1 and 2.2.2 herein; copies of these supporting investigation reports are included in Appendix B.

An investigation of the locations and depths of utilities present in the offsite vicinity of the Site was conducted for the purposes of providing information needed to evaluate potential remedial measures and for assessing potential migration pathways for Site-associated LNAPL. This survey also included measuring the elevations of the top of casing of the Site-related wells to assist with further evaluation of the groundwater flow directions in the Site vicinity. This survey is included in Appendix B and the results are discussed in Section 2.2.3 below.

Existing water level measurements from the ongoing IRM activities were integrated with the newly-obtained well survey data to more fully evaluate the groundwater flow directions in the Site vicinity under seasonal conditions. This evaluation is presented in Section 2.2.4 and copies of the groundwater monitoring data used during this evaluation are included in Appendix B.

Existing boring logs from previous investigations of the Site and vicinity were reviewed to more fully evaluate the stratigraphic framework beneath the Site and vicinity and assess potential relationships between the stratigraphy, the Site infrastructure, subsurface utilities, and the distribution of Site-related contaminants. This evaluation is presented in Section 2.2.5.

An evaluation of the nature of the wastes that may be produced during Site-related remedial activities was performed. This evaluation is presented in Section 2.2.6. Additional testing of the product was also performed following identification of low-level polychlorinated biphenyls (PCB) contamination in waste product removed during the IRM; the results of this testing are also included in Section 2.2.6.

2.2.1 Product Testing – Assessment of Well Conditions, Migration Rate, Viscosity

Several of the wells containing product were video-taped under pumping and recovery conditions to assess whether the PVC wells screens and/or casings may be affected by contact with the LNAPL. None of the video testing results showed any apparent distortions of the well casings or screens, widening or obstruction of the screen slots, restriction of groundwater or product flow into the wells, encrustations or growths adhering to the casings or screens, or other conditions that may affect the integrity of the wells or well screens, or the flow of fluids into the wells. This information supports the continued use of Schedule 40 PVC well materials at this Site for monitoring or other purposes that do not typically require use of alternate well materials, and also indicates that the data obtained from these wells is anticipated to be valid.

The observed presence of sand at RW-8 and RW-10 suggests that additional measures may be necessary to preclude sand intrusion into future wells if such wells are used for LNAPL recovery purposes. These measures may include reducing the screen slot and/or gravel pack size, more intensive well development, or some combination of these measures.

The hydraulic conductivity (K) of the formation with respect to LNAPL was evaluated using bail-down tests, with the recovery data used to evaluate the K of the formation relative to LNAPL. This analysis was performed using the Dagan solution (1978), which is a straight-line solution appropriate for partially-penetrating wells screened across the water table in an unconfined aquifer. The calculated K values for the LNAPL range from 1.099×10^{-6} to 8.991×10^{-5} feet/minute (ft/min). Sensitivity analyses were performed to assess the impact parameter selection on the calculated K values. In the case of these tests, the aquifer anisotropy ratio (ratio of vertical to horizontal hydraulic conductivity) was evaluated to have the most potential variability. The initial solutions utilized a typical aquifer anisotropy ratio of 0.1 (Todd, 1980). However, as the formation at the Site contains a significant amount of silt, a lower anisotropy ratio may be more appropriate. Additional solutions were calculated using an anisotropy ratio of 0.01 and demonstrated little change in the calculated K values.

Once the K values had been calculated, they were integrated with groundwater gradient (i) values calculated from the water table contours previously presented in the RI Report to calculate the potential flow rate of the LNAPL under existing aquifer conditions. The calculated i values ranged from 0.002 to 0.004. Using these i values and the range of K values, an LNAPL flow rate of between 2.2×10^{-9} and 3.6×10^{-7} ft/min was calculated. Converting these values to feet per year resulted in calculated LNAPL flow rates of between 0.0012 and 0.18 feet/year, which indicates that the product is essentially immobile. It was noted that the calculated K values for the LNAPL include the effect of the water table recovery and, therefore, may be somewhat higher than actual K values for the LNAPL alone. This further supports the conclusion that the LNAPL is essentially immobile under existing conditions (low K and low i).

The calculated LNAPL flow rates were assessed relative to the presumed source(s) and known information concerning former Site operations and the extent of the LNAPL. The Site was used for plastic manufacturing from about 1950 until 2004 and the tanks, piping, and associated infrastructure were likely onsite since about 1950 as they were an integral part of the plastic manufacturing operations. The tanks, piping, and associated trench system were cleaned and closed in mid-2006.

Based on this information, the releases that resulted in the presence of the product on the water table could have occurred during the 1950 to 2006 interval. Based on the apparent volume and extent of the product (including its extent in 2006) and its variable composition, it is likely that the releases occurred from multiple sources and were ongoing for a number of years.

The initial subsurface investigation of the Site, conducted in late 2006, included installation of many of the Site wells. At that time LNAPL was documented to be present beneath much of the western portion of the Site and extended downgradient to offsite wells MW-5 through MW-7, MW-15 and MW-16, but not to offsite wells MW-11 through MW-14 (none of the other offsite wells had been installed at this time). This information indicates that by late 2006, when the tanks and other potential sources of the releases were closed, the LNAPL was already present beneath much of the Site and had moved somewhat offsite, which suggests that the releases likely began early during the Site's history of plastic manufacturing and were likely ongoing for a number of years.

Additional wells have been added on several occasions and product monitoring and recovery have been ongoing since 2006. The monitoring data indicate that all wells that now contain product have contained product (or significant indications of product) since their installation. Wells that did not contain product (or exhibit significant indications of product) at the time of their installation still do not contain product. These observations suggest that there has been no apparent change in the configuration of the product plume since at least 2006, which is consistent with the calculated negligible product migration rate and with the closure of the tanks, piping system, and associated infrastructure in 2006 (thereby eliminating the release sources).

The extent of the onsite LNAPL and the variable nature of its composition (as discussed below) suggest that the LNAPL likely originated from several onsite releases. The majority of the tanks from which the releases may have occurred are located in the southwestern portion of the Site. This area is approximately 100 feet upgradient of the apparent location of the leading edge of the product at present. Using this information alone, a simple arithmetic calculation would suggest an LNAPL migration rate of between 1.7 and 3 feet a year. However, it should be recognized that initial LNAPL migration, particularly while a release is ongoing, is generally faster than later migration due to a number of factors, including driving forces during the release associated with continuous vertical columns of LNAPL extending from the release site to the water table surface, initial lateral expansion of the LNAPL mound(s) under gravitational forces, and the likely lower viscosity of the released LNAPL before subsurface weathering processes further increased its viscosity. These factors typically result in an initial LNAPL migration rate that is higher than the migration rate that is observed later in the life of an LNAPL plume, after the release source is ended, the LNAPL has finished spreading out under gravitational forces, and the viscosity has increased due to weathering. Therefore, a sample arithmetic calculation of the LNAPL migration rate based on the locations of the apparent source(s) of the releases and the current downgradient edge of the LNAPL will not accurately represent the LNAPL's current migration rate under the forces that presently act on the LNAPL.

It was noted that LNAPL re-accumulated in the wells during both well screen integrity testing and bail-down testing. During both types of testing the fluid levels in the wells were drawn down to generally 2 to 5 feet below their static levels and recovery was very slow. This results in a very steep gradient (high i value) in proximity to the wellbore during much of each test. Based on the test information it was estimated that the induced i values in immediate proximity to the wells during testing may reasonably have ranged from 1 to 5. Using these induced i values, the calculated LNAPL velocity in immediate proximity to the wellbores during testing ranged from 0.6 to 236 feet per year. This information suggests that under high induced gradients (such as may result from significant groundwater pumping) the LNAPL may move more rapidly than under in-situ conditions where the actual gradient is very low.

It should be noted that these velocities were mathematically calculated based on drawdown information from the immediate proximity of the wellbores during testing and, as such, may include wellbore effects that likely artificially increased the calculated velocities. It should also be noted that significant flow velocity increases would occur only if the induced gradient were significantly increased (by three orders of magnitude) over the normal very low gradient and if the induced gradient were to extend beyond the immediate area of the pumped wellbore, which is also unlikely. These conditions are highly unlikely to occur, and have not been observed at any time during LNAPL monitoring, even when dewatering was reportedly underway for nearby construction projects. We note that all of the LNAPL observations over the past 10 years have shown the LNAPL plume to be static.

Samples of LNAPL were obtained from several wells located throughout the LNAPL plume and were analyzed for kinematic viscosity over a range of temperatures, starting from the in-situ ground temperature (estimated at 55 degrees F) and proceeding in 10 degree F increments up to 125 degrees F. This temperature range was selected to assess LNAPL viscosity changes that may reasonably be anticipated to occur during remediation via thermal treatment. The resulting data indicated that the in-situ product kinematic viscosity under ambient conditions (about 55 degrees F) ranges from 28.25 mm^2/s (or centiStokes) at onsite well MW-21 to 273.69 centiStokes at onsite well RW-8. At offsite well MW-5 the kinematic viscosity of the in-situ product was measured at 192.48 centiStokes. As the density of the product appears to be very close to 1, the calculated dynamic viscosity values for the in-situ conditions are similar, ranging from 27.12 to 262.74 mPas (or centiPoise). These data indicate that the in-situ product is highly viscous. For comparison, the in-situ product viscosity generally ranges between that of vegetable oil and maple syrup. The highly-viscous nature of this LNAPL is consistent with the calculated K values (discussed above) and with the calculated low flow rate of the LNAPL under in-situ conditions. Although the LNAPL viscosity does decrease with increasing temperature, significant reductions in LNAPL viscosity are not achieved until higher temperatures (generally over 100 degrees F) are obtained and the LNAPL viscosity remained significantly above that of water throughout the entire range of temperatures tested.

Published information concerning the viscosity of phthalates (including the phthalate products reported to have been formerly used onsite) and Hecla oils (which are presently manufactured by ExxonMobil Oil Corporation), was obtained via a literature search. These data indicate that the viscosity of phthalate products is significantly higher than the viscosity of the groundwater on which the LNAPL is present and the viscosity of the Hecla oil is even higher than that of phthalates. Specifically, the published viscosity values for phthalate products at temperatures near the natural in-situ formation temperature (up to 77 degrees F) range from 55 to 80 centiPoise. Hecla oil viscosity is reported to range from 680 to 1,000 centiStokes at 104 degrees F (the lowest temperature for which data could be located). A comparison of the viscosity data for the in-situ LNAPL versus published information indicates that, in general, the in-situ viscosities for the LNAPL on the western side of the Site (RW-8 and RW-10) and offsite downgradient (MW-5) are higher than the published values for phthalates, but lower than the values for Hecla oil. These data suggest that the LNAPL in this area consists of a mixture of phthalates and Hecla oil, consistent with the locations of former underground storage tanks (USTs) that stored the products. The in-situ viscosity values may also be affected by weathering processes, which typically increase the viscosity of in-situ LNAPL relative to its original viscosity.

The viscosity data for the onsite well located in a more upgradient position (MW-21) indicate a somewhat lower viscosity than the published values for phthalates, but well above the viscosity of water. This well is located away from the USTs in which Hecla oil was formerly stored and is closest to UST #16, which was formerly used to store unspecified “plasticizer”. It is possible that the material formerly stored in UST #16 was somewhat different than the other plasticizers reported to have been used onsite. We note that this well is located in an upgradient position on the Site and not in an area where the product is likely to migrate offsite.

The LNAPL was “fingerprinted” in 2010 using samples from wells RW-12 and MW-4. The results indicated that the LNAPL in both wells contained compounds consistent with phthalates, and that the sample from RW-12 (near the western side of the Site, in proximity to the RW-8 and MW-5 wells) also contained compounds consistent with a high boiling-point paraffinic oil. This information is consistent with the locations of these wells relative to the former USTs. RW-12 is located in proximity to USTs where both phthalates and Hecla oil were stored and well MW-4 is located near the center of the Site (and near MW-21) in an area where USTs formerly containing phthalates are the closest USTs. Thus, the 2010 “fingerprint” data are consistent with the viscosity data, all of which indicate that the LNAPL near the western portion of the Site and offsite downgradient of this area is consistent with a mixture of phthalates and Hecla oil, while the LNAPL in the more upgradient portion of the Site is consistent with phthalates and does not appear to have a petroleum component.

2.2.2 Product Depth and Thickness

Although product monitoring has been performed in Site wells for several years, the actual depth to product and thickness in the formation were not clearly understood due to processes that typically exaggerate the thickness of product observed in monitoring wells. Because of these processes, the thickness of product as measured in monitoring wells is typically noted as “apparent thickness”. These measurements are understood to provide general information about product in the formation, but are not generally accepted to accurately represent the true depth and thickness of product.

An additional investigation was performed to obtain more information concerning the actual depth and thickness of the product in the formation at this Site. Specifically, this investigation included obtaining information concerning the depth to and visible thickness of the smear zone in the soil above and below the water table, the visible thickness of product on the water table surface, and subjective observations of product mobility, odor, and other features that may affect evaluation and implementation of remedial alternatives. This investigation included performing a test pit near the center of the LNAPL area and conducting a detailed examination of boring logs throughout the LNAPL area.

The following observations were noted from the test pit, which was performed in proximity to RW-12 near the southwest corner of the Site:

- Although staining and odors typical of product were noted at two intervals in the test pit (top of clay at about 5.75 feet and about 12.5 feet, just above the top of the product), no organic vapors were detected by the photoionization detector (PID). The odors were observed to be moderate in proximity to the removed stained materials, but were not perceived to extend beyond the immediate area of the test pit or the pile of excavated impacted soil placed adjacent to the test pit pile. Odor was not noticeable at a short distance from the stained materials. These observations suggest that odors from product-impacted materials that may be exposed during remedial activities may not present a significant concern.

- Historic fill containing significant amounts of anthropogenic debris, ash, and cinders is present to a depth of about five feet in the test pit area. Although this material did not exhibit any significant odors or staining, the visual appearance of the historic fill suggests that it is likely to contain constituents commensurate with its origin and the fill, if excavated, will likely require offsite disposal as regulated material.

- Native soil, including silty fine sand and clay, is present beneath the historic fill to a depth of about 10.5 feet in the test pit area. No visible indications of potential impacts were noted in this soil, with the exception of some minor staining and odor at the top of the clay; these impacts did not appear to extend significantly into the clay. This suggests that the soil beneath the Site slab and above the product smear zone is not likely to be impacted by the product except in areas where releases occurred and the product migrated downward from tanks, piping, trenches or other structures that formerly contained product.

- Native material that appears to be glacial till (an apparently unsorted mixture of fine to coarse-grained materials ranging from silt up to cobbles) is present from about 10.5 feet to at least 14 feet in the test pit area. This material is extremely loose and was noted to run into the test pit as each bucket of soil was removed. The behavior of this material suggests that shoring will be required for any excavations that penetrate this material.

- A smear zone (stained soil with moderate odor but no free product) was noted to extend from about 12.5 to 13.5 feet in the test pit. Product was encountered at 13.5 feet and extended to at least 14 feet in the test pit. The product was noted to consist of dark brown oily fluid with an approximate consistency of used motor oil. The visible properties of the product observed in the test pit were consistent with the product testing results discussed above.

Depth to product and water measurements were obtained from the wells in the product area during the test pit procedure and were compared to the test pit observations. Boring logs throughout the product area were also reviewed to evaluate the depth and actual thickness of product observed in formation materials. The following were noted:

- The actual depth to the product in the formation as noted in the test pit (13.5 feet below the slab, approximate elevation of 0 feet relative to NAD 1988) is somewhat greater (about 1.5 to 2 feet) than indicated by the measurements in the closest nearby wells. Therefore, it appears that the depth to product as measured in the wells is somewhat inaccurate, as is typical of product measurements in wells. The actual depth to the product is likely to be greater than reported in the wells, perhaps by 1.5 to 2 feet. For planning purposes, it can be conservatively assumed that the actual depth to the product is about 1.5 feet greater than reported in the wells.

- Boring logs throughout the product area indicate that product-impacted interval ranges from about 0.5 to 2 feet thick. The top of the product-impacted zone is generally found at about elevation 0 (consistent with the test pit) and generally extends to elevation -0.5 to -2. The smear zone above the product can be assumed to be about one foot thick. The boring logs provide very consistent information, given the inherent nature of the boring process and the variability of subsurface materials beneath the Site.

Based on this information, it can be concluded that except for areas where the product releases are likely to have occurred (vicinity of tanks, piping and/or trench systems), the interval impacted by product (smear zone and LNAPL) is likely to be present between an elevation of +1 and -2 in the LNAPL area. For purposes of remedial alternative evaluation, and based on the data obtained during this investigation, it will be assumed that the smear zone is approximately 1 foot thick and the LNAPL interval is approximately 2 feet thick.

2.2.3 Underground Utility Survey

An underground utility survey and markout was performed by the Subsurface Utilities Division of BL Companies (BL), under contract to FPM, to obtain information for remedial measures assessment and planning. BL is a professional utility location and surveying firm with extensive experience in New York City. The survey was performed to delineate the locations, approximate depths, and construction of underground utilities present beneath the sidewalks and roads in proximity to and downgradient and crossgradient of the Site (the survey area). During the survey the locations of all identified utilities on the streets and sidewalks in the survey area were marked for future identification purposes and the topography of the survey area was recorded. In addition, the top of the casing of the Site-related wells was surveyed so that a comprehensive set of well elevations was available for evaluation of groundwater and LNAPL level data. The survey is shown on Figure 2.2.3.1 and a copy of the survey (BL Companies, October 26, 2015) is included in Appendix B.

FPM provided BL with an AutoCAD survey and utility location information previously obtained by others for use in developing the survey. A utility markout was conducted in the survey area, including identification of visible utility features, identification of known utilities in the Site building and the exterior surfaces of buildings in the survey area, surveying with an electromagnetic induction device, and surveying with a ground-penetrating radar device. Utility records were consulted during the markout, with the findings incorporated into the markout and survey. The markout/survey personnel were assisted with obtaining access to the Site building during this process. It should be noted that the markout did not include excavation to confirm utility depths or construction. This information was obtained, as feasible, via the utility records and markout procedures.

Following the markout, a utility and partial topographic survey was prepared by a NYC-licensed surveyor. This survey depicts the utility information obtained during the markout and utility records search, curbs, sidewalks, building faces, Site-related wells, and pipe inverts, sizes, and types, as feasible. It is noted that information concerning pipe inverts, sizes and types is limited due to the incomplete nature of the information provided in the utility company records, lack of access to fully-buried utilities, and the nature of the survey procedures. It should be noted that this survey was not performed for the purposes of establishing legal property lines or street lines.

The survey was reviewed together with previously-obtained survey information to evaluate the locations and depths of underground utilities present in the survey area, the estimated depths of utility backfill material (usually a granular material), and to compare this information with the elevation of the water table and the location and elevation of Site-related LNAPL. An assessment of the potential for utility backfill to provide a conduit for LNAPL migration was made. The following information was noted from these evaluations:

- Underground utilities present in the survey area include water supply (blue lines), natural gas (yellow lines), electric (red lines), sewer (combined sanitary and stormwater, green lines), fire protection (purple lines), and fiber optic (orange lines, limited to the southern part of Franklin Street).

- Utilities are present beneath each of the streets in the survey area, with Franklin Street containing the greatest concentration of utilities. In some cases, multiple lines of the same type of utility are present beneath the streets. Utilities are also present beneath many of the sidewalks in the survey area, including gas and/or electric lines beneath the sidewalks on both sides of Franklin Street, gas, electric and/or sewer lines beneath the sidewalks adjoining the southwest and northwest corners of the Site, and electric and sewer lines beneath the sidewalks

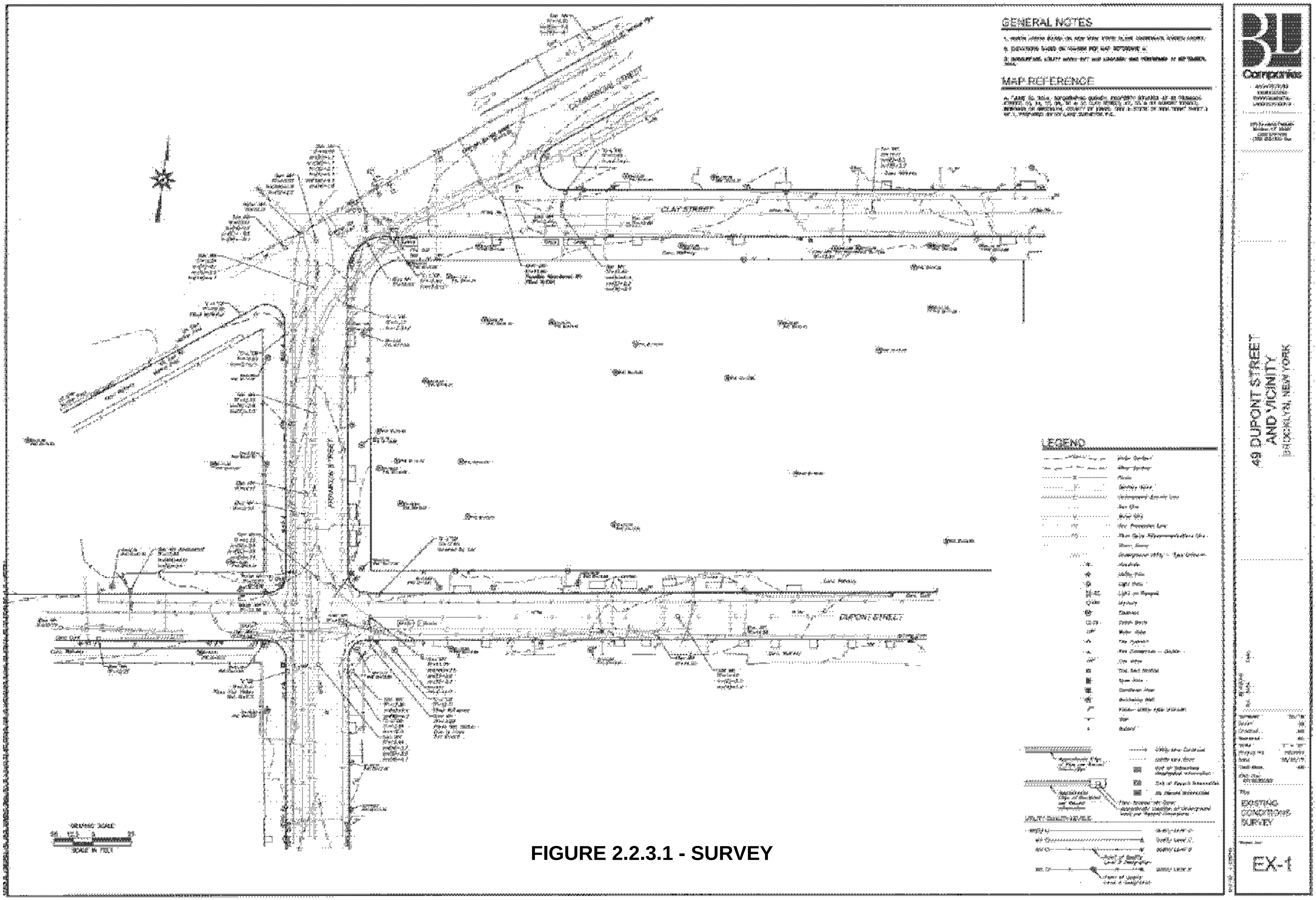

FIGURE 2.2.3.1 - SURVEY

on either side of Commercial Street. In addition, utility service connections to properties are present in many locations beneath the streets and sidewalks. The locations of these utilities must be considered during evaluation of remedial measures that involve intrusive activities in the utility areas.

- Utility elevation information obtained during this survey was limited to the electric manholes (top flange), sewer (top flange and inverts at manholes), fire protection manholes (top flange), and stormwater catch basins (top flange and invert). Of this information, only the sewer invert (bottom of pipe) information is necessary for assessing the potential for utility backfill to provide a conduit for LNAPL migration, as further discussed below. A limited amount of additional useful utility elevation information was obtained from a May 1946 contract drawing (City of New York Department of Public Works Bureau of Water Pollution Control, Contract No. 16, Sheet S-5), which depicts the depths of several utilities beneath Franklin and Dupont Streets to the southwest of the Site; a copy of this contract drawing is included in Appendix B. This contract drawing shows that the electric, gas, water, and fire protection lines located beneath the intersection of Franklin and Dupont Streets at that time were all located within approximately 5 feet of the ground surface, well above the depth of the water table and LNAPL. Although the water supply lines beneath Franklin Street and the eastern portion of Dupont Street have been replaced since this contract drawing was developed (NYCDEP Bureau of Water and Sewer Operations, Water Mapping, March 5, 2013, copy in Appendix B), it is most likely that the water lines would have been installed above the existing sewer line, as per typical construction practice. Because of the shallow depth of these utilities (above the groundwater surface), the backfill around these utilities is not a potential pathway for migration of contaminants associated with groundwater (including LNAPL). Construction activities that involve these utilities are also unlikely to involve potential contact with Site-related groundwater contamination or LNAPL.

- The sewer invert elevations were reviewed and it was confirmed that the sewer lines slope downward to the north along Franklin Street and downward to the west along Dupont Street, with two lines intersecting just north of the of the Franklin Street/Dupont Street intersection. A sewer line also slopes downward to the west along Clay Street to intersect with the Franklin Street sewer. From the intersection of Clay, Commercial and Franklin Streets the sewer continues further to the northwest. Of note, there is no sewer mapped to the west of the Franklin Street/Dupont Street intersection and, therefore, no potential utility pathway for migration of groundwater contaminants or LNAPL was identified in this direction.

- The deepest sewer invert elevations near the Franklin/Dupont Street intersection are 3.8 and 3.5 feet (relative to the North American Vertical Datum of 1988, or NAVD88). Allowing for the New York City Department of Environmental Protection (NYCDEP)-required 0.5 feet of granular backfill material beneath the sewer pipe results in the bottom of the backfill material being at an estimated elevation of 3.0 to 3.3 feet in this area. Recent water level data from well MW-24, which is located closest to this intersection and the edge of the LNAPL, indicates that the water table in this well has fluctuated between elevations of 2.48 and 2.73 feet, which would not intersect with the sewer pipe backfill. Further to the east along Dupont Street the sewer invert is at 3.8 feet (bottom of backfill at 3.3 feet) and the water level in well MW-27, which is located near the edge of the LNAPL in this area, has varied between 2.52 and 2.79 feet, also below the sewer backfill. Groundwater elevation maps discussed in Section 2.2.4 below provide additional information concerning the depth to groundwater and further confirm that the water table is below the sewer backfill in these areas. This information indicates that LNAPL migration along the sewer alignment in Dupont Street or the sewers in the intersection of Dupont and Franklin

Streets is not reasonably possible as the water table does not intersect the sewer line backfill in these areas.

- Further north along Franklin Street, about halfway between Dupont and Clay Streets and near the northern limit of LNAPL beneath the street, the sewer invert is at 2.8 feet (bottom of backfill at 2.3 feet) and the water level in well MW-32, which is located near the edge of the LNAPL in this area, has varied between 2.37 and 2.67 feet. In this case, it is possible that the northern edge of the LNAPL could intersect the sewer backfill in this area. It is unlikely that any LNAPL migration could occur to the south as the sewer slopes upward in this direction, resulting in the backfill being above the water table. To the north the sewer slopes downward into the water table, which may allow LNAPL migration in this direction if the sewer backfill is sufficiently permeable to provide a preferential migration pathway. It should be noted that LNAPL has never been observed in well MW-12, located near the north end of the sewer beneath Franklin Street, and LNAPL was not reported during recent construction activities involving the existing sewer connection at the intersection of Franklin and Commercial Streets. We conclude that any LNAPL migration to the north along the sewer alignment, if the LNAPL actually intersects the backfill, is likely to be limited and no indications of potential LNAPL have been noted along the sewer alignment.

2.2.4 Groundwater Flow Direction

Additional groundwater monitoring data obtained by FPM in 2015 during routine IRM activities and previously reported to the NYSDEC in the monthly monitoring reports were evaluated to obtain more comprehensive groundwater flow direction information. This evaluation was performed using well top of casing elevations surveyed by BL Companies during the course of the utility survey documented above and additional well casing survey information obtained following alteration of several wells in late October 2015. The survey information and water level data used during this evaluation are presented in Appendix B. Figures 2.2.4.1 and 2.2.4.2 present the groundwater flow direction information derived from the April and November 2015 water level measurements and represent the water table configuration during seasonal high groundwater conditions and seasonal low groundwater conditions, respectively.

It should be noted that data from wells containing LNAPL were not used in this evaluation as the presence of LNAPL on the groundwater affects the depth of the groundwater surface. Although a correction can be applied to the groundwater level measurements based on the density and apparent thickness of the LNAPL, as discussed above the LNAPL apparent thickness measurements in the wells are generally greater (and sometimes significantly greater) than the actual LNAPL thicknesses in the formation due to capillary and other forces acting within the wells and the density of the LNAPL is likely to be somewhat variable, depending on the relative amounts of Hecla oil and phthalates. Because of the inaccuracy of the LNAPL apparent thickness measurements and density variability, use of the resulting data may lead to over-correction and/or inaccurate correction of the water level data. Therefore, to avoid these data evaluation issues only water level data from wells without LNAPL were used in this evaluation.

In addition, the water level data used in this analysis includes data from wells with the same diameter to avoid potential variability that may be introduced by wells with different diameters. This resulted in the inclusion of water level data from all of the 2-inch diameter wells (without product) and the omission of water level data only from well RW-1, which is a 4-inch diameter well. Any potential effect on water level measurements due to capillary forces in the 2-inch wells is anticipated to be small.

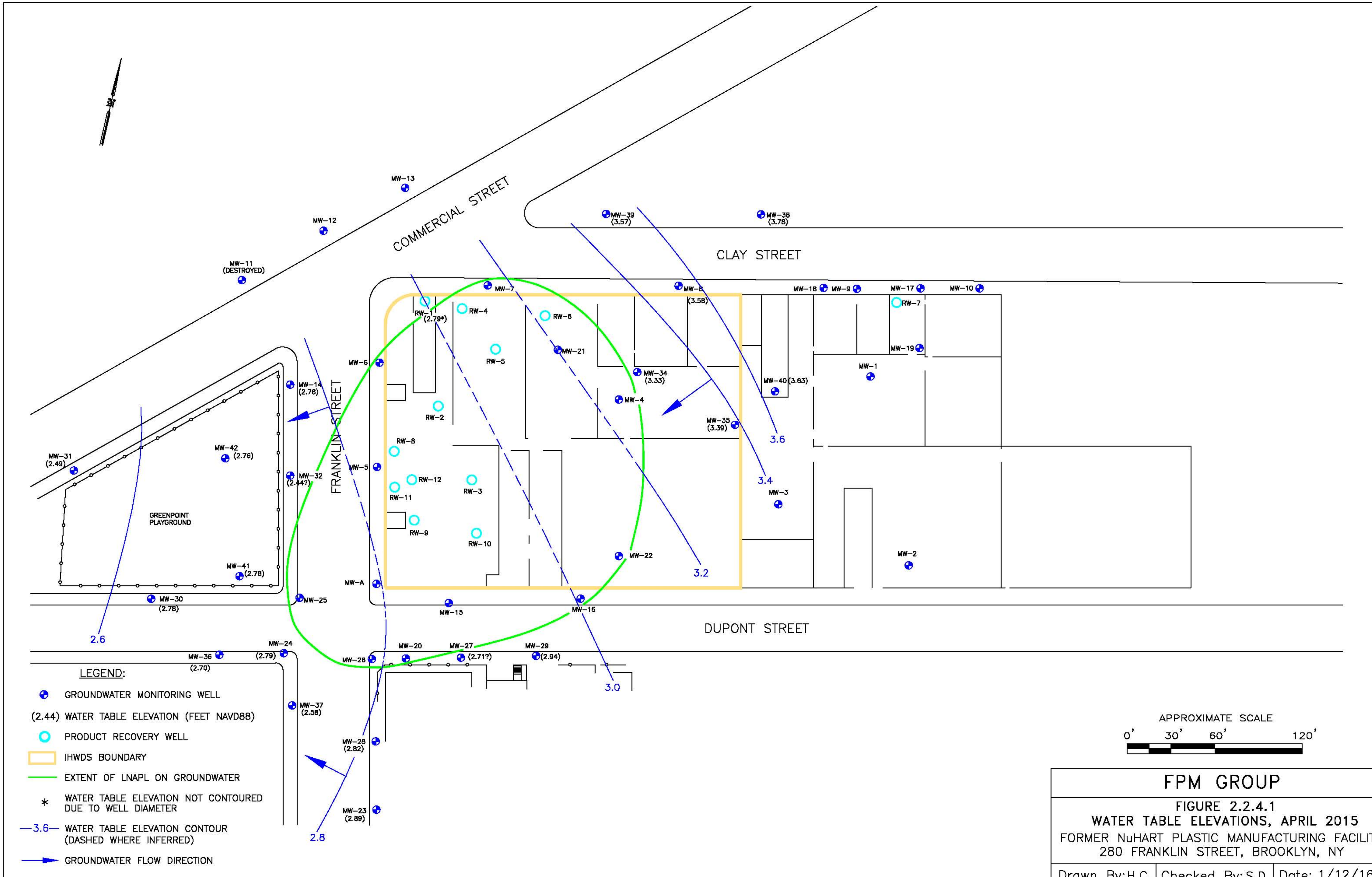

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FIGURE 2.2.4.1
WATER TABLE ELEVATIONS, APRIL 2015
FORMER NuHART PLASTIC MANUFACTURING FACILITY
280 FRANKLIN STREET, BROOKLYN, NY

Drawn By: H.C. | Checked By: S.D. | Date: 1/12/16

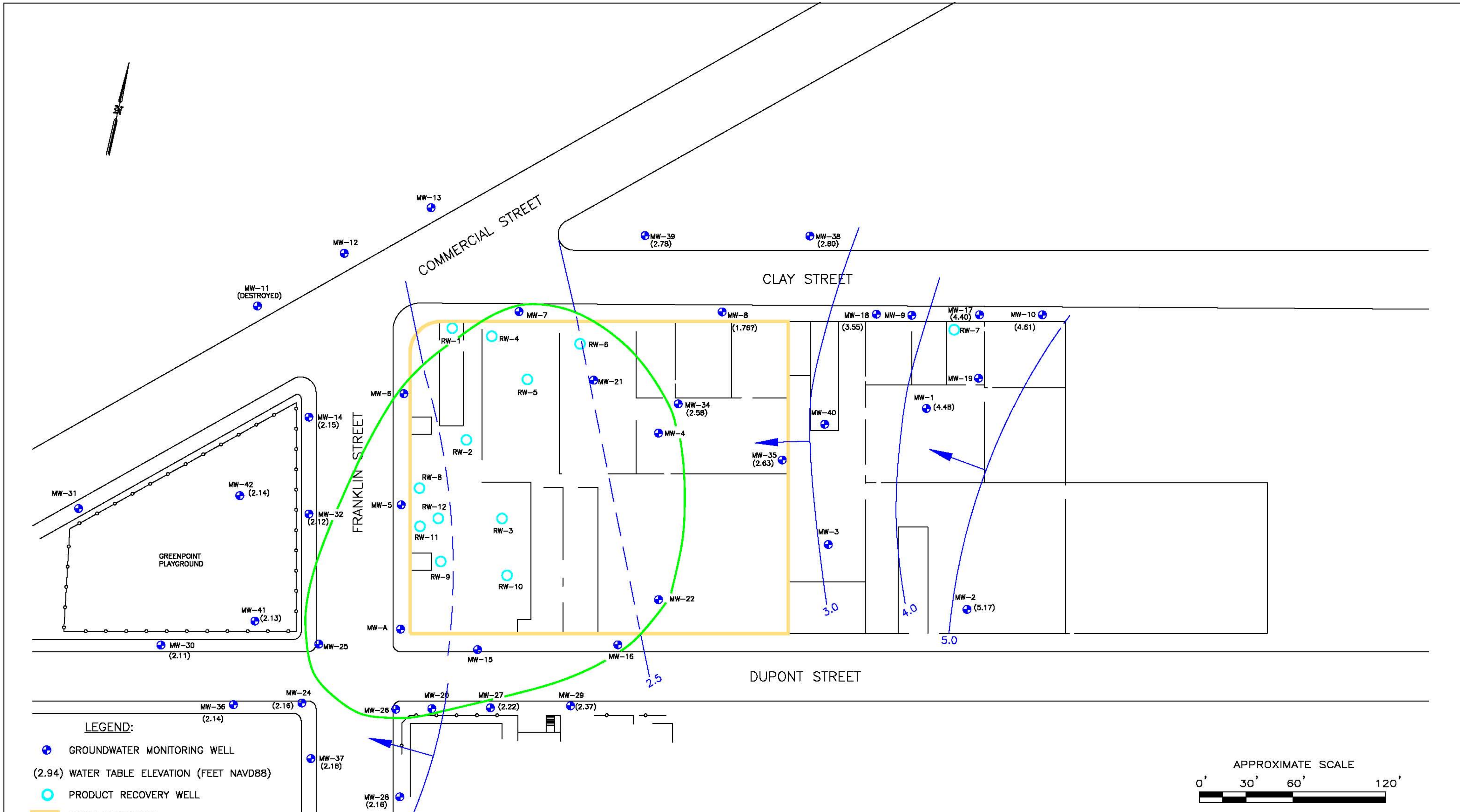

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FIGURE 2.2.4.2
WATER TABLE ELEVATIONS, NOVEMBER 2015
FORMER NuHART PLASTIC MANUFACTURING FACILITY
280 FRANKLIN STREET, BROOKLYN, NY

Drawn By: H.C.	Checked By: S.D.	Date: 1/12/16

The elevation of the water table in April 2015 (seasonal high water level) is shown on Figure 2.2.4.1 and indicates that groundwater flow beneath the Site and vicinity is generally to the southwest. The gradient (slope) is relatively low (about 0.004) on the northeastern portion of the Site and becomes nearly flat (about 0.001) on the southwestern portion of the Site and further to the southwest. This indicates that groundwater flow beneath the Site is very slow and likely decreases further to the southwest. Some variability was noted in the water levels, particularly to the southwest of the Site. This variability may be due to the nature of the materials in which the well screens are installed, as further discussed in Section 2.2.5 below. For the purpose of understanding the overall direction of groundwater flow in the Site vicinity, minor variations in water levels were ignored during development of Figures 2.2.4.1 and 2.2.4.2.

The elevation of the water table in November 2015 (seasonal low water level) is presented on Figure 2.2.4.2 and shows a similar west to southwest groundwater flow direction. The depth to groundwater was noted to be between 0.6 and 0.9 feet greater than in April 2015. The gradient on the northeastern portion of the Site (0.004) is about the same as during the seasonal high water level, is somewhat higher further to the east, and becomes nearly flat (slightly less than 0.001) to the southwest, also indicating very slow groundwater flow.

2.2.5 Stratigraphic Cross-Sections

A general discussion of the Site stratigraphy was provided in the RI Report based on the borings performed during the RI and geotechnical borings performed in late 2014 in support of Site redevelopment. Additional analysis of the available stratigraphic data has been performed to more fully evaluate the stratigraphic framework beneath the Site and vicinity and assess potential relationships between the stratigraphy, the Site infrastructure, subsurface utilities, and the distribution of Site-related contaminants.

As noted in the RI Report, published information documents that the Site vicinity is generally underlain by unconsolidated fill that, in turn, overlies marsh and alluvial deposits, till, ground moraine, and other glacial deposits, and finally Paleozoic and Precambrian bedrock (USGS, 1999 and USGS, 1989). The shallow unconsolidated glacial deposits that cover much of western Long Island, including the Site vicinity, were deposited during the Wisconsian Glacial period and were associated with the southern-most extent of the Laurentide Ice Sheet. The Site is located in an area dominated by a recessional moraine associated with the retreating Laurentide Ice Sheet. The resulting stratigraphy reflects depositional environments associated with the retreating glacier and includes:

- Recessional moraine deposits caused by linear accumulation of till material formed during a hiatus in the retreat of a glacier. A published geologic map (Bennington, 2003) indicates that there are recessional moraines in the vicinity of the Site;
- Silt and clay deposits associated with kettle ponds and glacial lakes; and
- Fine to medium-grained sand deposits associated with deltas that form where lower-energy streams feed into kettle ponds or glacial lakes.

It is important to note that many depositional environments can occur within relatively short distances in proximity to receding glaciers. Therefore, it is typical for the resulting stratigraphy to be a complex mixture, both vertically and laterally, of various materials. This variability is evident in the stratigraphic framework underlying the Site and vicinity.

The available boring/monitoring well logs from the RI Report, the geotechnical investigation, and previous investigations performed by others (Advanced Site Restoration, LLC, March 2007) were reviewed together with the information obtained from the test pit (described above) to identify the significant stratigraphic layers present in the subsurface. These layers were then correlated to develop several stratigraphic cross-sections across the Site and into the surrounding vicinity. The cross-section locations are shown on Figure 2.2.5.1 and the cross-sections are depicted on Figures 2.2.5.2 through 2.2.5.6.

It should be noted that the quality and nature of the stratigraphic information shown on the boring/monitoring well logs is highly variable and, therefore, when interpreting stratigraphic relationships more emphasis was placed on information that appeared to be of higher quality (recent boring/well logs, geotechnical borings, test pit log) and less emphasis was placed on older information of apparent lower quality. It should also be noted that the cross-sections do not depict each individual layer that may be identified on the more detailed boring logs, but were prepared to show that nature of more significant stratigraphic layers and their interpreted relationships.

Following cross-section development, the subsurface infrastructure beneath the Site (tanks), subsurface utility information from the utility survey, and the approximate configuration of the water table surface and LNAPL extent were added to the cross-sections so that potential relationships between these features and the stratigraphy could be discerned. It should be noted that the depth of the water table surface and LNAPL are approximations as the depths of these fluids vary somewhat over time.

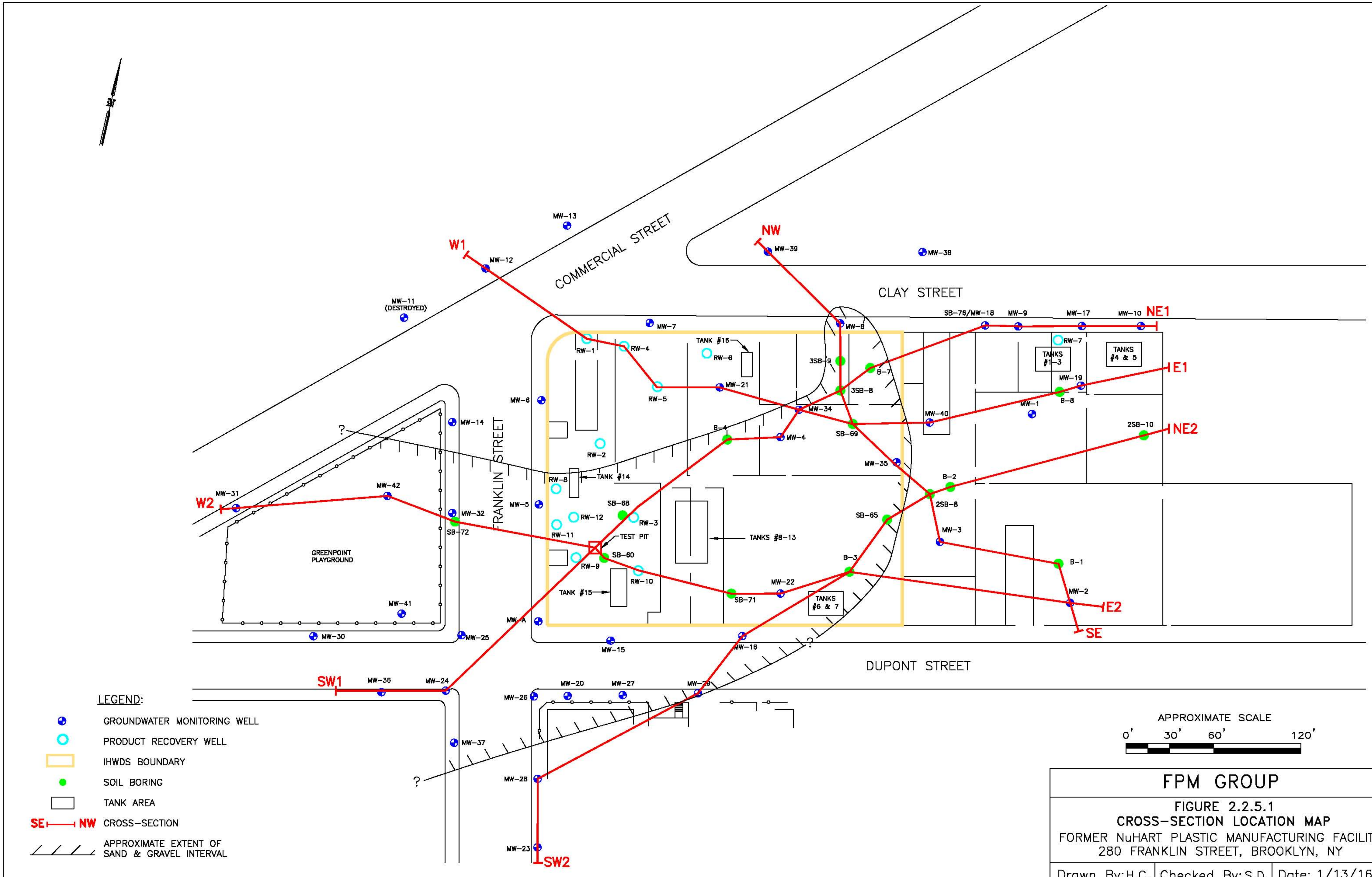
The significant stratigraphic layers identified include the following (from shallow to deep):

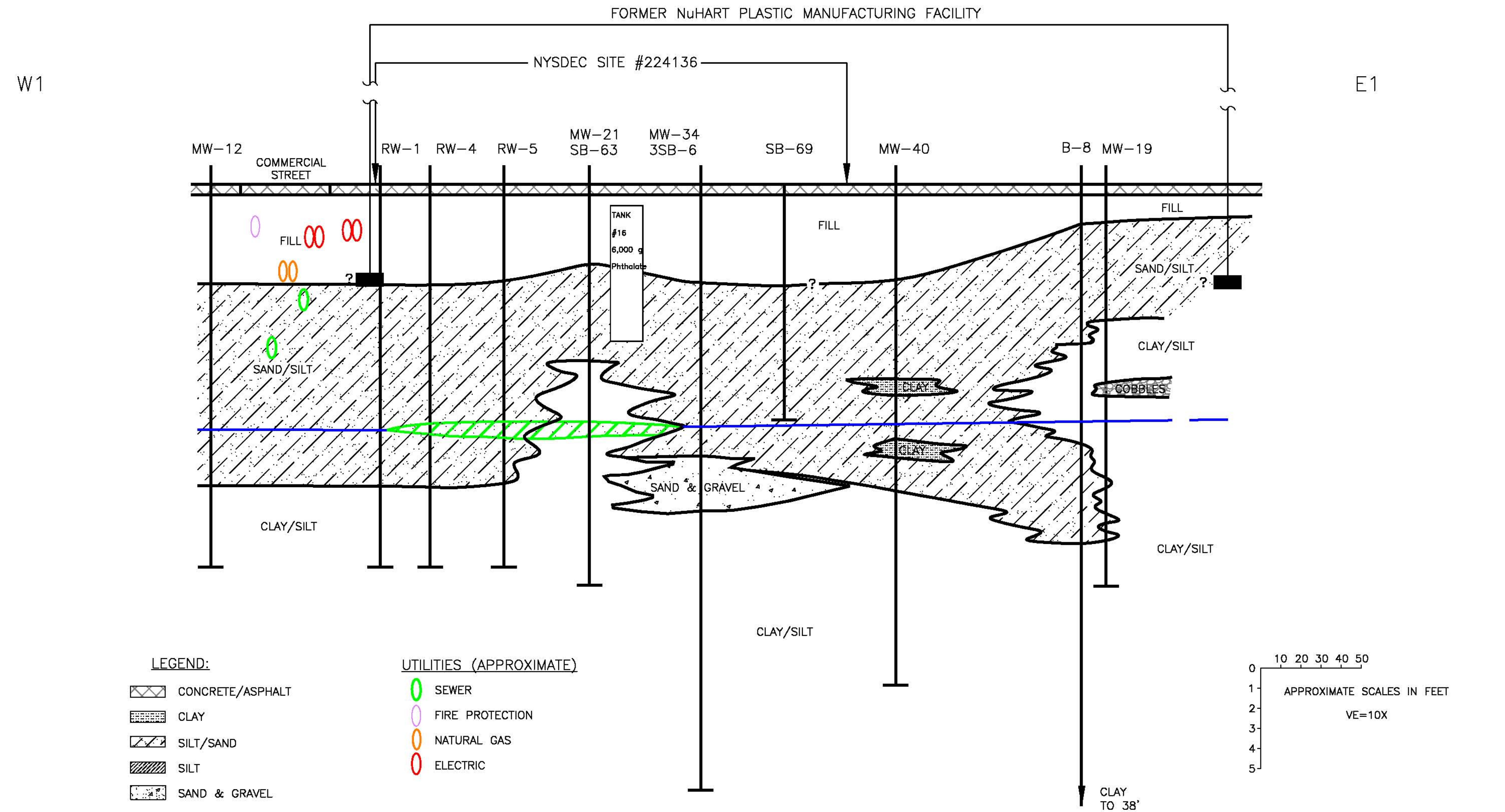
- Fill – Found from beneath the overlying impervious material (building slabs, streets, sidewalks) to a maximum of about 8 feet below the onsite slab, the fill is a variable mixture of sand, silt, gravel, often containing anthropogenic debris. Fill (often termed "historic fill") is common in the New York City metro area, particularly in proximity to surface water bodies and other former low-lying areas, and appears to underlie the entire Site and vicinity with the possible exception of the Greenpoint Playground where anthropogenic debris was not evident.

- Sand/Silt – An interval consisting of sand, silty sand and/or sandy silt underlies nearly all of the Site and vicinity. This sand/silt interval appears to be missing beneath the southeastern portion of the Site and may also be missing to the southwest of the Site. Intervals of clay, silt, sand, and gravel were identified within the sand/silt, particularly in the lower portions of this interval, but do not appear to be continuous. This sand/silt interval may represent delta deposits associated with a glacial lake or larger kettle hole.

- Clay (upper) – An interval of clay is found just below, and perhaps intercalated with, the sand/silt deposits on the southwest portion of the Site and extending offsite to the west and southwest. This clay interval may be associated with a former kettle hole.

- Sand and Gravel – An interval of very loose sand and gravel with cobbles was observed in the test pit and is correlated with similar sand and gravel deposits identified in borings beneath primarily the eastern, southern and southwestern portions of the Site and extending offsite to the west and southwest. The approximate extent of the sand and gravel deposits is depicted on Figure 2.2.5.1. These deposits were noted to thicken to the west and southwest and were not fully penetrated by borings in these areas. This material appears to represent till deposits associated with a recessional moraine.

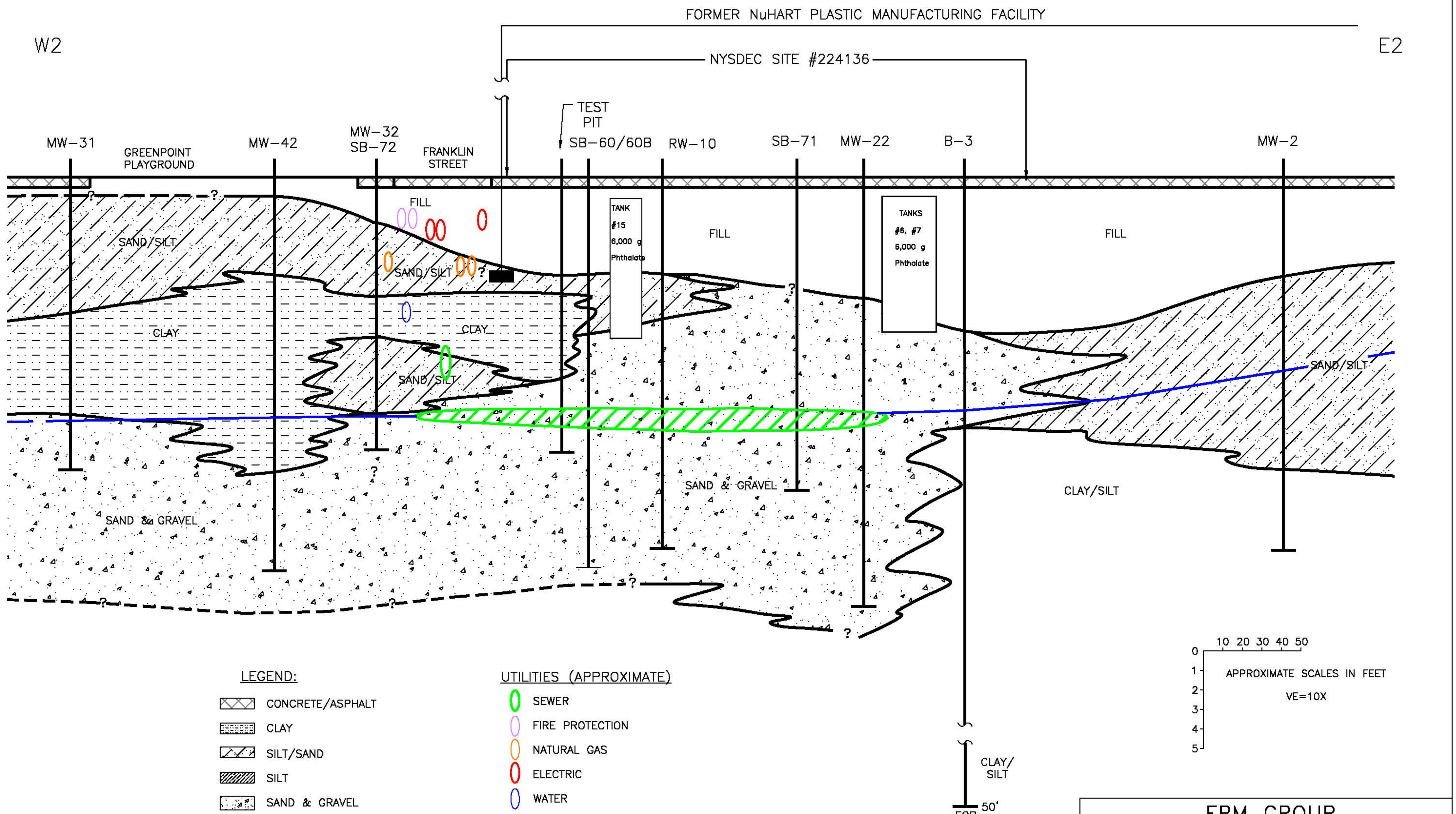

COMMERCIAL STREET
CLAY STREET
DUPONT STREET
FRANKLIN STREET
GREENPOINT PLAYGROUND
W1
W2
NW
NE1
E1
NE2
E2
SE
SW1
SW2
MW-13
MW-12
MW-11 (DESTROYED)
MW-39
MW-38
MW-7
MW-8
SB-75/MW-18
MW-9
MW-17
MW-10
RW-1
RW-4
RW-5
RW-6
TANK #16
MW-21
3SB-9
B-7
3SB-8
MW-34
SB-69
RW-7
TANKS #1-3
TANKS #4 & 5
MW-19
B-8
MW-1
MW-40
2SB-10
MW-6
MW-14
RW-2
B-4
MW-4
MW-35
RW-8
TANK #14
B-2
2SB-8
MW-31
MW-42
MW-32
SB-72
MW-5
SB-68
RW-12
RW-3
RW-11
TEST PIT
TANKS #8-13
SB-65
MW-3
SB-60
RW-9
RW-10
B-3
B-1
TANK #15
MW-22
SB-71
TANKS #6 & 7
MW-2
MW-41
MW-A
MW-30
MW-25
MW-15
MW-16
MW-36
MW-24
MW-20
MW-27
MW-29
MW-26
MW-37
MW-28
MW-23
LEGEND:
GROUNDWATER MONITORING WELL
PRODUCT RECOVERY WELL
IHWDS BOUNDARY
SOIL BORING
TANK AREA
SE NW CROSS-SECTION
APPROXIMATE EXTENT OF SAND & GRAVEL INTERVAL
APPROXIMATE SCALE
0' 30' 60' 120'
FPM GROUP
FIGURE 2.2.5.1
CROSS-SECTION LOCATION MAP
FORMER NuHART PLASTIC MANUFACTURING FACILITY
280 FRANKLIN STREET, BROOKLYN, NY
Drawn By: H.C.
Checked By: S.D.
Date: 1/13/16



FPM GROUP

FIGURE 2.2.5.2
W1-E1 CROSS-SECTION
FORMER NuHART PLASTIC MANUFACTURING FACILITY
280 FRANKLIN STREET, BROOKLYN, NY

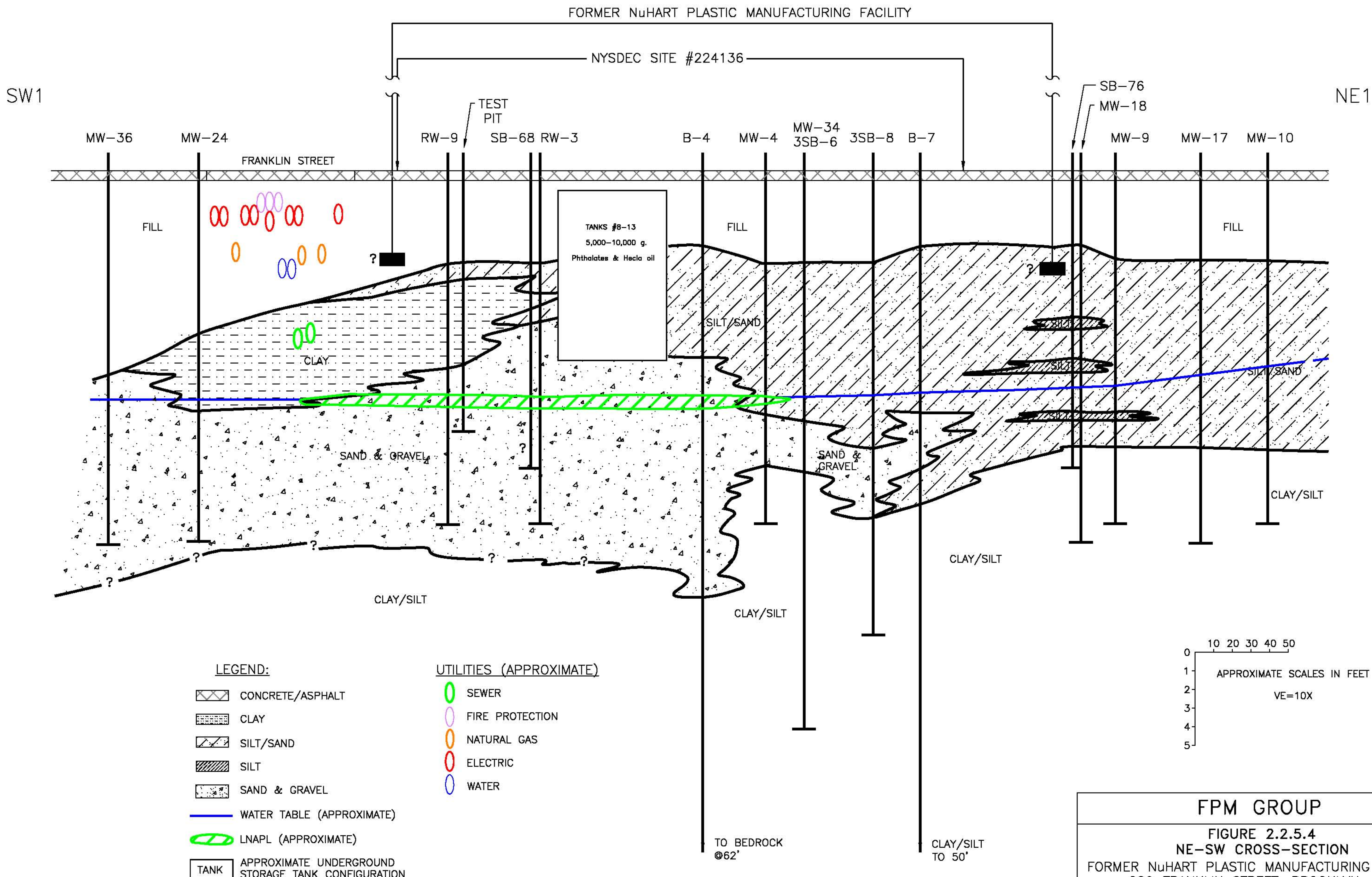
Drawn By: H.C.	Checked By: S.D.	Date: 1/13/16



FPM GROUP

FIGURE 2.2.5.3
W2-E2 CROSS-SECTION
FORMER NuHART PLASTIC MANUFACTURING FACILITY
280 FRANKLIN STREET, BROOKLYN, NY

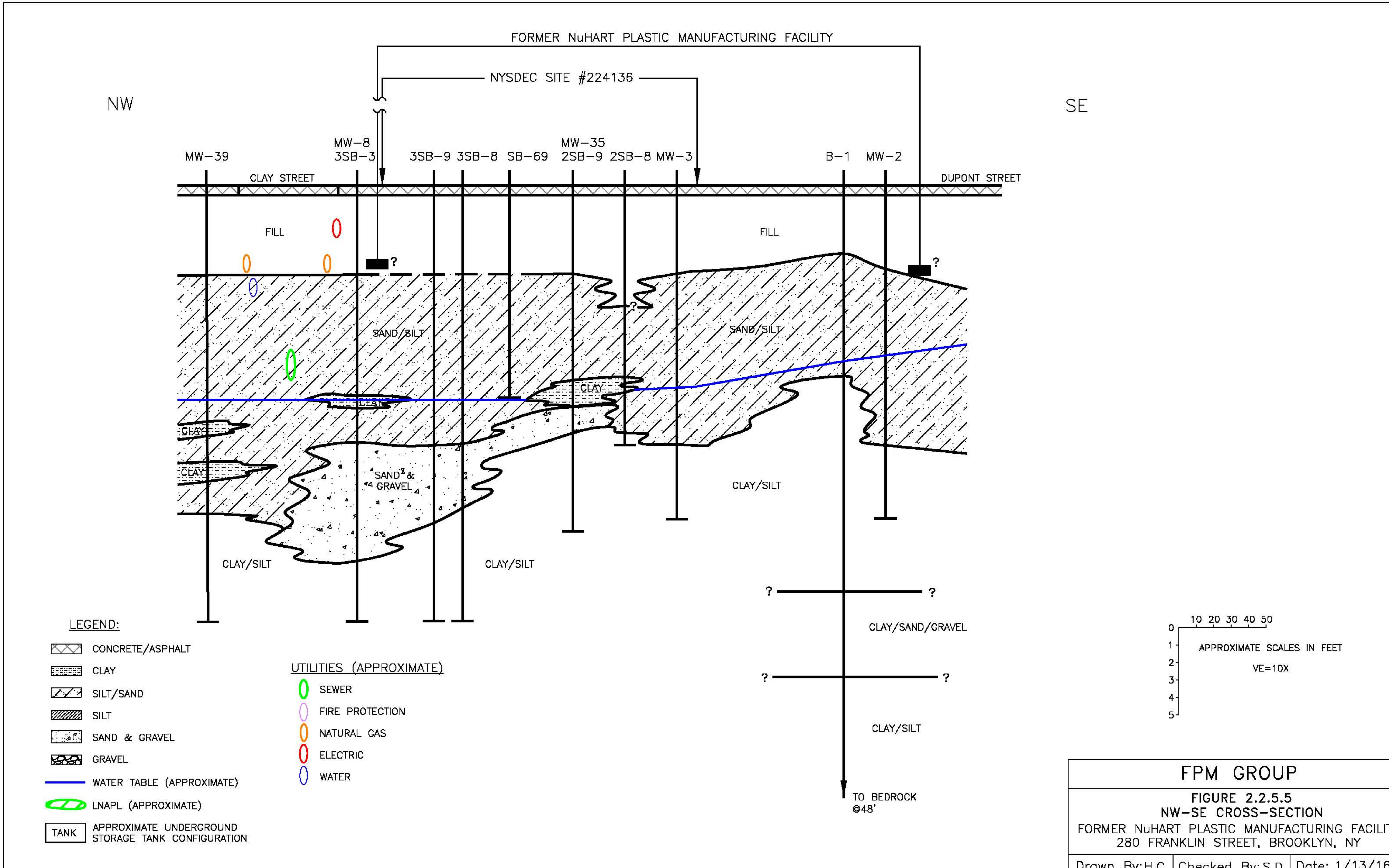
Drawn By: H.C.	Checked By: S.D.	Date: 1/13/16

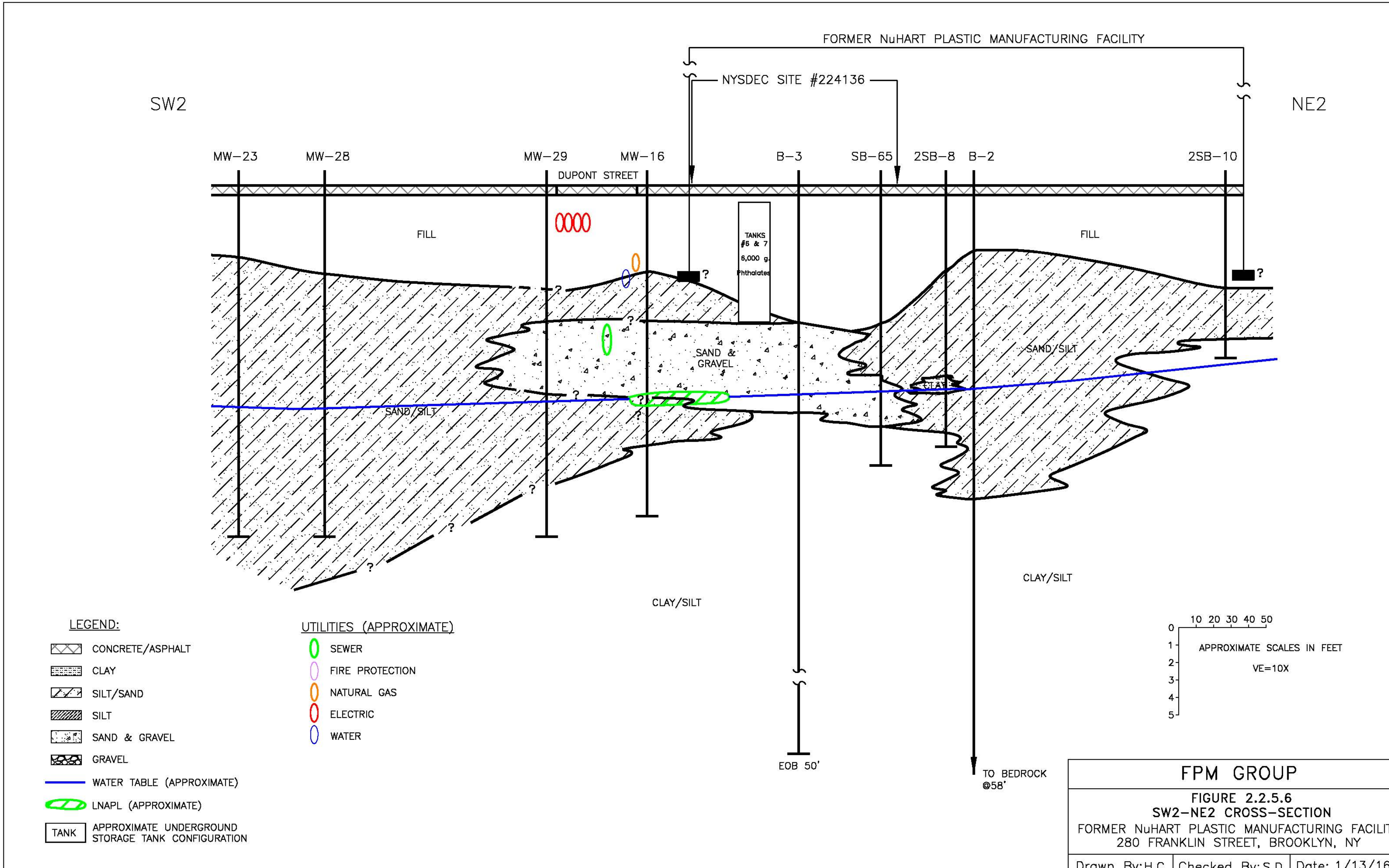


FPM GROUP

FIGURE 2.2.5.4
NE-SW CROSS-SECTION
FORMER NuHART PLASTIC MANUFACTURING FACILITY
280 FRANKLIN STREET, BROOKLYN, NY

Drawn By: H.C.	Checked By: S.D.	Date: 1/13/16


FORMER NuHART PLASTIC MANUFACTURING FACILITY
NYSDEC SITE #224136
NW
SE
MW-39
MW-8
3SB-3
3SB-9
3SB-8
SB-69
MW-35
2SB-9
2SB-8
MW-3
B-1
MW-2
CLAY STREET
DUPONT STREET
FILL
FILL
SAND/SILT
SAND/SILT
CLAY
CLAY
CLAY
CLAY
SAND & GRAVEL
CLAY/SILT
CLAY/SILT
CLAY/SILT
CLAY/SAND/GRAVEL
CLAY/SILT
TO BEDROCK @48'
LEGEND:
CONCRETE/ASPHALT
CLAY
SILT/SAND
SILT
SAND & GRAVEL
GRAVEL
WATER TABLE (APPROXIMATE)
LNAPL (APPROXIMATE)
TANK
APPROXIMATE UNDERGROUND STORAGE TANK CONFIGURATION
UTILITIES (APPROXIMATE)
SEWER
FIRE PROTECTION
NATURAL GAS
ELECTRIC
WATER
0 10 20 30 40 50
1 2 3 4 5
APPROXIMATE SCALES IN FEET
VE=10X
FPM GROUP
FIGURE 2.2.5.5
NW-SE CROSS-SECTION
FORMER NuHART PLASTIC MANUFACTURING FACILITY
280 FRANKLIN STREET, BROOKLYN, NY
Drawn By: H.C.
Checked By: S.D.
Date: 1/13/16



FPM GROUP

FIGURE 2.2.5.6
SW2-NE2 CROSS-SECTION
FORMER NuHART PLASTIC MANUFACTURING FACILITY
280 FRANKLIN STREET, BROOKLYN, NY

Drawn By: H.C. | Checked By: S.D. | Date: 1/13/16

- Clay (lower) – A significant thickness of clay and silt is found below the sand and gravel interval (where present) throughout the Site and to the north and northwest. This clay was found to extend to bedrock (between about 48 and 62 feet bgs) in nearly all of the geotechnical borings performed on the Site. The lower clay/silt interval may also be present to the west and southwest of the Site, but this was not confirmed as the borings in these areas did not fully penetrate the sand and gravel interval. Based on the extent and thickness of this clay and silt interval, it likely represents deposits associated with a glacial lake.

The estimated configurations of the USTs present beneath the Site building are shown on Figures 2.2.5.2 through 2.2.5.6. These configurations are based on the known locations of the USTs, their sizes, and their projected depths based on typical tank gauge charts. It appears that the USTs were installed through the fill and into the underlying native materials, including the sand/silt interval and the sand and gravel interval. None of the USTs appears to intercept the groundwater. There is a close association between the locations of the USTs that formerly contained phthalate or Hecla Oil and the current onsite location of LNAPL.

The groundwater surface, or water table, is found at a depth of approximately 10 to 15 feet beneath the Site. The generalized elevation of the water table is depicted on the stratigraphic cross-sections. Where the water table surface is within the sand and gravel interval it is noted to be relatively flat and where the water table is found within the sand/silt deposits or upper clay it appears to have a greater slope, consistent with the lower permeability of these materials. Although some finer-grained materials are present within the sand and gravel deposits, the likely higher permeability of these deposits, in comparison to the clay and sand/silt intervals, may facilitate groundwater migration in the areas where these deposits are present. The variable nature of the materials into which the well screens are installed likely affects the water levels in the wells, resulting in some variability in the measured elevation of the water table surface.

The LNAPL is found primarily within the sand and gravel deposits, although it is noted to extend laterally somewhat into the sand/silt deposits or upper clay. It was noted that the top of the sand and gravel interval is deeper to the west of the Site (beneath Greenpoint Playground and in the MW-24 area, Figures 2.2.5.3 and 2.2.5.4) and in these areas the water table surface extends into the upper clay that overlies the sand and gravel deposits. This upper clay, where it is present and intersects the water table, likely restricts groundwater and LNAPL movement. Further to the south (Figure 2.2.5.6) the bottom of the sand and gravel interval is found at a shallower depth and the interval is not laterally extensive. In this area the water table is near the bottom of the sand and gravel and intersects the surrounding sand/silt interval. In this area groundwater and LNAPL movement are likely restricted by the lower-permeability sand/silt.

The locations and approximate depths of the surveyed utilities in the Site vicinity are depicted on the cross-sections shown in Figures 2.2.5.2 through 2.2.5.6 (a map view showing the utility locations was presented in Figure 2.2.3.1). It should be noted that these depictions include only the utility lines and do not reflect the backfilled utility trenches. The utilities in the Site vicinity (and their associated trench backfill) appear to be located above the water table in all cases, with the possible exception of the sewer line beneath the northern portion of Franklin Street. At the location where the cross-section shown on Figure 2.2.5.3 intersects Franklin Street, the sewer (including backfill) is estimated to be above the LNAPL. However, as discussed in Section 2.2.3, the sewer slopes downward to the north and it is possible that the northern edge of the LNAPL intersects the backfill beneath the sewer under the northern portion of Franklin Street.

2.2.6 Waste Evaluations

It is anticipated that contaminated Site media (product, groundwater, soil, and/or vapor) will be removed and disposed as waste during remedial activities. An assessment was performed of the nature (hazardous vs. non-hazardous) of those media that will generally require transport and disposal at permitted facilities (product, groundwater, soil). Additional testing of the product has also been performed to evaluate its PCB content.

For contaminated vapors, it is understood that these are generally treated (if necessary) at the point of generation (remedial system) and discharged to the atmosphere in compliance with NYSDEC Air Guide 1 criteria. In this case, the treatment media may require treatment and/or disposal. As this waste stream (treatment media) is anticipated to represent a relatively small portion of the overall waste streams that may result from Site-related remediation, its potential characterization is not further evaluated in this FS.

For the product, the NYSDEC has previously determined (Order on Consent R2-20110524-870) that the phthalate-containing product removed from the Site USTs during closure and the phthalate-containing product on the groundwater were considered to be hazardous waste as they were understood to contain the listed hazardous wastes diethylhexyl phthalate (U028) and/or di-n-octyl phthalate (U107). Based on this determination, for the purposes of this FS it is assumed that phthalate-containing product will be continued to be considered a listed hazardous waste; however, this determination is still being evaluated and will be further discussed in future design documents.

Under the NYSDEC's Technical Administrative Guidance Memorandum (TAGM) 3028 "Contained-In" Criteria for Environmental Media" environmental media (soil and groundwater) containing hazardous constituents from listed hazardous waste identified in 6 NYCRR Part 371 must be managed as hazardous wastes unless the media contain hazardous constituent concentrations that are at or below action level concentrations. This policy is applicable to soil and groundwater removed from their natural environmental pursuant to a NYSDEC-approved permit, order or work plan. The NYSDEC was contacted to confirm the necessary protocol and it is planned to obtain a "contained-in" determination from the NYSDEC following the procedures in TAGM 3028.

The "contained in" demonstration document will evaluate soil and groundwater data from the RI relative to the Groundwater Action Levels and Soil Action Levels in TAGM 3028 (8/26/97 version) for the listed hazardous wastes associated with the Site. This evaluation is anticipated to indicate that soil heavily contaminated by phthalates and generally found in the vicinity of the LNAPL plume would be classified as hazardous waste and that soil outside of this area would be determined to be non-hazardous waste. For the groundwater, although waste determinations are still being evaluated, for the purposes of this FS it is assumed that groundwater near the east side and beneath the LNAPL plume that contains phthalates may be classified as hazardous waste if it were removed and disposed as waste. It is anticipated that groundwater in other areas would be determined to be non-hazardous waste. The waste disposal evaluations included in Section 4 of this FS were developed using these assumptions; however, waste determinations are still being evaluated and will be further discussed in future design documents.

In August 2015, during routine screening of the waste product generated during IRM activities, PCBs were identified in the product. The levels of PCBs were low (product was classified as non-Toxic Substance Control Act (TSCA) regulated hazardous waste) and previously-obtained RI data did not indicate a potential PCB source at the Site. Additional product sampling was performed to evaluate the nature and extent of PCBs within the product.

Product sampling was conducted on September 14, October 15, and November 12, 2015. The locations sampled in September included each of the three intermediate bulk container (IBC) totes in which the removed product is contained onsite pending transport for disposal (one tote in use and two not in use) and wells MW-21, MW-22, MW-25 and RW-9. The locations sampled in October include wells MW-A, MW-5, MW-15, RW-2, RW-3, RW-10 and RW-12. Well RW-R was sampled in November. Sampling was conducted by FPM environmental professionals using standard techniques for product sampling from monitoring and recovery wells. The samples were containerized, labeled, and shipped via lab courier under chain of custody procedures to Alpha Analytical of Westborough, MA, which is a NYSDOH-Environmental Laboratory Accreditation Program (ELAP) certified lab. The laboratory reports from these sampling events are included in Appendix B and the results have been uploaded to the NYSDEC's Electronic Information Management System (EIMS).

The data from these three sampling events are presented on Table 2.2.6.1 and demonstrate the following:

- PCBs were not detected in the residual product in the two IBC totes not in use at that time (C-1 and C-2), or in any of wells MW-A, MW-15, RW-10, MW-21, MW-22, MW-25, or RW-4;
- The PCB Aroclor 1260 was detected at between 1.24 J and 6.71 mg/kg in the product samples from the remaining sampled wells (note that PCBs in oil are reported on a per-weight basis; as the specific gravity of this product is very close to that of water, the mg/kg unit may reasonably be expressed as ppm); and
- The PCB Aroclor 1260 was detected at 3.66 mg/kg in the product sample from the IBC tote that was in use to store product onsite (C-3) in September 2015.

Based on this information, it appears that PCBs may be present in a limited portion of the onsite product plume near the southwest side of the Site and in offsite product to the southwest along Franklin Street, as shown in Figure 2.2.6.1. Historic records indicate several spills of PCB-containing oils in Con Ed electric vaults and manholes on Dupont and Franklin Streets, which may have resulted in the PCB detections in the product. The detected concentrations of PCBs are low (no more than 6.71 ppm) and are well below the level (50 ppm or greater) that would trigger disposal as a TSCA-regulated waste. However, the affected product will require disposal as a waste with low-level PBC contamination. The testing provided sufficient information to allow for segregation of product containing PCBs from product that does not contain PCBs. Product segregation was initiated during IRM activities in November 2015.

TABLE 2.2.6.1
PRODUCT PCB ANALYTICAL DATA
FORMER NUHART PLASTIC MANUFACTURING SITE, NYSDEC #224136
280 FRANKLIN STREET, BROOKLYN, NY

Sample No.	MW-A	MW-5	MW-15	MW-21	MW-22	MW-25	RW-2	RW-3	RW-4	RW-9	RW-10	RW-12	C-1	C-2	C-3
Sample Date	**10/15/15**			**09/14/15**			**10/15/15**		**11/12/15**	**09/14/15**	**10/15/15**		**09/14/15**		
Polychlorinated Biphenyls in milligrams per kilogram															
Aroclor 1260	ND	2.63	ND	ND	ND	ND	2.46	6.71	ND	1.24 J	ND	2.86	ND	ND	3.66

Notes:

C = IBC totes
ND = Not detected

J = Estimated concentration above the Method Detection Limit (MDL) and below the Reporting Limit (RL).

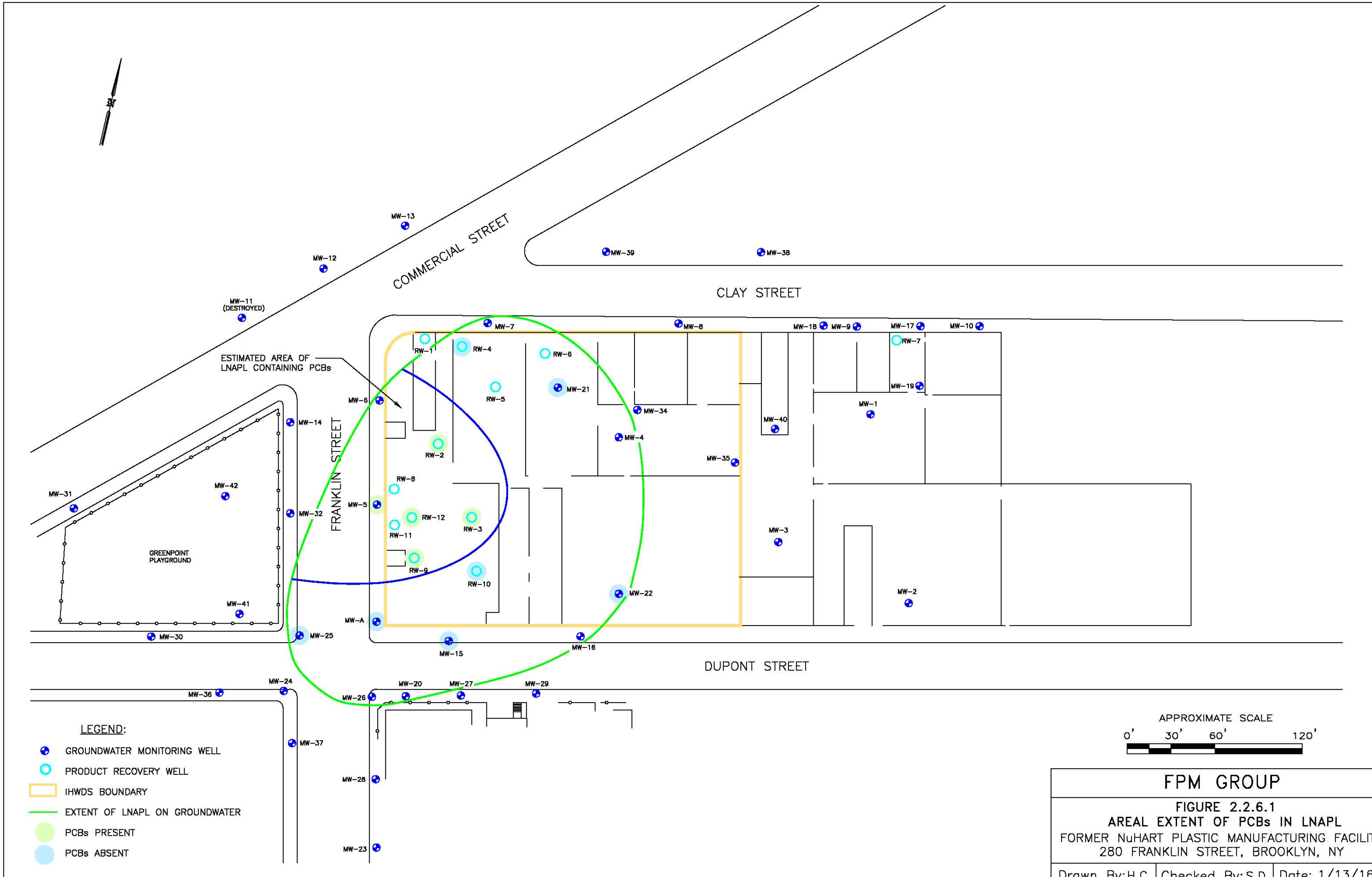


FIGURE 2.2.6.1
AREAL EXTENT OF PCBs IN LNAPL
FORMER NuHART PLASTIC MANUFACTURING FACILITY
280 FRANKLIN STREET, BROOKLYN, NY

SECTION 3.0
REMEDIAL GOALS, REMEDIAL ACTION OBJECTIVES, GENERAL RESPONSE ACTIONS, REMEDIAL TECHNOLOGY SCREENING

3.1 Remedial Goals

Chemical-specific remediation goals are use to define the area and volume of impacted media to be addressed to meet the Remedial Action Objectives (RAOs) discussed in the section below. These remediation goals are based on the evaluation of Standards, Criteria and Guidance (SCGs), which are standards and criteria that are generally applicable, consistently applied, and officially promulgated. SCGs incorporate both the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) concept of “applicable or relevant and appropriate requirements” (ARARs) and the EPA’s “to be considered” category of non-enforceable criteria and guidance. These evaluations are used to determine contaminant levels that will not endanger human health or the environment.

The terms “Standards, Criteria, and Guidance” (SCGs) as defined by the NYSDEC encompass the terms “ARARs” and “criteria and guidelines”. The term “ARARs” refers to a promulgated and legally enforceable rule or regulation. “Criteria and guidelines” refer to policy documents that are not promulgated and not legally enforceable. However, “criteria and guidelines” become enforceable if they are incorporated into an accepted Record of Decision (ROD) or other Decision Document. The NYSDEC term “SCGs” is used in this FS.

There are three types of SCGs that remedial actions may have to comply with:

- Chemical-specific SCGs set concentrations for the chemicals of concern (e.g., SCOs established under 6NYCRR Subpart 375-6);
- Location-specific SCGs may restrict remedial actions based on the characteristics of the site or its environs (remedial activities proposed for wetlands may be restricted by regulations protecting these areas); and
- Action-specific SCGs may affect remediation activities based on the type of technology selected.

The following chemical-specific SCGs and guidelines have been identified for soil for this Site:

- Federal Resource Conservation and Recovery Act (RCRA) regulations establish regulatory levels for various contaminants to be utilized in the evaluation of whether a solid waste is a hazardous waste;
- 6 NYCRR Part 371 – Identification and Listing of Hazardous Wastes provides guidance concerning the identification of hazardous waste;
- TAGM 3028 – “Contained-In” Criteria for Environmental Media: Soil Action Levels provides guidance concerning the identification of hazardous waste; and
- The NYSDEC Part 375 Environmental Remediation Program and the associated CP-51 Soil Cleanup Guidance Policy provide guidance (SCOs) concerning remediation levels for various contaminants present in soil.

The following chemical-specific SCGs have been identified for groundwater at the Site:

- NYSDEC Water Quality Regulations for Surface Waters and Groundwaters (6NYCRR Parts 700-705, revised January 17, 2008), establish water quality standards for surface waters, groundwater, and effluent discharges.

The following chemical-specific guidelines have been identified for soil vapor/indoor air at the Site:

- The NYSDOH Guidance Document for Evaluating Soil Vapor Intrusion in the State of New York (October 2006) provides guidance concerning remediation levels for various contaminants that may be present in indoor air and soil vapor; and

- The NYSDEC's DAR-1 Guidelines for the Control of Toxic Ambient Air Contaminants establishes criteria used to evaluate air emissions that may be associated with remedial systems.

3.2 Remedial Action Objectives

Remedial Action Objectives (RAOs) are media-specific goals for protecting human health and the environment. RAOs form the basis for this FS by providing overall remedial goals for addressing the Site-related contamination. The RAOs are considered during the identification of appropriate remedial technologies and formulation of alternatives. Documentation of the rationale employed in the selection of the RAOs is presented in the following sections.

The proposed remedial measures for this Site are intended to be consistent with, and an integral part of, the final remedy. The RAOs were selected from the NYSDEC's compilation of generic RAOs for public health protection and environmental protection based on the anticipated restricted residential and/or commercial use of the Site and on potential impacts to the surrounding community and environment as identified during the RI and discussed above. The selected RAOs are to mitigate, to the extent necessary and practical, the following:

➢ <u>Soil – Public Health Protection</u>

- Prevent ingestion/direct contact with soil contaminated with Site-related contaminants, including TCE and related chlorinated solvents in soil in the northeastern portion of the Site beneath the Site's existing building slab and in the immediate offsite area beneath the sidewalk, and LNAPL-related contaminants in the soil in and near areas where LNAPL is present; and

- Prevent inhalation of or exposure from contaminants volatilizing from Site-related VOC contaminants in soil.

➢ <u>Soil – Environmental Protection</u>

- Prevent migration of contaminants from TCE-impacted soils in the northeastern portion of the Site that could result in groundwater and/or soil vapor contamination; and

- Prevent migration of contaminants from LNAPL-impacted soils that could result in groundwater contamination.

➢ <u>Groundwater – Public Health Protection</u>

- Prevent ingestion of groundwater impacted by Site-related contaminants in excess of drinking water standards; and

- Prevent contact with or inhalation of Site-related chlorinated VOCs from impacted groundwater.

➢ <u>Groundwater – Environmental Protection</u>

- Restore groundwater to pre-release conditions to the extent practicable; and

- Remove the source of groundwater contamination.

➢ <u>Soil Vapor – Public Health Protection</u>

- Mitigate potential impacts to public health resulting from the potential for soil vapor intrusion from Site-related VOCs.

RAOs were selected to address the protection of both human health and the environment. The anticipated performance of each remedial action will be evaluated relative to the RAOs to estimate the acceptability of public health and environmental impacts. Final remediation goals may differ from RAOs and will be established in the ROD for the Site.

For soils, the 6NYCRR Part 375 and CP-51 Soil Cleanup Objectives (SCOs) have been established as the RAOs. These SCOs are applicable to soil and were formulated to be protective of human health and the environment.

For groundwater, the NYSDEC Class GA Ambient Water Quality Standards established in the NYSDEC Water Quality Regulations for Surface Waters and Groundwaters (6NYCRR Parts 700-705, revised March 8, 1998) have been selected as the RAOs. It should be noted that these water quality standards were developed for fresh groundwater that has the potential to be utilized for water supply. As noted above, the sodium content of the groundwater in the Site vicinity is elevated due to natural conditions, precluding its use for water supply purposes without significant treatment (desalinization). Therefore, although the GA Standards are the selected RAOs, application of these RAOs is considered from a practical perspective in this FS.

For sub-slab soil vapor, the guidance in the NYSDOH Guidance Document for Evaluating Soil Vapor Intrusion in the State of New York (October 2006) has been selected as the RAO. This guidance is used to establish no further action, monitoring, and mitigation levels for VOCs in indoor air and soil vapor.

It should be recognized that although these RAOs have been identified, it may be technically and/or economically impractical to actively remediate the media of concern to the levels dictated by these RAOs. Because of the Site's location in a heavily-developed urban area, the location of the impacted materials beneath cover materials (building slab and/or pavement) and/or at depths where no human contact is reasonably anticipated with the use of appropriate controls, and the lack of use of the groundwater in proximity of the Site for water supply purposes, remediation to levels proscribed by the RAOs may not be practicable. Therefore, the implementation of engineering controls (ECs) and institutional controls (ICs) is anticipated for this Site to control potential exposures to residual impacts that are not remediated to the RAOs.

3.3 Identification of General Response Actions

Based on the information presented in Section 2, general response actions (GRAs) are identified to address the identified soil, groundwater, and soil vapor contamination associated with the Site for the protection of public health and the environment. GRAs describe classes of technologies that can be used to meet the remediation objectives for each medium of concern. GRAs are considered in this FS with the understanding that ECs and ICs are anticipated for this Site.

- Soil impacted with SVOCs (phthalates) is present onsite and offsite at and near the groundwater interface in the area where LNAPL is present. Soil impacted by phthalates is also likely to be associated with some of the onsite USTs and piping systems formerly used to store and manage the phthalates and Hecla oil when the facility was operating. These soils are presently covered by the concrete building slab (onsite) and pavement (offsite) and do not present a current exposure hazard. There is the potential for exposure to these soils during sub-slab construction and/or remedial activities at the Site and during offsite intrusive activities that extend to the depth where these impacts are present. Accordingly, the GRAs to be considered for the SVOC- and LNAPL-impacted soil onsite and offsite are no action, in-situ treatment/containment, and excavation/disposal.

- Soil impacted by several metals is present onsite and offsite. These metals detections are related to materials in the historic fill identified onsite and offsite and are characteristic of historic fill commonly found in the New York City metropolitan area. Neither the distribution of these detections nor the levels of the detections is indicative of a release of metals contaminants at the Site, and metals impacts do not contribute to groundwater or soil vapor impacts. Therefore, GRAs are not indicated for metals-impacted soil for remedial purposes. GRAs are indicated to control potential exposures to metals-impacted soil that may during ground-intrusive activities that disturb this soil. Therefore, the GRAs considered for remedial purposes that involve intrusive activities will include GRAs that address potential exposures to metals-impacted soil.

- Soil impacted by TCE and related chlorinated solvents is present in a limited solvent “hot spot” area in the northeastern portion of the Site. The impacts extend to offsite soil on the south side of Clay Street immediately to the north of the onsite area of TCE impact, but do not extend to north side of Clay Street, confirming that the area of chlorinated VOC-impacted offsite soil is limited. The impacted soil has been identified generally only at depth (10 feet bgs and deeper). These soils are presently covered by the concrete building slab (onsite) and pavement (offsite) and do not present a current exposure hazard. There is the potential for exposure to these soils during sub-slab construction and/or remedial activities at the Site and during offsite intrusive activities that extend to the depth where these impacts are present. As noted below, the VOC-impacted soil is the likely source for chlorinated solvent impacts to groundwater and soil vapor beneath the northeastern portion of the Site and extending offsite somewhat to the north-northwest. Accordingly, the GRAs to be considered for the VOC-impacted soil onsite and offsite are no action, in-situ treatment, and excavation/disposal.

- LNAPL containing phthalates and Hecla oil is present floating on the groundwater surface beneath much of the western portion of the Site and extends offsite to the west and southwest, including beneath the east side of Franklin Street, the north side of Dupont Street, and across these streets somewhat to the northwest and southeast corners of the Franklin/Dupont intersection. LNAPL has also been found in one offsite well (MW-7) on the south side of Clay Street. LNAPL does not extend as far as the playground to the west of the Site, the vacant property to the southwest of the Site, or across Clay or Commercial Streets. The LNAPL is presently covered by the concrete building slab (onsite) and pavement (offsite) and does not present a current exposure hazard. LNAPL is not volatile or highly soluble and, therefore, does not contribute to soil vapor impacts and only minimally contributes to dissolved groundwater impacts. There is the potential for exposure to LNAPL during sub-slab construction and/or remedial activities at the Site and during offsite intrusive activities that extend to the depth where LNAPL is present. Accordingly, the GRAs to be considered for the LNAPL onsite and offsite are no action, in-situ treatment, in-situ containment, and recovery/disposal.

- Phthalates are present dissolved in groundwater generally located on the periphery of the area where LNAPL is present, including offsite wells to the east, south, and southwest of the Site. The phthalate DEHP was also detected in three wells located offsite to the northeast, in proximity to the offsite portion of the former NuHart facility. The groundwater is not used for drinking water (or any other purpose) in the Site vicinity and, therefore, the groundwater does not present a current or future concern for exposure except during intrusive activities that extend to the depth of the groundwater. The GRAs to be considered for the phthalate-impacted groundwater associated with the Site include no action, monitoring, and in-situ and ex-situ treatments.

- TCE and related chlorinated VOCs associated with the Site are present dissolved in groundwater beneath the northeastern portion of the Site and extend a short distance offsite to the north-northwest. The groundwater is not used for drinking water (or any other purpose) in the Site vicinity and, therefore, the groundwater does not present a current or future concern for exposure except during intrusive activities that extend to the depth of the groundwater. VOC-impacted groundwater can contribute to soil vapor impacts. The GRAs to be considered for the VOC-impacted groundwater associated with the Site include no action, monitoring, and in-situ and ex-situ treatments.

- Soil vapor impacted by TCE and related CVOCs is present beneath the northeastern portion of the Site building, with the greatest impacts coinciding with CVOC-impacted groundwater in this area. The impacts do not extend to the western or southern portions of the Site. CVOCs are present in offsite soil vapor in a limited area to the east and north of the Site. Site-related CVOC soil vapor impacts extend to the north, across Clay Street, but do not extend as far northward as the north side of Commercial Street. Direct contact and/or inhalation of soil vapor released from the subsurface during intrusive activities presents a potential exposure concern. Exposure to vapors in indoor air resulting from soil vapor intrusion also presents an exposure concern. The GRAs to be considered for sub-slab soil vapor at the Site and affected offsite areas include no action, monitoring, and mitigation.

In addition to technology-related GRAs, non-technology GRAs are identified for this Site, including ICs such as controls on Site usage, groundwater usage, and offsite subsurface access, and ECs, including cover systems. These GRAs are included in the evaluation of remedial action alternatives, as described in the following sections.

3.4 Identification and Screening of Remedial Technologies

Potential remedial technologies to address the Site-related impacts are identified in this section and are initially screened with respect to effectiveness and implementability. Recommendations are developed regarding retaining technologies for further consideration or rejecting technologies due to significant concerns. Remedial technologies that are retained for further evaluation are combined to form comprehensive remedial action alternatives, which are discussed in Section 4.

It should be noted that the screening of remedial technologies includes an assessment of implementability relative to existing and anticipated conditions at the Site and surrounding vicinity. These conditions include the following factors:

- The Site is anticipated to be redeveloped, but the redevelopment schedule is not known and redevelopment is not imminent. At present and for the near term, the Site building is not occupied or in use for any purpose. Following future redevelopment it is anticipated that the Site will be used for restricted residential and/or commercial purposes;

- The Site is located in a highly-urbanized area with significant below-grade utility infrastructure in the public streets and sidewalks that adjoin the north, west and south sides of the Site. Subsurface access in the streets and sidewalks is controlled via a permit process;

- The ground surface at the Site and surrounding area is fully covered by pavement or building slabs. The only significant unpaved surface in the vicinity of the Site is in the Greenpoint Playground, located to the west of the Site, across Franklin Street;

- One property located to the southwest of the Site, across the Franklin Street/Dupont Street intersection, is anticipated to be redeveloped with a school building. The proposed configuration of this redevelopment is not known;

- The NYSDEC has issued correspondence (March 17, 2015) indicating that an impermeable barrier to prevent migration onto downgradient properties not already impacted by NAPL will be a required element of the final remedy to address the contamination at this Site. As noted in Section 2.2.1 above, testing results have demonstrated that the LNAPL is essentially immobile and repeated observations from multiple wells over several years have not shown any migration of the LNAPL. The data do not demonstrate the need for a barrier to prevent LNAPL migration; and

- The Site area is served by the public water supply and no private water supply wells are reported to exist in the vicinity of the Site. As noted above, the sodium content of the groundwater, which appears to be a natural condition related to the Site's location in proximity to surface water bodies, precludes use of the groundwater for potable water purposes unless desalinization is performed. Therefore, evaluation of groundwater remediation technologies takes into consideration the natural quality and reasonable potential use of the groundwater.

Potential remedial technologies that may be used to address impacted soil, groundwater, and soil vapor and for LNAPL associated with the Site are identified in Tables 3.4.1 through 3.4.4, respectively, on the following pages. Each technology was evaluated in terms of effectiveness and implementability. After the preliminary screening, the retained technologies were combined to form remedial action alternatives, which are discussed in Section 4. The remedial action alternatives also include consideration of ICs and ECs.

TABLE 3.4.1
SCREENING OF SOIL REMEDIAL TECHNOLOGIES
FORMER NUHART PLASTIC MANUFACTURING SITE #224136
BROOKLYN, NEW YORK

Technology	Effectiveness	Implementability	Recommended Action
No Action	Not effective as there is no active reduction in contaminant concentrations. Chemical and/or biological degradation of VOCs may occur over time.	Readily implemented as no action is required.	Retain for further consideration due to easy implementation.
In-situ Treatment of VOC impacts by Soil Vapor Extraction (SVE)	Effective - will directly reduce VOC concentrations in soil and soil vapor in the treatment area and remove source of groundwater impacts. Less effective in tight soils.	Readily available and implementable technology.	Retain for further consideration due to effectiveness on most media and ready implementability. Design must consider soil types.
In-situ Treatment of VOCs by Chemical Oxidation	Will directly reduce VOC concentrations in soil in contact areas and reduce source of soil vapor and groundwater impacts. Effectiveness is limited if not all impacted soil is contacted.	May be difficult to apply effectively in unsaturated zone and/or tight soils due to contact issues. Highly oxidizing treatment chemicals may cause elevated subsurface temperatures.	Reject due to application difficulties, effectiveness limitations, and overheating risk.
In-situ Thermal Treatment - Electrical Resistivity Heating (ERH)	Will directly reduce VOC concentrations in soil and remove source of soil vapor and groundwater impacts. ERH to high temperatures can increase mobility of LNAPL, thereby facilitating LNAPL removal. ERH can result in high soil vapor VOC concentrations.	Difficult to apply ERH safely in occupied and/or populated spaces due to potential electrical exposure issues. ERH causes elevated subsurface temperatures, resulting in additional safety concerns and potential damage to subsurface utilities. Application of ERH precludes other remedial activities while ERH is ongoing.	Reject due to risk of increasing soil vapors, safety issues, potential utility damage, and potential conflicts with other remedial activities.
In-situ Thermal Treatment - Steam Injection	High temperatures can increase mobility of LNAPL, thereby facilitating LNAPL removal. Injection must be controlled; stratigraphic or other subsurface variations can reduce effectiveness. Difficult to control surface steam venting in shallow intervals.	Difficult to apply steam safely in occupied and/or populated spaces due to potential high heat/steam escape issues. Steam injection causes elevated subsurface temperatures, resulting in additional safety concerns and potential damage to subsurface utilities. Application of steam precludes other remedial activities while injection is ongoing.	Reject due to safety issues, potential utility damage, and potential conflicts with other remedial activities.

TABLE 3.4.1 (CONTINUED)
SCREENING OF SOIL REMEDIAL TECHNOLOGIES
FORMER NUHART PLASTIC MANUFACTURING SITE #224136
BROOKLYN, NEW YORK

Technology	Effectiveness	Implementability	Recommended Action
In-situ Thermal Treatment - Thermal Conduction Treatment	Will indirectly reduce VOC concentrations in soil and remove source of soil vapor and groundwater impacts. Can result in high soil vapor VOC concentrations – typically used with SVE. Will not affect SVOCs or significantly lower phthalate LNAPL viscosity. Can be effective in tight soils.	Requires closely-spaced wells. Somewhat elevated subsurface temperatures result - subsurface utilities may require monitoring. Little impact on phthalate LNAPL.	Retain due to potential for reducing VOCs in tighter soils.
Excavation with Offsite Disposal	Will directly reduce SVOC and VOC concentrations in soil and remove LNAPL. Directly reduces source of soil vapor and groundwater impacts. Added benefit of facilitating removal of metals-impacted historic fill.	Readily available technology and can be coordinated with onsite redevelopment. Disruptive to offsite operations over short term. May be difficult to implement offsite due to access concerns and utility density. Will require significant construction management and dewatering if below the water table.	Retain for further consideration due to effectiveness.

TABLE 3.4.2
SCREENING OF GROUNDWATER REMEDIAL TECHNOLOGIES
FORMER NUHART PLASTIC MANUFACTURING SITE #224136
BROOKLYN, NEW YORK

Technology	Effectiveness	Implementability	Recommended Action
No Action	Not effective as there is no active reduction in contaminant concentrations. VOCs may be reduced over time due to chemical and/or biological activity.	Readily implemented as no action is required.	Retain for further consideration due to easy implementation.
Groundwater Monitoring	Not effective for remedial purposes as there is no active reduction in contaminant concentrations. However, monitoring data would be available to assess changes in contaminant concentrations and the nature and extent of groundwater impacts.	Readily implemented.	Retain for further consideration due to easy implementation.
In-Situ Chemical Treatment	Will likely reduce VOC concentrations, but may not fully remediate groundwater impacts, depending on aquifer conditions and ability to fully contact affected aquifer. Will not directly remediate soil vapor, but may indirectly reduce VOCs in vapors.	Readily available technology, but additional investigation needed for remedial design. Safety concerns with application of some chemical treatment materials. Monitoring required.	Reject due to effectiveness concerns, need for additional investigation, and safety concerns.
In-Situ Treatment - Air Sparging	Will reduce elevated VOC concentrations. Must be used with SVE to avoid increasing soil vapor concentrations. Not effective for phthalate LNAPL.	Readily available technology. Requires SVE to remove vapors. Monitoring required.	Retain for further consideration due to effectiveness and ready implementation for VOCs.
In-Situ Control – Physical Barrier System	Will not reduce contaminant levels, but will control migration of dissolved contaminants.	Readily available technology. Requires good understanding of stratigraphy, extraction system to control groundwater mounding, groundwater (waste) disposal, discharge permit, and monitoring. Hazardous waste issues may complicate waste disposal.	Reject due to low effectiveness for contaminant reduction relative to implementation issues.
Ex-Situ Treatment - Groundwater Pump-and-Treat	Can reduce elevated VOC and SVOC concentrations, but less effective for low VOC/SVOC concentrations. Can be used to control groundwater migration. Additional controls (barriers) may be needed to increase effectiveness. Low-permeability stratigraphy can significantly reduce effectiveness.	Readily available technology. Discharge permit and monitoring required. Hazardous waste issues may complicate waste disposal. Significant pilot testing and design issues. Potential impacts in highly urbanized settings (settlement).	Reject due to questionable effectiveness and significant implementation issues.

TABLE 3.4.3
SCREENING OF SOIL VAPOR REMEDIAL TECHNOLOGIES
FORMER NUHART PLASTIC MANUFACTURING SITE #224136
BROOKLYN, NEW YORK

Technology	Effectiveness	Implementability	Recommended Action
No Action	Not effective as there is no active reduction in VOC concentrations and no assessment of potential SVI.	Easily implemented as no action is required.	Retain for further consideration due to easy implementation.
Monitoring	Not effective as there is no active reduction in VOC concentrations. However, potential SVI may be assessed with monitoring data.	Readily implemented onsite. Offsite implementation requires access approvals.	Retain for further consideration due to effectiveness for assessing SVI, and relatively easy implementation.
Soil Vapor Extraction	Will reduce elevated VOC concentrations in treatment area. Effectiveness is increased if vapor source is remediated.	Readily available technology. Monitoring required.	Retain for further consideration due to effectiveness and relatively easy implementation.
Mitigation – Vapor Barrier	No active reduction in VOC concentrations. Will reduce the potential for SVI.	Readily implementable in new buildings. Vapor barrier not readily implemented for existing buildings. Offsite implementation requires access approvals.	Retain for further consideration due to SVI reduction potential, and easy implementation for new buildings.
Mitigation - Sub-Slab Depressurization	Will reduce soil vapor VOC concentrations in a limited area and reduce the potential for SVI. Will not effectively treat VOC-impacted soil.	Readily available technology and readily implemented for new buildings. More difficult to implement in existing occupied buildings or with low-permeability soils. Monitoring required. Offsite implementation requires access approvals.	Retain for further consideration due to effectiveness for preventing SVI.

TABLE 3.4.4
SCREENING OF LNAPL REMEDIAL TECHNOLOGIES
FORMER NUHART PLASTIC MANUFACTURING SITE #224136
BROOKLYN, NEW YORK

Technology	Effectiveness	Implementability	Recommended Action
No Action	Not effective as there is no active reduction of LNAPL or monitoring of potential LNAPL migration.	Readily implemented as no action is required.	Retain for further consideration due to easy implementation.
Monitoring	No active reduction on LNAPL. Potential LNAPL migration may be assessed with monitoring data.	Readily implemented.	Retain for further consideration due to effectiveness for assessing potential LNAPL migration and easy implementation.
Barrier - Physical	No reduction in LNAPL. Can control potential LNAPL migration, but LNAPL migration not demonstrated by test results. Sheetpile barriers are likely more effective than low-permeability (grout) walls due to control on placement.	Readily available technology for migration control. Subsurface infrastructure and access issues will complicate implementation. Monitoring required. Requires LNAPL extraction system.	Reject for general use due to absence of LNAPL migration and no effectiveness for LNAPL reduction. Retain for onsite source control.
Barrier – Hydraulic	Actively removes mobile LNAPL in area of influence and controls potential LNAPL migration. Most effective when significant drawdown (groundwater pumping) is created. Effectiveness is compromised if active equipment fails. Less effective in areas of complex stratigraphy.	Readily available technology, but requires detailed subsurface information. Subsurface stratigraphic, infrastructure, and access issues may complicate implementation. Significant long-term waste (LNAPL hazardous waste and groundwater) disposal concerns. Monitoring required.	Reject due to effectiveness questions and implementation difficulties.
In-situ Thermal Treatment - Electrical Resistivity Heating (ERH)	ERH may increase mobility of LNAPL, but only at higher temps – site-specific viscosity testing indicates little potential for reduced viscosity. Must be used with a recovery (extraction) system. May increase soil VOC vapors.	Difficult to apply ERH safely in occupied and/or populated spaces due to potential electrical exposure issues. ERH causes elevated subsurface temperatures, resulting in additional safety concerns and potential damage to subsurface utilities. Application of ERH precludes other remedial activities while ERH is ongoing.	Reject due to low effectiveness relative to risk of increasing soil vapors, safety issues, potential utility damage, and potential conflicts with other remedial activities.

TABLE 3.4.4 (CONTINUED)
SCREENING OF LNAPL REMEDIAL TECHNOLOGIES
FORMER NUHART PLASTIC MANUFACTURING SITE #224136
BROOKLYN, NEW YORK

Technology	Effectiveness	Implementability	Recommended Action
In-situ Thermal Treatment - Thermal Conduction Treatment	Will not lower phthalate LNAPL viscosity, as per site-specific testing. Must be used with a recovery (extraction) system. Can result in high soil vapor VOC concentrations – typically used with SVE to remove VOCs.	Requires closely-spaced wells. Somewhat elevated subsurface temperatures result - subsurface utilities may require monitoring	Reject due to low effectiveness on phthalate LNAPL.
In-situ Stabilization	Can lower mobility of LNAPL by reducing soil porosity/permeability, but does not remove LNAPL from subsurface. Bench testing required to confirm that LNAPL in soil does not prevent stabilizing materials from setting properly.	Requires closely-spaced injection points/auger holes. Difficult to control injections in variable stratigraphy. May present concerns in subsurface utility areas.	Reject due to low/uncertain effectiveness and implementation concerns.
Extraction and Disposal	Actively removes LNAPL from subsurface. Removal amounts are significantly affected by LNAPL properties and remedial design.	Readily available technology. Waste management issues may be significant. Monitoring required.	Retain for further consideration due to effectiveness and implementability.

SECTION 4.0
REMEDIAL ACTION ALTERNATIVES

4.1 Evaluation of Remedial Action Alternatives

Remedial action alternatives appropriate to address impacts for the affected media at the Site were formulated by combining the retained technologies screened in Section 3.4 with ICs and/or ECs, as appropriate, to develop comprehensive remedial actions. In general, the retained remedial technologies for soil include no action, in-situ soil vapor extraction or SVE (for VOCs), low-temperature thermal treatment (for VOCs), and excavation with offsite disposal. The retained remedial technologies for groundwater include no action, groundwater monitoring, and in-situ treatment by air sparging (AS). The retained remedial technologies for sub-slab soil vapor include no action, monitoring, remediation by SVE, mitigation by vapor barrier installation, and mitigation using sub-slab depressurization. The retained remedial technologies for LNAPL include no action, monitoring, physical barrier for onsite source control, and extraction and disposal. In general, the ICs considered include restrictions on Site usage, restriction of groundwater usage, implementation of a Site Management Plan (SMP) to provide for management of ongoing remedial activities and residual impacts, implementation of an environmental easement for the Site, and implementation of an offsite access control. The ECs considered include maintenance of a cover system over residual impacted materials, and implementation and operation of remedial systems.

The retained remedial technologies for each of the media have been combined into comprehensive remedial alternatives that address all media. The comprehensive alternatives include a No Action Alternative, two alternatives that address the identified impacts for the Site and provide protection for potential exposures, and an alternative that is intended to achieve a full cleanup of the Site to pre-release conditions to the extent practicable.

Each of the comprehensive remedial actions considered is evaluated against eight criteria, including:

- Overall protection of public health and the environment;
- Compliance with SCGs;
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume;
- Short-term impacts and effectiveness;
- Implementability;
- Cost-effectiveness; and
- Land use.

4.1.1 Alternative 1 - No Action Alternative

A No Action remedial alternative was considered for soil, groundwater, soil vapor, and LNAPL at the Site. Soil impacted by phthalates is present onsite and offsite at and near the water table surface in and near the area where LNAPL is present and is also likely associated with at least some of the USTs and piping systems beneath the Site. Soil impacted by CVOCs is also present in a limited “hotspot” area beneath the northeastern portion of the Site and extending a short distance offsite. These soils are covered by the concrete slab of the Site building and surrounding road and sidewalk pavements and are generally found at 10 feet below grade and deeper. In limited areas beneath the Site building soil above 10 feet is impacted by phthalates or CVOCs. Although there is no potential for exposure to the impacted soil during routine onsite or offsite activities, there is the potential for exposure to these soils during future onsite construction or remedial activities if these activities occur beneath the Site slab and during offsite intrusive activities (such as remediation or construction) if these activities extend to the depth of the impacted soil. Furthermore, the CVOC-impacted soil most likely contributes to CVOC impacts in the onsite sub-slab soil vapor and to the CVOC impacts noted in groundwater beneath the northeastern portion of the Site and extending somewhat offsite to the north-northwest. The No Action alternative would leave the soil as it currently exists beneath and near the Site. Contaminant concentrations may decrease slowly as the result of natural processes such as volatilization, chemical reactions, and/or biologic activity. However, no sampling would be performed to evaluate changes soil conditions over time. Under the No Action alternative, protective measures to control exposures, such as ICs (Site usage and a Site Management Plan, or SMP), would not be implemented.

Groundwater is impacted by Site-related phthalates and CVOCs at levels exceeding SCGs in the areas beneath and in proximity to the Site. This groundwater does not present a current concern for exposure as groundwater is not used for any purpose in the Site area. Monitoring workers may contact the impacted groundwater during future monitoring activities, which may be reasonably anticipated under the current and future uses of the Site. Construction and/or remedial workers may also contact the groundwater during intrusive activities that extend to the depth of the groundwater. CVOC-impacted groundwater may continue to contribute to soil vapor impacts. In the unlikely event that onsite and/or nearby groundwater is utilized in the future there would also be a potential for future exposure. The No Action alternative would leave the groundwater as it currently exists beneath and in proximity to the Site. Contaminant concentrations identified at wells may decrease slowly as the result of natural processes such as physical dispersion, chemical reactions, and/or biologic activity. However, no monitoring would be performed to evaluate groundwater conditions over time. Under the No Action alternative, protective measures to control exposures, such as ICs (Site usage and groundwater usage restrictions, SMP), would not be implemented.

Sub-slab soil vapor beneath the northeastern portion of the Site and soil vapor beneath the pavement to the north and east of the Site is impacted by TCE and related CVOCs at levels for which monitoring and/or mitigation are the indicated due to the potential for SVI. Direct contact and/or inhalation of soil vapor released from the subsurface during intrusive activities present a potential exposure concern. Exposure to vapors in indoor air resulting from SVI also presents an exposure concern. The No Action alternative would leave the soil vapor as it currently exists beneath the concrete slab of the Site and the adjoining paved areas to the north and east. Contaminant concentrations in soil vapor may decrease slowly as the result of natural processes or remediation of other media. However, no monitoring of the soil vapor or indoor air concentrations would be performed to evaluate subsurface conditions over time or to assess potential impacts on indoor air quality. Although implementation of ECs (mitigation) and ICs (Site usage restrictions, SMP) are indicated to control exposures, under the No Action alternative these protective measures would not be implemented.

LNAPL containing phthalates and Hecla oil is present floating on the groundwater surface beneath much of the western portion of the Site and extends offsite generally to the west and southwest. LNAPL does not extend as far as the playground to the west of the Site, the vacant property to the southwest of the Site, or across Clay or Commercial Streets. The LNAPL is presently covered by the concrete building slab (onsite) and pavement (offsite) and does not present a current exposure hazard.

LNAPL is not volatile or highly soluble and, therefore, does not contribute to soil vapor impacts and only minimally contributes to dissolved groundwater impacts. There is the potential for exposure to LNAPL during sub-slab construction and/or remedial activities at the Site and during offsite intrusive activities that extend to the depth where LNAPL is present. The No Action alternative would leave the LNAPL as it currently exists beneath and in proximity to the Site. The extent and thickness of the LNAPL may decrease slowly as the result of natural processes such as physical dispersion, chemical reactions, and/or biologic activity. However, no monitoring would be performed to evaluate the extent or thickness of the LNAPL over time. Under the No Action alternative, protective measures to control exposures, such as ECs (cover system) or ICs (Site usage restrictions, SMP), would not be implemented.

The comprehensive No Action alternative is presented as a baseline for comparison to other alternatives and was evaluated relative to the eight criteria as follows:

- Overall protection of public health and the environment: This alternative is not protective of the environment as the phthalate and CVOC levels in soil, groundwater and/or soil vapor will not be actively reduced, nor will LNAPL be reduced; these conditions will continue to contribute to Site-related contamination. No monitoring would be performed to assess media conditions over time. This alternative is not protective of public health as there would be no implementation of protective measures to control exposures, such as ECs (cover system), and ICs (Site usage and groundwater usage restrictions, SMP), would not be implemented. This alternative can be implemented immediately but will not result in the achievement of RAOs;

- Compliance with SCGs: This alternative does not provide for compliance with SCGs as contaminant concentrations will not be significantly reduced nor will they be monitored. Contaminants will remain present in onsite soil, groundwater and soil vapor for some time;

- Long-term effectiveness and permanence: This alternative does not provide a long-term effective or permanent remedy for soil, groundwater, soil vapor or LNAPL;

- Reduction of toxicity, mobility, or volume: This alternative does not provide for a significant reduction of contaminant toxicity, mobility or volume in soil, soil vapor, groundwater, or LNAPL, although some reductions may occur due to natural processes over time;

- Short-term impacts and effectiveness: This remedy does not result in short-term adverse environmental impacts or human exposures as there would be no construction, active remedial measures, or monitoring conducted that might result in environmental impacts or exposures;

- Implementability: This alternative is readily implementable as there is no remedial action contemplated;

- Cost-effectiveness: This alternative does not provide any long-term or short-term effectiveness or result in any significant reduction in toxicity, mobility, or volume of contaminants in any of the media. However, as this alternative does not have any associated costs, the costs are proportional to the overall effectiveness; and

- Land use: This alternative is not protective of the current and reasonably-anticipated land use, which is restricted residential/commercial, as soils that likely contribute to soil vapor conditions would remain onsite, LNAPL would remain present in the subsurface, groundwater exceeding SCGs would remain present in the Site vicinity, soil vapors would remain onsite and in the nearby area to the north and east and continue to present a concern for SVI, and monitoring or protective measures (EC/ICs) to control potential exposures would not be implemented.

4.1.2 Alternative 2 - Air Sparging/Soil Vapor Extraction, LNAPL Extraction/Disposal, Groundwater/LNAPL Monitoring, Soil Vapor/SVI Monitoring, and ECs/ICs

This comprehensive remedial alternative would address identified impacts in each of the Site media, provide for monitoring of changes in contaminant levels, and implement protective measures to control potential exposures. This alternative assumes that the current Site condition (vacant, covered) continues during implementation of the remedy.

- Air Sparging/Soil Vapor Extraction

Air sparging (AS) and soil vapor extraction (SVE) would directly address groundwater VOC impacts identified on the northeastern portion of the Site and in the downgradient vicinity of the Site. This alternative would actively reduce VOC concentrations in the affected areas by enhancing volatilization of VOCs from the groundwater. An SVE system would be used in the AS areas to remove the volatilized VOCs from the subsurface and directly reduce soil vapor impacts. Groundwater and soil vapor monitoring would be required to document the progress of remediation.

This alternative would actively reduce VOC concentrations in the affected soils by enhancing volatilization of VOCs, which would be captured by the SVE system, removed from the subsurface, and discharged to the atmosphere. Effluent monitoring would be performed to evaluate the reduction in VOC concentrations over time and to confirm that emissions from the SVE system meet regulatory requirements. The NYSDEC DAR-1 guidance document would be used to determine if effluent treatment is necessary. SVE will reduce the amount of VOCs in Site soil that have the potential to migrate to groundwater or soil vapor and would also directly remove soil vapors in the system's radius of influence (ROI), thus providing soil vapor intrusion (SVI) mitigation in the system area.

A site plan showing the potential layout of an AS/SVE system is presented in Figure 4.1.2.1. The AS portion of the system would be designed to treat areas where significant groundwater VOC contamination has been observed onsite and in close downgradient and crossgradient proximity to the onsite VOC source area. The AS system would likely include four AS wells located onsite in the vicinity of the source area, two of which would be positioned so as to treat groundwater beneath the sidewalk immediately north of this area. The AS screens would be set at a depth of approximately 18 to 20 feet so as to treat groundwater situated in the more permeable stratigraphic intervals above the extensive clay/silt that underlies the area. Based on previous experience with other AS systems in the NYC metro area, it is anticipated that an airflow of between 10 and 16 standard cubic feet per minute (SCFM) per well at a pressure of 20 to 40 pounds per square inch would be needed to result in an ROI of about 30 feet at each AS well. A compressor capable of a total flow of 60 to 80 SCFM at the targeted pressure is indicated.

SVE wells would be required to capture vapors resulting from sparging. The SVE wells would also treat VOC-impacted soil that may be present in the unsaturated zone in the presumed source area and remove soil vapors associated with the VOC-impacted area. SVE system design would take stratigraphic variations into consideration to maximize effectiveness. The SVE system would likely include three wells; potential SVE well locations are shown on Figure 4.1.2.1 and are based on previous experience with SVE system layouts in the NYC metro area. It is anticipated that an SVE ROI of about 50 feet may be achieved with a flow rate of about 100 SCFM under a vacuum of between 10 and 150 inches of water. The blower would be appropriately sized for the anticipated total flow rate and vacuum of the SVE system. Sub-slab monitoring points would also be installed to just below the slab to allow for confirmation of the SVE ROI and to allow for sub-slab vapor sampling, as needed.

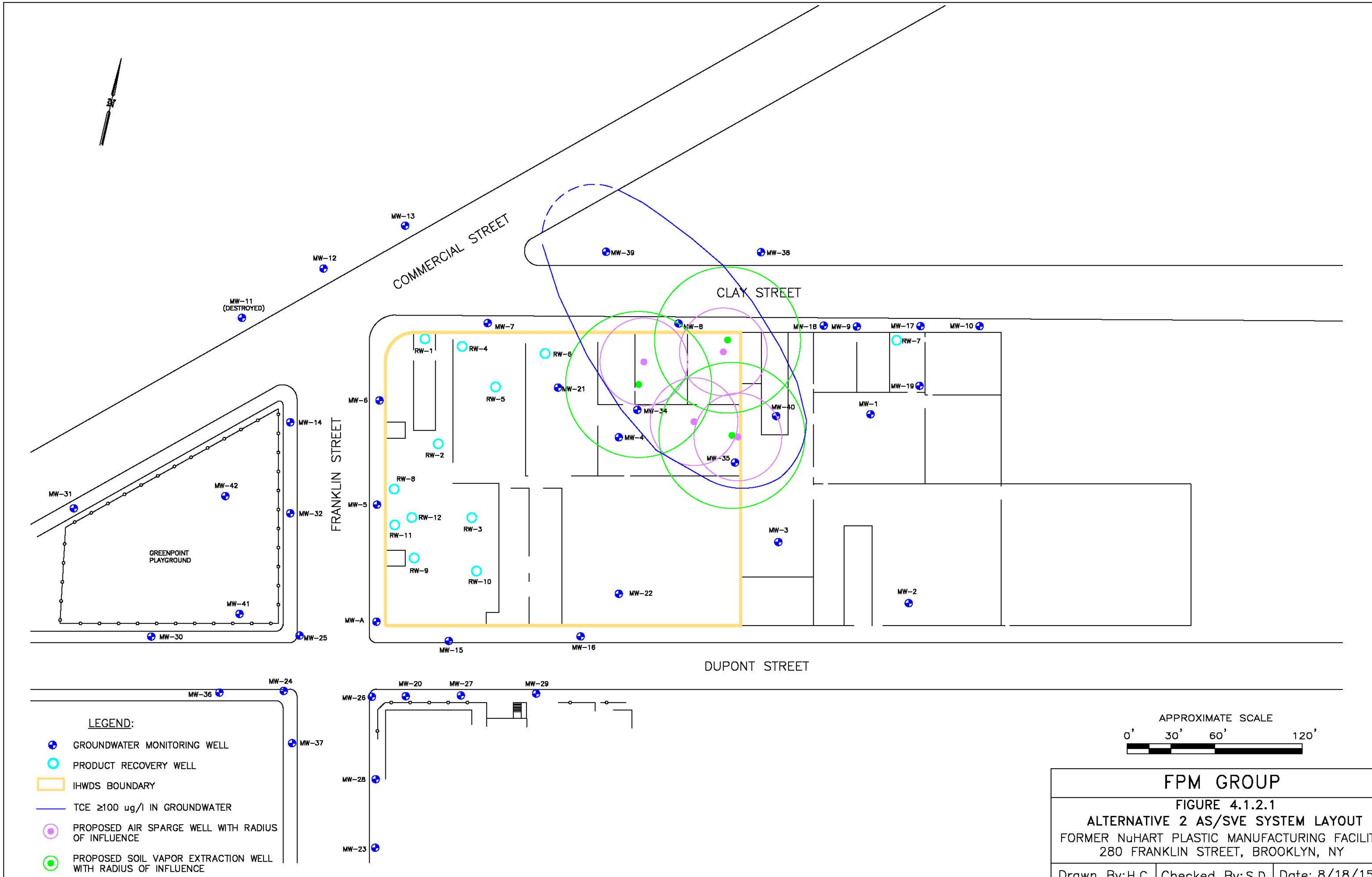


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FIGURE 4.1.2.1

ALTERNATIVE 2 AS/SVE SYSTEM LAYOUT

FORMER NuHART PLASTIC MANUFACTURING FACILITY
280 FRANKLIN STREET, BROOKLYN, NY

Drawn By: H.C. | Checked By: S.D. | Date: 8/18/15

Costs for an AS/SVE system to treat the VOC source area have been estimated as shown on Table 4.1.2.1. Backup for these costs is provided in Appendix C. Please note that the costs have been estimated on a net present worth basis for both a 30-year remedial period and a four-year remedial period. Based on previous experience with AS/SVE systems, the AS/SVE system is anticipated to reach the limits of its effectiveness within about four years of operation.

- LNAPL Extraction/Disposal

LNAPL extraction and disposal is considered as part of Remedial Alternative 2 to reduce the amount of LNAPL in the environment over time. Monitoring will be necessary to document the anticipated reduction in LNAPL and confirm the LNAPL extent over time; monitoring is discussed in the following section.

LNAPL extraction may be accomplished using recovery wells and/or recovery trenches. Recovery trenches would be excavated through the LNAPL and into the underlying groundwater and backfilled with a highly permeable material, such as gravel, to allow for LNAPL flow into and through the trench. LNAPL recovery sumps are placed at appropriate locations in the trench and each sump is equipped with LNAPL recovery equipment. Trenches can provide good LNAPL recovery but can be difficult to install properly in areas with significant subsurface infrastructure. Recovery wells consist of wells installed through the LNAPL and into the underlying groundwater to a depth sufficient to allow for variations in the depth of the LNAPL over time and to provide sufficient room for the recovery equipment. Each well must be spaced appropriately and properly sized for the recovery equipment, with the well screen and gravel pack properly sized for the surrounding soils. Recovery wells generally must be closely spaced to provide for good LNAPL recovery, but are generally more easily installed than trenches in areas with significant subsurface infrastructure. Recovery equipment in either trenches or wells may consist of manually operated equipment (if LNAPL recovery is slow) or installed powered equipment (if LNAPL recovery is more rapid).

The selection of recovery trenches or wells for each remedial area should be made following a full assessment of the implementation considerations at each location. For the purposes of evaluating this remedial alternative, it is assumed that closely-spaced recovery wells are used for LNAPL recovery. Similarly, recovery equipment selection should be based on the characteristics and behavior of the LNAPL at each recovery location. For the purposes of evaluating this remedial alternative it is assumed that the recovery equipment includes belt skimmers due to the high viscosity of the product to be recovered. This equipment typically provides the greatest recovery of high viscosity LNAPL with the least amount of associated water, and operates more dependably with less maintenance than other types of LNAPL recovery equipment.

LNAPL extraction is considered for three general areas, as shown on Figure 4.1.2.2. An onsite extraction area is considered for most of the western and southern borders of the Site in the area where LNAPL is present adjoining these Site boundaries. Extraction of LNAPL along these Site borders will essentially eliminate the potential for any further migration of LNAPL from the Site and remove some LNAPL from beneath the offsite areas immediately adjoining the Site.

An extraction area is also considered for an offsite location just to the southwest of the Franklin Street/Dupont Street intersection as a conservative measure. Although LNAPL has not been detected in any of the three existing monitoring wells located to the southwest of this intersection, the southwestern edge of the LNAPL plume (shown on Figure 4.1.2.2) is near this area. Potential LNAPL extraction wells would be installed and observed under the monitoring program (see below); LNAPL extraction would be implemented if LNAPL is detected in any of these wells in the future.

TABLE 4.1.2.1
ESTIMATED COSTS FOR REMEDIAL ALTERNATIVE 2
AIR SPARGING/SOIL VAPOR EXTRACTION

Description	Cost (30 Years)	Cost (4 Years)
Capital Costs		
AS/SVE System Installation	$108,000	$108,000
Engineering Design Costs (15%)	$16,200	$16,200
Contingency (15%)	$16,200	$16,200
Oversight and Management (25%)	$27,000	$27,000
Reporting (15%)	$16,200	$16,200
Capital Cost Subtotal	**$183,600**	**$183,600**
Annual Operation, Monitoring, and Maintenance Costs	$58,400	$58,400
OM&M Net Present Worth	**$1,179,400**	**$223,700**
AS/SVE System Removal	**$10,100**	**$21,800**
TOTAL COST (Capital and OM&M Net Present Worth)	**$1,373,100**	**$429,100**

Notes:

Assumed interest rate is 5% and assumed inflation rate is 2%.
All costs rounded to the nearest $100

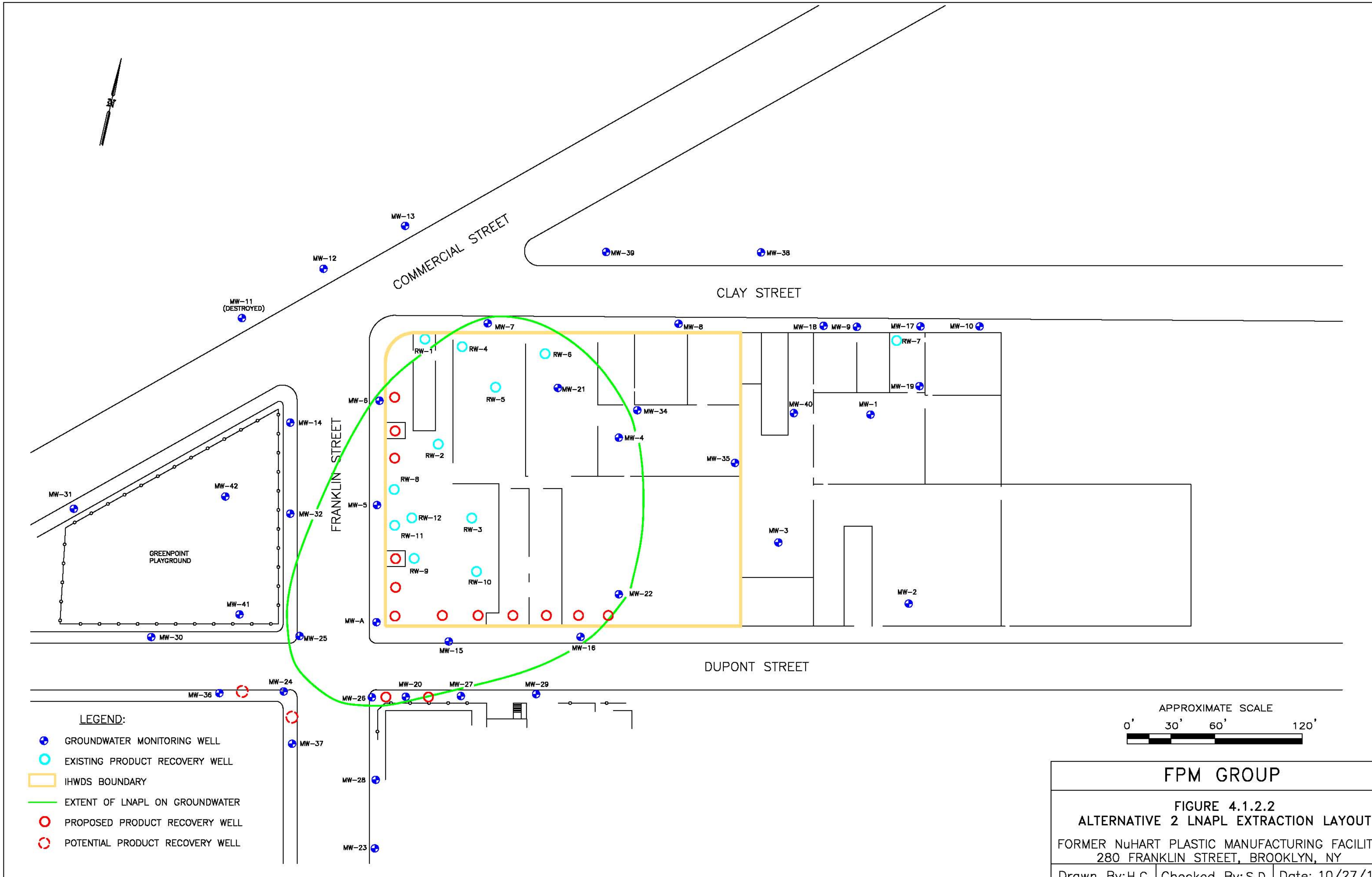

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FIGURE 4.1.2.2
ALTERNATIVE 2 LNAPL EXTRACTION LAYOUT

FORMER NuHART PLASTIC MANUFACTURING FACILITY
280 FRANKLIN STREET, BROOKLYN, NY

Drawn By: H.C.	Checked By: S.D.	Date: 10/27/15

LNAPL has been identified beneath the southeastern corner of the Franklin Street/Dupont Street intersection. Extraction and disposal of LNAPL from this location is considered so as to remove LNAPL from beneath the sidewalk and in proximity to the offsite properties in this area. Proposed LNAPL recovery well locations are shown on Figure 4.1.2.2.

Costs for LNAPL recovery wells have been estimated as shown on Table 4.1.2.2. Backup for these costs is provided in Appendix C. Please note that the costs have been estimated on a net present worth basis for a 30-year remedial period and a 10-year remedial period. Based on previous experience with product recovery systems and the highly viscous nature of the LNAPL at this Site, LNAPL recovery rates will decline over time and it is anticipated that the system designed for current conditions may reach the limits of its effectiveness within 10 years of operation. Thereafter, LNAPL recovery methods may require modification for continued effectiveness and/or further LNAPL recovery may become impractical.

➢ <u>Groundwater/LNAPL Monitoring</u>

Groundwater and LNAPL monitoring is considered as part of Remedial Alternative 2 to indirectly address the identified groundwater impacts and to confirm that the impacts continue to be limited to the proximity of the Site. LNAPL would also be monitored to document the anticipated reduction in LNAPL extent and apparent thickness over time. This alternative would not actively reduce groundwater contaminant concentrations or LNAPL, but would provide for assessment of the anticipated reduction in groundwater impacts and LNAPL extent and apparent thickness over time due to other factors, such as remediation of other affected media and ongoing natural processes.

Groundwater and LNAPL monitoring would be conducted at select wells downgradient, crossgradient, and upgradient of the Site. Figure 4.1.2.3 shows the proposed locations of groundwater monitoring wells (blue circles) and LNAPL monitoring wells (green circles) to be included in the monitoring networks. For reference, the locations of the LNAPL plume, the area of TCE-impacted groundwater, and proposed LNAPL recovery wells are also depicted on Figure 4.1.2.3. All of the monitoring wells presently exist except for one well that would be needed onsite near the east end of the line of proposed onsite LNAPL recovery wells. Groundwater monitoring for most of the wells would be conducted semiannually (twice per year) for VOCs and SVOCs and groundwater monitoring in the area of the AS/SVE system (MW-3, MW-8, MW-10, MW-13, MW-18, MW-34, MW-35, MW-39 and MW-40) would be conducted quarterly for VOCs so as to assess the progress of remediation. LNAPL monitoring would be conducted on a monthly basis. The monitoring frequencies would remain unchanged until the NYSDEC approves a change in monitoring frequency.

Costs for groundwater/LNAPL monitoring have been estimated as shown on Table 4.1.2.3 and are presented on a projected net present worth basis over 30 years and also over variable durations coordinated with the potential duration of remedial systems operations. Backup for the estimated costs for this alternative are included in Appendix C.

➢ <u>Soil Vapor/SVI Monitoring</u>

Monitoring for soil vapors and potential SVI is considered as part of Remedial Alternative 2 to assess soil vapor conditions over time and confirm that soil vapor impacts present beneath the concrete slab of the Site and pavement/sidewalks of nearby offsite areas do not affect indoor air quality at occupied structures. Soil vapor monitoring results would also be used to assess the progress of soil vapor remediation associated with SVE operation. This alternative would not actively reduce VOC concentrations in the soil vapor, but would be used to evaluate potential exposure issues, to assess

TABLE 4.1.2.2
ESTIMATED COSTS FOR REMEDIAL ALTERNATIVE 2
LNAPL EXTRACTION/DISPOSAL

Description	Cost (30 Years)	Cost (10 Years)
Capital Costs:		
Onsite Extraction Wells	$132,800	$132,800
Engineering Design Costs (15%)	$19,900	$19,900
Contingency (15%)	$19,900	$19,900
Oversight and Management (25%)	$33,200	$33,200
Reporting (15%)	$19,900	$19,900
Capital Cost Subtotal (onsite):	**$225,700**	**$225,700**
Offsite Extraction Wells	$209,600	$209,600
Engineering Design Costs (15%)	$31,400	$31,400
Contingency (15%)	$31,400	$31,400
Oversight and Management (25%)	$52,400	$52,400
Reporting (15%)	$31,400	$31,400
Capital Cost Subtotal (offsite):	**$356,200**	**$356,200**
Total Capital Costs:	**$581,900**	**$581,900**
Annual Operation, Monitoring and Maintenance Costs:	$171,200	$171,200
OM&M Net Present Worth	**$3,455,300**	**$1,503,800**
Extraction Systems Removal	**$89,100**	**$160,900**
TOTAL COST (Capital and OM&M Net Present Worth):	**$4,126,300**	**$2,246,600**

Note:
All costs rounded to the nearest $100.

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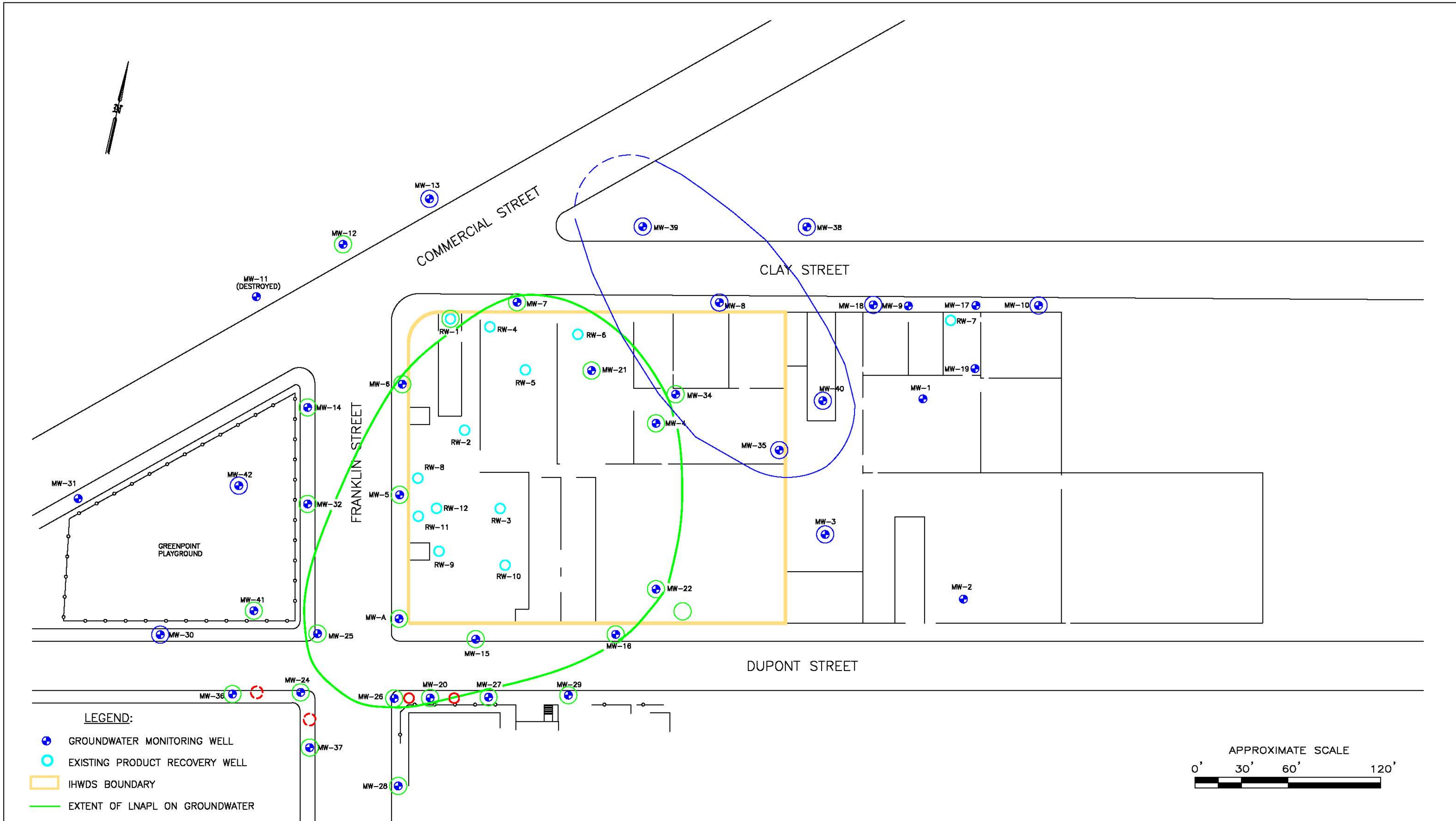

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FIGURE 4.1.2.3
ALTERNATIVE 2 GROUNDWATER/LNAPL MONITORING NETWORK LAYOUT
FORMER NuHART PLASTIC MANUFACTURING FACILITY
280 FRANKLIN STREET, BROOKLYN, NY

Drawn By: H.C. | Checked By: S.D. | Date: 10/27/15

TABLE 4.1.2.3
ESTIMATED COSTS FOR REMEDIAL ALTERNATIVE 2
GROUNDWATER/LNAPL MONITORING

Description	Cost (30 Years)	Cost (6 and 12 Years)
Capital Costs:		
Monitoring Network Installation	$6,300	$6,300
Contingency (15%)	$900	$900
Oversight and Management (25%)	$1,600	$1,600
Reporting (15%)	$900	$900
Total Capital Cost:	**$9,700**	**$9,700**
Annual GW Monitoring and Reporting Costs:	$81,300	$81,300
Annual LNAPL Monitoring and Reporting Costs:	$77,600	$77,600
OM&M Net Present Worth	**$3,208,200**	**$1,249,400**
Monitoring Network Abandonment	**$19,500**	**$33,200**
TOTAL COST (Capital and OM&M Net Present Worth):	**$3,237,400**	**$1,292,300**

Note:
All costs rounded to the nearest $100.

U:\Rigano LLC\49 Dupont Brooklyn\FS\FS Cost Tables\New Tables\Table4123GWLNAPLMonAlt2.Docx reductions in VOC concentrations in soil vapor that may result from remedial measures, and to serve as a trigger for implementing SVI mitigation measures should the need arise.

Soil vapor monitoring would include installation of vapor implants through the Site building slab and through nearby sidewalks at several key locations to allow for monitoring of soil vapors over time. Monitoring locations would be selected so as to provide monitoring data at the same locations as previously to allow for data comparisons over time. SVI monitoring would also include installation of vapor implants through the slabs of key offsite buildings (15 and 19 Clay Street) to allow for monitoring of sub-slab soil vapors and indoor air to be conducted periodically. SVI monitoring would require that building access for implant installation and sampling be obtained from the property owners and that access for indoor air sampling be obtained from building occupants. For the purposes of this FS it is assumed that access to offsite properties is obtained. Figure 4.1.2.4 shows the proposed locations of soil vapor monitoring points. SVI monitoring points would be selected in consultation with offsite property owners.

Soil vapor and SVI monitoring are anticipated to be conducted at a frequency of twice per year (once during the heating season and once during the cooling season). During the each monitoring event co-located sub-slab soil vapor and indoor air samples, an ambient air sample, soil vapor samples would be collected for laboratory analysis. All procedures and data evaluation would be in accordance with NYSDOH guidance. Monitoring would continue until the NYSDEC approves monitoring termination.

Costs for soil vapor and SVI monitoring have been estimated as shown on Table 4.1.2.4 and are presented on a projected net present worth basis over 30 years and over a six-year period as soil vapor conditions are anticipated to improve after the source soil is remediated. A monitoring frequency of twice per year is assumed. Backup for the estimated costs are included in Appendix C.

- <u>Implementation of ECs and ICs</u>

Implementation of ECs and ICs would be used to control potential exposures to impacts for all media under Remedial Alternative 2. Specifically, soil impacts will remain present onsite and LNAPL will remain present onsite and offsite. Soil vapor and groundwater impacts will also remain present, but are anticipated to diminish over time. ECs and ICs considered include a cover system EC (existing concrete slab for the Site and existing sidewalks and road pavement for offsite areas) to provide protection from impacted soil and LNAPL, and ICs (Site and groundwater usage restrictions, and an SMP) to control Site use and potential onsite exposures to soil, soil vapor, LNAPL, and/or groundwater.

Access to the offsite subsurface is presently controlled by an IC consisting of a street-opening permit process that is required for penetration of the existing EC (sidewalks/pavement). An additional IC will be necessary to control potential exposures during offsite subsurface activities that are conducted to depths where Site-related LNAPL and associated impacted soil are present. The IC considered under this alternative is posting of an environmental notice for street-opening permits requested in the area where Site-related subsurface impacts are present.

Implementation and control of onsite ECs and ICs would be governed by an environmental easement for the Site. Implementation and control of offsite ECs and ICs would be governed by the existing street-opening permit process and an environmental notice.

Costs for the ICs and ECs, including implementation of an environmental easement, SMP, annual inspections and cover system repairs, certification and reporting, have been estimated as shown on Table 4.1.2.5 on a net present worth basis over an assumed 30-year monitoring period. Backup for the estimated costs for this alternative are included in Appendix C.

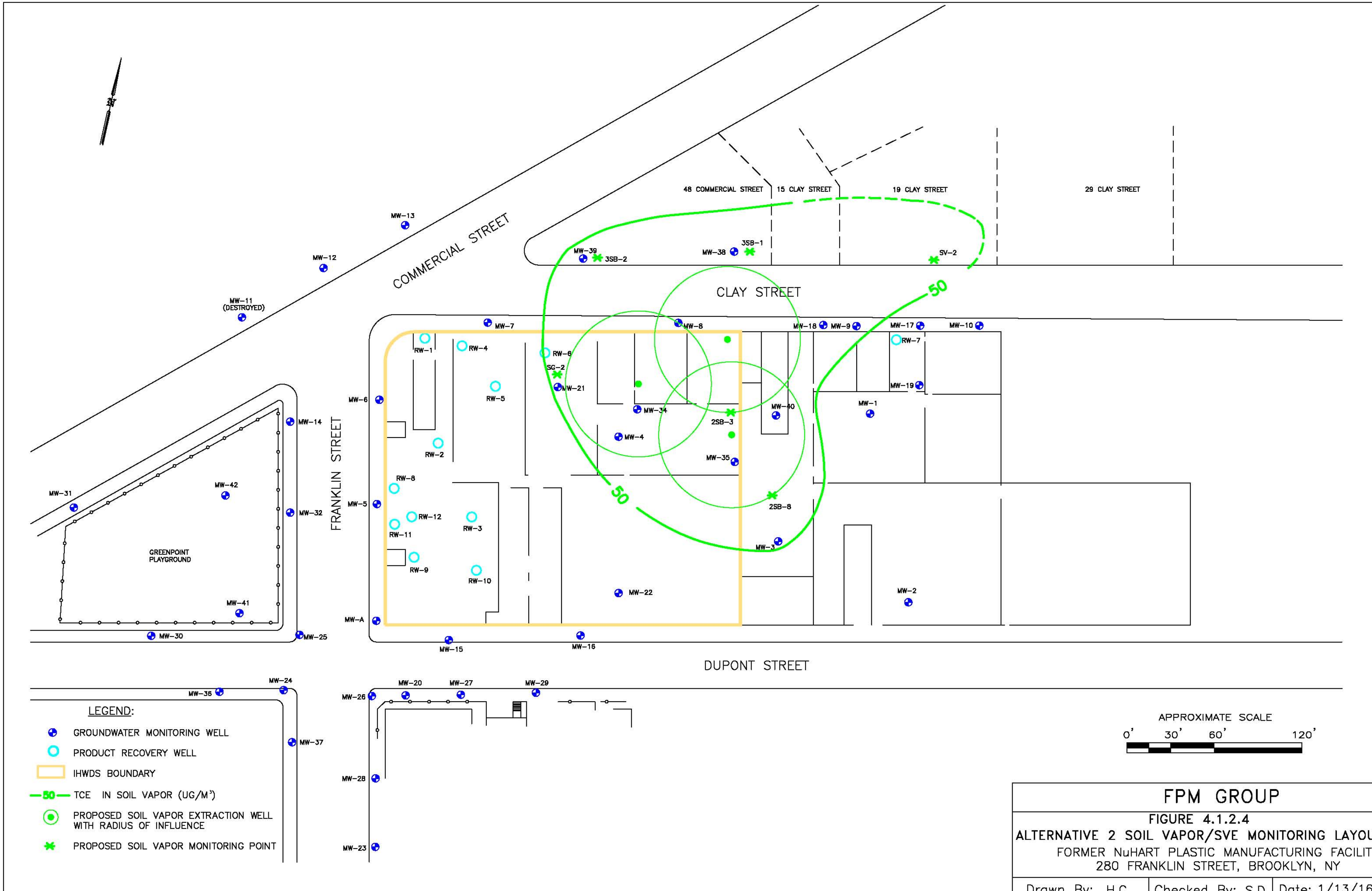

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FIGURE 4.1.2.4
ALTERNATIVE 2 SOIL VAPOR/SVE MONITORING LAYOUT
FORMER NuHART PLASTIC MANUFACTURING FACILITY
280 FRANKLIN STREET, BROOKLYN, NY

Drawn By: H.C.	Checked By: S.D.	Date: 1/13/16

TABLE 4.1.2.4
ESTIMATED COSTS FOR REMEDIAL ALTERNATIVE 2
SOIL VAPOR/SVI MONITORING

Description	Cost (30 Years)	Cost (6 Years)
Capital Costs:		
Monitoring Network Installation	$26,400	$26,400
Contingency (15%)	$4,000	$4,000
Design (15%)	$4,000	$4,000
Oversight and Management (25%)	$6,600	$6,600
Reporting (15%)	$4,000	$4,000
Total Capital Cost:	**$45,000**	**$45,000**
Annual Monitoring and Reporting Costs:	$44,000	$44,000
OM&M Net Present Worth	**$889,200**	**$245,800**
Monitoring Network Abandonment	**$15,600**	**$31,700**
TOTAL COST (Capital and OM&M Net Present Worth):	**$949,800**	**$322,500**

Note:
All costs rounded to the nearest $100.

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TABLE 4.1.2.5
ESTIMATED COSTS FOR REMEDIAL ALTERNATIVE 2
IMPLEMENT ECS AND ICS

Description	**Cost (30 Years)**
Capital Costs:	
Implement ECs and ICs	$40,000
Contingency (15%)	$6,000
Total Capital Cost:	**$46,000**
Annual Monitoring and Certification Costs:	$12,700
Monitoring and Certification Net Present Worth	**$255,400**
TOTAL COST (Capital and Mon./Cert. Net Present Worth):	**$301,400**

Note:
All costs rounded to the nearest $100.

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Comprehensive Remedial Alternative 2 was evaluated relative to the eight criteria as follows:

- Overall protection of public health and the environment: This alternative actively addresses groundwater, soil, and soil vapor VOC impacts within the AS/SVE system ROI, and is anticipated to indirectly reduce soil vapor impacts outside of the SVE ROI and groundwater VOC impacts outside and downgradient of the AS ROI. Therefore, this alternative is considered protective of public health and the environment in that contaminants in groundwater, soil, and soil vapor will be reduced. This alternative is also protective of the environment in that LNAPL in the environment will be reduced. This alternative also provides a means of assessing the anticipated reduction of contaminant concentrations in soil, groundwater, and soil vapor, evaluating the extent and apparent thickness of LNAPL over time, and assessing potential exposures to soil vapor via SVI. This alternative does not actively reduce contaminant concentrations in soil vapor outside of the SVE ROI; however, it provides a means of evaluating and preventing potential human exposures and triggering SVI mitigation measures if necessary and, therefore, is protective of public health. Potential public exposures to residual impacted materials would be controlled and monitored via ECs and ICs. This alternative is more protective than Alternative 1 (No Action), but less protective than Alternatives 3 or 4, as described below;

- Compliance with SCGs: This alternative provides for compliance with SCGs for VOCs in soil, groundwater and soil vapor in the VOC treatment area as VOC concentrations are anticipated to be reduced to near or below the SCGs in and downgradient of the AS/SVE treatment area. This alternative provides for limited compliance with SCGs relative to the LNAPL as LNAPL removal will occur and the extent and apparent thickness are anticipated to be reduced over time. This alternative does not directly provide for compliance with groundwater SCGs for other constituents (SVOCs), but does provide a means for evaluating achievement of SCGs in groundwater due to remediation by other measures and ongoing attenuation processes. This alternative does not directly provide for compliance with SCGs in soil vapor except within the SVE ROI, but it does provide a means for assessing achievement of SCGs in soil vapor that may result from soil and groundwater remediation by AS/SVE, and for evaluating compliance with the SCGs for indoor air in occupied buildings. This alternative includes ECs and ICs to monitor and control potential exposures for those media where SCGs are not obtained, thereby assuring that the SCGs are not exceeded at potential exposure points;

- Long-term effectiveness and permanence: The VOC contaminants in the groundwater, soil, and soil vapor within the AS/SVE ROIs would be actively and permanently reduced by this alternative, resulting in an effective and permanent long-term remedy for VOCs in this area. This alternative includes removal and offsite disposal of LNAPL over time, thus permanently reducing the amount of LNAPL in the subsurface. Groundwater/LNAPL monitoring does not provide a long-term effective or permanent remedy for groundwater impacts or LNAPL, but it provides a means to document changes in groundwater quality and LNAPL extent and apparent thickness due to other remedial measures and attenuation processes. Soil vapor and SVI monitoring do not actively remedy soil vapor impacts and, therefore, do not result in a long-term effective or permanent remedy for soil vapor. However, soil vapor and SVI monitoring do provide a means for documenting changes in soil vapor conditions and the potential for SVI due to other remedial measures and are a long-term effective means for assessing soil vapor conditions and the potential for SVI. Implementation of ECs and ICs will result in an effective long-term remedy from the standpoint of public health as the residual materials would be isolated from public contact by a cover, prohibition of groundwater usage, controls on Site usage, controls on offsite subsurface access, and an SMP to govern management of residual materials. Periodic inspection and certification would be required, resulting in an effective and permanent long-term remedy;

- Reduction of toxicity, mobility, or volume: This alternative provides for a reduction of toxicity, mobility and volume of VOC contaminants in the groundwater, soil, and soil vapor within the AS/SVE ROIs. This alternative also provides for some reduction of toxicity, mobility and volume of LNAPL. It does not directly provide for a reduction of the toxicity, mobility, or volume of other groundwater contaminants, but does provide a means for evaluating reductions in other groundwater contaminants due to other remedial measures or attenuation processes. This alternative does not directly reduce the toxicity, mobility, or volume of soil vapor contaminants except within the SVE ROI, but it does provide a means to evaluate reductions in soil vapor contaminants due to other remedial measures. The mobility of soil vapor contaminants would be reduced via maintaining the cover EC using ICs;

- Short-term impacts and effectiveness: The short-term adverse environmental impacts or human exposures would be minimal to moderate during activities associated with implementing the AS/SVE remedial system, LNAPL recovery systems, groundwater/LNAPL monitoring, soil vapor and SVI monitoring, and ECs/ICs. Most of the intrusive activities would be conducted within the existing Site building, which is anticipated to remain in place during remedial construction. An approved Health and Safety Plan (HASP) and Community Air Monitoring Plan (CAMP) would be required for the remedial construction and monitoring work and personal protective equipment (PPE) would be utilized by remedial workers to control exposures. CAMP monitoring results would be used to verify that short-term impacts are minimized and to trigger implementation of additional controls if needed. The surrounding community and remedial workers would generally be at little risk since there would be no contact with the affected media during the remedial and monitoring processes. It should be noted that the LNAPL remedial and monitoring processes will include both onsite and offsite operations, including vehicle and remedial worker activities and LNAPL transfer and transport activities through the surrounding community during the period of LNAPL removal. These activities will be conducted under a HASP and CAMP designed to address potential safety and community concerns with these activities, but there will be an increase in vehicle traffic and LNAPL handling in the public street area. Potential exposures to VOC emissions will be monitored via SVE system effluent sampling and emissions controls will be used if necessary to ensure that emissions meet Air Guide 1 requirements. Short-term adverse environmental impacts or human exposures are not anticipated in association with implementing ECs and ICs. Following completion of remedial construction and associated cover repairs, there are not anticipated to be any human exposures as the affected media will be covered and the cover would be monitored;

- Implementability: There are no significant technical limitations to implementing this alternative since readily-available AS/SVE remedial and monitoring technologies would be utilized, a majority of the proposed monitoring network and all of the cover are already present, there is no groundwater usage, the Site building is vacant and not scheduled to be redeveloped in the near future, and groundwater, LNAPL, and soil vapor/SVI monitoring procedures have already been conducted under the NYSDEC-approved work plans. Design of the AS and SVE systems will need to take stratigraphic variations into account. Design and construction of the LNAPL recovery systems will likely include some technical limitations due to the urban nature of the Site and vicinity and the presence of a significant amount of subsurface utilities. However, the selection of wells for the LNAPL recovery system is anticipated to reduce potential technical limitations. An SMP and an environmental easement would be required, both of which may be readily implemented. The existing street-opening permit process is anticipated to facilitate implementation of the offsite IC, which is anticipated to be posting of an environmental notice for street-opening permits in the Site vicinity. This alternative can be implemented within a reasonable time period, anticipated to be several months to a year;

- Cost-effectiveness: This alternative provides long-term and short-term effectiveness and results in significant reductions in toxicity, mobility, and volume for VOCs in groundwater, soil and soil vapor within the AS/SVE system's ROIs. This system is also likely to indirectly reduce groundwater and soil vapor impacts outside of the ROI, although it does not directly result in significant reductions in toxicity, mobility, and volume for groundwater or soil vapor contaminants outside of the ROI. This alternative also provides moderate long-term and short-term effectiveness for LNAPL reduction, including reductions in toxicity, mobility, and volume. Remedial system design, installation, operation, and monitoring costs are anticipated to be moderate, and the groundwater, LNAPL, soil vapor, and SVI monitoring design and implementation costs are low. Therefore, the costs for this comprehensive alternative are low to moderate, proportionally, relative to its overall effectiveness. The cost-effectiveness for the AS/SVE, LNAPL recovery, and monitoring components are increased when used in conjunction with the ECs/ICs that control potential exposures; and

- Land use: This alternative is protective of the current and reasonably-anticipated land use of the Site, which is presently vacant and anticipated to be redeveloped at a later date with a restricted residential and/or commercial use, as soil, groundwater and soil vapor impacted by VOCs within the AS/SVE system ROI would be remediated, mitigation of potential onsite SVI concerns would occur, LNAPL will be reduced, groundwater use is not occurring or contemplated, a cover will remain present over impacted materials, and monitoring data would be available to assess LNAPL changes, groundwater quality, and potential SVI concerns onsite. This alternative is also protective of the current and reasonably-anticipated land use in the Site vicinity, as the AS/SVE system is anticipated to significantly reduce offsite soil, groundwater and soil vapor impacts, thereby mitigating potential SVI concerns, LNAPL will be reduced, groundwater use is not occurring, a cover will remain present over impacted materials, and monitoring data would be available to assess changes in the condition of subsurface media over time. Under this alternative materials exceeding applicable SCGs would be isolated from the public via cover, controls on land use, and controls on groundwater use. These controls would be implemented onsite via an environmental easement and an SMP and offsite via the existing street-opening permit process and posting of an environmental notice for street-opening permits requested in the area where Site-related subsurface impacts are present.

4.1.3 Alternative 3: Source Area Physical Barrier with LNAPL Extraction/Disposal, Groundwater Air Sparging/Soil Vapor Extraction, Groundwater/LNAPL Monitoring, Sub-Slab Depressurization, Soil Vapor/SVI Monitoring, and ECs/ICs

This comprehensive remedial alternative would address identified impacts in each of the Site media with the objective of removing more impacts than Alternative 2, providing onsite containment of the LNAPL source materials, and providing protection from potential exposures for all media. This alternative involves more intrusive remedial activity onsite and offsite, with associated impacts as noted in the evaluation criteria below. ECs and ICs will continue to be necessary to implement this remedy, control potential exposures during remedial activities, and control potential exposures over the long term.

In evaluating this remedial alternative it is assumed that the current Site condition (vacant building) continues during implementation of the remedy. It is also assumed that the adjoining former NuHart property to the east is redeveloped.

➢ Source Area Physical Barrier with LNAPL Extraction/Disposal

A physical barrier for the LNAPL source area with LNAPL extraction and disposal is considered as part of Remedial Alternative 3 to prevent potential LNAPL migration from the source area and to remove LNAPL from onsite and offsite areas. A sheetpile physical barrier is considered in this remedial alternative. Monitoring will be necessary to confirm that LNAPL migration is not occurring and to document the removal of LNAPL over time; monitoring is discussed in the following section.

An onsite physical barrier is considered for most of the western and southern borders of the Site in the area where LNAPL is present adjoining these Site boundaries, as shown on Figure 4.1.3.1. Placement of a physical barrier at this location will prevent migration of LNAPL that may otherwise occur from the Site. Extraction and disposal of LNAPL from the east and north sides of this physical barrier is also contemplated. Extraction is necessary to reduce the potential for LNAPL migration around the ends of the physical barrier and will also reduce the amount of LNAPL present in the environment over time. Extraction and disposal of LNAPL from the west and south sides of this physical barrier is also contemplated to remove some LNAPL from beneath the offsite areas immediately adjoining the Site and reduce the amount of LNAPL present in the environment over time.

Extraction and disposal of LNAPL from the sidewalk area adjoining portions of the east and south sides of the Greenpoint Playground in and near the area where LNAPL is present (MW-25) is also contemplated. Extraction would remove the LNAPL that is present in the vicinity of well MW-25 and reduce the amount of LNAPL present beneath the west side of Franklin Street and the Franklin/Dupont Street intersection over time.

Potential LNAPL extraction wells are also considered for an offsite location just to the southwest of the Franklin Street/Dupont Street intersection. Although LNAPL has not been detected to the southwest of this intersection, the configuration of the LNAPL plume (shown on Figure 4.1.3.1) suggests that this area may become impacted if migration occurs in the future. As construction is contemplated on this offsite property, there is the potential for exposure should LNAPL migrate onto this property. Therefore, to prevent potential future exposure and reduce the potential impact to the environment, potential LNAPL extraction is considered. As LNAPL has not been observed in any of the three existing monitoring wells located to the southwest of the Franklin Street/Dupont Street intersection, LNAPL extraction would not be implemented as part of the remedy unless LNAPL is detected in any of these wells in the future. Potential LNAPL recovery well locations are shown on Figure 4.1.3.1, should LNAPL recovery become necessary.

LNAPL has been identified beneath the southeastern corner of the Franklin Street/Dupont Street intersection. Extraction and disposal of LNAPL from this location is considered so as to remove LNAPL from beneath the sidewalk and in proximity to the offsite properties in this area. A physical barrier is not contemplated for this location as it may reduce the effectiveness of LNAPL recovery.

LNAPL extraction may be accomplished using recovery wells and/or recovery trenches. As discussed in Section 4.1.2, the selection of recovery trenches or wells for each remedial area should be made following a full assessment of the implementation considerations at each location. For the purposes of this remedial alternative, it is assumed that closely-spaced recovery wells are used for both onsite and offsite LNAPL recovery. Similarly, it is assumed that the recovery equipment includes belt skimmers installed in the extraction wells due to the high viscosity of the product to be recovered. The removed LNAPL would be temporarily contained at each offsite recovery location in a tank to be located in a subgrade vault. It is anticipated that the LNAPL recovered onsite would be stored in a centrally-located tank onsite. The LNAPL would be periodically removed from the tanks using a vacuum truck and transported for offsite disposal at an approved facility.

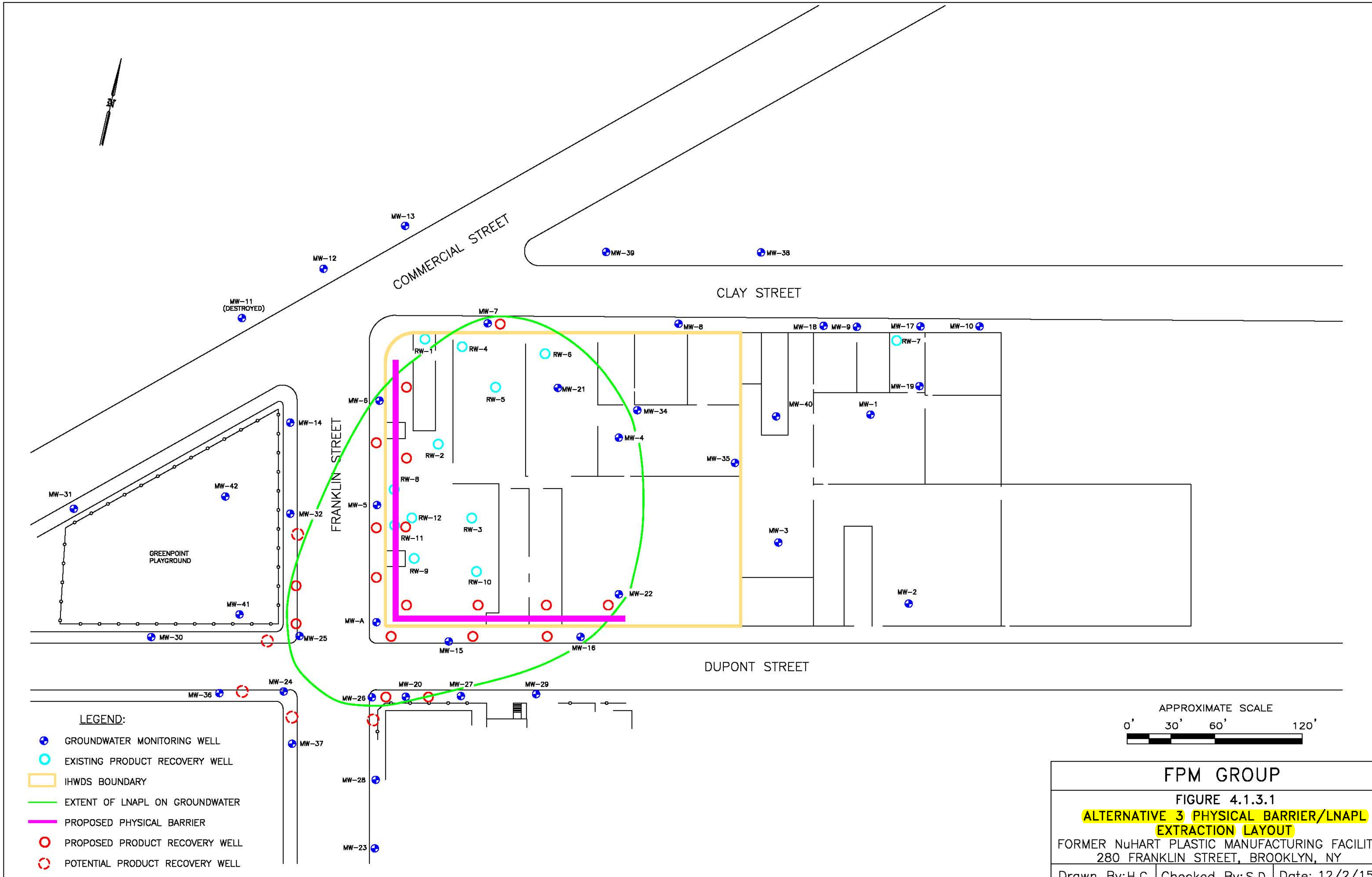

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FIGURE 4.1.3.1

ALTERNATIVE 3 PHYSICAL BARRIER/LNAPL EXTRACTION LAYOUT

FORMER NuHART PLASTIC MANUFACTURING FACILITY
280 FRANKLIN STREET, BROOKLYN, NY

Drawn By: H.C.	Checked By: S.D.	Date: 12/2/15

Costs for physical barriers and LNAPL recovery wells under this Alternative have been estimated as shown on Table 4.1.3.1. Backup for these costs is provided in Appendix C. Please note that the costs have been estimated on a net present worth basis for a 30-year remedial period and a 15-year remedial period. Based on previous experience with product recovery systems and the highly viscous nature of the LNAPL at this Site, it is anticipated that the system that will be designed for current conditions may reach the limits of its effectiveness within a few years of operation but (under this Alternative) will continue to be operated for up to 15 years to maximize LNAPL recovery.

➢ Groundwater Air Sparging/Soil Vapor Extraction

Under Alternative 3, AS and SVE would be used to directly address groundwater VOC impacts identified on the northeastern portion of the Site and in the downgradient vicinity of the Site, similar to the AS/SVE system contemplated under Alternative 2. This alternative would actively reduce VOC concentrations in the affected areas by enhancing volatilization of VOCs from the groundwater. An SVE system would be used in the AS areas to remove the volatilized VOCs from the subsurface and directly reduce soil vapor impacts. Groundwater and soil vapor monitoring would be required to document the progress of remediation.

This alternative would actively reduce VOC concentrations in the affected soil and groundwater by enhancing volatilization of VOCs, which would be captured by the SVE system, removed from the subsurface, and discharged to the atmosphere. SVE would also directly reduce VOC concentrations in unsaturated zone soils and soil vapor in the onsite and offsite areas within its ROI. Effluent monitoring would be performed to evaluate the reduction in VOC concentrations over time and to confirm that emissions from the SVE system meet regulatory requirements. The NYSDEC DAR-1 guidance document would be used to determine if effluent treatment is necessary. SVE will reduce the amount of VOCs in Site soil that have the potential to migrate to groundwater or soil vapor and would also directly remove soil vapors in the SVE treatment area, thus providing SVI mitigation within the SVE ROI.

A site plan showing the potential layout of an AS/SVE system is presented in Figure 4.1.3.2; this layout is the same as for Remedial Alternative 2. The AS portion of the system would be designed to treat areas where significant groundwater VOC contamination has been observed onsite and in close downgradient and crossgradient proximity to the onsite VOC source area. The AS system would likely include four AS wells located onsite in the vicinity of the source area; two of the AS wells would be positioned so as to treat groundwater beneath the sidewalk immediately north of this area. The AS screens would be set at a depth of approximately 18 to 20 feet so as to treat groundwater situated in the more permeable stratigraphic intervals above the extensive clay/silt that underlies the area. Based on previous experience with other AS systems in the NYC metro area, it is anticipated that an airflow of between 10 and 16 SCFM per well at a pressure of 20 to 40 pounds per square inch would be needed to result in an ROI of about 30 feet at each AS well. A compressor capable of a total flow of 60 to 80 SCFM at the targeted pressure is indicated.

SVE wells would be required to capture vapors resulting from sparging and would likely include three wells centered on the AS area. SVE system design would take stratigraphic variations into consideration to maximize effectiveness. It is anticipated that an SVE ROI of about 50 feet may be achieved with a flow rate of about 100 SCFM under a vacuum of between 10 and 150 inches of water. The blower(s) would be appropriately sized for the anticipated total flow rate and vacuum of the SVE system. Sub-slab monitoring points would also be installed to just below the slab to allow for confirmation of the SVE ROI and to allow for sub-slab vapor sampling, as needed.

TABLE 4.1.3.1
ESTIMATED COSTS FOR REMEDIAL ALTERNATIVE 3
LNAPL PHYSICAL BARRIER AND EXTRACTION/DISPOSAL

Description	Cost (30 Years)	Cost (15 Years)
Capital Costs:		
Onsite Barrier and Extraction Wells	$991,500	$991,500
Engineering Design Costs (15%)	$148,200	$148,200
Contingency (15%)	$148,200	$148,200
Oversight and Management (25%)	$247,900	$247,900
Reporting (15%)	$148,200	$148,200
Capital Cost Subtotal (onsite):	**$1,685,500**	**$1,685,500**
Offsite Extraction Wells	$426,600	$426,600
Engineering Design Costs (15%)	$64,000	$64,000
Contingency (15%)	$64,000	$64,000
Oversight and Management (25%)	$106,700	$106,700
Reporting (15%)	$64,000	$64,000
Capital Cost Subtotal (offsite):	**$725,300**	**$725,300**
Total Capital Costs:	**$2,410,800**	**$2,410,800**
Annual Operation, Monitoring and Maintenance Costs:	$223,600	$223,600
OM&M Net Present Worth	**$4,514,800**	**$990,300**
Extraction Systems Removal	**$154,400**	**$240,500**
TOTAL COST (Capital and OM&M Net Present Worth):	**$7,080,000**	**$5,641,600**

Note:
All costs rounded to the nearest $100.

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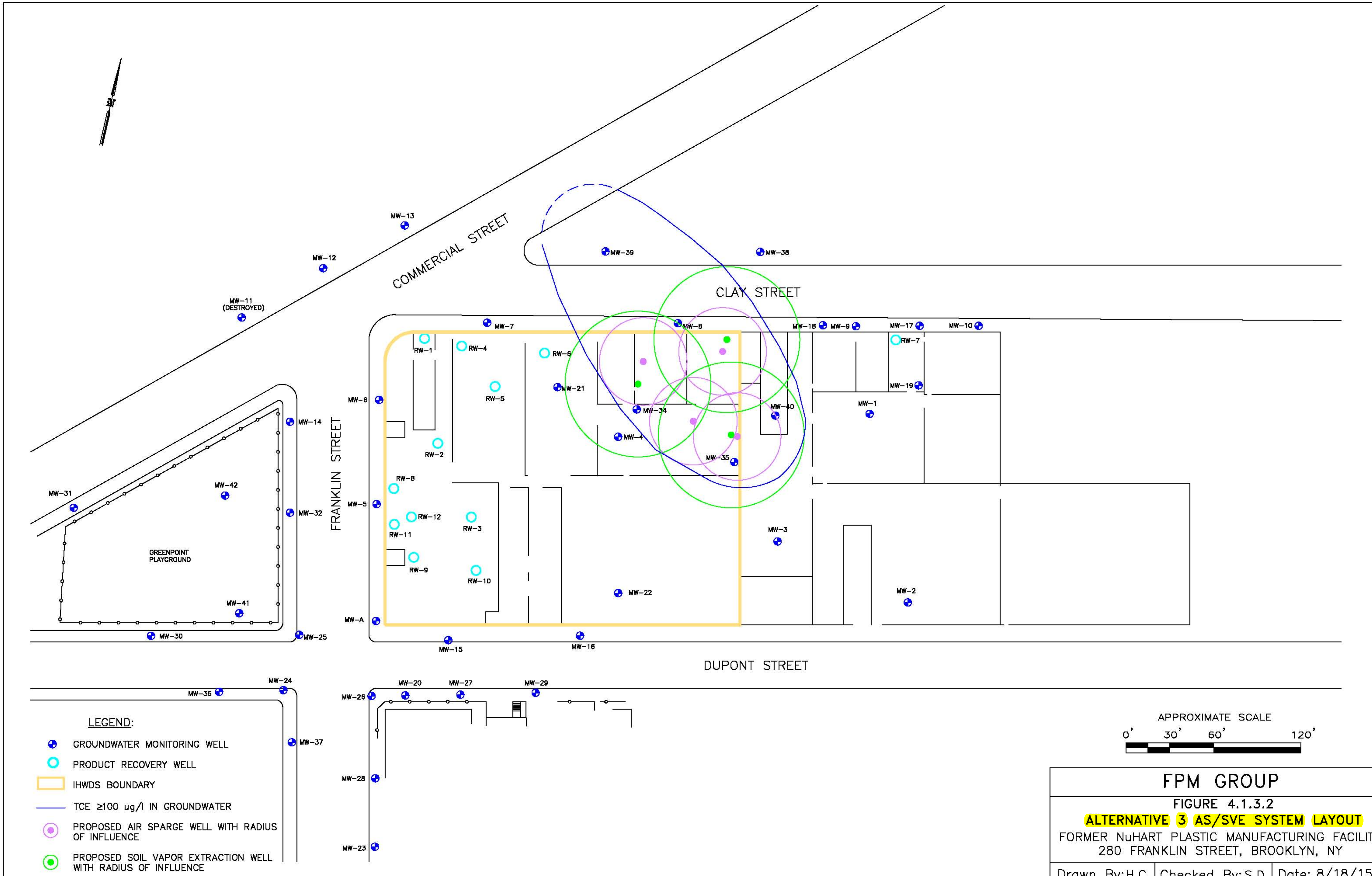
COMMERCIAL STREET
CLAY STREET
FRANKLIN STREET
DUPONT STREET
GREENPOINT PLAYGROUND
MW-11 (DESTROYED)
MW-12
MW-13
MW-14
MW-31
MW-42
MW-32
MW-41
MW-30
MW-25
MW-6
MW-5
MW-A
MW-7
MW-8
MW-18
MW-9
MW-17
MW-10
MW-39
MW-38
MW-21
MW-34
MW-4
MW-35
MW-40
MW-19
MW-1
MW-3
MW-2
MW-22
MW-15
MW-16
MW-24
MW-36
MW-37
MW-26
MW-20
MW-27
MW-29
MW-28
MW-23
RW-1
RW-4
RW-6
RW-5
RW-2
RW-7
RW-8
RW-12
RW-11
RW-3
RW-9
RW-10
LEGEND:
GROUNDWATER MONITORING WELL
PRODUCT RECOVERY WELL
IHWDS BOUNDARY
TCE ≥100 ug/l IN GROUNDWATER
PROPOSED AIR SPARGE WELL WITH RADIUS OF INFLUENCE
PROPOSED SOIL VAPOR EXTRACTION WELL WITH RADIUS OF INFLUENCE
APPROXIMATE SCALE
0' 30' 60' 120'
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FIGURE 4.1.3.2
ALTERNATIVE 3 AS/SVE SYSTEM LAYOUT
FORMER NuHART PLASTIC MANUFACTURING FACILITY
280 FRANKLIN STREET, BROOKLYN, NY
Drawn By: H.C.
Checked By: S.D.
Date: 8/18/15

Costs for an AS/SVE system to treat the VOC source area have been estimated as shown on Table 4.1.3.2. Backup for these costs is provided in Appendix C. Please note that the costs have been estimated on a net present worth basis for both a 30-year remedial period and a four-year remedial period. Based on previous experience with AS/SVE systems and the targeted removal of VOC source soil under this Alternative, the AS/SVE system is anticipated to reach the limits of its effectiveness within about four years of operation.

➢ Groundwater/LNAPL Monitoring

Groundwater and LNAPL monitoring is considered as part of Remedial Alternative 3 to provide the data needed to confirm that the identified groundwater impacts are being reduced by the active remedial methods. LNAPL would also be monitored to confirm that migration is not occurring and to document the anticipated reduction in LNAPL extent and apparent thickness in the onsite and offsite areas over time. This alternative would not actively reduce groundwater contaminant concentrations or LNAPL, but would provide for assessment of the anticipated reduction in groundwater impacts and LNAPL extent and apparent thickness over time due to other factors, such as remediation of other affected media and ongoing natural processes.

Groundwater and LNAPL monitoring would be conducted at select wells downgradient, crossgradient, and upgradient of the Site. Figure 4.1.3.3 shows the proposed locations of groundwater monitoring wells (blue circles) and LNAPL monitoring wells (green circles) to be included in the monitoring networks. For reference, the locations of the offsite LNAPL plume, the area of TCE-impacted groundwater, and proposed physical barrier and LNAPL extraction wells are also depicted on Figure 4.1.3.3. All of the wells presently exist except for two wells that would be needed near the edges of the existing onsite LNAPL plume. Groundwater monitoring for most of the wells would be conducted semiannually (twice per year) and groundwater monitoring in the area of the AS/SVE system (MW-3, MW-8, MW-13, MW-18, MW-34, MW-35, MW-39 and MW-40) would be conducted quarterly so as to assess the progress of remediation. LNAPL monitoring would be conducted on a monthly basis. The monitoring frequencies would remain unchanged until the NYSDEC approves a change in monitoring frequency.

Costs for groundwater/LNAPL monitoring have been estimated as shown on Table 4.1.3.3 and are presented on a projected net present worth basis over 30 years and also over variable durations coordinated with the potential duration of remedial systems operations. Backup for the estimated costs for this alternative are included in Appendix C.

➢ Sub-Slab Depressurization

A sub-slab depressurization system (SSDS) would be used to prevent potential impacts to indoor air quality that may occur due to SVI. Under Alternative 3 an SSDS is contemplated for the offsite property (adjoining NuHart facility building to the east) beneath which TCE-impacted soil vapors have been identified and the potential for SVI has been documented. The SSDS would not significantly reduce VOC concentrations in the sub-slab soil vapor, but would significantly reduce the potential for migration of soil vapors into indoor air. SVI monitoring would be used in conjunction with the SSDS to confirm that SVI is not occurring. Additional monitoring points would be necessary to optimize the operation of the SSDS.

TABLE 4.1.3.2
ESTIMATED COSTS FOR REMEDIAL ALTERNATIVE 3
AIR SPARGING/SOIL VAPOR EXTRACTION

Description	Cost (30 Years)	Cost (4 Years)
Capital Costs		
AS/SVE System Installation	$108,000	$108,000
Engineering Design Costs (15%)	$16,200	$16,200
Contingency (15%)	$16,200	$16,200
Oversight and Management (25%)	$27,000	$27,000
Reporting (15%)	$16,200	$16,200
Capital Cost Subtotal	**$183,600**	**$183,600**
Annual Operation, Monitoring, and Maintenance Costs	$58,400	$58,400
OM&M Net Present Worth	**$1,179,400**	**$223,700**
AS/SVE System Removal	**$6,900**	**$14,800**
TOTAL COST (Capital and OM&M Net Present Worth)	**$1,369,900**	**$422,100**

Notes:

Assumed interest rate is 5% and assumed inflation rate is 2%.
All costs rounded to the nearest $100

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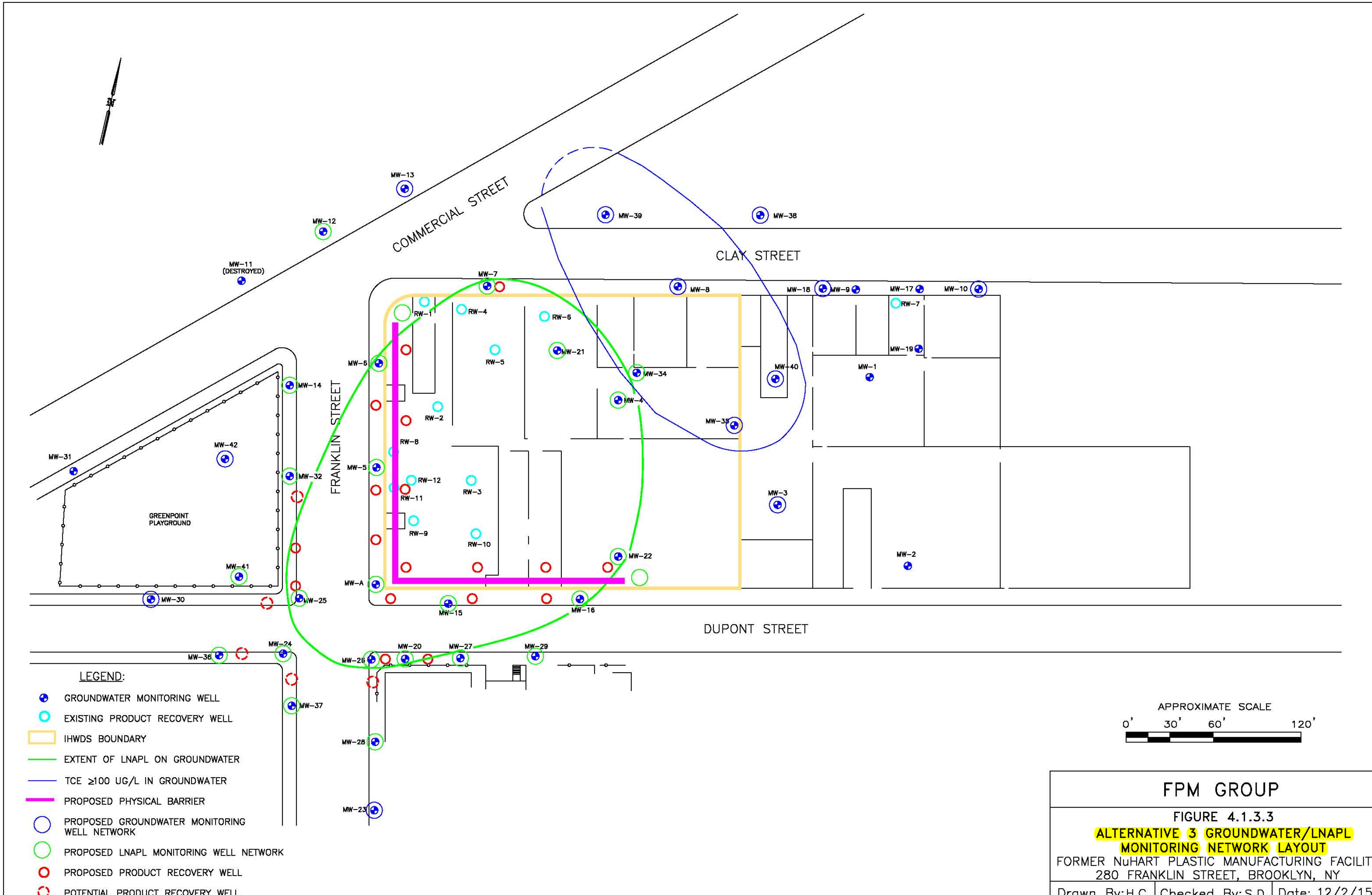

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FIGURE 4.1.3.3

ALTERNATIVE 3 GROUNDWATER/LNAPL MONITORING NETWORK LAYOUT

FORMER NuHART PLASTIC MANUFACTURING FACILITY
280 FRANKLIN STREET, BROOKLYN, NY

Drawn By: H.C.	Checked By: S.D.	Date: 12/2/15

TABLE 4.1.3.3
ESTIMATED COSTS FOR REMEDIAL ALTERNATIVE 3
GROUNDWATER/LNAPL MONITORING

Description	Cost (30 Years)	Cost (6 and 15 Years)
Capital Costs:		
Monitoring Network Installation	$6,300	$6,300
Contingency (15%)	$900	$900
Oversight and Management (25%)	$1,600	$1,600
Reporting (15%)	$900	$900
Total Capital Cost:	**$9,700**	**$9,700**
Annual GW Monitoring and Reporting Costs:	$81,300	$81,300
Annual LNAPL Monitoring and Reporting Costs:	$76,600	$76,600
OM&M Net Present Worth	**$3,187,300**	**$1,238,800**
Monitoring Network Abandonment	**$19,500**	**$30,300**
TOTAL COST (Capital and OM&M Net Present Worth):	**$3,216,500**	**$1,278,800**

Note:
All costs rounded to the nearest $100.

SSDS construction would require installation of lateral piping beneath the offsite building. For the purposes of evaluating Alternative 3, it is assumed that lateral piping (and associated vapor barrier) is installed beneath a new building on the adjoining NuHart facility to the east. As the amount of piping to be installed is significant, pilot testing would be required to confirm the anticipated ROI of the SSDS laterals prior to design of the individual SSDS components and to assess the interaction between the SSDSs and the SVE remedial system that would be installed under this alternative. A potential layout of the SSDS laterals is shown on Figure 4.1.3.4 and takes into account the potential SVE layout and the extent of soil vapors extending beneath the offsite property. The actual design of the SSDS would be developed during the remedial design phase.

Installation of SSDS laterals and a vapor barrier would be conducted during construction of a new building on the adjoining former NuHart facility to the east. The vapor barrier would be placed above the SSDS laterals and beneath the slab. The lateral piping would be connected to one or more blowers which would then discharge via a stack to the atmosphere; for the purposes of evaluating Alternative 3 it is assumed that one blower is used. The potential flow rates for the horizontally-piped SSDS would be approximately 100 standard cubic feet per minute at a vacuum of up to 20 inches of water per leg of the system. SSDS equipment would be housed in an enclosure within the building; the enclosure would be insulated to reduce noise, ventilated to control temperature, and equipped with typical automated monitoring equipment and alarm systems.

Costs for SSDS design, construction, and monitoring have been estimated as shown on Table 4.1.3.4 and are presented on a projected net present worth basis over 30 years. It is possible that operation of other remedial systems, such as the SVE system and associated AS system will reduce the soil vapor levels sufficiently such that SSDS operation is no longer necessary. Therefore, we have also projected SSDS costs over six years (two years beyond the anticipated completion of AS/SVE remediation, as discussed above). Backup for the estimated costs for this alternative are included in Appendix C.

➢ <u>Soil Vapor/SVI Monitoring</u>

Monitoring for soil vapors and potential SVI is considered as part of Remedial Alternative 3 to assess the anticipated improvement in soil vapor conditions over time due to remedial activities and confirm that soil vapor impacts present beneath the pavement/sidewalks of nearby offsite areas do not affect indoor air quality at occupied structures. The monitoring activities would not actively reduce VOC concentrations in the soil vapor, but would be used to evaluate potential exposure issues, to assess reductions in VOC concentrations in soil vapor that are anticipated result from other remedial measures, and to assess whether the SVI mitigation measures (described below) are effective.

Soil vapor/SVI monitoring would include installation of vapor implants through the existing Site building slab, through nearby sidewalks at several key locations, and through the slab of the targeted offsite building (adjacent NuHart facility) in the area where TCE vapors have been identified to monitor soil vapors over time. SVI monitoring would also include installation of vapor implants through the slabs of key offsite buildings (15 and 19 Clay Street) to allow for monitoring of sub-slab soil vapor and indoor air to be conducted periodically. SVI monitoring would require that building access for implant installation and sampling be obtained from the offsite property owners and that access for indoor air sampling be obtained from building occupants. For the purposes of this FS it is assumed that access to offsite properties is obtained. Figure 4.1.3.4 (previously presented) shows the proposed locations of the soil vapor monitoring points and SVI monitoring points at the adjacent NuHart facility. SVI monitoring point locations for the other offsite properties would be selected in consultation with offsite property owners.

Soil vapor and SVI monitoring is anticipated to be conducted at an initial frequency of twice per year (once during the heating season and once during the cooling season). During the each monitoring

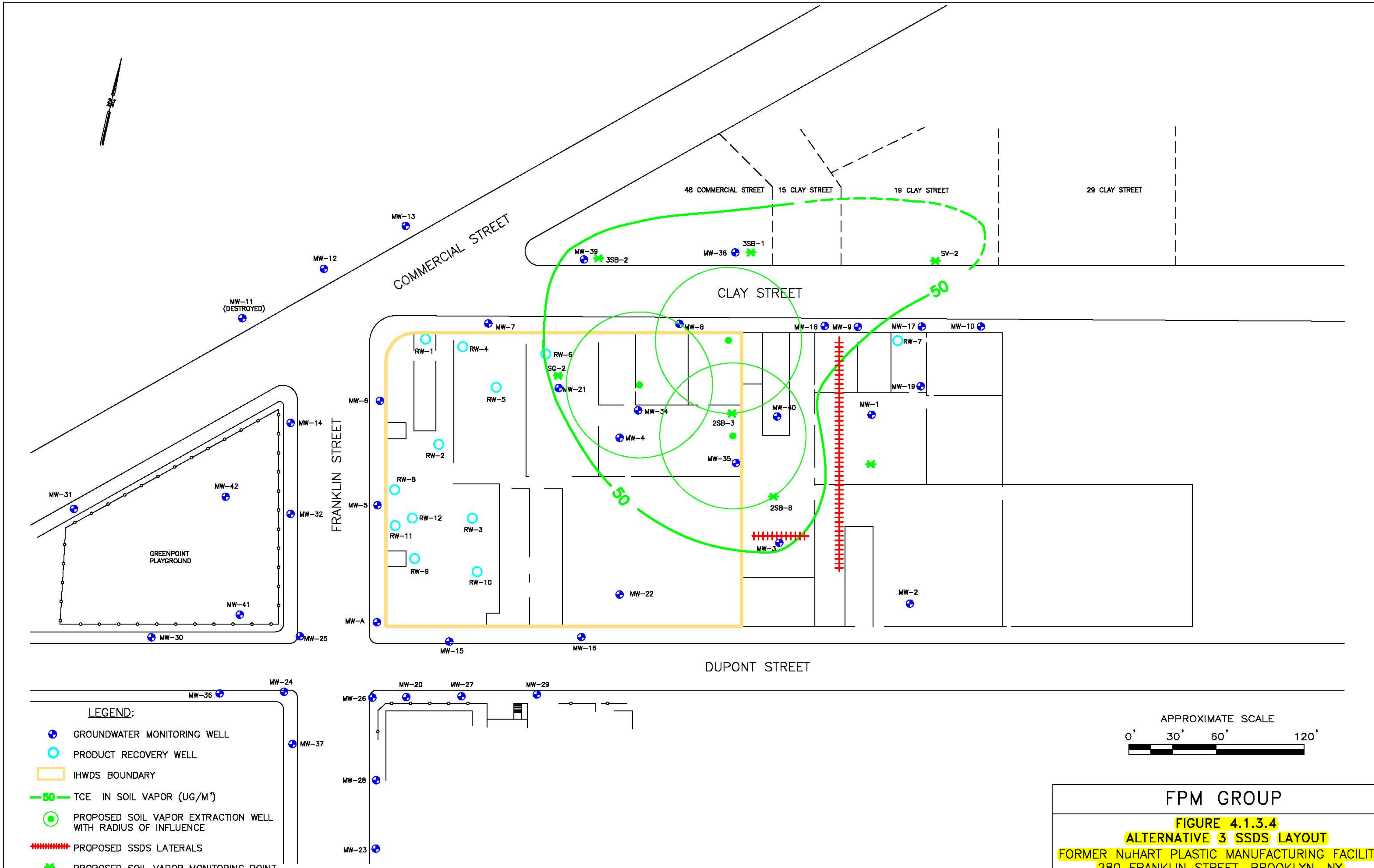

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FIGURE 4.1.3.4
ALTERNATIVE 3 SSDS LAYOUT
FORMER NuHART PLASTIC MANUFACTURING FACILITY
280 FRANKLIN STREET, BROOKLYN, NY

Drawn By: H.C.	Checked By: S.D.	Date: 1/13/16

TABLE 4.1.3.4
ESTIMATED COSTS FOR REMEDIAL ALTERNATIVE 3
SUB-SLAB DEPRESSURIZATION

Description	Cost (30 Years)	Cost (6 Years)
Capital Costs		
SSDS Installation	$172,300	$172,300
Engineering Design Costs (15%)	$25,800	$25,800
Contingency (15%)	$25,800	$25,800
Oversight and Management (25%)	$43,100	$43,100
Reporting (15%)	$25,800	$25,800
Capital Cost Subtotal	**$292,800**	**$292,800**
Annual Operation, Monitoring, and Maintenance Costs	$58,500	$58,500
OM&M Net Present Worth	**$1,181,700**	**$326,600**
SSDS Removal	**$3,200**	**$6,600**
TOTAL COST (Capital and OM&M Net Present Worth)	**$1,477,700**	**$626,000**

Notes:

Assumed interest rate is 5% and assumed inflation rate is 2%.
All costs rounded to the nearest $100

U:\Rigano LLC\49 Dupont Brooklyn\FS\FS Cost Tables\New Tables\Table4134SSDS6yearAlt3.Docx event co-located sub-slab soil vapor and indoor air samples, an ambient air sample, and soil vapor samples (from the non-SVI locations) would be collected for laboratory analysis. All procedures and data evaluation would be in accordance with NYSDOH guidance. Monitoring would be continued until the NYSDEC approves termination of monitoring.

Costs for soil vapor and SVI monitoring have been estimated as shown on Table 4.1.3.5 and are presented on a projected net present worth basis over 30 years and over a six-year period as soil vapor conditions are anticipated to improve after the source soil is remediated via AS/SVE. A monitoring frequency of twice per year is assumed. Backup for the estimated costs for this alternative are included in Appendix C.

- Implementation of ECs and ICs

Implementation of ECs and ICs would be used to control potential exposures to impacts for all media under Remedial Alternative 3. Specifically, soil impacts and LNAPL will remain present onsite and LNAPL will remain present offsite in areas. Soil vapor and groundwater impacts will also remain present, but are anticipated to diminish over time. ECs and ICs considered include a cover system EC (building slab for the Site and existing sidewalks and road pavement for offsite areas) to provide protection from impacted soil and LNAPL, and ICs (Site and groundwater usage restrictions, and an SMP) to control Site use and potential onsite exposures to soil, soil vapor, LNAPL, and/or groundwater. Access to the offsite subsurface is presently controlled by an IC consisting of a street-opening permit process that is required for penetration of the existing EC (sidewalks/pavement). An additional IC will be needed to control potential exposures during offsite subsurface activities that are conducted to depths where Site-related LNAPL and associated impacted soil are present. The IC considered under this alternative is posting of an environmental notice for street-opening permits requested in the area where Site-related subsurface impacts are present. Implementation and control of onsite ECs and ICs would be governed by an environmental easement for the Site. Implementation and control of offsite ECs and ICs would be governed by the existing street-opening permit process and an environmental notice.

Costs for the ICs and ECs, including implementation of an environmental easement, SMP, annual inspections and cover system repairs, certification and reporting, have been estimated as shown on Table 4.1.3.6 on a net present worth basis over an assumed 30-year monitoring period. Backup for the estimated costs for this alternative are included in Appendix C.

Comprehensive Remedial Alternative 3 was evaluated relative to the eight criteria as follows:

Overall protection of public health and the environment: This alternative actively addresses groundwater, soil, and soil vapor VOC impacts within the AS/SVE system ROIs, provides active protection from SVI (via the SSDS) for the offsite area where the potential for SVI is documented, and provides for additional protection from SVI (vapor barrier) for the potential new building to be constructed on the adjoining property to the east. This alternative is also anticipated to indirectly reduce groundwater VOC impacts outside and downgradient of the AS ROI. Therefore, this alternative is considered protective of public health and the environment in that contaminants in groundwater, soil, and soil vapor will be reduced or eliminated. This alternative also actively reduces the amount of LNAPL and controls potential LNAPL migration from the source area and is, therefore, protective of public health and the environment in that LNAPL will be considerably reduced and potential offsite migration controlled. This alternative also provides a means of assessing the anticipated reduction of contaminant concentrations in soil, groundwater, and soil vapor, evaluating the extent and apparent thickness of LNAPL over time, and assessing potential exposures to soil vapor via SVI. Potential public exposures to residual impacted materials would be controlled and monitored via ECs and ICs.

TABLE 4.1.3.5
ESTIMATED COSTS FOR REMEDIAL ALTERNATIVE 3
SOIL VAPOR/SVI MONITORING

Description	Cost (30 Years)	Cost (6 Years)
Capital Costs:		
Monitoring Network Installation	$22,700	$22,700
Contingency (15%)	$3,400	$3,400
Design (15%)	$3,400	$3,400
Oversight and Management (25%)	$5,700	$5,700
Reporting (15%)	$3,400	$3,400
Total Capital Cost:	**$38,600**	**$38,600**
Annual Monitoring and Reporting Costs:	$46,600	$46,600
OM&M Net Present Worth	**$940,300**	**$259,900**
Monitoring Network Abandonment	**$15,700**	**$32,000**
TOTAL COST (Capital and OM&M Net Present Worth):	**$994,600**	**$330,500**

Note:
All costs rounded to the nearest $100.

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TABLE 4.1.3.6
ESTIMATED COSTS FOR REMEDIAL ALTERNATIVE 3
IMPLEMENT ECS AND ICS

Description	Cost (30 Years)
Capital Costs:	
Implement ECs and ICs	$40,000
Contingency (15%)	$6,000
Total Capital Cost:	**$46,000**
Annual Monitoring and Certification Costs:	$12,700
Monitoring and Certification Net Present Worth	**$255,400**
TOTAL COST (Capital and Mon./Cert. Net Present Worth):	**$301,400**

Note:
All costs rounded to the nearest $100.

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This alternative, once fully completed, is more protective than Alternative 1 (No Action) and Alternative 2, but not as protective as Alternative 4;

- Compliance with SCGs: This alternative provides for compliance with SCGs for VOCs in soil, groundwater and soil vapor in the VOC treatment area, which encompasses much of the VOC-impacted area, as VOC concentrations are anticipated to be reduced to near or below the SCGs within and downgradient of this remedial area. This alternative provides for partial compliance with SCGs relative to LNAPL in the onsite and offsite areas as LNAPL in the source area will be contained and removed over time, and the extent and apparent thickness of offsite LNAPL are anticipated to be reduced over time. This alternative does not directly provide for compliance with groundwater SCGs for other constituents (SVOCs), but does provide a means for evaluating achievement of SCGs in groundwater due to remediation by other measures and ongoing attenuation processes. This alternative does not directly provide for compliance with SCGs in soil vapor outside of the VOC treatment area, but it does provide for mitigation of SVI concerns via implementation of an SSDS in the offsite area where soil vapors are documented and a vapor barrier for new construction. This alternative also provides a means for assessing achievement of SCGs in soil vapor that may result from VOC remediation, and for evaluating compliance with the SCGs for indoor air in occupied buildings. This alternative includes ECs and ICs to monitor and control potential exposures for those media where SCGs are not obtained, thereby assuring that the SCGs are not exceeded at potential exposure points;

- Long-term effectiveness and permanence: The VOC contaminants in the groundwater, soil, and soil vapor within the AS/SVE ROIs would be actively and permanently reduced by this alternative, resulting in an effective and permanent long-term remedy for VOCs in this area. This alternative includes containment of the LNAPL source area and removal and offsite disposal of LNAPL over time, thus permanently reducing the amount of LNAPL in the subsurface. Groundwater and LNAPL monitoring does not provide a long-term effective or permanent remedy for groundwater impacts or LNAPL, but it provides a means to document changes in groundwater quality and LNAPL extent and apparent thickness due to other remedial measures and attenuation processes. The SSDS does not significantly remedy soil vapor impacts; however, SSDS operation will gradually reduce soil vapor impacts within its ROI over time and provide long-term effective protection from SVI. Soil vapor and SVI monitoring do not actively remedy soil vapor impacts. However, soil vapor and SVI monitoring do provide a means for documenting changes in soil vapor conditions and the potential for SVI due to other remedial measures and are a long-term effective means for assessing soil vapor conditions and the potential for SVI. Implementation of ECs and ICs will result in an effective long-term remedy from the standpoint of public health as the residual materials remaining after remediation is complete would be isolated from public contact by a cover, prohibition of groundwater usage, controls on Site usage, controls on offsite subsurface access, and an SMP to govern management of residual materials. Periodic inspection and certification would be required, resulting in an effective and permanent long-term remedy;

- Reduction of toxicity, mobility, or volume: This alternative provides for a reduction of toxicity, mobility and volume of VOC contaminants in the groundwater, soil, and soil vapor within the AS/SVE ROIs. This alternative also provides for a reduction of toxicity, mobility and volume of LNAPL. It does not directly provide for a reduction of the toxicity, mobility, or volume of other groundwater contaminants, but does provide a means for evaluating reductions in other groundwater contaminants due to other remedial measures or attenuation processes. This alternative does not directly reduce the toxicity, mobility, or volume of soil vapor contaminants except within the SVE ROI, but it does provide a means to evaluate reductions in soil vapor contaminants due to other remedial measures. The mobility of soil vapor contaminants would be reduced via operation of the SSDS, implementation of a vapor barrier for new construction, and maintaining the cover EC using ICs;

- Short-term impacts and effectiveness: The short-term adverse environmental impacts or human exposures would be variable during the activities associated with implementing the Alternative 3 remedial measures. Short-term adverse environmental impacts or human exposures are anticipated to be minimal to moderate for the onsite physical barrier and LNAPL recovery aspects of Alternative 3. Although installation of the onsite physical barrier is anticipated to be conducted within the existing Site building, there will be impacts from construction-related noise and vehicles. As additional LNAPL removal will occur in offsite areas relative to Alternative 2, there will be more construction activity, vehicle activity, and hazardous waste transfer operations than for Alternative 2. The short-term adverse environmental impacts or human exposures are anticipated to be minimal for the AS/SVE remedial system, groundwater/LNAPL monitoring, soil vapor and SVI monitoring, and SSDS. The intrusive activities for SSDS construction would be conducted onsite, although some of the offsite vapor monitoring point construction would, of necessity, take place inside the offsite buildings. For all remedial activities an approved HASP and CAMP would be required for the remedial construction and monitoring work and personal protective equipment PPE would be utilized by remedial workers to control exposures. CAMP monitoring results would be used to verify that short-term impacts are minimized and to trigger implementation of additional controls if needed. Potential exposures to VOC emissions will be monitored via SVE and SSDS effluent sampling and emissions controls will be used if necessary to ensure that emissions meet Air Guide 1 requirements. Short-term adverse environmental impacts or human exposures are not anticipated in association with implementing ECs and ICs. Following completion of remedial construction and associated cover repairs, there are not anticipated to be any human exposures as the remaining affected media will be covered and the cover would be monitored;

- Implementability: There are anticipated to be some technical limitations to implementing certain aspects of this alternative. For the physical barrier and recovery wells, as these features are more numerous than for Alternative 2, it is anticipated that there will be an increased risk of encountering subsurface issues (utilities, old foundations, etc.) that may affect portions of their construction due to the urban nature of the Site vicinity. Since readily-available AS/SVE and SSDS remedial and monitoring technologies would be utilized, a majority of the proposed monitoring network is already present, there is no groundwater usage, and groundwater, LNAPL, and soil vapor/SVI monitoring procedures have already been conducted under the NYSDEC-approved work plans, there do not appear to be significant technical limitations to these aspects of Alternative 3. Design of the AS and SVE systems will need to take stratigraphic variations into account. Access issues may limit offsite SVI monitoring. An SMP and an environmental easement would be required, both of which may be readily implemented. The existing street-opening permit process is anticipated to facilitate implementation of the offsite IC, which is anticipated to be posting of an environmental notice for street-opening permits in the Site vicinity. It is anticipated that this alternative would be implemented in stages, each of which may last at least several months; the overall construction period for this alternative is anticipated to be one to two years;

- Cost-effectiveness: This alternative provides long-term and short-term effectiveness and results in reductions in toxicity, mobility, and volume for VOCs in groundwater, soil and soil vapor within the AS/SVE system's ROIs. This system is also likely to indirectly reduce groundwater and soil vapor impacts outside of the ROI. The SSDSs will also provide long-term and short-term effectiveness, but will not result in significant reductions in toxicity or volume of soil vapor VOCs (although mobility will be significantly reduced). This alternative also provides long-term and short-term effectiveness for LNAPL migration control from the source area via the physical barrier and onsite recovery system and results in reductions in toxicity, mobility, and volume for LNAPL in the areas where removal occurs. Design, construction and operating costs for the offsite LNAPL removal system will be moderate to high. AS/SVE remedial system and SSDS design, installation, operation, and monitoring costs are anticipated to be moderate, and the groundwater, LNAPL, soil vapor, and SVI monitoring design and implementation costs are relatively low. Overall, the costs for this comprehensive alternative are moderate, proportionally, relative to its overall effectiveness. The cost-effectiveness for the remedial and monitoring components are increased somewhat when used in conjunction with the ECs/ICs that control potential exposures; and

- Land use: This alternative is protective of the current and reasonably-anticipated land use of the Site, which is presently vacant and anticipated to be redeveloped with a restricted residential and/or commercial use, as the soil, groundwater and soil vapor impacted by VOCs within the AS/SVE system ROI would be remediated, mitigation of potential onsite SVI concerns would occur, potential LNAPL migration from the source area would be controlled and LNAPL will be removed, groundwater use is not occurring or contemplated, a cover will remain present over impacted materials, and monitoring data would be available to assess LNAPL changes, groundwater quality, and potential SVI concerns onsite. This alternative is also protective of the current and reasonably-anticipated land use in the Site vicinity, as the AS/SVE system is anticipated to reduce or eliminate offsite soil, groundwater and soil vapor impacts thereby mitigating potential SVI concerns, additional SVI mitigation would be provided by the SSDS, LNAPL will be removed, groundwater use is not occurring, a cover will remain present over impacted materials, and monitoring data would be available to assess changes in the condition of subsurface media over time. Under Alternative 3 materials exceeding applicable SCGs would be isolated from the public via cover, controls on land use, and controls on groundwater use. These controls would be implemented onsite via an environmental easement and an SMP and offsite via the existing street-opening permit process and posting of an environmental notice for street-opening permits requested in the area where Site-related subsurface impacts are present.

4.1.4 Alternative 4: Soil and LNAPL Excavation and Disposal, LNAPL Physical Barrier (onsite) and Extraction/Disposal (offsite), Groundwater Air Sparging/Thermal Conduction Treatment/Soil Vapor Extraction, Groundwater/LNAPL Monitoring, Sub-Slab Depressurization, Soil Vapor/SVI Monitoring, and ECs/ICs

This comprehensive remedial alternative would address identified impacts in each of the Site media with the objective of returning the Site and vicinity to pre-release conditions to the extent practicable for all media. Although the goal of this alternative would be to maximize remediation, ECs and ICs will continue to be necessary to implement this remedy, control potential exposures during remedial activities, and in the likely event that pre-release conditions are not obtained, control potential exposures over the long term.

In evaluating this remedial alternative it is assumed that following excavation and disposal of the onsite soil and LNAPL the Site is restored to a condition that supports redevelopment of a building comparable to the configuration of the existing Site building (no basement). It is also assumed that this building is intended to be occupied; the remedial measures were developed accordingly.

➢ Soil and LNAPL Excavation and Disposal

Soil and LNAPL excavation and disposal would directly address soil impacts associated with the presumed LNAPL source areas on the Site, soil impacts in proximity to the LNAPL plume, VOC-impacted soils in the northeastern portion of the Site, and also remove as much of the onsite LNAPL plume as feasible. This remedial method would also indirectly address the dissolved SVOC groundwater impacts found onsite and in proximity to the Site by removing the sources of these impacts. The targeted soils under this alternative consist of LNAPL-saturated soils that may be present in proximity to the USTs and piping trench systems formerly used to store and convey phthalates and Hecla oil during the former plastic manufacturing process, onsite LNAPL-saturated soils in proximity to (above, within, and below) the LNAPL plume, and VOC-impacted soils in the northeastern portion of the Site. This alternative would actively reduce soil contaminant concentrations by removing the targeted affected soils from the Site subsurface and replacing the impacted soils with clean backfill. The LNAPL source would also actively be removed. Confirmatory (end-point) sampling would be conducted to document the condition of the remaining soil and assess if residual soil (exceeding applicable SCOs) remains present.

The area of excavation to remove the impacted soil beneath the Site (approximately 210 feet by 190 feet) is shown on Figure 4.1.4.1 and encompasses the closed-in-place USTs, the onsite LNAPL plume area, and the area where VOC-impacted soil is present in the northeastern portion of the Site. The closed USTs, associated piping, and piping trenches would also be removed during this remedial process. The vertical limit of soil removal in the area of LNAPL impact is based on the test pit results described in Section 2.2.2 of this document; excavation to an approximate elevation of -2 feet relative to NAD 1988 (approximately 16 feet below the Site building floor) is estimated to remove the LNAPL-impacted soil in this area. Soil removal to 16 feet below the Site building floor in the area of VOC impact is anticipated to remove nearly all of the VOC-impacted soil. Some soil below 16 feet exhibits VOC impacts; this soil will be remediated using an alternate method, as described below.

The estimated volume of all soil to be excavated and disposed under this remedial alternative is 22,500 cubic yards. This volume does not include the estimated volume of the Site building slab or closed USTs. The estimated volume of LNAPL-saturated soil to be removed (including soil in potential release areas) is 5,220 cubic yards, of which an estimated 900 cubic yards may contain low-level PCBs. Both of these types of soil will require disposal as hazardous waste. The estimated volume of VOC-impacted soil is 1,380 cubic yards. The remaining soil (estimated as 15,900 cubic yards) is anticipated to include non-hazardous historic fill and unimpacted native soil. Although it may be feasible to segregate some of the unimpacted native soil and demonstrate through testing that it meets 6 NYCRR Part 375 and DER-10 criteria for onsite reuse, for the purposes of this FS it is assumed that segregation of significant quantities of unimpacted native soil will not be feasible and that this soil will require offsite disposal as non-hazardous waste.

For the purposes of this FS it is assumed that the excavation and removal process would be conducted in a phased approach and proceed sequentially across the Site, such that the actual excavation area at any time would be smaller than the total area to be excavated. This approach, while potentially extending the total time that excavation work would be conducted, would allow for better management of equipment and truck traffic, reduce potential odor impacts, reduce dewatering needs, and facilitate improvements in excavation procedures and materials management throughout the process.

Shoring would be required for the entire perimeter of the excavation area to an estimated depth of approximately 30 feet due to the proximity of load-bearing walls/columns of the Site building, portions of which are anticipated to remain in place during these efforts, and the proximity of public sidewalks, streets, utilities, and other infrastructure to the excavation area. The actual shoring depth would be determined during remedial design. Shoring is anticipated to be placed just inside of the existing building exterior walls, so as to allow the exterior walls to remain in place, as feasible, during excavation work. The shoring would remain in place following the completion of excavation to prevent LNAPL that may remain outside of the excavation from re-entering the remediated area. The shoring,

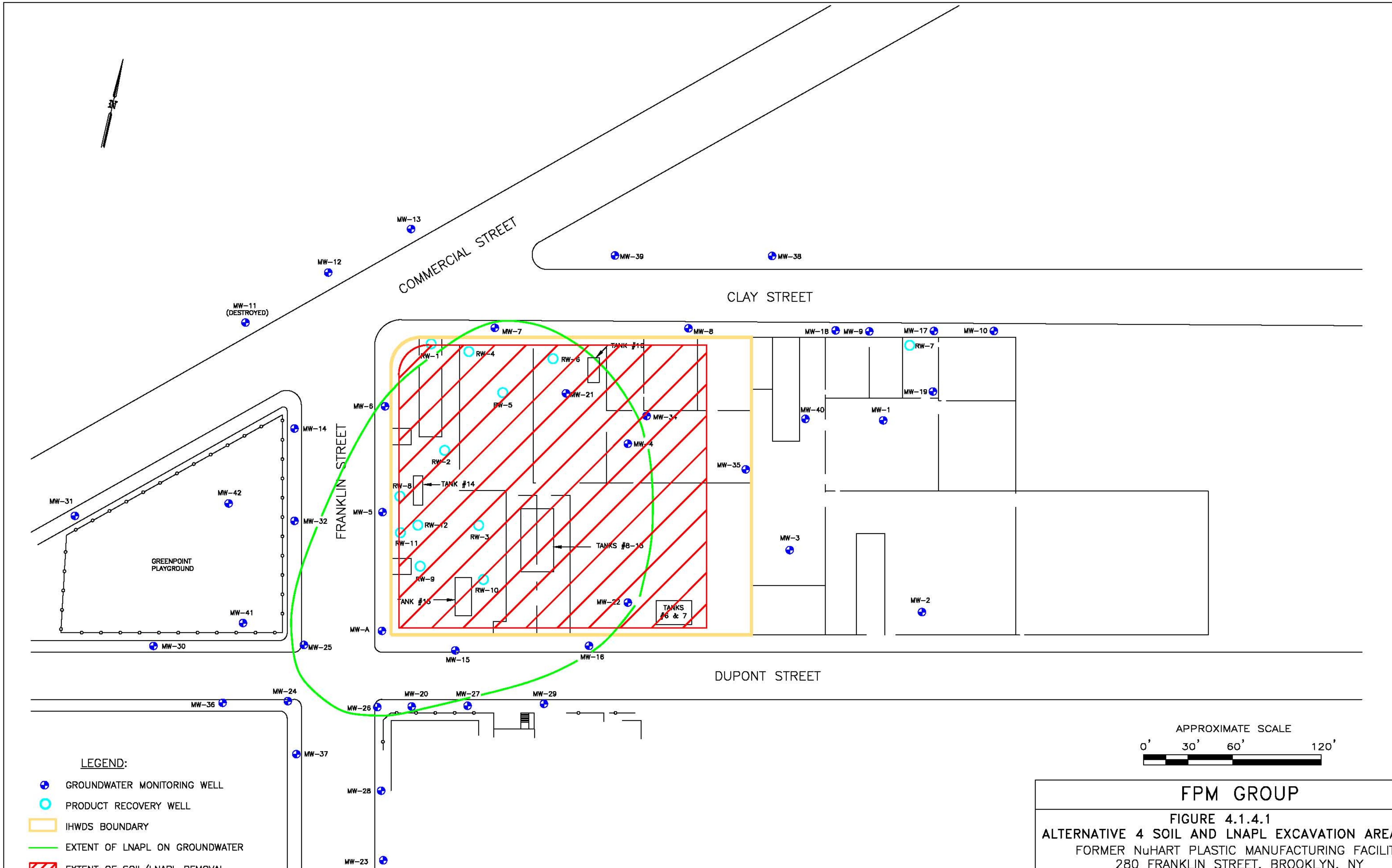

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FIGURE 4.1.4.1
ALTERNATIVE 4 SOIL AND LNAPL EXCAVATION AREA
FORMER NuHART PLASTIC MANUFACTURING FACILITY
280 FRANKLIN STREET, BROOKLYN, NY

Drawn By: H.C.	Checked By: S.D.	Date: 8/24/15

which is anticipated to consist of sheetpiling, would also prevent potential offsite migration of any LNAPL that remains onsite following remediation, as discussed in the next section.

Although odors did not present a concern during the test pit activities described in Section 2.2.2 of this FS, it is possible that odor control may be necessary during excavation into LNAPL-impacted materials, particularly if these activities are undertaken during warm weather and/or large excavations are allowed to remain open. Measures to monitor and, if necessary, control odors will be implemented during excavation activities. The control measures will include limiting the size of open excavations (particularly those excavations that extend to the depth of the LNAPL), use of odor-control foam on odorous excavation surfaces and excavated materials as needed, covering stockpiles and loaded trucks with tight-fitting covers, limiting stockpile sizes, and promptly loading and transporting removed materials.

If necessary to control odors that cannot be controlled by other means, the excavation and waste-management areas will be shrouded with a tent so as to completely contain the odorous materials. The tent will be ventilated with a high-capacity ventilation system so as to maintain a negative pressure inside of the tent (relative to the ambient atmosphere), with the exhaust treated as needed to reduce odor and discharged via a stack that extends sufficiently above the building so as to disperse any remaining odor. Pilot testing will be performed during the remedial design process to assess the potential need for a tent enclosure and ventilation system for odor control. For the purposes of this FS the costs of pilot testing are included in the estimated design costs and the costs for a tent enclosure and ventilation system are provided as an alternate cost.

Excavation to 16 feet bgs will also require dewatering in the deeper interval of the excavation. Dewatering will include removal of the LNAPL within the excavation area. Dewatering efforts would require close coordination to ensure that the LNAPL is effectively removed prior to significant lowering of the groundwater so as not to result in further soil contamination. Once the excavation reaches a depth sufficient to allow for LNAPL removal, the LNAPL would be skimmed from the bottom of the excavation and disposed offsite as hazardous waste. Once LNAPL was significantly removed, then further excavation would be conducted with dewatering as needed. LNAPL would be removed from the dewatering fluids and transported for offsite disposal as hazardous waste. Discharge of groundwater from dewatering is anticipated to be to the sewer system under a dewatering permit. Groundwater treatment (LNAPL removal, entrained particulate removal, and PCB and VOC treatment, as needed) will be required to confirm that the discharge meets permit limits.

Confirmatory soil sampling for SVOCs and VOCs (depending on the location) would be conducted in the floor of the excavation to evaluate the nature of impacts that may remain present after soil removal. The completed excavations would require backfilling and compaction to address safety concerns and prepare the Site surface for redevelopment.

Costs for the soil and LNAPL excavation and disposal alternative have been estimated as shown on Table 4.1.4.1. Backup for these costs are provided in Appendix C. Please note that these costs include capital costs for soil and LNAPL removal in the targeted area only. Costs for additional measures, including ECs and ICs, needed to address soil and LNAPL contamination that is not removed by excavation are addressed below.

TABLE 4.1.4.1
ESTIMATED COSTS FOR REMEDIAL ALTERNATIVE 4
SOIL AND LNAPL EXCAVATION AND DISPOSAL

Description	Cost
Capital Costs:	
Sheetpiling/Excavate/Dispose/Confirmatory Sampling	$10,958,100
Contingency (15%)	$1,643,700
Engineering Design (15%)	$1,643,700
Oversight and Management (25%)	$2,739,500
Reporting (15%)	$1,643,700
TOTAL COST:	**$18,628,700**
Alternate Costs for Tent & Ventilation System (Allowance)	
Capital Costs:	
Tent/Ventilation/Treatment System	$500,000
Contingency (15%)	$75,000
Design (15%)	$75,000
Oversight and Management (25%)	$125,000
Reporting (15%)	$75,000
Total Capital Costs:	**$850,000**
Operation, Monitoring &Maintenance Costs (assume 90 days)	$630,000
Contingency (15%)	$94,500
Oversight and Management (25%)	$157,500
Additional Reporting (15%)	$94,500
Total OM&M Cost:	**$976,500**
TENT AND VENTILATION ALTERNATE TOTAL COST:	**$1,826,500**

Note:
All costs rounded to the nearest $100.

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➢ LNAPL Physical Barrier and Extraction/Disposal

A physical barrier and LNAPL extraction and disposal are considered as part of Remedial Alternative 4 to prevent potential LNAPL migration between onsite and offsite areas and to remove LNAPL from offsite areas. Monitoring will be necessary to confirm that LNAPL migration is not occurring and to document the removal of LNAPL over time; monitoring is discussed in the following section.

Shoring, which is anticipated to consist of a physical barrier of sheetpiling, will be placed around the entire perimeter of the onsite excavation area to an estimated depth of approximately 30 feet, as discussed above and shown in Figure 4.1.4.2. The shoring will remain in place following the completion of excavation and will prevent LNAPL that may remain outside of the excavation from re-entering the remediated area. The shoring will also prevent potential offsite migration of any LNAPL that remains onsite following remediation.

Extraction and disposal of LNAPL remaining outside of the shoring would be conducted using a series of recovery wells located beneath the sidewalks adjoining the west and south sides of the Site. These wells would remove LNAPL from beneath the sidewalks and from portions of the adjoining Franklin and Dupont Streets. Proposed LNAPL recovery well locations are shown on Figure 4.1.4.2.

LNAPL extraction is also considered for three offsite areas, as shown on Figure 4.1.4.2. Extraction wells would be installed in the sidewalk area adjoining portions of the east and south sides of the Greenpoint Playground in and near the area where LNAPL is present (MW-25). Extraction would remove the LNAPL that is present in the vicinity of well MW-25 and also reduce the amount of LNAPL present beneath Franklin Street and the Franklin/Dupont Street intersection over time.

LNAPL recovery wells are also considered for an offsite location just to the southwest of the Franklin Street/Dupont Street intersection as a preventative measure. Although LNAPL has not been detected to the southwest of this intersection, the configuration of the LNAPL plume (shown on Figure 4.1.4.2) suggests that this area may become impacted if migration occurs in the future. As construction is contemplated on this offsite property, there is the potential for exposure should LNAPL migrate onto this property. Potential LNAPL recovery well locations are shown on Figure 4.1.4.2, should LNAPL recovery become necessary. As LNAPL has not been observed in any of the three existing monitoring wells located to the southwest of the Franklin Street/Dupont Street intersection, LNAPL extraction would not be implemented unless LNAPL is detected in any of these wells in the future.

LNAPL has been identified beneath the southeastern corner of the Franklin Street/Dupont Street intersection. Extraction and disposal of LNAPL from this location is considered so as to remove LNAPL from beneath the sidewalk and in proximity to the offsite properties in this area. LNAPL extraction wells for this area are shown on Figure 4.1.4.2.

LNAPL extraction may be accomplished using recovery wells and/or recovery trenches. As discussed in Section 4.1.2, the selection of recovery trenches or wells for each remedial area should be made following a full assessment of the implementation considerations at each location. For the purposes of this remedial alternative, it is assumed that closely-spaced recovery wells are used for LNAPL recovery. Similarly, it is assumed that the recovery equipment includes belt skimmers installed in the extraction wells due to the high viscosity of the product to be recovered. The removed LNAPL would be temporarily contained at each recovery location in a tank to be located in a subgrade vault. The LNAPL would be periodically removed from the tanks using a vacuum truck and transported for offsite disposal at an approved facility.

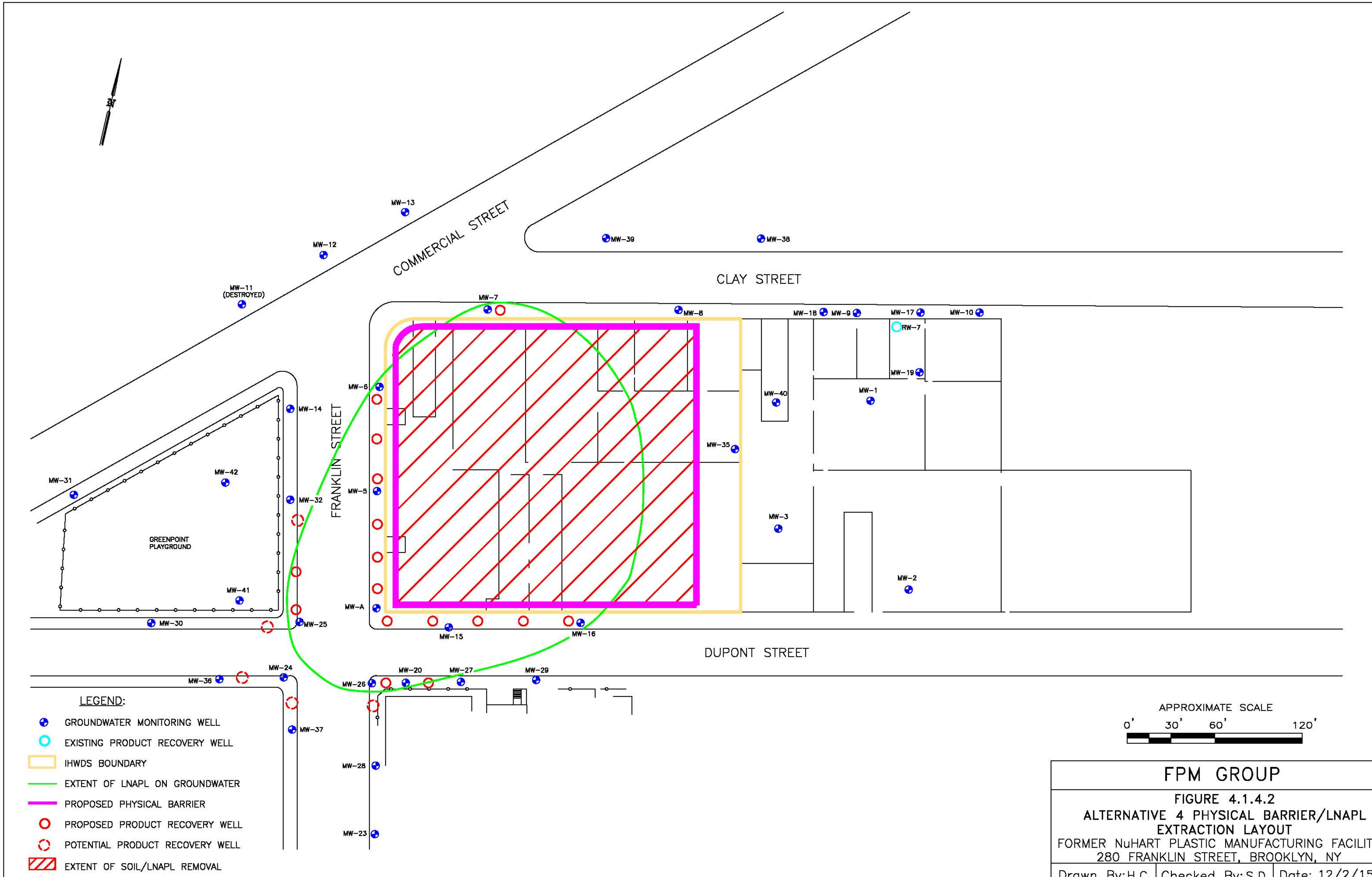

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FIGURE 4.1.4.2
ALTERNATIVE 4 PHYSICAL BARRIER/LNAPL EXTRACTION LAYOUT
FORMER NuHART PLASTIC MANUFACTURING FACILITY
280 FRANKLIN STREET, BROOKLYN, NY

Drawn By: H.C.	Checked By: S.D.	Date: 12/2/15

Costs for the LNAPL recovery wells under this Alternative have been estimated as shown on Table 4.1.4.2. Backup for these costs is provided in Appendix C. As the physical barrier costs have been included in the costs associated with the soil and LNAPL excavation and disposal, they are not included in Table 4.1.4.2. Please note that the costs have been estimated on a net present worth basis for a 30-year remedial period and a 15-year remedial period. Based on previous experience with product recovery systems and the highly viscous nature of the LNAPL at this Site, it is anticipated that the system that will be designed for current conditions may reach the limits of its effectiveness within a few years of operation but (under this Alternative) will continue to be operated for up to 15 years to maximize LNAPL recovery.

- <u>Groundwater Air Sparging/Thermal Conduction Treatment/Soil Vapor Extraction</u>

Following the completion of the remedial excavation described above, there would remain some VOC-impacted soil onsite (below 16 feet) and offsite. Thermal treatment is proposed to treat VOC-impacted soil below the water table onsite, with AS used to treat impacted groundwater and SVE used to remove vapors resulting from both of these treatment methods. A site plan showing the potential layout of an AS/Thermal/SVE system is presented in Figure 4.1.4.3.

Thermal conduction treatment would be used to raise the temperature of the saturated soil in the limited onsite VOC source area that is anticipated to remain present following excavation of soil to 16 feet. This treatment would raise the temperature of the soil and associated groundwater, thereby increasing VOC volatilization and release from the lower-permeability soils and would directly reduce VOC impacts in the soil and groundwater in the targeted area. The area to be treated includes the soils in proximity to the borings 3SB-9, 3SB-8, and 2SB-1/MW-34 (Figure 6 in Appendix A), all of which showed TCE-impacted soil to depths of at least 20 feet. The impacted soil at depth includes portions of the lower permeability clay/silt layer underlying the sand and gravel; as soil thermal conductivity is relatively consistent over a wide range of soil types, uniform heat propagation is anticipated in the geologic materials underlying this portion of the Site. Thermal treatment would be applied to the targeted soils via installation and operation of thermal (heating) wells; potential thermal treatment wells locations are shown on Figure 4.1.4.3. Based on a review of thermal wells at other sites, a well spacing of 10 feet is anticipated. The treatment wells would be extended to the bottom of the impacted interval, which has not been completely defined but is known to extend to at least 20 feet in the targeted treatment area. Additional soil borings would be needed in this area during the remedial design phase to determine the depth of the thermal treatment wells. This treatment would be limited to onsite areas only and would not be applied in the vicinity of subsurface utilities or other features with the potential to be damaged by the induced heat.

AS and SVE would also be used to directly address groundwater VOC impacts identified on the northeastern portion of the Site and in the downgradient vicinity of the Site. AS would actively reduce VOC concentrations in the affected areas by enhancing volatilization of VOCs from the groundwater. An SVE system would be used in the AS and thermal treatment areas to remove the volatilized VOCs from the subsurface for discharge to the atmosphere. SVE would also directly reduce VOC concentrations in the unsaturated zone soils in the offsite areas within their ROIs. SVE will reduce the amount of VOCs in Site soil that have the potential to migrate to groundwater or soil vapor and would also directly remove soil vapors in the AS and thermal treatment areas, thus providing SVI mitigation within the SVE ROIs. Groundwater monitoring would be required to document the progress of remediation. Effluent monitoring would be performed to evaluate the reduction in VOC concentrations over time and to confirm that emissions from the SVE system meet regulatory requirements. The NYSDEC DAR-1 guidance document would be used to determine if effluent treatment is necessary.

TABLE 4.1.4.2
ESTIMATED COSTS FOR REMEDIAL ALTERNATIVE 4
LNAPL PHYSICAL BARRIER AND EXTRACTION/DISPOSAL

Description	Cost (30 Years)	Cost (15 Years)
Capital Costs:		
Extraction Wells Adjoining Site	$488,100	$488,100
Engineering Design Costs (15%)	$73,200	$73,200
Contingency (15%)	$73,200	$73,200
Oversight and Management (25%)	$122,000	$122,000
Reporting (15%)	$73,200	$73,200
Capital Cost Subtotal (adjoining site):	**$829,700**	**$829,700**
Offsite Extraction Wells	$424,100	$424,100
Engineering Design Costs (15%)	$63,600	$63,600
Contingency (15%)	$63,600	$63,600
Oversight and Management (25%)	$106,000	$106,000
Reporting (15%)	$63,600	$63,600
Capital Cost Subtotal (offsite):	**$720,900**	**$720,900**
Total Capital Costs:	**$1,550,600**	**$1,550,600**
Annual Operation, Monitoring and Maintenance Costs:	$198,500	$198,500
OM&M Net Present Worth	**$4,006,600**	**$2,696,500**
Extraction Systems Removal	**$164,500**	**$256,200**
TOTAL COST (Capital and OM&M Net Present Worth):	**$5,721,700**	**$4,563,300**

Note:
All costs rounded to the nearest $100.

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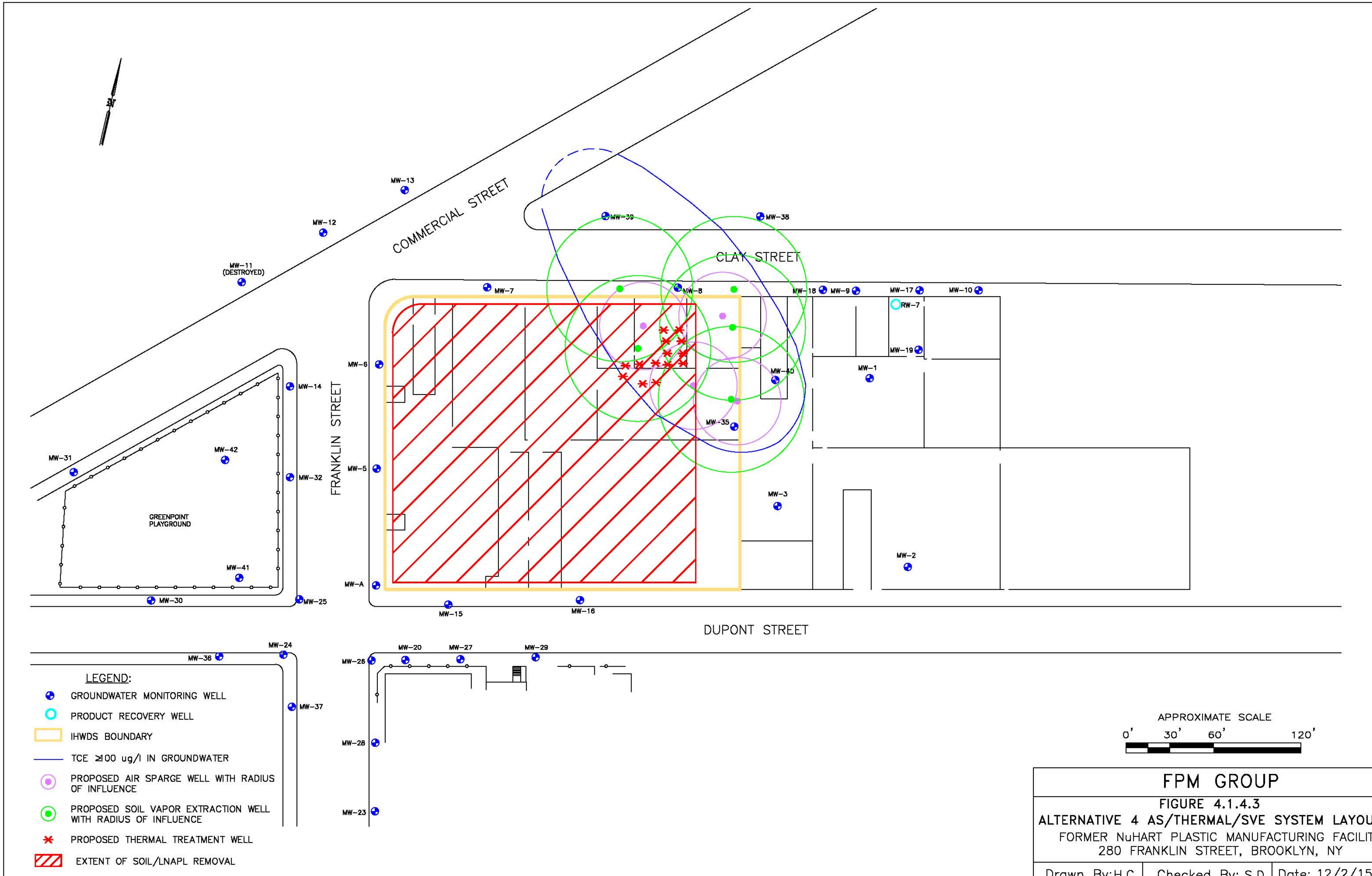

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FIGURE 4.1.4.3
ALTERNATIVE 4 AS/THERMAL/SVE SYSTEM LAYOUT
FORMER NuHART PLASTIC MANUFACTURING FACILITY
280 FRANKLIN STREET, BROOKLYN, NY

Drawn By:H.C. | Checked By: S.D. | Date: 12/2/15

The AS portion of the system would be designed to treat areas where significant groundwater VOC contamination has been observed onsite and in close downgradient and crossgradient proximity to the onsite VOC source area. The AS system would likely include four AS wells located onsite in the vicinity of the source area and away from the thermal treatment area (see Figure 4.1.4.3); two of the AS wells would be positioned so as to treat groundwater beneath the sidewalk immediately north of this area. The AS screens would be set at a depth of approximately 18 to 20 feet so as to treat groundwater situated in the more permeable stratigraphic intervals above the extensive clay/silt that underlies the area. Based on previous experience with other AS systems in the NYC metro area, it is anticipated that an airflow of between 10 and 16 SCFM per well at a pressure of 20 to 40 pounds per square inch would be needed to result in an ROI of about 30 feet at each AS well. A compressor capable of a total flow of 60 to 80 SCFM at the targeted pressure is indicated.

SVE wells would be required to capture vapors resulting from thermal treatment and sparging. The SVE wells would also treat VOC-impacted soil that may be present in the unsaturated zone within their ROIs and remove soil vapors associated with the VOC-impacted area. SVE system design will need to take into account stratigraphic variation to maximize effectiveness. The SVE system would likely include five wells, including two wells beneath the sidewalk on the south side of Clay Street to provide for enhanced offsite treatment, one well centered on the thermal treatment area, and two wells along the eastern Site boundary to provide for additional soil treatment and vapor recovery. It is anticipated that an SVE ROI of about 50 feet may be achieved with a flow rate of about 100 SCFM under a vacuum of between 10 and 150 inches of water. The blower(s) would be appropriately sized for the anticipated total flow rate and vacuum of the SVE system. Sub-slab monitoring points would also be installed to just below the slab to allow for confirmation of the SVE ROI and to allow for sub-slab vapor sampling, as needed.

Costs for an AS/thermal treatment/SVE system to treat the VOC source area have been estimated as shown on Table 4.1.4.3. Backup for these costs is provided in Appendix C. Please note that the costs have been estimated on a net present worth basis for both a 30-year remedial period, a four-year remedial period for the AS/SVE and a one-year remedial period for the thermal treatment. Based on previous experience with AS/SVE systems and published information concerning thermal treatment systems, the AS/SVE system is anticipated to reach the limits of its effectiveness within about four years of operation and thermal treatment is anticipated to require no more than one year to treat the targeted area.

➢ <u>Groundwater/LNAPL Monitoring</u>

Groundwater and LNAPL monitoring is considered as part of Remedial Alternative 4 to provide data needed to confirm that the identified groundwater impacts are being reduced by the active remedial methods. LNAPL would also be monitored to confirm that migration is not occurring, to document the anticipated reduction in LNAPL extent and apparent thickness in the offsite areas over time, and to confirm that LNAPL remains absent in the onsite remediation area. This alternative would not actively reduce groundwater contaminant concentrations or LNAPL, but would provide for assessment of the anticipated reduction in groundwater impacts and LNAPL extent and apparent thickness over time due to other factors, such as remediation of other affected media and ongoing natural processes.

Groundwater and LNAPL monitoring would be conducted at select wells downgradient, crossgradient, and upgradient of the Site. Figure 4.1.4.4 shows the proposed locations of groundwater monitoring wells (blue circles) and LNAPL monitoring wells (green circles) to be included in the monitoring networks. For reference, the locations of the offsite LNAPL plume and the onsite excavation/removal area, the area of TCE-impacted groundwater, and proposed physical barrier and LNAPL extraction wells are also depicted on Figure 4.1.4.4. All of the wells presently exist except for the wells that would

TABLE 4.1.4.3
ESTIMATED COSTS FOR REMEDIAL ALTERNATIVE 4
AIR SPARGING/SOIL VAPOR EXTRACTION/THERMAL TREATMENT

Description	Cost (30 Years)	Cost (4 Years)
Capital Costs – AS/SVE System		
AS/SVE System Installation	$145,000	$145,000
Engineering Design Costs (15%)	$21,800	$21,800
Contingency (15%)	$21,800	$21,800
Oversight and Management (25%)	$36,300	$36,300
Reporting (15%)	$21,800	$21,800
AS/SVE Capital Cost Subtotal	**$246,700**	**$246,700**
Capital Costs – Thermal Treatment System		
Thermal System Installation	$150,400	$150,400
Engineering Design Costs (15%)	$22,600	$22,600
Contingency (15%)	$22,600	$22,600
Oversight and Management (25%)	$37,600	$37,600
Reporting (15%)	$22,600	$22,600
Thermal System Capital Cost Subtotal	**$255,800**	**$255,800**
Thermal Operation, Monitoring, & Maintenance Costs	**$73,600**	**$73,600**
Thermal System Removal	**$37,400**	**$37,400**
AS/SVE Annual Operation, Monitoring, & Maintenance Costs	$65,300	$65,300
AS/SVE OM&M Net Present Worth	**$1,318,700**	**$250,100**
AS/SVE System Removal	**$6,900**	**$14,800**
TOTAL COST (Capital and OM&M Net Present Worth)	**$1,939,100**	**$878,400**

Notes:

Assumed interest rate is 5% and assumed inflation rate is 2%.
All costs rounded to the nearest $100

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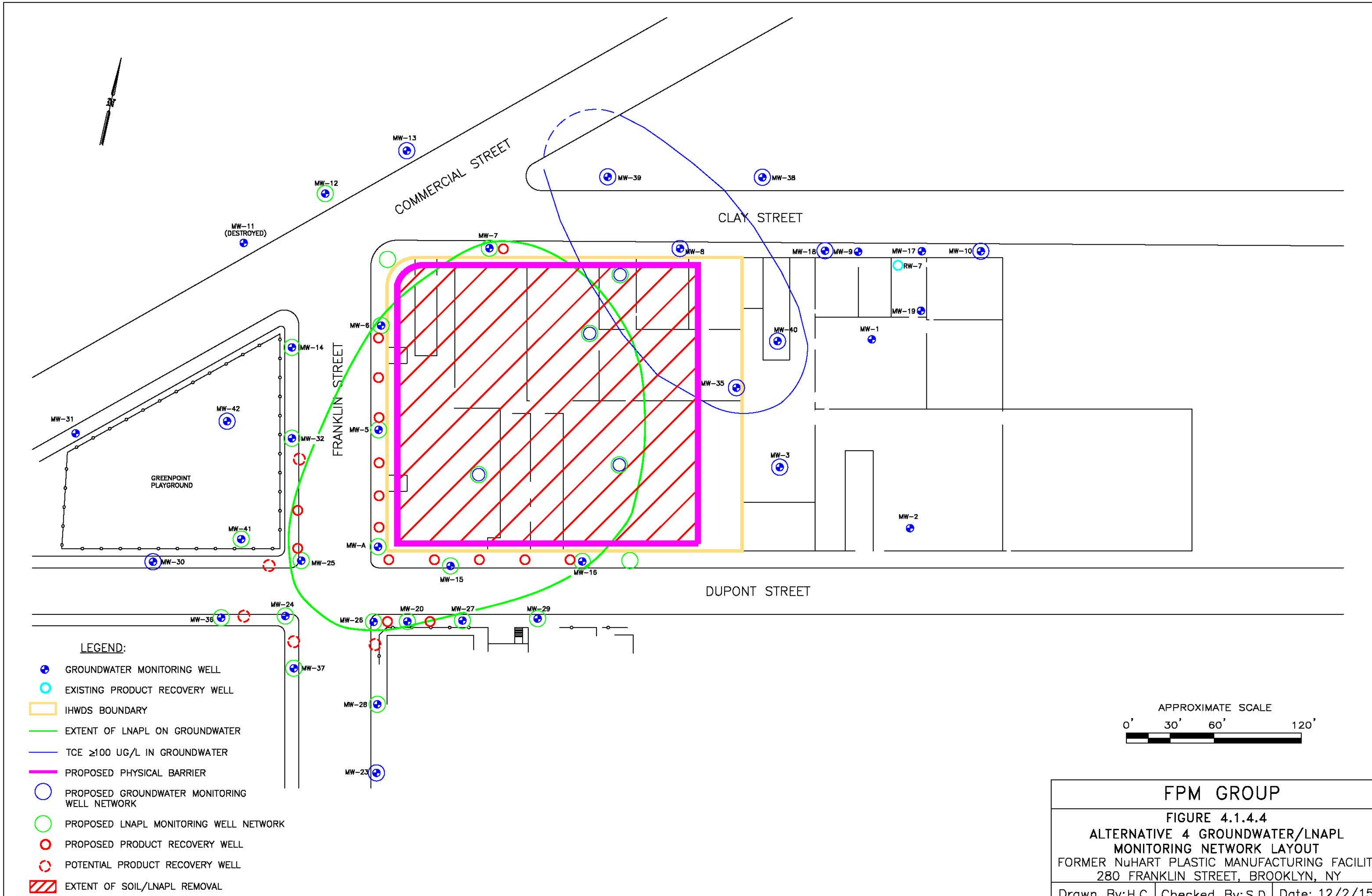

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FIGURE 4.1.4.4
ALTERNATIVE 4 GROUNDWATER/LNAPL MONITORING NETWORK LAYOUT
FORMER NuHART PLASTIC MANUFACTURING FACILITY
280 FRANKLIN STREET, BROOKLYN, NY

Drawn By: H.C.	Checked By: S.D.	Date: 12/2/15

be installed in the soil/LNAPL excavation area (to replace wells that would be removed during excavation) and two needed near the edges of the existing onsite LNAPL plume. Groundwater monitoring for most of the wells would be conducted semiannually (twice per year) and groundwater monitoring in the area of the AS/SVE/thermal treatment system (MW-3, MW-8, MW-13, MW-18, MW-34 replacement, MW-35, MW-39 and MW-40) would be conducted quarterly so as to assess the progress of remediation. LNAPL monitoring would be conducted on a monthly basis. The monitoring frequencies would remain unchanged until the NYSDEC approves a change in monitoring frequency.

Costs for groundwater/LNAPL monitoring have been estimated as shown on Table 4.1.4.4 and are presented on a projected net present worth basis over 30 years and also over variable durations coordinated with the potential duration of remedial systems operations. Backup for the estimated costs for this alternative are included in Appendix C.

➢ Sub-Slab Depressurization

SSDSs would be used to prevent potential impacts to indoor air quality that may occur due to SVI. Under Alternative 4 SSDSs are contemplated for the onsite building to be constructed during redevelopment and for offsite properties in proximity to the area where TCE-impacted soil vapors have been identified. These areas include the adjoining NuHart facility building to the east and the two offsite buildings on the north side of Clay Street (15 and 19 Clay Street) where the potential for SVI has been identified. The SSDSs would not significantly reduce VOC concentrations in the sub-slab soil vapor, but would significantly reduce the potential for migration of soil vapors into indoor air. SVI monitoring would be used in conjunction with the SSDS to confirm that SVI is not occurring. Additional monitoring points would be necessary to optimize the operation of the SSDSs.

SSDS construction would require installation of lateral piping and/or vertical piping connected to suction points beneath the new building to be constructed onsite Site as well as the offsite buildings. For the purposes of evaluating Alternative 4, it is assumed that lateral piping is installed beneath the new building to be constructed onsite as well as beneath a new building contemplated for the adjoining NuHart facility building to the east and that vertical piping connected to a suction point is installed for the two offsite buildings on the north side of Clay Street. It is also assumed that a vapor barrier would be installed beneath the new buildings to be constructed onsite and on the adjoining NuHart facility to the east. It is also assumed that access is provided for installation of the offsite suction point. As the amount of piping to be installed is significant, pilot testing would be required to confirm the anticipated ROI of the SSDS laterals/suction point prior to design of the individual SSDS components and to assess the interaction between the SSDSs and the SVE remedial system that would be installed under this alternative. A potential layout of the SSDSs using laterals and vertical piping connected to a suction point is shown on Figure 4.1.4.5 and takes into account the potential SVE layout and the extent of soil vapors extending beneath offsite properties. The actual design of the SSDSs would be developed during the remedial design phase.

Installation of SSDS laterals and the vapor barrier would be conducted during construction of the contemplated new buildings for the Site and the adjoining NuHart facility to the east. The lateral piping would be connected to one or more blowers which would then discharge via a stack to the atmosphere; for the purposes of evaluating Alternative 4 it is assumed that two blowers are used; one each for the Site building and the adjoining building to the east. The potential flow rates for the horizontally-piped SSDSs would be approximately 100 standard cubic feet per minute at a vacuum of up to 20 inches of water per leg of the system. SSDS equipment would be housed in enclosures within each building; the enclosures would be insulated to reduce noise, ventilated to control temperature, and equipped with typical automated monitoring equipment and alarm systems. The vapor barrier would be installed

TABLE 4.1.4.4
ESTIMATED COSTS FOR REMEDIAL ALTERNATIVE 4
GROUNDWATER/LNAPL MONITORING

Description	**Cost (30 Years)**	**Cost (6 and 15 Years)**
Capital Costs:		
Monitoring Network Installation	$46,700	$46,700
Contingency (15%)	$7,000	$7,000
Oversight and Management (25%)	$11,700	$11,700
Reporting (15%)	$7,000	$7,000
Total Capital Cost:	**$72,400**	**$72,400**
Annual GW Monitoring and Reporting Costs:	$81,300	$81,300
Annual LNAPL Monitoring and Reporting Costs:	$76,600	$76,600
OM&M Net Present Worth	**$3,187,300**	**$1,168,700**
Monitoring Network Abandonment	**$15,500**	**$24,164**
TOTAL COST (Capital and OM&M Net Present Worth):	**$3,275,200**	**$1,265,300**

Note:
All costs rounded to the nearest $100.

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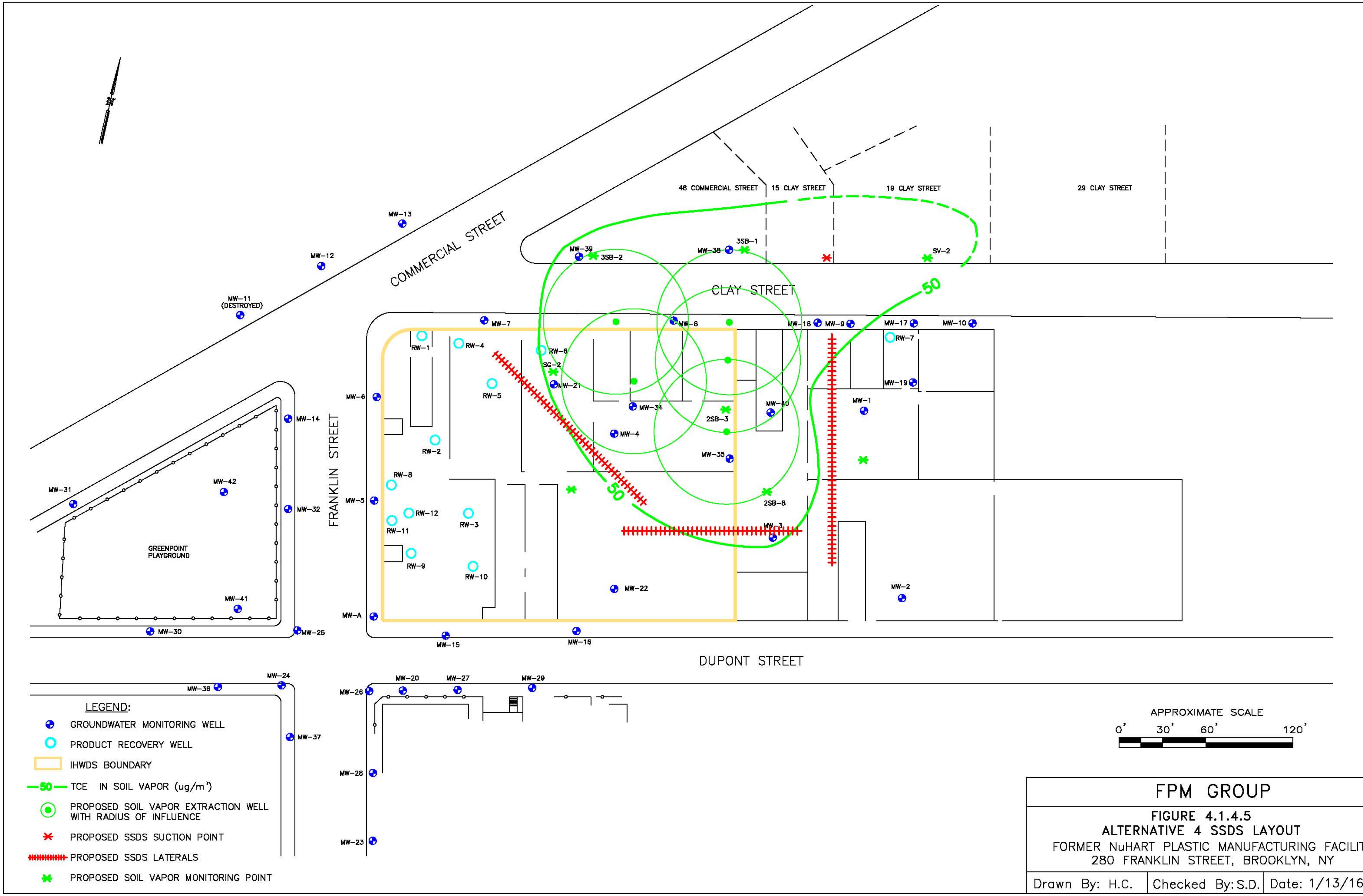

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FIGURE 4.1.4.5
ALTERNATIVE 4 SSDS LAYOUT
FORMER NuHART PLASTIC MANUFACTURING FACILITY
280 FRANKLIN STREET, BROOKLYN, NY

Drawn By: H.C. | Checked By: S.D. | Date: 1/13/16

above the SSDS laterals in conjunction with installation of the new building slabs. Vapor barrier design would be coordinated with design of the new buildings.

Installation of the suction point and associated vertical piping and blower would be conducted in coordination with each of the affected property owners and their tenants. It is anticipated that the vertical pipe for the suction point would be connected to an in-line fan and the piping would discharge to the atmosphere above the building roofs. The potential flow rate for the vertically-piped SSDS would be approximately 100 standard cubic feet per minute at a vacuum of up to 10 inches of water.

Costs for SSDS design, construction, and monitoring, including vapor barrier installation beneath the new buildings to be constructed on the Site and adjoining former NuHart facility, have been estimated as shown on Table 4.1.4.5 and are presented on a projected net present worth basis over 30 years. It is possible that operation of other remedial systems, such as the SVE system and associated AS and thermal treatment systems, will reduce the soil vapor levels sufficiently such that SSDS operation is no longer necessary. Therefore, we have also projected SSDS costs over six years (two years beyond the anticipated completion of AS/SVE remediation, as discussed above). Backup for the estimated costs for this alternative are included in Appendix C.

➢ <u>Soil Vapor/SVI Monitoring</u>

Monitoring for soil vapors and potential SVI is considered as part of Remedial Alternative 4 to assess the anticipated improvement in soil vapor conditions over time due to remedial activities and confirm that soil vapor impacts present beneath the pavement/sidewalks of nearby offsite areas do not affect indoor air quality at occupied structures. The monitoring activities would not actively reduce VOC concentrations in the soil vapor, but would be used to evaluate potential exposure issues, to assess reductions in VOC concentrations in soil vapor that are anticipated result from other remedial measures, and to assess whether the SVI mitigation measures (described below) are effective.

Soil vapor/SVI monitoring would include installation of vapor implants through the new building slab that is anticipated to be present following Site redevelopment, through sidewalks at several key locations, and through the slab of the targeted offsite building (adjacent NuHart facility) in the area where TCE vapors have been identified to monitor soil vapors over time. SVL monitoring would also include installation of vapor implants through the slabs of key offsite buildings (15 and 19 Clay Street) to allow for monitoring of sub-slab soil vapor and indoor air to be conducted periodically. SVI monitoring would include indoor air sampling at those locations where sub-slab implants are installed. SVI monitoring would require that building access for implant installation and sampling be obtained from the property owners and that access for indoor air sampling be obtained from building occupants. For the purposes of this FS it is assumed that access to offsite properties is obtained. Figure 4.1.4.5 (previously presented) shows the proposed locations of soil vapor monitoring points and SVI monitoring points at the Site and adjacent NuHart facility. SVI monitoring point locations for other offsite properties would be selected in consultation with the property owners.

Soil vapor and SVI monitoring is anticipated to be conducted at an initial frequency of twice per year (once during the heating season and once during the cooling season). During the each monitoring event co-located sub-slab soil vapor and indoor air samples, an ambient air sample, and soil vapor samples (from the non-SVI locations) would be collected for laboratory analysis. All procedures and data evaluation would be in accordance with NYSDOH guidance. Monitoring would be continued until the NYSDEC approves termination of monitoring.

Costs for soil vapor and SVI monitoring have been estimated as shown on Table 4.1.4.6 and are presented on a projected net present worth basis over 30 years and over a six-year period as soil vapor

TABLE 4.1.4.5
ESTIMATED COSTS FOR REMEDIAL ALTERNATIVE 4
SUB-SLAB DEPRESSURIZATION AND VAPOR BARRIER

Description	Cost (30 Years)	Cost (6 Years)
Capital Costs		
SSDS, Vapor Barrier, and Suction Point Installation	$401,400	$401,400
Engineering Design Costs (15%)	$60,200	$60,200
Contingency (15%)	$60,200	$60,200
Oversight and Management (25%)	$100,400	$100,400
Reporting (15%)	$60,200	$60,200
Capital Cost Subtotal	**$682,400**	**$682,400**
Annual Operation, Monitoring, and Maintenance Costs	$69,600	$69,600
OM&M Net Present Worth	**$1,404,600**	**$328,200**
SSDS and Suction Point Removal	**$8,300**	**$17,400**
TOTAL COST (Capital and OM&M Net Present Worth)	**$2,095,300**	**$1,028,000**

Notes:

Assumed interest rate is 5% and assumed inflation rate is 2%.
All costs rounded to the nearest $100

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TABLE 4.1.4.6
ESTIMATED COSTS FOR REMEDIAL ALTERNATIVE 4
SOIL VAPOR/SVI MONITORING

Description	Cost (30 Years)	Cost (6 Years)
Capital Costs:		
Monitoring Network Installation	$23,000	$23,000
Contingency (15%)	$3,500	$3,500
Design (15%)	$3,500	$3,500
Oversight and Management (25%)	$5,800	$5,800
Reporting (15%)	$3,500	$3,500
Total Capital Cost:	**$39,300**	**$39,300**
Annual Monitoring and Reporting Costs:	$55,000	$55,000
OM&M Net Present Worth	**$1,109,800**	**$306,700**
Monitoring Network Abandonment	**$15,900**	**$32,300**
TOTAL COST (Capital and OM&M Net Present Worth):	**$1,165,000**	**$378,300**

Note:
All costs rounded to the nearest $100.

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conditions are anticipated to improve after the source soil is remediated via thermal treatment and AS.

A monitoring frequency of twice per year is assumed. Backup for the estimated costs for this alternative are included in Appendix C.

➢ Implementation of ECs and ICs

Implementation of ECs and ICs would be used to control potential exposures to impacts for all media under Remedial Alternative 4. Specifically, soil impacts and/or LNAPL may remain present onsite and LNAPL will remain present offsite in areas where it cannot be reasonably accessed. Soil vapor and groundwater impacts will also remain present, but are anticipated to diminish over time. ECs and ICs considered include a cover system EC (building slab for the Site and existing sidewalks and road pavement for offsite areas) to provide protection from impacted soil and LNAPL, and ICs (Site and groundwater usage restrictions, and an SMP) to control Site use and potential onsite exposures to soil, soil vapor, LNAPL, and/or groundwater. Access to the offsite subsurface is presently controlled by an IC consisting of a street-opening permit process that is required for penetration of the existing EC (sidewalks/pavement). An additional IC will be needed to control potential exposures during offsite subsurface activities that are conducted to depths where Site-related LNAPL and associated impacted soil are present. The IC considered under this alternative is posting of an environmental notice for street-opening permits that may be requested in the area where Site-related subsurface impacts are present. Implementation and control of onsite ECs and ICs would be governed by an environmental easement for the Site. Implementation and control of offsite ECs and ICs would be governed by the existing street-opening permit process and an environmental notice.

Costs for the ICs and ECs, including implementation of an environmental easement, SMP, annual inspections and cover system repairs, certification and reporting, have been estimated as shown on Table 4.1.4.7 on a net present worth basis over an assumed 30-year monitoring period. Backup for the estimated costs for this alternative are included in Appendix C.

Comprehensive Remedial Alternative 4 was evaluated relative to the eight criteria as follows:

- Overall protection of public health and the environment: This alternative actively addresses groundwater, soil, and soil vapor VOC impacts within the AS/thermal treatment/SVE system ROIs, provides for active protection from SVI (via the SSDSs) for areas where the potential for SVI exists, and provides for additional protection from SVI (vapor barrier) for the contemplated new buildings to be constructed onsite and the adjoining property to the east. This alternative is also anticipated to indirectly reduce groundwater VOC impacts outside and downgradient of the AS ROI. Therefore, this alternative is considered protective of public health and the environment in that contaminants in groundwater, soil, and soil vapor will be reduced or eliminated. This alternative also actively reduces the amount of LNAPL and controls potential LNAPL migration and is, therefore, protective of public health and the environment in that LNAPL will be considerably reduced and potential migration will be controlled. This alternative also provides a means of assessing the anticipated reduction of contaminant concentrations in soil, groundwater, and soil vapor, evaluating the extent and apparent thickness of LNAPL over time, and assessing potential exposures to soil vapor via SVI. Potential public exposures to residual impacted materials would be controlled and monitored via ECs and ICs. This alternative, once fully completed, is more protective than Alternative 1 (No Action), Alternative 2, or Alternative 3;

TABLE 4.1.4.7
ESTIMATED COSTS FOR REMEDIAL ALTERNATIVE 4
IMPLEMENT ECS AND ICS

Description	**Cost (30 Years)**
Capital Costs:	
Implement ECs and ICs	$40,000
Contingency (15%)	$6,000
Total Capital Cost:	**$46,000**
Annual Monitoring and Certification Costs:	$12,700
Monitoring and Certification Net Present Worth	**$255,400**
TOTAL COST (Capital and Mon./Cert. Net Present Worth):	**$301,400**

Note:
All costs rounded to the nearest $100.

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- Compliance with SCGs: This alternative provides for compliance with SCGs for VOCs in soil, groundwater and soil vapor in the VOC treatment area, which encompasses nearly all of the VOC-impacted area, as VOC concentrations are anticipated to be reduced to near or below the SCGs in and downgradient of the AS/thermal treatment/SVE treatment area. This alternative provides for compliance with SCGs relative to soil and LNAPL in the onsite area as impacted soil and LNAPL removal is anticipated to be largely complete. In the offsite areas this alternative provides for partial compliance with SCGs relative to the LNAPL as the extent and apparent thickness of LNAPL are anticipated to be reduced over time and a physical barrier will be present to prevent offsite migration of any remaining onsite LNAPL. This alternative does not directly provide for compliance with groundwater SCGs for other constituents (SVOCs), but does provide a means for evaluating achievement of SCGs in groundwater due to remediation by other measures and ongoing attenuation processes. This alternative does not directly provide for compliance with SCGs in soil vapor outside of the VOC treatment area, but it does provide for mitigation of SVI concerns via implementation of SSDSs outside of the treatment area and vapor barriers for new construction. This alternative also provides a means for assessing achievement of SCGs in soil vapor that may result from soil and groundwater remediation by AS/thermal treatment/SVE, and for evaluating compliance with the SCGs for indoor air in occupied buildings. This alternative includes ECs and ICs to monitor and control potential exposures for those media where SCGs are not obtained, thereby assuring that the SCGs are not exceeded at potential exposure points;

- Long-term effectiveness and permanence: The VOC contaminants in the groundwater, soil, and soil vapor within the AS/thermal treatment/SVE ROIs would be actively and permanently reduced by this alternative, resulting in an effective and permanent long-term remedy for VOCs in this area. This alternative includes removal and offsite disposal of onsite impacted soil and LNAPL and offsite LNAPL over time, thus permanently reducing the amount of impacted soil and LNAPL in the subsurface. This alternative also provides for long-term control of potential migration of any LNAPL remaining in the onsite source area. Groundwater/LNAPL monitoring does not provide a long-term effective or permanent remedy for groundwater impacts or LNAPL, but it provides a means to document changes in groundwater quality and LNAPL extent and apparent thickness due to other remedial measures and attenuation processes. The SSDSs and vapor barriers do not significantly remedy soil vapor impacts; however, SSDS operation will gradually reduce soil vapor impacts within its ROI over time and both SSDSs and vapor barriers provide long-term effective protection from SVI. Soil vapor and SVI monitoring do not actively remedy soil vapor impacts. However, soil vapor and SVI monitoring do provide a means for documenting changes in soil vapor conditions and the potential for SVI due to other remedial measures and are a long-term effective means for assessing soil vapor conditions and the potential for SVI. Implementation of ECs and ICs will result in an effective long-term remedy from the standpoint of public health as the residual materials remaining after remediation is complete would be isolated from public contact by a cover, prohibition of groundwater usage, controls on Site usage, controls on offsite subsurface access, and an SMP to govern management of residual materials. Periodic inspection and certification would be required, resulting in an effective and permanent long-term remedy;

- Reduction of toxicity, mobility, or volume: This alternative provides for a reduction of toxicity, mobility and volume of VOC contaminants in the groundwater, soil, and soil vapor within the AS/thermal treatment/SVE ROIs. It also reduces the toxicity, mobility, and volume of impacted soil and LNAPL in the onsite area as these materials will be removed. This alternative also provides for a reduction of toxicity, mobility and volume of offsite LNAPL. It does not directly provide for a reduction of the toxicity, mobility, or volume of other groundwater contaminants, but does provide a means for evaluating reductions in other groundwater contaminants due to other remedial measures or attenuation processes. This alternative does not directly reduce the toxicity, mobility, or volume of soil vapor contaminants except within the SVE ROI, but it does provide a means to evaluate reductions in soil vapor contaminants due to other remedial measures. The mobility of soil vapor contaminants would be reduced via operation of the SSDSs, implementation of vapor barriers for new construction, and maintaining the cover EC using ICs;

- Short-term impacts and effectiveness: The short-term adverse environmental impacts or human exposures would be variable during the activities associated with implementing the Alternative 4 remedial measures. The onsite soil excavation, LNAPL removal, and physical barrier placement are anticipated to be conducted with the Site building at least partially in place, although some building infrastructure removal may be required. These activities will require a significant period of excavation and liquid removal operations, some of which may be conducted without the full protection of the existing building and, therefore, there will be impacts from construction-related noise and vehicle operations. Although it is anticipated that the excavation work would be conducted in stages so as to reduce the potential for odor impacts, if odor impacts occur then additional protective measures may be required (a tent enclosure, and/or odor-control systems). In addition, all of the removed soil and LNAPL would be transported by truck through the surrounding neighborhood to reach the nearest major transportation route to the disposal facilities. Short-term adverse environmental impacts or human exposures are anticipated to be minimal to moderate for the LNAPL recovery aspects of Alternative 4. As the recovery wells are more numerous than the other alternatives, there will be a longer period of construction, with the associated noise and construction operations. As additional LNAPL removal will occur in the offsite areas relative to the other alternatives, there will be more vehicle and hazardous waste transfer operations than for the other alternatives. The short-term adverse environmental impacts or human exposures are anticipated to be minimal for the AS/thermal treatment/SVE remedial system, groundwater/LNAPL monitoring, soil vapor and SVI monitoring, vapor barriers and SSDSs. Most of the intrusive activities for system construction would be conducted onsite, although much of the offsite SSDS construction would, of necessity, take place inside the offsite buildings. For all remedial activities an approved HASP and CAMP would be required for the remedial construction and monitoring work and PPE would be utilized by remedial workers to control exposures. CAMP monitoring results would be used to verify that short-term impacts are minimized and to trigger implementation of additional controls if needed. Potential exposures to VOC emissions will be monitored via SVE and SSDS effluent sampling and emissions controls will be used if necessary to ensure that emissions meet Air Guide 1 requirements. Short-term adverse environmental impacts or human exposures are not anticipated in association with implementing ECs and ICs. Following completion of remedial construction and associated cover repairs/replacement, there are not anticipated to be any human exposures as the remaining affected media will be covered and the cover would be monitored;

- Implementability: There are anticipated to be significant technical limitations to implementing certain aspects of this alternative. For the onsite soil excavation and LNAPL removal, the excavation to 16 feet below grade with associated shoring (physical barrier placement), dewatering, LNAPL removal, and backfill placement, is anticipated to present considerable engineering considerations, including soil and fluids management onsite, noise and odor control, and transportation issues. For the recovery wells, as these features are larger/more numerous than for the other alternatives, it is anticipated that there will be an increased risk of encountering subsurface issues (utilities, old foundations, etc.) that may affect portions of their construction due to the urban nature of the Site vicinity. The implementability of thermal treatment for the onsite VOC-impacted soil that will remain following excavation is anticipated to be evaluated through pilot testing as part of remedial design and before full construction. Since readily-available AS/SVE, SSDS, and vapor barrier remedial and monitoring technologies would be utilized, a majority of the proposed monitoring network is already present, there is no groundwater usage, and groundwater, LNAPL, and soil vapor/SVI monitoring procedures have already been conducted under the NYSDEC-approved work plans, there do not appear to be significant technical limitations to these aspects of Alternative 4. Design of the AS and SVE systems will need to take stratigraphic variations into account. An SMP and an environmental easement would be required, both of which may be readily implemented. The existing street-opening permit process is anticipated to facilitate implementation of the offsite IC, which is anticipated to be posting of an environmental notice for street-opening permits in the Site vicinity. It is anticipated that this alternative would be implemented in stages, each of which may last between several months to over a year; the overall construction period for this alternative is anticipated to be several years;

- Cost-effectiveness: This alternative provides long-term and short-term effectiveness and results in significant reductions in toxicity, mobility, and volume for VOCs in groundwater, soil and soil vapor within the AS/thermal treatment/SVE system's ROIs. This system is also likely to indirectly reduce groundwater and soil vapor impacts outside of the ROI. The SSDSs and vapor barriers will also provide long-term and short-term effectiveness, but will not result in significant reductions in toxicity or volume of soil vapor VOCs (although mobility will be significantly reduced). This alternative also provides long-term and short-term effectiveness for LNAPL and impacted soil reductions onsite, offsite migration control via the physical barrier, and results in reductions in toxicity, mobility, and volume for LNAPL in the areas where recovery wells are operated. Remedial design and implementation for the onsite soil excavation and LNAPL removal will be very high. Design, construction and operating costs for the offsite LNAPL removal will be moderate to high. AS/thermal treatment/SVE remedial system and SSDS design, installation, operation, and monitoring costs are anticipated to be moderate, and the groundwater, LNAPL, soil vapor, and SVI monitoring and vapor barrier design and implementation costs are relatively low. Overall, the costs for this comprehensive alternative are high, proportionally, relative to its overall effectiveness. The cost-effectiveness for the remedial and monitoring components are increased somewhat when used in conjunction with the ECs/ICs that control potential exposures; and

- Land use: This alternative is protective of the reasonably-anticipated land use of the Site, which is anticipated to be redeveloped with a restricted residential and/or commercial use, as impacted soil will be removed to 16 feet below grade, LNAPL will be removed, VOCs within the AS/thermal treatment/SVE system ROI would be remediated, an SSDS and vapor barrier would provide for mitigation of potential onsite SVI concerns, groundwater use is not occurring or contemplated, a cover will be installed over any residual impacted materials, and monitoring data would be available to assess LNAPL changes, groundwater quality, and potential SVI concerns onsite. This alternative is also protective of the current and reasonably-anticipated land use in the Site vicinity, as the AS/thermal treatment/SVE system is anticipated to reduce or eliminate offsite soil, groundwater and soil vapor VOC impacts and SSDSs would be installed to mitigate potential SVI concerns, potential migration of any remaining onsite LNAPL would be controlled, offsite LNAPL will be removed, groundwater use is not occurring, a cover will remain present over impacted materials, and monitoring data would be available to assess changes in the condition of subsurface media over time. Under this alternative, residual materials exceeding applicable SCGs would be isolated from the public via cover, controls on land use, and controls on groundwater use. These controls would be implemented onsite via an environmental easement and an SMP and offsite via the existing street-opening permit process and posting of an environmental notice for street-opening permits requested in the area where Site-related subsurface impacts are present.

4.2 Recommended Remedial Alternative

The above-described comprehensive remedial alternatives have been evaluated and a recommendation developed; a summary of this evaluation is presented on Table 4.2.1. The recommended remedial alternative (Remedial Alternative 3) takes into account the evaluation of each alternative relative to the eight criteria, the existing and anticipated future use of the Site, the absence and anticipated continued absence of groundwater use, the presence of protective cover materials onsite and offsite, and the potential exposure scenarios for the identified impacts. The recommended remedial alternative includes the following elements:

- Implementation and control of onsite ECs and ICs under an environmental easement for the Site. Implementation and control of offsite ECs and ICs would be governed by the existing street-opening permit process and an environmental notice.

- ICs to include Site and groundwater usage restrictions, and an SMP to control Site use and potential onsite exposures to soil, soil vapor, LNAPL, and/or groundwater. The SMP would include provisions for operation, maintenance, monitoring, annual certification, and other procedures necessary to implement the ECs and ICs. The SMP would also include provisions for additional remedial measures that may be needed for future redevelopment of the Site. Access to the offsite subsurface is presently controlled by an IC consisting of a street-opening permit process that is required for penetration of the existing EC (sidewalks/pavement). An additional IC will be needed to control potential exposures during offsite subsurface activities and would include posting of an environmental notice for street-opening permits requested in the area where Site-related subsurface impacts are present.

- Implementing an AS/SVE system to remediate soil and groundwater VOC impacts identified on the northeastern portion of the Site and in the downgradient vicinity. SVE would also reduce soil vapor VOC concentrations in onsite and offsite areas within its ROI. Effluent monitoring would be performed to evaluate the reduction in VOC concentrations over time and confirm that emissions from the SVE system meet regulatory requirements and determine if effluent treatment is necessary. Soil vapor monitoring would be used in conjunction with the SVE to evaluate the anticipated reduction in soil vapor VOC concentrations over time.

- Implementing an SSDS and vapor barrier for the offsite property where TCE-impacted soil vapors have been identified (the adjoining NuHart facility building to the east) beneath which TCE-impacted soil vapors have been identified and the potential for SVI has been documented. SVI and soil vapor monitoring would be used in conjunction with the SSDS to confirm that SVI is not occurring.

- Implementing an onsite physical barrier with onsite and offsite LNAPL extraction and disposal to prevent potential LNAPL migration from the source area and to remove LNAPL from onsite and offsite areas. Extraction and disposal of LNAPL from the east and north sides of the physical barrier would be conducted to remove the LNAPL and reduce the potential for LNAPL migration around the ends of the physical barrier. Extraction and disposal of LNAPL on the west and south sides of this physical barrier would also be conducted to remove LNAPL from offsite areas immediately adjoining the Site. Extraction and disposal of LNAPL would also be conducted in offsite areas to include the sidewalk area adjoining portions of the east and south sides of the Greenpoint Playground, the sidewalk area at the southwest corner of the Franklin Street/Dupont Street intersection (if monitoring results indicate LNAPL in this area), and the sidewalk area on the southeast corner of the Franklin Street/Dupont Street intersection.

TABLE 4.2.1
EVALUATION OF REMEDIAL ALTERNATIVES
FORMER NUHART PLASTIC MANUFACTURING SITE #224136
280 FRANKLIN STREET, BROOKLYN, NEW YORK

Remedial Alternatives	Alternative #1	Alternative #2					Alternative #3						Alternative #4						
Evaluation Criteria	**No Action**	**AS/SVE (onsite)**	**LNAPL Extraction**	**Groundwater & LNAPL Monitoring**	**Soil Vapor & SVI Monitoring**	**ECs & ICs**	**LNAPL Barrier & Extraction**	**AS/SVE (onsite)**	**Groundwater & LNAPL Monitoring**	**SSDS & Vapor Barrier**	**Soil Vapor & SVI Monitoring**	**ECs & ICs**	**Soil & LNAPL Excavation & Disposal**	**LNAPL Barrier & Extraction**	**AS/SVE, Thermal Treatment (onsite & offsite)**	**Groundwater & LNAPL Monitoring**	**SSDS & Vapor Barrier**	**Soil Vapor & SVI Monitoring**	**ECs & ICs**
Overall Protection of Public Health and the Environment	Not protective of public health or environment	**Protective of public health and environment**	**Protective of public health and environment**	Indirectly protective of public health and environment	Indirectly protective of public health and environment	**Protective of public health**	**Protective of public health and environment**	**Protective of public health and environment**	Indirectly protective of public health and environment	**Protective of public health**	Indirectly protective of public health and environment	**Protective of public health**	**Protective of public health and environment**	**Protective of public health and environment**	**Protective of public health and environment**	Indirectly protective of public health and environment	**Protective of public health**	Indirectly protective of public health and environment	**Protective of public health**
Compliance with SCGs	No compliance with SCGs	**Provides for compliance with SCGs**	Provides for limited compliance with SCGs	Provides data to assess compliance with SCGs	Provides data to assess compliance with SCGs	Does not provide for compliance with SCGs	Provides for limited compliance with SCGs	**Provides for compliance with SCGs**	Provides data to assess compliance with SCGs	**Provides for compliance with SCGs in indoor air**	Provides data to assess compliance with SCGs	Does not provide for compliance with SCGs	**Provides for compliance with SCGs onsite**	Provides for partial compliance with SCGs	**Provides for compliance with SCGs**	Provides data to assess compliance with SCGs	**Provides for compliance with SCGs in indoor air**	Provides data to assess compliance with SCGs	Does not provide for compliance with SCGs
Long-Term Effectiveness and Permanence	Not a long-term effective or permanent remedy	**Provides effective permanent remedy**	Provides permanent remedy, limited effectiveness for LNAPL reduction	Provides data to evaluate effectiveness of other measures	Provides data to evaluate effectiveness of other measures	**Provides effective permanent remedy to control exposures**	Provides permanent remedy, limited effectiveness for LNAPL reduction	**Provides effective permanent remedy**	Provides data to evaluate effectiveness of other measures	**Provides effective SVI protection**	Provides data to evaluate effectiveness of other measures	**Provides effective permanent remedy to control exposures**	**Provides permanent remedy and LNAPL reduction**	Provides permanent remedy, partial effectiveness for LNAPL reduction	**Provides effective permanent remedy**	Provides data to evaluate effectiveness of other measures	**Provides effective SVI protection**	Provides data to evaluate effectiveness of other measures	**Provides effective permanent remedy to control exposures**
Reduction of Toxicity, Mobility, or Volume	No significant reductions	**Provides for reductions in contaminant toxicity, mobility and volume**	Reduces volume of LNAPL somewhat	Provides data to evaluate reductions in toxicity, mobility and volume	Provides data to evaluate reductions in toxicity, mobility and volume	**Cover system EC reduces contaminant mobility**	**Reduces volume of LNAPL somewhat, provides protection for LNAPL mobility from source**	**Provides for reductions in contaminant toxicity, mobility and volume**	Provides data to evaluate reductions in toxicity, mobility and volume	Does not significantly reduce contaminant toxicity or volume, reduces mobility	Provides data to evaluate reductions in toxicity, mobility and volume	**Cover system EC reduces contaminant mobility**	**Significantly reduces volume and mobility of LNAPL**	**Reduces volume of LNAPL, provides protection for LNAPL mobility**	**Provides for reductions in contaminant toxicity, mobility and volume**	Provides data to evaluate reductions in toxicity, mobility and volume	Does not significantly reduce contaminant toxicity or volume, reduces mobility	Provides data to evaluate reductions in toxicity, mobility and volume	**Cover system EC reduces contaminant mobility**
Short-Term Impacts and Effectiveness	No short-term impacts	**Minimal short-term impacts, mitigation measures (HASP, CAMP) are effective**	Moderate short- and long-term impacts, mitigation measures (HASP, CAMP) are effective	**Minimal short- and long-term impacts, mitigation measures (HASP, CAMP) are effective**	**Minimal short- and long-term impacts, mitigation measures (HASP, CAMP) are effective**	**No short-term impacts**	Moderate short- and long-term impacts, mitigation measures (HASP, CAMP) are effective	**Minimal short-term impacts, mitigation measures (HASP, CAMP) are effective**	**Minimal short- and long-term impacts, mitigation measures (HASP, CAMP) are effective**	**Minimal short-term impacts, mitigation measures (HASP, CAMP) are effective**	**Minimal short- and long-term impacts, mitigation measures (HASP, CAMP) are effective**	**No short-term impacts**	Significant short- and long-term impacts, significant mitigation measures required	Moderate short- and long-term impacts, mitigation measures (HASP, CAMP) are effective	**Minimal short-term impacts, mitigation measures (HASP, CAMP) are effective**	**Minimal short- and long-term impacts, mitigation measures (HASP, CAMP) are effective**	**Minimal short-term impacts, mitigation measures (HASP, CAMP) are effective**	**Minimal short- and long-term impacts, mitigation measures (HASP, CAMP) are effective**	**No short-term impacts**
Implementability	Readily implemented	**No significant technical limitations**	Technical limitations due to subsurface infrastructure	**No significant technical limitations**	No significant technical limitations, private property access may limit implementation	**No significant technical limitations**	Technical limitations due to subsurface infrastructure	**No significant technical limitations**	**No significant technical limitations**	**No significant technical limitations.**	No significant technical limitations, private property access may limit implementation	**No significant technical limitations**	Technical limitations due to subsurface infrastructure, odor, noise, and materials management concerns	Technical limitations due to subsurface infrastructure	**No significant technical limitations**	**No significant technical limitations**	**No significant technical limitations**	No significant technical limitations, private property access may limit implementation	**No significant technical limitations**
Cost-Effectiveness	Costs are proportional to the overall effectiveness	**Costs are low relative to effectiveness**	Costs are moderate relative to overall effectiveness.	**Costs are low relative to overall effectiveness for data-gathering.**	**Costs are low relative to overall effectiveness for data-gathering.**	**Costs are low relative to overall effectiveness**	Costs are moderate relative to overall effectiveness.	**Costs are low relative to effectiveness**	**Costs are low relative to overall effectiveness for data-gathering.**	**Costs are low relative to effectiveness**	**Costs are low relative to overall effectiveness for data-gathering.**	**Costs are low relative to overall effectiveness**	Costs are high relative to overall effectiveness.	Costs are high relative to overall effectiveness.	Costs are moderate relative to effectiveness	**Costs are low relative to overall effectiveness for data-gathering.**	**Costs are low relative to effectiveness**	**Costs are low relative to overall effectiveness for data-gathering.**	**Costs are low relative to overall effectiveness**
Land Use	Not protective of land use	**Protective of land use**	**Protective of land use.**	**Protective of land use.**	**Protective of land use.**	**Protective of land use**	**Protective of land use.**	**Protective of land use**	**Protective of land use.**	**Protective of land use.**	**Protective of land use.**	**Protective of land use**	**Protective of land use.**	**Protective of land use.**	**Protective of land use**	**Protective of land use.**	**Protective of land use.**	**Protective of land use.**	**Protective of land use**
Total Cost (30 years)	$0	$1,373,100	$4,126,300	$3,237,400	$949,800	$301,400	$7,080,000	$1,369,900	$3,216,500	$1,477,700	$994,600	$301,400	$18,628,700 (incl. barrier) (plus $1,826,500 for tent)	$5,721,700	$1,939,100	$3,275,200	$2,095,300	$1,165,000	$301,400
Total Cost (Estimated duration for remedies with completion)	$0	$429,100 (4 years)	$2,246,600 (10 years)	$1,292,300 (6 & 12 years)	$322,500 (6 years)	$301,400	$5,641,600 (15 years)	$422,100 (4 years)	$1,278,800 (6 & 15 years)	$626,000 (6 years)	$330,500 (6 years)	$301,400	$18,628,700 (incl. barrier) (plus $1,826,500 for tent)	$4,503,300 (15 years)	$878,400 (4 years)	$1,265,300 (6 & 15 years)	$1,028,000 (6 years)	$378,300 (6 years)	$301,400
Total Alternative Cost (30 years)	**$0**	**$9,988,000**					**$14,440,100**						**$33,126,400 (potential $1,826,500 for tent)**						
Total Alternative Cost (Variable durations)	**$0**	**$4,591,900**					**$8,600,400**						**$26,983,400 (potential $1,826,500 for tent)**						

Notes:

Bold type and shading indicate the most positive evaluation.

- Groundwater and LNAPL monitoring would be implemented to provide the data needed to confirm that groundwater impacts are being reduced by the AS/SVE system, to confirm that LNAPL migration is not occurring, and to document the anticipated reduction in LNAPL extent and apparent thickness in the onsite and offsite areas over time.

As shown in Table 4.2.2, the capital cost for the recommended remedial alternative is $2,981,500 and includes preparing an SMP, implementing an environmental easement for the Site and an offsite IC, implementing an LNAPL barrier for the onsite source area and onsite and offsite LNAPL removal, implementing an AS/SVE system to treat soil and groundwater in the northeastern area of the Site and downgradient vicinity and soil vapor within the SVE ROI, implementing an SSDS for the offsite area with a confirmed SVI concern, and associated monitoring and maintenance programs. Operation, maintenance, monitoring and certification costs are estimated at $5,294,700 (net present worth) for the estimated active remedial and monitoring periods. Post-remedial capital costs are estimated at $324,200 for the anticipated ends of the active remedial and monitoring periods. The net present worth of the recommended remedial alternative is $14,440,100 over a 30-year period and $8,600,400 over the estimated remedial and monitoring periods.

TABLE 4.2.2
ESTIMATED COSTS FOR
RECOMMENDED REMEDIAL ALTERNATIVE 3

Description	Cost
Initial Capital Costs	
LNAPL Physical Barrier (onsite) and Extraction (onsite and offsite)	$2,410,800
AS/SVE (TCE-impacted area)	$183,600
Groundwater/LNAPL Monitoring Points	$9,700
SSDS	$292,800
Soil Vapor/SVI Monitoring Points	$38,600
Implement ECs and ICs (environmental easement, SMP)	$46,000
Initial Capital Cost Subtotal:	**$2,981,500**
O&M Net Present Worth over Anticipated O&M Periods	
LNAPL Extraction (onsite and offsite, 15 years)	$2,990,300
AS/SVE O&M (4 years)	$223,700
Groundwater/LNAPL Monitoring (6 and 15 years)	$1,238,800
SSDS OM&M (6 years)	$326,600
Soil Vapor/SVI monitoring (6 years)	$259,900
Certification and Reporting (30 years)	$255,400
O&M, Certification and Reporting Net Present Worth Subtotal:	**$5,294,700**
Post-Remedial Capital Costs	
Extraction System Removal (15 years)	$240,500
AS/SVE System Removal (4 years)	$14,800
Groundwater and LNAPL Monitoring Network Abandonment (15 years)	$30,300
SSDS Removal (6 years)	$6,600
Soil Vapor/SVI Monitoring Network Abandonment (6 years)	$32,000
Post-Remedial Capital Cost Subtotal:	**$324,200**
TOTAL COST (Initial and Post-Remediation Capital, O&M/Certification/ Reporting)	**$8,600,400**

Note: Assumed interest rate is 5% and assumed inflation rate is 2%.
All subtotal and total costs are rounded to the nearest $100.

U:\Rigano LLC\49 Dupont Brooklyn\FS\FS Cost Tables\New Tables\Table422RecAltCosts.Docx

SECTION 5.0
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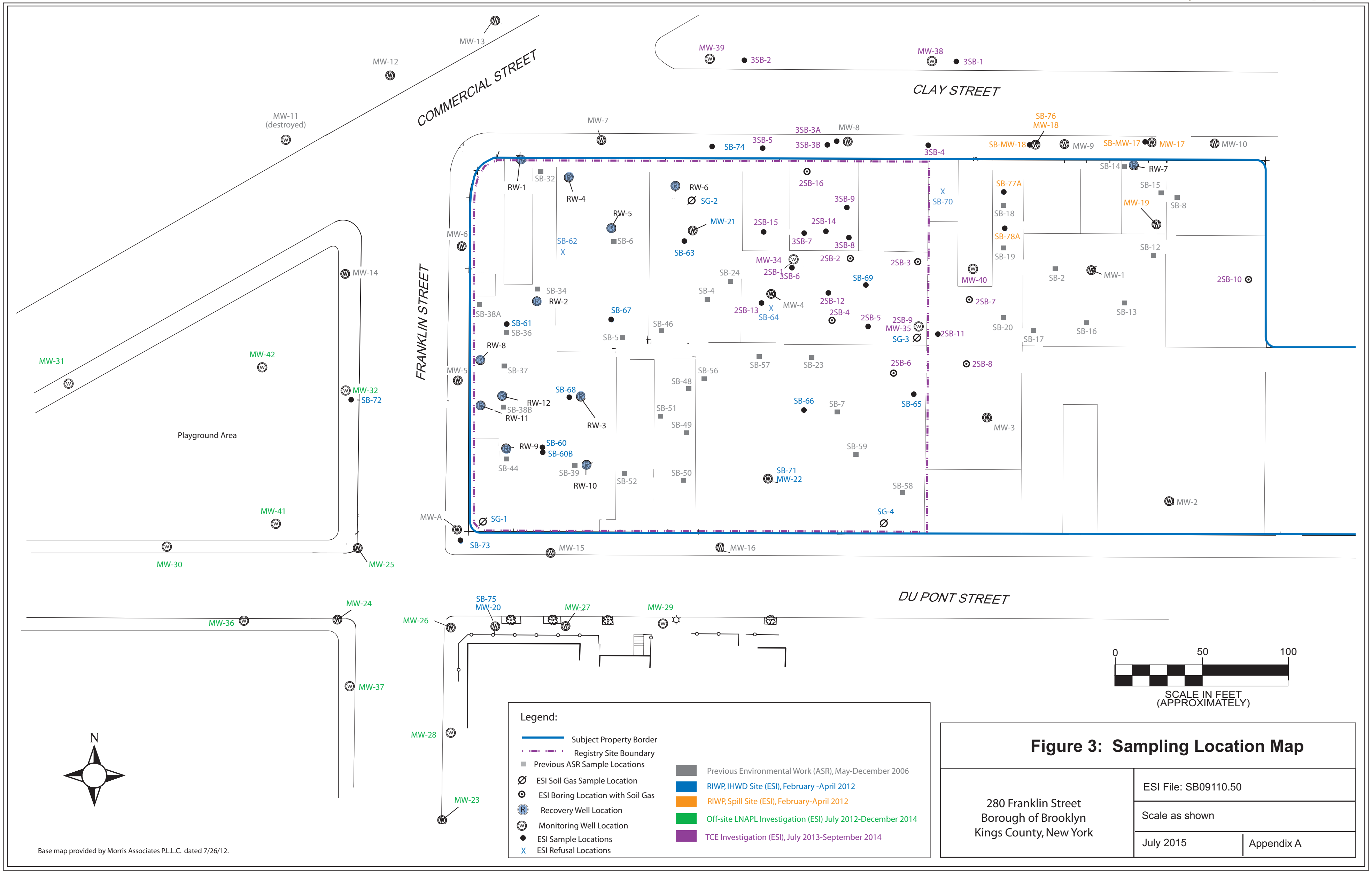
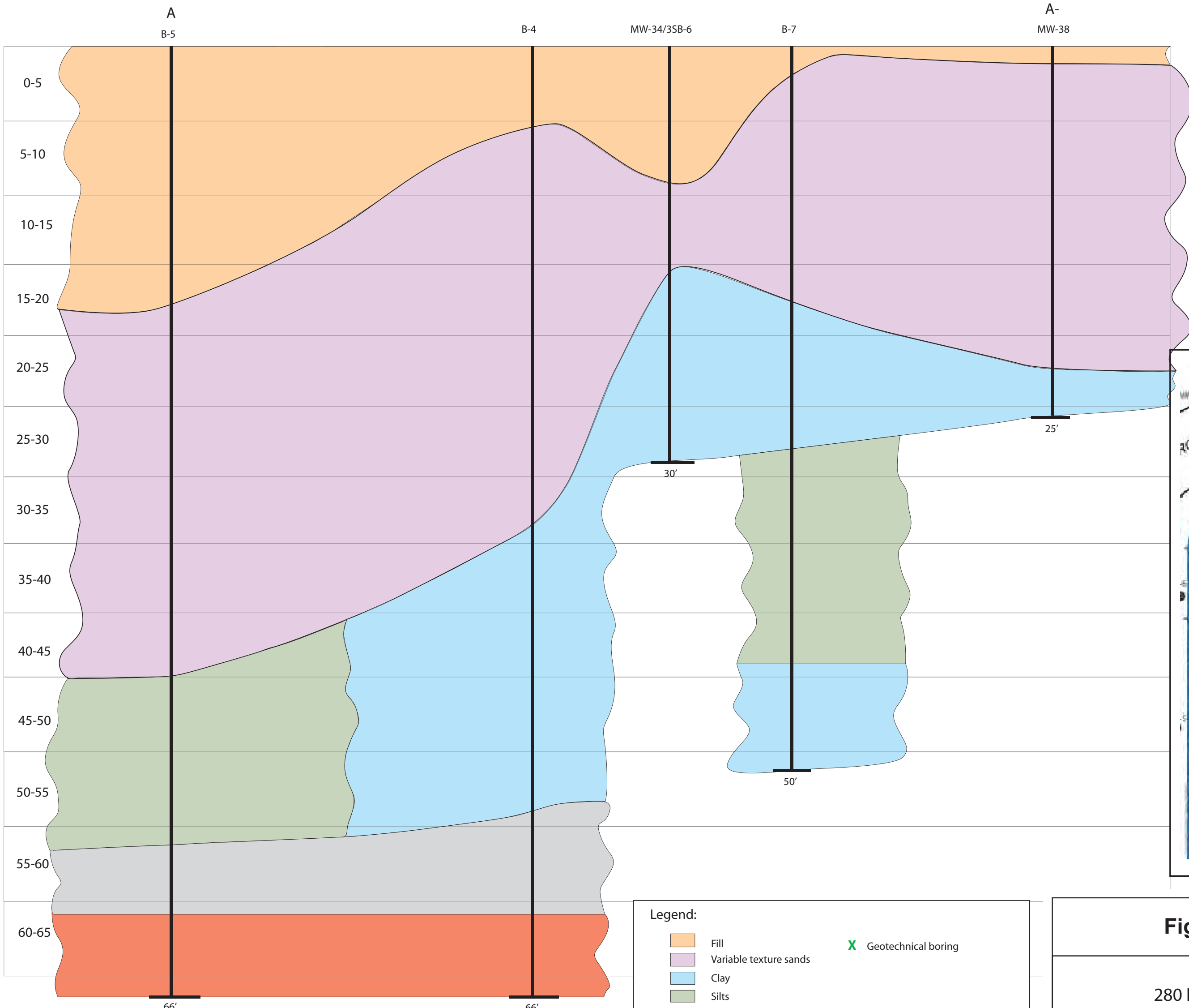
APPENDIX A

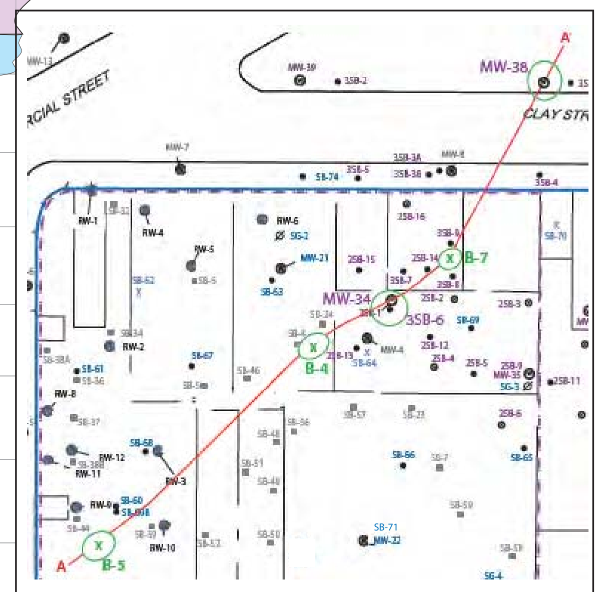
REMEDIAL INVESTIGATION REPORT FIGURES

Ecosystems Strategies, Inc.



Ecosystems Strategies, Inc.





Legend:

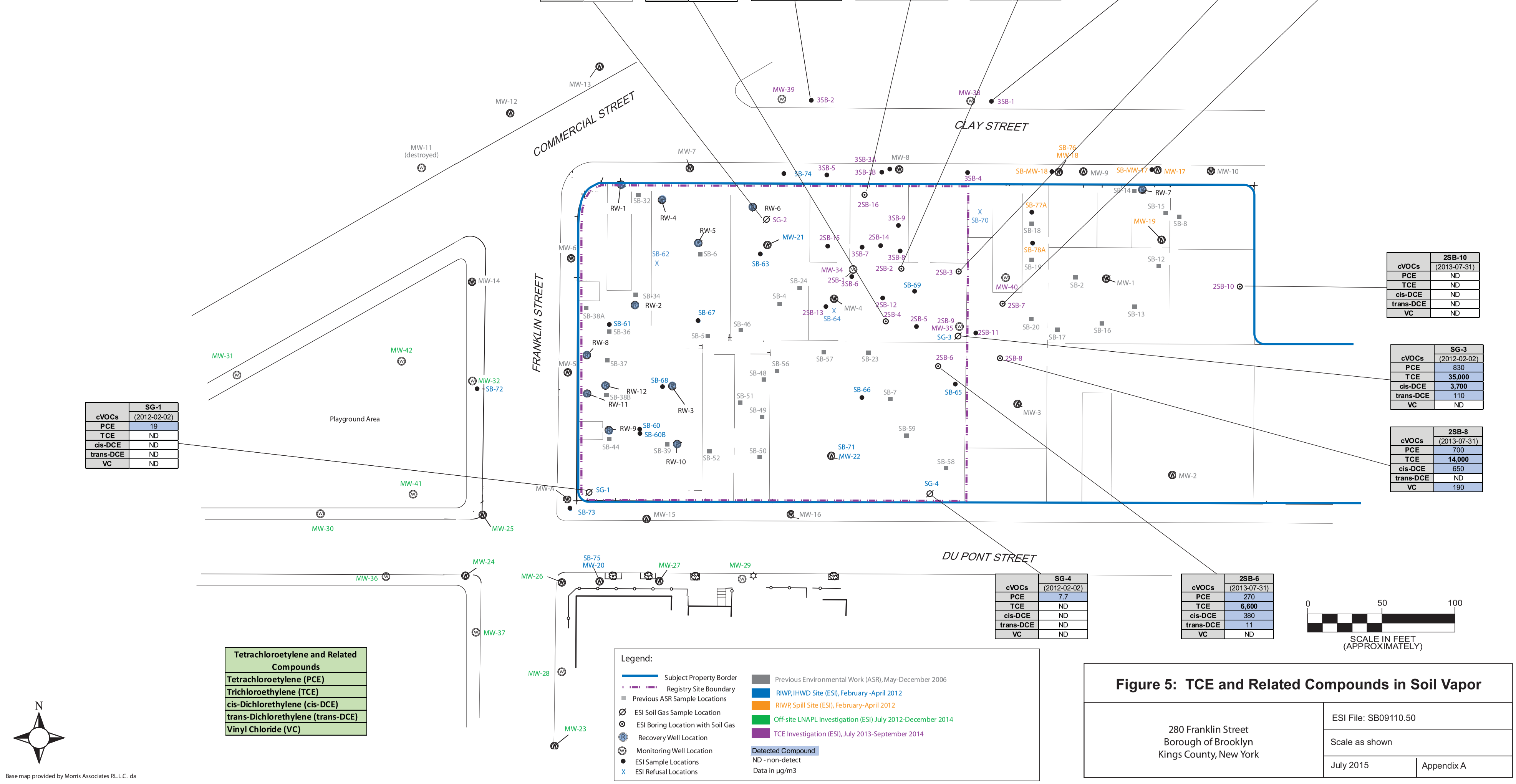
- Fill
- Variable texture sands
- Clay
- Silts
- Silty sand
- Bedrock (gneiss)
- X Geotechnical boring

All feature locations are approximate. This map is intended as a schematic to be used in conjunction with the associated report, and it should not be relied upon as a survey for planning or other activities.

Figure 4: Geological Cross Section

280 Franklin Street Borough of Brooklyn Kings County, New York	ESI File: SB09110.50	
	Not to scale	
	July 2015	Appendix A

Ecosystems Strategies, Inc.



cVOCs	SG-2 (2012-02-02)
PCE	5.5
TCE	59
cis-DCE	2.7
trans-DCE	ND
VC	ND

cVOCs	2SB-4 (2013-07-31)
PCE	540
TCE	12,000
cis-DCE	1,500
trans-DCE	11
VC	ND

cVOCs	3SB-2 (2013-12-04)
PCE	36
TCE	134
cis-DCE	ND
trans-DCE	ND
VC	ND

cVOCs	2SB-16 (2013-12-04)
PCE	ND
TCE	1,100
cis-DCE	ND
trans-DCE	ND
VC	ND

cVOCs	2SB-2 (2013-07-31)
PCE	1,000
TCE	33,000
cis-DCE	2,300
trans-DCE	69
VC	5.3

cVOCs	3SB-1 (2013-07-31)
PCE	102
TCE	6,130
cis-DCE	28.9
trans-DCE	ND
VC	ND

cVOCs	2SB-3 (2013-07-31)
PCE	2,500
TCE	43,000
cis-DCE	3,600
trans-DCE	120
VC	ND

cVOCs	2SB-7 (2013-07-31)
PCE	850
TCE	5,600
cis-DCE	570
trans-DCE	13
VC	ND

cVOCs	2SB-10 (2013-07-31)
PCE	ND
TCE	ND
cis-DCE	ND
trans-DCE	ND
VC	ND

cVOCs	SG-3 (2012-02-02)
PCE	830
TCE	35,000
cis-DCE	3,700
trans-DCE	110
VC	ND

cVOCs	2SB-8 (2013-07-31)
PCE	700
TCE	14,000
cis-DCE	650
trans-DCE	ND
VC	190

cVOCs	SG-1 (2012-02-02)
PCE	19
TCE	ND
cis-DCE	ND
trans-DCE	ND
VC	ND

cVOCs	SG-4 (2012-02-02)
PCE	7.7
TCE	ND
cis-DCE	ND
trans-DCE	ND
VC	ND

cVOCs	2SB-6 (2013-07-31)
PCE	270
TCE	6,600
cis-DCE	380
trans-DCE	11
VC	ND

Tetrachloroetylene and Related Compounds
Tetrachloroetylene (PCE)
Trichloroethylene (TCE)
cis-Dichloroethylene (cis-DCE)
trans-Dichlorethylene (trans-DCE)
Vinyl Chloride (VC)

Figure 5: TCE and Related Compounds in Soil Vapor

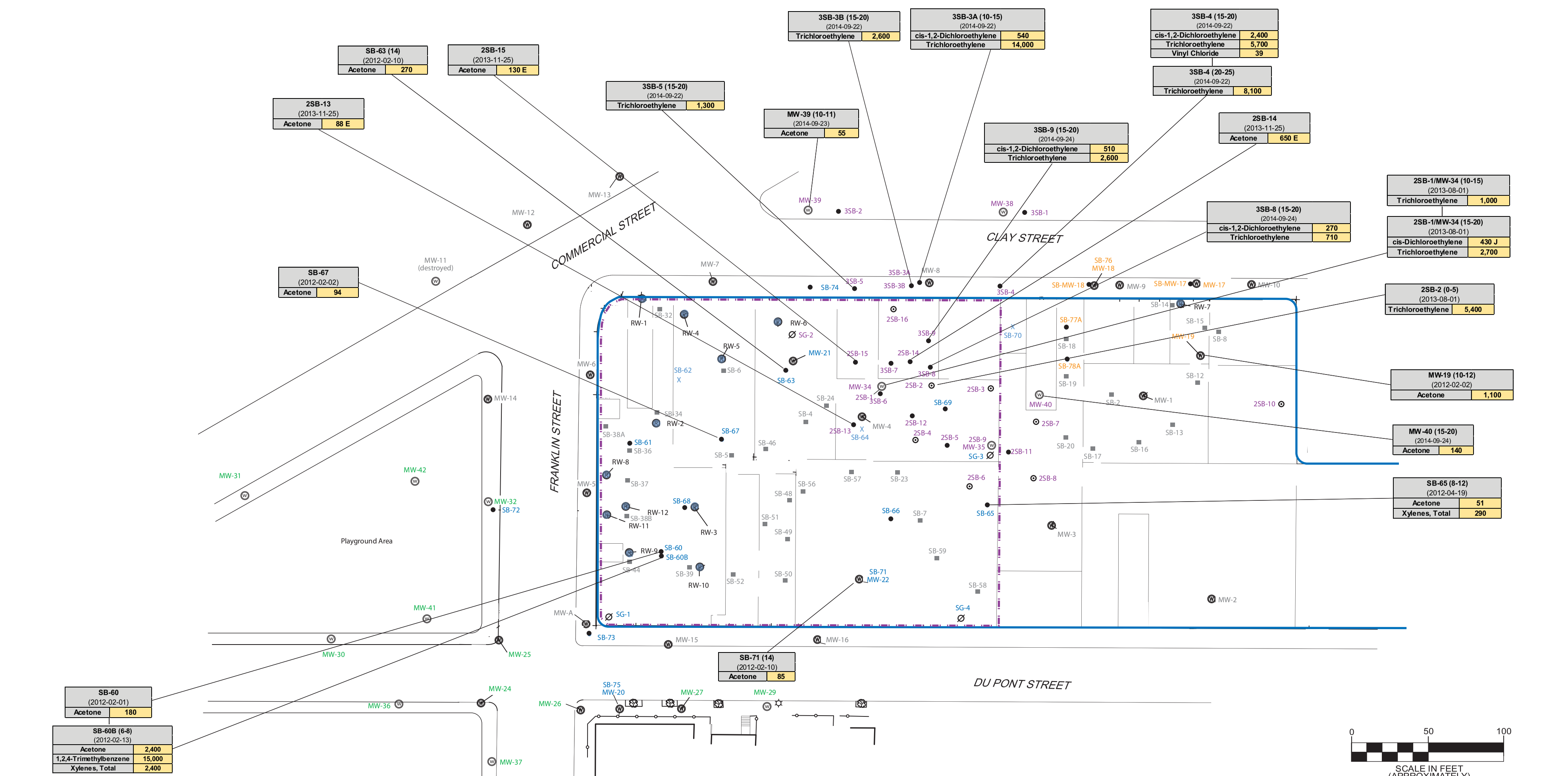
280 Franklin Street
Borough of Brooklyn
Kings County, New York

ESI File: SB09110.50

Scale as shown

July 2015 | Appendix A

Ecosystems Strategies, Inc.



VOCs	Unrestricted SCO	Restricted-Residential SCO
1,2,4-Trimethylbenzene	3,600	52,000
Acetone	50	100,000
cis-1,2-Dichloroethylene	250	100,000
Methylene chloride	50	500,000
Trichloroethylene	470	21,000
Xylenes, Total	260	100,000
Vinyl Chloride	20	900

Legend:

- Subject Property Border
- Registry Site Boundary
- Previous ASR Sample Locations
- ESI Soil Gas Sample Location
- ESI Boring Location with Soil Gas
- Recovery Well Location
- Monitoring Well Location
- ESI Sample Locations
- ESI Refusal Locations
- Previous Environmental Work (ASR), May-December 2006
- RIWP, IHWD Site (ESI), February -April 2012
- RIWP, Spill Site (ESI), February-April 2012
- Off-site LNAPL Investigation (ESI) July 2012-December 2014
- TCE Investigation (ESI), July 2013-September 2014
- Above UUSCO

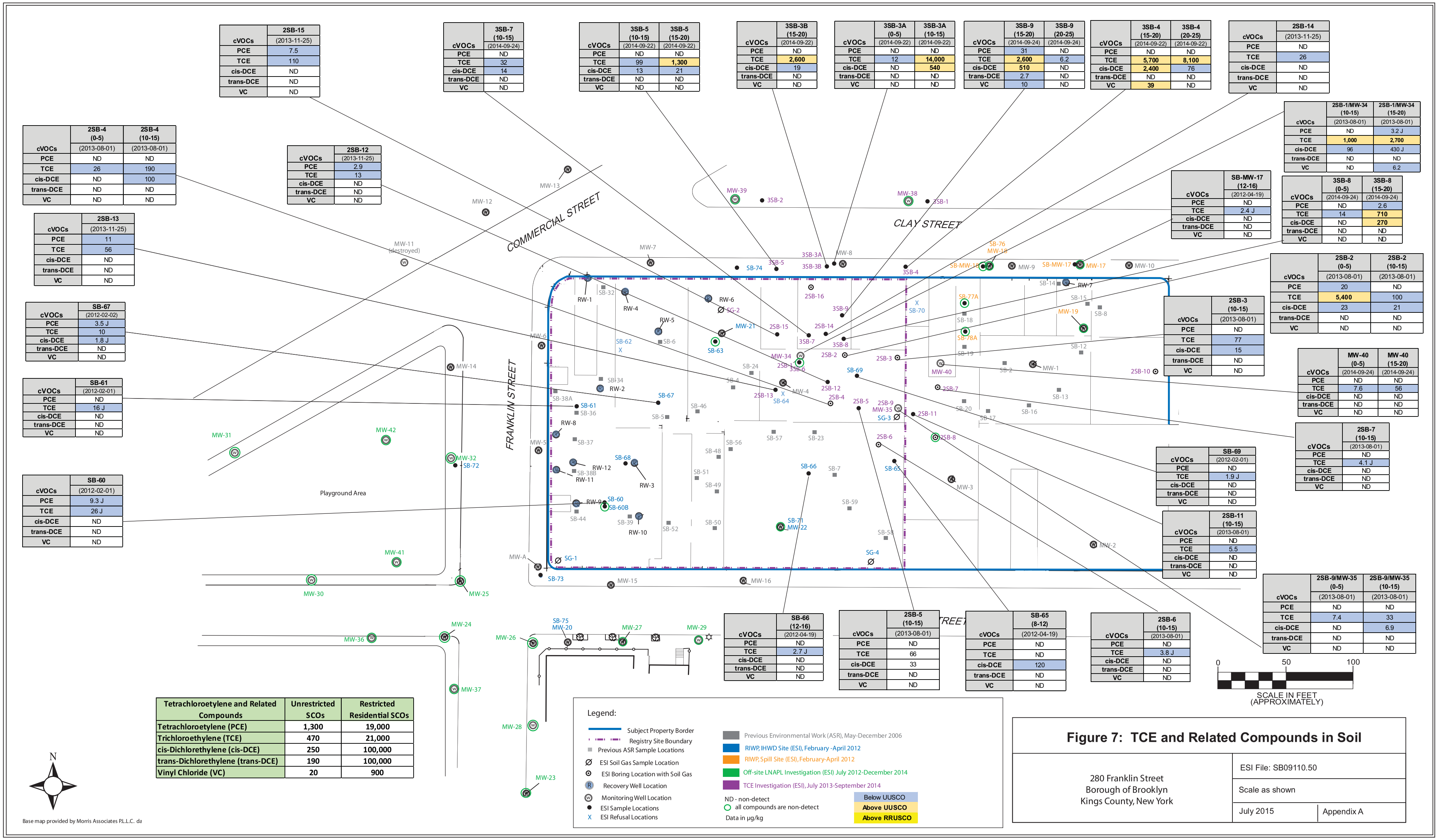
Data in µg/kg

Figure 6: VOCs Above UUSCOs in Soil

280 Franklin Street
Borough of Brooklyn
Kings County, New York

ESI File: SB09110.50
Scale as shown
July 2015
Appendix A

Base map provided by Morris Associates PL.L.C. da



cVOCs	2SB-15 (2013-11-25)
PCE	7.5
TCE	110
cis-DCE	ND
trans-DCE	ND
VC	ND

cVOCs	3SB-7 (10-15) (2014-09-24)
PCE	ND
TCE	32
cis-DCE	14
trans-DCE	ND
VC	ND

cVOCs	3SB-5 (10-15) (2014-09-22)	3SB-5 (15-20) (2014-09-22)
PCE	ND	ND
TCE	99	1,300
cis-DCE	13	21
trans-DCE	ND	ND
VC	ND	ND

cVOCs	3SB-3B (15-20) (2014-09-22)
PCE	ND
TCE	2,600
cis-DCE	19
trans-DCE	ND
VC	ND

cVOCs	3SB-3A (0-5) (2014-09-22)	3SB-3A (10-15) (2014-09-22)
PCE	ND	ND
TCE	12	14,000
cis-DCE	ND	540
trans-DCE	ND	ND
VC	ND	ND

cVOCs	3SB-9 (15-20) (2014-09-24)	3SB-9 (20-25) (2014-09-24)
PCE	31	ND
TCE	2,600	6.2
cis-DCE	510	ND
trans-DCE	2.7	ND
VC	10	ND

cVOCs	3SB-4 (15-20) (2014-09-22)	3SB-4 (20-25) (2014-09-22)
PCE	ND	ND
TCE	5,700	8,100
cis-DCE	2,400	76
trans-DCE	ND	ND
VC	39	ND

cVOCs	2SB-14 (2013-11-25)
PCE	ND
TCE	26
cis-DCE	ND
trans-DCE	ND
VC	ND

cVOCs	2SB-1/MW-34 (10-15) (2013-08-01)	2SB-1/MW-34 (15-20) (2013-08-01)
PCE	ND	3.2 J
TCE	1,000	2,700
cis-DCE	96	430 J
trans-DCE	ND	ND
VC	ND	6.2

cVOCs	SB-MW-17 (12-16) (2012-04-19)
PCE	ND
TCE	2.4 J
cis-DCE	ND
trans-DCE	ND
VC	ND

cVOCs	3SB-8 (0-5) (2014-09-24)	3SB-8 (15-20) (2014-09-24)
PCE	ND	2.6
TCE	14	710
cis-DCE	ND	270
trans-DCE	ND	ND
VC	ND	ND

cVOCs	2SB-2 (0-5) (2013-08-01)	2SB-2 (10-15) (2013-08-01)
PCE	20	ND
TCE	5,400	100
cis-DCE	23	21
trans-DCE	ND	ND
VC	ND	ND

cVOCs	2SB-3 (10-15) (2013-08-01)
PCE	ND
TCE	77
cis-DCE	15
trans-DCE	ND
VC	ND

cVOCs	MW-40 (0-5) (2014-09-24)	MW-40 (15-20) (2014-09-24)
PCE	ND	ND
TCE	7.6	56
cis-DCE	ND	ND
trans-DCE	ND	ND
VC	ND	ND

cVOCs	2SB-7 (10-15) (2013-08-01)
PCE	ND
TCE	4.1 J
cis-DCE	ND
trans-DCE	ND
VC	ND

cVOCs	SB-69 (2012-02-01)
PCE	ND
TCE	1.9 J
cis-DCE	ND
trans-DCE	ND
VC	ND

cVOCs	2SB-11 (10-15) (2013-08-01)
PCE	ND
TCE	5.5
cis-DCE	ND
trans-DCE	ND
VC	ND

cVOCs	2SB-9/MW-35 (0-5) (2013-08-01)	2SB-9/MW-35 (10-15) (2013-08-01)
PCE	ND	ND
TCE	7.4	33
cis-DCE	ND	6.9
trans-DCE	ND	ND
VC	ND	ND

cVOCs	2SB-6 (10-15) (2013-08-01)
PCE	ND
TCE	3.8 J
cis-DCE	ND
trans-DCE	ND
VC	ND

cVOCs	SB-65 (8-12) (2012-04-19)
PCE	ND
TCE	ND
cis-DCE	120
trans-DCE	ND
VC	ND

cVOCs	2SB-5 (10-15) (2013-08-01)
PCE	ND
TCE	66
cis-DCE	33
trans-DCE	ND
VC	ND

cVOCs	SB-66 (12-16) (2012-04-19)
PCE	ND
TCE	2.7 J
cis-DCE	ND
trans-DCE	ND
VC	ND

cVOCs	2SB-4 (0-5) (2013-08-01)	2SB-4 (10-15) (2013-08-01)
PCE	ND	ND
TCE	26	190
cis-DCE	ND	100
trans-DCE	ND	ND
VC	ND	ND

cVOCs	2SB-12 (2013-11-25)
PCE	2.9
TCE	13
cis-DCE	ND
trans-DCE	ND
VC	ND

cVOCs	2SB-13 (2013-11-25)
PCE	11
TCE	56
cis-DCE	ND
trans-DCE	ND
VC	ND

cVOCs	SB-67 (2012-02-02)
PCE	3.5 J
TCE	10
cis-DCE	1.8 J
trans-DCE	ND
VC	ND

cVOCs	SB-61 (2012-02-01)
PCE	ND
TCE	16 J
cis-DCE	ND
trans-DCE	ND
VC	ND

cVOCs	SB-60 (2012-02-01)
PCE	9.3 J
TCE	26 J
cis-DCE	ND
trans-DCE	ND
VC	ND

Tetrachloroetylene and Related Compounds	Unrestricted SCOs	Restricted Residential SCOs
Tetrachloroetylene (PCE)	1,300	19,000
Trichloroethylene (TCE)	470	21,000
cis-Dichlorethylene (cis-DCE)	250	100,000
trans-Dichlorethylene (trans-DCE)	190	100,000
Vinyl Chloride (VC)	20	900

Legend:

- Subject Property Border
- Registry Site Boundary
- Previous ASR Sample Locations
- ESI Soil Gas Sample Location
- ESI Boring Location with Soil Gas
- Recovery Well Location
- Monitoring Well Location
- ESI Sample Locations
- ESI Refusal Locations

- Previous Environmental Work (ASR), May-December 2006
- RIWP, IHWD Site (ESI), February -April 2012
- RIWP, Spill Site (ESI), February-April 2012
- Off-site LNAPL Investigation (ESI) July 2012-December 2014
- TCE Investigation (ESI), July 2013-September 2014

ND - non-detect
all compounds are non-detect
Data in µg/kg

Below UUSCO
Above UUSCO
Above RRUSCO

Figure 7: TCE and Related Compounds in Soil

280 Franklin Street
Borough of Brooklyn
Kings County, New York

ESI File: SB09110.50

Scale as shown

July 2015

Appendix A

Ecosystems Strategies, Inc.

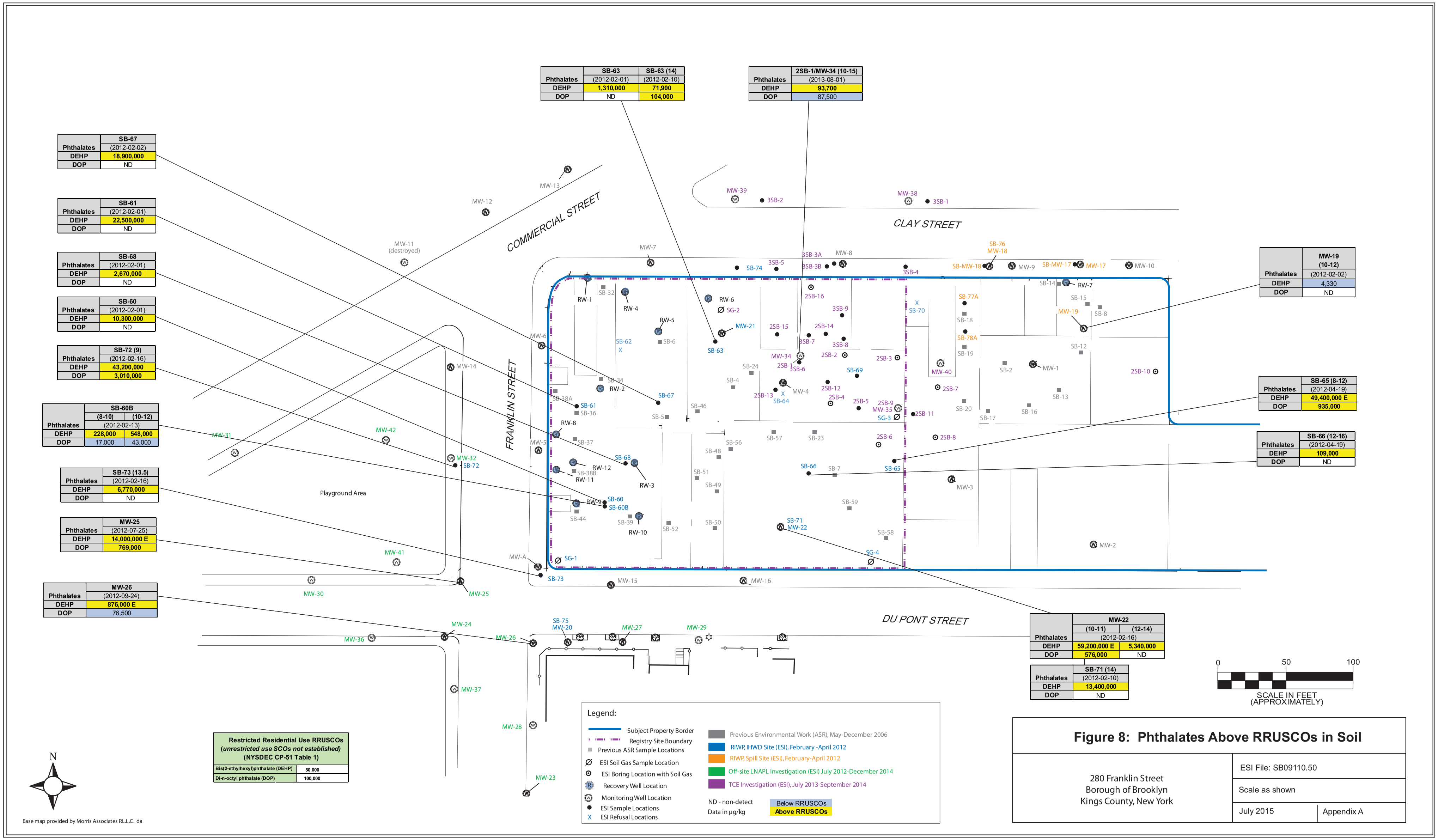


Figure 8: Phthalates Above RRUSCOs in Soil

280 Franklin Street
Borough of Brooklyn
Kings County, New York

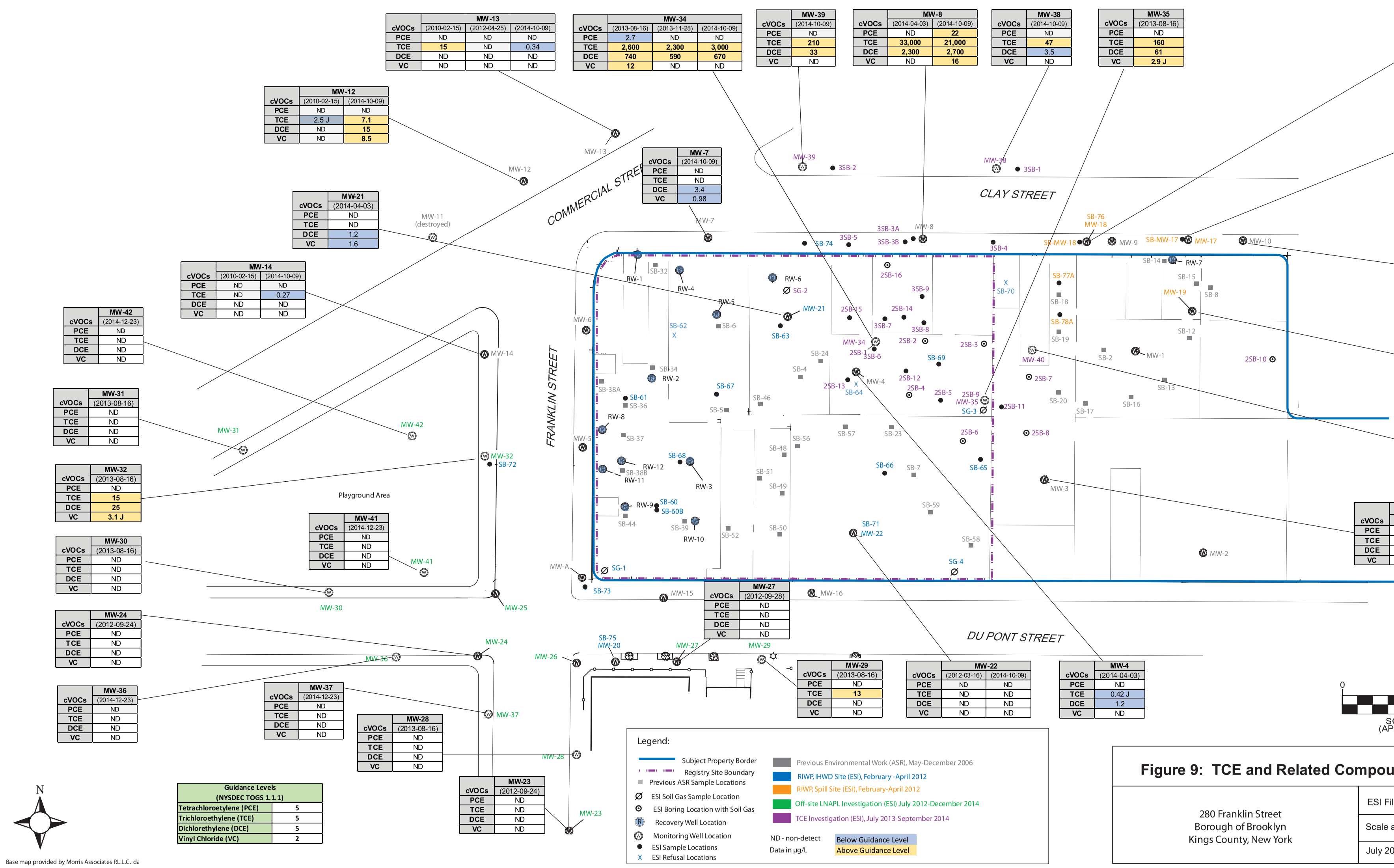
ESI File: SB09110.50

Scale as shown

July 2015

Appendix A

Ecosystems Strategies, Inc.



cVOCs	MW-13 (2010-02-15)	MW-13 (2012-04-25)	MW-13 (2014-10-09)
PCE	ND	ND	ND
TCE	15	ND	0.34
DCE	ND	ND	ND
VC	ND	ND	ND

cVOCs	MW-34 (2013-08-16)	MW-34 (2013-11-25)	MW-34 (2014-10-09)
PCE	2.7	ND	ND
TCE	2,600	2,300	3,000
DCE	740	590	670
VC	12	ND	ND

cVOCs	MW-39 (2014-10-09)
PCE	ND
TCE	210
DCE	33
VC	ND

cVOCs	MW-8 (2014-04-03)	MW-8 (2014-10-09)
PCE	ND	22
TCE	33,000	21,000
DCE	2,300	2,700
VC	ND	16

cVOCs	MW-38 (2014-10-09)
PCE	ND
TCE	47
DCE	3.5
VC	ND

cVOCs	MW-35 (2013-08-16)
PCE	ND
TCE	160
DCE	61
VC	2.9 J

cVOCs	MW-18 (2012-03-16)	MW-18 (2014-10-09)
PCE	ND	ND
TCE	3 J	16
DCE	1.5 J	4.5
VC	ND	0.41

cVOCs	MW-12 (2010-02-15)	MW-12 (2014-10-09)
PCE	ND	ND
TCE	2.5 J	7.1
DCE	ND	15
VC	ND	8.5

cVOCs	MW-17 (2012-04-19)
PCE	ND
TCE	7
DCE	2.5 J
VC	ND

cVOCs	MW-7 (2014-10-09)
PCE	ND
TCE	ND
DCE	3.4
VC	0.98

cVOCs	MW-21 (2014-04-03)
PCE	ND
TCE	ND
DCE	1.2
VC	1.6

cVOCs	MW-10 (2010-02-15)	MW-10 (2012-03-16)
PCE	ND	ND
TCE	1.1 J	0.86 J
DCE	ND	ND
VC	ND	ND

cVOCs	MW-14 (2010-02-15)	MW-14 (2014-10-09)
PCE	ND	ND
TCE	ND	0.27
DCE	ND	ND
VC	ND	ND

cVOCs	MW-42 (2014-12-23)
PCE	ND
TCE	ND
DCE	ND
VC	ND

cVOCs	MW-19 (2012-04-19)
PCE	ND
TCE	1.5 J
DCE	1.8 J
VC	ND

cVOCs	MW-31 (2013-08-16)
PCE	ND
TCE	ND
DCE	ND
VC	ND

cVOCs	MW-40 (2014-10-09)
PCE	ND
TCE	7,400
DCE	530
VC	ND

cVOCs	MW-32 (2013-08-16)
PCE	ND
TCE	15
DCE	25
VC	3.1 J

cVOCs	MW-3 (2010-02-15)	MW-3 (2012-04-25)	MW-3 (2013-11-25)
PCE	ND	ND	ND
TCE	ND	ND	ND
DCE	ND	ND	ND
VC	ND	ND	ND

cVOCs	MW-41 (2014-12-23)
PCE	ND
TCE	ND
DCE	ND
VC	ND

cVOCs	MW-30 (2013-08-16)
PCE	ND
TCE	ND
DCE	ND
VC	ND

cVOCs	MW-27 (2012-09-28)
PCE	ND
TCE	ND
DCE	ND
VC	ND

cVOCs	MW-24 (2012-09-24)
PCE	ND
TCE	ND
DCE	ND
VC	ND

cVOCs	MW-29 (2013-08-16)
PCE	ND
TCE	13
DCE	ND
VC	ND

cVOCs	MW-22 (2012-03-16)	MW-22 (2014-10-09)
PCE	ND	ND
TCE	ND	ND
DCE	ND	ND
VC	ND	ND

cVOCs	MW-4 (2014-04-03)
PCE	ND
TCE	0.42 J
DCE	1.2
VC	ND

cVOCs	MW-36 (2014-12-23)
PCE	ND
TCE	ND
DCE	ND
VC	ND

cVOCs	MW-37 (2014-12-23)
PCE	ND
TCE	ND
DCE	ND
VC	ND

cVOCs	MW-28 (2013-08-16)
PCE	ND
TCE	ND
DCE	ND
VC	ND

cVOCs	MW-23 (2012-09-24)
PCE	ND
TCE	ND
DCE	ND
VC	ND

Guidance Levels (NYSDEC TOGS 1.1.1)	
Tetrachloroethylene (PCE)	5
Trichloroethylene (TCE)	5
Dichloroethylene (DCE)	5
Vinyl Chloride (VC)	2

Legend:

- Subject Property Border
- Registry Site Boundary
- Previous ASR Sample Locations
- ESI Soil Gas Sample Location
- ESI Boring Location with Soil Gas
- Recovery Well Location
- Monitoring Well Location
- ESI Sample Locations
- ESI Refusal Locations
- Previous Environmental Work (ASR), May-December 2006
- RIWP, IHWD Site (ESI), February -April 2012
- RIWP, Spill Site (ESI), February-April 2012
- Off-site LNAPL Investigation (ESI) July 2012-December 2014
- TCE Investigation (ESI), July 2013-September 2014

ND - non-detect
Data in μg/L

Below Guidance Level
Above Guidance Level

Figure 9: TCE and Related Compounds in Groundwater

280 Franklin Street
Borough of Brooklyn
Kings County, New York

ESI File: SB09110.50
Scale as shown
July 2015
Appendix A

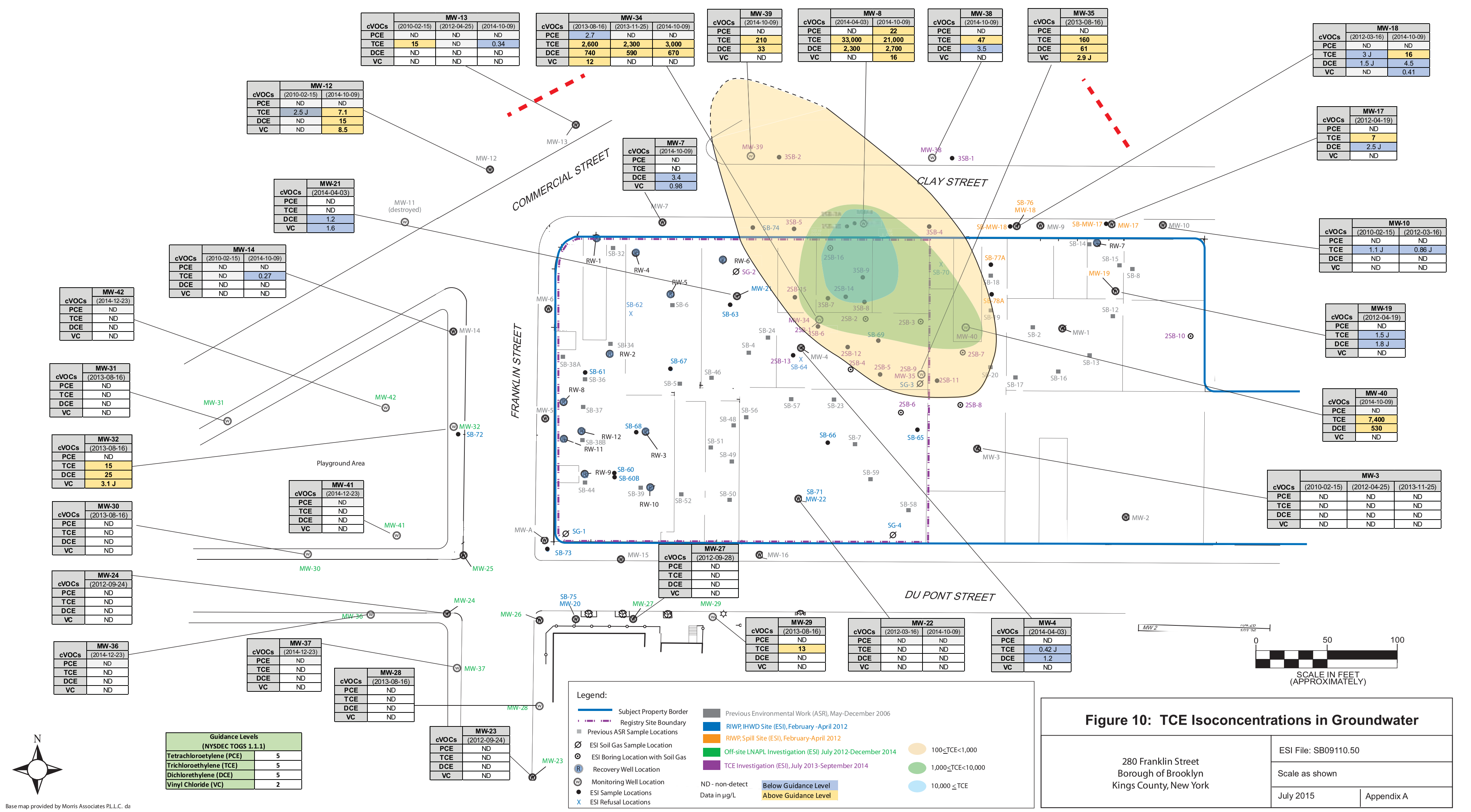


Figure 10: TCE Isoconcentrations in Groundwater

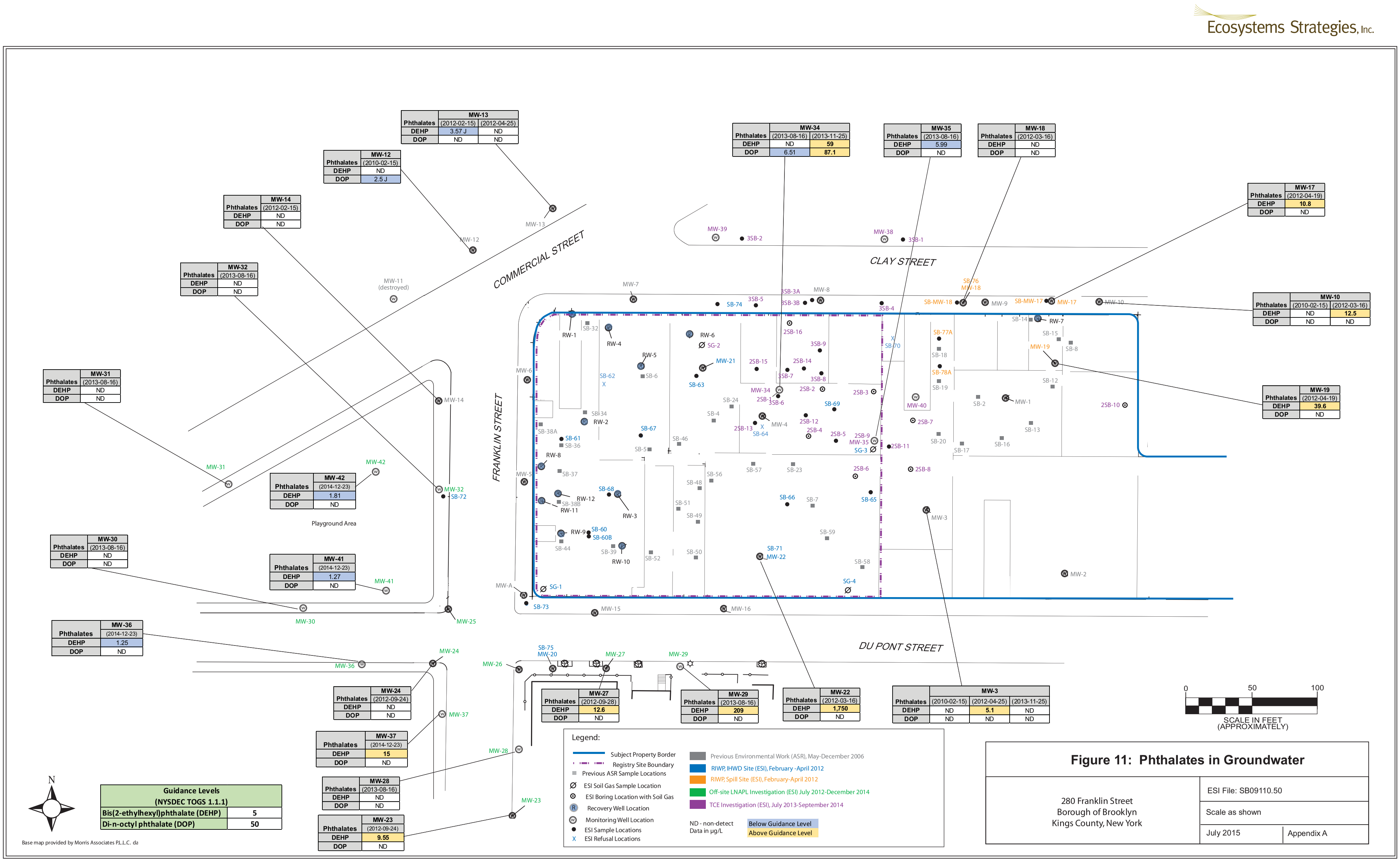
280 Franklin Street
Borough of Brooklyn
Kings County, New York

ESI File: SB09110.50

Scale as shown

July 2015

Appendix A


Ecosystems Strategies, Inc.
MW-13 Phthalates (2012-02-15) (2012-04-25) DEHP 3.57 J ND DOP ND ND
MW-12 Phthalates (2010-02-15) DEHP ND DOP 2.5 J
MW-14 Phthalates (2012-02-15) DEHP ND DOP ND
MW-32 Phthalates (2013-08-16) DEHP ND DOP ND
MW-31 Phthalates (2013-08-16) DEHP ND DOP ND
MW-30 Phthalates (2013-08-16) DEHP ND DOP ND
MW-36 Phthalates (2014-12-23) DEHP 1.25 DOP ND
MW-42 Phthalates (2014-12-23) DEHP 1.81 DOP ND
MW-41 Phthalates (2014-12-23) DEHP 1.27 DOP ND
MW-24 Phthalates (2012-09-24) DEHP ND DOP ND
MW-37 Phthalates (2014-12-23) DEHP 15 DOP ND
MW-28 Phthalates (2013-08-16) DEHP ND DOP ND
MW-23 Phthalates (2012-09-24) DEHP 9.55 DOP ND
MW-27 Phthalates (2012-09-28) DEHP 12.6 DOP ND
MW-29 Phthalates (2013-08-16) DEHP 209 DOP ND
MW-22 Phthalates (2012-03-16) DEHP 1,750 DOP ND
MW-3 Phthalates (2010-02-15) (2012-04-25) (2013-11-25) DEHP ND 5.1 ND DOP ND ND ND
MW-34 Phthalates (2013-08-16) (2013-11-25) DEHP ND 59 DOP 6.51 87.1
MW-35 Phthalates (2013-08-16) DEHP 5.99 DOP ND
MW-18 Phthalates (2012-03-16) DEHP ND DOP ND
MW-17 Phthalates (2012-04-19) DEHP 10.8 DOP ND
MW-10 Phthalates (2010-02-15) (2012-03-16) DEHP ND 12.5 DOP ND ND
MW-19 Phthalates (2012-04-19) DEHP 39.6 DOP ND
COMMERCIAL STREET
CLAY STREET
FRANKLIN STREET
DU PONT STREET
Playground Area
MW-11 (destroyed)
Guidance Levels (NYSDEC TOGS 1.1.1)
Bis(2-ethylhexyl)phthalate (DEHP) 5
Di-n-octyl phthalate (DOP) 50
N
Base map provided by Morris Associates PLLC. da
Legend:
Subject Property Border
Registry Site Boundary
Previous ASR Sample Locations
ESI Soil Gas Sample Location
ESI Boring Location with Soil Gas
Recovery Well Location
Monitoring Well Location
ESI Sample Locations
ESI Refusal Locations
Previous Environmental Work (ASR), May-December 2006
RIWP, IHWD Site (ESI), February -April 2012
RIWP, Spill Site (ESI), February-April 2012
Off-site LNAPL Investigation (ESI) July 2012-December 2014
TCE Investigation (ESI), July 2013-September 2014
ND - non-detect
Data in µg/L
Below Guidance Level
Above Guidance Level
0 50 100
SCALE IN FEET (APPROXIMATELY)
Figure 11: Phthalates in Groundwater
280 Franklin Street
Borough of Brooklyn
Kings County, New York
ESI File: SB09110.50
Scale as shown
July 2015
Appendix A

Ecosystems Strategies, Inc.

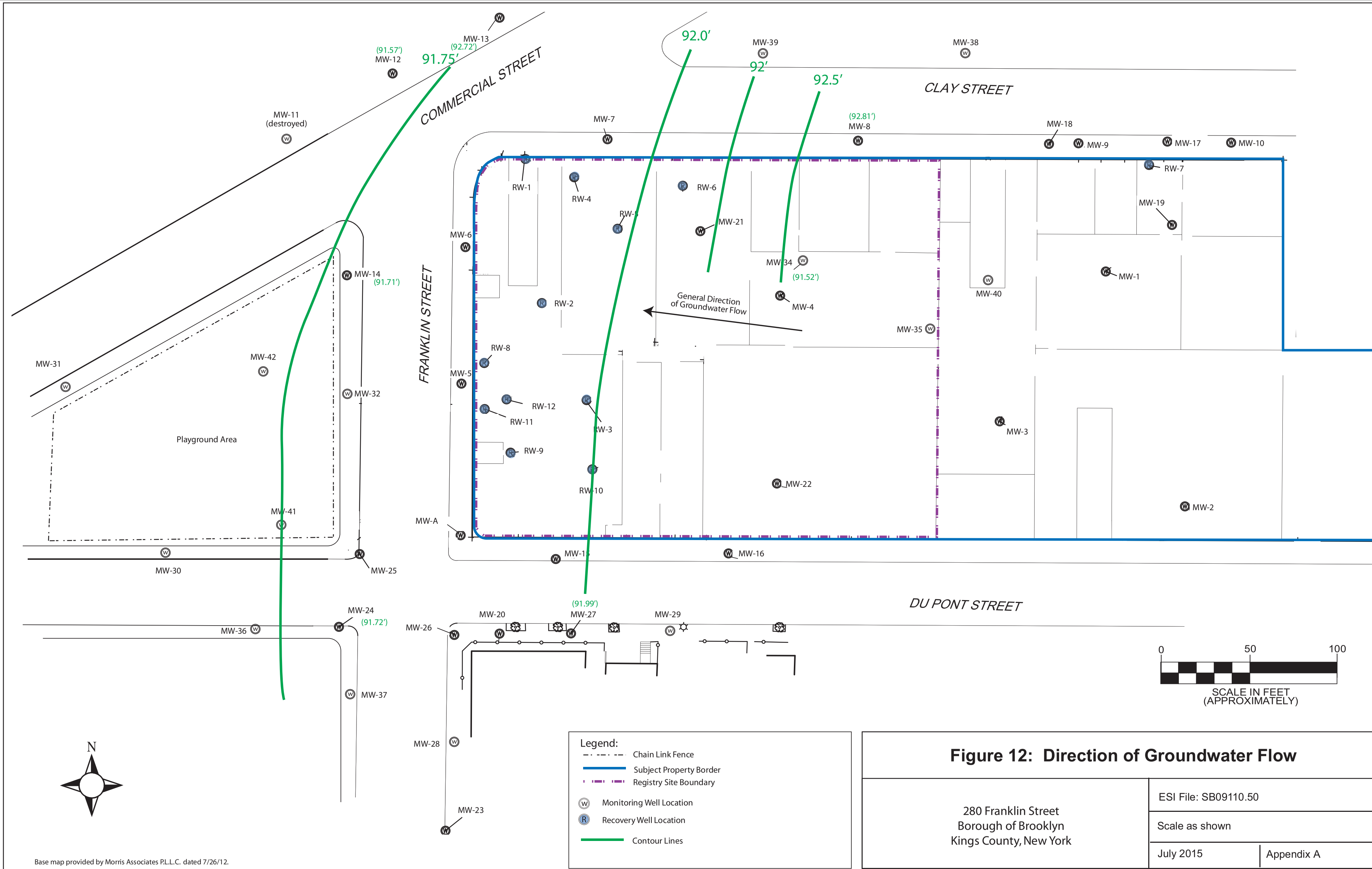


Figure 12: Direction of Groundwater Flow

280 Franklin Street
Borough of Brooklyn
Kings County, New York

ESI File: SB09110.50	
Scale as shown	
July 2015	Appendix A

Ecosystems Strategies, Inc.

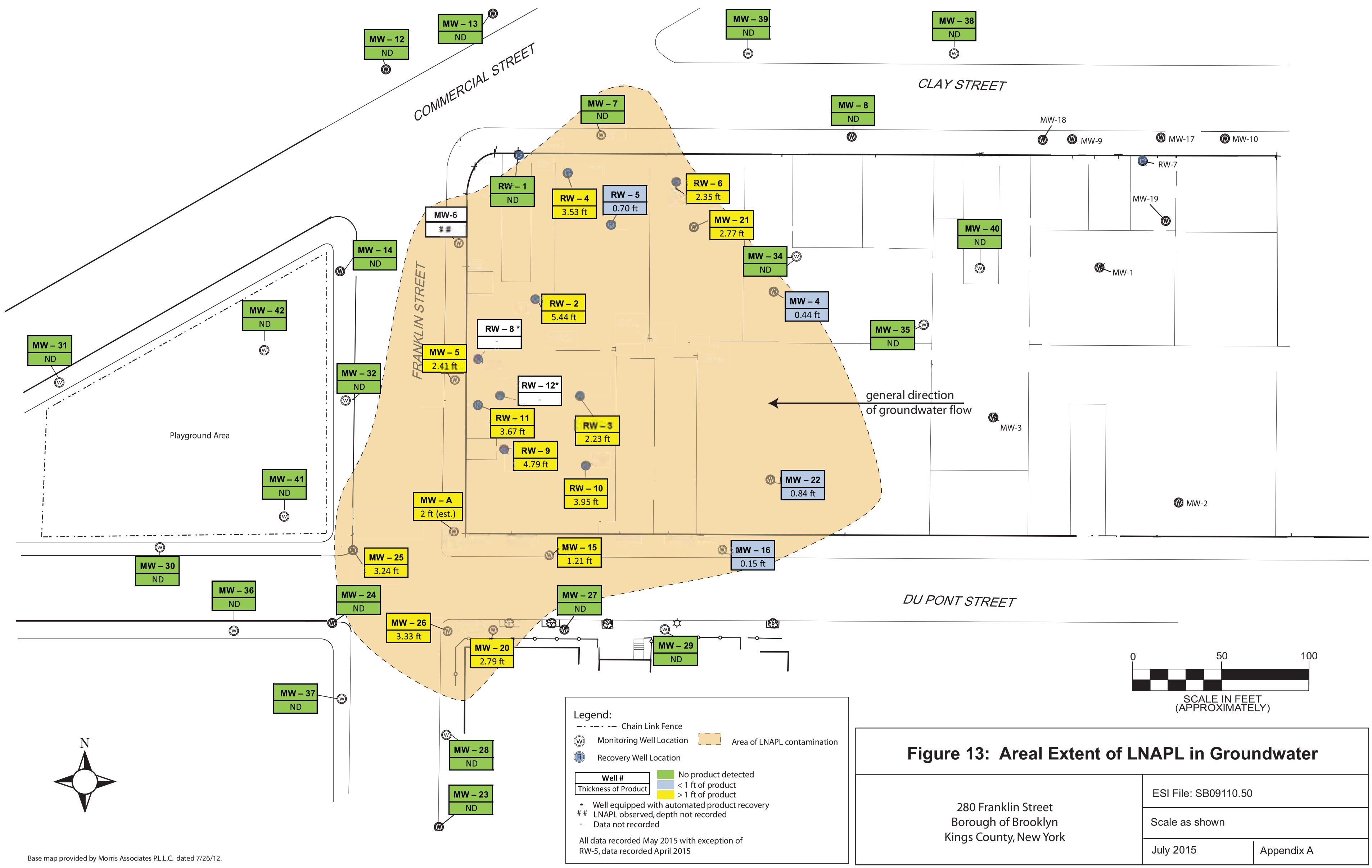
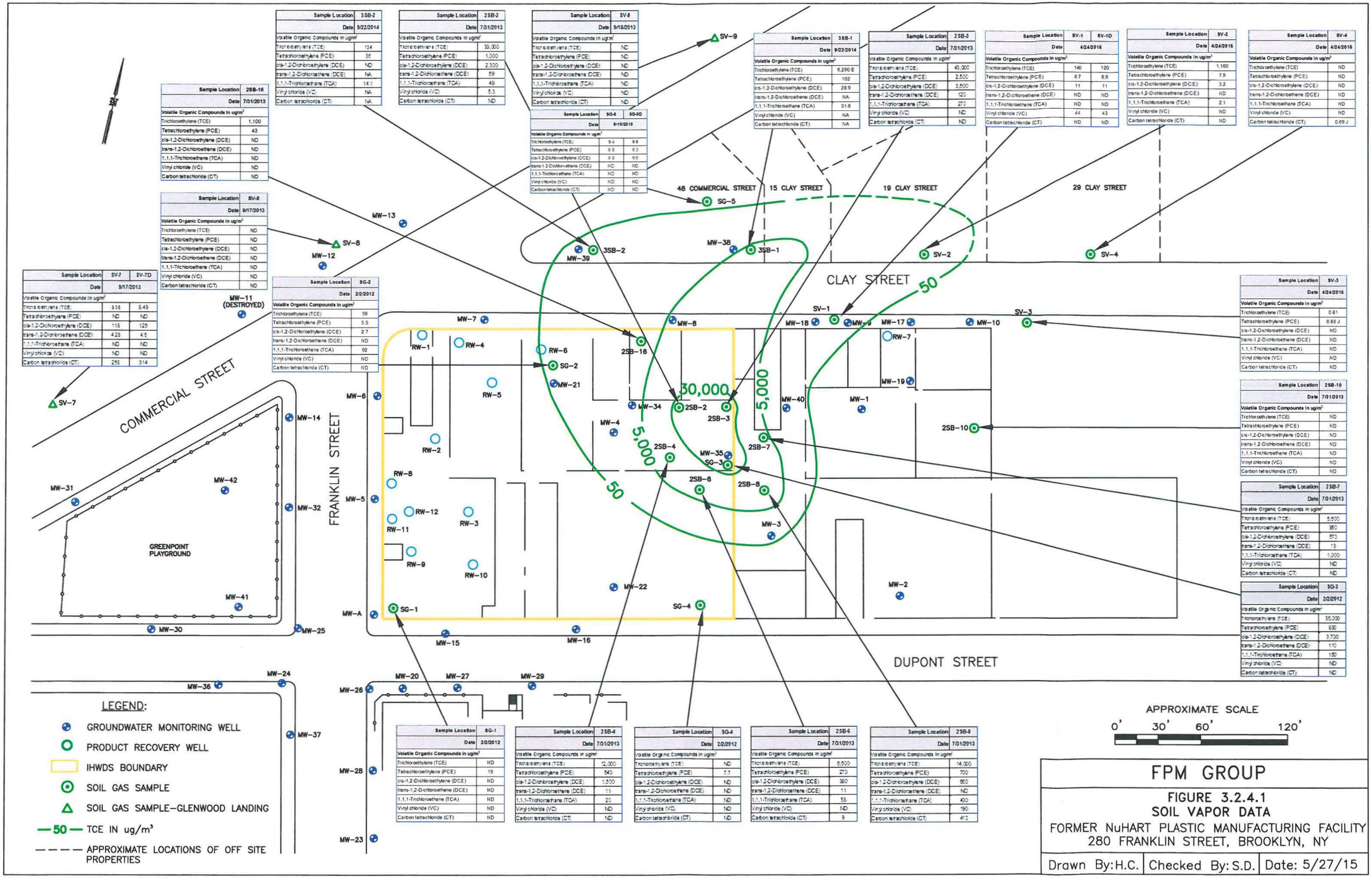


Figure 13: Areal Extent of LNAPL in Groundwater

280 Franklin Street Borough of Brooklyn Kings County, New York	ESI File: SB09110.50
	Scale as shown
	July 2015 / Appendix A



Sample Location	3SB-2
Date	9/22/2014
Volatile Organic Compounds in ug/m³	
Trichloroethylene (TCE)	134
Tetrachloroethylene (PCE)	35
cis-1,2-Dichloroethylene (DCE)	ND
trans-1,2-Dichloroethene (DCE)	NA
1,1,1-Trichloroethane (TCA)	14.1
Vinyl chloride (VC)	NA
Carbon tetrachloride (CT)	NA

Sample Location	2SB-2
Date	7/31/2013
Volatile Organic Compounds in ug/m³	
Trichloroethylene (TCE)	33,000
Tetrachloroethylene (PCE)	1,000
cis-1,2-Dichloroethylene (DCE)	2,300
trans-1,2-Dichloroethene (DCE)	69
1,1,1-Trichloroethane (TCA)	48
Vinyl chloride (VC)	5.3
Carbon tetrachloride (CT)	ND

Sample Location	SV-9
Date	9/18/2013
Volatile Organic Compounds in ug/m³	
Trichloroethylene (TCE)	ND
Tetrachloroethylene (PCE)	ND
cis-1,2-Dichloroethylene (DCE)	ND
trans-1,2-Dichloroethene (DCE)	ND
1,1,1-Trichloroethane (TCA)	ND
Vinyl chloride (VC)	ND
Carbon tetrachloride (CT)	ND

Sample Location	SG-5	SG-5D
Date	6/19/2015	
Volatile Organic Compounds in ug/m³		
Trichloroethylene (TCE)	9.4	9.9
Tetrachloroethylene (PCE)	6.0	6.3
cis-1,2-Dichloroethylene (DCE)	6.0	6.0
trans-1,2-Dichloroethene (DCE)	ND	ND
1,1,1-Trichloroethane (TCA)	ND	ND
Vinyl chloride (VC)	ND	ND
Carbon tetrachloride (CT)	ND	ND

Sample Location	3SB-1
Date	9/22/2014
Volatile Organic Compounds in ug/m³	
Trichloroethylene (TCE)	6,290 E
Tetrachloroethylene (PCE)	102
cis-1,2-Dichloroethylene (DCE)	28.9
trans-1,2-Dichloroethene (DCE)	NA
1,1,1-Trichloroethane (TCA)	31.6
Vinyl chloride (VC)	NA
Carbon tetrachloride (CT)	NA

Sample Location	2SB-3
Date	7/31/2013
Volatile Organic Compounds in ug/m³	
Trichloroethylene (TCE)	43,000
Tetrachloroethylene (PCE)	2,500
cis-1,2-Dichloroethylene (DCE)	3,500
trans-1,2-Dichloroethene (DCE)	120
1,1,1-Trichloroethane (TCA)	270
Vinyl chloride (VC)	ND
Carbon tetrachloride (CT)	ND

Sample Location	SV-1	SV-1D
Date	4/24/2015	
Volatile Organic Compounds in ug/m³		
Trichloroethylene (TCE)	140	120
Tetrachloroethylene (PCE)	8.7	8.9
cis-1,2-Dichloroethylene (DCE)	11	11
trans-1,2-Dichloroethene (DCE)	ND	ND
1,1,1-Trichloroethane (TCA)	ND	ND
Vinyl chloride (VC)	44	43
Carbon tetrachloride (CT)	ND	ND

Sample Location	SV-2
Date	4/24/2015
Volatile Organic Compounds in ug/m³	
Trichloroethylene (TCE)	1,100
Tetrachloroethylene (PCE)	7.9
cis-1,2-Dichloroethylene (DCE)	3.2
trans-1,2-Dichloroethene (DCE)	ND
1,1,1-Trichloroethane (TCA)	2.1
Vinyl chloride (VC)	ND
Carbon tetrachloride (CT)	ND

Sample Location	SV-4
Date	4/24/2015
Volatile Organic Compounds in ug/m³	
Trichloroethylene (TCE)	ND
Tetrachloroethylene (PCE)	ND
cis-1,2-Dichloroethylene (DCE)	ND
trans-1,2-Dichloroethene (DCE)	ND
1,1,1-Trichloroethane (TCA)	ND
Vinyl chloride (VC)	ND
Carbon tetrachloride (CT)	0.69 J

Sample Location	2SB-16
Date	7/31/2013
Volatile Organic Compounds in ug/m³	
Trichloroethylene (TCE)	1,100
Tetrachloroethylene (PCE)	43
cis-1,2-Dichloroethylene (DCE)	ND
trans-1,2-Dichloroethene (DCE)	ND
1,1,1-Trichloroethane (TCA)	ND
Vinyl chloride (VC)	ND
Carbon tetrachloride (CT)	ND

Sample Location	SV-8
Date	9/17/2013
Volatile Organic Compounds in ug/m³	
Trichloroethylene (TCE)	ND
Tetrachloroethylene (PCE)	ND
cis-1,2-Dichloroethylene (DCE)	ND
trans-1,2-Dichloroethene (DCE)	ND
1,1,1-Trichloroethane (TCA)	ND
Vinyl chloride (VC)	ND
Carbon tetrachloride (CT)	ND

Sample Location	SV-7	SV-7D
Date	9/17/2013	
Volatile Organic Compounds in ug/m³		
Trichloroethylene (TCE)	8.38	8.49
Tetrachloroethylene (PCE)	ND	ND
cis-1,2-Dichloroethylene (DCE)	115	125
trans-1,2-Dichloroethene (DCE)	4.28	4.5
1,1,1-Trichloroethane (TCA)	ND	ND
Vinyl chloride (VC)	ND	ND
Carbon tetrachloride (CT)	256	314

Sample Location	SG-2
Date	2/2/2012
Volatile Organic Compounds in ug/m³	
Trichloroethylene (TCE)	59
Tetrachloroethylene (PCE)	5.5
cis-1,2-Dichloroethylene (DCE)	2.7
trans-1,2-Dichloroethene (DCE)	ND
1,1,1-Trichloroethane (TCA)	92
Vinyl chloride (VC)	ND
Carbon tetrachloride (CT)	ND

Sample Location	SV-3
Date	4/24/2015
Volatile Organic Compounds in ug/m³	
Trichloroethylene (TCE)	0.81
Tetrachloroethylene (PCE)	0.88 J
cis-1,2-Dichloroethylene (DCE)	ND
trans-1,2-Dichloroethene (DCE)	ND
1,1,1-Trichloroethane (TCA)	ND
Vinyl chloride (VC)	ND
Carbon tetrachloride (CT)	ND

Sample Location	2SB-10
Date	7/31/2013
Volatile Organic Compounds in ug/m³	
Trichloroethylene (TCE)	ND
Tetrachloroethylene (PCE)	ND
cis-1,2-Dichloroethylene (DCE)	ND
trans-1,2-Dichloroethene (DCE)	ND
1,1,1-Trichloroethane (TCA)	ND
Vinyl chloride (VC)	ND
Carbon tetrachloride (CT)	ND

Sample Location	2SB-7
Date	7/31/2013
Volatile Organic Compounds in ug/m³	
Trichloroethylene (TCE)	5,500
Tetrachloroethylene (PCE)	850
cis-1,2-Dichloroethylene (DCE)	570
trans-1,2-Dichloroethene (DCE)	13
1,1,1-Trichloroethane (TCA)	1,000
Vinyl chloride (VC)	ND
Carbon tetrachloride (CT)	ND

Sample Location	SG-3
Date	2/2/2012
Volatile Organic Compounds in ug/m³	
Trichloroethylene (TCE)	35,000
Tetrachloroethylene (PCE)	830
cis-1,2-Dichloroethylene (DCE)	3,700
trans-1,2-Dichloroethene (DCE)	110
1,1,1-Trichloroethane (TCA)	150
Vinyl chloride (VC)	ND
Carbon tetrachloride (CT)	ND

Sample Location	SG-1
Date	2/2/2012
Volatile Organic Compounds in ug/m³	
Trichloroethylene (TCE)	ND
Tetrachloroethylene (PCE)	19
cis-1,2-Dichloroethylene (DCE)	ND
trans-1,2-Dichloroethene (DCE)	ND
1,1,1-Trichloroethane (TCA)	ND
Vinyl chloride (VC)	ND
Carbon tetrachloride (CT)	ND

Sample Location	2SB-4
Date	7/31/2013
Volatile Organic Compounds in ug/m³	
Trichloroethylene (TCE)	12,000
Tetrachloroethylene (PCE)	540
cis-1,2-Dichloroethylene (DCE)	1,500
trans-1,2-Dichloroethene (DCE)	11
1,1,1-Trichloroethane (TCA)	20
Vinyl chloride (VC)	ND
Carbon tetrachloride (CT)	ND

Sample Location	SG-4
Date	2/2/2012
Volatile Organic Compounds in ug/m³	
Trichloroethylene (TCE)	ND
Tetrachloroethylene (PCE)	7.7
cis-1,2-Dichloroethylene (DCE)	ND
trans-1,2-Dichloroethene (DCE)	ND
1,1,1-Trichloroethane (TCA)	ND
Vinyl chloride (VC)	ND
Carbon tetrachloride (CT)	ND

Sample Location	2SB-6
Date	7/31/2013
Volatile Organic Compounds in ug/m³	
Trichloroethylene (TCE)	6,500
Tetrachloroethylene (PCE)	270
cis-1,2-Dichloroethylene (DCE)	380
trans-1,2-Dichloroethene (DCE)	11
1,1,1-Trichloroethane (TCA)	58
Vinyl chloride (VC)	ND
Carbon tetrachloride (CT)	9

Sample Location	2SB-8
Date	7/31/2013
Volatile Organic Compounds in ug/m³	
Trichloroethylene (TCE)	14,000
Tetrachloroethylene (PCE)	700
cis-1,2-Dichloroethylene (DCE)	550
trans-1,2-Dichloroethene (DCE)	ND
1,1,1-Trichloroethane (TCA)	430
Vinyl chloride (VC)	190
Carbon tetrachloride (CT)	410

FPM GROUP

FIGURE 3.2.4.1
SOIL VAPOR DATA
FORMER NuHART PLASTIC MANUFACTURING FACILITY
280 FRANKLIN STREET, BROOKLYN, NY

Drawn By: H.C. | Checked By: S.D. | Date: 5/27/15

Z:\DUPONT\ADDITIONAL TCE 1134g-15-12\SITE PLA AND SAMP LOC WITH CONTOURS.dwg, 7/30/2015 2:46:27 PM

APPENDIX B

SUPPORTING INVESTIGATION REPORTS
(on CD)

- PRODUCT TESTING REPORT
- TEST PIT REPORT
- SURVEY (BL COMPANIES, OCTOBER 26, 2015)
- NYCDPW MAY 1946 CONTRACT NO. 16 DRAWING
- NYCDEP WATER MAPPING, 3/5/2013
- WATER LEVEL DATA
- LABORATORY REPORTS – PRODUCT TESTING FOR PCBS

FPM group — Engineering and Environmental Science

FPM Group, Ltd.
FPM Engineering Group, P.C.
formerly Fanning, Phillips and Molnar

CORPORATE HEADQUARTERS
909 Marconi Avenue
Ronkonkoma, NY 11779
631/737-6200
Fax 631/737-2410

VIA EMAIL

February 23, 2015

Mr. Bryan Wong
Environmental Engineer
New York State Department of Environmental Conservation
Division of Environmental Remediation, Region 2
47-40 21st Street
Long Island City, NY 11101

Re: **Product Testing Report**
Former NuHart Plastic Manufacturing Site, NYSDEC #224136
280 Franklin Street, Brooklyn, New York
FPM File No. 1134g-15-08

This report has been prepared by FPM Group (FPM) to document the results of product testing conducted at the above-referenced Site in accordance with our September 25, 2014 Product Testing Work Plan (PTWP), approved by the New York State Department of Environmental Conservation (NYSDEC) on September 30, 2014. The purpose of the product testing was to obtain additional data on the properties of the floating phthalate/Hecla oil mixture (product) present at the Site.

The types and purposes of the testing performed under the PTWP are as follows:

- Field testing to assess the integrity of the screens of select recovery wells and the communication of the wells with the surrounding formation;
- Field testing (bail-down testing) to obtain data concerning the product thickness, mobility, and migration rate in the formation under ambient conditions; and
- Laboratory testing to obtain product viscosity data as a function of temperature for use in evaluating remedial alternatives for the product.

As noted in the PTWP, these activities were originally to have been conducted by others as part of a Supplemental Remedial Investigation (SRI) for this Site. However, as these activities were conducted by FPM, which is not contracted to prepare the SRI, these activities are documented in summary form in this report and will be more fully documented in the Feasibility Study (FS) for this Site, the preparation of which is contracted to FPM.

Additional product testing will be performed during the remedial design phase for this Site, as noted in the PTWP. This later phase of product testing is anticipated to include testing of the product recovery rate under pumping conditions, including both groundwater pumping and product pumping. A detailed scope of work for product recovery testing will be provided once the remedial approach is more fully developed and appropriate wells are identified for this testing.

The below-described product testing activities were conducted by FPM in accordance with the requirements and procedures in the existing Remedial Investigation Work Plan (RIWP) and associated documents approved by the NYSDEC for this Site, to the extent applicable. These requirements and procedures included the provisions of the Health and Safety Plan (HASP) and Community Air Monitoring Plan (CAMP). Please note that no exceedances of the CAMP monitoring criteria were noted. CAMP monitoring results will be included in the FS.

Product testing included both field testing and laboratory testing activities to obtain additional information concerning product properties. Field activities and data analysis were performed by experienced FPM personnel with specific training in hydrogeologic testing and analyses and the field testing crew included two experienced personnel. Additional services were provided by Aquifer Drilling & Testing, Inc. (ADT, well pumping) and Xray Locating Service (Xray, downhole camera). All waste was containerized onsite in appropriate containers for offsite disposal by others.

Well Screen Integrity Testing Procedures and Results

Three onsite wells that contain product were assessed to evaluate the integrity of the well screens and their communication with the surrounding formation and fluids. The wells selected for this testing included RW-4, RW-10, and RW-8; the locations of these wells are shown on Figure 11 from the RIR (attached). These wells were selected so as to assess well conditions in several areas of the Site where the product is anticipated to contain variable proportions of phthalates and Hecla oil. Each of these wells also contains a significant apparent thickness of product that has been in contact with the well screen for several years.

To evaluate each well's condition, the well was accessed and the depth to product and the depth to groundwater were measured to the nearest 0.01 foot with an interface probe. All measurements were recorded. Other information noted for each well (as obtained from the boring/well installation logs and confirmed in the field) included the well number, casing and borehole diameters, total well depth, screened interval depths, the annular gravel pack, and the lithology of the screened interval. This information is documented on Table 1.

Each well selected for evaluation was tested as follows: a submersible pump was used to remove product and groundwater from the well and develop sufficient drawdown such that the screen interval where product was noted was exposed. Once sufficient drawdown was achieved, a downhole video camera equipped with a lighting system was used to view the well screen and observe its condition and the flow of groundwater and product through the screen. The video was observed on-screen in the field and pumping and video recording was continued as necessary and feasible to provide definitive data. Specific information assessed during the video work included apparent distortions of the well casing and/or screen, widening or obstruction of the screen slots, potential restriction of groundwater and/or product flow into the well, the apparent interval of product flow into the well, encrustations or growths adhering to the casing or screen, or other conditions that may affect the integrity of the well or well screen, or the flow of fluids into the well. All video and video times were recorded for later review.

Video recording was complicated by the cold ambient weather conditions, which resulted in rapid fogging of the camera lens once the equipment was placed into the wells. The camera lens was also periodically fouled by product and groundwater. These conditions resulted in the need for frequent camera cleaning and shortened the recording times. Upon review of the video recording in the office, it was also noted that the quality of the recording was somewhat less than the quality of the video observed in the field by the FPM representative. The representative's detailed observations based on the video in the field are noted below. Example still shots of each well are included in Attachment A.

Field notes from the well screen integrity testing are included in Attachment A and include information pertaining to the pumping rates, duration of pumping, and other pertinent observations. We note the following observations concerning each well tested:

- <u>RW-4:</u>

The well was confirmed to be constructed of solid PVC casing from grade to 8 feet below grade and a screen from 8 to approximately 18 feet below grade. A static measurement of liquids in the well indicated that the depth to product was 12.12 feet and that 2.15 feet of product were present in the well prior to performing any pumping. The pump was able to draw down liquids in the well approximately five feet, thus leaving approximately one foot of liquid at the bottom of the well. Both the casing and screen intervals were observed to be in good condition; no defects or obstructions were noted that could potentially block the flow of liquids into the well screen. The slotted openings throughout the screen appeared to be in good condition; no corrosion, encrustations, or deformation of the slotted screen was observed. During the drawdown, both product and groundwater were observed to sporadically enter the well, generally throughout the entire length of exposed well screen, although it appeared that the majority of product passed through the well screen at a depth between approximately 13 and 15 feet below grade. Although the influx of groundwater and product was noted to remain steady, the process was visibly slow and the pump was routinely shut down for periods of up to five minutes due to lack of enough liquid in the well. The product removed and observed flowing back into the well was noted to be visibly more viscous than the product noted in wells RW-8 and RW-10.

- <u>RW-10:</u>

The well was confirmed to be constructed of solid PVC casing from grade to 8 feet below grade and a screen from 8 to approximately 18 feet below grade. A static measurement of liquids in the well indicated that the depth to product was 13.16 feet and that 2.04 feet of product were present in the well prior to performing any pumping. The pump was able to draw down liquids in the well approximately three feet, thus leaving approximately two feet of liquid at the bottom of the well. Considerable sand and some sludge globules were observed in the well and tended to periodically clog the pump. Both the casing and screen intervals were observed to be in good condition; no defects or obstructions were noted that could potentially block the flow of liquids into the well screen. The slotted openings throughout the screen appeared to be in good condition; no corrosion, encrustations, or deformation of the slotted screen was observed. During the drawdown, both product and groundwater were observed to enter the well throughout the entire length of exposed well screen. The product removed and observed flowing back into the well was noted to be less viscous than the product noted in well RW-4.

- RW-8:

The well was confirmed to be constructed of solid PVC casing from grade to 8 feet below grade and a screen from 8 to approximately 18 feet below grade. A static measurement of liquids in the well indicated that the depth to product was 13.85 feet and that 2.90 feet of product was present in the well prior to performing any pumping. The pump was able to draw down liquids in the well between two and three feet, thus leaving approximately two feet of liquid at the bottom of the well. Considerable sand and some sludge globules were observed in oil being pumped from the well and tended to periodically clog the pump. Both the casing and screen intervals were observed to be in good condition; no defects or obstructions were noted that could potentially block the flow of liquids into the well screen. The slotted openings throughout the screen appeared to be in good condition; no corrosion, encrustations, or deformation of the slotted screen was observed. During the drawdown, both product and groundwater were observed to enter the well throughout the entire length of exposed well screen. The product removed and observed flowing back into the well was noted to be very similar to the product encountered in well RW-10 and less viscous than the product noted in well RW-4.

In summary, none of the video testing results showed any apparent distortions of the well casings or screens, widening or obstruction of the screen slots, restriction of groundwater or product flow into the wells, encrustations or growths adhering to the casings or screens, or other conditions that may affect the integrity of the wells or well screens, or the flow of fluids into the wells. This information supports the continued use of Schedule 40 PVC well materials at this Site for monitoring or other purposes that do not typically require use of alternate well materials, and also indicates that the data obtained from these wells is anticipated to be valid.

The observed presence of sand at RW-8 and RW-10 suggests that additional measures may be necessary to preclude sand intrusion into future wells. These measures may include reducing the screen slot and/or gravel pack size, more intensive well development, or some combination of these measures.

Bail-Down Testing Procedures and Results

As the video testing did not demonstrate any integrity issues with the wells in contact with product, four wells that contain product were accessed and bail-down tests were performed to obtain data to evaluate the rate of product migration. The wells for bail-down testing (MW-21, RW-10, RW-8, and MW-5) were selected so as to test product in several areas of the Site and in the downgradient offsite area and to have a product apparent thickness of at least one foot based on recent monitoring data. The locations of these wells are shown on Figure 11 from the RIR (attached) and were approved by the NYSDEC.

- Procedures

To evaluate each proposed well's suitability for bail-down testing, the well was accessed and the depth to product and the depth to groundwater measured to the nearest 0.01 foot with an interface probe. Each well was confirmed to have at least one foot of apparent thickness of product. All measurements and times of measurement were recorded and other pertinent information was noted for each well (as obtained/estimated from the boring/well installation log and confirmed in the field), including the casing and borehole diameters, total well depth, screened interval depths, annular gravel pack, and the lithology of the screened interval. This information is documented on Table 1.

Each well selected for bail-down testing was tested as follows:

- A large-diameter bailer that fit snugly inside of the casing was used to remove only product from the well. All removed product was containerized and managed as described below. Product removal was conducted quickly and with no direct disturbance of the underlying groundwater, to the extent feasible. Product was removed sufficiently rapidly so as to result in at least one foot of drawdown in the product within the well;

- Following product removal, measurement of the product recovery began. Measurements of the depth to the top of the product were made to the nearest 0.01 foot with an interface probe during the recovery period at a frequency dependent on the rate of recovery. All measurements and measurement times were recorded and monitoring of recovery was continued until the well recovered significantly. Each selected well was tested at least once, with two wells (RW-10 and MW-21) tested twice;

- The bail-down testing results were field-checked to ensure that sufficient data were obtained and properly recorded. Following testing, the wells were re-secured and the removed product that was not to be used for laboratory testing and the fluids removed during the video work were properly containerized onsite in the designated product and fluid containers. The removed fluids will be properly disposed offsite in accordance with the established product disposal protocols for this Site; and

- The bail-down testing results were tabulated and evaluated as described below to assess product thickness and potential migration rates.

➢ <u>Results</u>

The bail-down testing data are summarized on tables included in Attachment A and were used together with the well and lithologic information to calculate hydraulic conductivity (K) for the product, a key parameter for assessment of product mobility. This parameter was then used together with other hydraulic information (gradient) to estimate the product migration rate.

It should be noted that the measurements of depth to product and depth to groundwater obtained during the bail-down tests may be somewhat affected by the nature of the product, which has a tendency to coat the interface probe sensors and somewhat delay responses. The field personnel regularly cross-checked the measurements and cleaned to probe to reduce the potential for error and/or anomalous readings.

It should also be noted that recovery responses were observed for both fluids (product and groundwater) during the tests, although only product was bailed from the wells. This observation suggests that the product is depressing the water table surface, as is typical, and confirms that water level data from within the product area should not be used for evaluation of the water table elevation unless they are corrected for the effect of the product.

The recovery response of the groundwater beneath the product also affects the measurements of product recovery, and is anticipated to somewhat increase the measured recovery rate of the product surface relative to what would be observed if the groundwater surface remained static. As the K values were calculated using the product recovery data (so as to assess the rate of product movement), we anticipate that the effect of the groundwater recovery somewhat increases the calculated K values for the product.

To make an initial assessment of the product recovery behavior, the product apparent thicknesses were plotted relative to elapsed time, as shown on the graphs included in Attachment A. The following observations were noted from these graphs:

- Each test showed an initial period of relatively rapid recovery of product apparent thickness followed by a generally longer period of slower recovery. The initial recovery period is likely affected by initial inflow of product from the high-permeability wellbore gravel pack and is not representative of flow from the surrounding formation. Therefore, these early data were not considered when calculating K;

- For those tests for which longer-term data are available (RW-10 test 1 and MW-21 test 1), the late-time data suggest that product recovery over the longer term (hour scale) is even slower than over a moderate term (10 to 30-minute scale). For these tests K values have been calculated for both scales; and

- The product apparent thicknesses did not fully recover over the duration of any of the bail-down tests (typically about 30 minutes, although two tests were run for about 2 hours). Generally a recovery of about 20% to 50% was observed. This suggests that the apparent thicknesses of product observed in the wells are affected by effects and processes (interactions with well casing/screen, water table fluctuations) that typically act to increase the apparent thickness in the well relative to what may be present in the formation.

The product recovery data were used to evaluate the K of the formation relative to product. This analysis was performed using the Aqtesolv Pro software (v. 4.01, HydroSOLV, Inc.). The recovery data and appropriate formation and well data were input into the slug test module, checked, and then evaluated using the Dagan solution (1978), which is a straight-line solution appropriate for partially-penetrating wells screened across the water table in an unconfined aquifer. In each case the early recovery data were omitted from the analysis by using the manual line-fitting method, as shown on the well test analysis graphs in Attachment A. K values were determined for each bail-down test and are summarized on Table 2. As noted above, for those tests with late-time data two K values were calculated; however, for consistency and to be conservative, only the moderate-term data were used in the subsequent calculations. The calculated K values for the product range from 1.099×10^{-6} to 8.991×10^{-5} feet/minute (ft/min).

Sensitivity analyses were performed to assess the impact of the input formation and well data values on the calculated K values. In the case of these tests, nearly all of the well and formation values are reasonably well known, with the exception of the aquifer anisotropy ratio (ratio of vertical to horizontal hydraulic conductivity). The initial solutions utilized a typical aquifer anisotropy ratio of 0.1 (Todd, 1980). However, as the formation at the Site contains a significant amount of silt, a lower anisotropy ratio may be more appropriate. Additional solutions were calculated using an anisotropy ratio of 0.01 and demonstrated little change in the calculated K values (see Table 2). None of the other values are anticipated to vary significantly from the values used during the analysis and, therefore, further sensitivity testing was not conducted.

Once the K values had been calculated, they were integrated with groundwater gradient (i) values calculated from the water table contours previously presented in the Remedial Investigation Report (see Figure 10, attached) to calculate the potential flow rate of the product under existing aquifer conditions. The i values calculated from Figure 10 range from 0.002 to 0.004. Using these i values and the range of K values (moderate-term data only) shown in Table 2, we calculate a product flow rate of between 2.2×10^{-9} and 3.6×10^{-7} ft/min. Converting these values to feet per year results in calculated product flow rates of between 0.0012 and 0.18 feet/year, which indicates that the product is essentially immobile.

It should be noted, as discussed above, that the calculated K values for the product include the effect of the water table recovery and, therefore, may be somewhat higher than actual K values for the product alone. This further supports our conclusion that the product is essentially immobile.

➢ Discussion

The above-described calculated flow rate values were assessed relative to the presumed source(s) and known information concerning former Site operations and the extent of the product. We note that the subject property was used for plastic manufacturing from about 1950 until 2004. Although the date of tank installation is not known, presumably, the tanks, piping, and associated infrastructure were onsite since about 1950 as they were an integral part of the plastic manufacturing operations. The tanks, piping, and associated trench system were cleaned and closed in mid-2006. Based on this information, the releases that resulted in the presence of the product on the water table could have occurred during the 1950 to 2006 interval. Based on the apparent volume and extent of the product (including its extent in 2006) and its variable composition, it is likely that the releases occurred from multiple sources and were ongoing for a number of years.

We also note that the initial subsurface investigation of the property, conducted in late 2006 by ASR, included installation of many of the wells located onsite, in the surrounding sidewalks, and offsite to the northwest. At that time product (as indicated by free-phase NAPL, highly-contaminated soil at the water table, and/or elevated dissolved levels) was documented to be present beneath much of the western portion of the Site and extended downgradient to offsite wells MW-5 through MW-7, MW-15 and MW-16, but not to offsite wells MW-11 through MW-14 (none of the other offsite wells had been installed at this time). This information indicates that by late 2006, when the tanks and other potential sources of the releases were closed, the product was already present beneath much of the Site and had moved somewhat offsite, which suggests that the releases likely began early during the property's history of plastic manufacturing and were likely ongoing for a number of years.

Additional wells have been added on several occasions and product monitoring and recovery have been ongoing since 2006. The available data were reviewed and it was noted that all wells that now contain product have contained product (or significant indications of product) since their installation. Wells that did not contain product (or exhibit significant indications of product) at the time of their installation still do not contain product. These observations suggest that there has been no apparent change in the configuration of the product plume since at least

2006, which is consistent with the calculated negligible product migration rate and with the closure of the tanks, piping system, and associated infrastructure in 2006 (thereby eliminating the release sources).

The extent of the onsite product and the variable nature of its composition (see discussions above and below) suggest that the product likely originated from several onsite releases. The majority of the tanks from which the releases may have occurred are located in the southwestern portion of the Site. This area is approximately 100 feet upgradient of the apparent location of the leading edge of the product at present (see Figure 11, attached). A simple arithmetic calculation using this information would suggest a product migration rate of between 1.7 feet per year (if the releases started in 1955) and about 3 feet a year (if the releases did not start until after the facility had been operating for a couple of decades). However, it should be recognized that initial product migration, particularly while a release is ongoing, is generally faster than later migration due to a number of factors, including driving forces during the release associated with continuous vertical columns of product extending from the release site to the water table surface, initial lateral expansion of the product mound(s) under gravitational forces, and the likely lower viscosity of the released product before subsurface weathering processes further increased its viscosity. These factors typically result in an initial product migration rate that is higher than the migration rate that is observed later in the life of a product plume, after the release source is ended, the product has finished spreading out under gravitational forces, and the viscosity has increased due to weathering. Therefore, a sample arithmetic calculation of the product migration rate based on the locations of the apparent source(s) of the releases and the current downgradient edge of the product will not accurately represent the product's current migration rate under the forces that presently act on the product.

It was noted that product did re-accumulate in the wells during both the well screen integrity testing and the bail-down testing. As indicated by the bail-down testing observations, it is likely that at least some of this product migrated into the wells from the surrounding formation. It has been suggested that this re-accumulation indicates that the product is more readily mobile under in-situ conditions than the calculations from the bail-down tests would suggest. However, we note that during both types of testing the fluid levels in the wells were drawn down to generally 2 to 5 feet below their static levels and recovery was very slow. This results in a very steep gradient (high i value) in proximity to the wellbore during much of each test. The fluid volumes removed during the well screen integrity testing were about 30 gallons; using the range of drawdown values we estimate that these fluids likely originated from within 1 to 2 feet of the well. Based on these distances and the observed drawdowns, we estimate that the induced i values in proximity to the wells during testing may reasonably have ranged from 1 to 5. Using these induced i values, the calculated product velocity in proximity to the wellbores during testing ranges from 0.6 to 236 feet per year. Thus, while we would agree that under high induced gradients the product may move more rapidly, the actual gradient under in-situ conditions in the formation (which is what presently drives the movement of product) is very low and, therefore, the calculated product migration rate under in-situ conditions is very low.

Laboratory Viscosity Testing Procedures and Results

During the field testing program samples of the product from each of the four selected wells, including offsite downgradient well MW-5 and onsite wells RW-8, RW-10, and MW-21, were retained for laboratory testing for viscosity. Testing was performed by Texas Oil Tech

Laboratories, Inc. of Houston, TX, an established oil testing laboratory. The sample quantities and management were in accordance with the laboratory's requirements for product samples.

The samples were analyzed for kinematic viscosity over a range of temperatures, starting from the in-situ ground temperature (estimated at 55 degrees F) and proceeding in 10 degree F increments up to 125 degrees F. Based on our experiences and literature review of thermal treatment projects, we anticipate that this temperature range may reasonably be anticipated to occur during remediation via thermal treatment. The laboratory reported the viscosity result at each temperature increment for each sample, as noted in the laboratory report included in Attachment B. These results are summarized in Table 3 (attached); the highlighted values are representative of the kinematic viscosity of the product at the in-situ formation temperature.

To facilitate a comparison to published viscosity values, the kinematic viscosity laboratory data were converted to calculated dynamic viscosity values using an average of published values of product and Hecla oil density, as shown on Table 4. Hecla oil is reported to have a density of 0.92 kg/m^3 at a temperature of about 60 degrees F and phthalates are reported to have densities ranging from about 0.96 to about 0.99 kg/m^3 at temperatures of about 68 degrees F (the lowest temperature for which phthalate density data were identified). We used an average density value of 0.96 kg/m^3 for the product, which is at the low end of the phthalate density range and results in a lower (more conservative) calculated dynamic viscosity. The equation used was:

$$\text{kinematic viscosity } (mm^2/s) \text{ X density } (kg/m^3) = \text{dynamic viscosity (mPa s)}$$

In general, these data indicate that the in-situ product kinematic viscosity under ambient conditions (about 55 degrees F) ranges from 28.25 mm^2/s (or centiStokes) at onsite well MW-21 to 273.69 centiStokes at onsite well RW-8. At offsite well MW-5 the kinematic viscosity of the in-situ product was measured at 192.48 centiStokes. As the density of the product appears to be very close to 1, the calculated dynamic viscosity values for the in-situ conditions are similar, ranging from 27.12 to 262.74 mPa s (or centiPoise). These data indicate that the in-situ product is highly viscous. For comparison, the viscosity of water under in-situ conditions in the formation is about 1 centiStoke or centiPoise; in this case the in-situ product viscosity generally ranges between that of vegetable oil and maple syrup. The highly-viscous nature of this product is consistent with the calculated K values (discussed above) and with the calculated low flow rate of the product.

Published information concerning the viscosity of phthalates (including the phthalate products reported to have been formerly used onsite) and Hecla oils (which are presently manufactured by ExxonMobil Oil Corporation), was obtained via a literature search. These data are summarized on Table 4 (attached) together with published viscosity values for water, for reference. Values within the range of natural in-situ formation temperatures and temperatures that might be obtained during thermal treatment are indicated by shading. These data indicate that the viscosity of phthalate products is significantly higher than the viscosity of the groundwater on which the product is present and the viscosity of the Hecla oil is even higher than that of phthalates. Specifically, the published viscosity values for phthalate products at temperatures near the natural in-situ formation temperature (up to 77 degrees F) range from 55 to 80 centiPoise. Hecla oil viscosity is reported to range from 680 to 1,000 centiStokes at 104 degrees F (the lowest temperature for which data could be located).

A comparison of the viscosity data for the in-situ product versus published information indicates that, in general, the in-situ product viscosities for the product on the western side of the Site (RW-8 and RW-10) and offsite downgradient (MW-5) are higher than the published values for phthalates, but lower than the values for Hecla oil. These data suggest that the product in this area consists of a mixture of phthalates and Hecla oil, which is consistent with the locations of former underground storage tanks (USTs) in which these products were stored (see Figure 4, attached). The in-situ viscosity values may also be affected by weathering processes, which typically increase the viscosity of in-situ product relative to its original viscosity.

The viscosity data for the onsite well located in a more upgradient position (MW-21) indicate a somewhat lower viscosity than the published values for phthalates, but well above the viscosity of water. This well is located away from the USTs in which Hecla oil was formerly stored and is closest to UST #16, which was formerly used to store unspecified "plasticizer". It is possible that the material formerly stored in UST #16 was somewhat different than the other plasticizers reported to have been used onsite. We note that this well is located in an upgradient position on the Site and not in an area where the product is likely to migrate offsite.

The March 31, 2010 report from Friedman & Bruya, Inc. (Attachment B) was reviewed to assess the recently-obtained viscosity data relative to previous product "fingerprint" testing data. The previous testing was conducted on samples from wells RW-12 and MW-4 and the results indicated that the product in both wells contained compounds consistent with phthalates, and that the sample from RW-12 (near the western side of the Site, in proximity to the RW-8 and MW-5 wells) also contained compounds consistent with a high boiling-point paraffinic oil. This information is consistent with the locations of these wells relative to the former USTs (see Figures 11 and 4, attached). RW-12 is located in proximity to USTs where both phthalates and Hecla oil were stored and well MW-4 is located near the center of the Site (and near MW-21) in an area where USTs formerly containing phthalates are the closest USTs. Thus, the previous 'fingerprint' data are consistent with the viscosity data, all of which indicate that the product near the western portion of the Site and offsite downgradient of this area is consistent with a mixture of phthalates and Hecla oil, while the product in the more upgradient portion of the Site is consistent with phthalates and does not appear to have a petroleum component.

As noted above, laboratory testing was performed, in part, to obtain product viscosity data as a function of temperature for use in evaluating remedial alternatives for the product, particularly thermal treatment options. At present, we note that the testing data shows that product viscosity does decrease with increasing temperature, but that significant reductions in product viscosity are not achieved until higher temperatures (generally over 100 degrees F) are obtained. In all cases, the product viscosity remains significantly above that of water. These data will be evaluated more fully in the FS for this Site.

Very truly yours,

Stephanie O. Davis, CPG
Senior Project Manager
Vice President

Attachments

U:\Rigano LLC\49 Dupont Brooklyn\Product testing\ProductTestingReportrev.docx

Ecosystems Strategies, Inc.

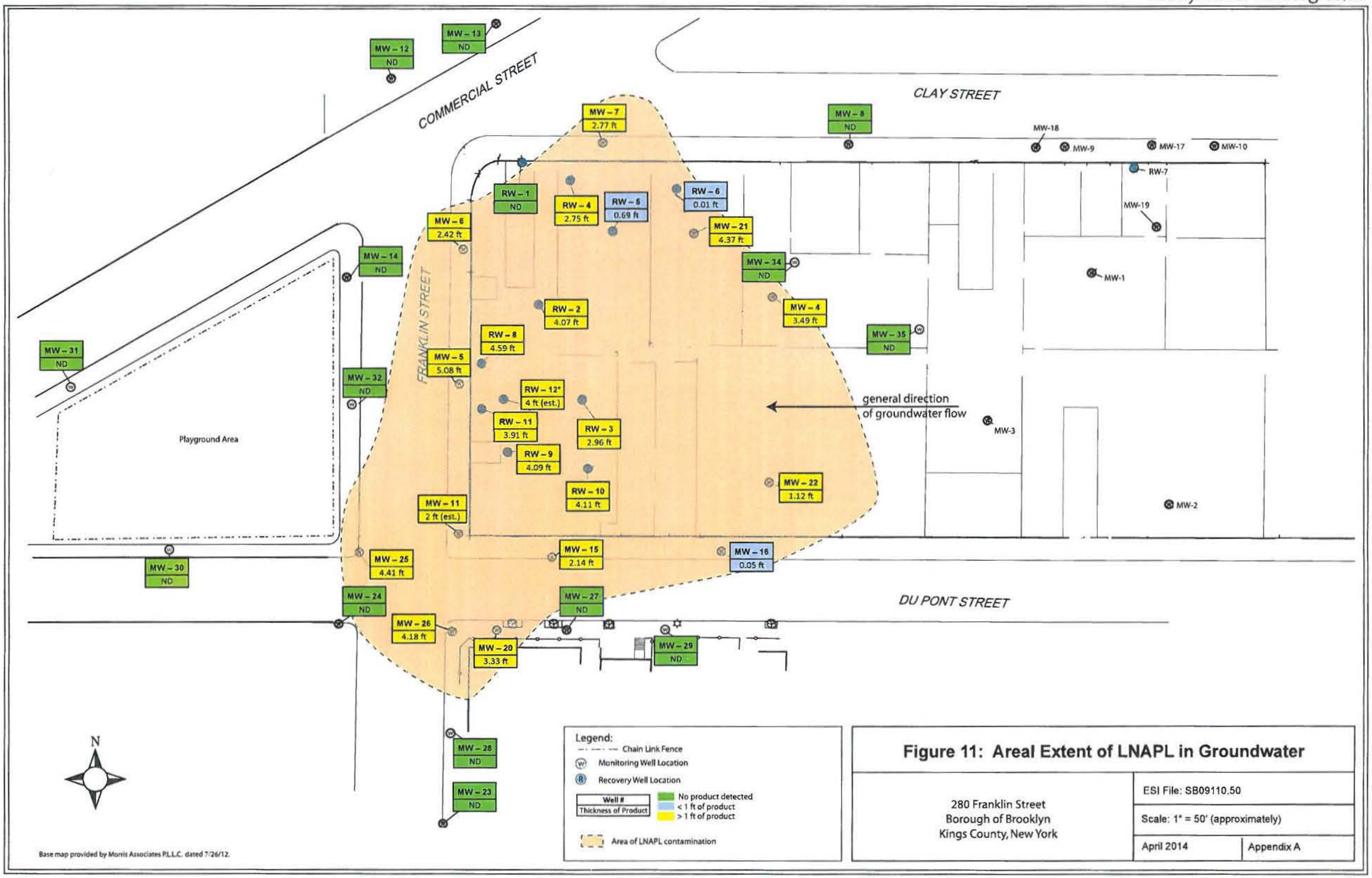
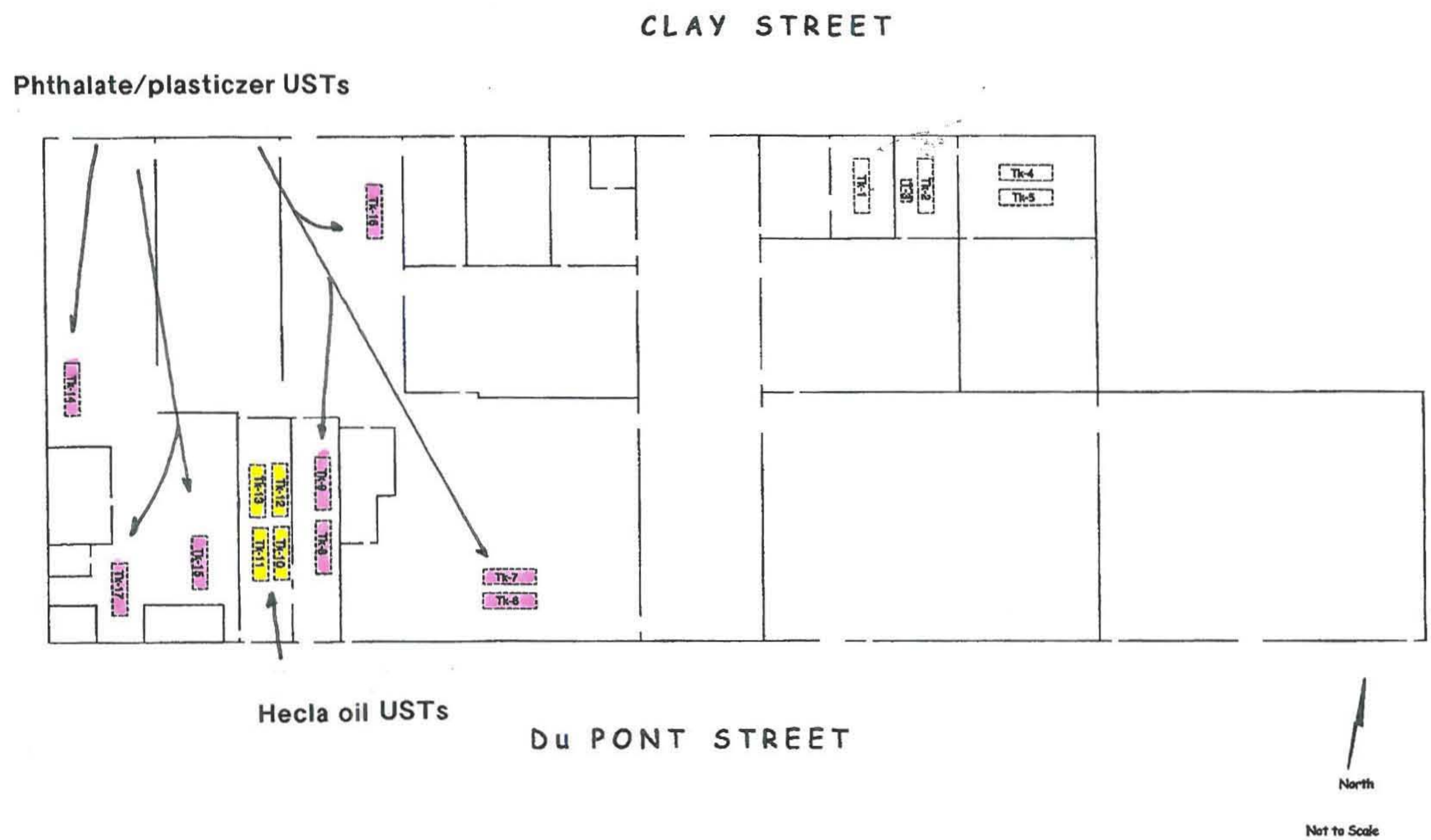


Figure 11: Areal Extent of LNAPL in Groundwater

280 Franklin Street Borough of Brooklyn Kings County, New York	ESI File: SB09110.50
	Scale: 1" = 50' (approximately)
	April 2014 — Appendix A



ASR

ADVANCED Site Restoration, LLC.
Environmental Services

62 William St., 3rd Floor, New York, NY 10005
Tel: 212-809-1110 Fax: 212-809-1779 info@askasr.com

Figure - 4
UST Location Map

SWM

Rev: 06/20/06

NuHart & Company, Inc.
49 - 55 Dupont Street
Brooklyn, New York

Ecosystems Strategies, Inc.

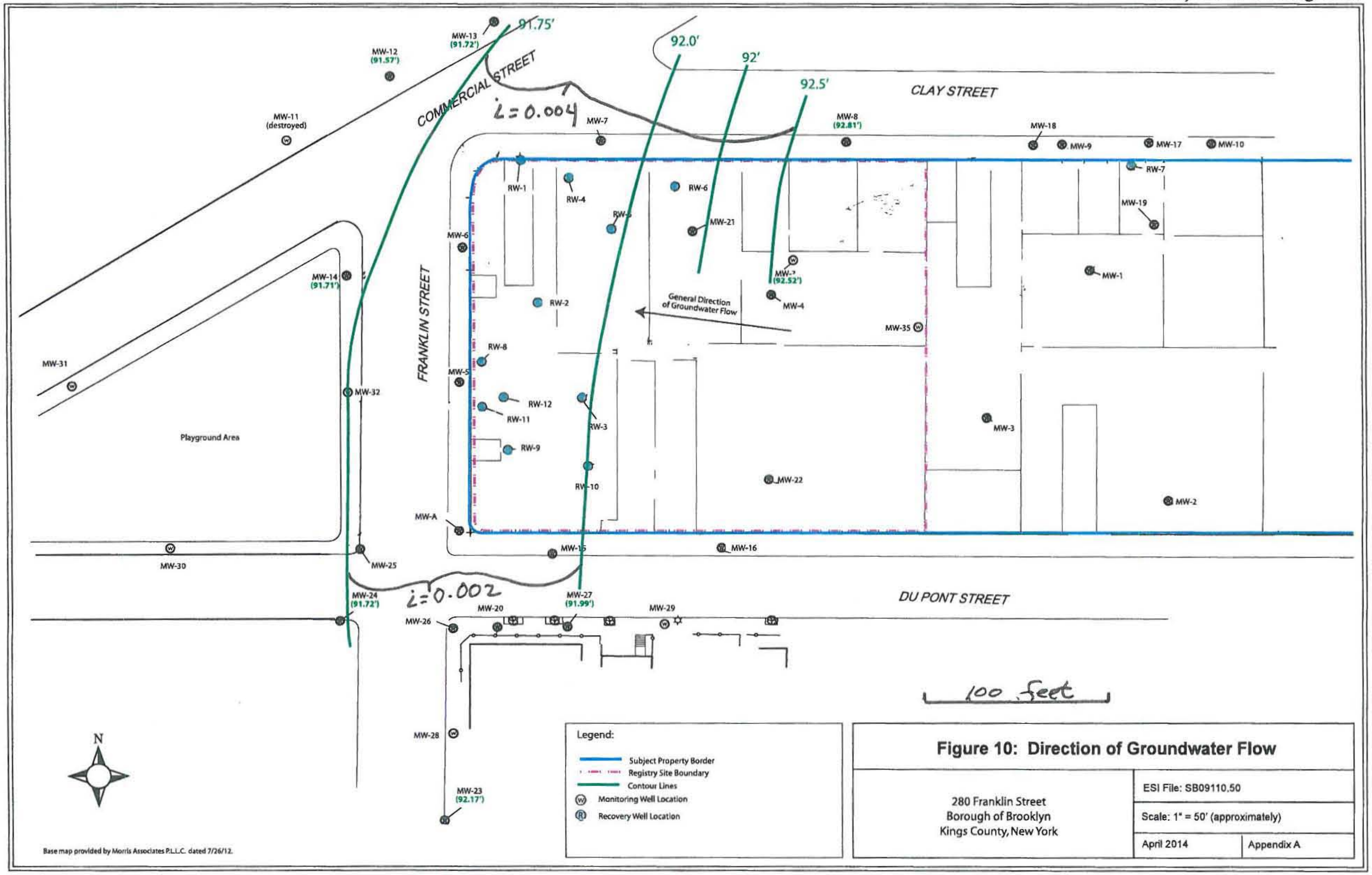


Figure 10: Direction of Groundwater Flow

280 Franklin Street
Borough of Brooklyn
Kings County, New York

ESI File: SB09110.50

Scale: 1" = 50' (approximately)

April 2014 | Appendix A

TABLE 1
WELL CONSTRUCTION, WATER AND PRODUCT DEPTHS
280 FRANKLIN STREET, BROOKLYN, NEW YORK

Well No	Screen Interval (ft bgs)	Screen Interval (ft from TOC)	Screen Length (ft)	Screen Diameter (inches)	Slot Size (inches)	Borehole Diameter (inches)	Screen Interval Lithology	Date	Depth to Product (ft)	Depth to Water (ft)
MW-5	8 to 18	8 to 18	10	2	0.01**	8***	sand/silt*	1/21/15	9.84	13.84
MW-21	5 to 20	5 to 20	15	2	0.01	8	silt/clay/sand	1/21/15	11.64	15.10
RW-4	8 to 18	8 to 18	10	4	0.01**	8***	silt/clay/sand*	1/20/15	12.12	14.27
RW-8	8 to 18	8 to 18	10	4	0.01**	8***	sand/silt*	1/20/15	13.85	16.75
RW-10	8 to 18	8 to 18	10	4	0.01**	8***	sand/gravel/silt*	1/20/15	13.16	15.20

Notes:

*A boring log for the well was not available, therefore lithology is derived from the nearest well.
**A boring log for the well was not provided; slot size is based on well video observations.
***A boring log for the well was not provided; borehole diameter is assumed based on installation specs from nearby wells.

TABLE 2
HYDRAULIC CONDUCTIVITY VALUES
280 FRANKLIN STREET, BROOKLYN, NEW YORK

Well No.	K, assuming $K_V/K_H = 0.1$	K, assuming $K_V/K_H = 0.01$
MW-5	1.099×10^{-6} ft/min	1.118×10^{-6} ft/min
RW-8	2.724×10^{-5} ft/min	3.935×10^{-5} ft/min
RW-10:		
Test 1 (10 to 30-minute interval)	3.474×10^{-5} ft/min	3.474×10^{-5} ft/min
Test 1 (hour scale)	6.386×10^{-6} ft/min	
Test 2	2.223×10^{-6} ft/min	1.104×10^{-6} ft/min
MW-21:		
Test 1 (10 to 30-minute interval)	1.674×10^{-5} ft/min	1.654×10^{-5} ft/min
Test 1 (hour scale)	7.562×10^{-6} ft/min	
Test 2	8.75×10^{-5} ft/min	8.991×10^{-5} ft/min

TABLE 3
SITE-SPECIFIC PRODUCT VISCOSITY VALUES
280 FRANKLIN STREET, BROOKLYN, NEW YORK

Well Number	Temperature		Kinematic Viscosity (lab data)	Dynamic (Absolute) Viscosity (calculated)
	degrees F	degrees C	centiStokes or mm^2/s	centiPoise, or mPa s
MW-5	55	13	192.48	184.78
	65	18	132.35	127.06
	75	24	92.74	89.03
	85	29	67.06	64.38
	95	35	50.42	48.40
	105	41	36.74	35.27
	115	46	30.27	29.06
	125	52	23.85	22.90
RW-8	55	13	273.69	262.74
	65	18	182.54	175.24
	75	24	126.04	121.00
	85	29	89.88	86.28
	95	35	65.53	62.91
	105	41	49.59	47.61
	115	46	38.28	36.75
	125	52	29.95	28.75
RW-10	55	13	125.44	120.42
	65	18	96.39	92.53
	75	24	69.25	66.48
	85	29	48.77	46.82
	95	35	37.72	36.21
	105	41	29.07	27.91
	115	46	22.79	21.88
	125	52	18.51	17.77
MW-21	55	13	28.25	27.12
	65	18	21.86	20.99
	75	24	17.36	16.67
	85	29	13.96	13.40
	95	35	11.44	10.98
	105	41	9.62	9.24
	115	46	7.99	7.67
	125	52	7.05	6.77

Shaded values are within the range of natural formation temperatures for this Site.
Product samples obtained January 21, 2015, tested at Texas Oil Tech Laboratories, Inc.
Kinematic viscosity values are from lab tests.
Dynamic viscosity values were calculated from kinematic viscosity values assuming a product density of 0.96 kg/m^3.

TABLE 4
PUBLISHED DENSITY AND VISCOSITY VALUES

Product	Temperature		Density	Kinematic Viscosity	Dynamic (Absolute) Viscosity
	degrees F	degrees C	kg/m^3	centiStokes or mm^2/s	centiPoise, or mPa s
Dioctyl phthalate (DOP)	68	20	0.99	-	-
	77	25	0.99	-	54.76
	81	27	0.98	-	-
	95	35	-	-	32.06
	113	45	-	-	20.22
	131	55	-	-	13.52
	149	65	-	-	9.35
	167	75	-	-	6.89
	187	86	-	-	5.12
Diundecyl phthalate (DUP)	68	20	0.96	-	70
	77	25	0.95	-	50
Diisononyl phthalate (DINP)	32	0	-	-	345
	68	20	0.97	97	79-80
	81	27	0.97	-	-
	104	40	-	-	28
Extra Hecla Super Cylinder Oil	61	16	0.92	-	-
	104	40	-	680	-
	212	100	-	35.8	-
Extra Hecla Super Cylinder Oil (mineral)	59	15	0.92	-	-
	104	40	-	1,000	-
	212	100	-	42	-
Water (for reference)	50	10	1	1.307	1.307
	68	20	1	1.004	1.002

Shaded values are within the range of natural formation and reasonable thermal treatment temperatures.

ATTACHMENT A

- VIDEO STILL SHOTS
- FIELD NOTES
- BAIL-DOWN TEST DATA
- PRODUCT APPARENT THICKNESS GRAPHS
- WELL TEST ANALYSES

FPM

RW-4

Product entering well after well is pumped down.

RW-8

Product entering well after well is pumped down. The joint between the solid casing and screen is visible. It should be noted that much of the product visible on the lower and right portions of the photo is running off of the pump which has just been pulled from the well, and is not representative of what is entering the screen.

RW-10

Product entering well after well is pumped down.

280 Franklin St 1/20/15

Pump Tests on wells RW-10, RW-8, and RW-4.

ADT performing pump tests using 0.5 polyethylene tubing connected to Monsoon stainless steel 12V pump.

XRay Locating Services performing downhole video recording of well interiors.

1/20/15

RW-10

Baseline DTP: 13.16
DTW: 15.20

Pump set at ~ 16.0' below grade (2' above base of well). Video camera inserted to view casing and screen.
Pump operated at approximately 2.5 gallons per minute.

Time Elapsed (min)	Depth to Liquids (ft)	Notes
0:00	13.16	pump started
0:01	~15'	
0:02	~15.5	
0:03	~16.0	pump lowered to 17'
0:04	~16.0	
0:05	~16.5	pump clogged with sand, halted for 2 min to clean out.
0:07	~15	pump restarted
0:10	~16.5	
		pump clogged, cleanout of pump repeated

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RW-10

Time Elapsed	Depth to Liquid	Notes
0:13	~14.5	Pump restarted
0:15	~15.5	
0:17	~16.0	
0:20	~16.5	pump sputtering sporadically ~2.0 gal per min
0:25	~16.0	~2.5 to 3.0 gal per min
0:30	~16.5	pump sputtering due to low volume in well & sand

Liquids removed included acombination of water and product. Liquids containerized for disposal. Product viscosity similar to warm maple syrup.
Although camera lens was repeated blocked by product getting on lens and issues with the lens fogging up, the lens was removed numerous times and cleaned and the entire screen from 8' to

RW-10

~17.0 was observed. Screen noted to be in excellent shape. No blockages or deformaties were observed. Both product and water were observed to flow freely through the screen. Product and water appeared to alternate sporadically through screen.

Beyond 0:30 pump was run intermittent due to constant clogging and stoppages in an effort to depress liquids and record video of product and water flow.
Recharge rate appeared to be quick, constant flow observed.

Pump shut down and removed after approx. one hr. and left to recover.

Time after shutdown of pump	DTP	DTW
0:10	13.26	14.80
0:20	13.20	14.97
0:30	13.18	15.10

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RW-8 pumptest

Baseline DTP: 13.85
DTW: 16.75

TIME	Depth to Liquid	Notes
0:00		Pump inserted to a depth of ~ 16.5' and operated at ~2.5 to 3.0 gal/min
0:02	~15.5	Immediate significant drawdown noted. Camera inserted
0:05	~16.5	Pump intermitently clogging. Pulled from well and cleaned when necessary. Camera lens routinely fouled by product and/or fogging. Lens cleaned as necessary.
0:10	~17.0	Pump flow at 3 gal/min Product visocity slightly greater than RW-10 but close to same material. Well screen viewed from 8' to ~ 17' and observed to be in very good condition. No growths, fouling, obstructions or damage noted. Product and water observed to

RW-8 pumptest

TIME	Depth to Liquids	Notes
		flow freely through screen and into well. Unclear to view whether water and/or product is flowing through screen below 15.5' due to liquids flowing from above but it appears that both product and water are flowing through entire screen interval sporadically.
0:15	~16.5	Pump clogging due to presence of sand/silt in pump. Rate = ~2gal/min
0:20 to 0:30	~16.5	Camera routinely cleaned to attempt to get better video. Monitor clearly shows good flow into well and a decent recharge rate

Additional attempts made by ADT and XRAY to depress water table and acquire additional video footage.

280 Franklin 1/20/15

RW-8

Pump Shutdown and well allowed to equillibrate.

Time Elapsed after shutdown:	DTP	DTW
0:10 (min)	14.05	15.20
0:20	13.99	15.35
0:30	13.94	15.95
1:00	13.90	16.43

Approximately 30 total gallons of water and product removed from well.

1/20/15

RW-4 pump test

Baseline DTP: 12.12
DTW: 14.27

TIME	Depth to Liquid	Notes
0:00		Pump inserted to 16'. Flow 3.0 gal/min
0:05	~16'	Significant immediate drawdown noted
[Camera inserted]		although pump routinely clogs due to heavier product. Higher viscosity noted when compared to RW-10 and RW-8. Material more consistent with warm molasses.
0:10	~17'	Video observed to show blobs of thicker product oozing throughout well screen between 8' and at least 15'. Water intermittently entering screen with product. Recharge rate noted to be much slower than RW-8 and RW-10.

Z 80 Franklin 1/20/15

RW-4

TIME	Depth to Liquid	Notes
0:15	~17'	Screen observed to be in excellent condition, no damage, blockages, fouling, growths noted. Camera easily fouled due to thickness and stickyness of product.
0:15 to ~0:40		Pump and camera repeatedly removed and cleaned. Water and product were observed to continually filter back into well through entire length of screen however process observed to be sign. slower than at RW-8 and RW-10.
		Total of ~20 gallons of water and product removed from well.
		Pump shut down to monitor recovery.

Z80 Franklin

RW-4

TIME (post-shutdown)	DTP	DTW
0:10	13.70	14.01
0:20	13.01	13.95
0:35	12.51	13.93
1:00	12.20	13.88

MW-5

	Time Elapsed	DTP	Product Displacement (ft)	DTW	Ap Thickness
Baseline		9.84		13.84	4.00
5 gal product removed	0:00				
TD = 17.11	0:01	9.97	0.13	10.20	0.23
	0:03	9.96	0.12	10.22	0.26
	0:04	9.96	0.12	10.22	0.26
	0:06	9.96	0.12	10.63	0.67
	0:08	9.96	0.12	10.30	0.34
	0:11	9.97	0.13	10.29	0.32
	0:13	9.97	0.13	10.31	0.34
	0:15	9.97	0.13	10.33	0.36
	0:17	9.97	0.13	10.32	0.35
	0:20	9.97	0.13	10.33	0.36

RW-8

	Time Elapsed	DTP	Product Displacement (ft)	DTW	Ap Thickness (ft)
Baseline		13.85		16.75	2.90
6 gal product removed	0:00				
TD = 17.0	0:01	14.62	0.77	15.10	0.48
	0:03	14.12	0.27	15.30	1.18
	0:04	14.10	0.25	15.30	1.20
	0:06	14.00	0.15	15.32	1.32
	0:08	13.97	0.12	15.35	1.38
	0:10	13.97	0.12	15.35	1.38
	0:12	13.96	0.11	15.36	1.40
	0:14	13.96	0.11	15.36	1.40
	0:16	13.96	0.11	15.37	1.41
	0:18	13.95	0.10	15.37	1.42
	0:20	13.95	0.10	15.37	1.42

RW-10 Test 1

	Time Elapsed	DTP		DTW	Ap Thickness (ft)
Baseline		13.11		17.40	4.29
5 gal product removed	0:00				
TD = 17.2	0:01	13.30	0.19	13.90	0.60
	0:02	13.29	0.18	14.25	0.96
	0:03	13.25	0.14	15.06	1.81
	0:04	13.20	0.09	14.25	1.05
	0:05	13.20	0.09	13.90	0.70
	0:06	13.22	0.11	14.30	1.08
	0:07	13.20	0.09	15.00	1.80
	0:08	13.19	0.08	15.02	1.83
	0:10	13.18	0.07	14.99	1.81
	0:12	13.18	0.07	14.90	1.72
	0:14	13.17	0.06	14.70	1.53
	0:18	13.17	0.06	14.55	1.38
	0:20	13.17	0.06	14.50	1.33
	0:25	13.16	0.05	14.48	1.32
	0:30	13.16	0.05	14.47	1.31
	1:47	13.16	0.05	15.20	2.04

RW-10 Test 2

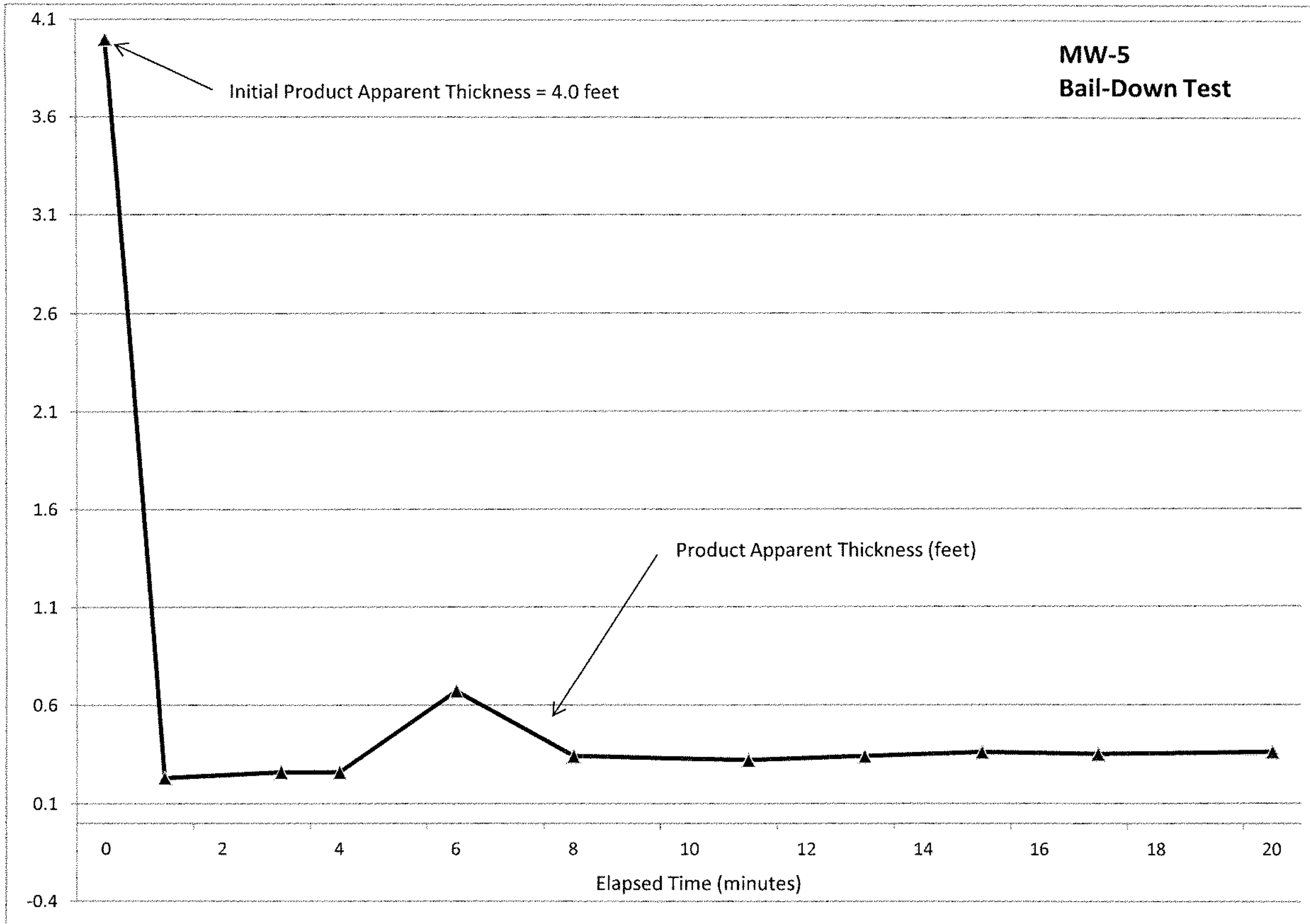
	Time Elapsed	DTP	Product Displacement (ft)	DTW	Ap Thickness (ft)
		13.16		15.20	2.04
6 gal product removed	0:00				
	0:01	13.23	0.07	13.50	0.27
	0:02	13.19	0.03	13.46	0.27
	0:03	13.20	0.04	13.50	0.30
	0:06	13.20	0.04	13.56	0.36
	0:08	13.19	0.03	13.46	0.27
	0:09	13.20	0.04	13.50	0.30
	0:12	13.20	0.04	13.56	0.36
	0:14	13.19	0.03	13.53	0.34
	0:18	13.20	0.04	13.58	0.38
	0:21	13.20	0.04	13.61	0.41
	0:25	13.20	0.04	13.64	0.44
	0:30	13.20	0.04	13.71	0.51
	0:33	13.20	0.04	13.72	0.52
	0:36	13.20	0.04	13.72	0.52

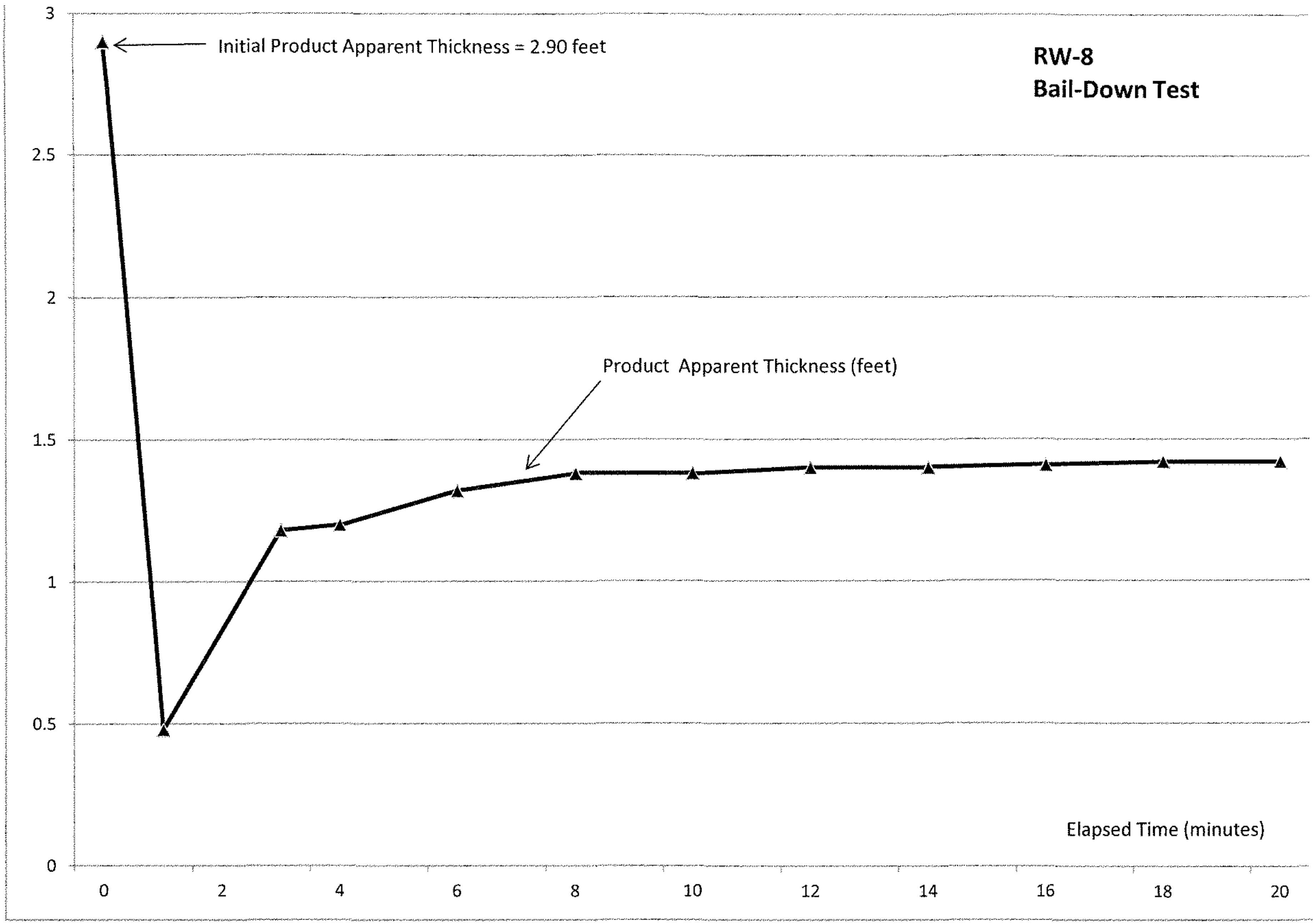
MW-21 Test 1

	Time Elapsed	DTP	Product Displacement (ft)	DTW	Apparent Thickness (ft)
Baseline		11.64		15.10	3.46
1.5 gal product removed	0:00				
TD = 19.2	0:01	12.45	0.81	13.02	0.57
	0:04	12.17	0.53	12.88	0.71
	0:06	12.03	0.39	12.70	0.67
	0:08	11.94	0.30	12.41	0.47
	0:11	11.90	0.26	12.32	0.42
	0:15	11.88	0.24	12.40	0.52
	0:19	11.85	0.21	12.72	0.87
	0:26	11.80	0.16	12.85	1.05
	0:30	11.78	0.14	12.93	1.15
	0:33	11.77	0.13	12.93	1.16
	0:37	11.76	0.12	12.94	1.18
	0:40	11.76	0.12	12.94	1.18
	2:00	11.62	-0.02	14.00	2.38

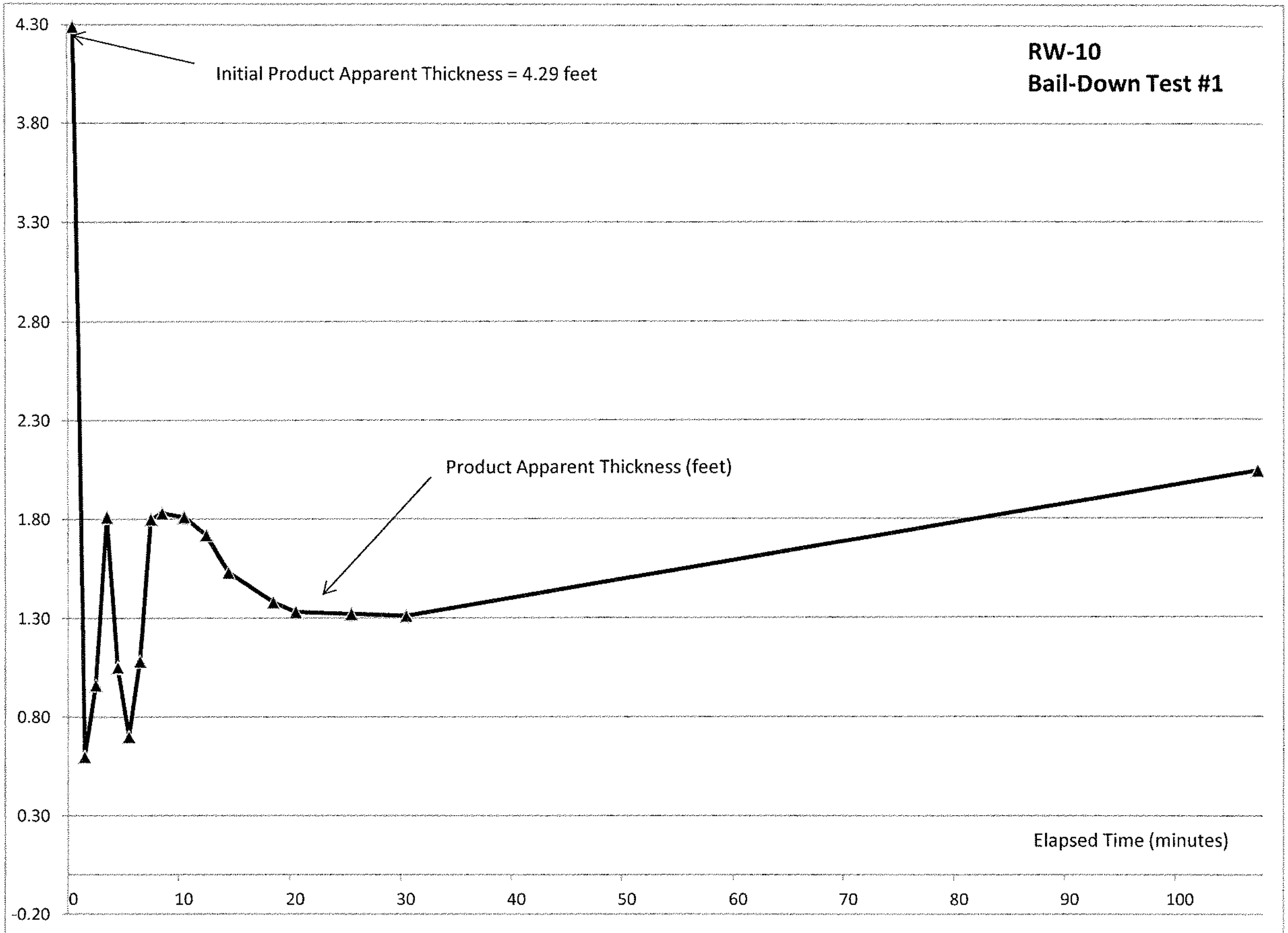
MW-21 Test 2

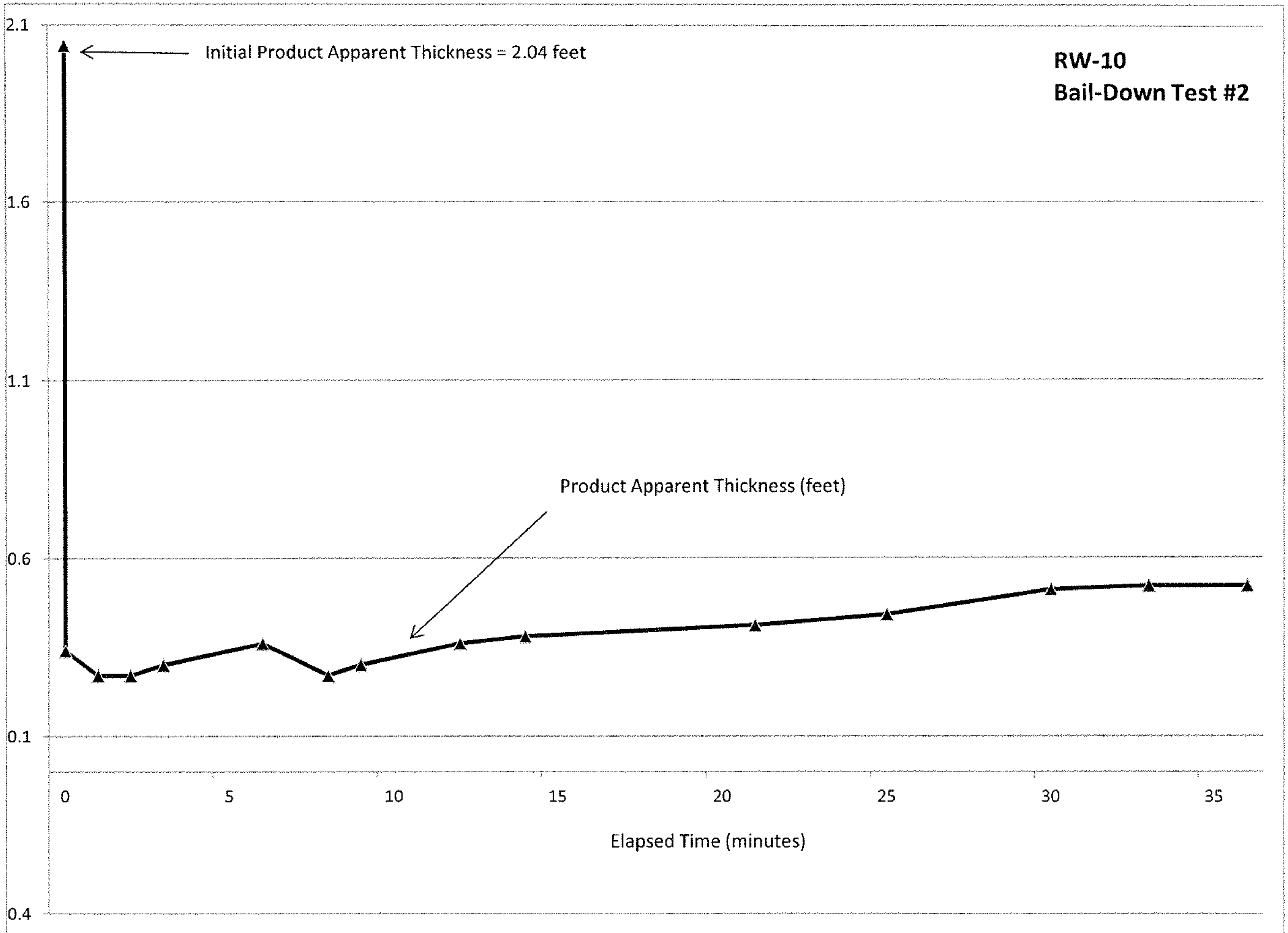
	Time Elapsed	DTP		DTW	
		11.62		14.00	2.38
1.5 gal product removed	0:00				
	0:01	12.53	0.91	13.12	0.59
	0:02	12.30	0.68	12.95	0.65
	0:03	12.20	0.58	12.80	0.60
	0:05	12.00	0.38	12.65	0.65
	0:08	11.90	0.28	12.41	0.51
	0:11	11.86	0.24	12.39	0.53
	0:14	11.80	0.18	12.37	0.57
	0:18	11.66	0.04	12.39	0.73
	0:22	11.64	0.02	12.40	0.76
	0:26	11.64	0.02	12.40	0.76
	0:30	11.64	0.02	12.40	0.76


MW-5
Bail-Down Test
Initial Product Apparent Thickness = 4.0 feet
Product Apparent Thickness (feet)
4.1
3.6
3.1
2.6
2.1
1.6
1.1
0.6
0.1
-0.4
0
2
4
6
8
10
12
14
16
18
20
Elapsed Time (minutes)

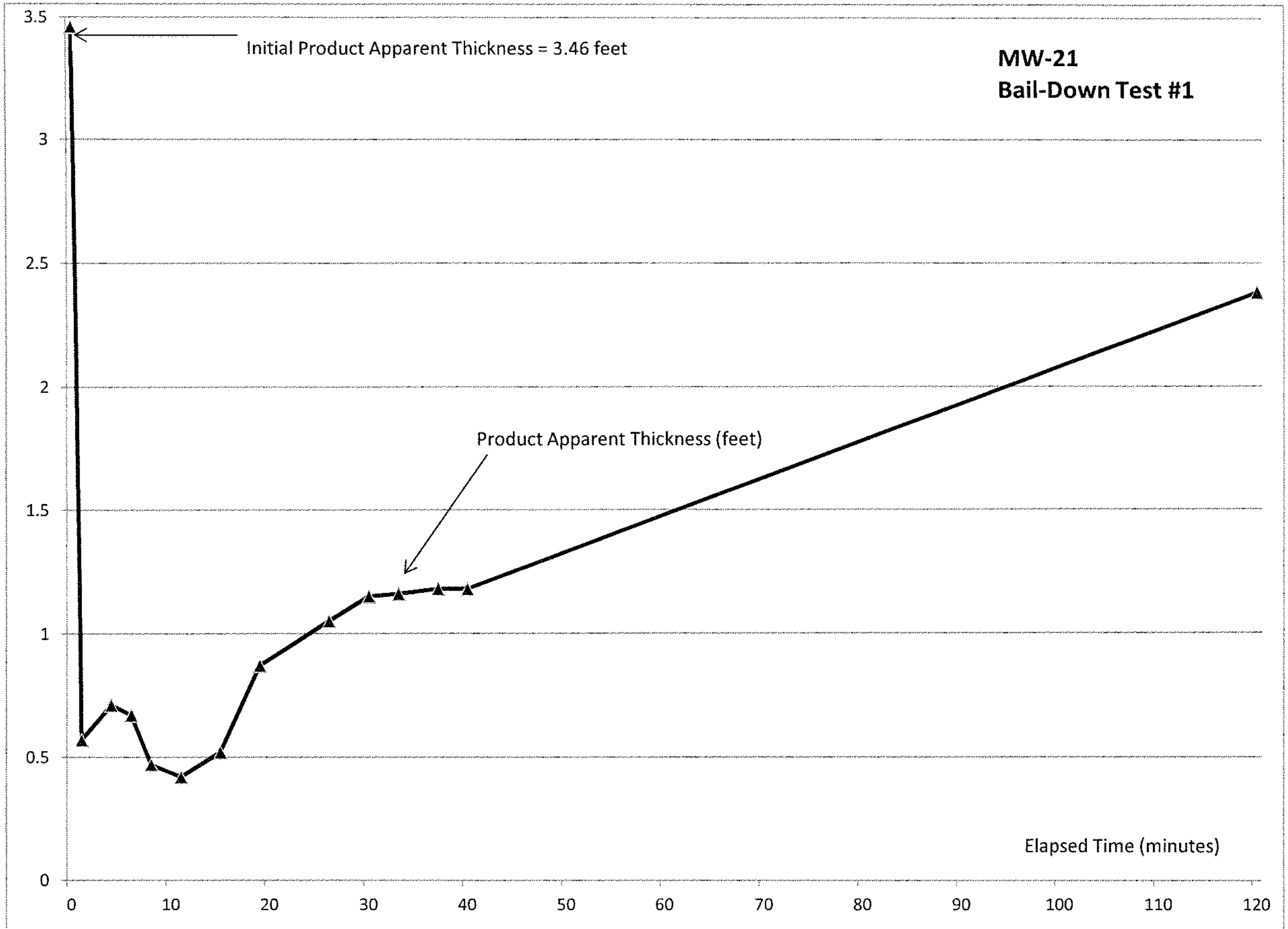


Initial Product Apparent Thickness = 2.90 feet
RW-8
Bail-Down Test
Product Apparent Thickness (feet)
Elapsed Time (minutes)
3
2.5
2
1.5
1
0.5
0
0
2
4
6
8
10
12
14
16
18
20

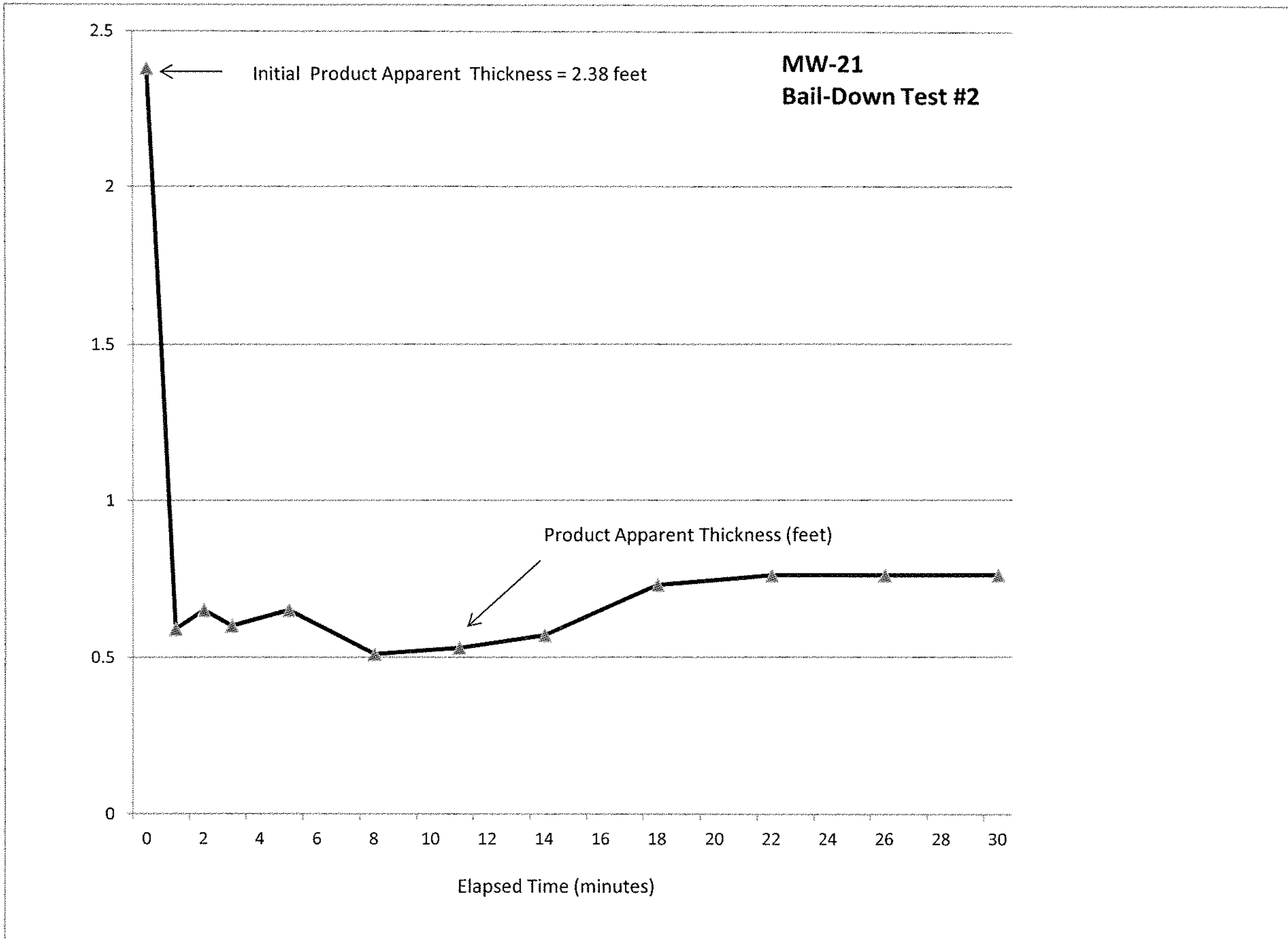

RW-10
Bail-Down Test #1
Initial Product Apparent Thickness = 4.29 feet
Product Apparent Thickness (feet)
Elapsed Time (minutes)
4.30
3.80
3.30
2.80
2.30
1.80
1.30
0.80
0.30
-0.20
0
10
20
30
40
50
60
70
80
90
100

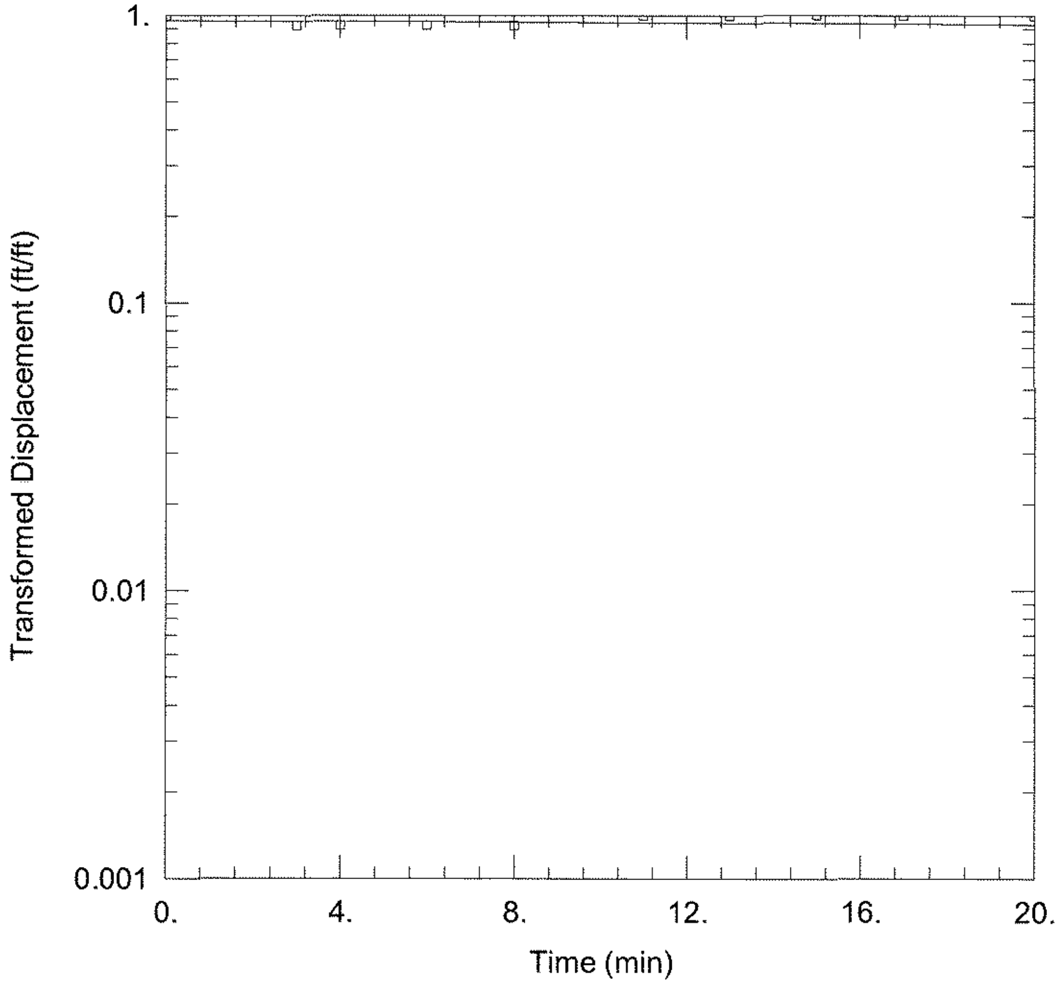


RW-10
Bail-Down Test #2
Initial Product Apparent Thickness = 2.04 feet
Product Apparent Thickness (feet)
2.1
1.6
1.1
0.6
0.1
0.4
0
5
10
15
20
25
30
35
Elapsed Time (minutes)



MW-21
Bail-Down Test #1
Initial Product Apparent Thickness = 3.46 feet
Product Apparent Thickness (feet)
Elapsed Time (minutes)
3.5
3
2.5
2
1.5
1
0.5
0
0
10
20
30
40
50
60
70
80
90
100
110
120


MW-21
Bail-Down Test #2
Initial Product Apparent Thickness = 2.38 feet
Product Apparent Thickness (feet)
2.5
2
1.5
1
0.5
0
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
Elapsed Time (minutes)



WELL TEST ANALYSIS

Data Set: C:\Program Files\HydroSOLVE\AQTESOLV Pro 4.0\MW5.aqt
Date: 02/05/15 Time: 11:13:23

PROJECT INFORMATION

Company: FPM Group
Client: Dupont Realty
Location: 49 Dupont Street
Test Well: MW-5
Test Date: January 21, 2015

AQUIFER DATA

Saturated Thickness: 5. ft Anisotropy Ratio (Kz/Kr): 0.1

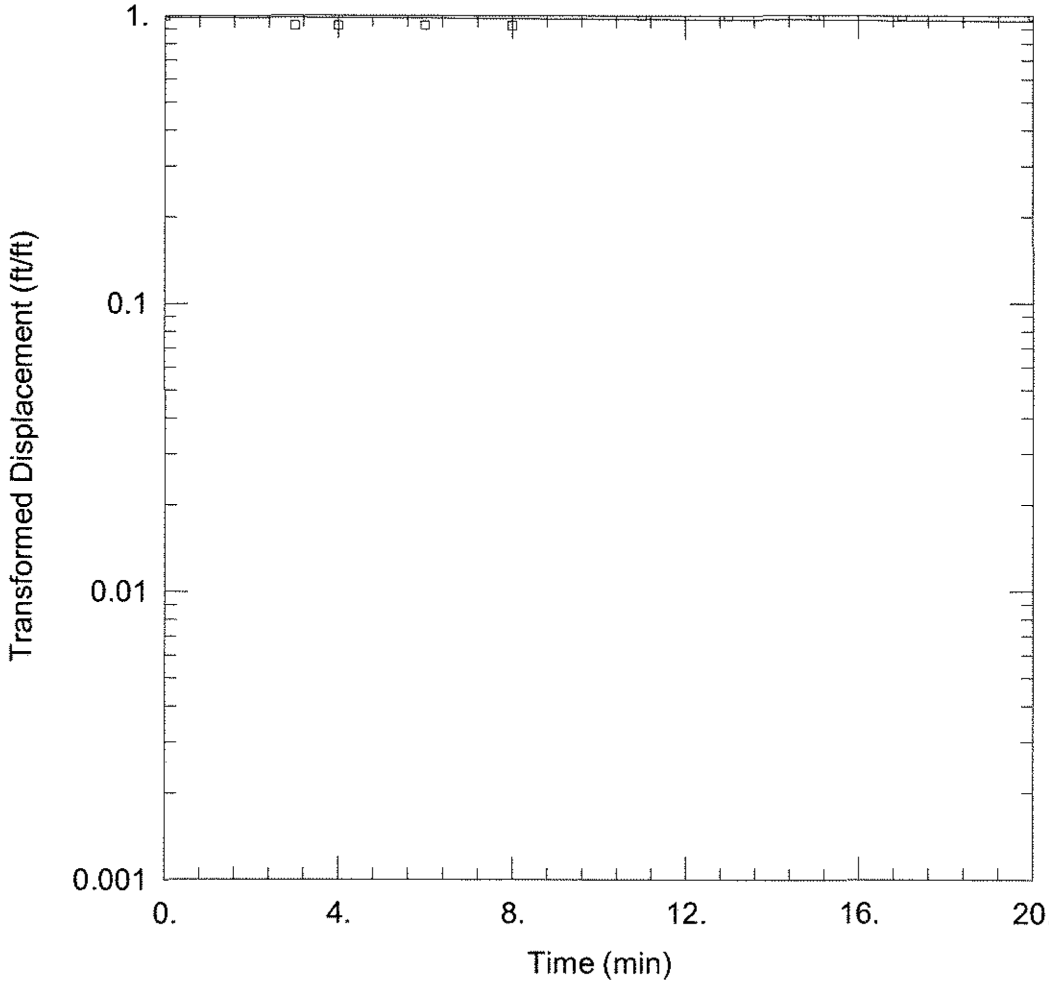
WELL DATA (MW-5)

Initial Displacement: 0.13 ft Static Water Column Height: 7.27 ft
Total Well Penetration Depth: 10. ft Screen Length: 10. ft
Casing Radius: 0.083 ft Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Dagan

K = 1.099E-6 ft/min y0 = 0.1247 ft



WELL TEST ANALYSIS

Data Set: C:\Program Files\HydroSOLVE\AQTESOLV Pro 4.0\MW5.01.aqt
Date: 02/05/15 Time: 11:14:44

PROJECT INFORMATION

Company: FPM Group
Client: Dupont Realty
Location: 49 Dupont Street
Test Well: MW-5
Test Date: January 21, 2015

AQUIFER DATA

Saturated Thickness: 5. ft
Anisotropy Ratio (Kz/Kr): 0.01

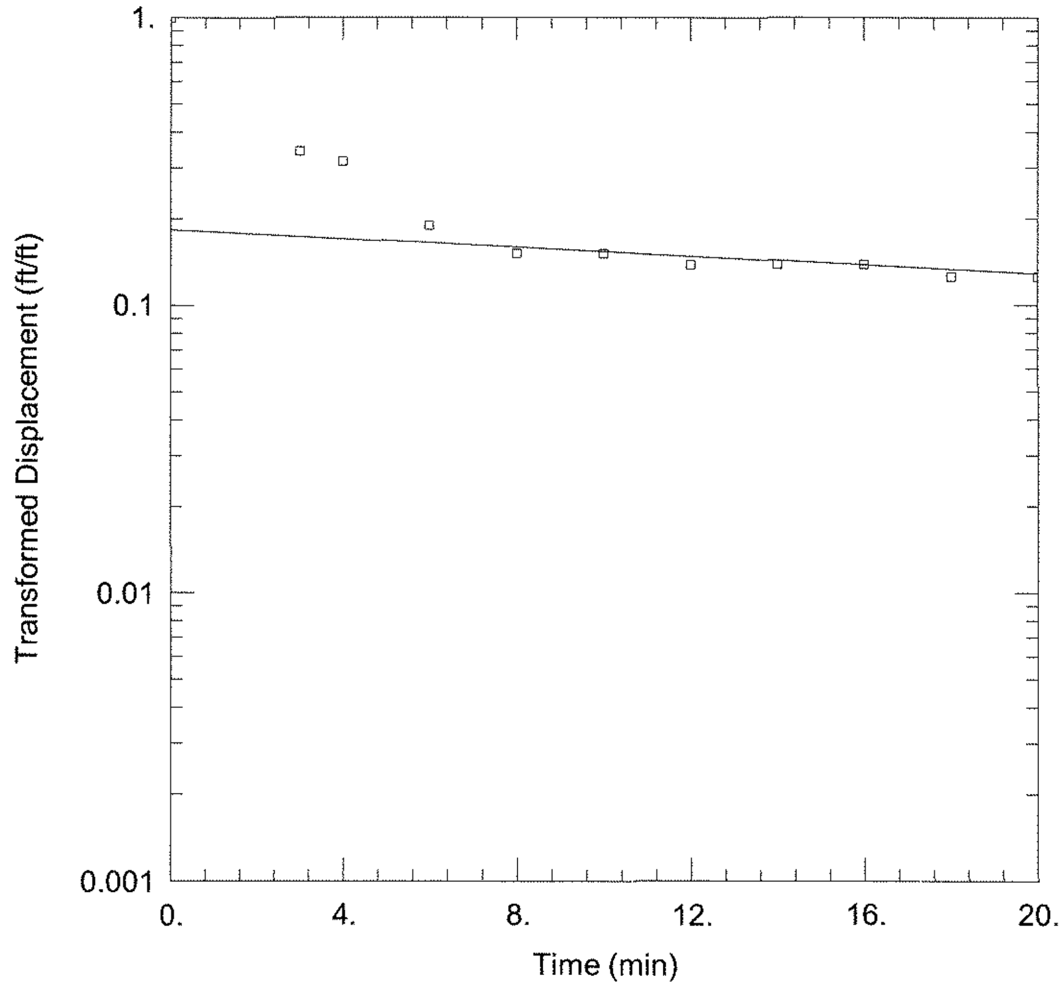
WELL DATA (MW-5)

Initial Displacement: 0.13 ft
Total Well Penetration Depth: 10. ft
Casing Radius: 0.083 ft
Static Water Column Height: 7.27 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Dagan

K = 1.118E-6 ft/min
y0 = 0.1284 ft



WELL TEST ANALYSIS

Data Set: C:\Program Files\HydroSOLVE\AQTESOLV Pro 4.0\RW8.aqt
Date: 02/05/15 Time: 10:42:19

PROJECT INFORMATION

Company: FPM Group
Client: Dupont Realty
Location: 49 Dupont Street
Test Well: RW-8
Test Date: January 21, 2015

AQUIFER DATA

Saturated Thickness: 5. ft Anisotropy Ratio (Kz/Kr): 0.1

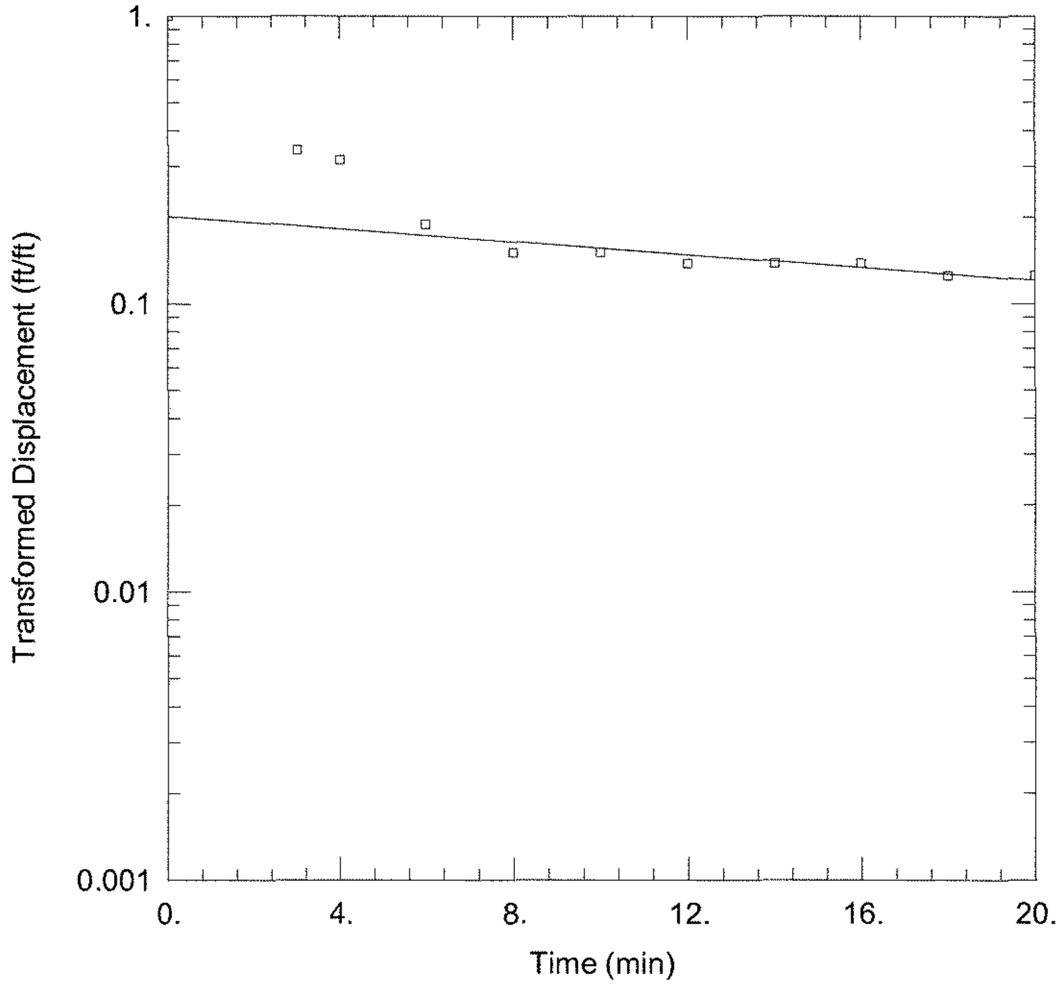
WELL DATA (RW-8)

Initial Displacement: 0.77 ft Static Water Column Height: 3.15 ft
Total Well Penetration Depth: 10. ft Screen Length: 10. ft
Casing Radius: 0.167 ft Well Radius: 0.167 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Dagan

K = 2.724E-5 ft/min y0 = 0.1455 ft



WELL TEST ANALYSIS

Data Set: C:\Program Files\HydroSOLVE\AQTESOLV Pro 4.0\RW8.01.aqt
Date: 02/05/15 Time: 10:43:02

PROJECT INFORMATION

Company: FPM Group
Client: Dupont Realty
Location: 49 Dupont Street
Test Well: RW-8
Test Date: January 21, 2015

AQUIFER DATA

Saturated Thickness: 5. ft Anisotropy Ratio (Kz/Kr): 0.01

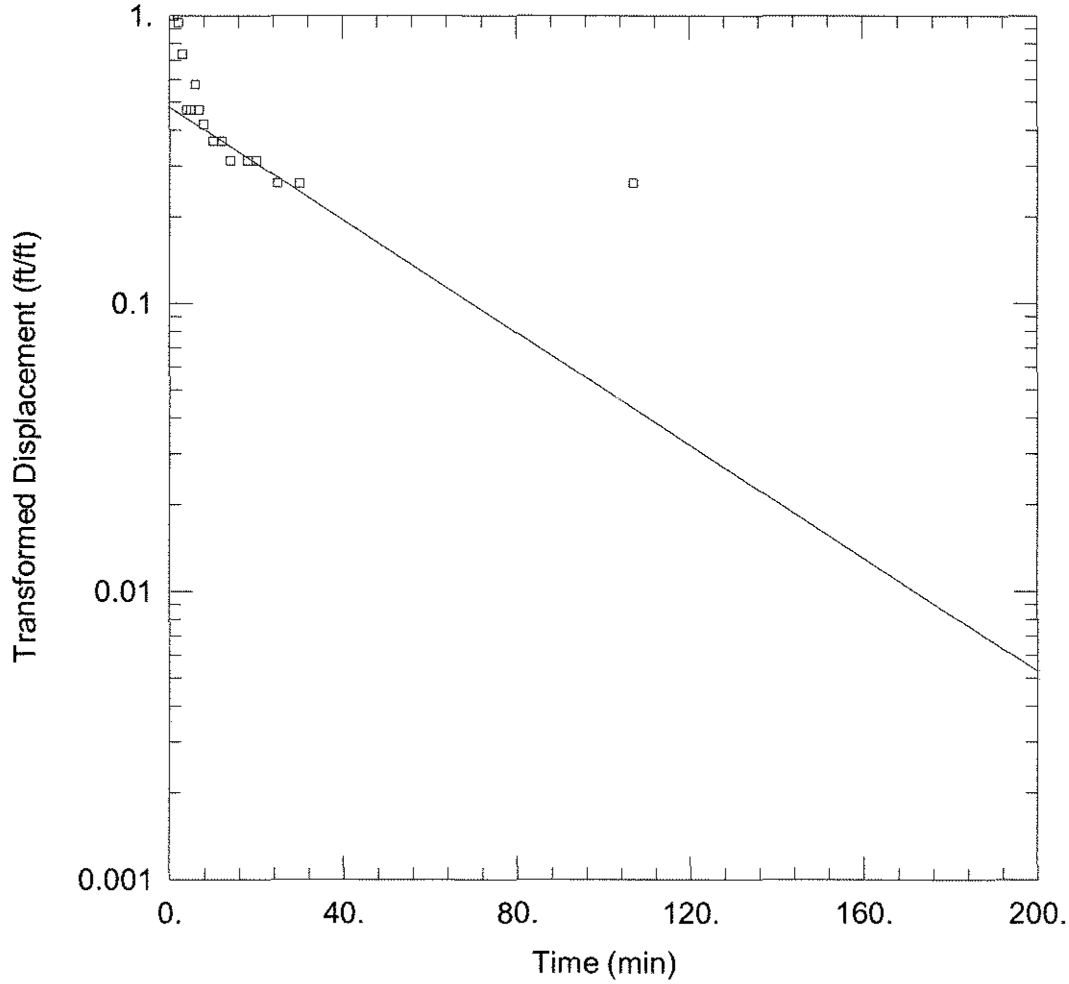
WELL DATA (RW-8)

Initial Displacement: 0.77 ft Static Water Column Height: 3.15 ft
Total Well Penetration Depth: 10. ft Screen Length: 10. ft
Casing Radius: 0.167 ft Well Radius: 0.167 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Dagan

K = 3.935E-5 ft/min y0 = 0.1599 ft



WELL TEST ANALYSIS

Data Set: C:\Program Files\HydroSOLVE\AQTESOLV Pro 4.0\RW10tst1earlyrev.aqt
Date: 02/09/15 Time: 09:21:53

PROJECT INFORMATION

Company: FPM Group
Client: Dupont Realty
Location: 49 Dupont Street
Test Well: RW-10 test 1
Test Date: January 21, 2015

AQUIFER DATA

Saturated Thickness: 5. ft
Anisotropy Ratio (Kz/Kr): 0.1

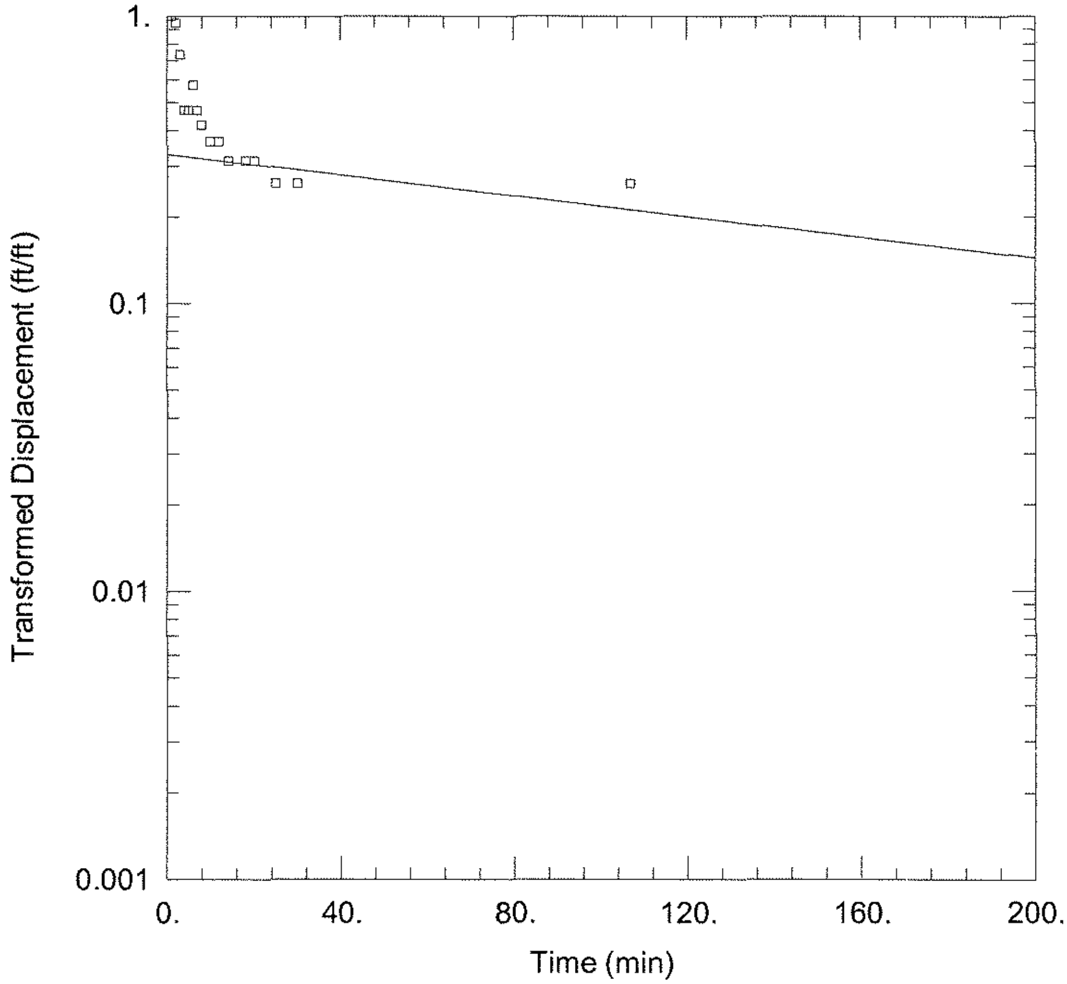
WELL DATA (RW-10 test 1)

Initial Displacement: 0.19 ft
Total Well Penetration Depth: 10. ft
Casing Radius: 0.167 ft
Static Water Column Height: 4.09 ft
Screen Length: 10. ft
Well Radius: 0.167 ft

SOLUTION – moderate-term data

Aquifer Model: Unconfined
Solution Method: Dagan

K = 3.474E-5 ft/min
y0 = 0.09184 ft



WELL TEST ANALYSIS

Data Set: C:\Program Files\HydroSOLVE\AQTESOLV Pro 4.0\RW10test2.aqt
Date: 02/05/15 Time: 10:49:19

PROJECT INFORMATION

Company: FPM Group
Client: Dupont Realty
Location: 49 Dupont Street
Test Well: RW-10 test 1
Test Date: January 21, 2015

AQUIFER DATA

Saturated Thickness: 5. ft Anisotropy Ratio (Kz/Kr): 0.1

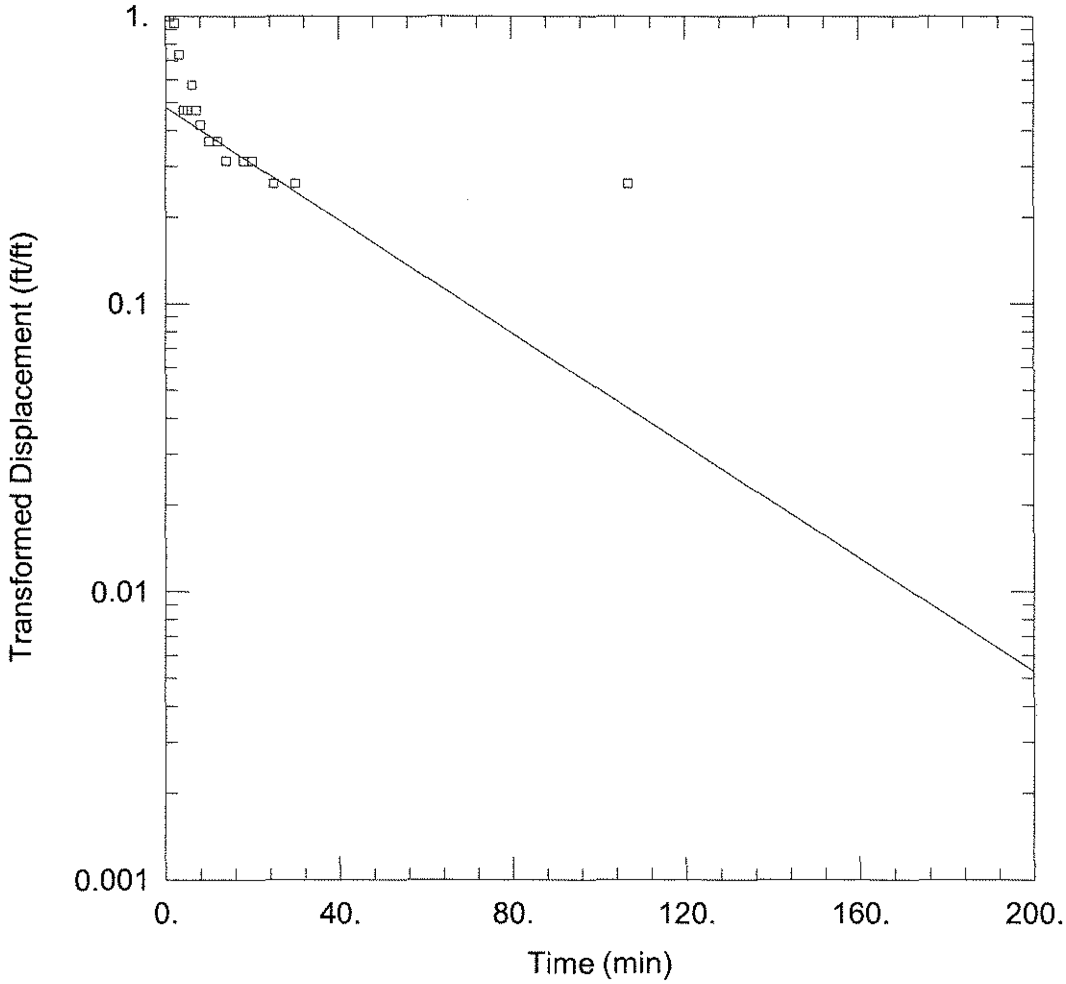
WELL DATA (RW-10 test 1)

Initial Displacement: 0.19 ft
Total Well Penetration Depth: 10. ft
Casing Radius: 0.167 ft
Static Water Column Height: 4.09 ft
Screen Length: 10. ft
Well Radius: 0.167 ft

SOLUTION – late data

Aquifer Model: Unconfined Solution Method: Dagan

K = 6.386E-6 ft/min y0 = 0.0631 ft



WELL TEST ANALYSIS

Data Set: C:\Program Files\HydroSOLVE\AQTESOLV Pro 4.0\RW10tst1.01earlyrev.aqt
Date: 02/09/15 Time: 10:15:12

PROJECT INFORMATION

Company: FPM Group
Client: Dupont Realty
Location: 49 Dupont Street
Test Well: RW-10 test 1
Test Date: January 21, 2015

AQUIFER DATA

Saturated Thickness: 5. ft
Anisotropy Ratio (Kz/Kr): 0.01

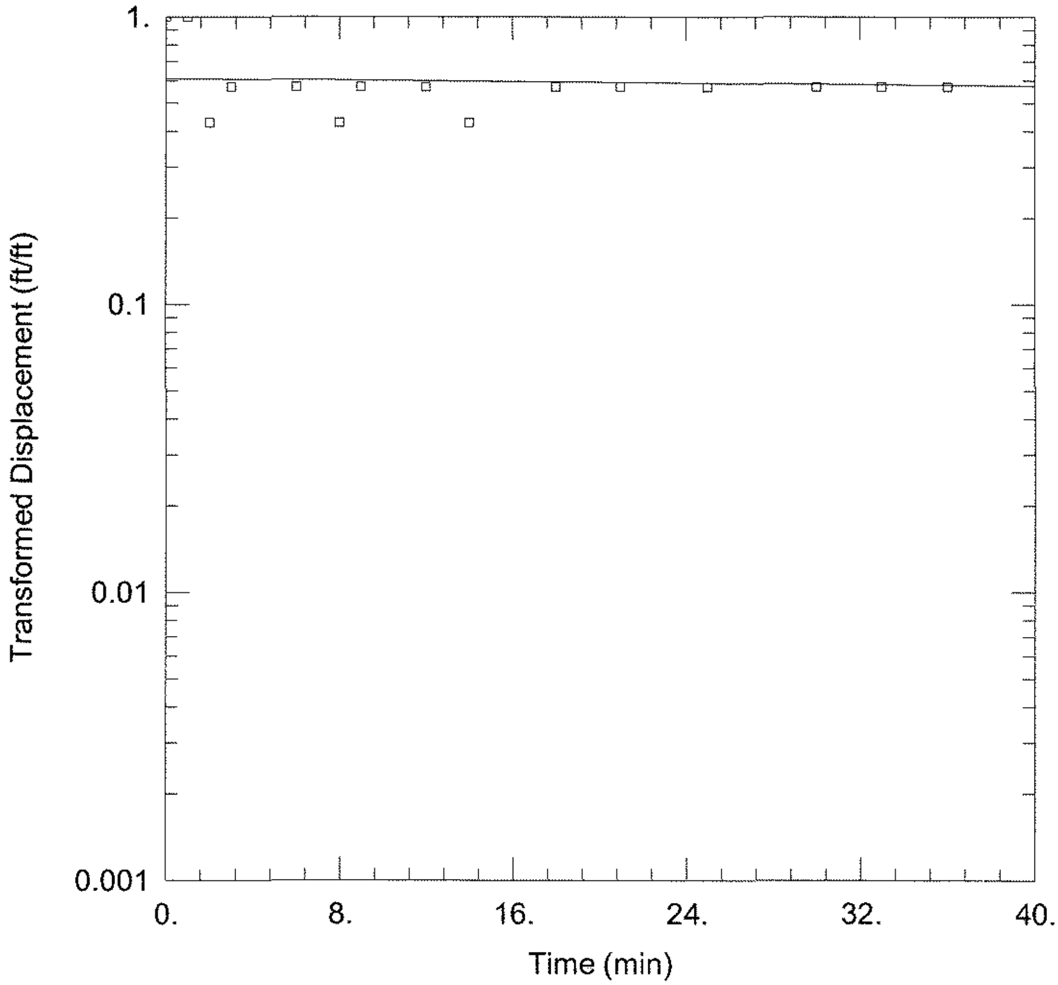
WELL DATA (RW-10 test 1)

Initial Displacement: 0.19 ft
Total Well Penetration Depth: 10. ft
Casing Radius: 0.167 ft
Static Water Column Height: 4.09 ft
Screen Length: 10. ft
Well Radius: 0.167 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Dagan

K = 3.474E-5 ft/min
y0 = 0.09184 ft



WELL TEST ANALYSIS

Data Set: C:\Program Files\HydroSOLVE\AQTESOLV Pro 4.0\RW10test1.aqt
Date: 02/05/15 Time: 11:03:13

PROJECT INFORMATION

Company: FPM Group
Client: Dupont Realty
Location: 49 Dupont Street
Test Well: RW-10 test 2
Test Date: January 21, 2015

AQUIFER DATA

Saturated Thickness: 5. ft
Anisotropy Ratio (Kz/Kr): 0.1

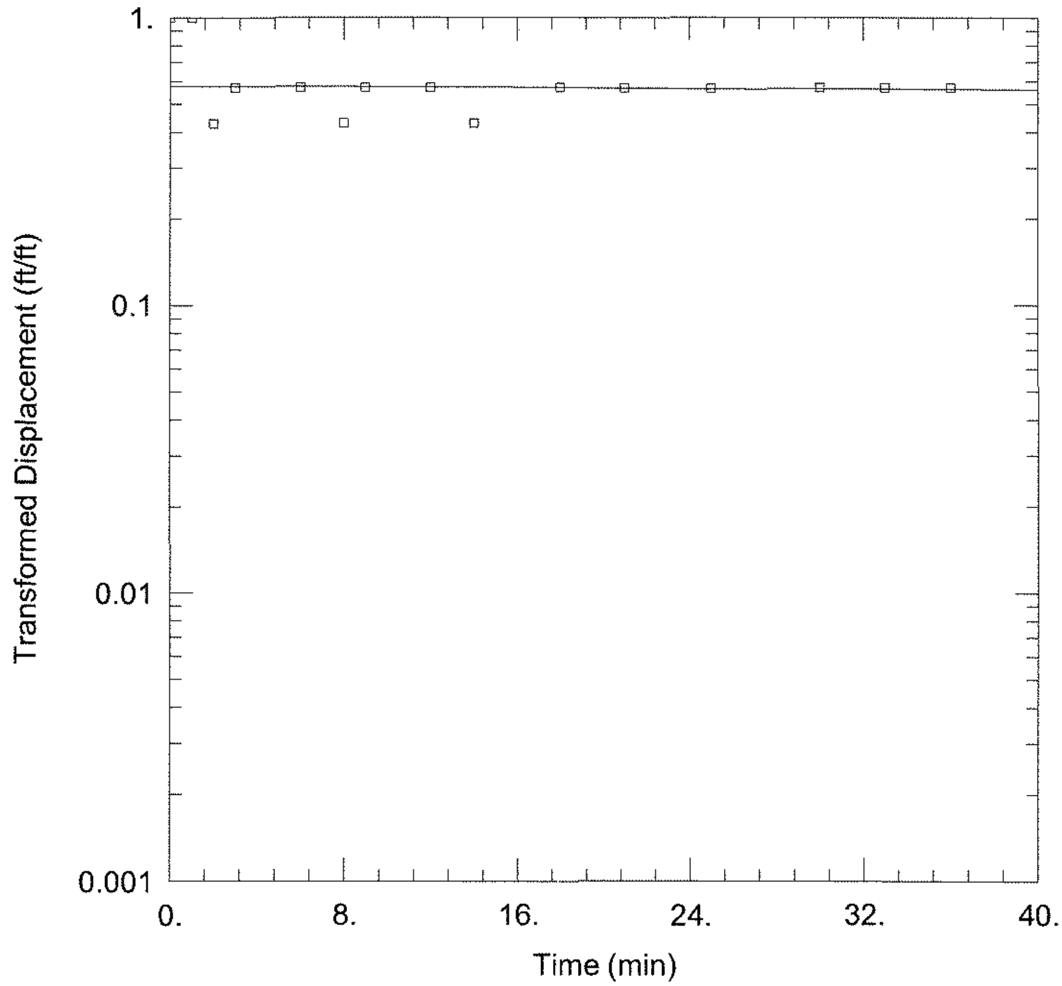
WELL DATA (RW-10 test 2)

Initial Displacement: 0.07 ft
Static Water Column Height: 4.04 ft
Total Well Penetration Depth: 10. ft
Screen Length: 10. ft
Casing Radius: 0.167 ft
Well Radius: 0.167 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Dagan

K = 2.223E-6 ft/min
y0 = 0.04271 ft



WELL TEST ANALYSIS

Data Set: C:\Program Files\HydroSOLVE\AQTESOLV Pro 4.0\RW10tst2.01rev.aqt
Date: 02/05/15 Time: 11:05:06

PROJECT INFORMATION

Company: FPM Group
Client: Dupont Realty
Location: 49 Dupont Street
Test Well: RW-10 test 2
Test Date: January 21, 2015

AQUIFER DATA

Saturated Thickness: 5. ft
Anisotropy Ratio (Kz/Kr): 0.01

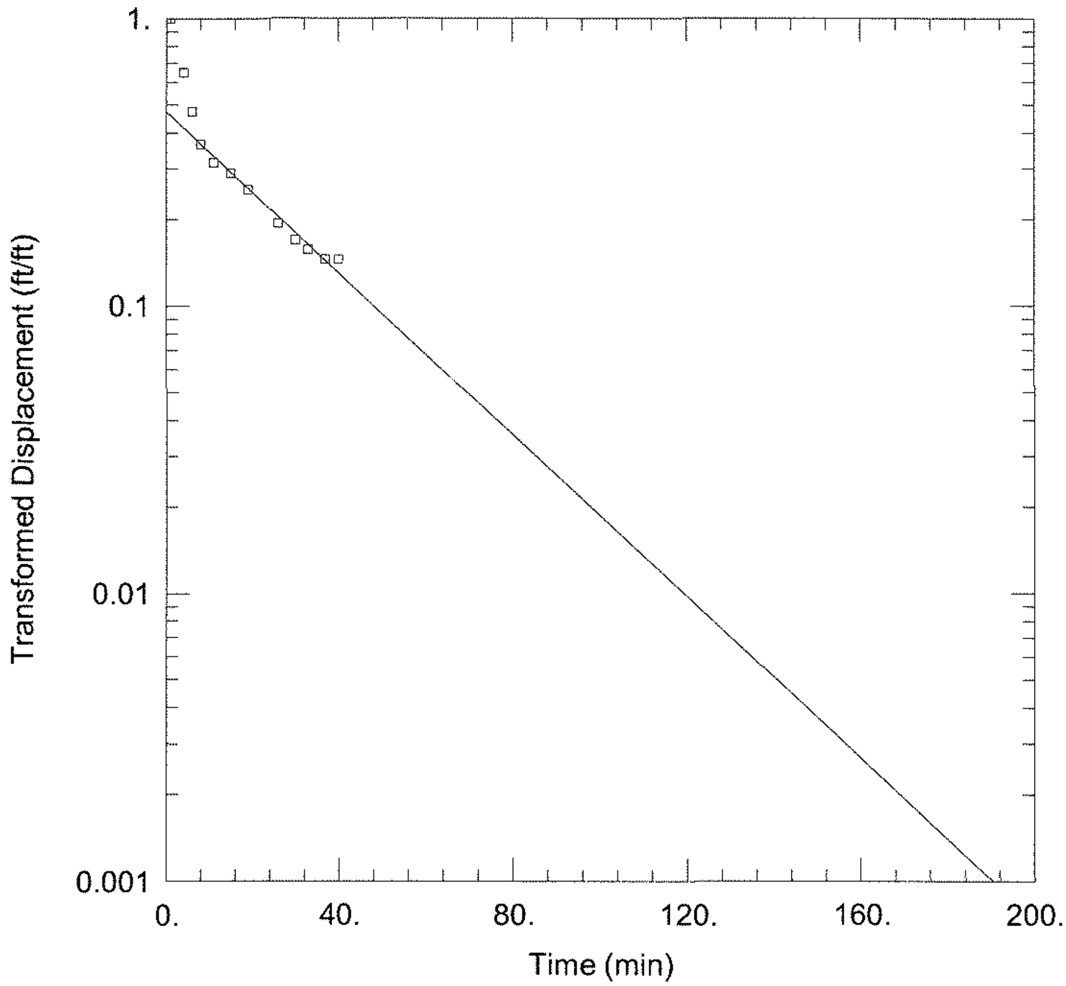
WELL DATA (RW-10 test 2)

Initial Displacement: 0.07 ft
Total Well Penetration Depth: 10. ft
Casing Radius: 0.167 ft
Static Water Column Height: 4.04 ft
Screen Length: 10. ft
Well Radius: 0.167 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Dagan

K = 1.104E-6 ft/min
y0 = 0.04049 ft



WELL TEST ANALYSIS

Data Set: C:\Program Files\HydroSOLVE\AQTESOLV Pro 4.0\MW21test1.aqt
Date: 02/05/15 Time: 11:24:35

PROJECT INFORMATION

Company: FPM Group
Client: Dupont Realty
Location: 49 Dupont Street
Test Well: MW-21 test 1
Test Date: January 21, 2015

AQUIFER DATA

Saturated Thickness: 5. ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (MW-21 test 1)

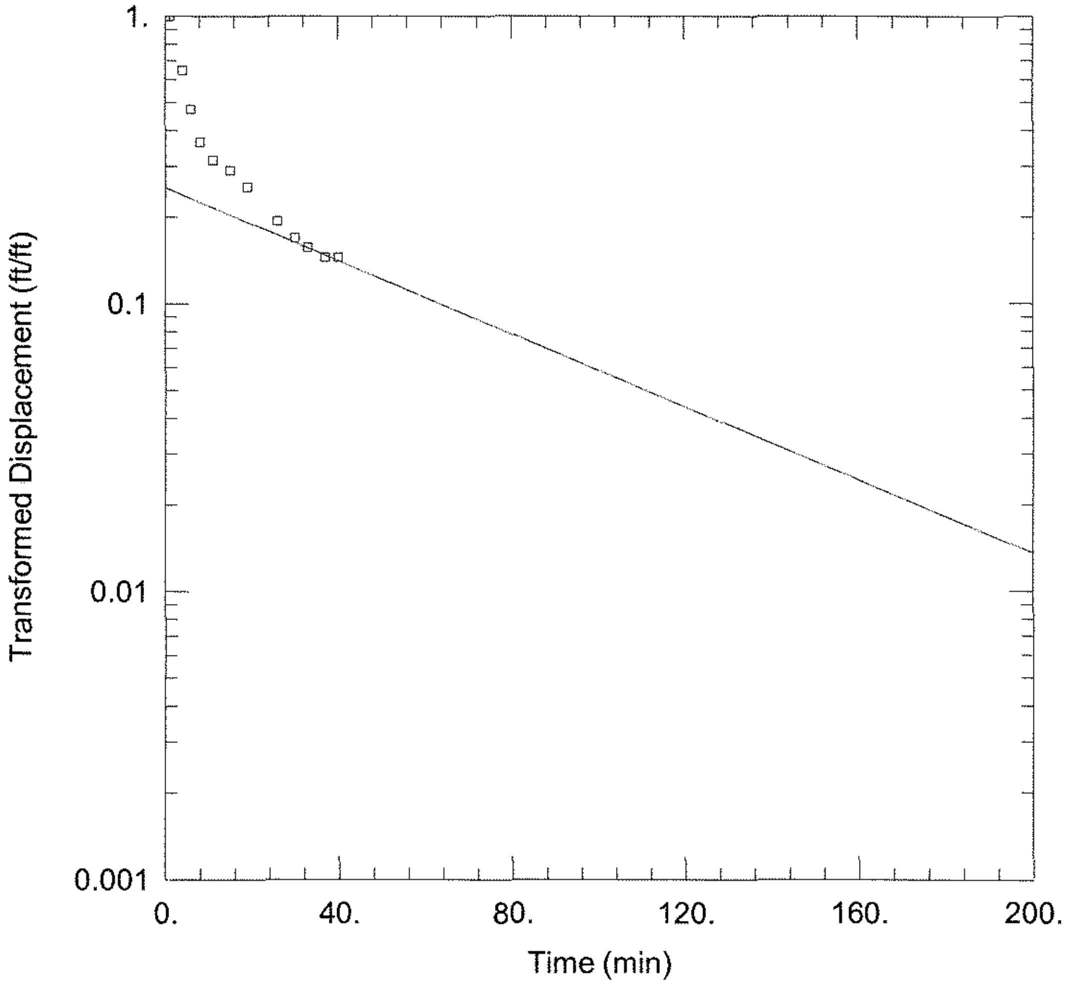
Initial Displacement: 0.81 ft
Total Well Penetration Depth: 15. ft
Casing Radius: 0.083 ft

Static Water Column Height: 7.56 ft
Screen Length: 15. ft
Well Radius: 0.083 ft

SOLUTION - moderate - term data

Aquifer Model: Unconfined
Solution Method: Dagan

K = 1.674E-5 ft/min
y0 = 0.3894 ft



WELL TEST ANALYSIS

Data Set: C:\Program Files\HydroSOLVE\AQTESOLV Pro 4.0\MW21test1late.aqt
Date: 02/09/15 Time: 09:29:47

PROJECT INFORMATION

Company: FPM Group
Client: Dupont Realty
Location: 49 Dupont Street
Test Well: MW-21 test 1
Test Date: January 21, 2015

AQUIFER DATA

Saturated Thickness: 5. ft
Anisotropy Ratio (Kz/Kr): 0.1

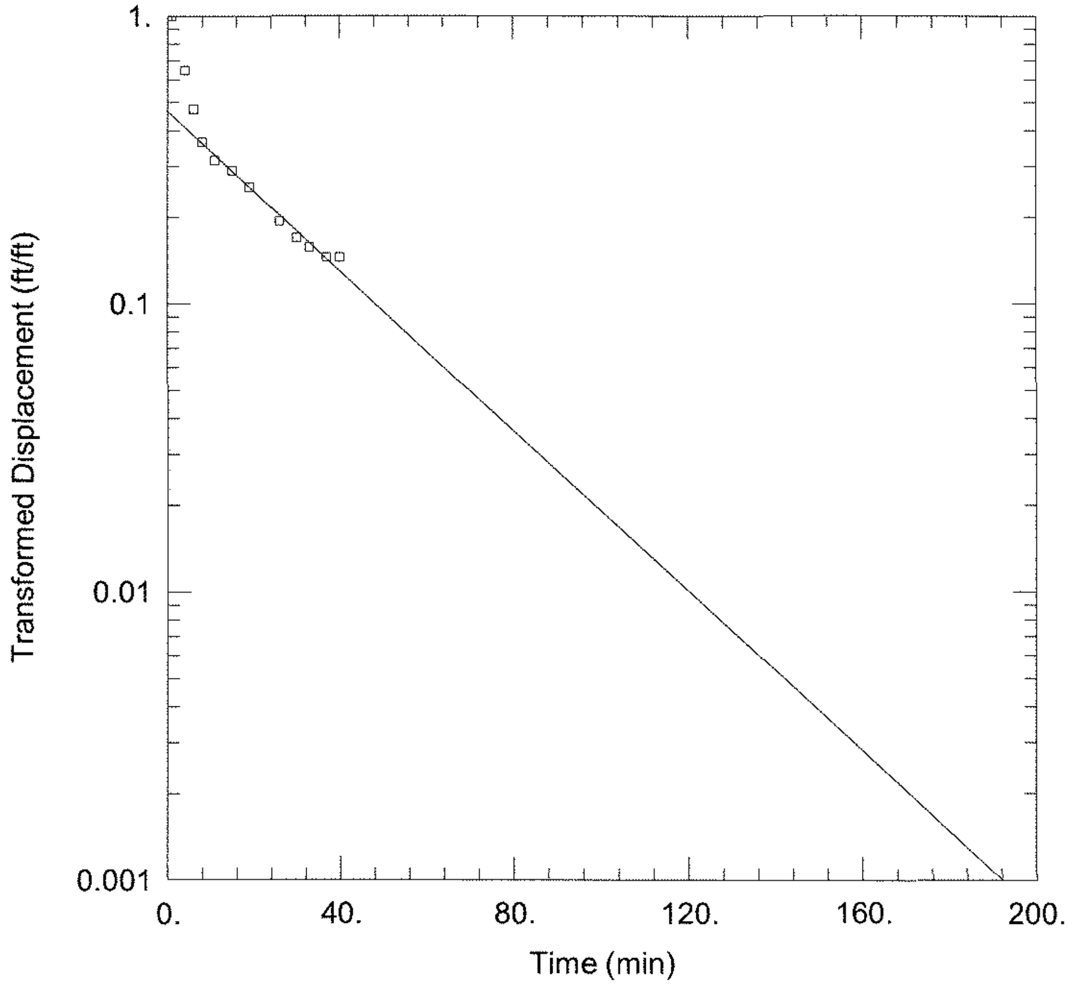
WELL DATA (MW-21 test 1)

Initial Displacement: 0.81 ft
Total Well Penetration Depth: 15. ft
Casing Radius: 0.083 ft
Static Water Column Height: 7.56 ft
Screen Length: 15. ft
Well Radius: 0.083 ft

SOLUTION – late data

Aquifer Model: Unconfined
Solution Method: Dagan

K = 7.562E-6 ft/min
y0 = 0.209 ft



WELL TEST ANALYSIS

Data Set: C:\Program Files\HydroSOLVE\AQTESOLV Pro 4.0\MW21test1.01rev.aqt
Date: 02/05/15 Time: 11:25:25

PROJECT INFORMATION

Company: FPM Group
Client: Dupont Realty
Location: 49 Dupont Street
Test Well: MW-21 test 1
Test Date: January 21, 2015

AQUIFER DATA

Saturated Thickness: 5. ft
Anisotropy Ratio (Kz/Kr): 0.01

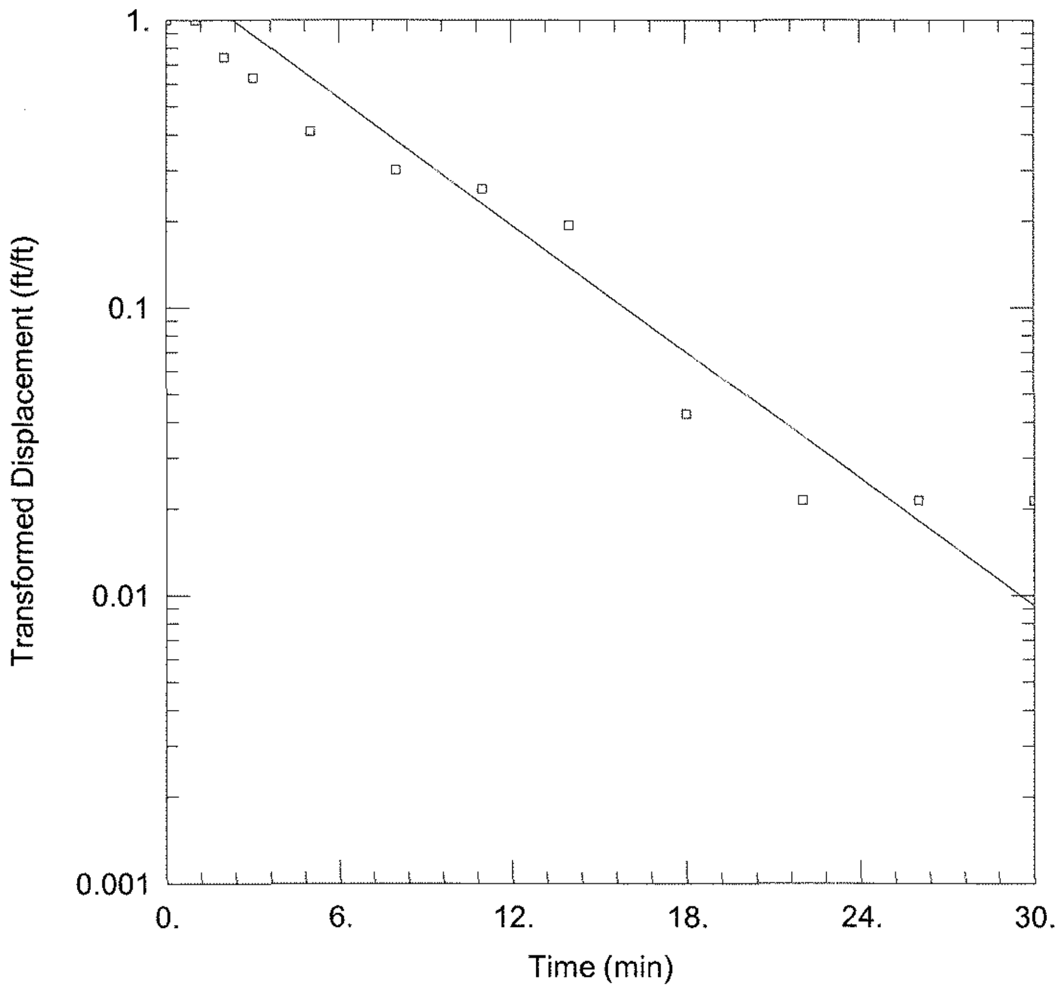
WELL DATA (MW-21 test 1)

Initial Displacement: 0.81 ft
Total Well Penetration Depth: 15. ft
Casing Radius: 0.083 ft
Static Water Column Height: 7.56 ft
Screen Length: 15. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Dagan

K = 1.654E-5 ft/min
y0 = 0.3827 ft



WELL TEST ANALYSIS

Data Set: C:\Program Files\HydroSOLVE\AQTESOLV Pro 4.0\MW21test2.aqt
Date: 02/05/15 Time: 11:35:06

PROJECT INFORMATION

Company: FPM Group
Client: Dupont Realty
Location: 49 Dupont Street
Test Well: MW-21 test 2
Test Date: January 21, 2015

AQUIFER DATA

Saturated Thickness: 5. ft
Anisotropy Ratio (Kz/Kr): 0.1

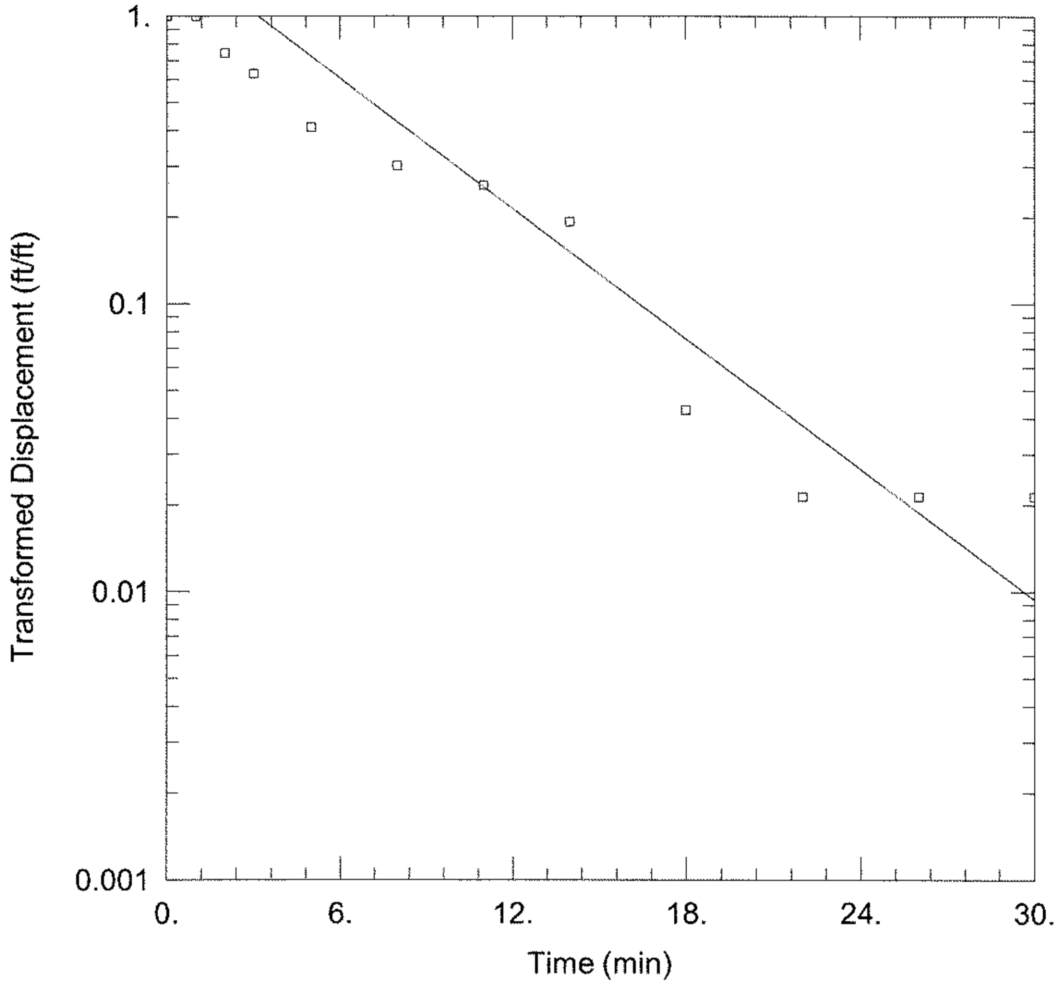
WELL DATA (MW-21 test 2)

Initial Displacement: 0.91 ft
Static Water Column Height: 7.58 ft
Total Well Penetration Depth: 15. ft
Screen Length: 15. ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Dagan

K = 8.75E-5 ft/min
y0 = 1.324 ft



WELL TEST ANALYSIS

Data Set: C:\Program Files\HydroSOLVE\AQTESOLV Pro 4.0\MW21test2.01rev.aqt
Date: 02/05/15 Time: 11:37:45

PROJECT INFORMATION

Company: FPM Group
Client: Dupont Realty
Location: 49 Dupont Street
Test Well: MW-21 test 2
Test Date: January 21, 2015

AQUIFER DATA

Saturated Thickness: 5. ft
Anisotropy Ratio (Kz/Kr): 0.01

WELL DATA (MW-21 test 2)

Initial Displacement: 0.91 ft
Total Well Penetration Depth: 15. ft
Casing Radius: 0.083 ft
Static Water Column Height: 7.58 ft
Screen Length: 15. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Dagan

K = 8.991E-5 ft/min
y0 = 1.536 ft

ATTACHMENT B

- VISCOSITY TESTING DATA
- FRIEDMAN & BRUYA, INC., MARCH 31, 2010 "FINGERPRINT" REPORT

Certificate of Analysis

SINCE 1985
Quality Controlled Through Analysis

10630 FALLSTONE RD. HOUSTON, TEXAS 77099
P.O. BOX 741905, HOUSTON, TEXAS 77274

TEL: (281) 495-2400
FAX: (281) 495-2410

CLIENT:	FPM Group	**REQUESTED BY:**	Mr. John Bukoski
CLIENT PROJECT:	Nultart	**PURCHASE ORDER NO:**	11346-14-08
LABORATORY NO:	77352-001	**REPORT DATE:**	February 05, 2015
SAMPLE:	MW-21		

TEST **RESULT**

Parameter	***Results***
Viscosity, Kinematic, at 55°F, ASTM D 445.c, cSt	28.25
Viscosity, Kinematic, at 65°F, ASTM D 445.c, cSt	21.86
Viscosity, Kinematic, at 75°F, ASTM D 445.c, cSt	17.36
Viscosity, Kinematic, at 85°F, ASTM D 445.c, cSt	13.96
Viscosity, Kinematic, at 95°F, ASTM D 445.c, cSt	11.44
Viscosity, Kinematic, at 105°F, ASTM D 445.c, cSt	9.62
Viscosity, Kinematic, at 115°F, ASTM D 445.c, cSt	7.99
Viscosity, Kinematic, at 125°F, ASTM D 445.c, cSt	7.05

Respectfully submitted
For Texas OilTech Laboratories, L.P.

A. Phillip Sorurbakhsh
Director of Laboratory Operations

Certificate of Analysis

SINCE 1985
Quality Controlled Through Analysis

10630 FALLSTONE RD. HOUSTON, TEXAS 77099
P.O. BOX 741905, HOUSTON, TEXAS 77274

TEL: (281) 495-2400
FAX: (281) 495-2410

CLIENT:	FPM Group	**REQUESTED BY:**	Mr. John Bukoski
CLIENT PROJECT:	Nultart	**PURCHASE ORDER NO:**	11346-14-08
LABORATORY NO:	77352-002	**REPORT DATE:**	February 05, 2015
SAMPLE:	MW-5		

TEST **RESULT**

Parameter	***Results***
Viscosity, Kinematic, at 55°F, ASTM D 445.c, cSt	192.48
Viscosity, Kinematic, at 65°F, ASTM D 445.c, cSt	132.35
Viscosity, Kinematic, at 75°F, ASTM D 445.c, cSt	92.74
Viscosity, Kinematic, at 85°F, ASTM D 445.c, cSt	67.06
Viscosity, Kinematic, at 95°F, ASTM D 445.c, cSt	50.42
Viscosity, Kinematic, at 105°F, ASTM D 445.c, cSt	36.74
Viscosity, Kinematic, at 115°F, ASTM D 445.c, cSt	30.27
Viscosity, Kinematic, at 125°F, ASTM D 445.c, cSt	23.85

Respectfully submitted
For Texas OilTech Laboratories, L.P.

A. Phillip Sorurbakhsh
Director of Laboratory Operations

Cert. No.: 0005085, 17025
Quality Management System Certified to ISO 9001:2008, and ISO 17025:2005

Certificate of Analysis

SINCE 1985
Quality Controlled Through Analysis

10630 FALLSTONE RD. HOUSTON, TEXAS 77099
P.O. BOX 741905, HOUSTON, TEXAS 77274

TEL: (281) 495-2400
FAX: (281) 495-2410

CLIENT:	FPM Group	**REQUESTED BY:**	Mr. John Bukoski
CLIENT PROJECT:	Nultart	**PURCHASE ORDER NO:**	11346-14-08
LABORATORY NO:	77352-004	**REPORT DATE:**	February 05, 2015
SAMPLE:	RW-8		

TEST **RESULT**

Parameter	***Results***
Viscosity, Kinematic, at 55°F, ASTM D 445.c, cSt	273.69
Viscosity, Kinematic, at 65°F, ASTM D 445.c, cSt	182.54
Viscosity, Kinematic, at 75°F, ASTM D 445.c, cSt	126.04
Viscosity, Kinematic, at 85°F, ASTM D 445.c, cSt	89.88
Viscosity, Kinematic, at 95°F, ASTM D 445.c, cSt	65.53
Viscosity, Kinematic, at 105°F, ASTM D 445.c, cSt	49.59
Viscosity, Kinematic, at 115°F, ASTM D 445.c, cSt	38.28
Viscosity, Kinematic, at 125°F, ASTM D 445.c, cSt	29.95

Respectfully submitted
For Texas OilTech Laboratories, L.P.

A. Phillip Sorurbakhsh
Director of Laboratory Operations

Cert. No.: 0005085, 17025
Quality Management System Certified to ISO 9001:2008, and ISO 17025:2005

Certificate of Analysis

SINCE 1985

Quality Controlled Through Analysis

10630 FALLSTONE RD. HOUSTON, TEXAS 77099
P.O. BOX 741905, HOUSTON, TEXAS 77274

TEL: (281) 495-2400
FAX: (281) 495-2410

CLIENT:	FPM Group	**REQUESTED BY:**	Mr. John Bukoski
CLIENT PROJECT:	Nultart	**PURCHASE ORDER NO:**	11346-14-08
LABORATORY NO:	77352-003	**REPORT DATE:**	February 05, 2015
SAMPLE:	RW-10		

TEST **RESULT**

Parameter	***Results***
Viscosity, Kinematic, at 55°F, ASTM D 445.c, cSt	125.44
Viscosity, Kinematic, at 65°F, ASTM D 445.c, cSt	96.39
Viscosity, Kinematic, at 75°F, ASTM D 445.c, cSt	69.25
Viscosity, Kinematic, at 85°F, ASTM D 445.c, cSt	48.77
Viscosity, Kinematic, at 95°F, ASTM D 445.c, cSt	37.72
Viscosity, Kinematic, at 105°F, ASTM D 445.c, cSt	29.07
Viscosity, Kinematic, at 115°F, ASTM D 445.c, cSt	22.79
Viscosity, Kinematic, at 125°F, ASTM D 445.c, cSt	18.51

Respectfully submitted
For Texas OilTech Laboratories, L.P.

A. Phillip Sorurbakhsh
Director of Laboratory Operations

Cert. No.: 0005085, 17025
Quality Management System Certified to ISO 9001:2008, and ISO 17025:2005

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

James E. Bruya, Ph.D.
Charlene Morrow, M.S.
Yelena Aravkina, M.S.
Bradley T. Benson, B.S.
Kurt Johnson, B.S.

3012 16th Avenue West
Seattle, WA 98119-2029
TEL: (206) 285-8282
FAX: (206) 283-5044
e-mail: fbi@isomedia.com

March 31, 2010

Emery Lawson, Project Manager
Ecosystems Strategies, Inc.
24 Davis Avenue
Poughkeepsie, NY 12603

Dear Ms. Lawson:

Included are the results from the testing of material submitted on February 25, 2010 from the 49 Dupont Street/SB09110, F&BI 002242 project. The product samples submitted for forensic evaluation arrived in good condition. Upon arrival, the samples RW-12 and MW-4 were placed in a refrigerator maintained at 4°C until removed for sample processing.

The samples RW-12 and MW-4 were diluted and analyzed for semivolatile organic compounds with library search using a gas chromatograph fitted with a mass spectrometer (GC/MS). The results of this testing are enclosed.

Review of the GC/MS results generated shows that the majority of material present in the samples RW-12 and MW-4 is consistent with carboxylic acid esters. Phthalates are in the class of compounds known as carboxylic acid esters.

In addition, review of the GC/MS results generated shows that the sample RW-12 also contains material which appears to be a high boiling petroleum based oil. Selective ion monitoring was performed on this sample to determine if this oil is paraffinic or naphthenic in nature. Review of the data generated shows that this sample contains a prominent pattern of material with a M/Z ratio of 43, 57, 71, and 85. These ions are consistent with paraffinic material.

Emery Lawson
March 31, 2010
Page 2

Please contact us if additional consultation is needed by our firm in the interpretation of the analytical results provided. We appreciate this opportunity to be of service to you and hope you will call if you should have any questions. We will hold your samples for 30 days before disposal unless directed otherwise.

Sincerely,

FRIEDMAN & BRUYA, INC.

Bradley T. Benson
Chemist

Enclosures
mcp/BTB
NAA0331R.DOC

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

GC/MS Library Search Compound Report By EPA Method 8270D

Client Sample ID:	RW-12	Client:	Ecosystems Strategies, Inc.
Date Received:	02/25/10	Project:	49 Dupont Street, F&BI 002242
Date Extracted:	03/02/10	Lab ID:	002242-01 1/100
Date Analyzed:	03/02/10	Data File:	030213.D
Matrix:	Product	Instrument:	GCMS3
Units:	mg/kg (ppm)	Operator:	YA

Tentative ID	CAS #	Qual.	Conc.
1,2-Benzenedicarboxylic acid, decyl hexyl ester	025724-58-7	64	26,000
1,2-Benzenedicarboxylic acid, isodecyl octyl ester	001330-96-7	64	25,000
1,2-Benzenedicarboxylic acid, diisononyl ester	028553-12-0	64	24,000
1,2-Benzenedicarboxylic acid, bis(4-methylpentyl) ester	000146-50-9	64	20,000
Bis(2-ethylhexyl) phthalate	000117-81-7	53	15,000
1,2-Benzenedicarboxylic acid, butyl 8-methylnonyl ester	000089-18-9	64	14,000
Cyclopropanenonanoic acid, 2-[(2-butylcyclopropyl)methyl]-, methyl ester	010152-69-9	95	12,000
1,2-Benzenedicarboxylic acid, diisononyl ester	028553-12-0	72	11,000
1,2-Benzenedicarboxylic acid, isodecyl octyl ester	001330-96-7	59	7,900
1,2-Benzenedicarboxylic acid, bis(1-methylheptyl) ester	000131-15-7	59	6,300
1,2-Benzenedicarboxylic acid, isodecyl octyl ester	001330-96-7	72	5,700
1,2-Benzenedicarboxylic acid, isodecyl octyl ester	001330-96-7	64	5,000
1,2-Benzenedicarboxylic acid, diisooctyl ester	027554-26-3	50	4,700
1,2-Benzenedicarboxylic acid, bis(8-methylnonyl) ester	000089-16-7	59	4,300

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

GC/MS Library Search Compound Report By EPA Method 8270D

Client Sample ID:	MW-4	Client:	Ecosystems Strategies, Inc.
Date Received:	02/25/10	Project:	49 Dupont Street, F&BI 002242
Date Extracted:	03/02/10	Lab ID:	002242-02 1/100
Date Analyzed:	03/02/10	Data File:	030214.D
Matrix:	Product	Instrument:	GCMS3
Units:	mg/kg (ppm)	Operator:	YA

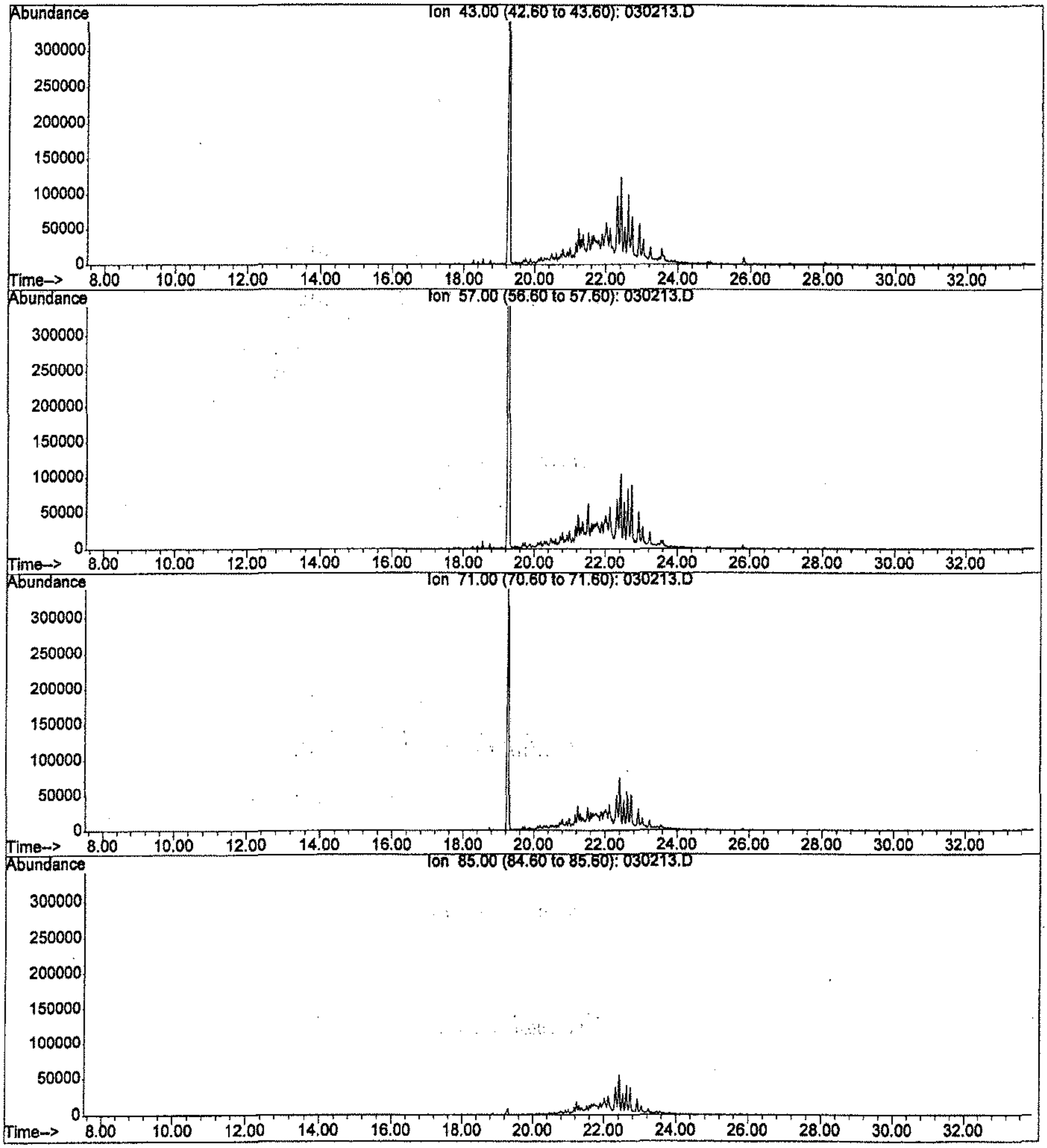
Tentative ID	CAS #	Qual.	Conc.
Hexanedioic acid, mono(2-ethylhexyl) ester	004337-65-9	64	96,000
Phosphoric acid, tris(2-ethylhexyl) ester	000078-42-2	72	63,000
1,2-Benzenedicarboxylic acid, bis(1-methylheptyl) ester	000131-15-7	80	43,000
Cyclopropanenonanoic acid, 2-[(2-butylcyclopropyl)methyl]-, methyl ester	010152-69-9	59	40,000
1,2-Benzenedicarboxylic acid, diheptyl ester	003648-21-3	78	37,000
1,2-Benzenedicarboxylic acid, bis(4-methylpentyl) ester	000146-50-9	50	26,000
1,2-Benzenedicarboxylic acid, isodecyl octyl ester	001330-96-7	72	25,000
1,2-Benzenedicarboxylic acid, diheptyl ester	003648-21-3	86	15,000
1,2-Benzenedicarboxylic acid, isode isodecyl octyl ester	001330-96-7	78	11,000
1,2-Benzenedicarboxylic acid, butyl octyl ester	000084-78-6	64	10,000
1,2-Benzenedicarboxylic acid, bis(4-methylpentyl) ester	000146-50-9	64	9,900
1,2-Benzenedicarboxylic acid, decyl octyl ester	000119-07-3	72	9,300
1,2-Benzenedicarboxylic acid, bis(1-methylheptyl) ester	000131-15-7	72	9,200
1,2-Benzenedicarboxylic acid, isodecyl octyl ester	001330-96-7	72	6,800
1,2-Benzenedicarboxylic acid, diheptyl ester	003648-21-3	78	4,400

Analysis For Semivolatile Compounds By EPA Method 8270D

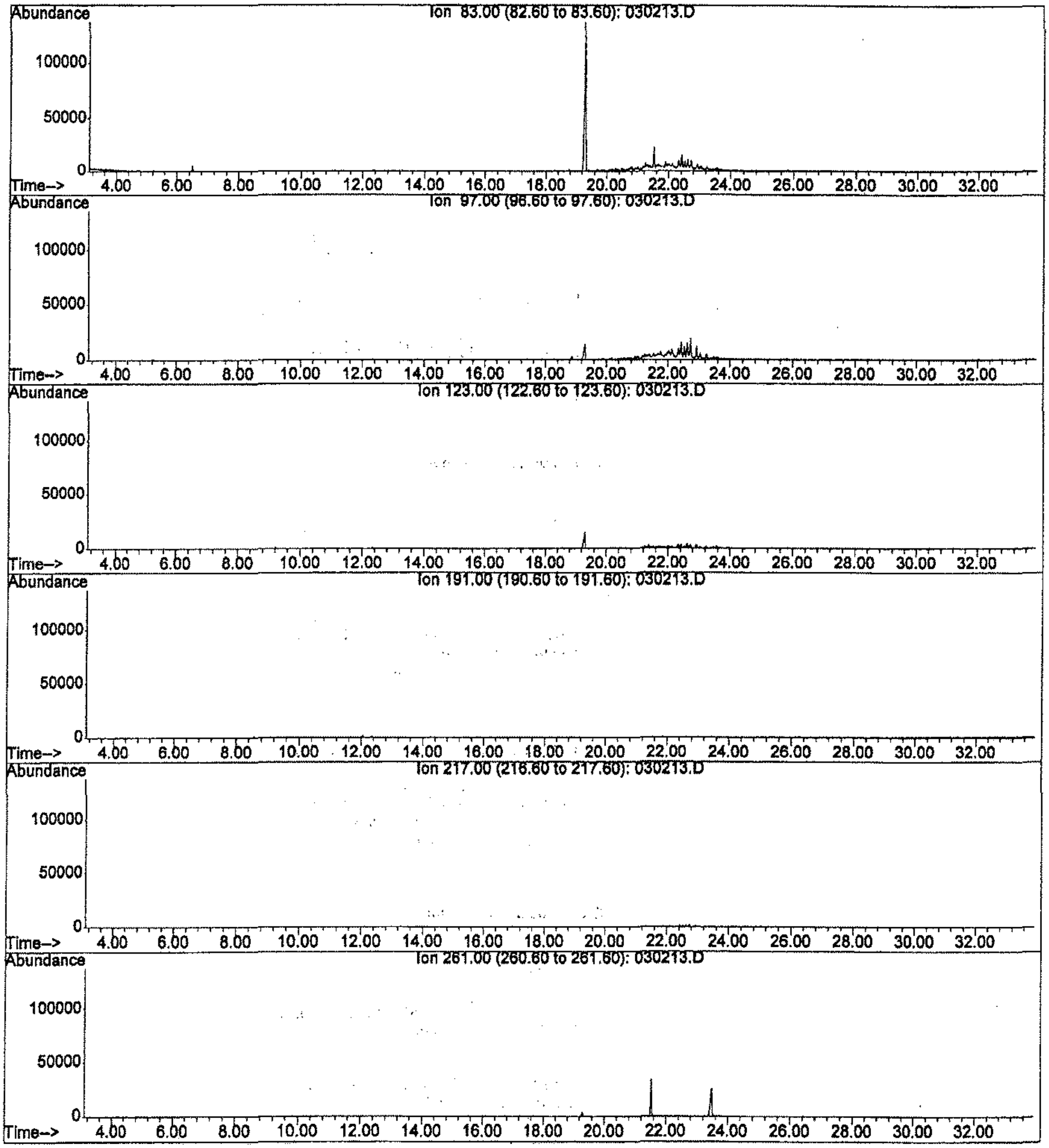
Client Sample ID:	Method Blank	Client:	Ecosystems Strategies, Inc.
Date Received:	Not Applicable	Project:	49 Dupont Street, F&BI 002242
Date Extracted:	03/02/10	Lab ID:	00293mb
Date Analyzed:	03/02/10	Data File:	030210.D
Matrix:	Product	Instrument:	GCMS3
Units:	mg/kg (ppm)	Operator:	YA

Note: There were no library search compounds detected.

File   : D:\DATA\03-02-10\030213.D
Operator   : YA
Acquired   : 2 Mar 2010   7:07 pm using AcqMethod 0222BNA
Instrument :   GCMS3
Sample Name: 002242-01 1/100
Misc Info   : product
Vial Number: 10



File   : D:\DATA\03-02-10\030213.D
Operator   : YA
Acquired   : 2 Mar 2010   7:07 pm using AcqMethod 0222BNA
Instrument :   GCMS3
Sample Name: 002242-01 1/100
Misc Info   : product
Vial Number: 10



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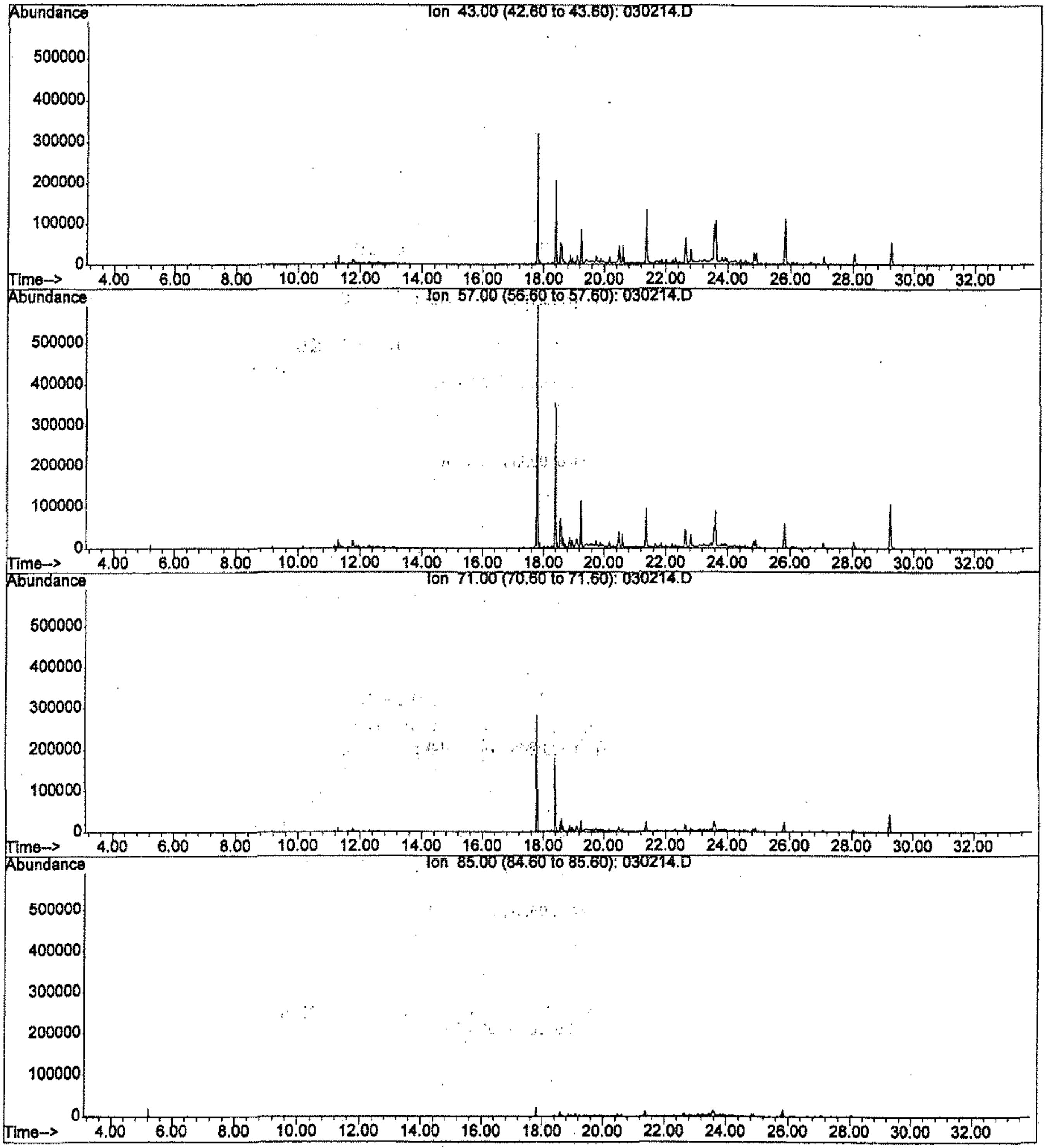
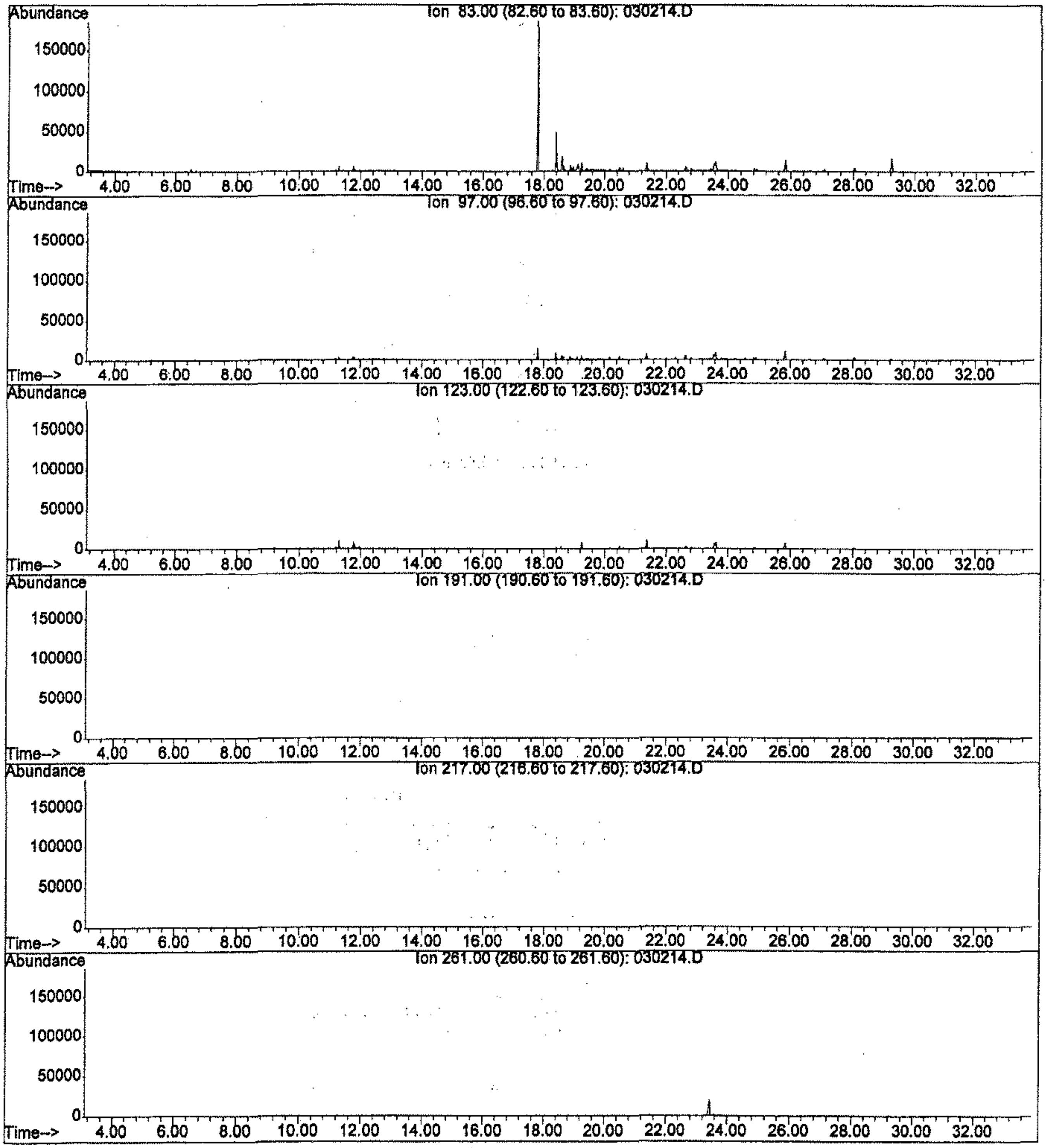
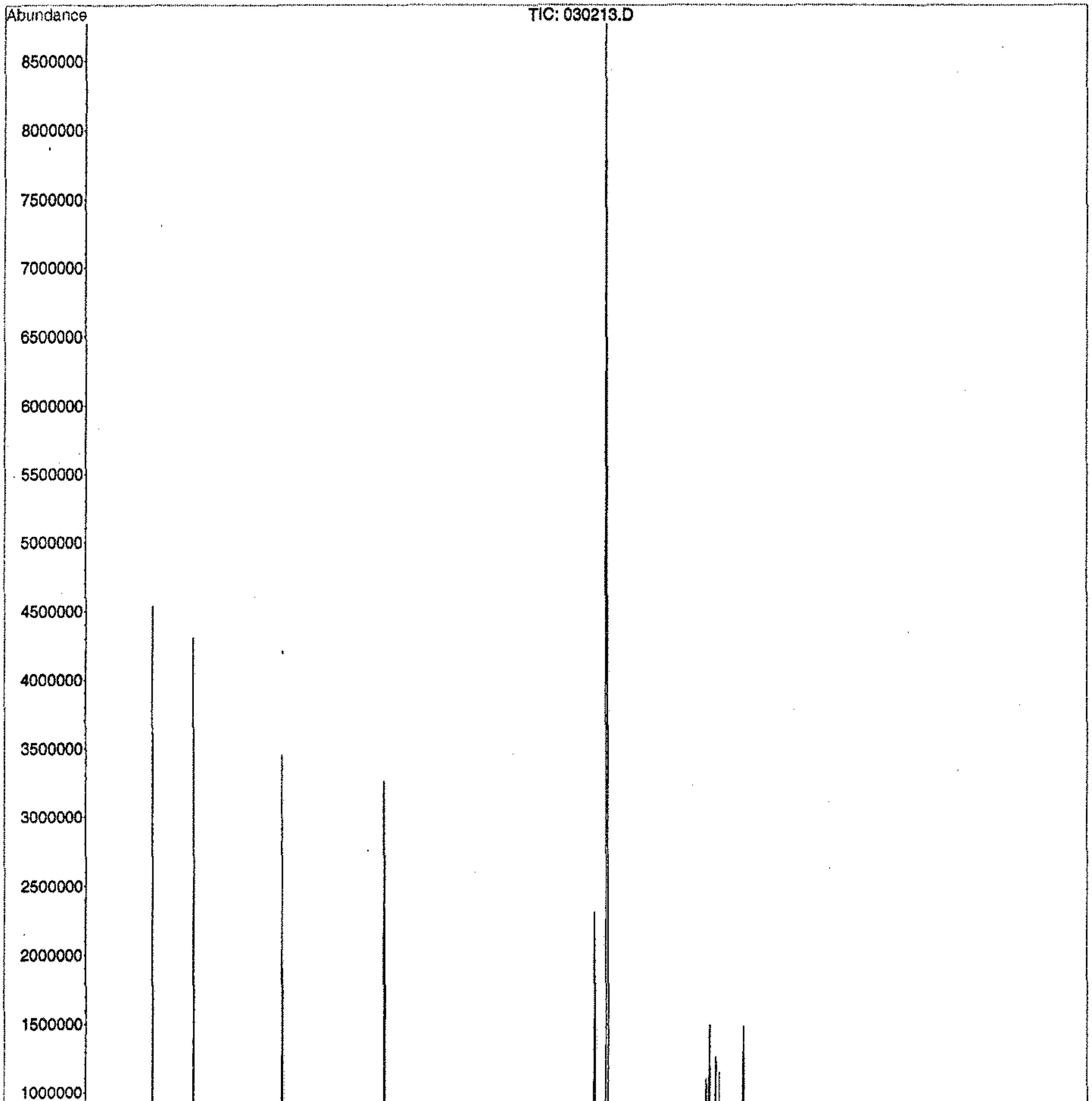
File        : D:\DATA\03-02-10\030214.D
Operator    : YA
Acquired    :  2 Mar 2010   7:48 pm using AcqMethod 0222BNA
Instrument  :   GCMS3
Sample Name: 002242-02 1/100
Misc Info   : product
Vial Number: 11
```



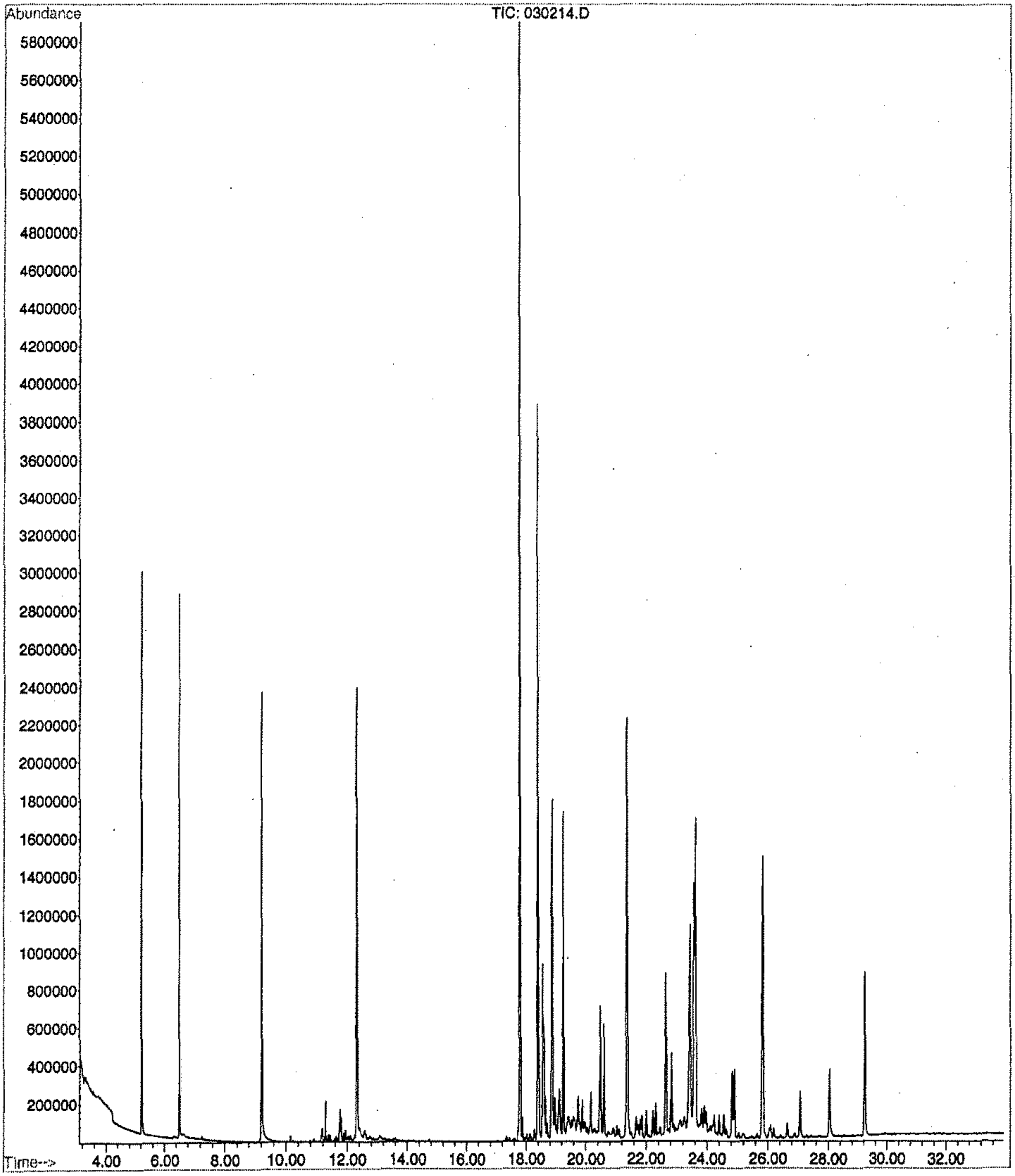
```
File         : D:\DATA\03-02-10\030214.D
Operator     : YA
Acquired     :  2 Mar 2010   7:48 pm using AcqMethod 0222BNA
Instrument :   GCMS3
Sample Name: 002242-02 1/100
Misc Info  : product
Vial Number: 11
```



File   : F:\DATA\03-02-10\030213.D
Operator   : YA
Acquired   : 2 Mar 2010   7:07 pm using AcqMethod 0222BNA
Instrument :   GCMS3
Sample Name: 002242-01 1/100
Misc Info   : product
Vial Number: 10



```
File        : F:\DATA\03-02-10\030214.D
Operator    : YA
Acquired    :  2 Mar 2010   7:48 pm using AcqMethod 0222BNA
Instrument  :   GCMS3
Sample Name: 002242-02 1/100
Misc Info   : product
Vial Number: 11
```



002242

Send Report To

Company Ecosystems Strategies, Inc.

Address 24 Davis Avenue

City, State, ZIP Poughkeepsie, New York 12603

Phone # (845)452-1658 Fax # (845)-485-7083

CHAIN OF COUSTODY

MP 02/25/10 D02

Page # 1 of 1

SAMPLERS (*signature*) Em Jansen

PROJECT NAME/NO.	PO #
49 Dupont Street / SB09110	

REMARKS

TURNAROUND TIME
X Standard (2 Weeks)
☐ RUSH
Rush charges authorized by:

SAMPLE DISPOSAL
☐ Dispose after 30 days
☐ Return samples
X Will call with instructions

Sample ID	Lab ID	Date Sampled	Time Sampled	Sample Type	# of containers	TPH-Diesel	TPH-Gasoline	BTEX by 8021B	VOCs by 8260	SVOCs by 8270	HFS	GC/MS Fingerprint						Notes
RW-12	01	2/15/10	10:45	Free Product	1, 8oz							X						
MW-4	02	2/22/10	11:22	Free Product	1, 8oz							X						

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282
Fax (206) 283-5044

SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by:				
Received by:	Nhan Phan	FeBI	2/25/10	1500
Relinquished by:				
Received by:			Samples received at 20 °C	

FORMS\COC\COC.DOC

FPM group — Engineering and Environmental Science

FPM Group, Ltd.
FPM Engineering Group, P.C.
formerly Fanning, Phillips and Molnar

CORPORATE HEADQUARTERS
909 Marconi Avenue
Ronkonkoma, NY 11779
631/737-6200
Fax 631/737-2410

VIA EMAIL

May 28, 2015

Mr. Bryan Wong, Environmental Engineer
New York State Department of Environmental Conservation
Division of Environmental Remediation, Region 2
47-40 21st Street
Long Island City, NY 11101

Re: **Test Pit Report**
Former NuHart Plastic Manufacturing Site, NYSDEC #224136
280 Franklin Street, Brooklyn, New York
FPM File No. 1134g-14-06

This Test Pit Report (TPR) has been prepared by FPM Group (FPM) to describe the procedures and results of performing a test pit in the area where the floating phthalate/Hecla oil mixture (product) is present in the subsurface at the above-referenced Site. The test pit was performed in accordance with the February 9, 2015 Test Pit Work Plan, conditionally approved by the New York State Department of Environmental Conservation (NYSDEC) on February 18, 2015. Any deviations from the work plan and conditions of approval are discussed below.

The below-described test pit activities were observed and documented by an FPM Qualified Environmental Professional (QEP), and an FPM QEP has certified this report, as noted below. The Community Air Monitoring Plan (CAMP) for this Site was also implemented by FPM during test pit activities. The NYSDEC was notified in advance of field activities and NYSDEC representatives were present to observe the activities.

Purpose of Test Pit

The purposes of the test pit were to obtain information from field observations of the product as follows:

- Depth to and visible thickness of the smear zone in the soil above and below the water table. This information will be used to assist in the assessment of the depth to which excavation may be needed if the removal of visibly-impacted soil is conducted, and assessment of the volume of visibly-impacted soil that may be present;

- Visible thickness of product on the water table in the test pit area. This information will be used together with product apparent thickness information from nearby wells to assist in the assessment of the actual thickness of product that may be present on the water table surface; and

- Subjective observations of product mobility, odor, and other features that may affect evaluation and implementation of remedial alternatives.

The test pit results will be used in discussions with the NYSDEC and others concerning the product associated with the Site and will be integrated with other Site information during the evaluation of remedial alternatives in the Feasibility Study (FS) for this Site.

Test Pit Activities

The test pit was performed on February 12, 2015 in the southwestern portion of the Site building in proximity to several recovery wells (RW-9, RW-12, RW-11, RW-3 and RW-10) and in the vicinity of closed tanks (tanks 8 through 15 and 17) that formerly contained phthalates and Hecla oil (see Figure 1, attached). Product apparent thicknesses in the recovery wells in this area were significant and had ranged between approximately 3.4 and 5.6 feet in recent months.

Prior to commencing test pit activities the One-Call Center was notified to mark out utilities in the surrounding streets. These markings were observed and there were no indications of potential utilities in the work area. A representative of the Site owner was also questioned and reported no active utilities in the work area.

The depth to product and depth to groundwater were then measured to the nearest 0.01 foot in each well inside of the Site building within the product area using an interface probe. The resulting measurements are shown on Table 1 (attached). As these measurements were obtained relative to the top of each well casing, the height of each well casing above or below the surface of the building slab was measured such that all depth measurements (test pit and wells) could be referenced to the top of the building slab as a datum. The measurements referenced to the building slab are also shown on Table 1. We note that the slab surface in the test pit area has been surveyed (June 10, 2014, NY Land Surveying, PC) and found to be at an elevation of 13.53 feet (NAD 1988). The elevation measurements obtained in this area of the Site building were also converted to reference this datum, as shown on Table 1.

CAMP activities were also initiated, including monitoring for organic vapors using a calibrated photoionization detector (PID). No organic vapors were detected at any point during the test pit activities and no significant odors with the potential to impact the surrounding community were noted. Dust monitoring was not performed as all activities took place inside of the building, none of the soil was very dry, and no visible dust was observed at any point during the test pit activities. No complaints of any kind were received.

As a precautionary measure, and in accordance with one of the NYSDEC conditions for approval of the test pit work plan, an odor suppressant spray (BioSolv Pinkwater) was maintained onsite in proximity to the test pit in a spray application bottle. Odors were monitored as the test pit was advanced. Although contaminated soil and product were encountered, the odor was not particularly noticeable and odor suppression was not required. Following the completion of test pit activities the BioSolv Pinkwater was applied to the surface of the backfilled excavation and surrounding area as a precautionary measure.

The test pit excavation and materials management was performed by Eastern Environmental Solutions, Inc. Following selection of the test pit location the building slab was saw cut and the concrete pieces laid to the side on the concrete slab. No significant indications of potential impacts were noted in association with the concrete and no building infrastructure, piping, utilities or other potential obstructions were noted beneath the slab. Plastic sheeting (double layer) was then placed on the concrete slab on one side of the test pit and excavation commenced in a stepwise manner, with the removed soil placed onto the plastic sheeting. The removed soil was observed and screened by FPM personnel, and was also observed by NYSDEC representatives and Site owner representatives. Measurements were made of the depths to soil layers and fluids in the test pit using a measuring tape and the observations were recorded for later compilation into a test pit log, as discussed below. Measurements were referenced to the top of the building slab. Photographs were also taken to document the observations. Once visibly-impacted soil was identified a second area of plastic sheeting (double layer) was placed on the concrete surface on the other side of the test pit and visibly-impacted soil was segregated and placed onto this second laydown area. Once fluids were encountered the wet soil was placed into the center of this second laydown area. No fluid run-off occurred from the laydown areas or the test pit.

Following completion of the test pit, as controlled by the behavior of the deepest soil encountered (discussed below), the test pit was observed for indications of fluid inflow. The test pit was then backfilled, with the visibly-impacted soil placed into the bottom of the test pit and covered with plastic sheeting, followed by placement of the overlying soil and another layer of plastic sheeting, and completed with placement of the concrete fragments of the building slab on top of the replaced materials. All excavated materials were placed back into the test pit excavation; no investigation-derived soil or fluids were generated or stockpiled. A field crew cleaned the work area during this process using brooms to ensure that all materials were returned to the test pit and BioSolv Pinkwater was applied to the completed backfilled test pit, as described above.

Test Pit and Product Observations

The materials encountered in the test pit were logged by QEP, as documented in the attached Test Pit Log. Photographs showing aspects of the test pit activities are included in the attached photolog. The outdoor weather during test pit activities was sunny, cold (reportedly 36 to 47 degrees F, with an average of 42 degrees F), and windy (8 mph northwest wind, gusting to 33 mph). Conditions inside of the building were noted to be colder than outdoors, likely due to thermal inertia from the cold building slab.

The following observations were noted from the test pit:

- Although staining and odors were noted at two intervals in the test pit (top of clay at about 5.75 feet and about 12.5 feet, just above the top of the product), no organic vapors were detected by the PID. The odors were observed to be moderate in proximity to the removed stained materials, but were not perceived to extend beyond the immediate area of the test pit or impacted soil pile. Odor was not noticeable at a short distance from the stained materials.

- Historic fill containing significant amounts of anthropogenic debris, ash, and cinders is present to a depth of about five feet in the test pit area. This material did not exhibit any significant odors or staining.

- Native soil, including silty fine sand and clay, is present beneath the fill to a depth of about 10.5 feet in the test pit area. No visible indications of potential impacts were noted in this soil with the exception of some minor staining and odor at the top of the clay; these impacts did not appear to extend significantly into the clay.

- Native material that appears to be glacial till (an apparently unsorted mixture of fine to coarse-grained materials ranging from silt up to cobbles) is present from about 10.5 feet to at least 14 feet in the test pit area. This material is extremely loose and was noted to run into the test pit as each bucket of soil was removed, preventing further advancement of the test pit without shoring to retain the till. This material was repeatedly removed from the test pit, resulting in some undermining beneath the clay interval without making further progress beyond 14 feet where the test pit was terminated. Some staining and odor were noted on the till materials starting at about 12.5 feet (smear zone) and product was confirmed to be present at 13.5 feet.

- The product was noted to consist of dark brown oily fluid with an approximate consistency of used motor oil. The product was noted to coat the materials removed from below 13.5 feet, but was not observed to run off of the backhoe bucket. At the bottom of the test pit the product was noted to ooze or trickle into the test pit, forming small areas of accumulation. Although the test pit was observed for about 30 minutes while open to 14 feet, during this time the product did not enter sufficiently to form a continuous layer at the bottom of the pit. No product was removed from the pit, other than the product adhering to the removed soil, which was replaced into the pit.

Depth to product and water measurements were obtained from the wells in the product area, as described above and documented on Table 1. Observations from these measurements are as follows:

- Product was noted in all of the wells where product has previously been present and product remained absent in the two wells (RW-1 and MW-35) where it previously was absent.

- Product apparent thicknesses were significant in the test pit area, ranging from 2.30 feet at RW-12 up to 5.53 feet at RW-10.

- The depth to the top of the product relative to the top of the slab generally ranged from about 10.5 feet to 12.3 feet, with one location (RW-7) at 9.18 feet and one location (RW-11) at 10.45 feet.

- The depth to the top of the product relative to the top of the slab was 11.77 to 12.00 feet in the two wells closest to the test pit (RW-9 and RW-12, respectively) and 11.92 to 12.22 feet in the next closest wells (RW-10 and RW-3, respectively). In comparison, the depth to the top of the product (relative to the slab) was 13.5 feet in the test pit. Furthermore, staining and moderate odor associated with the product smear zone were not observed above 12.5 feet in the test pit.

Additional Product Thickness Information

Existing boring logs from previous investigations of the Site were reviewed to obtain additional information concerning product thickness to supplement the test pit data. All available boring logs in the product area within and directly adjacent to the Site were reviewed and the upper and lower limits of product indicators (staining, visible product, significant odors) were noted. This information is presented on Table 2 (attached) and the borings for which this information is available are annotated on the attached figure entitled "Fieldwork Map" (boring logs are available in the RI Report). As the depths of product indicators on the logs were referenced to the top of the building slab (or sidewalk, in one case), the elevations of the top of the slab/sidewalk at each boring location were obtained from a June 10, 2014 survey of the Site and vicinity (relative to NAD 1988) to derive the elevations of the top and bottom of the product-impacted interval, as shown on Table 2.

We note the following from this information:

- Information concerning the depth and thickness of the product-impacted interval is available from 8 borings scattered throughout the onsite product area and from one boring next to the Site building. This information covers the area for which product thickness and depth information is needed for the Site;

- If the top of product indicator depth information is discounted from borings that were performed next to former tanks (from which releases likely occurred), it appears that the product-impacted interval ranges from about 0.5 to 2 feet thick throughout the product area. This is very consistent information, given the inherent nature of the boring process and the variability of subsurface materials beneath the Site; and

- The top of the product-impacted zone, although somewhat variable, is found at an average elevation of about 0 and generally extends to elevation -0.5 to -2. The top of the interval is consistent with the test pit observations.

Based on this information, it is our opinion that existing boring logs provide sufficient information to estimate the top and bottom elevations of the product-impacted zone with some reliability throughout the portions of the Site where product is present. It does not appear that additional investigations (borings or test pits) are needed as the existing data provide sufficient information in the area of interest.

Discussion

These above-described observations indicate the following:

- Historic fill containing debris and other materials is present beneath the Site building slab. Native soil (silty sand, clay and till) is present beneath the historic fill. In the test pit area these materials did not show any significant indications of potential product contamination above the smear zone. This suggests that the soil beneath the Site slab and above the smear zone is not likely to be impacted by the product except in areas where releases occurred and the product migrated downward from tanks, piping, trenches or other structures that formerly contained product. Observations of the historic fill suggest that the fill is likely to contain constituents commensurate with its origin.

- A smear zone (stained soil with moderate odor but no free product) was noted to extend from about 12.5 to 13.5 feet below the top of the slab in the test pit area. Product was encountered at 13.5 feet and extended to at least 14 feet in the test pit area. No organic vapors were detected by the PID in association with any of the product or stained materials encountered in the test pit. Odors were observed to be moderate in proximity to stained materials, but were not perceived to extend beyond the immediate area of the test pit or impacted soil pile. Odor was not noticeable at a short distance from the stained materials. These observations suggest that odors from exposed product-impacted materials may not present a significant concern.

- The product consists of dark brown oily fluid with an approximate consistency of used motor oil, which is consistent with previous visual observations of the product. The product observed in the test pit did not appear to be highly mobile, which is also consistent with the product testing results previously reported (February 23, 2015). The extent of product within the Site building at the time the test pit was performed was the same as during previous monitoring events.

- The test pit was performed in an area where a significant apparent thickness of product was documented via the wells and, therefore, was appropriately located to address the purposes of the test pit.

- The actual depth to the product in the formation (13.5 feet below the slab, approximate elevation of 0 feet relative to NAD 1988) as noted in the test pit is somewhat greater (about 1.5 to 2 feet) than indicated by the measurements in the closest nearby wells. Therefore, it appears that the depth to product as measured in the wells is somewhat in error, as is typical of product measurements in wells. The actual depth to the product is likely to be greater than reported in the wells, perhaps by 1.5 to 2 feet. For planning purposes, it can be conservatively assumed that the actual depth to the product is about 1.5 feet greater than reported in the wells. The smear zone above the product can be assumed to be about one foot thick.

- Boring logs throughout the product area indicate that product-impacted interval ranges from about 0.5 to 2 feet thick. The top of the product-impacted zone is generally found at about elevation 0 (consistent with the test pit) and generally extends to elevation -0.5 to -2.

This information will be incorporated into the analysis of potential remedies in the FS.

Deviations from the Approved Work Plan and NYSDEC Conditions

There were no deviations from the NYSDEC-approved work plan or conditions, with the exceptions described below. These deviations did not significantly impact either the work performed or the resulting data.

- The work plan included provisions for performing at least one and possibly up to two test pits during the designated field day, depending on access, timing, and other considerations. One test pit was performed as the Site conditions (building access, need to clear the work area, thickness of the concrete slab) precluded conducting additional test pits during the designated field day. The test pit location was near the center of the product plume (most impacted area) and where several recovery wells are located (so as to facilitate comparison of test pit observations with well data). Therefore, this test pit provides sufficient data to meet the key work plan objectives.

- The work plan included extending test pits completely through the interval of product so as to evaluate the actual thickness of product in the formation. This objective could not be accomplished as the loose till below the clay layer ran into the test pit continuously, preventing further advancement of the test pit without shoring (shoring was not planned or envisioned to be necessary). However, the data obtained from the test pit as completed provides a significant amount of information concerning the actual depth of the product relative to information from the surrounding wells. In addition, a number of boring logs in the product area provide information concerning the actual thickness of the product in the formation, as discussed above. It is concluded that sufficient information is available from a combination of the test pit and boring log data.

- The work plan included a provision to obtain water and product level measurements from the nearby wells following the completion of the test pits. However, as the test pit activities did not include the removal of product or extending the test pit significantly into the product layer (which might have resulted in changes in the depth or apparent thickness of product in nearby wells), these additional measurements were not deemed to be necessary.

- The NYSDEC in its approval letter recommended (but did not require) installing wire-wound PVC screens and coarse backfill in the test pits to enhance LNAPL recovery under the Interim Remedial Measure (IRM) currently implemented at the Site. This is a reasonable recommendation if the test pit(s) were performed in areas without existing LNAPL recovery wells. However, as the test pit was located in immediate proximity (within approximately 15 to 20 feet) of two existing recovery wells, a PVC screen was not installed in the completed test pit as installation of an additional well at this location would not significantly enhance LNAPL recovery. LNAPL recovery via wells under the IRM is anticipated to be replaced by more comprehensive and effective remedial measures for the LNAPL recovery.

Certification

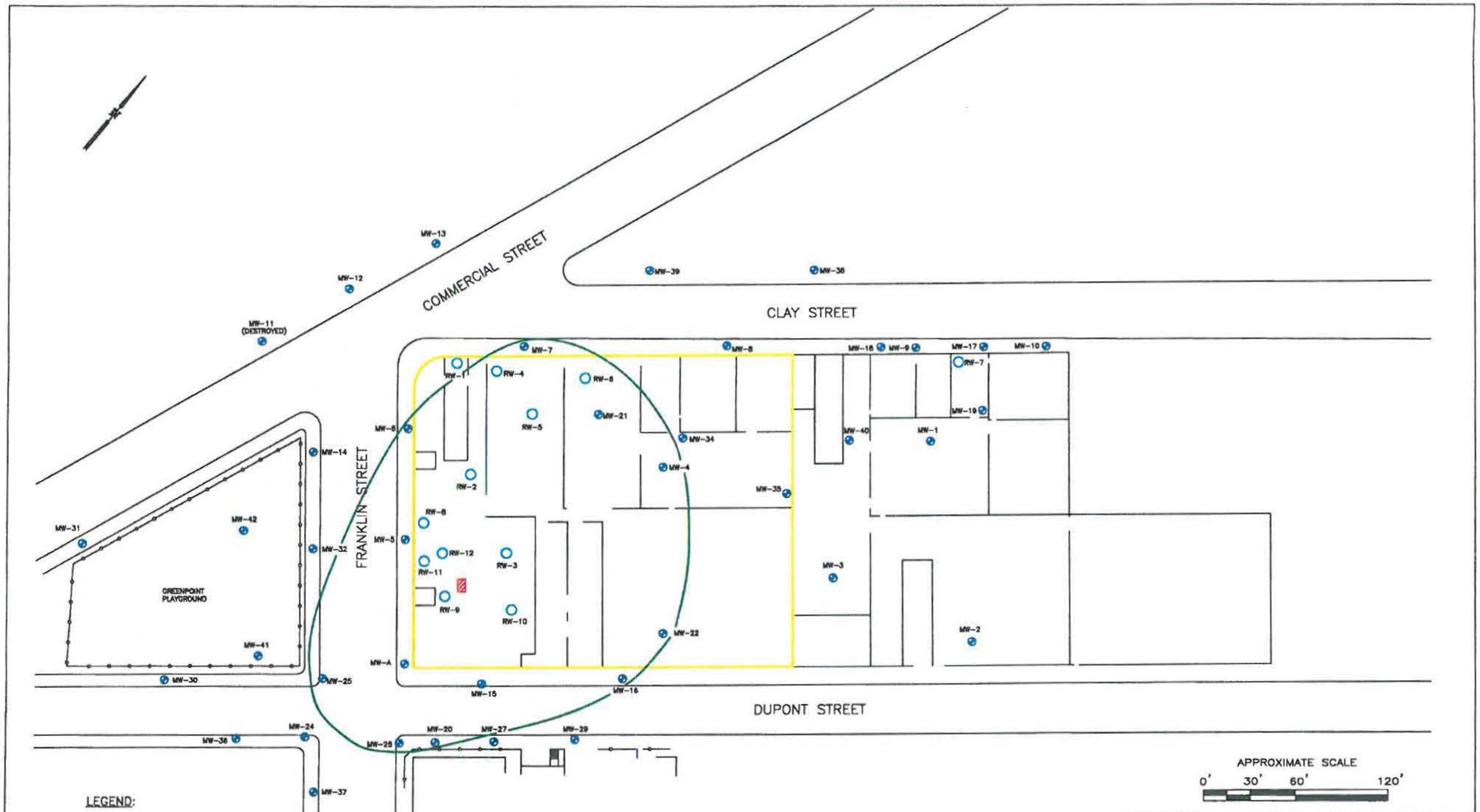
I, Stephanie O. Davis, CPG, certify that I am currently a Qualified Environmental Professional as defined in 6 NYCRR Part 375 and that this Test Pit Report was prepared in accordance with all applicable statues and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10) and that all activities were performed in full accordance with the DER-approved work plan and any DER-approved modifications.

Stephanie O. Davis, CPG
Name

[signature]
Signature

Attachments

SOD:tac



FPM GROUP

FIGURE 1
TEST PIT LOCATION
FORMER NuHART PLASTIC MANUFACTURING FACILITY
280 FRANKLIN STREET, BROOKLYN, NY

Drawn By: H.C.	Checked By: S.D.	Date: 3/24/15

H:\DUPONT\ADDITIONAL TCE 1134g-15-12\TEST PIT LOCATION 1134g-15-10.dwg, 3/24/2015 11:19:44 AM, Tabloid

Ecosystems Strategies, Inc.

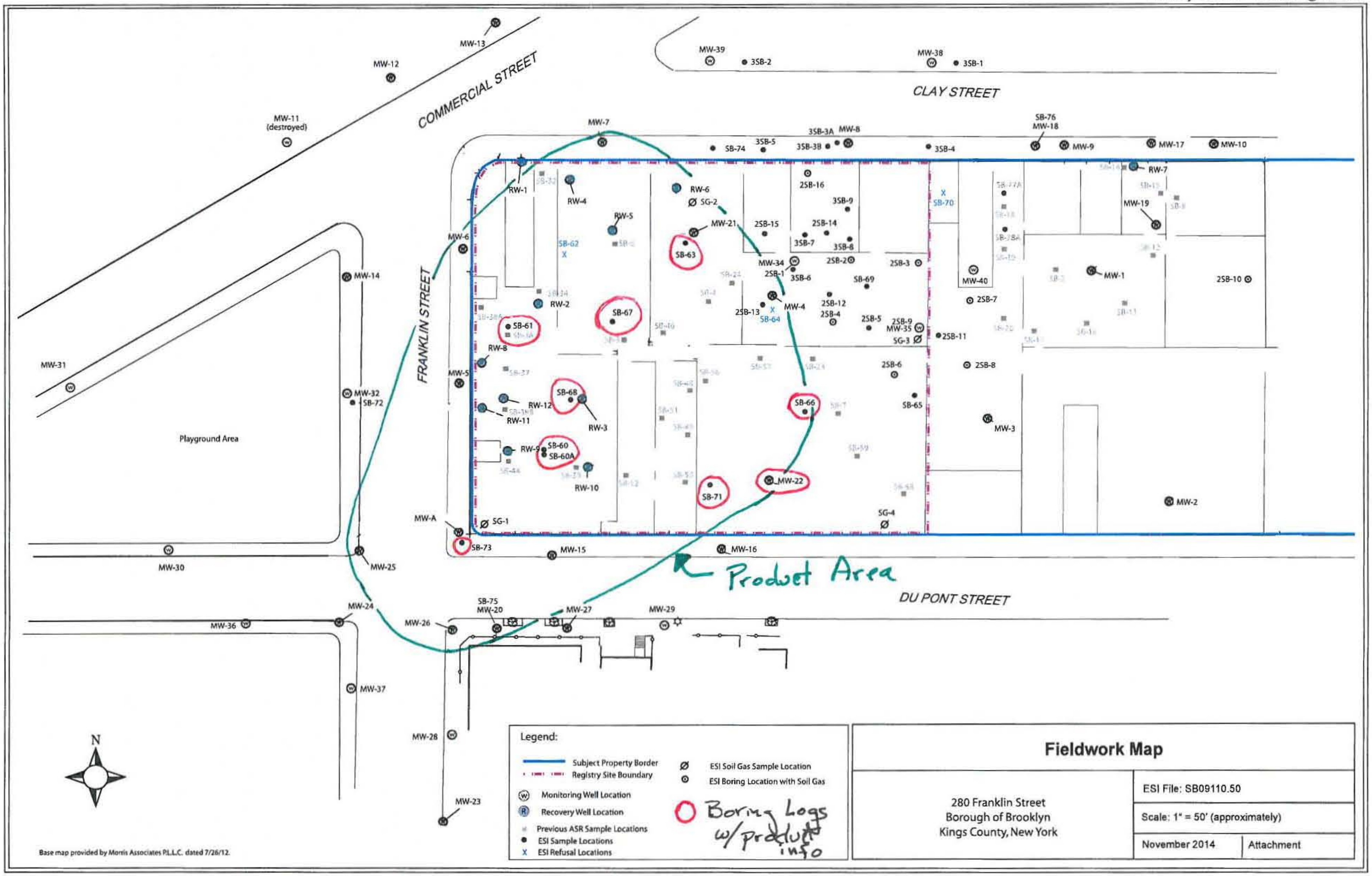


TABLE 1
WATER AND PRODUCT MEASUREMENTS
FORMER NUHART PLASTIC MANUFACTURING SITE NYSDEC #224136
280 FRANKLIN STREET, BROOKLYN, NY

Well No.	Screen Diameter (inches)	Depth to Product from TOC (ft)	Depth to Water from TOC (ft)	TOC Height from Slab (ft)	Depth to Product From Slab (ft)	Depth to Water From Slab (ft)	Apparent Elevation of Top of Product (NAD 1988)	Apparent Elevation of Top of Water (NAD 1988)	Product Apparent Thickness (ft)
MW-21	2	11.48	14.62	-0.25	11.73	14.87			3.14
MW-22	2	12.10	12.90	-0.17	12.27	13.07			0.80
MW-35	2	-	14.31	+3.00	-	-			-
RW-1	4	-	8.85	-2.92	-	-			-
RW-2	4	13.75	18.65	+1.67	12.08	16.98			4.90
RW-3	4	15.05	18.45	+2.83	12.22	15.62	1.31	-2.09	3.40
RW-4	4	14.85	18.00	+2.83	12.02	15.17			3.15
RW-5	4	13.65	18.00	+2.08	11.57	15.92			4.35
RW-6	4	11.65	12.70	-0.17	11.82	12.87			1.05
RW-7	4	9.10	**	-0.08	9.18	**			**
RW-8	4	13.88	15.8	+1.83	12.05	13.97	1.48	-0.44	1.92
RW-9	4	13.35	18.25	+1.58	11.77	16.67	1.76	-3.14	4.90
RW-10	4	13.17	18.70	+1.25	11.92	17.45	1.61	-3.92	5.53
RW-11	4	12.12	16.65	+1.67	10.45	14.98	3.08	-1.45	4.53
RW-12	4	13.00	15.30	+1.00	12.00	14.30	1.53	-0.77	2.30

Notes:

All measurements obtained on March 12, 2015.
TOC = Top of casing.
- = No measurable product.
** = Unable to measure depth to water due to product sticking to the probe.
Apparent elevations are provided for those wells located within the building slab in the southwest portion of the Site where the top of slab is surveyed at elevation 13.53 (NAD 1988)

TABLE 2
PRODUCT OBSERVATIONS FROM BORING LOGS
FORMER NUHART PLASTIC MANUFACTURING SITE, NYSDEC #224136
280 FRANKLIN STREET, BROOKLYN, NY

Boring/Well No.	Depth to Top of Product Indicators from Slab Top (ft)	Depth to Bottom of Product Indicators from Slab Top (ft)	Thickness of Impacted Interval (ft)	Elevation of Top of Slab (NAD 1988)	Elevation of Top of Product Indicators (NAD 1988)	Elevation of Bottom of Product Indicators (NAD 1988)
SB-60 *	4	14	10	13.53	9.53	-0.47
SB-61 *	11.5	15	3.5	13.53	2.03	-1.47
SB-63	15	17	2	14.80	-0.20	-2.20
SB-66	15	15.5	0.5	14.07	-0.93	-1.43
SB-67	14	14.75	0.75	13.53	-0.47	-1.22
SB-68	13.5	14	0.5	13.53	0.03	-0.47
SB-71 *	13	16	3	14.07	1.07	-1.93
SB-73	12	14	2	13.23	1.23	-0.77
MW-22 *	10	14	4	14.07	4.07	0.07

Notes:

All measurements obtained from ESI boring logs in RI Report.

* = Well is next to closed UST - product thickness may reflect a release area.

Elevations are derived from June 10, 2014 survey of building slab relative to NAD 1988.

Shaded values represent the most accurate information regarding overall thickness and depth of the product-impacted interval from the boring logs.

TEST PIT LOG

FPM ENGINEERING GROUP, PC
Ronkonkoma, NY

FPM PROJECT	Former NuHart Plastic Manufacturing	**FPM JOB #**	1134G-15-10
SITE ADDRESS	280 Franklin Street, Brooklyn, NY	**DATE**	3/12/15
TEST PIT NO.	TP-1	**TOTAL DEPTH (ft)**	14
SURFACE ELEV.	13.53 (bldg. floor, 6/10/14 survey)	**WATER LEVEL INITIAL**	13.5 ft (product)
WIDTH (ft)	5	**STATIC WATER LEVEL**	13.5 ft (product)
LENGTH (ft)	8		
EXCAVATION CO.	Eastern Environmental Solutions, Inc.	**EXCAVATION METHOD**	Backhoe - extended arm
OPERATOR	Brian Little	**LOG BY**	SOD - FPM

DEPTH (feet relative to top of concrete slab)	USCS CLASSIFICATION	PID (ppm)	DESCRIPTION (Soil type, color, moisture content, odor, staining, etc.)
	Concrete		**0 to 0.5' Concrete Slab**
1	**Fill**	0	**0.5 to 4.75' Fill** Medium brown to black and gray sand and gravel with ash, cinders, wood, brick and concrete fragments. Dry to slightly moist. No odor. Historic fill. PID = 0 throughout.
2		0	
3		0	
4		0	
5	**SM**	0	**4.75' to 5.75' SM** Reddish brown silty fine sand. Dry to slightly moist. No odor or stain. PID = 0.
6	**CL with intervals of SM**	0	**5.75' to 10.5' CL with intervals of SM** Gray clay. Dark (minor stain) at top with some petro odor. PID = 0. Odor decreasing downward. Moist. Cohesive. Intervals of brown to reddish brown fine silty sand. No odor or stain. PID = 0 throughout.
7		0	
8		0	
9		0	
10		0	
11	**GM (till)**	0	**10.5' to 14' GM (till)** Dark gray coarse to fine gravel, coarse to fine sand and silt mixture with cobbles and mica. Moist to very moist. Wet (product) at about 13.5'. Staining and moderate odor starting at 12.5'. Loose - running into pit. PID = 0 throughout.
12		0	
13	▼	0	
14			Bottom of Test Pit

Photolog of Test Pit Activities
Former NuHart Plastic Manufacturing Site
NYSDEC #224136
280 Franklin Street, Brooklyn, NY

Photo #1 – Soil pile consisting of historic fill and native soil.

Photo #2 – Bucket of till soil with cobbles visible. Darker areas are stained with product.

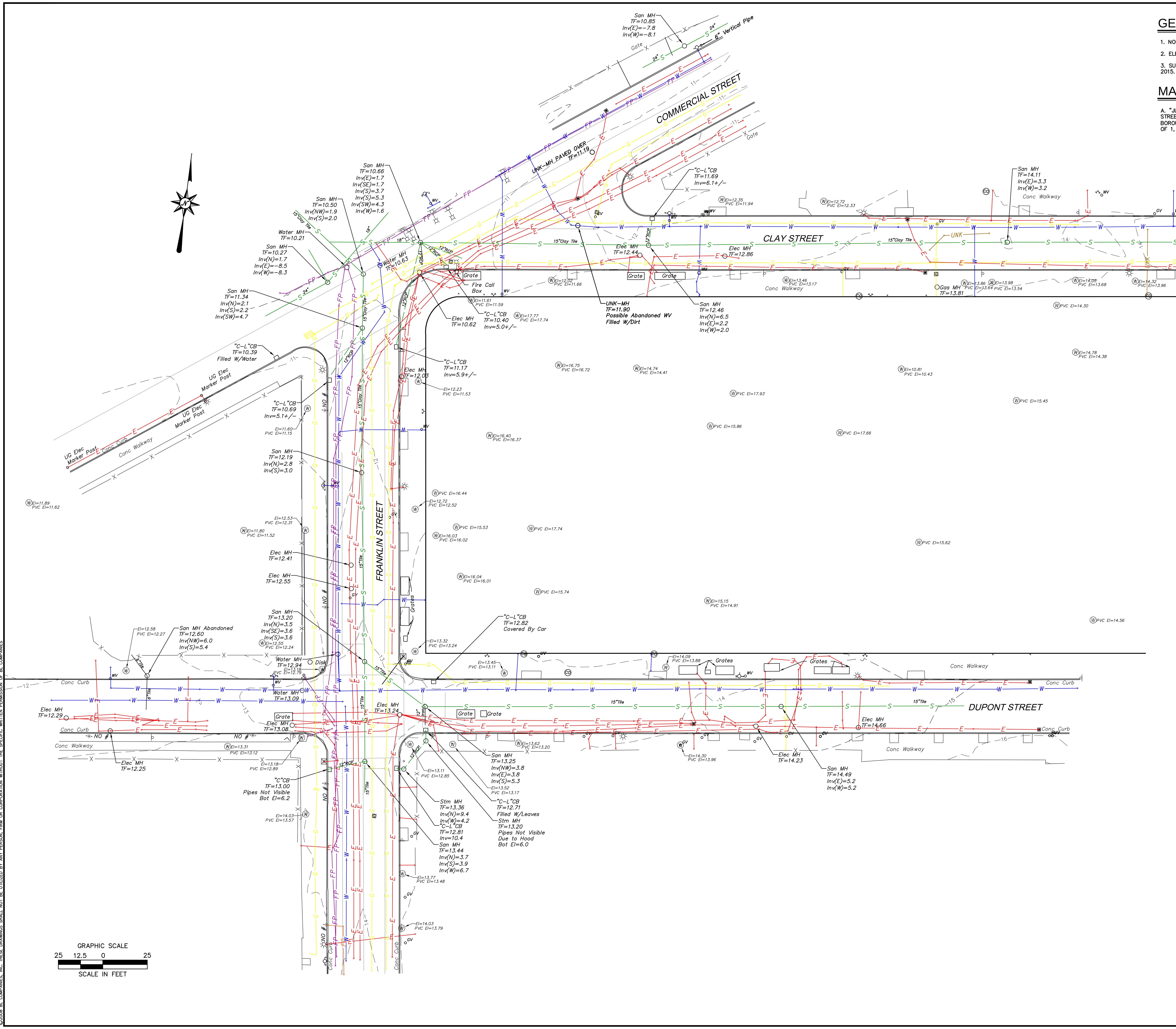
FPM

Photo #3 – Complete test pit. Visible stratigraphy includes historic fill (gray, at top), native sand/silt (tan), clay (gray), and till (bottom of pit). Product can be discerned as small shiny areas at the bottom of the pit.

Photo #4 – Cleanup after test pit was backfilled. Laydown area for contaminated material was located between the pit and the backhoe bucket. Biosolv Pinkwater is being applied.

Photo #5 – Cleaned laydown area for unimpacted soil.

Photo #6 – Test pit area upon completion of activities.



GENERAL NOTES

1. NORTH ARROW BASED ON NEW YORK STATE PLANE COORDINATE SYSTEM NAD83.
2. ELEVATIONS BASED ON NAVD88 PER MAP REFERENCE A.
3. SUBSURFACE UTILITY MARK-OUT AND LOCATION WAS PERFORMED IN SEPTEMBER, 2015.

MAP REFERENCE

A. "JUNE 10, 2014; TOPOGRAPHIC SURVEY; PROPERTY SITUATED AT 28 FRANKLIN STREET; 10, 14, 22, 26, 30 & 32 CLAY STREET; 47, 55 & 57 DUPONT STREET; BOROUGH OF BROOKLYN; COUNTY OF KINGS; CITY & STATE OF NEW YORK" SHEET 1 OF 1, PREPARED BY NY LAND SURVEYOR P.C.

LEGEND

- Major Contour
- Minor Contour
- Fence
- Sanitary Sewer
- Underground Electric Line
- Gas Line
- Water Line
- Fire-Protection Line
- Fiber Optic Telecommunications Line
- Storm Sewer
- Underground Utility – Type Unknown
- Handhole
- Utility Pole
- Light Pole
- Light on Parapet
- Manhole
- Cleanout
- Catch Basin
- Water Valve
- Fire Hydrant
- Fire Connection – Double
- Gas Valve
- Gas Test Station
- Span Pole
- Cantilever Pole
- Monitoring Well
- Valve- Utility Type Unknown
- Sign
- Bollard

- Approximate Edge of Pipe per Record Information
- Approximate Edge of Ductbank per Record Information
- Utility Line Continues
- Utility Line Ends
- End of Subsurface Geophysical Information
- End of Record Information
- No Record Information
- Field-located MH Cover
- Approximate Location of Underground Vault per Record Dimensions

UTILITY QUALITY LEVELS

- MH(R) Quality Level D
- MH Quality Level C
- MH Quality Level B — Point of Quality Level B Designation
- MH Quality Level A — Point of Quality Level A Designation

BL Companies
ARCHITECTURE
ENGINEERING
ENVIRONMENTAL
LAND SURVEYING

355 Research Parkway
Meriden, CT 06450
(203) 630-1406
(203) 630-2615 Fax

49 DUPONT STREET AND VICINITY

BROOKLYN, NEW YORK

REVISIONS

No.	Date	Desc.

Surveyed	GN/TW
Drawn	EB
Checked	MG
Approved	MG
Scale	1" = 25'
Project No.	15S2603
Date	10/26/15
Field Book	GN
CAD File:	XY15S260301

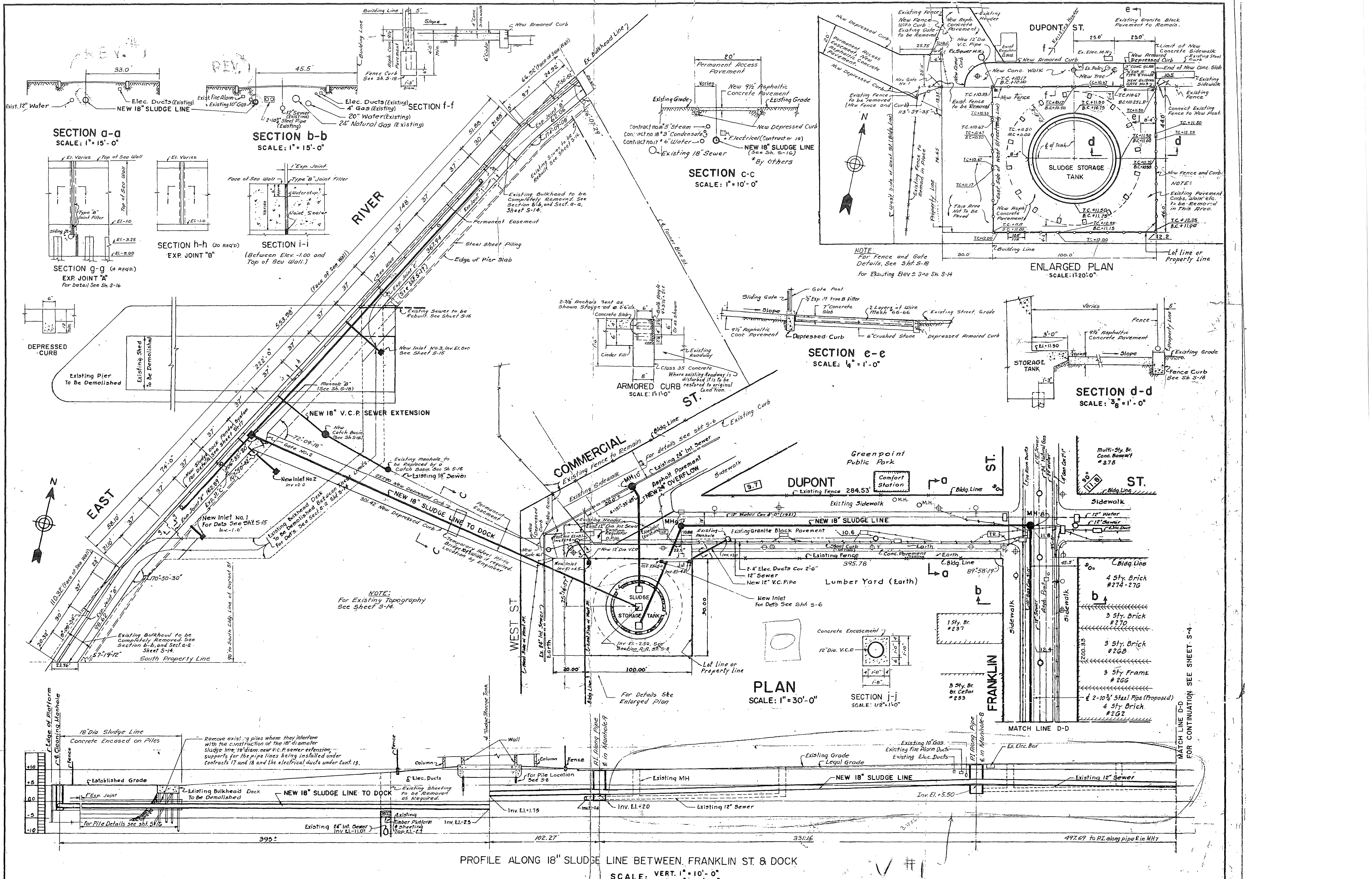
Title

EXISTING CONDITIONS SURVEY

Sheet No.

EX-1

Xref (s): : 2487xte



NO.	DATE	DESCRIPTION	APPR'D.
1	3/24/66	MANHOLE NO. 8 & FLOOR EL. RAISED FROM EL.-2.0 TO EL.+4.0. SLUDGE LINE EL. ALONG FRANKLIN ST. & DUPONT ST. RAISED FROM APPROX. EL.+0.0 TO APPROX. EL.+5.00.	

REVISIONS

SCALE: AS SHOWN

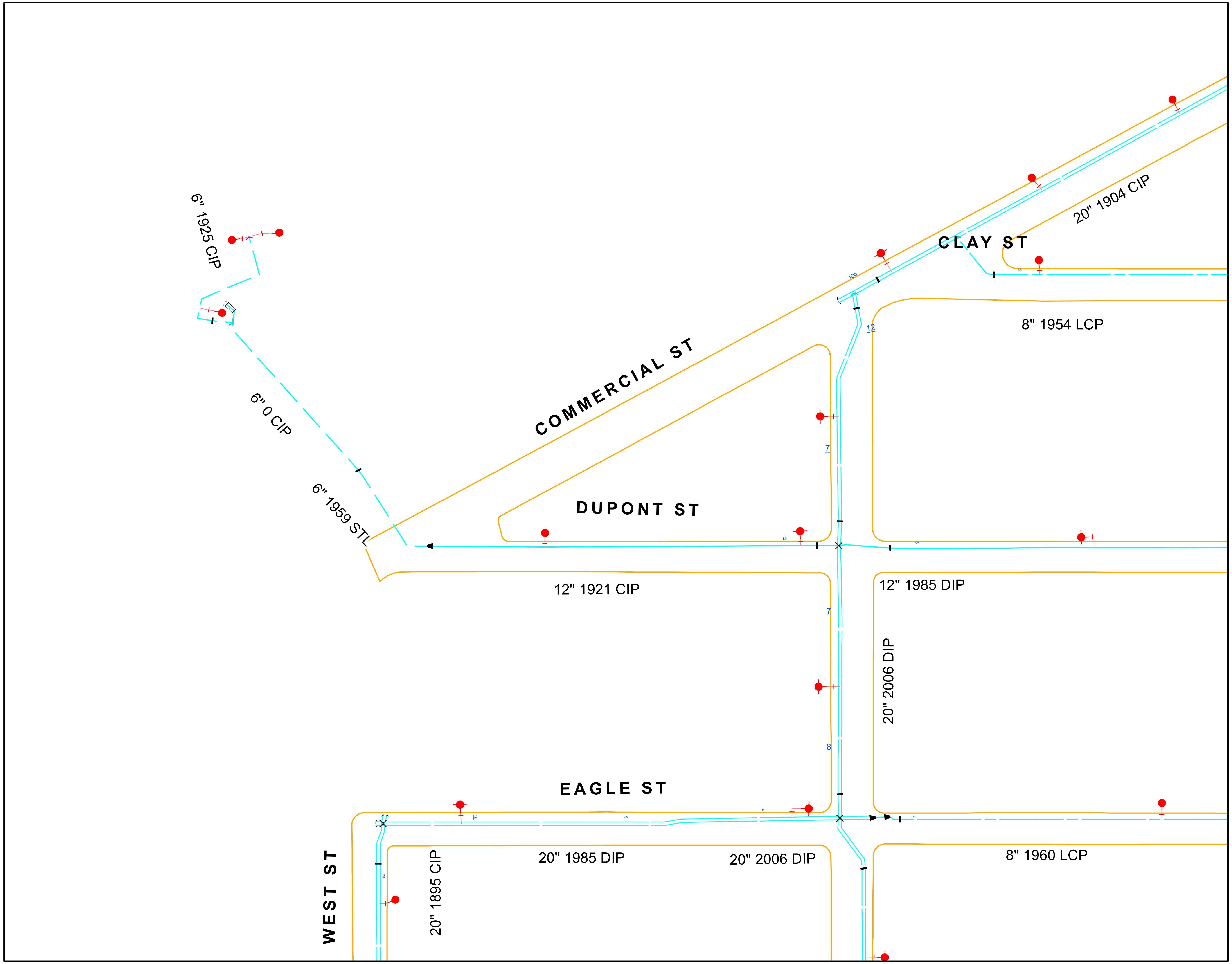
CITY OF NEW YORK
DEPARTMENT OF PUBLIC WORKS
BUREAU OF WATER POLLUTION CONTROL
DIVISION OF PLANT DESIGN
P.W. 53 NEWTOWN CREEK POLLUTION CONTROL PROJECT

CONTRACT NO. 16 STRUCTURES & EQUIPMENT
SLUDGE LINE, STORAGE TANK, & DOCKING FACILITIES - EAST RIVER
FRANKLIN ST., DUPONT ST., & DOCK SITE
PLAN, PROFILE & DETAILS

DATE MAY 1964
SHEET S-5 OF 21

30" x 40"

PRELIM.



Water Map Legend

Valve Type and Status V100392 22 EN/5 SS

- Butterfly, Open
- Butterfly, Boundary
- Butterfly, Closed
- Check, Open
- LH Gate, Open
- LH Gate, Closed or Boundary
- Gate Open
- Gate, Closed or Boundary

Water Connections

- 3 Way
- 4 Way
- Bulkhead
- CAP
- Eccentric Reducer
- Reducer
- Plug
- Riser
- Manifolds / Reducer Bank
- Wet Connection
- Expansion Joint
- Terminus

BO Discharge and Valve

- BLIND
- Direct to Sewer
- Direct to Unknown
- Direct to Waterway
- POT to Sewer
- POT to Waterway
- BO Valve O2048

Appurtenance

- Access Manhole
- Aqualog
- Electrolysis Connection
- Gauge/Meter
- Pitot Chamber
- Vent
- Venturi Tube
- Water Fed Transformer
- Street Washer

Hydrants H435123

- Breakaway
- Standard
- Unknown
- Hydrant Gate

Structures and Miscellaneous

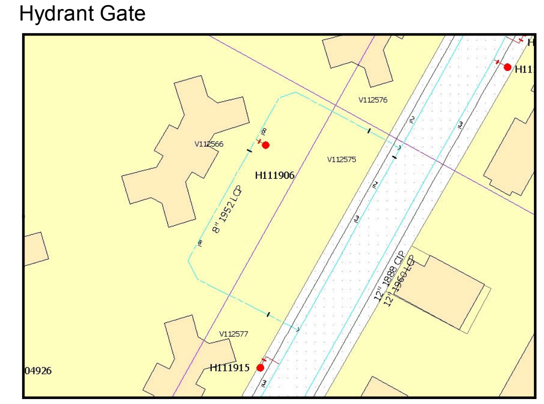
- Tank
- Well
- Sampling Station 7356A
- Regulator R5025
- Shaft, Chamber, Vault, Etc

General WaterMain Sizes (in inches)

Aqueduct, 96, 84, 72, 66, 60, 54, 48, 42, 36, 30, 24, 20, 18, 16, 14, 12, 10, 8, 6, 4, 3, <3

Base Map Layers

- Railroad (NYCMAP)
- Road Edge (NYCMAP)
- Borough Boundary
- City Tile Boundary (NYCMAP)
- Buildings (NYCMAP)
- Open Space (NYCMAP)
- Tax Lot (COGIS)
- Elevated Transportation Structures (NYCMAP)



"Curb dimensions may exist in the water data in areas where there are not curb lines in the current NYCMAP landbase transportation edge layer. This may be because the curbs no longer exist or they are not in NYCMAP because the roadways are private or newly constructed"

Water Mapping

NYC Environmental Protection

NYC Department of Environmental Protection
Bureau of Water and Sewer Operations
59-17 Junction Boulevard, 3rd Floor
Corona, NY 11373-5108

Datum:
NAD_1983
StatePlane_New_York_Long_Island
FIPS_3104_Feet

N W E S

Map Printed: 3/5/2013

50 25 0 50 100 150 200 250 300
Feet

Brooklyn Pressure Gradient Colors: K02, K03, K05, K06
Bronx Pressure Gradient Colors: X01, X03, X04, X06, X07
Manhattan Pressure Gradient Colors: M01, M02, M03, M04, M06, M07
Queens Pressure Gradient Colors: Q01, Q02, Q03, Q04, Q05, Q06, Q07, Q08, Q09, Q10
Staten Island Pressure Gradient Colors: R03, R04, R05, R06, R07, R08, R09

Pipe Material

DIP	Ductile Iron Pipe	ACP	Asbestos Concrete Pipe	LCP	Lined Cast Iron Pipe
CIP	Cast Iron Pipe	RCP	Reinforced Concrete Pipe	STL	Steel Pipe
PVC	Polyvinyl Chloride Pipe	COP	Copper Pipe	TRN	Transite Pipe

PWM - Private Water Main
IWM - Internal Water Main

This map is intended to be a schematic representation of the water system ONLY, and is not warranted to be accurate for construction and/or surveying purposes.

Groundwater Elevations
Former NuHart Plastic Manufacturing Site, NYSDEC #224136
280 Franklin Street, Brooklyn, NY

Well Number	Ground Surface Elevation	PVC Elevation	PVC Elevation Updated 11/12/15	Depth to Product	Depth to Water	Groundwater elevation	Depth to Product	Depth to Water	Groundwater elevation	Depth to Product	Depth to Water	Groundwater elevation	Depth to Product	Depth to Water	Groundwater elevation	Depth to Product	Depth to Water	Groundwater elevation	Depth to Product	Depth to Water	Groundwater elevation
				March 26, 2015			April 23, 2015			August 28, 2015			September 14, 2015			October 15, 2015			November 12, 2015		
MW – A	13.32	13.24	13.24	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	11.02	14.19	-
MW -1	-	15.45	15.45	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	10.97	4.48
MW - 2	-	14.56	14.56	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	9.39	5.17
MW - 3	-	15.62	15.62	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW – 4	-	15.86	14.43	12.79	13.35	-	-	-	-	12.70	14.92	-	12.81	14.58	-	12.97	14.96	-	11.77	13.81	-
MW – 5	12.72	12.52	12.52	10.81	13.91	-	8.65	11.20	-	9.62	14.07	-	9.77	14.03	-	9.96	14.12	-	10.18	15.59	-
MW – 6	12.23	11.53	11.53	9.52	11.00	-	9.01	10.59	-	8.71	##	-	8.88	—	-	9.04	-	-	9.31	—	-
MW – 7	12.02	11.66	11.66	9.79	11.58	-	9.48	11.42	-	9.02	10.30	-	9.15	10.61	-	9.21	11.79	-	9.38	12.69	-
MW – 8	13.46	13.17	13.17	ND	9.79	3.38	ND	9.59	3.58	ND	10.00	3.17	ND	10.14	3.03	ND	10.17	3.00	ND	11.41	1.76
MW – 9	13.98	13.54	13.54	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.19	—	-
MW–10	14.32	13.96	13.96	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	9.35	4.61
MW – 12	-	-	-	ND	7.81	-	ND	7.71	-	-	-	-	-	-	-	-	-	-	ND	7.62	-
MW – 13	-	-	-	ND	7.54	-	ND	7.48	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	7.78	-
MW – 14	11.60	11.15	11.15	ND	8.73	2.42	ND	8.37	2.78	ND	8.44	2.71	ND	8.67	2.48	ND	8.78	2.37	ND	9.00	2.15
MW – 15	13.45	13.11	13.11	10.88	12.55	-	10.64	12.20	-	10.35	11.40	-	10.50	11.55	-	10.64	12.61	-	10.82	13.89	-
MW – 16	14.09	13.88	13.88	11.71	11.79	-	10.89	10.92	-	11.05	11.10	-	11.17	11.22	-	11.38	11.50	-	11.61	11.63	-
MW – 17	14.05	13.68	13.68	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	9.28	4.4
MW – 18	13.86	13.64	13.64	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	10.09	3.55
MW - 19	14.78	14.38	14.38	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10.01	-	-
MW – 20	13.52	13.17	13.17	9.38	13.76	-	9.17	13.01	-	10.29	13.41	-	10.45	13.70	-	10.62	13.95	-	10.87	13.89	-
MW – 21	14.74	14.41	14.41	11.75	15.21	-	11.15	14.13	-	11.30	14.62	-	11.52	15.15	-	11.51	16.02	-	11.73	15.58	-
MW – 22	15.15	14.91	14.91	12.46	13.79	-	11.88	12.62	-	12.04	13.08	-	12.14	13.31	-	12.32	12.81	-	12.62	13.63	-
MW – 23	14.03	13.79	13.79	ND	11.26	2.53	ND	10.90	2.89	ND	11.00	2.79	ND	11.15	2.64	ND	11.33	2.46	ND	11.58	2.21
MW – 24	13.18	12.89	12.89	ND	10.41	2.48	ND	10.10	2.79	ND	10.16	2.73	ND	10.31	2.58	ND	10.50	2.39	ND	10.73	2.16
MW – 25	13.18	12.79	12.79	12.09	13.16	-	9.82	13.18	-	9.91	13.59	-	10.08	13.61	-	10.28	13.91	-	10.53	14.06	-
MW – 26	13.11	12.85	12.85	10.57	14.71	-	9.93	13.57	-	9.97	13.67	-	10.12	14.12	-	10.31	14.08	-	10.56	14.64	-
MW – 27	13.62	13.20	13.20	ND	10.68	2.52	ND	10.49	2.71	ND	10.41	2.79	ND	10.57	2.63	ND	10.74	2.46	ND	10.98	2.22
MW – 28	13.77	13.48	13.48	ND	11.01	2.47	ND	10.66	2.82	ND	10.92	2.56	ND	10.89	2.59	ND	11.06	2.42	ND	11.32	2.16
MW – 29	14.30	13.96	13.96	ND	11.31	2.65	ND	11.02	2.94	ND	11.07	2.89	ND	11.21	2.75	ND	11.38	2.58	ND	11.59	2.37
MW – 30	12.58	12.27	12.27	ND	9.81	2.46	ND	9.49	2.78	ND	9.21	3.06	ND	9.69	2.58	ND	9.91	2.36	ND	10.16	2.11
MW – 31	11.89	11.62	11.62	ND	9.27	2.35	ND	9.13	2.49	ND	9.17	2.45	ND	9.09	2.53	ND	9.27	2.35	—	—	-
MW – 32	12.53	12.31	12.31	ND	9.94	2.37	ND	9.87	2.44	ND	9.64	2.67	ND	9.81	2.50	ND	9.97	2.34	ND	10.19	2.12
MW – 34	-	17.93	14.63	ND	15.21	2.72	ND	14.60	3.33	ND	14.88	3.05	ND	14.99	2.94	ND	15.07	2.86	ND	12.05	2.58
MW – 35	-	17.66	17.66	ND	14.79	2.87	ND	14.27	3.39	ND	14.60	3.06	ND	14.65	3.01	ND	14.75	2.91	ND	15.03	2.63
MW – 36	13.31	13.12	13.12	ND	10.61	2.51	ND	10.42	2.70	ND	10.42	2.70	ND	10.58	2.54	ND	10.76	2.36	ND	10.98	2.14
MW – 37	14.03	13.57	13.57	ND	11.21	2.36	ND	10.99	2.58	ND	10.84	2.73	ND	11.02	2.55	ND	11.19	2.38	ND	11.41	2.16
MW – 38	12.72	12.33	12.33	ND	9.31	3.02	ND	8.55	3.78	ND	9.10	3.23	ND	9.21	3.12	ND	9.20	3.13	ND	9.44	2.89
MW – 39	12.35	11.94	11.94	-	-	-	-	8.37	3.57	ND	8.89	3.05	ND	9.00	2.94	ND	9.00	2.94	ND	9.16	2.78
MW – 40	10.81	10.43	10.43	ND	7.29	3.14	ND	6.80	3.63	ND	7.22	3.21	ND	7.32	3.11	ND	7.42	3.01	—	—	-
MW – 41	12.55	12.24	12.24	ND	10.3	1.94	ND	9.46	2.78	ND	9.51	2.73	ND	9.71	2.53	ND	9.88	2.36	ND	10.11	2.13
MW – 42	11.80	11.52	11.52	ND	9.39	2.13	ND	8.76	2.76	ND	8.72	2.80	ND	8.97	2.55	ND	9.03	2.49	ND	9.38	2.14
RW – 1	11.61	11.59	11.59	ND	6.25	5.34	ND	8.80	2.79	ND	8.91	2.68	ND	9.04	2.55	ND	9.15	2.44	—	—	-
RW – 2	16.40	16.37	16.37	13.83	18.02	-	13.50	16.32	-	13.52	16.93	-	13.61	16.58	-	13.76	16.40	-	—	—	-
RW – 3	-	17.74	17.74	15.22	18.5	-	14.92	16.73	-	14.85	16.99	-	15.01	16.40	-	13.21	17.35	-	15.47	18.39	-
RW – 4	17.77	17.74	14.84	15.28	16.71	-	13.41	16.94	-	14.91	16.93	-	15.06	16.15	-	15.15	17.14	-	12.51	14.82	-
RW – 5	16.75	16.72	14.53	13.09	13.94	-	13.00	13.70	-	13.90	19.69	-	14.03	16.06	-	13.83	18.01	-	12.19	17.83	-
RW – 6	-	-	14.72	12.46	13.65	-	11.80	12.51	-	11.92	12.53	-	12.03	12.68	-	12.12	12.78	-	12.37	13.02	-
RW - 7	-	14.30	14.30	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.93	_	-
RW – 8 **	-	16.44	16.44	13.99	16.92	-	13.56	15.70	-	-	-	-	-	-	-	-	-	-	—	—	-
RW – 9	16.04	16.01	16.01	13.41	19.09	-	13.12	17.40	-	13.17	16.40	-	13.30	15.98	-	13.47	16.99	-	13.65	18.02	-
RW – 10	-	15.74	15.74	13.29	18.25	-	12.82	16.47	-	12.93	17.05	-	13.06	17.18	-	13.20	17.65	-	13.45	18.77	-
RW – 11	16.03	16.02	16.02	13.35	17.22	-	13.20	16.20	-	13.19	16.81	-	13.09	16.33	-	13.44	17.03	-	13.68	18.07	-
RW – 12 **	-	15.53	15.53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	—	—	-

Notes:

All measurements in feet.
Data recorded using an oil/water interface probe, measurements from the tops of well casings.
= LNAPL observed, depth not determined
ND = Not Detected
NA = Wells MW-1, MW-2, MW-3, MW-9, MW-10, MW-17, MW-18, MW-19 and RW-7 are associated with NYSDEC Spill ID 06-01852 and are under the scope of a separate investigation.
** = Well equipped with automated product recovery system
- = Not calculated or not recorded

ANALYTICAL REPORT

Lab Number:	L1522686
Client:	FPM Group 909 Marconi Avenue Ronkonkoma, NY 11779
ATTN:	George Holmes
Phone:	(631) 737-6200
Project Name:	DUPONT
Project Number:	1134G-15-11
Report Date:	09/24/15

Certifications & Approvals: MA (M-MA086), NY (11148), CT (PH-0574), NH (2003), NJ NELAP (MA935), RI (LAO00065), ME (MA00086), PA (68-03671), VA (460195), MD (348), IL (200077), NC (666), TX (T104704476), DOD (L2217), USDA (Permit #P-330-11-00240).

Eight Walkup Drive, Westborough, MA 01581-1019
508-898-9220 (Fax) 508-898-9193 800-624-9220 - www.alphalab.com

Project Name: DUPONT
Project Number: 1134G-15-11

Lab Number: L1522686
Report Date: 09/24/15

Alpha Sample ID	Client ID	Matrix	Sample Location	Collection Date/Time	Receive Date
L1522686-01	MW-25	OIL	BROOKLYN, NY	09/14/15 09:30	09/15/15
L1522686-02	C-1	OIL	BROOKLYN, NY	09/14/15 10:00	09/15/15
L1522686-03	C-2	OIL	BROOKLYN, NY	09/14/15 10:15	09/15/15
L1522686-04	C-3	OIL	BROOKLYN, NY	09/14/15 10:30	09/15/15
L1522686-05	MW-21	OIL	BROOKLYN, NY	09/14/15 11:00	09/15/15
L1522686-06	MW-22	OIL	BROOKLYN, NY	09/14/15 11:30	09/15/15
L1522686-07	RW-9	OIL	BROOKLYN, NY	09/14/15 12:00	09/15/15

Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet all of the requirements of NELAC, for all NELAC accredited parameters. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. Tentatively Identified Compounds (TICs), if requested, are reported for compounds identified to be present and are not part of the method/program Target Compound List, even if only a subset of the TCL are being reported. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively. When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report. All specific QC information is also incorporated in the Data Usability format of our Data Merger tool where it can be reviewed along with any associated usability implications. Soil/sediments, solids and tissues are reported on a dry weight basis unless otherwise noted. Definitions of all data qualifiers and acronyms used in this report are provided in the Glossary located at the back of the report.

In reference to questions H (CAM) or 4 (RCP) when "NO" is checked, the performance criteria for CAM and RCP methods allow for some quality control failures to occur and still be within method compliance. In these instances the specific failure is not narrated but noted in the associated QC table. The information is also incorporated in the Data Usability format of our Data Merger tool where it can be reviewed along with any associated usability implications.

Please see the associated ADEx data file for a comparison of laboratory reporting limits that were achieved with the regulatory Numerical Standards requested on the Chain of Custody.

HOLD POLICY
For samples submitted on hold, Alpha's policy is to hold samples (with the exception of Air canisters) free of charge for 21 calendar days from the date the project is completed. After 21 calendar days, we will dispose of all samples submitted including those put on hold unless you have contacted your Client Service Representative and made arrangements for Alpha to continue to hold the samples. Air canisters will be disposed after 3 business days from the date the project is completed.

Please contact Client Services at 800-624-9220 with any questions.

Project Name: DUPONT
Project Number: 1134G-15-11

Lab Number: L1522686
Report Date: 09/24/15

Case Narrative (continued)

Report Submission

All non-detect (ND) or estimated concentrations (J-qualified) have been quantitated to the limit noted in the MDL column.

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature: Cristin Walker

Title: Technical Director/Representative

Date: 09/24/15

ORGANICS

PCBS

Project Name: DUPONT **Lab Number:** L1522686
Project Number: 1134G-15-11 **Report Date:** 09/24/15

SAMPLE RESULTS

Lab ID:	L1522686-01	Date Collected:	09/14/15 09:30
Client ID:	MW-25	Date Received:	09/15/15
Sample Location:	BROOKLYN, NY	Field Prep:	Not Specified
Matrix:	Oil	Extraction Method:	EPA 3580A
Analytical Method:	1,8082A	Extraction Date:	09/21/15 14:04
Analytical Date:	09/22/15 17:59	Cleanup Method:	EPA 3665A
Analyst:	JW	Cleanup Date:	09/22/15
Percent Solids:	Results reported on an 'AS RECEIVED' basis.	Cleanup Method:	EPA 3660B
		Cleanup Date:	09/22/15

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		mg/kg	3.66	0.289	1	A
Aroclor 1221	ND		mg/kg	3.66	0.337	1	A
Aroclor 1232	ND		mg/kg	3.66	0.429	1	A
Aroclor 1242	ND		mg/kg	3.66	0.448	1	A
Aroclor 1248	ND		mg/kg	3.66	0.309	1	A
Aroclor 1254	ND		mg/kg	3.66	0.301	1	A
Aroclor 1260	ND		mg/kg	3.66	0.279	1	A
Aroclor 1262	ND		mg/kg	3.66	0.181	1	A
Aroclor 1268	ND		mg/kg	3.66	0.530	1	A
PCBs, Total	ND		mg/kg	3.66	0.181	1	A

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	109		30-150	A
Decachlorobiphenyl	104		30-150	A
2,4,5,6-Tetrachloro-m-xylene	127		30-150	B
Decachlorobiphenyl	120		30-150	B

Project Name: DUPONT | **Lab Number:** L1522686

Project Number: 1134G-15-11 | **Report Date:** 09/24/15

SAMPLE RESULTS

Lab ID:	L1522686-02	Date Collected:	09/14/15 10:00
Client ID:	C-1	Date Received:	09/15/15
Sample Location:	BROOKLYN, NY	Field Prep:	Not Specified
Matrix:	Oil	Extraction Method:	EPA 3580A
Analytical Method:	1,8082A	Extraction Date:	09/21/15 14:04
Analytical Date:	09/22/15 18:16	Cleanup Method:	EPA 3665A
Analyst:	JW	Cleanup Date:	09/22/15
Percent Solids:	Results reported on an 'AS RECEIVED' basis.	Cleanup Method:	EPA 3660B
		Cleanup Date:	09/22/15

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		mg/kg	3.90	0.308	1	A
Aroclor 1221	ND		mg/kg	3.90	0.360	1	A
Aroclor 1232	ND		mg/kg	3.90	0.457	1	A
Aroclor 1242	ND		mg/kg	3.90	0.478	1	A
Aroclor 1248	ND		mg/kg	3.90	0.329	1	A
Aroclor 1254	ND		mg/kg	3.90	0.321	1	A
Aroclor 1260	ND		mg/kg	3.90	0.297	1	A
Aroclor 1262	ND		mg/kg	3.90	0.194	1	A
Aroclor 1268	ND		mg/kg	3.90	0.566	1	A
PCBs, Total	ND		mg/kg	3.90	0.194	1	A

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	109		30-150	A
Decachlorobiphenyl	117		30-150	A
2,4,5,6-Tetrachloro-m-xylene	125		30-150	B
Decachlorobiphenyl	126		30-150	B

Project Name: DUPONT **Lab Number:** L1522686

Project Number: 1134G-15-11 **Report Date:** 09/24/15

SAMPLE RESULTS

Lab ID:	L1522686-03	Date Collected:	09/14/15 10:15
Client ID:	C-2	Date Received:	09/15/15
Sample Location:	BROOKLYN, NY	Field Prep:	Not Specified
Matrix:	Oil	Extraction Method:	EPA 3580A
Analytical Method:	1,8082A	Extraction Date:	09/21/15 14:04
Analytical Date:	09/22/15 18:32	Cleanup Method:	EPA 3665A
Analyst:	JW	Cleanup Date:	09/22/15
Percent Solids:	Results reported on an 'AS RECEIVED' basis.	Cleanup Method:	EPA 3660B
		Cleanup Date:	09/22/15

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		mg/kg	3.92	0.309	1	A
Aroclor 1221	ND		mg/kg	3.92	0.361	1	A
Aroclor 1232	ND		mg/kg	3.92	0.459	1	A
Aroclor 1242	ND		mg/kg	3.92	0.479	1	A
Aroclor 1248	ND		mg/kg	3.92	0.330	1	A
Aroclor 1254	ND		mg/kg	3.92	0.322	1	A
Aroclor 1260	ND		mg/kg	3.92	0.298	1	A
Aroclor 1262	ND		mg/kg	3.92	0.194	1	A
Aroclor 1268	ND		mg/kg	3.92	0.568	1	A
PCBs, Total	ND		mg/kg	3.92	0.194	1	A

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	101		30-150	A
Decachlorobiphenyl	104		30-150	A
2,4,5,6-Tetrachloro-m-xylene	118		30-150	B
Decachlorobiphenyl	110		30-150	B

Project Name: DUPONT **Lab Number:** L1522686

Project Number: 1134G-15-11 **Report Date:** 09/24/15

SAMPLE RESULTS

Lab ID:	L1522686-04	Date Collected:	09/14/15 10:30
Client ID:	C-3	Date Received:	09/15/15
Sample Location:	BROOKLYN, NY	Field Prep:	Not Specified
Matrix:	Oil	Extraction Method:	EPA 3580A
Analytical Method:	1,8082A	Extraction Date:	09/21/15 14:04
Analytical Date:	09/22/15 18:48	Cleanup Method:	EPA 3665A
Analyst:	JW	Cleanup Date:	09/22/15
Percent Solids:	Results reported on an 'AS RECEIVED' basis.	Cleanup Method:	EPA 3660B
		Cleanup Date:	09/22/15

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		mg/kg	3.35	0.264	1	A
Aroclor 1221	ND		mg/kg	3.35	0.308	1	A
Aroclor 1232	ND		mg/kg	3.35	0.392	1	A
Aroclor 1242	ND		mg/kg	3.35	0.410	1	A
Aroclor 1248	ND		mg/kg	3.35	0.282	1	A
Aroclor 1254	ND		mg/kg	3.35	0.275	1	A
Aroclor 1260	3.66		mg/kg	3.35	0.255	1	B
Aroclor 1262	ND		mg/kg	3.35	0.166	1	A
Aroclor 1268	ND		mg/kg	3.35	0.485	1	A
PCBs, Total	3.66		mg/kg	3.35	0.166	1	A

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	103		30-150	A
Decachlorobiphenyl	85		30-150	A
2,4,5,6-Tetrachloro-m-xylene	117		30-150	B
Decachlorobiphenyl	101		30-150	B

Project Name: DUPONT | **Lab Number:** L1522686
Project Number: 1134G-15-11 | **Report Date:** 09/24/15

SAMPLE RESULTS

Lab ID:	L1522686-05	Date Collected:	09/14/15 11:00
Client ID:	MW-21	Date Received:	09/15/15
Sample Location:	BROOKLYN, NY	Field Prep:	Not Specified
Matrix:	Oil	Extraction Method:	EPA 3580A
Analytical Method:	1,8082A	Extraction Date:	09/21/15 14:04
Analytical Date:	09/22/15 19:04	Cleanup Method:	EPA 3665A
Analyst:	JW	Cleanup Date:	09/22/15
Percent Solids:	Results reported on an 'AS RECEIVED' basis.	Cleanup Method:	EPA 3660B
		Cleanup Date:	09/22/15

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		mg/kg	3.09	0.244	1	A
Aroclor 1221	ND		mg/kg	3.09	0.285	1	A
Aroclor 1232	ND		mg/kg	3.09	0.362	1	A
Aroclor 1242	ND		mg/kg	3.09	0.378	1	A
Aroclor 1248	ND		mg/kg	3.09	0.261	1	A
Aroclor 1254	ND		mg/kg	3.09	0.254	1	A
Aroclor 1260	ND		mg/kg	3.09	0.236	1	A
Aroclor 1262	ND		mg/kg	3.09	0.153	1	A
Aroclor 1268	ND		mg/kg	3.09	0.448	1	A
PCBs, Total	ND		mg/kg	3.09	0.153	1	A

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	99		30-150	A
Decachlorobiphenyl	99		30-150	A
2,4,5,6-Tetrachloro-m-xylene	101		30-150	B
Decachlorobiphenyl	88		30-150	B

Project Name: DUPONT
Lab Number: L1522686
Project Number: 1134G-15-11
Report Date: 09/24/15

SAMPLE RESULTS

Lab ID:	L1522686-06	Date Collected:	09/14/15 11:30
Client ID:	MW-22	Date Received:	09/15/15
Sample Location:	BROOKLYN, NY	Field Prep:	Not Specified
Matrix:	Oil	Extraction Method:	EPA 3580A
Analytical Method:	1,8082A	Extraction Date:	09/21/15 14:04
Analytical Date:	09/22/15 19:20	Cleanup Method:	EPA 3665A
Analyst:	JW	Cleanup Date:	09/22/15
Percent Solids:	Results reported on an 'AS RECEIVED' basis.	Cleanup Method:	EPA 3660B
		Cleanup Date:	09/22/15

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		mg/kg	3.53	0.279	1	A
Aroclor 1221	ND		mg/kg	3.53	0.326	1	A
Aroclor 1232	ND		mg/kg	3.53	0.414	1	A
Aroclor 1242	ND		mg/kg	3.53	0.432	1	A
Aroclor 1248	ND		mg/kg	3.53	0.298	1	A
Aroclor 1254	ND		mg/kg	3.53	0.290	1	A
Aroclor 1260	ND		mg/kg	3.53	0.269	1	A
Aroclor 1262	ND		mg/kg	3.53	0.175	1	A
Aroclor 1268	ND		mg/kg	3.53	0.512	1	A
PCBs, Total	ND		mg/kg	3.53	0.175	1	A

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	92		30-150	A
Decachlorobiphenyl	89		30-150	A
2,4,5,6-Tetrachloro-m-xylene	115		30-150	B
Decachlorobiphenyl	98		30-150	B

Project Name: DUPONT **Lab Number:** L1522686

Project Number: 1134G-15-11 **Report Date:** 09/24/15

SAMPLE RESULTS

Lab ID:	L1522686-07	Date Collected:	09/14/15 12:00
Client ID:	RW-9	Date Received:	09/15/15
Sample Location:	BROOKLYN, NY	Field Prep:	Not Specified
Matrix:	Oil	Extraction Method:	EPA 3580A
Analytical Method:	1,8082A	Extraction Date:	09/21/15 14:04
Analytical Date:	09/22/15 19:37	Cleanup Method:	EPA 3665A
Analyst:	JW	Cleanup Date:	09/22/15
Percent Solids:	Results reported on an 'AS RECEIVED' basis.	Cleanup Method:	EPA 3660B
		Cleanup Date:	09/22/15

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		mg/kg	3.74	0.295	1	A
Aroclor 1221	ND		mg/kg	3.74	0.344	1	A
Aroclor 1232	ND		mg/kg	3.74	0.438	1	A
Aroclor 1242	ND		mg/kg	3.74	0.457	1	A
Aroclor 1248	ND		mg/kg	3.74	0.315	1	A
Aroclor 1254	ND		mg/kg	3.74	0.307	1	A
Aroclor 1260	1.24	J	mg/kg	3.74	0.285	1	A
Aroclor 1262	ND		mg/kg	3.74	0.185	1	A
Aroclor 1268	ND		mg/kg	3.74	0.542	1	A
PCBs, Total	1.24	J	mg/kg	3.74	0.185	1	A

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	93		30-150	A
Decachlorobiphenyl	80		30-150	A
2,4,5,6-Tetrachloro-m-xylene	112		30-150	B
Decachlorobiphenyl	101		30-150	B

Project Name: DUPONT
Project Number: 1134G-15-11

Lab Number: L1522686
Report Date: 09/24/15

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8082A
Analytical Date: 09/22/15 17:11
Analyst: JW

Extraction Method: EPA 3580A
Extraction Date: 09/21/15 14:04
Cleanup Method: EPA 3665A
Cleanup Date: 09/22/15
Cleanup Method: EPA 3660B
Cleanup Date: 09/22/15

Parameter	Result	Qualifier	Units	RL	MDL	Column
Polychlorinated Biphenyls by GC - Westborough Lab for sample(s): 01-07 Batch: WG823354-1						
Aroclor 1016	ND		mg/kg	4.71	0.372	A
Aroclor 1221	ND		mg/kg	4.71	0.435	A
Aroclor 1232	ND		mg/kg	4.71	0.552	A
Aroclor 1242	ND		mg/kg	4.71	0.577	A
Aroclor 1248	ND		mg/kg	4.71	0.398	A
Aroclor 1254	ND		mg/kg	4.71	0.388	A
Aroclor 1260	ND		mg/kg	4.71	0.359	A
Aroclor 1262	ND		mg/kg	4.71	0.234	A
Aroclor 1268	ND		mg/kg	4.71	0.684	A
PCBs, Total	ND		mg/kg	4.71	0.234	A

Surrogate	%Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	87		30-150	A
Decachlorobiphenyl	117		30-150	A
2,4,5,6-Tetrachloro-m-xylene	94		30-150	B
Decachlorobiphenyl	113		30-150	B

Lab Control Sample Analysis
Batch Quality Control

Project Name: DUPONT
Project Number: 1134G-15-11

Lab Number: L1522686
Report Date: 09/24/15

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits	Column
Polychlorinated Biphenyls by GC - Westborough Lab Associated sample(s): 01-07 Batch: WG823354-2 WG823354-3									
Aroclor 1016	94		98		40-140	4		50	A
Aroclor 1260	97		104		40-140	7		50	A

Surrogate	LCS %Recovery	Qual	LCSD %Recovery	Qual	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	97		103		30-150	A
Decachlorobiphenyl	127		135		30-150	A
2,4,5,6-Tetrachloro-m-xylene	104		111		30-150	B
Decachlorobiphenyl	125		130		30-150	B

Project Name: DUPONT
Project Number: 1134G-15-11

Lab Number: L1522686
Report Date: 09/24/15

Sample Receipt and Container Information

Were project specific reporting limits specified? YES

Reagent H2O Preserved Vials Frozen on: NA

Cooler Information

Cooler	Custody Seal
A	Absent

Container Information

Container ID	Container Type	Cooler	pH	Temp deg C	Pres	Seal	Analysis(*)
L1522686-01A	Vial unpreserved	A	N/A	4.9	Y	Absent	NYTCL-8082(14)
L1522686-01B	Vial unpreserved	A	N/A	4.9	Y	Absent	NYTCL-8082(14)
L1522686-02A	Vial unpreserved	A	N/A	4.9	Y	Absent	NYTCL-8082(14)
L1522686-02B	Vial unpreserved	A	N/A	4.9	Y	Absent	NYTCL-8082(14)
L1522686-03A	Vial unpreserved	A	N/A	4.9	Y	Absent	NYTCL-8082(14)
L1522686-03B	Vial unpreserved	A	N/A	4.9	Y	Absent	NYTCL-8082(14)
L1522686-04A	Vial unpreserved	A	N/A	4.9	Y	Absent	NYTCL-8082(14)
L1522686-04B	Vial unpreserved	A	N/A	4.9	Y	Absent	NYTCL-8082(14)
L1522686-05A	Vial unpreserved	A	N/A	4.9	Y	Absent	NYTCL-8082(14)
L1522686-05B	Vial unpreserved	A	N/A	4.9	Y	Absent	NYTCL-8082(14)
L1522686-06A	Vial unpreserved	A	N/A	4.9	Y	Absent	NYTCL-8082(14)
L1522686-06B	Vial unpreserved	A	N/A	4.9	Y	Absent	NYTCL-8082(14)
L1522686-07A	Vial unpreserved	A	N/A	4.9	Y	Absent	NYTCL-8082(14)
L1522686-07B	Vial unpreserved	A	N/A	4.9	Y	Absent	NYTCL-8082(14)

*Values in parentheses indicate holding time in days

GLOSSARY

Acronyms

EDL - Estimated Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The EDL includes any adjustments from dilutions, concentrations or moisture content, where applicable. The use of EDLs is specific to the analysis of PAHs using Solid-Phase Microextraction (SPME).

EPA - Environmental Protection Agency.

LCS - Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.

LCSD - Laboratory Control Sample Duplicate: Refer to LCS.

LFB - Laboratory Fortified Blank: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.

MDL - Method Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The MDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.

MS - Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available.

MSD - Matrix Spike Sample Duplicate: Refer to MS.

NA - Not Applicable.

NC - Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.

NI - Not Ignitable.

NP - Non-Plastic: Term is utilized for the analysis of Atterberg Limits in soil.

RL - Reporting Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RL includes any adjustments from dilutions, concentrations or moisture content, where applicable.

RPD - Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.

SRM - Standard Reference Material: A reference sample of a known or certified value that is of the same or similar matrix as the associated field samples.

TIC - Tentatively Identified Compound: A compound that has been identified to be present and is not part of the target compound list (TCL) for the method and/or program. All TICs are qualitatively identified and reported as estimated concentrations.

Footnotes

1 - The reference for this analyte should be considered modified since this analyte is absent from the target analyte list of the original method.

Terms

Total: With respect to Organic analyses, a 'Total' result is defined as the summation of results for individual isomers or Aroclors. If a 'Total' result is requested, the results of its individual components will also be reported. This is applicable to 'Total' results for methods 8260, 8081 and 8082.

Analytical Method: Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

Data Qualifiers

A - Spectra identified as "Aldol Condensation Product".

B - The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For MCP-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank. For NJ-Air-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte above the reporting limit. For NJ-related projects (excluding Air), flag only applies to associated field samples that have detectable concentrations of the analyte, which was detected above the reporting limit in the associated method blank or above five times the reporting limit for common lab contaminants (Phthalates, Acetone, Methylene Chloride, 2-Butanone).

C - Co-elution: The target analyte co-elutes with a known lab standard (i.e. surrogate, internal standards, etc.) for co-extracted analyses.

Report Format: DU Report with 'J' Qualifiers

Project Name:	DUPONT	**Lab Number:**	L1522686
Project Number:	1134G-15-11	**Report Date:**	09/24/15

Data Qualifiers

D - Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.

E - Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.

G - The concentration may be biased high due to matrix interferences (i.e, co-elution) with non-target compound(s). The result should be considered estimated.

H - The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.

I - The lower value for the two columns has been reported due to obvious interference.

M - Reporting Limit (RL) exceeds the MCP CAM Reporting Limit for this analyte.

NJ - Presumptive evidence of compound. This represents an estimated concentration for Tentatively Identified Compounds (TICs), where the identification is based on a mass spectral library search.

P - The RPD between the results for the two columns exceeds the method-specified criteria.

Q - The quality control sample exceeds the associated acceptance criteria. For DOD-related projects, LCS and/or Continuing Calibration Standard exceedences are also qualified on all associated sample results. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less than 5x the RL. (Metals only.)

R - Analytical results are from sample re-analysis.

RE - Analytical results are from sample re-extraction.

S - Analytical results are from modified screening analysis.

J - Estimated value. The Target analyte concentration is below the quantitation limit (RL), but above the Method Detection Limit (MDL) or Estimated Detection Limit (EDL) for SPME-related analyses. This represents an estimated concentration for Tentatively Identified Compounds (TICs).

ND - Not detected at the method detection limit (MDL) for the sample, or estimated detection limit (EDL) for SPME-related analyses.

Report Format: DU Report with 'J' Qualifiers

REFERENCES

1 Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. EPA SW-846. Third Edition. Updates I - IV, 2007.

LIMITATION OF LIABILITIES

Certification Information

Last revised December 16, 2014

The following analytes are not included in our NELAP Scope of Accreditation:

Westborough Facility
EPA 524.2: Acetone, 2-Butanone (Methyl ethyl ketone (MEK)), Tert-butyl alcohol, 2-Hexanone, Tetrahydrofuran, 1,3,5-Trichlorobenzene, 4-Methyl-2-pentanone (MIBK), Carbon disulfide, Diethyl ether.
EPA 8260C: 1,2,4,5-Tetramethylbenzene, 4-Ethyltoluene, Iodomethane (methyl iodide), Methyl methacrylate, Azobenzene.
EPA 8270D: 1-Methylnaphthalene, Dimethylnaphthalene,1,4-Diphenylhydrazine.
EPA 625: 4-Chloroaniline, 4-Methylphenol.
SM4500: Soil: Total Phosphorus, TKN, NO2, NO3.
EPA 9071: Total Petroleum Hydrocarbons, Oil & Grease.

Mansfield Facility
EPA 8270D: Biphenyl.
EPA 2540D: TSS
EPA TO-15: Halothane, 2,4,4-Trimethyl-2-pentene, 2,4,4-Trimethyl-1-pentene, Thiophene, 2-Methylthiophene, 3-Methylthiophene, 2-Ethylthiophene, 1,2,3-Trimethylbenzene, Indan, Indene, 1,2,4,5-Tetramethylbenzene, Benzothiophene, 1-Methylnaphthalene.

The following analytes are included in our Massachusetts DEP Scope of Accreditation, Westborough Facility:

Drinking Water
EPA 200.8: Sb,As,Ba,Be,Cd,Cr,Cu,Pb,Ni,Se,Tl; **EPA 200.7**: Ba,Be,Ca,Cd,Cr,Cu,Na; **EPA 245.1:** Mercury;
EPA 300.0: Nitrate-N, Fluoride, Sulfate; **EPA 353.2**: Nitrate-N, Nitrite-N; **SM4500NO3-F**: Nitrate-N, Nitrite-N; **SM4500F-C, SM4500CN-CE, EPA 180.1, SM2130B, SM4500Cl-D, SM2320B, SM2540C, SM4500H-B**
EPA 332: Perchlorate.
Microbiology: **SM9215B; SM9223-P/A, SM9223B-Colilert-QT, Enterolert-QT.**

Non-Potable Water
EPA 200.8: Al,Sb,As,Be,Cd,Cr,Cu,Pb,Mn,Ni,Se,Ag,Tl,Zn;
EPA 200.7: Al,Sb,As,Be,Cd,Ca,Cr,Co,Cu,Fe,Pb,Mg,Mn,Mo,Ni,K,Se,Ag,Na,Sr,Ti,Tl,V,Zn;
EPA 245.1, SM4500H,B, EPA 120.1, SM2510B, SM2540C, SM2340B, SM2320B, SM4500CL-E, SM4500F-BC, SM426C, SM4500NH3-BH, **EPA 350.1**: Ammonia-N, **LACHAT 10-107-06-1-B**: Ammonia-N, **SM4500NO3-F,**
EPA 353.2: Nitrate-N**, SM4500NH3-BC-NES, EPA 351.1, SM4500P-E, SM4500P-B, E, SM5220D, EPA 410.4, SM5210B, SM5310C, SM4500CL-D, EPA 1664, SM14 510AC, EPA 420.1, SM4500-CN-CE, SM2540D.**
EPA 624: Volatile Halocarbons & Aromatics,
EPA 608: Chlordane, Toxaphene, Aldrin, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, Dieldrin, DDD, DDE, DDT, Endosulfan I, Endosulfan II, Endosulfan sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, PCBs
EPA 625: SVOC (Acid/Base/Neutral Extractables), **EPA 600/4-81-045**: PCB-Oil.
Microbiology: **SM9223B-Colilert-QT; Enterolert-QT, SM9222D-MF**.

For a complete listing of analytes and methods, please contact your Alpha Project Manager.

NEW YORK CHAIN OF CUSTODY

ALPHA ANALYTICAL

Service Centers
Mahwah, NJ 07430: 35 Whitney Rd, Suite 5
Albany, NY 12205: 14 Walker Way
Tonawanda, NY 14150: 275 Cooper Ave, Suite 105

Page 1 of 1

Date Rec'd in Lab: 9/16/15

ALPHA Job #: L1522686

Westborough, MA 01581
8 Walkup Dr.
TEL: 508-898-9220
FAX: 508-898-9193

Mansfield, MA 02048
320 Forbes Blvd
TEL: 508-822-9300
FAX: 508-822-3288

Project Information

Project Name: DuPont
Project Location: Brooklyn, NY
Project # 1134g-15-11
(Use Project name as Project #) ☐
Project Manager: George Holmes
ALPHAQuote #:

Turn-Around Time

Standard ☒ Due Date:
Rush (only if pre approved) ☐ # of Days:

Deliverables

☒ ASP-A ☐ ASP-B
☐ EQuIS (1 File) ☐ EQuIS (4 File)
☐ Other

Billing Information

☒ Same as Client Info
PO #

Regulatory Requirement

☐ NY TOGS ☐ NY Part 375
☐ AWQ Standards ☐ NY CP-51
☐ NY Restricted Use ☐ Other
☐ NY Unrestricted Use
☐ NYC Sewer Discharge

Disposal Site Information

Please identify below location of applicable disposal facilities.
Disposal Facility:
☐ NJ ☒ NY
☐ Other:

Client Information

Client: FPM Group
Address: 909 Marconi Avenue
Ronkonkoma, NY 11779
Phone: (631) 737-6200
Fax: (631) 737-2410
Email: g.holmes@fpm-group.com

These samples have been previously analyzed by Alpha ☐

Other project specific requirements/comments:

Please specify Metals or TAL.

ANALYSIS

Sample Filtration
☐ Done
☐ Lab to do
Preservation
☐ Lab to do
(Please Specify below)

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials	PCB's	Sample Specific Comments	Total Bottles
22686 01	MW-25	9/14/15	9:30	Oil	GH	X		2
02	C-1	↓	10:00	↓	↓	↓		↓
03	C-2	↓	10:15	↓	↓	↓		↓
04	C-3	↓	10:30	↓	↓	↓		↓
05	MW-21	↓	11:00	↓	↓	↓		↓
06	MW-22	↓	11:30	↓	↓	↓		↓
07	RW-9	↓	12:00	↓	↓	↓		↓

Preservative Code:
A = None
B = HCl
C = HNO_3
D = H_2SO_4
E = NaOH
F = MeOH
G = $NaHSO_4$
H = $Na_2S_2O_3$
K/E = Zn Ac/NaOH
O = Other

Container Code
P = Plastic
A = Amber Glass
V = Vial
G = Glass
B = Bacteria Cup
C = Cube
O = Other
E = Encore
D = BOD Bottle

Westboro: Certification No: MA935
Mansfield: Certification No: MA015

	PCB's
Container Type	V
Preservative	A

Relinquished By:	Date/Time	Received By:	Date/Time
[signature]	9/15/15	[signature] AAL	9/15/15 1044
[signature] - AAL	9/15/15 1820	Tom T[signature]	9/15/15 1820
Tom T[signature]	9/16/15 0015	[signature]	9/16/15 0015

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. BY EXECUTING THIS COC, THE CLIENT HAS READ AND AGREES TO BE BOUND BY ALPHA'S TERMS & CONDITIONS. (See reverse side.)

Form No: 01-25 HC (rev. 30-Sept-2013)

ANALYTICAL REPORT

Lab Number:	L1526386
Client:	FPM Group 909 Marconi Avenue Ronkonkoma, NY 11779
ATTN:	John Bukoski
Phone:	(631) 737-6200
Project Name:	DUPONT
Project Number:	1134G-15-11
Report Date:	10/23/15

Certifications & Approvals: MA (M-MA086), NY (11148), CT (PH-0574), NH (2003), NJ NELAP (MA935), RI (LAO00065), ME (MA00086), PA (68-03671), VA (460195), MD (348), IL (200077), NC (666), TX (T104704476), DOD (L2217), USDA (Permit #P-330-11-00240).

Eight Walkup Drive, Westborough, MA 01581-1019
508-898-9220 (Fax) 508-898-9193 800-624-9220 - www.alphalab.com

Project Name: DUPONT
Project Number: 1134G-15-11

Lab Number: L1526386
Report Date: 10/23/15

Alpha Sample ID	Client ID	Matrix	Sample Location	Collection Date/Time	Receive Date
L1526386-01	MW-5	OIL	BROOKYLN, NY	10/15/15 08:00	10/16/15
L1526386-02	MW-A	OIL	BROOKYLN, NY	10/15/15 08:30	10/16/15
L1526386-03	MW-15	OIL	BROOKYLN, NY	10/15/15 09:00	10/16/15
L1526386-04	RW-12	OIL	BROOKYLN, NY	10/15/15 09:30	10/16/15
L1526386-05	RW-2	OIL	BROOKYLN, NY	10/15/15 10:30	10/16/15
L1526386-06	RW-3	OIL	BROOKYLN, NY	10/15/15 11:00	10/16/15
L1526386-07	RW-10	OIL	BROOKYLN, NY	10/15/15 12:00	10/16/15

Project Name: DUPONT **Lab Number:** L1526386
Project Number: 1134G-15-11 **Report Date:** 10/23/15

Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet all of the requirements of NELAC, for all NELAC accredited parameters. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. Tentatively Identified Compounds (TICs), if requested, are reported for compounds identified to be present and are not part of the method/program Target Compound List, even if only a subset of the TCL are being reported. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively. When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report. All specific QC information is also incorporated in the Data Usability format of our Data Merger tool where it can be reviewed along with any associated usability implications. Soil/sediments, solids and tissues are reported on a dry weight basis unless otherwise noted. Definitions of all data qualifiers and acronyms used in this report are provided in the Glossary located at the back of the report.

In reference to questions H (CAM) or 4 (RCP) when "NO" is checked, the performance criteria for CAM and RCP methods allow for some quality control failures to occur and still be within method compliance. In these instances the specific failure is not narrated but noted in the associated QC table. The information is also incorporated in the Data Usability format of our Data Merger tool where it can be reviewed along with any associated usability implications.

Please see the associated ADEx data file for a comparison of laboratory reporting limits that were achieved with the regulatory Numerical Standards requested on the Chain of Custody.

HOLD POLICY
For samples submitted on hold, Alpha's policy is to hold samples (with the exception of Air canisters) free of charge for 21 calendar days from the date the project is completed. After 21 calendar days, we will dispose of all samples submitted including those put on hold unless you have contacted your Client Service Representative and made arrangements for Alpha to continue to hold the samples. Air canisters will be disposed after 3 business days from the date the project is completed.

Please contact Client Services at 800-624-9220 with any questions.

Case Narrative (continued)

Report Submission

All non-detect (ND) or estimated concentrations (J-qualified) have been quantitated to the limit noted in the MDL column.

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature: Cristin Walker Cristin Walker

Title: Technical Director/Representative Date: 10/23/15

ORGANICS

PCBS

Project Name: DUPONT **Lab Number:** L1526386

Project Number: 1134G-15-11 **Report Date:** 10/23/15

SAMPLE RESULTS

Lab ID:	L1526386-01	Date Collected:	10/15/15 08:00
Client ID:	MW-5	Date Received:	10/16/15
Sample Location:	BROOKYLN, NY	Field Prep:	Not Specified
Matrix:	Oil	Extraction Method:	EPA 3580A
Analytical Method:	1,8082A	Extraction Date:	10/19/15 15:40
Analytical Date:	10/20/15 07:46	Cleanup Method:	EPA 3665A
Analyst:	JT	Cleanup Date:	10/20/15
Percent Solids:	Results reported on an 'AS RECEIVED' basis.	Cleanup Method:	EPA 3660B
		Cleanup Date:	10/20/15

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
PCB by GC - Westborough Lab							
Aroclor 1016	ND		mg/kg	2.87	0.378	1	A
Aroclor 1221	ND		mg/kg	2.87	0.441	1	A
Aroclor 1232	ND		mg/kg	2.87	0.561	1	A
Aroclor 1242	ND		mg/kg	2.87	0.586	1	A
Aroclor 1248	ND		mg/kg	1.91	0.404	1	A
Aroclor 1254	ND		mg/kg	2.87	0.393	1	A
Aroclor 1260	2.63		mg/kg	1.91	0.364	1	A
Aroclor 1262	ND		mg/kg	0.957	0.237	1	A
Aroclor 1268	ND		mg/kg	0.957	0.694	1	A
PCBs, Total	2.63		mg/kg	0.957	0.237	1	A

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	90		30-150	A
Decachlorobiphenyl	105		30-150	A
2,4,5,6-Tetrachloro-m-xylene	88		30-150	B
Decachlorobiphenyl	145		30-150	B

Project Name: DUPONT | **Lab Number:** L1526386

Project Number: 1134G-15-11 | **Report Date:** 10/23/15

SAMPLE RESULTS

Lab ID:	L1526386-02	Date Collected:	10/15/15 08:30
Client ID:	MW-A	Date Received:	10/16/15
Sample Location:	BROOKYLN, NY	Field Prep:	Not Specified
Matrix:	Oil	Extraction Method:	EPA 3580A
Analytical Method:	1,8082A	Extraction Date:	10/19/15 15:40
Analytical Date:	10/20/15 08:02	Cleanup Method:	EPA 3665A
Analyst:	JT	Cleanup Date:	10/20/15
Percent Solids:	Results reported on an 'AS RECEIVED' basis.	Cleanup Method:	EPA 3660B
		Cleanup Date:	10/20/15

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
PCB by GC - Westborough Lab							
Aroclor 1016	ND		mg/kg	2.81	0.370	1	A
Aroclor 1221	ND		mg/kg	2.81	0.432	1	A
Aroclor 1232	ND		mg/kg	2.81	0.550	1	A
Aroclor 1242	ND		mg/kg	2.81	0.574	1	A
Aroclor 1248	ND		mg/kg	1.88	0.396	1	A
Aroclor 1254	ND		mg/kg	2.81	0.385	1	A
Aroclor 1260	ND		mg/kg	1.88	0.357	1	A
Aroclor 1262	ND		mg/kg	0.938	0.233	1	A
Aroclor 1268	ND		mg/kg	0.938	0.680	1	A
PCBs, Total	ND		mg/kg	0.938	0.233	1	A

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	81		30-150	A
Decachlorobiphenyl	93		30-150	A
2,4,5,6-Tetrachloro-m-xylene	82		30-150	B
Decachlorobiphenyl	103		30-150	B

Project Name: DUPONT **Lab Number:** L1526386

Project Number: 1134G-15-11 **Report Date:** 10/23/15

SAMPLE RESULTS

Lab ID:	L1526386-03	Date Collected:	10/15/15 09:00
Client ID:	MW-15	Date Received:	10/16/15
Sample Location:	BROOKYLN, NY	Field Prep:	Not Specified
Matrix:	Oil	Extraction Method:	EPA 3580A
Analytical Method:	1,8082A	Extraction Date:	10/19/15 15:40
Analytical Date:	10/20/15 08:18	Cleanup Method:	EPA 3665A
Analyst:	JT	Cleanup Date:	10/20/15
Percent Solids:	Results reported on an 'AS RECEIVED' basis.	Cleanup Method:	EPA 3660B
		Cleanup Date:	10/20/15

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
PCB by GC - Westborough Lab							
Aroclor 1016	ND		mg/kg	2.79	0.367	1	A
Aroclor 1221	ND		mg/kg	2.79	0.428	1	A
Aroclor 1232	ND		mg/kg	2.79	0.545	1	A
Aroclor 1242	ND		mg/kg	2.79	0.569	1	A
Aroclor 1248	ND		mg/kg	1.86	0.392	1	A
Aroclor 1254	ND		mg/kg	2.79	0.382	1	A
Aroclor 1260	ND		mg/kg	1.86	0.354	1	A
Aroclor 1262	ND		mg/kg	0.929	0.230	1	A
Aroclor 1268	ND		mg/kg	0.929	0.674	1	A
PCBs, Total	ND		mg/kg	0.929	0.230	1	A

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	83		30-150	A
Decachlorobiphenyl	82		30-150	A
2,4,5,6-Tetrachloro-m-xylene	84		30-150	B
Decachlorobiphenyl	98		30-150	B

Project Name: DUPONT **Lab Number:** L1526386

Project Number: 1134G-15-11 **Report Date:** 10/23/15

SAMPLE RESULTS

Lab ID:	L1526386-04	Date Collected:	10/15/15 09:30
Client ID:	RW-12	Date Received:	10/16/15
Sample Location:	BROOKYLN, NY	Field Prep:	Not Specified
Matrix:	Oil	Extraction Method:	EPA 3580A
Analytical Method:	1,8082A	Extraction Date:	10/19/15 15:40
Analytical Date:	10/20/15 08:33	Cleanup Method:	EPA 3665A
Analyst:	JT	Cleanup Date:	10/20/15
Percent Solids:	Results reported on an 'AS RECEIVED' basis.	Cleanup Method:	EPA 3660B
		Cleanup Date:	10/20/15

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
PCB by GC - Westborough Lab							
Aroclor 1016	ND		mg/kg	2.86	0.377	1	A
Aroclor 1221	ND		mg/kg	2.86	0.440	1	A
Aroclor 1232	ND		mg/kg	2.86	0.559	1	A
Aroclor 1242	ND		mg/kg	2.86	0.584	1	A
Aroclor 1248	ND		mg/kg	1.91	0.402	1	A
Aroclor 1254	ND		mg/kg	2.86	0.392	1	A
Aroclor 1260	2.86		mg/kg	1.91	0.363	1	B
Aroclor 1262	ND		mg/kg	0.954	0.236	1	A
Aroclor 1268	ND		mg/kg	0.954	0.691	1	A
PCBs, Total	2.86		mg/kg	0.954	0.236	1	A

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	84		30-150	A
Decachlorobiphenyl	90		30-150	A
2,4,5,6-Tetrachloro-m-xylene	86		30-150	B
Decachlorobiphenyl	100		30-150	B

Project Name: DUPONT **Lab Number:** L1526386

Project Number: 1134G-15-11 **Report Date:** 10/23/15

SAMPLE RESULTS

Lab ID:	L1526386-05	Date Collected:	10/15/15 10:30
Client ID:	RW-2	Date Received:	10/16/15
Sample Location:	BROOKYLN, NY	Field Prep:	Not Specified
Matrix:	Oil	Extraction Method:	EPA 3580A
Analytical Method:	1,8082A	Extraction Date:	10/19/15 15:40
Analytical Date:	10/20/15 08:49	Cleanup Method:	EPA 3665A
Analyst:	JT	Cleanup Date:	10/20/15
Percent Solids:	Results reported on an 'AS RECEIVED' basis.	Cleanup Method:	EPA 3660B
		Cleanup Date:	10/20/15

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
PCB by GC - Westborough Lab							
Aroclor 1016	ND		mg/kg	2.89	0.380	1	A
Aroclor 1221	ND		mg/kg	2.89	0.444	1	A
Aroclor 1232	ND		mg/kg	2.89	0.564	1	A
Aroclor 1242	ND		mg/kg	2.89	0.589	1	A
Aroclor 1248	ND		mg/kg	1.92	0.406	1	A
Aroclor 1254	ND		mg/kg	2.89	0.396	1	A
Aroclor 1260	2.46		mg/kg	1.92	0.367	1	B
Aroclor 1262	ND		mg/kg	0.963	0.239	1	A
Aroclor 1268	ND		mg/kg	0.963	0.698	1	A
PCBs, Total	2.46		mg/kg	0.963	0.239	1	A

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	90		30-150	A
Decachlorobiphenyl	90		30-150	A
2,4,5,6-Tetrachloro-m-xylene	88		30-150	B
Decachlorobiphenyl	108		30-150	B

Project Name: DUPONT **Lab Number:** L1526386

Project Number: 1134G-15-11 **Report Date:** 10/23/15

SAMPLE RESULTS

Lab ID:	L1526386-06	Date Collected:	10/15/15 11:00
Client ID:	RW-3	Date Received:	10/16/15
Sample Location:	BROOKYLN, NY	Field Prep:	Not Specified
Matrix:	Oil	Extraction Method:	EPA 3580A
Analytical Method:	1,8082A	Extraction Date:	10/19/15 15:40
Analytical Date:	10/20/15 09:05	Cleanup Method:	EPA 3665A
Analyst:	JT	Cleanup Date:	10/20/15
Percent Solids:	Results reported on an 'AS RECEIVED' basis.	Cleanup Method:	EPA 3660B
		Cleanup Date:	10/20/15

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
PCB by GC - Westborough Lab							
Aroclor 1016	ND		mg/kg	2.80	0.369	1	A
Aroclor 1221	ND		mg/kg	2.80	0.431	1	A
Aroclor 1232	ND		mg/kg	2.80	0.548	1	A
Aroclor 1242	ND		mg/kg	2.80	0.572	1	A
Aroclor 1248	ND		mg/kg	1.87	0.394	1	A
Aroclor 1254	ND		mg/kg	2.80	0.384	1	A
Aroclor 1260	6.71		mg/kg	1.87	0.356	1	B
Aroclor 1262	ND		mg/kg	0.934	0.232	1	A
Aroclor 1268	ND		mg/kg	0.934	0.677	1	A
PCBs, Total	6.71		mg/kg	0.934	0.232	1	A

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	79		30-150	A
Decachlorobiphenyl	87		30-150	A
2,4,5,6-Tetrachloro-m-xylene	81		30-150	B
Decachlorobiphenyl	92		30-150	B

Project Name: DUPONT **Lab Number:** L1526386

Project Number: 1134G-15-11 **Report Date:** 10/23/15

SAMPLE RESULTS

Lab ID:	L1526386-07	Date Collected:	10/15/15 12:00
Client ID:	RW-10	Date Received:	10/16/15
Sample Location:	BROOKYLN, NY	Field Prep:	Not Specified
Matrix:	Oil	Extraction Method:	EPA 3580A
Analytical Method:	1,8082A	Extraction Date:	10/19/15 15:40
Analytical Date:	10/20/15 09:21	Cleanup Method:	EPA 3665A
Analyst:	JT	Cleanup Date:	10/20/15
Percent Solids:	Results reported on an 'AS RECEIVED' basis.	Cleanup Method:	EPA 3660B
		Cleanup Date:	10/20/15

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
PCB by GC - Westborough Lab							
Aroclor 1016	ND		mg/kg	2.96	0.390	1	A
Aroclor 1221	ND		mg/kg	2.96	0.455	1	A
Aroclor 1232	ND		mg/kg	2.96	0.578	1	A
Aroclor 1242	ND		mg/kg	2.96	0.604	1	A
Aroclor 1248	ND		mg/kg	1.97	0.416	1	A
Aroclor 1254	ND		mg/kg	2.96	0.405	1	A
Aroclor 1260	ND		mg/kg	1.97	0.376	1	A
Aroclor 1262	ND		mg/kg	0.986	0.244	1	A
Aroclor 1268	ND		mg/kg	0.986	0.715	1	A
PCBs, Total	ND		mg/kg	0.986	0.244	1	A

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	83		30-150	A
Decachlorobiphenyl	82		30-150	A
2,4,5,6-Tetrachloro-m-xylene	87		30-150	B
Decachlorobiphenyl	96		30-150	B

Project Name: DUPONT
Project Number: 1134G-15-11

Lab Number: L1526386
Report Date: 10/23/15

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8082A
Analytical Date: 10/20/15 09:37
Analyst: JT

Extraction Method: EPA 3580A
Extraction Date: 10/19/15 15:40
Cleanup Method: EPA 3665A
Cleanup Date: 10/20/15
Cleanup Method: EPA 3660B
Cleanup Date: 10/20/15

Parameter	Result	Qualifier	Units	RL	MDL	Column
PCB by GC - Westborough Lab for sample(s): 01-07 Batch: WG832165-1						
Aroclor 1016	ND		mg/kg	2.76	0.363	A
Aroclor 1221	ND		mg/kg	2.76	0.423	A
Aroclor 1232	ND		mg/kg	2.76	0.538	A
Aroclor 1242	ND		mg/kg	2.76	0.562	A
Aroclor 1248	ND		mg/kg	1.84	0.388	A
Aroclor 1254	ND		mg/kg	2.76	0.378	A
Aroclor 1260	ND		mg/kg	1.84	0.350	A
Aroclor 1262	ND		mg/kg	0.919	0.228	A
Aroclor 1268	ND		mg/kg	0.919	0.666	A
PCBs, Total	ND		mg/kg	0.919	0.228	A

Surrogate	%Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	64		30-150	A
Decachlorobiphenyl	104		30-150	A
2,4,5,6-Tetrachloro-m-xylene	68		30-150	B
Decachlorobiphenyl	103		30-150	B

Lab Control Sample Analysis
Batch Quality Control

Project Name: DUPONT
Lab Number: L1526386
Project Number: 1134G-15-11
Report Date: 10/23/15

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits	Column
PCB by GC - Westborough Lab Associated sample(s): 01-07 Batch: WG832165-2 WG832165-3									
Aroclor 1016	62		64		40-140	3		50	A
Aroclor 1260	60		63		40-140	5		50	A

Surrogate	LCS %Recovery	Qual	LCSD %Recovery	Qual	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	74		71		30-150	A
Decachlorobiphenyl	121		119		30-150	A
2,4,5,6-Tetrachloro-m-xylene	78		75		30-150	B
Decachlorobiphenyl	119		115		30-150	B

Project Name: DUPONT
Project Number: 1134G-15-11

Lab Number: L1526386
Report Date: 10/23/15

Sample Receipt and Container Information

Were project specific reporting limits specified? YES

Cooler Information Custody Seal

Cooler	Custody Seal
A	Absent

Container Information

Container ID	Container Type	Cooler	pH	Temp deg C	Pres	Seal	Analysis(*)
L1526386-01A	Vial unpreserved	A	N/A	5.0	Y	Absent	PCB-8082LL(14)
L1526386-01B	Vial unpreserved	A	N/A	5.0	Y	Absent	PCB-8082LL(14)
L1526386-02A	Vial unpreserved	A	N/A	5.0	Y	Absent	PCB-8082LL(14)
L1526386-02B	Vial unpreserved	A	N/A	5.0	Y	Absent	PCB-8082LL(14)
L1526386-03A	Vial unpreserved	A	N/A	5.0	Y	Absent	PCB-8082LL(14)
L1526386-03B	Vial unpreserved	A	N/A	5.0	Y	Absent	PCB-8082LL(14)
L1526386-04A	Vial unpreserved	A	N/A	5.0	Y	Absent	PCB-8082LL(14)
L1526386-04B	Vial unpreserved	A	N/A	5.0	Y	Absent	PCB-8082LL(14)
L1526386-05A	Vial unpreserved	A	N/A	5.0	Y	Absent	PCB-8082LL(14)
L1526386-05B	Vial unpreserved	A	N/A	5.0	Y	Absent	PCB-8082LL(14)
L1526386-06A	Vial unpreserved	A	N/A	5.0	Y	Absent	PCB-8082LL(14)
L1526386-06B	Vial unpreserved	A	N/A	5.0	Y	Absent	PCB-8082LL(14)
L1526386-07A	Vial unpreserved	A	N/A	5.0	Y	Absent	PCB-8082LL(14)
L1526386-07B	Vial unpreserved	A	N/A	5.0	Y	Absent	PCB-8082LL(14)

*Values in parentheses indicate holding time in days

GLOSSARY

Acronyms

EDL	- Estimated Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The EDL includes any adjustments from dilutions, concentrations or moisture content, where applicable. The use of EDLs is specific to the analysis of PAHs using Solid-Phase Microextraction (SPME).
EPA	- Environmental Protection Agency.
LCS	- Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
LCSD	- Laboratory Control Sample Duplicate: Refer to LCS.
LFB	- Laboratory Fortified Blank: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
MDL	- Method Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The MDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
MS	- Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available.
MSD	- Matrix Spike Sample Duplicate: Refer to MS.
NA	- Not Applicable.
NC	- Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.
NI	- Not Ignitable.
NP	- Non-Plastic: Term is utilized for the analysis of Atterberg Limits in soil.
RL	- Reporting Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
RPD	- Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.
SRM	- Standard Reference Material: A reference sample of a known or certified value that is of the same or similar matrix as the associated field samples.
STLP	- Semi-dynamic Tank Leaching Procedure per EPA Method 1315.
TIC	- Tentatively Identified Compound: A compound that has been identified to be present and is not part of the target compound list (TCL) for the method and/or program. All TICs are qualitatively identified and reported as estimated concentrations.

Footnotes

1 - The reference for this analyte should be considered modified since this analyte is absent from the target analyte list of the original method.

Terms

Total: With respect to Organic analyses, a 'Total' result is defined as the summation of results for individual isomers or Aroclors. If a 'Total' result is requested, the results of its individual components will also be reported. This is applicable to 'Total' results for methods 8260, 8081 and 8082.

Analytical Method: Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

Data Qualifiers

A - Spectra identified as "Aldol Condensation Product".

B - The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For MCP-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank. For NJ-Air-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte above the reporting limit. For NJ-related projects (excluding Air), flag only applies to associated field samples that have detectable concentrations of the analyte, which was detected above the reporting limit in the associated method blank or above five times the reporting limit for common lab contaminants (Phthalates, Acetone, Methylene Chloride, 2-Butanone).

Report Format: DU Report with 'J' Qualifiers

Project Name: DUPONT **Lab Number:** L1526386
Project Number: 1134G-15-11 **Report Date:** 10/23/15

Data Qualifiers

- **C** - Co-elution: The target analyte co-elutes with a known lab standard (i.e. surrogate, internal standards, etc.) for co-extracted analyses.
- **D** - Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.
- **E** - Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.
- **G** - The concentration may be biased high due to matrix interferences (i.e, co-elution) with non-target compound(s). The result should be considered estimated.
- **H** - The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.
- **I** - The lower value for the two columns has been reported due to obvious interference.
- **M** - Reporting Limit (RL) exceeds the MCP CAM Reporting Limit for this analyte.
- **NJ** - Presumptive evidence of compound. This represents an estimated concentration for Tentatively Identified Compounds (TICs), where the identification is based on a mass spectral library search.
- **P** - The RPD between the results for the two columns exceeds the method-specified criteria.
- **Q** - The quality control sample exceeds the associated acceptance criteria. For DOD-related projects, LCS and/or Continuing Calibration Standard exceedences are also qualified on all associated sample results. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less than 5x the RL. (Metals only.)
- **R** - Analytical results are from sample re-analysis.
- **RE** - Analytical results are from sample re-extraction.
- **S** - Analytical results are from modified screening analysis.
- **J** - Estimated value. The Target analyte concentration is below the quantitation limit (RL), but above the Method Detection Limit (MDL) or Estimated Detection Limit (EDL) for SPME-related analyses. This represents an estimated concentration for Tentatively Identified Compounds (TICs).
- **ND** - Not detected at the method detection limit (MDL) for the sample, or estimated detection limit (EDL) for SPME-related analyses.

Report Format: DU Report with 'J' Qualifiers

REFERENCES

1 Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. EPA SW-846. Third Edition. Updates I - IV, 2007.

LIMITATION OF LIABILITIES

Alpha Analytical performs services with reasonable care and diligence normal to the analytical testing laboratory industry. In the event of an error, the sole and exclusive responsibility of Alpha Analytical shall be to re-perform the work at it's own expense. In no event shall Alpha Analytical be held liable for any incidental, consequential or special damages, including but not limited to, damages in any way connected with the use of, interpretation of, information or analysis provided by Alpha Analytical.

We strongly urge our clients to comply with EPA protocol regarding sample volume, preservation, cooling, containers, sampling procedures, holding time and splitting of samples in the field.

Certification Information

The following analytes are not included in our Primary NELAP Scope of Accreditation:

Westborough Facility
EPA 8260C: 1,2,4,5-Tetramethylbenzene, 4-Ethyltoluene, Iodomethane (methyl iodide) (soil), Methyl methacrylate (soil), Azobenzene.
EPA 8270D: Dimethylnaphthalene,1,4-Diphenylhydrazine.
EPA 625: 4-Chloroaniline, 4-Methylphenol.
SM4500: Soil: Total Phosphorus, TKN, NO2, NO3.

Mansfield Facility
EPA 8270D: Biphenyl.
EPA 2540D: TSS
EPA TO-15: Halothane, 2,4,4-Trimethyl-2-pentene, 2,4,4-Trimethyl-1-pentene, Thiophene, 2-Methylthiophene, 3-Methylthiophene, 2-Ethylthiophene, 1,2,3-Trimethylbenzene, Indan, Indene, 1,2,4,5-Tetramethylbenzene, Benzothiophene, 1-Methylnaphthalene.

The following analytes are included in our Massachusetts DEP Scope of Accreditation, Westborough Facility:

Drinking Water
EPA 200.8: Sb,As,Ba,Be,Cd,Cr,Cu,Pb,Ni,Se,Tl; **EPA 200.7**: Ba,Be,Ca,Cd,Cr,Cu,Na; **EPA 245.1:** Mercury;
EPA 300.0: Nitrate-N, Fluoride, Sulfate; **EPA 353.2**: Nitrate-N, Nitrite-N; **SM4500NO3-F**: Nitrate-N, Nitrite-N; **SM4500F-C, SM4500CN-CE, EPA 180.1, SM2130B, SM4500Cl-D, SM2320B, SM2540C, SM4500H-B**
EPA 332: Perchlorate.
Microbiology: **SM9215B; SM9223-P/A, SM9223B-Colilert-QT, Enterolert-QT.**

Non-Potable Water
EPA 200.8: Al,Sb,As,Be,Cd,Cr,Cu,Pb,Mn,Ni,Se,Ag,Tl,Zn;
EPA 200.7: Al,Sb,As,Be,Cd,Ca,Cr,Co,Cu,Fe,Pb,Mg,Mn,Mo,Ni,K,Se,Ag,Na,Sr,Ti,Tl,V,Zn;
EPA 245.1, SM4500H,B, EPA 120.1, SM2510B, SM2540C, SM2340B, SM2320B, SM4500CL-E, SM4500F-BC, SM426C, SM4500NH3-BH, **EPA 350.1**: Ammonia-N, **LACHAT 10-107-06-1-B**: Ammonia-N, **SM4500NO3-F, EPA 353.2**: Nitrate-N**, SM4500NH3-BC-NES, EPA 351.1, SM4500P-E, SM4500P-B, E, SM5220D, EPA 410.4, SM5210B, SM5310C, SM4500CL-D, EPA 1664, SM14 510AC, EPA 420.1, SM4500-CN-CE, SM2540D.**
EPA 624: Volatile Halocarbons & Aromatics,
EPA 608: Chlordane, Toxaphene, Aldrin, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, Dieldrin, DDD, DDE, DDT, Endosulfan I, Endosulfan II, Endosulfan sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, PCBs
EPA 625: SVOC (Acid/Base/Neutral Extractables), **EPA 600/4-81-045**: PCB-Oil.
Microbiology: **SM9223B-Colilert-QT; Enterolert-QT, SM9222D-MF.**

For a complete listing of analytes and methods, please contact your Alpha Project Manager.

ALPHA NEW YORK CHAIN OF CUSTODY

Service Centers
Mahwah, NJ 07430: 35 Whitney Rd, Suite 5
Albany, NY 12205: 14 Walker Way
Tonawanda, NY 14150: 275 Cooper Ave, Suite 105

Westborough, MA 01581
8 Walkup Dr.
TEL: 508-898-9220
FAX: 508-898-9193

Mansfield, MA 02048
320 Forbes Blvd
TEL: 508-822-9300
FAX: 508-822-3288

Page 1 of 1

Date Rec'd in Lab: 10/17/15

ALPHA Job #: L1526386

Project Information
Project Name: DuPont
Project Location: Brooklyn, NY
Project #: 1134g-15-11
(Use Project name as Project #) ☐
Project Manager: George Holmes
ALPHAQuote #:

Client Information
Client: FPM Group
Address: 909 Marconi Avenue
Ronkonkoma, NY 11779
Phone: (631) 737-6200
Fax: (631) 737-2410
Email: g.holmes@fpm-group.com

Turn-Around Time
Standard ☒ Due Date:
Rush (only if pre approved) ☐ # of Days:

Deliverables
☒ ASP-A ☐ ASP-B
☐ EQuIS (1 File) ☐ EQuIS (4 File)
☐ Other

Billing Information
☒ Same as Client Info
PO #

Regulatory Requirement
☐ NY TOGS ☐ NY Part 375
☐ AWQ Standards ☐ NY CP-51
☐ NY Restricted Use ☐ Other
☐ NY Unrestricted Use
☐ NYC Sewer Discharge

Disposal Site Information
Please identify below location of applicable disposal facilities.
Disposal Facility:
☐ NJ ☒ NY
☐ Other:

These samples have been previously analyzed by Alpha ☐

Other project specific requirements/comments:

Please specify Metals or TAL.

ANALYSIS: PCB's

Sample Filtration
☐ Done
☐ Lab to do
Preservation
☐ Lab to do
(Please Specify below)

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials	PCB's	Sample Specific Comments	Total Bottles
26386-01	MW-5	10/15/15	8:00	Oil	GH	X		2
-02	MW-A	↓	8:30	↓	GH	↓		↓
-03	MW-15	↓	9:00	↓	GH	↓		↓
-04	RW-12	↓	9:30	↓	GH	↓		↓
-05	RW-2	↓	10:30	↓	GH	↓		↓
-06	RW-3	↓	11:00	↓	GH	↓		↓
-07	RW-10	↓	12:00	↓	GH	↓		↓

Container Type: V
Preservative: A

Preservative Code:
A = None
B = HCl
C = HNO_3
D = H_2SO_4
E = NaOH
F = MeOH
G = $NaHSO_4$
H = $Na_2S_2O_3$
K/E = Zn Ac/NaOH
O = Other

Container Code
P = Plastic
A = Amber Glass
V = Vial
G = Glass
B = Bacteria Cup
C = Cube
O = Other
E = Encore
D = BOD Bottle

Westboro: Certification No: MA935
Mansfield: Certification No: MA015

Relinquished By:	Date/Time	Received By:	Date/Time
[signature]	10/16/15	[signature]-AAL	10/16/15 11:40
[signature]-AAL	10/16/15 1830	Tom Tahn	10-16-15 1830
Tom Tahn	10/17/15 0005	Graham Phillips	10/17/15 0005

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. BY EXECUTING THIS COC, THE CLIENT HAS READ AND AGREES TO BE BOUND BY ALPHA'S TERMS & CONDITIONS. (See reverse side.)

Form No: 01-25 HC (rev. 30-Sept-2013)

ANALYTICAL REPORT

Lab Number:	L1529769
Client:	FPM Group 909 Marconi Avenue Ronkonkoma, NY 11779
ATTN:	George Holmes
Phone:	(631) 737-6200
Project Name:	DUPONT
Project Number:	1134G-15-11
Report Date:	11/23/15

Certifications & Approvals: MA (M-MA086), NY (11148), CT (PH-0574), NH (2003), NJ NELAP (MA935), RI (LAO00065), ME (MA00086), PA (68-03671), VA (460195), MD (348), IL (200077), NC (666), TX (T104704476), DOD (L2217), USDA (Permit #P-330-11-00240).

Eight Walkup Drive, Westborough, MA 01581-1019
508-898-9220 (Fax) 508-898-9193 800-624-9220 - www.alphalab.com

Project Name: DUPONT
Project Number: 1134G-15-11

Lab Number: L1529769
Report Date: 11/23/15

Alpha Sample ID	Client ID	Matrix	Sample Location	Collection Date/Time	Receive Date
L1529769-01	RW-4	OIL	BROOKLYN, NY	11/12/15 12:00	11/13/15

Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet all of the requirements of NELAC, for all NELAC accredited parameters. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. Tentatively Identified Compounds (TICs), if requested, are reported for compounds identified to be present and are not part of the method/program Target Compound List, even if only a subset of the TCL are being reported. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively. When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report. All specific QC information is also incorporated in the Data Usability format of our Data Merger tool where it can be reviewed along with any associated usability implications. Soil/sediments, solids and tissues are reported on a dry weight basis unless otherwise noted. Definitions of all data qualifiers and acronyms used in this report are provided in the Glossary located at the back of the report.

In reference to questions H (CAM) or 4 (RCP) when "NO" is checked, the performance criteria for CAM and RCP methods allow for some quality control failures to occur and still be within method compliance. In these instances the specific failure is not narrated but noted in the associated QC table. The information is also incorporated in the Data Usability format of our Data Merger tool where it can be reviewed along with any associated usability implications.

Please see the associated ADEx data file for a comparison of laboratory reporting limits that were achieved with the regulatory Numerical Standards requested on the Chain of Custody.

HOLD POLICY
For samples submitted on hold, Alpha's policy is to hold samples (with the exception of Air canisters) free of charge for 21 calendar days from the date the project is completed. After 21 calendar days, we will dispose of all samples submitted including those put on hold unless you have contacted your Client Service Representative and made arrangements for Alpha to continue to hold the samples. Air canisters will be disposed after 3 business days from the date the project is completed.

Please contact Client Services at 800-624-9220 with any questions.

Project Name:	DUPONT	**Lab Number:**	L1529769
Project Number:	1134G-15-11	**Report Date:**	11/23/15

Case Narrative (continued)

Report Submission

All non-detect (ND) or estimated concentrations (J-qualified) have been quantitated to the limit noted in the MDL column.

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature: Lisa Westerlind

Title: Technical Director/Representative

Date: 11/23/15

ORGANICS

PCBS

Project Name: DUPONT **Lab Number:** L1529769

Project Number: 1134G-15-11 **Report Date:** 11/23/15

SAMPLE RESULTS

Lab ID:	L1529769-01	Date Collected:	11/12/15 12:00
Client ID:	RW-4	Date Received:	11/13/15
Sample Location:	BROOKLYN, NY	Field Prep:	Not Specified
Matrix:	Oil	Extraction Method:	EPA 3580A
Analytical Method:	1,8082A	Extraction Date:	11/21/15 08:59
Analytical Date:	11/21/15 18:10	Cleanup Method:	EPA 3665A
Analyst:	JT	Cleanup Date:	11/21/15
Percent Solids:	Results reported on an 'AS RECEIVED' basis.	Cleanup Method:	EPA 3660B
		Cleanup Date:	11/21/15

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
PCB by GC - Westborough Lab							
Aroclor 1016	ND		mg/kg	2.78	0.366	1	A
Aroclor 1221	ND		mg/kg	2.78	0.428	1	A
Aroclor 1232	ND		mg/kg	2.78	0.544	1	A
Aroclor 1242	ND		mg/kg	2.78	0.568	1	A
Aroclor 1248	ND		mg/kg	1.86	0.391	1	A
Aroclor 1254	ND		mg/kg	2.78	0.381	1	A
Aroclor 1260	ND		mg/kg	1.86	0.353	1	A
Aroclor 1262	ND		mg/kg	0.928	0.230	1	A
Aroclor 1268	ND		mg/kg	0.928	0.672	1	A
PCBs, Total	ND		mg/kg	0.928	0.230	1	A

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	66		30-150	A
Decachlorobiphenyl	58		30-150	A
2,4,5,6-Tetrachloro-m-xylene	67		30-150	B
Decachlorobiphenyl	96		30-150	B

Project Name: DUPONT
Project Number: 1134G-15-11
Lab Number: L1529769
Report Date: 11/23/15

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8082A
Analytical Date: 11/21/15 18:23
Analyst: JT

Extraction Method: EPA 3580A
Extraction Date: 11/21/15 08:59
Cleanup Method: EPA 3665A
Cleanup Date: 11/21/15
Cleanup Method: EPA 3660B
Cleanup Date: 11/21/15

Parameter	Result	Qualifier	Units	RL	MDL	Column
PCB by GC - Westborough Lab for sample(s): 01 Batch: WG843146-1						
Aroclor 1016	ND		mg/kg	2.97	0.391	A
Aroclor 1221	ND		mg/kg	2.97	0.456	A
Aroclor 1232	ND		mg/kg	2.97	0.580	A
Aroclor 1242	ND		mg/kg	2.97	0.605	A
Aroclor 1248	ND		mg/kg	1.98	0.417	A
Aroclor 1254	ND		mg/kg	2.97	0.406	A
Aroclor 1260	ND		mg/kg	1.98	0.377	A
Aroclor 1262	ND		mg/kg	0.989	0.245	A
Aroclor 1268	ND		mg/kg	0.989	0.717	A
PCBs, Total	ND		mg/kg	0.989	0.245	A

Surrogate	%Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	61		30-150	A
Decachlorobiphenyl	69		30-150	A
2,4,5,6-Tetrachloro-m-xylene	68		30-150	B
Decachlorobiphenyl	150		30-150	B

Lab Control Sample Analysis
Batch Quality Control

Project Name: DUPONT
Project Number: 1134G-15-11

Lab Number: L1529769
Report Date: 11/23/15

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits	Column
PCB by GC - Westborough Lab Associated sample(s): 01 Batch: WG843146-2 WG843146-3									
Aroclor 1016	61		59		40-140	3		50	A
Aroclor 1260	57		58		40-140	2		50	A

Surrogate	LCS %Recovery	Qual	LCSD %Recovery	Qual	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	61		62		30-150	A
Decachlorobiphenyl	69		73		30-150	A
2,4,5,6-Tetrachloro-m-xylene	68		69		30-150	B
Decachlorobiphenyl	150		**152**	Q	30-150	B

Project Name: DUPONT
Project Number: 1134G-15-11

Lab Number: L1529769
Report Date: 11/23/15

Sample Receipt and Container Information

Were project specific reporting limits specified? YES

Cooler Information

Cooler	Custody Seal
A	Absent

Container Information

Container ID	Container Type	Cooler	pH	Temp deg C	Pres	Seal	Analysis(*)
L1529769-01A	Vial unpreserved	A	N/A	2.3	Y	Absent	PCB-8082LL(14)
L1529769-01B	Vial unpreserved	A	N/A	2.3	Y	Absent	PCB-8082LL(14)

*Values in parentheses indicate holding time in days

GLOSSARY

Acronyms

EDL - Estimated Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The EDL includes any adjustments from dilutions, concentrations or moisture content, where applicable. The use of EDLs is specific to the analysis of PAHs using Solid-Phase Microextraction (SPME).

EPA - Environmental Protection Agency.

LCS - Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.

LCSD - Laboratory Control Sample Duplicate: Refer to LCS.

LFB - Laboratory Fortified Blank: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.

MDL - Method Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The MDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.

MS - Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available.

MSD - Matrix Spike Sample Duplicate: Refer to MS.

NA - Not Applicable.

NC - Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.

NI - Not Ignitable.

NP - Non-Plastic: Term is utilized for the analysis of Atterberg Limits in soil.

RL - Reporting Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RL includes any adjustments from dilutions, concentrations or moisture content, where applicable.

RPD - Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.

SRM - Standard Reference Material: A reference sample of a known or certified value that is of the same or similar matrix as the associated field samples.

STLP - Semi-dynamic Tank Leaching Procedure per EPA Method 1315.

TIC - Tentatively Identified Compound: A compound that has been identified to be present and is not part of the target compound list (TCL) for the method and/or program. All TICs are qualitatively identified and reported as estimated concentrations.

Footnotes

1 - The reference for this analyte should be considered modified since this analyte is absent from the target analyte list of the original method.

Terms

Total: With respect to Organic analyses, a 'Total' result is defined as the summation of results for individual isomers or Aroclors. If a 'Total' result is requested, the results of its individual components will also be reported. This is applicable to 'Total' results for methods 8260, 8081 and 8082.

Analytical Method: Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

Data Qualifiers

A - Spectra identified as "Aldol Condensation Product".

B - The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For MCP-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank. For NJ-Air-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte above the reporting limit. For NJ-related projects (excluding Air), flag only applies to associated field samples that have detectable concentrations of the analyte, which was detected above the reporting limit in the associated method blank or above five times the reporting limit for common lab contaminants (Phthalates, Acetone, Methylene Chloride, 2-Butanone).

Report Format: DU Report with 'J' Qualifiers

Project Name:	DUPONT	**Lab Number:**	L1529769
Project Number:	1134G-15-11	**Report Date:**	11/23/15

Data Qualifiers

C - Co-elution: The target analyte co-elutes with a known lab standard (i.e. surrogate, internal standards, etc.) for co-extracted analyses.

D - Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.

E - Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.

G - The concentration may be biased high due to matrix interferences (i.e, co-elution) with non-target compound(s). The result should be considered estimated.

H - The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.

I - The lower value for the two columns has been reported due to obvious interference.

M - Reporting Limit (RL) exceeds the MCP CAM Reporting Limit for this analyte.

NJ - Presumptive evidence of compound. This represents an estimated concentration for Tentatively Identified Compounds (TICs), where the identification is based on a mass spectral library search.

P - The RPD between the results for the two columns exceeds the method-specified criteria.

Q - The quality control sample exceeds the associated acceptance criteria. For DOD-related projects, LCS and/or Continuing Calibration Standard exceedences are also qualified on all associated sample results. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less than 5x the RL. (Metals only.)

R - Analytical results are from sample re-analysis.

RE - Analytical results are from sample re-extraction.

S - Analytical results are from modified screening analysis.

J - Estimated value. The Target analyte concentration is below the quantitation limit (RL), but above the Method Detection Limit (MDL) or Estimated Detection Limit (EDL) for SPME-related analyses. This represents an estimated concentration for Tentatively Identified Compounds (TICs).

ND - Not detected at the method detection limit (MDL) for the sample, or estimated detection limit (EDL) for SPME-related analyses.

Report Format: DU Report with 'J' Qualifiers

REFERENCES

1 Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. EPA SW-846. Third Edition. Updates I - IV, 2007.

LIMITATION OF LIABILITIES

Certification Information

The following analytes are not included in our Primary NELAP Scope of Accreditation:

Westborough Facility
EPA 8260C: 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene; Iodomethane (methyl iodide) (soil); Methyl methacrylate (soil); Azobenzene.
EPA 8270D: Dimethylnaphthalene,1,4-Diphenylhydrazine.
EPA 625: 4-Chloroaniline, 4-Methylphenol.
SM4500: Soil: Total Phosphorus, TKN, NO2, NO3.

Mansfield Facility
EPA 8270D: Biphenyl.
EPA 2540D: TSS
EPA TO-15: Halothane, 2,4,4-Trimethyl-2-pentene, 2,4,4-Trimethyl-1-pentene, Thiophene, 2-Methylthiophene, 3-Methylthiophene, 2-Ethylthiophene, 1,2,3-Trimethylbenzene, Indan, Indene, 1,2,4,5-Tetramethylbenzene, Benzothiophene, 1-Methylnaphthalene.

The following analytes are included in our Massachusetts DEP Scope of Accreditation, Westborough Facility:

Drinking Water
EPA 200.8: Sb,As,Ba,Be,Cd,Cr,Cu,Pb,Ni,Se,Tl; **EPA 200.7**: Ba,Be,Ca,Cd,Cr,Cu,Na; **EPA 245.1:** Mercury;
EPA 300.0: Nitrate-N, Fluoride, Sulfate; **EPA 353.2**: Nitrate-N, Nitrite-N; **SM4500NO3-F**: Nitrate-N, Nitrite-N; **SM4500F-C, SM4500CN-CE, EPA 180.1, SM2130B, SM4500Cl-D, SM2320B, SM2540C, SM4500H-B**
EPA 332: Perchlorate.
Microbiology: **SM9215B; SM9223-P/A, SM9223B-Colilert-QT, Enterolert-QT.**

Non-Potable Water
EPA 200.8: Al,Sb,As,Be,Cd,Cr,Cu,Pb,Mn,Ni,Se,Ag,Tl,Zn;
EPA 200.7: Al,Sb,As,Be,Cd,Ca,Cr,Co,Cu,Fe,Pb,Mg,Mn,Mo,Ni,K,Se,Ag,Na,Sr,Ti,Tl,V,Zn;
EPA 245.1, SM4500H,B, EPA 120.1, SM2510B, SM2540C, SM2340B, SM2320B, SM4500CL-E, SM4500F-BC, SM426C, SM4500NH3-BH, **EPA 350.1**: Ammonia-N, **LACHAT 10-107-06-1-B**: Ammonia-N, **SM4500NO3-F, EPA 353.2**: Nitrate-N**, SM4500NH3-BC-NES, EPA 351.1, SM4500P-E, SM4500P-B, E, SM5220D, EPA 410.4, SM5210B, SM5310C, SM4500CL-D, EPA 1664, SM14 510AC, EPA 420.1, SM4500-CN-CE, SM2540D.**
EPA 624: Volatile Halocarbons & Aromatics,
EPA 608: Chlordane, Toxaphene, Aldrin, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, Dieldrin, DDD, DDE, DDT, Endosulfan I, Endosulfan II, Endosulfan sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, PCBs
EPA 625: SVOC (Acid/Base/Neutral Extractables), **EPA 600/4-81-045**: PCB-Oil.
Microbiology: **SM9223B-Colilert-QT; Enterolert-QT, SM9222D-MF.**

For a complete listing of analytes and methods, please contact your Alpha Project Manager.

ALPHA

NEW YORK CHAIN OF CUSTODY

Service Centers
Mahwah, NJ 07430: 35 Whitney Rd, Suite 5
Albany, NY 12205: 14 Walker Way
Tonawanda, NY 14150: 275 Cooper Ave, Suite 105

Page 1 of 1

Date Rec'd in Lab: 11/14/15

ALPHA Job #: L1529769

Westborough, MA 01581
8 Walkup Dr.
TEL: 508-898-9220
FAX: 508-898-9193

Mansfield, MA 02048
320 Forbes Blvd
TEL: 508-822-9300
FAX: 508-822-3288

Project Information

Project Name: DuPont
Project Location: Brooklyn, NY
Project # 1134g-15-11
(Use Project name as Project #) ☐
Project Manager: George Holmes
ALPHAQuote #:

Turn-Around Time

Standard ☒ Due Date:
Rush (only if pre approved) ☐ # of Days:

Client Information

Client: FPM Group
Address: 909 Marconi Avenue
Ronkonkoma, NY 11779
Phone: (631) 737-6200
Fax: (631) 737-2410
Email: g.holmes@fpm-group.com

Deliverables

☒ ASP-A ☐ ASP-B
☐ EQuIS (1 File) ☐ EQuIS (4 File)
☐ Other

Billing Information

☒ Same as Client Info
PO #

Regulatory Requirement

☐ NY TOGS ☐ NY Part 375
☐ AWQ Standards ☐ NY CP-51
☐ NY Restricted Use ☐ Other
☐ NY Unrestricted Use
☐ NYC Sewer Discharge

Disposal Site Information

Please identify below location of applicable disposal facilities.
Disposal Facility:
☐ NJ ☒ NY
☐ Other:

These samples have been previously analyzed by Alpha ☐

Other project specific requirements/comments:

Please specify Metals or TAL.

ANALYSIS: PCB's

Sample Filtration
☐ Done
☐ Lab to do
Preservation
☐ Lab to do
(Please Specify below)

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials	PCB's								Sample Specific Comments	Total Bottles
29769-01	RW-4	11/12/15	12:00	Oil	GH	X									2

	PCB's
Container Type	V
Preservative	A

Preservative Code:
A = None
B = HCl
C = HNO_3
D = H_2SO_4
E = NaOH
F = MeOH
G = $NaHSO_4$
H = $Na_2S_2O_3$
K/E = Zn Ac/NaOH
O = Other

Container Code
P = Plastic
A = Amber Glass
V = Vial
G = Glass
B = Bacteria Cup
C = Cube
O = Other
E = Encore
D = BOD Bottle

Westboro: Certification No: MA935
Mansfield: Certification No: MA015

Relinquished By:	Date/Time	Received By:	Date/Time
[signature]	11/13/15 1055	[signature] (AAL)	11/13/15 1055
[signature] (AAL)	11/13/15 1830	Tom [signature]	11-13-15 1830
Tom [signature]	11/14/15 0105	Graham Phillips	11/14/15 0105

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. BY EXECUTING THIS COC, THE CLIENT HAS READ AND AGREES TO BE BOUND BY ALPHA'S TERMS & CONDITIONS. (See reverse side.)

Form No: 01-25 HC (rev. 30-Sept-2013)

APPENDIX C

FEASIBILITY STUDY COST ESTIMATES

Remedial Alternative 2: AS/SVE Onsite

	No. units	Unit Cost	Item Total
AS/SVE System Design and Installation			
AS Well installation (4 interior 2" PVC wells to 20 feet)	4	$2,500	$10,000
Trenching & Piping (200 feet in conc. slab)	200	$100	$20,000
SVE Well installation (3 interior 2" PVC well to 10 feet)	3	$2,000	$6,000
Trenching* & Piping (*assume mostly common trench with AS)	150	$30	$4,500
Waste Characterization (1/500 tons)	1	$1,000	$1,000
Transport/Dispose Excavated Soil (0.4 T/well, non-hazardous w/VOCs)	3	$150	$450
Transport/Dispose Excavated Soil (0.3 T/ft of trench, non-hazardous, w/VOCs)	60	$150	$9,000
SVE Components (blower, knockout drum, filter)	1	$20,000	$20,000
AS Components (compressor, filter)	1	$20,000	$20,000
Remedial Enclosure	1	$3,000	$3,000
Electrical Service	1	$8,000	$8,000
Electrical Controls	1	$6,000	$6,000
Subtotal:			**$107,950**
Contingency (15% of system construction costs)			$16,193
System Design (15% of system construction costs)			$16,193
Oversight and Management (25% of system construction costs)			$26,988
Reporting (15% of system construction costs)			$16,193
Total Capital Cost:			**$183,515**
AS/SVE OM&M and Reporting (Annual)			
Labor (monthly OM&M)	12	$600	$7,200
Repair and maintenance materials (routine, annual)	1	$1,000	$1,000
Repair and maintenance materials (non-routine, 1/3 of AS/SVE components)	1	$13,200	$13,200
Effluent lab analysis - TO-15, quarterly	4	$350	$1,400
Reporting, as part of Annual Certification	1	$4,000	$4,000
Electrical service (monthly)	12	$2,000	$24,000
Subtotal:			**$50,800**
Contingency (15% of annual costs)			$7,620
Total Annual OM&M Cost:			**$58,420**
AS/SVE System Removal and Well Abandonment			
Cut and plug below-grade piping	1	$3,000	$3,000
Remove/dispose above-grade components	1	$6,000	$6,000
Terminate/remove electrical service	1	$3,000	$3,000
AS well abandonment (4 to 20 feet, 2" PVC)	4	$500	$2,000
SVE well abandonment (3 to 10 feet, 2" PVC)	3	$300	$900
Subtotal:			**$14,000**
Contingency (15% of removal costs)			$2,100
Removal Specs (15% of removal costs)			$2,100
Oversight and Management (25% of removal costs)			$3,500
Reporting(15% of removal costs)			$2,100
Total Capital Cost for system removal and AS/SVE well abandonment:			**$23,800**

Remedial Alternative 2 - AS/SVE Onsite
Net Present Worth Calculations

		Net Present Worth (four years)		Net Present Worth (30 years)	Net Present Worth System Removal
Capital Cost for System Installation:	**$183,515**				
OM&M and Reporting (annual):	**$58,420**		**years**		
interest rate:	0.05	$58,420	**1**	$58,420	$23,800
inflation rate:	0.02	$56,718	**2**	$56,718	$23,107
Capital Cost for System Removal (year 1):	**$23,800**	$55,066	**3**	$55,066	$22,434
		$53,463	**4**	$53,463	$21,780
System Removal:		**$21,780**	**5**	$51,905	$21,146
Total Net Present Worth (4 years):		**$428,963**	**6**	$50,394	$20,530
			7	$48,926	$19,932
			8	$47,501	$19,352
			9	$46,117	$18,788
			10	$44,774	$18,241
			11	$43,470	$17,709
			12	$42,204	$17,194
			13	$40,975	$16,693
			14	$39,781	$16,207
			15	$38,623	$15,735
			16	$37,498	$15,276
			17	$36,405	$14,831
			18	$35,345	$14,399
			19	$34,316	$13,980
			20	$33,316	$13,573
			21	$32,346	$13,177
			22	$31,404	$12,794
			23	$30,489	$12,421
			24	$29,601	$12,059
			25	$28,739	$11,708
			26	$27,902	$11,367
			27	$27,089	$11,036
			28	$26,300	$10,714
			29	$25,534	$10,402
			30	$24,790	$10,099
		Capital Cost for System Removal:		**$10,099**	
		Total Net Present Worth (30 years):		**$1,373,024**	

Remedial Alternative 2: LNAPL Extraction/Disposal

	No. units	Unit Cost	Item Total
Extraction Well System Design and Installation			
Interior of Site Building:			
Recovery Well Installation (12 interior 4" PVC wells to 20 feet)	12	$4,000	$48,000
Waste Characterization (1/500 tons)	1	$1,000	$1,000
Transport/Dispose Excavated Soil (0.8 T/well, hazardous, low PCBs)	10	$275	$2,750
Collection Piping and Connections (400 linear feet)	400	$10	$4,000
Belt Skimmers and controls	14	$4,000	$56,000
Tanks (2-3,000-gallon ASTs)	2	$5,000	$10,000
Remedial Enclosure	1	$3,000	$3,000
Electrical Service	1	$8,000	$8,000
Subtotal for Interior Recovery Wells:			**$132,750**
Contingency (15% of construction costs)			$19,913
System Design (15% of construction costs)			$19,913
Oversight and Management (25% of construction costs)			$33,188
Reporting (15% of construction costs)			$19,913
Total Capital Cost Interior of Site Building:			**$225,675**
Offsite:			
Permitting (allowance per location)	4	$3,000	$12,000
Recovery Well Installation (4 offsite 4" PVC wells to 20 feet)	4	$4,000	$16,000
Vault Excavations (per well vault)	4	$3,000	$12,000
Waste Characterization (1/500 tons)	1	$1,000	$1,000
Transport/Dispose Excavated Soil (0.8 T/well, non-hazardous)	3	$125	$375
Transport/Dispose Excavated Soil (5 tons/vault, non-hazardous)	20	$125	$2,500
Vaults (purchased and installed)	4	$10,000	$40,000
Piping and Connections (in vault, per well)	4	$1,000	$4,000
Belt Skimmers, controls, and In-vault tanks	4	$8,000	$32,000
Electrical Service (offsite)	2	$12,000	$24,000
Saw cut and remove sidewalk (50 feet per well for electrical service)	200	$20	$4,000
Waste Characterization (1/500 tons)	1	$1,000	$1,000
Transport/Dispose Excavated Soil (30 tons, non-hazardous)	30	$125	$3,750
Concrete Sidewalk Restoration (allowance per well, including elect. service)	4	$3,000	$12,000
Safety Equipment/Road Closure (per week)	3	$15,000	$45,000
Subtotal for Offsite Recovery Wells:			**$209,625**
Contingency (15% of construction costs)			$31,444
System Design (15% of construction costs)			$31,444
Oversight and Management (25% of construction costs)			$52,406
Reporting (15% of construction costs)			$31,444
Total Capital Cost Offsite:			**$356,363**
Recovery Well OM&M and Reporting			
Labor (monthly OM&M)	12	$1,500	$18,000
Repair and maintenance materials (routine, annual)	1	$1,000	$1,000
Repair and maintenance materials (non-routine, 1/3 of skimmer components)	1	$29,040	$29,040
Waste Transport and Disposal (hazardous waste, non-PCB, per gallon)	5,000	$4.75	$23,750
Waste Transport and Disposal (hazardous waste, contains PCBs, per gallon)	5,000	$11.30	$56,500
Reporting, interim quarterly reports	4	$4,000	$16,000
Reporting, as part of Annual Certification	1	$4,000	$4,000
Electrical service (monthly, with allowance for account fees)	18	$30	$540
Subtotal:			**$148,830**
Contingency (15% of annual costs)			$22,325
Total Annual OM&M Cost:			**$171,155**
Recovery System Removal and Well Abandonment			
Remove/clean/dispose skimmer components	18	$5,000	$90,000
Terminate/remove electrical service	3	$1,500	$4,500
Recovery well abandonment (to 20 feet, 4" PVC)	18	$500	$9,000
Restore offsite well locations	4	$5,000	$20,000
Subtotal:			**$123,500**
Contingency (15% of removal costs)			$18,525
Removal Specs (15% of removal costs)			$18,525
Oversight and Management (25% of removal costs)			$30,875
Reporting (15% of removal costs)			$18,525
Total Capital Cost for system removal and well abandonment:			**$209,950**

Remedial Alternative 2 - LNAPL Extraction/Disposal
Net Present Worth Calculations

		OM&M Net Present Worth (ten years)	years	OM&M Net Present Worth (30 years)	Net Present Worth System Removal
Capital Cost for Onsite Installation:	**$225,675**				
Capital Cost for Offsite Installation:	**$356,363**				
Total Capital Cost for Installation:	**$582,038**				
OM&M and Reporting (annual):	**$171,155**				
interest rate:	0.05	$171,155	**1**	$171,155	$209,950
inflation rate:	0.02	$166,169	**2**	$166,169	$203,835
Capital Cost for System Removal (year 1):	**$209,950**	$161,330	**3**	$161,330	$197,898
		$156,631	**4**	$156,631	$192,134
		$152,069	**5**	$152,069	$186,538
		$147,639	**6**	$147,639	$181,105
		$143,339	**7**	$143,339	$175,830
		$139,164	**8**	$139,164	$170,709
		$135,111	**9**	$135,111	$165,736
		$131,176	**10**	$131,176	$160,909
OM&M Subtotal:		**$1,503,782**	**11**	$127,355	$156,223
System Removal:		**$160,909**	**12**	$123,646	$151,672
Total Net Present Worth (10 years):		**$2,246,729**	**13**	$120,044	$147,255
			14	$116,548	$142,966
			15	$113,153	$138,802
			16	$109,858	$134,759
			17	$106,658	$130,834
			18	$103,551	$127,023
			19	$100,535	$123,323
			20	$97,607	$119,732
			21	$94,764	$116,244
			22	$92,004	$112,858
			23	$89,324	$109,571
			24	$86,723	$106,380
			25	$84,197	$103,281
			26	$81,744	$100,273
			27	$79,363	$97,353
			28	$77,052	$94,517
			29	$74,808	$91,764
			30	$72,629	$89,092
		OM&M Subtotal:		**$3,455,345**	
		Capital Cost for System Removal:		**$89,092**	
		Total Net Present Worth (30 years):		**$4,126,474**	

Remedial Alternative 2: Groundwater/LNAPL Monitoring

	No. units	Unit Cost	Item Total
Monitoring Network Installation			
Assume existing GW monitoring wells are used	0	$0	$0
LNAPL monitor well installation (2 interior 2" PVC wells to 20 feet)	2	$2,500	$5,000
Waste Characterization (1/500 tons)	1	$1,000	$1,000
Transport/Dispose Excavated Soil (0.4 T/well, hazardous, low PCBs)	1	$275	$275
Subtotal:			**$6,275**
Contingency (15% of well construction costs)			$941
Oversight and Management (25% of well construction costs)			$1,569
Reporting (15% of well construction costs)			$941
Total Capital Cost for Monitoring Network Installation:			**$9,726**
GW Monitoring and Reporting			
Labor and Materials (12 wells semiannual monitoring)	2	$6,000	$12,000
Labor and Materials (9 wells, Q monitoring)	2	$6,000	$12,000
Repair and maintenance of wells (routine, annual)	1	$100	$100
Repair and maintenance of wells (non-routine, 1/3 of new well)	1	$825	$825
VOC and SVOC analysis (12 wells pls QAQC, semiannual)	36	$400	$14,400
VOC analysis (9 wells pls QAQC, quarterly)	28	$120	$3,360
DUSR prep	4	$2,000	$8,000
Reporting, interim quarterly reports	4	$4,000	$16,000
Reporting, as part of Annual Certification	1	$4,000	$4,000
Subtotal:			**$70,685**
Contingency (15% of annual costs)			$10,603
Total Annual GW Monitoring and Reporting Cost:			**$81,288**
LNAPL Monitoring and Reporting (Annual)			
Labor and Materials (monthly LNAPL monitoring)	12	$3,000	$36,000
Repair and maintenance of wells (routine, annual)	1	$1,000	$1,000
Repair and maintenance of wells (non-routine, 1 new well)	1	$2,500	$2,500
Reporting, monthly	12	$2,000	$24,000
Reporting, as part of Annual Certification	1	$4,000	$4,000
Subtotal:			**$67,500**
Contingency (15% of annual costs)			$10,125
Total Annual LNAPL Monitoring and Reporting Cost:			**$77,625**
Monitoring Network Abandonment			
Well abandonment (54 to 20 feet, 2" PVC)	54	$500	$27,000
Subtotal:			**$27,000**
Contingency (15% of abandonment costs)			$4,050
Abandonment Specs (15% of abandonment costs)			$4,050
Oversight and Management (25% of abandonment costs)			$6,750
Reporting (15% of abandonment costs)			$4,050
Total Capital Cost for monitoring network abandonment:			**$45,900**

Remedial Alternative 2: Groundwater/LNAPL Monitoring
Net Present Worth Calculations

		LNAPL Monitoring Net Present Worth (12 Years)	GW Monitoring Net Present Worth (6 Years)	years	GW/LNAPL Monitoring Net Present Worth (30 years)	Network Abandonment Net Present Worth
Capital Cost for Well Installation:	**$9,726**					
GW Monitoring and Reporting (annual):	**$81,288**					
LNAPL Monitoring and Reporting (annual):	**$77,625**			**years**		
interest rate:	0.05	$ 77,625	$ 81,288	**1**	$158,913	$45,900
inflation rate:	0.02	$ 75,364	$ 78,920	**2**	$154,284	$44,563
		$ 73,169	$ 76,622	**3**	$149,791	$43,265
		$ 71,038	$ 74,390	**4**	$145,428	$42,005
		$ 68,969	$ 72,223	**5**	$141,192	$40,782
		$ 66,960	$ 70,120	**6**	$137,080	$39,594
Capital Cost for Monitoring Network Abandonment (year 1):	**$45,900**	$ 65,010	**$453,562**	**7**	$133,087	$38,441
Total Net Present Worth GW Monitoring - 6 years:	**$453,562**	$ 63,116		**8**	$129,211	$37,321
Total Net Present Worth LNAPL Monitoring - 12 years:	**$795,860**	$ 61,278		**9**	$125,447	$36,234
		$ 59,493		**10**	$121,793	$35,179
		$ 57,760		**11**	$118,246	$34,154
		$ 56,078		**12**	$114,802	$33,159
		$795,860		**13**	$111,458	$32,193
Capital Cost for Network Abandonment (year 12):		**$33,159**		**14**	$108,212	$31,256
Total Net Present Worth (6 and 12 years):		**$1,292,307**		**15**	$105,060	$30,345
				16	$102,000	$29,461
				17	$99,029	$28,603
				18	$96,145	$27,770
				19	$93,344	$26,961
				20	$90,626	$26,176
				21	$87,986	$25,414
				22	$85,423	$24,674
				23	$82,935	$23,955
				24	$80,520	$23,257
				25	$78,175	$22,580
				26	$75,898	$21,922
				27	$73,687	$21,284
				28	$71,541	$20,664
				29	$69,457	$20,062
				30	$67,434	$19,477
			30 Years MonitoringSubtotal:		**$3,208,203**	
			Capital Cost for Network Abandonment:		**$19,477**	
			Total Net Present Worth (30 years):		**$3,237,407**	

Remedial Alternative 2: Soil Vapor/SVI Monitoring

	No. units	Unit Cost	Item Total
Soil Vapor/SVI Monitoring Network Installation			
Labor and Materials per SV implant installed	8	$300	$2,400
Permitting for Sidewalk Locations	3	$3,000	$9,000
Concrete Sidewalk Restoration (allowance per implant)	3	$3,000	$9,000
Allowance for offsite access costs (2 properties)	2	$3,000	$6,000
Subtotal:			**$26,400**
Contingency (15% of construction costs)			$3,960
Design (15% of construction costs)			$3,960
Oversight and Management (25% of construction costs)			$6,600
Reporting (15% of construction costs)			$3,960
Total Capital Cost:			**$44,880**
Soil Vapor/SVI Monitoring and Reporting (Annual)			
Labor and Materials (per monitoring event)	2	$6,000	$12,000
Repair and maintenance of implants (routine, annual)	1	$300	$300
Repair and maintenance of implants (non-routine, 1 new implant)	1	$300	$300
TO-15 VOC analysis (6 SV pls QAQC each event, 2 events)	16	$300	$4,800
TO-15LL VOC analysis (2 ind/2 subslab/1 amb pls QAQC each event, 2 events)	14	$350	$4,900
DUSR prep	2	$2,000	$4,000
Reporting, interim semiannual reports	2	$4,000	$8,000
Reporting, as part of Annual Certification	1	$4,000	$4,000
Subtotal:			**$38,300**
Contingency (15% of annual costs)			$5,745
Total Annual Soil Vapor/SVI Monitoring Cost:			**$44,045**
Soil Vapor/SVI Implant Network Abandonment			
Implant abandonment (remove implants, repair floors)	8	$200	$1,600
Permitting for Sidewalk Locations	3	$3,000	$9,000
Concrete Sidewalk Restoration (allowance per implant)	3	$3,000	$9,000
Allowance for offsite access costs (2 properties)	2	$1,000	$2,000
Subtotal:			**$21,600**
Contingency (15% of abandonment costs)			$3,240
Abandonment Specs (15% of abandonment costs)			$3,240
Oversight and Management (25% of abandonment costs)			$5,400
Reporting (15% of abandonment costs)			$3,240
Total Capital Cost for Implant Abandonment:			**$36,720**

Remedial Alternative 2: Soil Vapor/SVI Monitoring
Net Present Worth Calculations

		Monitoring/Reporting Net Present Worth (6 years)		Monitoring/Reporting Net Present Worth (30 years)	Net Present Worth Implant Abandonment
Capital Cost for Installation:	**$44,880**				
Monitoring and Reporting (annual):	**$44,045**		**years**		
interest rate:	0.05	$ 44,045	**1**	$44,045	$36,720
inflation rate:	0.02	$ 42,762	**2**	$42,762	$35,650
Capital Cost for Implant Abn. (year 1):	**$36,720**	$ 41,517	**3**	$41,517	$34,612
		$ 40,307	**4**	$40,307	$33,604
		$ 39,133	**5**	$39,133	$32,625
		$ 37,994	**6**	$37,994	$31,675
Subtotal:		**$245,758**	**7**	$36,887	$30,752
Capital Cost for Implant Abandonment (year 6):		**$31,675**	**8**	$35,813	$29,857
Total Net Present Worth (6 years):		**$322,313**	**9**	$34,770	$28,987
			10	$33,757	$28,143
			11	$32,774	$27,323
			12	$31,819	$26,527
			13	$30,892	$25,755
			14	$29,993	$25,005
			15	$29,119	$24,276
			16	$28,271	$23,569
			17	$27,447	$22,883
			18	$26,648	$22,216
			19	$25,872	$21,569
			20	$25,118	$20,941
			21	$24,387	$20,331
			22	$23,676	$19,739
			23	$22,987	$19,164
			24	$22,317	$18,606
			25	$21,667	$18,064
			26	$21,036	$17,538
			27	$20,423	$17,027
			28	$19,829	$16,531
			29	$19,251	$16,049
			30	$18,690	$15,582
		Subtotal:		**$889,200**	
		Capital Cost for Implant Abandonment (30 years):		**$15,582**	
		Total Net Present Worth (30 years):		**$949,662**	

Remedial Alternatives 2 - 4: ECs and ICs

		No. units	Unit Cost	Item Total
ICs				
Prepare Site Management Plan		1	$20,000	$20,000
Prepare/Record Environmental Easement		1	$10,000	$10,000
Alta survey		1	$10,000	$10,000
	Subtotal for ICs:			**$40,000**
Contingency (15% of IC costs)				$6,000
	Total Capital Cost for ICs:			**$46,000**
ECs				
Cover over residual soils - existing		1	$0	$0
Remedial systems - included elsewhere		1	$0	$0
	Subtotal for ECs:			**$0**
Contingency (15% of EC costs)				$0
	Total Capital Cost for ECs:			**$0**
Reporting and Certification (Annual)				
Labor (periodic and annual inspections)		2	$1,500	$3,000
Cover repairs (incidental, not included elsewhere)		1	$3,000	$3,000
Report preparation (inspections only, not incl. perf. monitoring covered elsewhere)		1	$5,000	$5,000
	Subtotal:			**$11,000**
Contingency (15% of annual costs)				$1,650
	Total Annual Reporting and Certification Cost:			**$12,650**

Remedial Alternatives 2-4: ECs and ICs
Net Present Worth Calculations

		Reporting and Certs. Net Present Worth	years
Capital Cost:	**$46,000**		
Reporting and Certification (annual):	**$12,650**		
interest rate:	0.05	$12,650	**1**
inflation rate:	0.02	$12,282	**2**
		$11,924	**3**
		$11,577	**4**
		$11,239	**5**
		$10,912	**6**
		$10,594	**7**
		$10,286	**8**
		$9,986	**9**
		$9,695	**10**
		$9,413	**11**
		$9,139	**12**
		$8,872	**13**
		$8,614	**14**
		$8,363	**15**
		$8,120	**16**
		$7,883	**17**
		$7,653	**18**
		$7,431	**19**
		$7,214	**20**
		$7,004	**21**
		$6,800	**22**
		$6,602	**23**
		$6,410	**24**
		$6,223	**25**
		$6,042	**26**
		$5,866	**27**
		$5,695	**28**
		$5,529	**29**
		$5,368	**30**
Reporting/Cert. Net Present Worth:		**$255,384**	
Total Net Present Worth:		**$301,384**	

Remedial Alternative 3: Onsite Sheetpile Wall and Extraction Wells

	No. units	Unit Cost	Item Total
Onsite Wall/Well System Design and Installation			
Interior Wall:			
Saw Cut and Remove Concrete Floor (1,700 sf along wall alignment)	1,700	$15	$25,500
Transport/Dispose Concrete (70 tons)	70	$50	$3,500
Targeted Excavation (200 CY along wall alignment)	200	$20	$4,000
Waste Characterization (1/500 tons)	1	$1,000	$1,000
Transport/Dispose Excavated Soil (300 tons, hazardous, low PCBs)	300	$275	$82,500
Additional Site Prep Allowance (remove excess infrastructure, obstructions)	1	$50,000	$50,000
Contractor Mob/Demob	1	$25,000	$25,000
Steel Sheetpiles to 20 feet depth (340 linear feet, 6800 sf, dedicated)	6800	$45	$306,000
Subtotal for Interior Wall:			**$497,500**
Interior Recovery Wells			
Recovery Well Installation (7 interior 4" PVC wells to 20 feet)	7	$4,000	$28,000
Waste Characterization (1/500 tons)	1	$1,000	$1,000
Transport/Dispose Excavated Soil (0.4 T/well, hazardous, low PCBs)	3	$275	$825
Vault Excavations (per well vault)	7	$3,000	$21,000
Waste Characterization (1/500 tons)	1	$1,000	$1,000
Transport/Dispose Excavated Soil (5 tons/vault, non-hazardous)	35	$125	$4,375
Vaults (purchased and installed)	7	$10,000	$70,000
Collection Piping and Connections (400 linear feet)	400	$10	$4,000
Belt Skimmers and controls	7	$4,000	$28,000
Tanks (2-3,000-gallon ASTs)	2	$5,000	$10,000
Remedial Enclosure	1	$3,000	$3,000
Electrical Service (onsite)	1	$8,000	$8,000
Exterior Recovery Wells			
Permitting (allowance per location)	7	$3,000	$21,000
Recovery Well Installation (7 offsite 4" PVC well to 20 feet)	7	$4,000	$28,000
Waste Characterization (1/500 tons)	1	$1,000	$1,000
Transport/Dispose Excavated Soil (0.4 T/well, non-hazardous)	3	$125	$375
Vault Excavations (per well vault)	7	$3,000	$21,000
Waste Characterization (1/500 tons)	1	$1,000	$1,000
Transport/Dispose Excavated Soil (5 tons/vault, non-hazardous)	35	$125	$4,375
Vaults (purchased and installed)	7	$10,000	$70,000
Piping and Connections (in vault, per well)	7	$1,000	$7,000
Belt Skimmers, controls, and In-vault tanks	7	$8,000	$56,000
Electrical Service (offsite)	2	$12,000	$24,000
Saw cut and remove sidewalk (50 feet per well for electrical service)	350	$20	$7,000
Waste Characterization (1/500 tons)	1	$1,000	$1,000
Transport/Dispose Excavated Soil (8 tons per well, non-hazardous)	56	$125	$7,000
Concrete Sidewalk Restoration (allowance per well, including elect. service)	7	$3,000	$21,000
Safety Equipment/Road Closure (per week)	3	$15,000	$45,000
Subtotal for Interior and Exterior Recovery Wells:			**$493,950**
Contingency (15% of construction costs)			$148,718
System Design (15% of construction costs)			$148,718
Oversight and Management (25% of construction costs)			$247,863
Reporting (15% of construction costs)			$148,718
Total Capital Cost Site Wall/Wells:			**$1,685,465**
Offsite Recovery Well System Design and Installation			
Offsite Wells (South of Dupont Street):			
Permitting (allowance per location)	5	$3,000	$15,000
Recovery Well Installation (5 offsite 4" PVC wells to 20 feet)	5	$4,000	$20,000
Vault Excavations (per well vault)	5	$3,000	$15,000
Waste Characterization (1/500 tons)	1	$1,000	$1,000
Transport/Dispose Excavated Soil (5 tons per vault, non-hazardous)	25	$125	$3,125
Vaults (purchased and installed)	5	$10,000	$50,000
Piping and Connections (in vault, per well)	5	$1,000	$5,000
Belt Skimmers, controls, and In-vault tanks	5	$8,000	$40,000
Electrical Service (offsite)	2	$12,000	$24,000
Saw cut and remove sidewalk (50 feet per well for electrical service)	250	$20	$5,000
Waste Characterization (1/500 tons)	1	$1,000	$1,000
Transport/Dispose Excavated Soil (8 tons per well, non-hazardous)	40	$125	$5,000
Concrete Sidewalk Restoration (allowance per well, including elect. service)	5	$3,000	$15,000
Safety Equipment/Road Closure (per week)	2	$15,000	$30,000
Subtotal for Offsite Recovery Wells (south):			**$229,125**
Contingency (15% of construction costs)			$34,369
System Design (15% of construction costs)			$34,369
Oversight and Management (25% of construction costs)			$57,281
Reporting (15% of construction costs)			$34,369
Total Capital Cost Offsite (south):			**$389,513**
Offsite Wells (Playground Vicinity):			
Permitting (allowance per location)	4	$3,000	$12,000
Recovery Well Installation (4 offsite 4" PVC wells to 20 feet)	4	$4,000	$16,000
Vault Excavations (per well vault)	4	$3,000	$12,000
Waste Characterization (1/500 tons)	1	$1,000	$1,000
Transport/Dispose Excavated Soil (5 tons per vault, non-hazardous)	20	$125	$2,500
Vaults (purchased and installed)	4	$10,000	$40,000
Piping and Connections (in vault, per well)	4	$1,000	$4,000
Belt Skimmers, controls, and In-vault tanks	4	$8,000	$32,000
Electrical Service (offsite)	1	$12,000	$12,000
Saw cut and remove sidewalk (50 feet per well for electrical service)	200	$20	$4,000
Waste Characterization (1/500 tons)	1	$1,000	$1,000
Transport/Dispose Excavated Soil (8 tons per well, non-hazardous)	32	$125	$4,000
Concrete Sidewalk Restoration (allowance per well, including elect. service)	4	$3,000	$12,000
Safety Equipment/Road Closure (per week)	3	$15,000	$45,000
Subtotal for Offsite Recovery Wells (playground):			**$197,500**
Contingency (15% of construction costs)			$29,625
System Design (15% of construction costs)			$29,625
Oversight and Management (25% of construction costs)			$49,375
Reporting (15% of construction costs)			$29,625
Total Capital Cost Offsite (playground):			**$335,750**
Total Capital Cost Offsite (south and playground):			**$725,263**
Recovery Well OM&M and Reporting (Annual)			
Labor (monthly OM&M)	12	$2,000	$24,000
Repair and maintenance materials (routine, annual)	1	$2,000	$2,000
Repair and maintenance materials (non-routine, 1/3 of skimmer components)	1	$51,480	$51,480
Waste Transport and Disposal (hazardous waste, non-PCB, per gallon)	6,700	$4.75	$31,825
Waste Transport and Disposal (hazardous waste, contains PCBs, per gallon)	5,000	$11.30	$56,500
Reporting, interim monthly	12	$2,000	$24,000
Reporting, as part of Annual Certification	1	$4,000	$4,000
Electrical service (monthly per skimmer, with allowance for account fees)	22	$30	$660
Subtotal:			**$194,465**
Contingency (15% of annual costs)			$29,170
Total Annual OM&M Cost:			**$223,635**
Recovery System Removal and Well Abandonment			
Remove/clean/dispose skimmer components	23	$5,000	$115,000
Terminate/remove electrical service	5	$1,500	$7,500
Recovery well abandonment (to 20 feet, 4" PVC)	23	$500	$11,500
Restore offsite well locations	16	$5,000	$80,000
Subtotal:			**$214,000**
Contingency (15% of removal costs)			$32,100
Removal Specs (15% of removal costs)			$32,100
Oversight and Management (25% of removal costs)			$53,500
Reporting (15% of removal costs)			$32,100
Total Capital Cost for system removal and well abandonment:			**$363,800**

Remedial Alternative 3 - Onsite Sheetpile Wall and Extraction Wells
Net Present Worth Calculations

		O&M Net Present Worth (15 years)	**years**	**O&M Net Present Worth (30 years)**	**System Removal Net Present Worth**
Capital Cost for Site Installation:	**$1,685,465**				
Capital Cost for Offsite Installation:	**$725,263**				
Total Capital Cost for Installation:	**$2,410,728**				
OM&M and Reporting (annual):	**$223,635**				
interest rate:	0.05	$223,635	**1**	$223,635	$363,800
inflation rate:	0.02	$217,121	**2**	$217,121	$353,204
Capital Cost for System Removal (year 1):	**$363,800**	$210,797	**3**	$210,797	$342,916
		$204,657	**4**	$204,657	$332,929
		$198,697	**5**	$198,697	$323,232
		$192,909	**6**	$192,909	$313,817
		$187,291	**7**	$187,291	$304,677
		$181,836	**8**	$181,836	$295,803
		$176,539	**9**	$176,539	$287,187
		$171,397	**10**	$171,397	$278,822
		$166,405	**11**	$166,405	$270,701
		$161,559	**12**	$161,559	$262,817
		$156,853	**13**	$156,853	$255,162
		$152,284	**14**	$152,284	$247,730
		$147,849	**15**	$147,849	$240,515
		$240,515	**16**	$143,543	$233,509
Total O&M (15 years):		**$2,990,344**	**17**	$139,362	$226,708
System Removal (year 15):		**$240,515**	**18**	$135,303	$220,105
Total Net Present Worth (15 years):		**$5,641,586**	**19**	$131,362	$213,694
			20	$127,536	$207,470
			21	$123,821	$201,427
			22	$120,215	$195,560
			23	$116,713	$189,864
			24	$113,314	$184,334
			25	$110,013	$178,965
			26	$106,809	$173,753
			27	$103,698	$168,692
			28	$100,678	$163,779
			29	$97,746	$159,009
			30	$94,899	$154,377
Total O&M (30 years):				**$4,514,840**	
Capital Cost for System Removal:				**$154,377**	
Total Net Present Worth (30 years):				**$7,079,945**	

Remedial Alternative 3: AS/SVE Onsite, 4-year operation

	No. units	Unit Cost	Item Total
AS/SVE System Design and Installation			
AS Well installation (4 interior 2" PVC wells to 20 feet)	4	$2,500	$10,000
Trenching & Piping (200 feet in conc. slab)	200	$100	$20,000
SVE Well installation (3 interior 2" PVC well to 10 feet)	3	$2,000	$6,000
Trenching* & Piping (*assume mostly common trench with AS)	150	$30	$4,500
Waste Characterization (1/500 tons)	1	$1,000	$1,000
Transport/Dispose Excavated Soil (0.4 T/well, non-hazardous, w/VOCs)	3	$150	$450
Transport/Dispose Excavated Soil (0.3 T/ft of trench, non-hazardous, w/VOCs)	60	$150	$9,000
SVE Components (blower, knockout drum, filter)	1	$20,000	$20,000
AS Components (compressor, filter)	1	$20,000	$20,000
Remedial Enclosure	1	$3,000	$3,000
Electrical Service	1	$8,000	$8,000
Electrical Controls	1	$6,000	$6,000
Subtotal:			**$107,950**
Contingency (15% of system construction costs)			$16,193
System Design (15% of system construction costs)			$16,193
Oversight and Management (25% of system construction costs)			$26,988
Reporting (15% of system construction costs)			$16,193
Total Capital Cost:			**$183,515**
AS/SVE OM&M and Reporting (Annual)			
Labor (monthly OM&M)	12	$600	$7,200
Repair and maintenance materials (routine, annual)	1	$1,000	$1,000
Repair and maintenance materials (non-routine, 1/3 of AS/SVE components)	1	$13,200	$13,200
Effluent lab analysis - TO-15, quarterly	4	$350	$1,400
Reporting, as part of Annual Certification	1	$4,000	$4,000
Electrical service (monthly)	12	$2,000	$24,000
Subtotal:			**$50,800**
Contingency (15% of annual costs)			$7,620
Total Annual OM&M Cost:			**$58,420**
AS/SVE System Removal and Well Abandonment			
Cut and plug below-grade piping	1	$2,000	$2,000
Remove/dispose above-grade components	1	$4,000	$4,000
Terminate/remove electrical service	1	$1,500	$1,500
AS well abandonment (4 to 20 feet, 2" PVC)	4	$500	$2,000
SVE well abandonment (3 to 10 feet, 2" PVC)	3	$300	$900
Subtotal:			**$9,500**
Contingency (15% of removal costs)			$1,425
Removal Specs (15% of removal costs)			$1,425
Oversight and Management (25% of removal costs)			$2,375
Reporting (15% of removal costs)			$1,425
Total Capital Cost for system removal and AS/SVE well abandonment:			**$16,150**

Remedial Alternative 3 - AS/SVE Onsite
Net Present Worth Calculations (4-year operation)

		OM&M Net Present Worth (4 years)		OM&M Net Present Worth (30 years)	Net Present Worth System Removal
Capital Cost for System Installation:	**$183,515**				
OM&M and Reporting (annual):	**$58,420**		**years**		
interest rate:	0.05	$58,420	**1**	$58,420	$16,150
inflation rate:	0.02	$56,718	**2**	$56,718	$15,680
Capital Cost for System Removal (year 1):	**$16,150**	$55,066	**3**	$55,066	$15,223
		$53,463	**4**	$53,463	$14,780
Total O&M Cost (4 years):		**$223,667**	**5**	$51,905	$14,349
System Removal:		**$14,780**	**6**	$50,394	$13,931
Total Net Present Worth (4 years):		**$421,962**	**7**	$48,926	$13,525
			8	$47,501	$13,131
			9	$46,117	$12,749
			10	$44,774	$12,378
			11	$43,470	$12,017
			12	$42,204	$11,667
			13	$40,975	$11,327
			14	$39,781	$10,997
			15	$38,623	$10,677
			16	$37,498	$10,366
			17	$36,405	$10,064
			18	$35,345	$9,771
			19	$34,316	$9,486
			20	$33,316	$9,210
			21	$32,346	$8,942
			22	$31,404	$8,681
			23	$30,489	$8,429
			24	$29,601	$8,183
			25	$28,739	$7,945
			26	$27,902	$7,713
			27	$27,089	$7,489
			28	$26,300	$7,271
			29	$25,534	$7,059
			30	$24,790	$6,853
Total O&M Cost (30 years):				**$1,179,410**	
Capital Cost for System Removal:				**$6,853**	
Total Net Present Worth (30 years):				**$1,369,778**	

Remedial Alternative 3: Groundwater/LNAPL Monitoring

	No. units	Unit Cost	Item Total
Monitoring Network Installation			
Assume existing GW monitoring wells are used	0	$0	$0
LNAPL monitor well installation (2 interior 2" PVC wells to 20 feet)	2	$2,500	$5,000
Waste Characterization (1/500 tons)	1	$1,000	$1,000
Transport/Dispose Excavated Soil (0.4 T/well, hazardous, low PCBs)	1	$275	$275
Subtotal:			**$6,275**
Contingency (15% of well construction costs)			$941
Oversight and Management (25% of well construction costs)			$1,569
Reporting (15% of well construction costs)			$941
Total Capital Cost for Monitoring Network Installation:			**$9,726**
GW Monitoring and Reporting (Annual)			
Labor and Materials (12 wells semiannual monitoring)	2	$6,000	$12,000
Labor and Materials (9 wells, Q monitoring)	2	$6,000	$12,000
Repair and maintenance of wells (routine, annual)	1	$100	$100
Repair and maintenance of wells (non-routine, 1/3 of new well)	1	$825	$825
VOC and SVOC analysis (12 wells pls QAQC, semiannual)	36	$400	$14,400
VOC analysis (9 wells pls QAQC, quarterly)	28	$120	$3,360
DUSR prep	4	$2,000	$8,000
Reporting, interim quarterly reports	4	$4,000	$16,000
Reporting, as part of Annual Certification	1	$4,000	$4,000
Subtotal:			**$70,685**
Contingency (15% of annual costs)			$10,603
Total Annual GW Monitoring and Reporting Cost:			**$81,288**
LNAPL Monitoring and Reporting (Annual)			
Labor and Materials (monthly LNAPL monitoring)	12	$3,000	$36,000
Repair and maintenance of wells (routine, annual)	1	$100	$100
Repair and maintenance of wells (non-routine, 1 new well)	1	$2,500	$2,500
Reporting, monthly	12	$2,000	$24,000
Reporting, as part of Annual Certification	1	$4,000	$4,000
Subtotal:			**$66,600**
Contingency (15% of annual costs)			$9,990
Total Annual LNAPL Monitoring and Reporting Cost:			**$76,590**
Monitoring Network Abandonment			
Well abandonment (54 to 20 feet, 2" PVC)	54	$500	$27,000
Subtotal:			**$27,000**
Contingency (15% of abandonment costs)			$4,050
Abandonment Specs (15% of abandonment costs)			$4,050
Oversight and Management (25% of abandonment costs)			$6,750
Reporting (15% of abandonment costs)			$4,050
Total Capital Cost for monitoring network abandonment:			**$45,900**

Remedial Alternative 3: Groundwater/LNAPL Monitoring
Net Present Worth Calculations

		LNAPL Monitoring Net Present Worth (15 Years)	GW Monitoring Net Present Worth (6 Years)		GW/LNAPL Monitoring Net Present Worth (30 years)	Network Abandonment Net Present Worth
Capital Cost for Well Installation:	**$9,726**					
GW Monitoring and Reporting (annual):	**$81,288**					
LNAPL Monitoring and Reporting (annual):	**$76,590**			**years**		
interest rate:	0.05	$ 76,590	$ 81,288	**1**	$157,878	$45,900
inflation rate:	0.02	$ 74,359	$ 78,920	**2**	$153,279	$44,563
		$ 72,193	$ 76,622	**3**	$148,815	$43,265
		$ 70,091	$ 74,390	**4**	$144,481	$42,005
		$ 68,049	$ 72,223	**5**	$140,272	$40,782
		$ 66,067	$ 70,120	**6**	$136,187	$39,594
Capital Cost for Network Abandonment (year 1):	**$45,900**	$ 64,143	**$453,562**	**7**	$132,220	$38,441
Total Net Present Worth GW Monitoring - 6 years:	**$453,562**	$ 62,275		**8**	$128,369	$37,321
Total Net Present Worth LNAPL Monitoring - 15 years:	**$785,248**	$ 60,461		**9**	$124,630	$36,234
		$ 58,700		**10**	$121,000	$35,179
		$ 56,990		**11**	$117,476	$34,154
		$ 55,330		**12**	$114,054	$33,159
		$ 53,719		**13**	$110,732	$32,193
		$ 52,154		**14**	$107,507	$31,256
		$ 50,635		**15**	$104,376	$30,345
15 Years LNAPL Monitoring Subtotal:		**$785,248**		**16**	$101,336	$29,461
Capital Cost for Network Abandonment (year 15):		**$30,345**		**17**	$98,384	$28,603
Total Net Present Worth (6 and 15 years):		**$1,278,882**		**18**	$95,519	$27,770
				19	$92,737	$26,961
				20	$90,035	$26,176
				21	$87,413	$25,414
				22	$84,867	$24,674
				23	$82,395	$23,955
				24	$79,995	$23,257
				25	$77,665	$22,580
				26	$75,403	$21,922
				27	$73,207	$21,284
				28	$71,075	$20,664
				29	$69,005	$20,062
				30	$66,995	$19,477
			30 Years Monitoring Subtotal:		**$3,187,308**	
			Capital Cost for Network Abandonment:		**$19,477**	
			Total Net Present Worth (30 years):		**$3,216,512**	

Remedial Alternative 3: SSDS, 6-year operation

	No. units	Unit Cost	Item Total
SSDS Design and Installation			
Trenching & Piping for SSDS laterals (200 feet during construction)	200	$60	$12,000
Trenching & Piping for connections (100 feet during construction)	100	$60	$6,000
Waste Characterization (1/500 tons)	1	$1,000	$1,000
Transport/Dispose Excavated Soil (0.3 T/ft of trench, non-hazardous)	90	$125	$11,250
Vapor barrier on NuHart east ($3 per SF installed, incl. penetration sealing)	36,000	$3	$108,000
SSDS Components onsite (blower, knockout drum, filter)	1	$10,000	$10,000
Remedial Enclosure	1	$3,000	$3,000
Electrical Service	1	$8,000	$8,000
Electrical Controls	1	$6,000	$6,000
System startup and testing	1	$5,000	$5,000
Roofing repairs (allowance)	1	$2,000	$2,000
Subtotal:			**$172,250**
Contingency (15% of system construction costs)			$25,838
System Design (15% of system construction costs)			$25,838
Oversight Management (25% of system construction costs)			$43,063
Reporting (15% of system construction costs)			$25,838
Total Capital Cost:			**$292,825**
SSDS OM&M and Reporting (Annual)			
Labor (monthly OM&M)	12	$600	$7,200
Repair and maintenance materials (routine, annual)	1	$1,000	$1,000
Repair and maintenance materials (non-routine, 1/3 of SSDS components)	1	$3,300	$3,300
SSDS Effluent lab analysis - TO-15, quarterly	4	$350	$1,400
Reporting, interim monthly	12	$1,000	$12,000
Reporting, as part of Annual Certification	1	$2,000	$2,000
SSDS Electrical service (monthly)	12	$2,000	$24,000
Subtotal:			**$50,900**
Contingency (15% of annual costs)			$7,635
Total Annual OM&M Cost:			**$58,535**
SSDS Abandonment			
Cut and plug below-grade SSDS piping	1	$500	$500
Remove/dispose above-grade components	1	$2,000	$2,000
Terminate/remove electrical service	1	$2,000	$2,000
Subtotal:			**$4,500**
Contingency (15% of abandonment costs)			$675
Abandonment Specs (15% of abandonment costs)			$675
Oversight and Management (25% of abandonment costs)			$1,125
Reporting (15% of abandonment costs)			$675
Total Capital Cost for system removal and point abandonment:			**$7,650**

Remedial Alternative 3: SSDS, 6-year operation

Net Present Worth Calculations		OM&M Net Present Worth (5 years)	years	OM&M Net Present Worth (30 years)	System Removal Net Present Worth
Capital Cost System Install:	**$292,825**				
OM&M and Reporting (annual):	**$58,535**				
interest rate:	0.05	$58,535	**1**	$58,535	$7,650
inflation rate:	0.02	$56,830	**2**	$56,830	$7,427
Capital Cost System Removal:	**$7,650**	$55,175	**3**	$55,175	$7,211
		$53,568	**4**	$53,568	$7,001
		$52,008	**5**	$52,008	$6,797
		$50,493	**6**	$50,493	$6,599
Subtotal of OM&M Costs (6 years):		**$326,608**	**7**	$49,022	$6,407
Capital Cost System Removal:		**$6,599**	**8**	$47,594	$6,220
Total Net Present Worth (6 years):		**$626,032**	**9**	$46,208	$6,039
			10	$44,862	$5,863
			11	$43,556	$5,692
			12	$42,287	$5,527
			13	$41,055	$5,366
			14	$39,859	$5,209
			15	$38,699	$5,058
			16	$37,571	$4,910
			17	$36,477	$4,767
			18	$35,415	$4,628
			19	$34,383	$4,494
			20	$33,382	$4,363
			21	$32,409	$4,236
			22	$31,465	$4,112
			23	$30,549	$3,992
			24	$29,659	$3,876
			25	$28,795	$3,763
			26	$27,957	$3,654
			27	$27,142	$3,547
			28	$26,352	$3,444
			29	$25,584	$3,344
			30	$24,839	$3,246
Subtotal of OM&M Costs (30 years):				**$1,181,731**	
Capital Cost System Removal:				**$3,246**	
Total Net Present Worth (30 years):				**$1,477,802**	

Remedial Alternative 3: Soil Vapor/SVI Monitoring

	No. units	Unit Cost	Item Total
Soil Vapor/SVI Monitoring Network Installation			
Labor and Materials per SV implant installed	9	$300	$2,700
Permitting for Sidewalk Locations	3	$3,000	$9,000
Concrete Sidewalk Restoration (allowance per implant)	3	$3,000	$9,000
Allowance for offsite access costs (2 properties)	2	$1,000	$2,000
Subtotal:			**$22,700**
Contingency (15% of construction costs)			$3,405
Design (15% of construction costs)			$3,405
Oversight and Management (25% of construction costs)			$5,675
Oversight and Reporting (15% of construction costs)			$3,405
Total Capital Cost:			**$38,590**
Soil Vapor/SVI Monitoring and Reporting (Annual)			
Labor and Materials (per monitoring event)	2	$6,000	$12,000
Repair and maintenance of implants (routine, annual)	1	$300	$300
Repair and maintenance of implants (non-routine, 1 new implant)	1	$300	$300
TO-15 VOC analysis (5 SV pls QAQC, per event, 2 events)	14	$300	$4,200
TO-15LL VOC analysis (4 ind/4 subslab/1 amb pls QAQC, per each of 2 events)	22	$350	$7,700
DUSR prep	2	$2,000	$4,000
Reporting, interim semiannual reports	2	$4,000	$8,000
Reporting, as part of Annual Certification	1	$4,000	$4,000
Subtotal:			**$40,500**
Contingency (15% of annual costs)			$6,075
Total Annual Soil Vapor/SVI Monitoring Cost:			**$46,575**
Soil Vapor/SVI Implant Network Abandonment			
Implant abandonment (remove implants, repair floors)	9	$200	$1,800
Permitting for Sidewalk Locations	3	$3,000	$9,000
Concrete Sidewalk Restoration (allowance per well)	3	$3,000	$9,000
Allowance for offsite access costs (2 properties)	2	$1,000	$2,000
Subtotal:			**$21,800**
Contingency (15% of abandonment costs)			$3,270
Abandonment Specs (15% of abandonment costs)			$3,270
Oversight and Management (25% of abandonment costs)			$5,450
Reporting (15% of abandonment costs)			$3,270
Total Capital Cost for Implant Abandonment:			**$37,060**

Remedial Alternative 3: Soil Vapor/SVI Monitoring

Net Present Worth Calculations

		Monitoring/Reporting Net Present Worth (6 years)		Monitoring/Reporting Net Present Worth (30 years)	Net Present Worth Implant Abandonment
Capital Cost for Installation:	**$38,590**				
Monitoring and Reporting (annual):	**$46,575**		**years**		
interest rate:	0.05	$ 46,575	**1**	$46,575	$37,060
inflation rate:	0.02	$ 45,218	**2**	$45,218	$35,981
Capital Cost for Implant Abn. (year 1):	**$37,060**	$ 43,901	**3**	$43,901	$34,933
		$ 42,623	**4**	$42,623	$33,915
		$ 41,381	**5**	$41,381	$32,927
		$ 40,176	**6**	$40,176	$31,968
Subtotal:		**$259,875**	**7**	$39,006	$31,037
Capital Cost for Implant Abandonment (year 6):		**$31,968**	**8**	$37,870	$30,133
Total Net Present Worth (6 years):		**$330,433**	**9**	$36,767	$29,256
			10	$35,696	$28,403
			11	$34,656	$27,576
			12	$33,647	$26,773
			13	$32,667	$25,993
			14	$31,715	$25,236
			15	$30,792	$24,501
			16	$29,895	$23,787
			17	$29,024	$23,095
			18	$28,179	$22,422
			19	$27,358	$21,769
			20	$26,561	$21,135
			21	$25,787	$20,519
			22	$25,036	$19,922
			23	$24,307	$19,341
			24	$23,599	$18,778
			25	$22,912	$18,231
			26	$22,244	$17,700
			27	$21,597	$17,185
			28	$20,968	$16,684
			29	$20,357	$16,198
			30	$19,764	$15,726
		Subtotal:		**$940,277**	
		Capital Cost for Implant Abandonment (30 years):		**$15,726**	
		Total Net Present Worth (30 years):		**$994,594**	

Remedial Alternative 4: Onsite Impacted Soil and LNAPL Excavation

	No. units	Unit Cost	Item Total
Remove/Dispose Onsite Impacted Soil, LNAPL and Tanks			
Remedial Contractor Mob/Demob	1	$50,000	$50,000
Site Prep Allowance (remove excess infrastructure, obstructions)	1	$100,000	$100,000
Sheetpile Contractor Mob/Demob	1	$25,000	$25,000
Steel Sheetpiles to 30 feet depth (800 linear feet, 24,000 sf, dedicated)	24,000	$45	$1,080,000
Saw Cut and Remove Concrete Floor (39,900 sf)	39,900	$15	$598,500
Transport/Dispose Concrete (1,035 tons)	1,035	$50	$51,750
Remove and Dispose Tanks (75,500 gallons, steel)	75,500	$1	$75,500
Remove and Dispose Concrete Trenches and Piping (allowance)	1	$25,000	$25,000
Excavate Soil in Impacted Area (22,500 CY)	22,500	$20	$450,000
Waste Characterization (1/500 tons)	63	$1,000	$63,000
Transport/Dispose Excavated Soil (6,060 tons, hazardous)	6,060	$250	$1,515,000
Transport/Dispose Excavated Soil (1,260 tons, hazardous, low PCBs)	1,260	$275	$346,500
Transport/Dispose Excavated Soil (1,930 tons, non-hazardous w/VOCs)	1,930	$150	$289,500
Transport/Dispose Excavated Soil (22,300 tons, non-hazardous)	22,300	$125	$2,787,500
Remove LNAPL from open excavations (per event)	20	$1,100	$22,000
LNAPL Transport and Disposal (hazardous, per gallon)	15,000	$4.75	$71,250
LNAPL Transport and Disposal (hazardous, contains low PCBs, per gallon)	5,000	$11.30	$56,500
Dewatering Permit, including testing (allowance)	1	$5,000	$5,000
Dewatering Equipment, including treatment equipment (allowance)	1	$10,000	$10,000
Dewatering Treatment, per gallon (allowance)	50,000	$2	$100,000
Sewer discharge fee (allowance)	1	$5,000	$5,000
Backfill (import, manually place and compact per cy)	23,645	$100	$2,364,500
Confirmatory samples (est. 44 for VOCs and SVOCs)	44	$400	$17,600
Re-concrete interior floor (39,900 sf)	39,900	$20	$798,000
Odor Control Pilot Testing (allowance)	1	$25,000	$25,000
CAMP for site-wide remedial activities (allowance)	1	$20,000	$20,000
Data validation	3	$2,000	$6,000
Subtotal:			**$10,958,100**
Contingency (15% of construction costs)			$1,643,715
Engineering Design (15% of construction costs)			$1,643,715
Oversight and Management (25% of construction costs)			$2,739,525
Reporting (15% of construction costs)			$1,643,715
Total Capital Cost:			**$18,628,770**
Alternate Costs for Enhanced Odor Control			
Tent, ventilation, and vapor treatment system (allowance)	1	$500,000	$500,000
Subtotal:			**$500,000**
Contingency (15% of construction costs)			$75,000
Engineering Design (15% of construction costs)			$75,000
Oversight and Management (25% of construction costs)			$125,000
Reporting (15% of construction costs)			$75,000
Total Capital Cost:			**$850,000**
Ventilation and treatment system operation and monitoring (per day)	90	$5,000	$450,000
Additional CAMP monitoring	90	$2,000	$180,000
Subtotal:			**$630,000**
Contingency (15%)			$94,500
Oversight and Management (25%)			$157,500
Additional Reporting (15%)			$94,500
Total O&M Cost:			**$976,500**

Remedial Alternative 4 - Sheetpile Wall Onsite and Extraction Wells Adjoining Site and Offsite
Note: Onsite sheetpile wall costs included in onsite excavation task.

	No. units	Unit Cost	Item Total
Adjoining Site Well System Design and Installation			
Exterior Recovery Wells			
Permitting (allowance per location)	12	$3,000	$36,000
Recovery Well Installation (12 offsite 4" PVC well to 20 feet)	12	$4,000	$48,000
Waste Characterization (1/500 tons)	1	$1,000	$1,000
Transport/Dispose Excavated Soil (0.4 T/well, non-hazardous)	5	$125	$625
Vault Excavations (per well vault)	12	$3,000	$36,000
Waste Characterization (1/500 tons)	1	$1,000	$1,000
Transport/Dispose Excavated Soil (5 tons per vault, non-hazardous)	60	$125	$7,500
Vaults (purchased and installed)	12	$10,000	$120,000
Piping and Connections (in vault, per well)	12	$1,000	$12,000
Belt Skimmers, controls, and In-vault tanks	12	$8,000	$96,000
Electrical Service (offsite)	2	$12,000	$24,000
Saw cut and remove sidewalk (50 feet per well for electrical service)	600	$20	$12,000
Waste Characterization (1/500 tons)	1	$1,000	$1,000
Transport/Dispose Excavated Soil (8 tons per well elect., non-hazardous)	96	$125	$12,000
Concrete Sidewalk Restoration (allowance per well, including elect. service)	12	$3,000	$36,000
Safety Equipment/Road Closure (per week)	3	$15,000	$45,000
Subtotal for Recovery Wells:			**$488,125**
Contingency (15% of construction costs)			$73,219
System Design (15% of construction costs)			$73,219
Oversight and Management (25% of construction costs)			$122,031
Reporting (15% of construction costs)			$73,219
Total Capital Cost Adjoining Site Wells:			**$829,813**
Offsite Well System Design and Installation			
Offsite Wells (South of Dupont Street):			
Permitting (allowance per location)	5	$3,000	$15,000
Recovery Well Installation (5 offsite 4" PVC wells to 20 feet)	5	$4,000	$20,000
Waste Characterization (1/500 tons)	1	$1,000	$1,000
Transport/Dispose Excavated Soil (0.4 T/well, non-hazardous)	2	$125	$250
Vault Excavations (per well vault)	5	$3,000	$15,000
Waste Characterization (1/500 tons)	1	$1,000	$1,000
Transport/Dispose Excavated Soil (5 tons per vault, non-hazardous)	25	$125	$3,125
Vaults (purchased and installed)	5	$10,000	$50,000
Piping and Connections (in vault, per well)	5	$1,000	$5,000
Belt Skimmers, controls, and In-vault tanks	5	$8,000	$40,000
Electrical Service (offsite)	2	$12,000	$24,000
Saw cut and remove sidewalk (50 feet per well for electrical service)	250	$20	$5,000
Waste Characterization (1/500 tons)	1	$1,000	$1,000
Transport/Dispose Excavated Soil (8 tons per well elect., non-hazardous)	40	$125	$5,000
Concrete Sidewalk Restoration (allowance per well, including elect. service)	5	$3,000	$15,000
Safety Equipment/Road Closure (per week)	3	$15,000	$45,000
Subtotal for Offsite Recovery Wells (south):			**$245,375**
Contingency (15% of construction costs)			$36,806
System Design (15% of construction costs)			$36,806
Oversight and Management (25% of construction costs)			$61,344
Reporting (15% of construction costs)			$36,806
Total Capital Cost Offsite (south):			**$417,138**
Offsite Wells (Playground Vicinity):			
Permitting (allowance per location)	4	$3,000	$12,000
Recovery Well Installation (4 offsite 4" PVC wells to 20 feet)	4	$4,000	$16,000
Waste Characterization (1/500 tons)	1	$1,000	$1,000
Transport/Dispose Excavated Soil (0.4 T/well, non-hazardous)	2	$125	$250
Vault Excavations (per well vault)	4	$3,000	$12,000
Waste Characterization (1/500 tons)	1	$1,000	$1,000
Transport/Dispose Excavated Soil (5 tons per vault, non-hazardous)	20	$125	$2,500
Vaults (purchased and installed)	4	$5,000	$20,000
Piping and Connections (in vault, per well)	4	$1,000	$4,000
Belt Skimmers, controls, and In-vault tanks	4	$8,000	$32,000
Electrical Service (offsite)	1	$12,000	$12,000
Saw cut and remove sidewalk (50 feet per well for electrical service)	200	$20	$4,000
Waste Characterization (1/500 tons)	1	$1,000	$1,000
Transport/Dispose Excavated Soil (8 tons per well elect., non-hazardous)	32	$125	$4,000
Concrete Sidewalk Restoration (allowance per well, including elect. service)	4	$3,000	$12,000
Safety Equipment/Road Closure (per week)	3	$15,000	$45,000
Subtotal for Offsite Recovery Wells (playground):			**$178,750**
Contingency (15% of construction costs)			$26,813
System Design (15% of construction costs)			$26,813
Oversight and Management (25% of construction costs)			$44,688
Reporting (15% of construction costs)			$26,813
Total Capital Cost Offsite (playground):			**$303,875**
Total Capital Cost Offsite (south and playground):			**$721,013**
Recovery Well OM&M and Reporting (Annual)			
Labor (monthly OM&M)	12	$2,000	$24,000
Repair and maintenance materials (routine, annual)	1	$2,000	$2,000
Repair and maintenance materials (non-routine, 1/3 of skimmer components)	1	$55,440	$55,440
Waste Transport and Disposal (hazardous waste, non-PCB, per gallon)	8,400	$4.75	$39,900
Waste Transport and Disposal (hazardous waste, contains PCBs, per gallon)	2,000	$11.30	$22,600
Reporting, interim monthly	12	$2,000	$24,000
Reporting, as part of Annual Certification	1	$4,000	$4,000
Electrical service (monthly per skimmer, with allowance for account fees)	21	$30	$630
Subtotal:			**$172,570**
Contingency (15% of annual costs)			$25,886
Total Annual OM&M Cost:			**$198,456**
Recovery System Removal and Well Abandonment			
Remove/clean/dispose skimmer components	21	$5,000	$105,000
Terminate/remove electrical service	5	$1,500	$7,500
Recovery well abandonment (to 20 feet, 4" PVC)	21	$500	$10,500
Restore offsite well locations	21	$5,000	$105,000
Subtotal:			**$228,000**
Contingency (15% of removal costs)			$34,200
Removal Specs (15% of removal costs)			$34,200
Oversight and Management (25% of removal costs)			$57,000
Reporting (15% of removal costs)			$34,200
Total Capital Cost for system removal and well abandonment:			**$387,600**

Remedial Alternative 4 - Sheetpile Wall Onsite and Extraction Wells Adjoining Site and Offsite
Net Present Worth Calculations

		O&M Net Present Worth (15 years)	years	O&M Net Present Worth (30 years)	System Removal Net Present Worth
Capital Cost for Wells Adjoining Site Installation:	**$829,813**				
Capital Cost for Offsite Installation:	**$721,013**				
Total Capital Cost for Installation:	**$1,550,825**				
OM&M and Reporting (annual):	**$198,456**				
interest rate:	0.05	$198,456	**1**	$198,456	$387,600
inflation rate:	0.02	$192,675	**2**	$192,675	$376,311
Capital Cost for System Removal (year 1):	**$387,600**	$187,063	**3**	$187,063	$365,350
		$181,615	**4**	$181,615	$354,709
		$176,325	**5**	$176,325	$344,378
		$171,189	**6**	$171,189	$334,347
		$166,203	**7**	$166,203	$324,609
		$161,362	**8**	$161,362	$315,154
		$156,663	**9**	$156,663	$305,975
		$152,100	**10**	$152,100	$297,063
		$147,670	**11**	$147,670	$288,411
		$143,368	**12**	$143,368	$280,010
		$139,193	**13**	$139,193	$271,855
		$135,139	**14**	$135,139	$263,937
		$131,202	**15**	$131,202	$256,249
		$256,249	**16**	$127,381	$248,786
Total O&M (15 years):		**$2,696,473**	**17**	$123,671	$241,540
System Removal (year 15):		**$256,249**	**18**	$120,069	$234,504
Total Net Present Worth (15 years):		**$4,503,547**	**19**	$116,572	$227,674
			20	$113,176	$221,043
			21	$109,880	$214,605
			22	$106,680	$208,354
			23	$103,572	$202,286
			24	$100,556	$196,394
			25	$97,627	$190,674
			26	$94,783	$185,120
			27	$92,023	$179,728
			28	$89,342	$174,493
			29	$86,740	$169,411
			30	$84,214	$164,477
Total O&M (30 years):				**$4,006,510**	
Capital Cost for System Removal:				**$164,477**	
Total Net Present Worth (30 years):				**$5,721,811**	

Remedial Alternative 4 - AS/SVE/Thermal Treatment

	No. units	Unit Cost	Item Total
AS/SVE System Design and Installation			
Permitting (allowance per offsite location)	2	$3,000	$6,000
AS Well installation (4 interior 2" PVC wells to 20 feet)	4	$2,500	$10,000
Trenching & Piping (interior, 200 feet in conc. slab)	200	$100	$20,000
SVE Well installation (3 interior 2" PVC well to 10 feet)	3	$2,000	$6,000
SVE Well installation (2 exterior 2" PVC well to 10 feet)	2	$2,000	$4,000
Trenching* & Piping (*assume mostly common trench with AS)	150	$30	$4,500
Trenching & Piping (exterior, 20 feet per well)	40	$200	$8,000
Waste Characterization (1/500 tons)	1	$1,000	$1,000
Transport/Dispose Excavated Soil (0.4 T/interior well, non-hazardous)	3	$125	$375
Transport/Dispose Excavated Soil (0.4 T/exterior well, non-hazardous)	1	$125	$125
Transport/Dispose Excavated Soil (0.3 T/ft of interior trench, non-hazardous)	60	$125	$7,500
Transport/Dispose Excavated Soil (0.3 T/ft of exterior trench, non-hazardous)	12	$125	$1,500
Concrete sidewalk restoration (allowance per well, including trenches)	2	$2,000	$4,000
Safety equipment/road closure (per week)	1	$15,000	$15,000
SVE Components (blower, knockout drum, filter)	1	$20,000	$20,000
AS Components (compressor, filter)	1	$20,000	$20,000
Remedial Enclosure	1	$3,000	$3,000
Electrical Service	1	$8,000	$8,000
Electrical Controls	1	$6,000	$6,000
Subtotal:			**$145,000**
Contingency (15% of system construction costs)			$21,750
System Design (15% of system construction costs)			$21,750
Oversight and Management (25% of system construction costs)			$36,250
Reporting (15% of system construction costs)			$21,750
Total Capital Cost AS/SVE:			**$246,500**
AS/SVE OM&M and Reporting (Annual)			
Labor (monthly OM&M)	12	$600	$7,200
Repair and maintenance materials (routine, annual)	1	$1,000	$1,000
Repair and maintenance materials (non-routine, 1/3 of AS/SVE components)	1	$13,200	$13,200
Effluent lab analysis - TO-15, quarterly	4	$350	$1,400
Reporting, as part of Annual Certification	1	$4,000	$4,000
Electrical service (monthly)	12	$2,500	$30,000
Subtotal:			**$56,800**
Contingency (15% of annual costs)			$8,520
Total Annual OM&M Cost:			**$65,320**
Thermal Treatment System Design and Installation			
Thermal Well installation (14 interior heater wells to 25 feet)	14	$2,500	$35,000
Thermocouple Well installation (12 interior to 25 feet)	12	$2,500	$30,000
Thermal trenching & Piping (interior, 20 feet/well in conc. slab)	280	$100	$28,000
Thermocouple Tr.* & Piping (*assume common trench with thermal)	280	$30	$8,400
Waste Characterization (1/500 tons)	1	$1,000	$1,000
Transport/Dispose Excavated Soil (0.4 T/well, non-hazardous, w/VOCs)	10	$150	$1,500
Transport/Dispose Excavated Soil (0.3 T/ft of trench, non-hazardous)	84	$125	$10,500
Natural gas burner and service connection	1	$15,000	$15,000
Remedial Enclosure	1	$3,000	$3,000
Electrical Service	1	$8,000	$8,000
Electrical Controls	1	$10,000	$10,000
Subtotal:			**$150,400**
Contingency (15% of system construction costs)			$22,560
System Design (15% of system construction costs)			$22,560
Oversight and Management (25% of system construction costs)			$37,600
Reporting (15% of system construction costs)			$22,560
Total Capital Cost Thermal Treatment:			**$255,680**
Thermal Treatment OM&M and Reporting (Annual)			
Labor (monthly OM&M)	12	$1,500	$18,000
Repair and maintenance materials (routine, annual)	1	$1,000	$1,000
Repair and maintenance materials (non-routine, allowance)	1	$5,000	$5,000
Natural gas service (monthly)	12	$2,500	$30,000
Reporting, as part of Annual Certification	1	$4,000	$4,000
Electrical service (monthly)	12	$500	$6,000
Subtotal:			**$64,000**
Contingency (15% of annual costs)			$9,600
Total Annual OM&M Cost:			**$73,600**
AS/SVE System Removal and Well Abandonment			
Cut and plug below-grade piping	1	$2,000	$2,000
Remove/dispose above-grade components	1	$4,000	$4,000
Terminate/remove electrical service	1	$1,500	$1,500
AS well abandonment (4 to 20 feet, 2" PVC)	4	$500	$2,000
SVE well abandonment (3 to 10 feet, 2" PVC)	3	$300	$900
Subtotal:			**$9,500**
Contingency (15% of removal costs)			$1,425
Removal Specs (15% of removal costs)			$1,425
Oversight and Management (25% of removal costs)			$2,375
Reporting (15% of removal costs)			$1,425
Total Capital Cost for system removal and AS/SVE well abandonment:			**$16,150**
Thermal Treatment System Removal and Well Abandonment			
Cut and plug below-grade piping	1	$2,000	$2,000
Remove/dispose above-grade components	1	$4,000	$4,000
Terminate/remove electrical service	1	$1,500	$1,500
Terminate/remove natural gas service	1	$1,500	$1,500
Heater & thermocouple well abandonment (14 to 25 feet)	26	$500	$13,000
Subtotal:			**$22,000**
Contingency (15% of removal costs)			$3,300
Removal Specs (15% of removal costs)			$3,300
Oversight and Management (25% of removal costs)			$5,500
Reporting (15% of removal costs)			$3,300
Total Capital Cost for Thermal system removal and well abandonment:			**$37,400**

Remedial Alternative 4 - AS/SVE/Thermal Treatment
Net Present Worth Calculations (4-year AS/SVE and 1-Year thermal operation)

		Net Present Worth (four years)	years	Net Present Worth (30 years)	Net Present Worth System Removal (AS/SVE only)
Capital Cost for Systems Installation:	**$502,180**				
AS/SVE OM&M and Reporting (annual):	**$65,320**				
Thermal OM&M and Reporting (annual):	**$73,600**				
interest rate:	0.05	$65,320	**1**	$65,320	$16,150
inflation rate:	0.02	$63,417	**2**	$63,417	$15,680
Capital Cost for AS/SVE Removal (year 1):	**$16,150**	$61,570	**3**	$61,570	$15,223
Capital Cost for Thermal System Removal:	**$37,400**	$59,777	**4**	$59,777	$14,780
Total AS/SVE O&M Cost (4 years):		**$250,085**	**5**	$58,036	$14,349
AS/SVE System Removal:		**$14,780**	**6**	$56,346	$13,931
Total Net Present Worth (4 years):		**$878,044**	**7**	$54,704	$13,525
			8	$53,111	$13,131
			9	$51,564	$12,749
			10	$50,062	$12,378
			11	$48,604	$12,017
			12	$47,189	$11,667
			13	$45,814	$11,327
			14	$44,480	$10,997
			15	$43,184	$10,677
			16	$41,926	$10,366
			17	$40,705	$10,064
			18	$39,520	$9,771
			19	$38,369	$9,486
			20	$37,251	$9,210
			21	$36,166	$8,942
			22	$35,113	$8,681
			23	$34,090	$8,429
			24	$33,097	$8,183
			25	$32,133	$7,945
			26	$31,197	$7,713
			27	$30,289	$7,489
			28	$29,406	$7,271
			29	$28,550	$7,059
			30	$27,718	$6,853
Total AS/SVE O&M Cost (30 years):				**$1,318,710**	
Capital Cost for AS/SVE System Removal:				**$6,853**	
Total Net Present Worth (30 years):				**$1,938,743**	

Remedial Alternative 4: Groundwater/LNAPL Monitoring

	No. units	Unit Cost	Item Total
Monitoring Network Installation			
Assume some existing GW monitoring wells are used	0	$0	$0
LNAPL monitor well installation (4 interior 2" PVC wells to 20 feet)	4	$2,500	$10,000
Waste Characterization (1/500 tons)	1	$1,000	$1,000
Transport/Dispose Excavated Soil (0.4 T/well, hazardous, low PCBs)	2	$275	$550
Permitting for offsite wells (allowance per location)	2	$3,000	$6,000
Offsite Well Installation (2 offsite 2" PVC well to 20 feet)	2	$4,000	$8,000
Waste Characterization (1/500 tons)	1	$1,000	$1,000
Transport/Dispose Excavated Soil (0.4 T/well, non-hazardous)	1	$125	$125
Concrete Sidewalk Restoration (allowance per well)	2	$2,500	$5,000
Safety Equipment/Road Closure (per week)	1	$15,000	$15,000
Subtotal:			**$46,675**
Contingency (15% of well construction costs)			$7,001
Oversight and Management (25% of well construction costs)			$11,669
Reporting (15% of well construction costs)			$7,001
Total Capital Cost for Monitoring Network Installation:			**$72,346**
GW Monitoring and Reporting (Annual)			
Labor and Materials (12 wells semiannual monitoring)	2	$6,000	$12,000
Labor and Materials (9 wells, Q monitoring)	2	$6,000	$12,000
Repair and maintenance of wells (routine, annual)	1	$100	$100
Repair and maintenance of wells (non-routine, 1/3 of new well)	1	$825	$825
VOC and SVOC analysis (12 wells pls QAQC, semiannual)	36	$400	$14,400
VOC analysis (9 wells pls QAQC, quarterly)	28	$120	$3,360
DUSR prep	4	$2,000	$8,000
Reporting, interim quarterly reports	4	$4,000	$16,000
Reporting, as part of Annual Certification	1	$4,000	$4,000
Subtotal:			**$70,685**
Contingency (15% of annual costs)			$10,603
Total Annual GW Monitoring and Reporting Cost:			**$81,288**
LNAPL Monitoring and Reporting (Annual)			
Labor and Materials (monthly LNAPL monitoring)	12	$3,000	$36,000
Repair and maintenance of wells (routine, annual)	1	$100	$100
Repair and maintenance of wells (non-routine, 1 new well)	1	$2,500	$2,500
Reporting, monthly	12	$2,000	$24,000
Reporting, as part of Annual Certification	1	$4,000	$4,000
Subtotal:			**$66,600**
Contingency (15% of annual costs)			$9,990
Total Annual LNAPL Monitoring and Reporting Cost:			**$76,590**
Monitoring Network Abandonment			
Well abandonment (43 to 20 feet, 2" PVC)	43	$500	$21,500
Subtotal:			**$21,500**
Contingency (15% of abandonment costs)			$3,225
Abandonment Specs (15% of abandonment costs)			$3,225
Oversight and Management (25% of abandonment costs)			$5,375
Reporting (15% of abandonment costs)			$3,225
Total Capital Cost for monitoring network abandonment:			**$36,550**

Remedial Alternative 4: Groundwater/LNAPL Monitoring
Net Present Worth Calculations

	LNAPL Monitoring Net Present Worth (15 Years)	GW Monitoring Net Present Worth (6 Years)	years	GW/LNAPL Monitoring Net Present Worth (30 years)	Network Abandonment Net Present Worth
Capital Cost for Well Installation: $72,346					
GW Monitoring and Reporting (annual): $81,288					
LNAPL Monitoring and Reporting (annual): $76,590			**years**		
interest rate: 0.05	$ 76,590	$ 81,288	**1**	$157,878	$36,550
inflation rate: 0.02	$ 74,359	$ 78,920	**2**	$153,279	$35,485
	$ 72,193	$ 76,622	**3**	$148,815	$34,452
	$ 70,091	$ 74,390	**4**	$144,481	$33,448
	$ 68,049	$ 72,223	**5**	$140,272	$32,474
	$ 66,067	$ 70,120	**6**	$136,187	$31,528
Capital Cost for Monitoring Network Abandonment (year 1): $36,550	$ 64,143	**$383,442**	**7**	$132,220	$30,610
Total Net Present Worth GW Monitoring - 6 years: $383,442	$ 62,275		**8**	$128,369	$29,718
Total Net Present Worth LNAPL Monitoring - 15 years: $785,248	$ 60,461		**9**	$124,630	$28,853
	$ 58,700		**10**	$121,000	$28,013
	$ 56,990		**11**	$117,476	$27,197
	$ 55,330		**12**	$114,054	$26,404
	$ 53,719		**13**	$110,732	$25,635
	$ 52,154		**14**	$107,507	$24,889
	$ 50,635		**15**	$104,376	$24,164
	$785,248		**16**	$101,336	$23,460
Capital Cost for Network Abandonment (year 15):	**$24,164**		**17**	$98,384	$22,777
Total Net Present Worth (6 and 15 years):	**$1,265,201**		**18**	$95,519	$22,113
			19	$92,737	$21,469
			20	$90,035	$20,844
			21	$87,413	$20,237
			22	$84,867	$19,647
			23	$82,395	$19,075
			24	$79,995	$18,520
			25	$77,665	$17,980
			26	$75,403	$17,456
			27	$73,207	$16,948
			28	$71,075	$16,454
			29	$69,005	$15,975
			30	$66,995	$15,510
30 Years MonitoringSubtotal:				**$3,187,308**	
Capital Cost for Network Abandonment:				**$15,510**	
Total Net Present Worth (30 years):				**$3,275,164**	

Remedial Alternative 4: SSDS and Vapor Barrier

	No. units	Unit Cost	Item Total
SSDS and Vapor Barrier Design and Installation			
Trenching & Piping for SSDS laterals (440 feet in soil)	440	$60	$26,400
Trenching & Piping for connections (200 feet in soil)	200	$60	$12,000
Waste Characterization (1/500 tons)	1	$1,000	$1,000
Transport/Dispose Excavated Soil (0.3 T/ft of trench, non-hazardous)	192	$125	$24,000
SSDS Components onsite (blower, knockout drum, filter)	2	$10,000	$20,000
Remedial Enclosure	2	$3,000	$6,000
Electrical Service	2	$8,000	$16,000
Electrical Controls	2	$6,000	$12,000
System startup and testing	2	$5,000	$10,000
Vapor barrier onsite ($3 per SF installed, incl. penetration sealing)	48,000	$3	$144,000
Vapor barrier on NuHart east ($3 per SF installed, incl. penetration sealing)	36,000	$3	$108,000
Labor and Materials per suction point installed	1	$3,000	$3,000
Roofing repairs (allowance)	1	$2,000	$2,000
Allowance for offsite access costs (1 properties)	1	$1,000	$1,000
Electrical Service (per property)	1	$8,000	$8,000
Electrical Controls (per point)	1	$3,000	$3,000
Suction point startup and testing	1	$5,000	$5,000
Subtotal:			**$401,400**
Contingency (15% of system construction costs)			$60,210
System Design (15% of system construction costs)			$60,210
Oversight and Management (25% of system construction costs)			$100,350
Reporting (15% of system construction costs)			$60,210
Total Capital Cost:			**$682,380**
SSDS OM&M and Reporting (Annual)			
Labor (monthly OM&M)	12	$800	$9,600
Repair and maintenance materials (routine, annual)	1	$1,500	$1,500
Repair and maintenance materials (non-routine, 1/3 of SSDS components)	1	$6,600	$6,600
SSDS Effluent lab analysis - TO-15, quarterly	8	$350	$2,800
Reporting, interim monthly	12	$1,000	$12,000
Reporting, as part of Annual Certification	1	$3,000	$3,000
Suction Point Electrical service (annual)	1	$1,000	$1,000
SSDS Electrical service (monthly)	12	$2,000	$24,000
Subtotal:			**$60,500**
Contingency (15% of annual costs)			$9,075
Total Annual OM&M Cost:			**$69,575**
SSDS and Suction Point Abandonment			
Suction Point abandonment (remove piping and point, repair floor and roof)	1	$1,500	$1,500
Allowance for offsite access costs (1 property)	1	$1,000	$1,000
Cut and plug below-grade SSDS piping	1	$1,000	$1,000
Remove/dispose above-grade components	1	$2,000	$2,000
Terminate/remove electrical services	3	$2,000	$6,000
Subtotal:			**$11,500**
Contingency (15% of abandonment costs)			$1,725
Abandonment Specs (15% of abandonment costs)			$1,725
Oversight and Management (25% of abandonment costs)			$2,875
Reporting (15% of abandonment costs)			$1,725
Total Capital Cost for system removal and point abandonment:			**$19,550**

Remedial Alternative 4: SSDS and Vapor Barrier

Net Present Worth Calculations		OM&M Net Present Worth (6 years)		OM&M Net Present Worth (30 years)	System Removal Net Present Worth
Capital Cost of Installation:	**$682,380**				
OM&M and Reporting (annual):	**$69,575**		**years**		
interest rate:	0.05	$69,575	**1**	$69,575	$19,550
inflation rate:	0.02	$67,549	**2**	$67,549	$18,981
Capital Cost System Removal:	**$19,550**	$65,581	**3**	$65,581	$18,428
		$63,671	**4**	$63,671	$17,891
		$61,816	**5**	$61,816	$17,370
		$60,016	**6**	$60,016	$16,864
Subtotal of OM&M Costs (6 years):		**$328,192**	**7**	$58,268	$16,373
Capital Cost System Removal:		**$17,370**	**8**	$56,571	$15,896
Total Net Present Worth (6 years):		**$1,027,942**	**9**	$54,923	$15,433
			10	$53,323	$14,983
			11	$51,770	$14,547
			12	$50,262	$14,123
			13	$48,799	$13,712
			14	$47,377	$13,313
			15	$45,997	$12,925
			16	$44,658	$12,548
			17	$43,357	$12,183
			18	$42,094	$11,828
			19	$40,868	$11,484
			20	$39,678	$11,149
			21	$38,522	$10,824
			22	$37,400	$10,509
			23	$36,311	$10,203
			24	$35,253	$9,906
			25	$34,226	$9,617
			26	$33,229	$9,337
			27	$32,262	$9,065
			28	$31,322	$8,801
			29	$30,410	$8,545
			30	$29,524	$8,296
		Subtotal of OM&M Costs (30 years):		**$1,404,612**	
		Capital Cost System Removal:		**$8,296**	
		Total Net Present Worth (30 years):		**$2,095,288**	

Remedial Alternative 4: Soil Vapor/SVI Monitoring

	No. units	Unit Cost	Item Total
Soil Vapor/SVI Monitoring Network Installation			
Labor and Materials per SV implant installed	10	$300	$3,000
Permitting for Sidewalk Locations	3	$3,000	$9,000
Concrete Sidewalk Restoration (allowance per well)	3	$3,000	$9,000
Allowance for offsite access costs (3 properties)	2	$1,000	$2,000
Subtotal:			**$23,000**
Contingency (15% of construction costs)			$3,450
Design (15% of construction costs)			$3,450
Oversight and Management (25% of construction costs)			$5,750
Reporting (15% of construction costs)			$3,450
Total Capital Cost:			**$39,100**
Soil Vapor/SVI Monitoring and Reporting (Annual)			
Labor and Materials (per monitoring event)	2	$7,400	$14,800
Repair and maintenance of implants (routine, annual)	1	$300	$300
Repair and maintenance of implants (non-routine, 1 new implant)	1	$300	$300
TO-15 VOC analysis (3 SV pls QAQC, per event, 2 events)	10	$300	$3,000
TO-15LL VOC analysis (7 ind/7 subslab/1 amb pls QAQC, per event, 2 events)	34	$350	$11,900
DUSR prep	2	$2,000	$4,000
Reporting, interim semiannual reports	2	$4,500	$9,000
Reporting, as part of Annual Certification	1	$4,500	$4,500
Subtotal:			**$47,800**
Contingency (15% of annual costs)			$7,170
Total Annual Soil Vapor/SVI Monitoring Cost:			**$54,970**
Soil Vapor/SVI Implant Network Abandonment			
Implant abandonment (remove implants, repair floors)	10	$200	$2,000
Permitting for Sidewalk Locations	3	$3,000	$9,000
Concrete Sidewalk Restoration (allowance per well)	3	$3,000	$9,000
Allowance for offsite access costs (2 properties)	2	$1,000	$2,000
Subtotal:			**$22,000**
Contingency (15% of abandonment costs)			$3,300
Abandonment Specs (15% of abandonment costs)			$3,300
Oversight and Management (25% of abandonment costs)			$5,500
Oversight and Reporting (15% of abandonment costs)			$3,300
Total Capital Cost for Implant Abandonment:			**$37,400**

Remedial Alternative 4: Soil Vapor/SVI Monitoring

Net Present Worth Calculations

		Monitoring/Reporting Net Present Worth (6 years)		Monitoring/Reporting Net Present Worth (30 years)	Net Present Worth Implant Abandonment
Capital Cost for Installation:	**$39,100**				
Monitoring and Reporting (annual):	**$54,970**		**years**		
interest rate:	0.05	$ 54,970	**1**	$54,970	$37,400
inflation rate:	0.02	$ 53,369	**2**	$53,369	$36,311
Capital Cost for Implant Abn. (year 1):	**$37,400**	$ 51,814	**3**	$51,814	$35,253
		$ 50,305	**4**	$50,305	$34,226
		$ 48,840	**5**	$48,840	$33,229
		$ 47,418	**6**	$47,418	$32,262
Subtotal:		**$306,717**	**7**	$46,037	$31,322
Capital Cost for Implant Abandonment (year 6):		**$32,262**	**8**	$44,696	$30,410
Total Net Present Worth (6 years):		**$378,078**	**9**	$43,394	$29,524
			10	$42,130	$28,664
			11	$40,903	$27,829
			12	$39,711	$27,019
			13	$38,555	$26,232
			14	$37,432	$25,468
			15	$36,342	$24,726
			16	$35,283	$24,006
			17	$34,255	$23,306
			18	$33,258	$22,628
			19	$32,289	$21,969
			20	$31,349	$21,329
			21	$30,436	$20,707
			22	$29,549	$20,104
			23	$28,688	$19,519
			24	$27,853	$18,950
			25	$27,042	$18,398
			26	$26,254	$17,862
			27	$25,489	$17,342
			28	$24,747	$16,837
			29	$24,026	$16,347
			30	$23,326	$15,871
		Subtotal:		**$1,109,759**	
		Capital Cost for Implant Abandonment (30 years):		**$15,871**	
		Total Net Present Worth (30 years):		**$1,164,730**	