SITE CHARACTERIZATION

PHASE III DATA SUMMARY REPORT

WORK ASSIGNMENT D004433-22

MEEKER AVENUE PLUME TRACKDOWN
GREENPOINT/EAST WILLIAMSBURG INDUSTRIAL AREA

SITE NO. 2-24-121
KINGS (C), NY

Prepared for:
NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
625 Broadway, Albany, New York

Alexander B. Grannis, Commissioner

DIVISION OF ENVIRONMENTAL REMEDIATION
REMEDIAL BUREAU B

URS Corporation
77 Goodell Street
Buffalo, New York 14203

Final
October 2008

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DATA SUMMARY REPORT

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SITE ID NO. 2-24-121

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LIST OF ACRONYMS AND ABBREVIATIONS

ADT	Aquifer Drilling and Testing, Inc.
aka	also known as
amsl	above mean sea level
ASP	Analytical Services Protocol
bgs	below ground surface
BP	British Petroleum
BQE	Brooklyn-Queens Expressway
C&D	construction and demolition
CD	compact disc
CO	carbon monoxide
COC	chain-of-custody
Con-Test	Con-Test Analytical Laboratory
DCA	dichloroethane
DCE	dichloroethene, aka dichloroethylene
DEP	Department of Environmental Protection
DNAPL	dense non-aqueous phase liquid
DOB	Department of Buildings
DOT	Department of Transportation
DUSR	Data Usability Summary Report
EDR	Environmental Data Resources, Inc.
ELAP	Environmental Laboratory Approval Program
EM	electromagnetic
EPM	Environmental Planning and Management, Inc.
FAP	Field Activities Plan
FDNY	New York City Fire Department
FID	flame ionization detector
FOIL	Freedom of Information Law
Frank's	Frank's Vacuum Truck Service, Inc.
FSP	Field Sampling Plan
GeoLogic-NY	GeoLogic NY, Inc.
GPR	ground penetrating radar
HASP	Health and Safety Plan
HC-V	Hampton-Clarke, Inc.- Veritech Laboratory
HDPE	high-density polyethylene
HSA	hollow stem auger
ID	inside diameter
IDW	investigation derived wastes
L	liter
LEL	lower explosive limit
mg/kg	milligrams per kilogram (parts per million)
MIP	membrane interface probe
mL	milliliter
MW	monitoring well
MTBE	Methyl tert-butyl ether

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

NAVD	North American Vertical Datum
NYC	New York City
NYCRR	New York Codes, Rules and Regulations
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSDOT	New York State Department of Transportation
OD	outside diameter
PCB	polychlorinated biphenyl
PCE	perchloroethene, aka tetrachloroethene or tetrachloroethylene or perchloroethylene
PID	photoionization detector
PMWP	Project Management Work Plan
ppbv	parts per billion by volume
PPE	personal protective equipment
ppm	parts per million
PVC	polyvinyl chloride
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RQD	rock quality designation
RSI	Radar Solutions International
SAP	Sampling and Analysis Plan
TAGM	Technical and Administrative Guidance Memorandums
TCE	trichloroethene, aka trichloroethylene
TCL	target compound list
TIC	tentatively identified compound
TOGS	Technical and Operational Guidance Series
µg/kg	micrograms per kilogram (parts per billion)
µg/L	micrograms per liter (parts per billion)
$\mu g/m^3$	micrograms per cubic meter
UHP	ultra high purity
URS	URS Corporation
USCG	United States Coast Guard
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
WA	Work Assignment
Zebra	Zebra Environmental Corporation

1.0 INTRODUCTION

This Site Characterization Phase III Data Summary Report has been prepared to summarize the field activities and analytical results for the Meeker Avenue Plume Trackdown Site in the Greenpoint/East Williamsburg Industrial Area section of Brooklyn, New York. The work for this site was issued to URS Corporation (URS) as Work Assignment (WA) No. D004433-22. This report presents data and information gathered prior to and during the Phase III field investigation, which was conducted from May 5 through July 24, 2008.

1.1 Site Background

The Meeker Avenue Plume Trackdown Site is located in the Greenpoint/East Williamsburg Industrial Area section of the Borough of Brooklyn, New York (Figure 1). Geographical, site use and background information is provided in the following sections.

1.1.1 Site Location and Description

The Meeker Avenue Plume Trackdown site investigation area is located in a region of historic petroleum refining and storage operations that occupied a significant portion of the Greenpoint area since approximately 1866, and by 1870 over 50 refineries were located along the banks of Newtown Creek. Currently, bulk oil storage terminals exist north of the site, including the BP Terminal, and the ExxonMobil Brooklyn Terminal (Brooklyn Terminal). The former Paragon Oil facility was located on the site along Newtown Creek, north of Bridgewater Street, between Meeker Avenue and Apollo Street. Peerless Importers, Inc., currently is located on a portion of the former Paragon Oil facility along Newtown Creek.

In September 1978, the United States Coast Guard (USCG) noted the signs of an oil spill entering Newtown Creek from the area at the end of Meeker Avenue. A subsequent investigation concluded that the area of the spill under the Greenpoint/East Williamsburg Industrial Area was in excess of 52 acres and the total spill volume, as estimated in 1979, was approximately 17 million

gallons of petroleum products. The current BP property was determined to be the source of the petroleum free product plume. Investigation and remediation activities were conducted by Roux Associates Inc. (Roux Associates) on behalf of ExxonMobil from 1990 to the present and have further defined the extent of the Off-Site Plume. The Off-Site Plume area consists of the area underlain by the petroleum free product plume that is not on the BP Terminal or the Peerless Imported, Inc. properties. Currently, the extent of the Off-Site Plume area is less than what it was in 1990 due to the operation of the Off-Site Free Product Recovery System (Off-Site System). The Off-Site System has recovered approximately 4,161,360 gallons since it became operational in 1995 (Roux, July 31, 2008). The current Off-Site Plume area boundary measured by Roux Associates on May 21, 2008 (Roux, July 31, 2008) is shown on Figure 2.

The original Meeker Avenue Plume Trackdown site investigation area was bounded by the former Mobil Brooklyn Refinery/current British Petroleum (BP) Terminal to the north (Norman Avenue/Bridgewater Street), Newtown Creek to the east, Lombardy Street to the south, and Kingsland Avenue to the west (Figure 2). During the first phase of fieldwork, the southern boundary of the site investigation area along Lombardy Street between Porter and Morgan Avenues was extended three blocks south to Richardson Street. During the second phase of fieldwork, the southern boundary of the site investigation area along Richardson Street between Vandervoort and Morgan Avenues was extended one block south to Frost Street. During the third phase of fieldwork, the southern boundary was additionally extended one block south to Withers Street between Vandervoort and Morgan Avenues. In addition, the boundary in the northwest corner of the site investigation area was extended west from Kingsland Avenue between Norman and Nassau Avenues to Monitor Street. The areas located north of Nassau Avenue, east of Van Dam Street, and south of Meeker Avenue are primarily used for commercial/industrial purposes. Residential areas are located in both the northwest portion of the site (extending from Van Dam Street between Nassau and Meeker Avenues, to the western site boundary) and within the southern portion of the site (along Beadel Street from Morgan to Porter Avenues and along Vandervoort Avenue from Lombardy Street to Division Place).

Based on the results of several investigations conducted in the area (see Section 1.1.2 for more details), chlorinated solvents such as tetrachloroethene (PCE) and trichloroethene (TCE) were found in soil vapor, soil, and groundwater in areas outside the historic petroleum spill. As these

chemicals are not related to petroleum, the NYSDEC initiated this investigation in order to determine the source(s) of this contamination.

1.1.2 Previous Investigations

In September 2005, Roux Associates on behalf of ExxonMobil sampled soil vapor at 23 temporary locations in and around the perimeter of the Off-Site Plume area (Roux, October 14, 2005). The soil vapor samples collected in September 2005 indicated the presence of PCE at a concentration of 10,200 micrograms per cubic meter ($\mu g/m^3$) at the monitoring point located on the southwest corner of the Vandervoort Avenue and Anthony Street intersection, and 7,050 $\mu g/m^3$ at the monitoring point on the west side of Morgan Avenue between Nassau and Norman Avenues. Much lower concentrations of PCE were detected throughout the remainder of and around the perimeter of the Off-Site Plume area. In addition, TCE was detected at concentrations of 4,500 $\mu g/m^3$ at the monitoring point located on west side of Apollo Street between Nassau Avenue and Meeker Avenue, and 151,000 $\mu g/m^3$ at the monitoring point on the west side of Morgan Avenue between Nassau Avenue and Norman Avenue. Much lower concentrations of TCE were detected throughout the remainder of and around the perimeter of the Off-Site Plume area. It was determined that the chlorinated solvents detected (i.e., PCE and TCE) were from a different source than the petroleum free product plume.

Between June and September 2006, Roux Associates performed a soil vapor investigation in and around the perimeter of the Off-Site Plume area (Roux, November 10, 2006). A total of 50 permanent soil vapor monitoring points were installed. This included 20 nested monitoring points (one shallow and one deep) in the commercial/industrial area and 10 deep monitoring points in the residential area. Elevated concentrations of PCE were detected at 1,300 $\mu g/m^3$ at the monitoring point located at the northwest corner of the Morgan and Nassau Avenues intersection, and 930 $\mu g/m^3$ at the monitoring point on the west side of Van Dam Street between Nassau and Meeker Avenues. Elevated concentrations of TCE were detected at 8,200 $\mu g/m^3$ at the monitoring point on east side of Apollo Street between Bridgewater Street and Nassau Avenue and 700 $\mu g/m^3$ at the monitoring point on the northwest corner of Morgan and Nassau Avenues intersection.

In September 2005, Environmental Planning and Management, Inc. (EPM) completed an investigation for the New York State (NYS) Department of Transportation (DOT) in connection with the Kosciuszko Bridge Project (EPM, January 2006). The investigation included the collection and analysis of soil and groundwater samples. PCE was detected at a concentration of 7,760 micrograms per kilogram (µg/kg) in the 0-4 foot sample from boring SB-29 (southeast corner at the intersection of Gardner Avenue and Thomas Street). PCE was also detected at concentration of 89.9, 569, and 1, 060 micrograms per liter (µg/L) in ExxonMobil wells MW-018 (east side of Vandervoort Avenue between Anthony and Cherry Streets), MW-023 (southwest corner at the intersection of Gardner Avenue and Thomas Street), and MW-030 (east side of Varick Avenue between Anthony and Cherry Streets), respectively.

1.2 Findings of Previous Phases of Fieldwork

To date, URS has conducted three phases of site investigative fieldwork at the Meeker Avenue Plume Trackdown site. The following sections discuss the findings from the Phase I and Phase II site investigations.

1.2.1 Summary of Phase I Findings

The Phase I field investigation was conducted from May 7 through July 10, 2007. Field activities associated with the Phase I field investigation included: obtaining historical information reports (e.g., Sanborn maps) from Environmental Data Resources, Inc.; obtaining utility clearances and permits; utility locating by a private subcontractor; manual and/or Vac-Tron® utility clearance for monitoring well installation; installation of 23 permanent soil-gas conduits; installation of 20 groundwater monitoring wells; collection of 27 soil-gas samples from 21 newly installed and 6 existing soil-gas conduits; collection of 26 soil samples from 20 monitoring well borings; collection of 28 groundwater samples from 20 newly installed and 8 existing monitoring wells; daily pick-up of investigation derived waste for disposal and a site survey. A copy of the Phase I Data Summary Report (URS, October 2007) is included within the Phase II Data Summary Report (URS, April 2008), provided on a compact disc (CD) in Appendix A.

Based upon the results of the Phase I field investigation, the following conclusions were made:

- Soil-gas samples from north of Meeker Avenue indicated that PCE has impacted soil-gas quality at all locations sampled, the highest concentrations may be found in the vicinity of SG-008, which is located adjacent to a former metal working facility and research lab and approximately 400 feet southeast of a former dry cleaner/dye works located on the southwest corner of Kingsland and Norman Avenues. Soil-gas has also been impacted to a lesser extent by TCE, most notably in the vicinity of SG-007, which is located approximately 300 feet south of SG-008, as shown on Figures 3 and 4.

- Soil-gas samples from south of Meeker Avenue indicated that PCE has impacted soil-gas quality at all locations sampled, the highest concentrations may be found in the vicinity of SG-015, SG-018, SG-022, and SG-023. SG-023 is located approximately 200 feet east of the former dry cleaner identified on the Sanborn maps between Beadel Street, Morgan Avenue, and Division Place. The remaining soil-gas samples are located either north or east of the former dry cleaner. Soil-gas has also been impacted to a lesser extent by TCE, most notably in the vicinity of SG-015, SG-018, SG-022, and SG-023, as shown on Figures 3 and 4.

- A soil sample from the 5-6 feet bgs interval from monitoring well location DEC-016 that is located adjacent to a former brass foundry was the only sample that exceeded TAGM 4046 criteria, with 220 milligrams per kilogram (mg/kg) of PCE.

- Groundwater samples from north of Meeker Avenue indicated that groundwater has been impacted slightly above Class GA groundwater standards for PCE at DEC-001 and DEC-003. Also, groundwater has been impacted above Class GA groundwater standards for TCE at DEC-001, DEC-003 and MW-092, as shown on Figures 5 and 6.

- Groundwater samples from south of Meeker Avenue indicated that groundwater has been impacted above Class GA groundwater standards for PCE at all locations except for MW-019. The highest concentrations of PCE appear to be centered on DEC-014 (downgradient and sidegradient of two former dry cleaners and sidegradient from a drum recycling facility); DEC-016 (adjacent to a former brass foundry); and DEC-018 (adjacent to a former soap manufacturer). Also, groundwater has been impacted above

Class GA groundwater standards for TCE at all locations except for DEC-019 and MW-019. The highest concentrations of TCE appear to be centered on DEC-005 (adjacent to a metal working facility) and DEC-018. Based on the groundwater results there appears to be potentially two point sources for PCE (DEC-014 and DEC-016); one point source for PCE and TCE (DEC-018); and one point source for TCE (DEC-005), as shown on Figures 5 and 6.

1.2.2 Summary of Phase II Findings

The Phase II field investigation was conducted from November 5 through December 27, 2007. The Phase II field investigation was focused on delineating the horizontal extent of impacted soil-gas, soil, and groundwater encountered during the Phase I investigation. Field activities associated with the Phase II field investigation included: a review of historical information reports (e.g., Sanborn maps) from Environmental Data Resources, Inc.; obtaining utility clearances and permits; utility locating by a private subcontractor; manual and/or Vac-Tron® utility clearance for monitoring well installation; installation of 28 permanent soil-gas conduits; advanced 11 direct-push borings; advanced 15 direct-push groundwater sample locations; installation of 14 groundwater monitoring wells; collection of 55 soil-gas samples from 28 newly installed and 27 existing soil-gas conduits; collection of 30 soil samples from 11 direct-push borings and 14 monitoring well borings; collection of 14 ground water samples from 15 direct-push groundwater sample locations; collection of 44 groundwater samples from 14 newly installed and 30 existing monitoring wells; daily pick-up of investigation derived waste for disposal and a site survey. A copy of the Phase II Data Summary Report (URS, April 2008) has been provided on a CD in Appendix A.

Based upon the results of the Phase II field investigation, the following conclusions were made:

Soil-Gas

The soil-gas at the site has adversely been impacted by chlorinated solvents. There appears to be five potential source areas within the site boundary as shown on Figures 7 and 8. The

horizontal extent of impacted soil-gas has not fully been determined at three of the five potential source areas. The soil-gas plumes in the area south of Meeker Avenue have coalesced however, the individual potential sources are apparent. The five potential sources are discussed below, as are any potential data gaps.

- Soil-gas samples from north of Meeker Avenue indicated that PCE and TCE have impacted soil-gas quality at most locations sampled, with the highest concentrations found in the vicinities of SG-007 and SG-027. SG-027 is approximately 150 feet southeast of a former dry cleaner/dye works located on the southwest corner of Kingsland and Norman Avenues. SG-007 is located approximately 300 feet south of a former metal working facility and research lab that was located on Sutton Avenue between Norman and Nassau Avenues. The south to southwest portion of the impacted soil-gas plume has not been delineated. An attempt was made during both Phase I and Phase II to determine the south to southwest extent however, attempts to obtain samples from SG-012, SG-013, SG-028 and SG–029 were unsuccessful presumably due to the presence of clayey silt in the subsurface. It should be noted that additional soil-gas points were installed at SG-012 and SG–013 (SG-012B and SG–013B) during Phase II in an unsuccessful attempt to obtain soil-gas samples from these locations.
- To the south of Meeker Avenue, soil-gas sample location SG-038 indicated a potential source of PCE and TCE near this location. SG-038 is found on the east side of Vandervoort Avenue between Anthony and Lombardy Streets and is located adjacent to a former and current metal working facility. The concentrations at location SG-038 may indicate the presence of an additional potential source of soil-gas contamination due to the significant increase in the concentrations at this point when compared to soil-gas locations south of this point. In addition, the concentration of TCE is significantly higher than that of PCE at this location, which may also indicate a potential source, and not the result of PCE degradation. To the north, concentrations decrease. The eastern portion of the impacted soil-gas plume has not been delineated. This plume is at the northern extent of the soil-gas plume identified south of Meeker Avenue.
- Results from soil-gas sample SG-042 indicated a potential source of 1,1,1-TCA and 1,1-DCA near this location. SG-042 is found on the east side of Vandervoort Avenue between Lombardy and Beadel Streets and is located adjacent to a former drum storage

area and current metal recycling facility. SG-042 appears to be at the center of the 1,1,1-TCA and 1,1-DCA plume. The extent of the 1,1,1-TCA and 1,1-DCA has been delineated within the area of Vandervoort Avenue between Lombardy and Beadel Streets. This plume is at the center of the soil-gas plume identified south of Meeker Avenue.

- Results from soil-gas sample SG-049 indicated a potential source of PCE and TCE near this location. SG-049 is found on the southwest corner of the intersection of Vandervoort Avenue and Richardson Street and is located next to a former dry cleaner that was found in the block bound by Richardson and Frost Streets between Morgan and Vandervoort Avenues. SG-049 appears to be located at or near a potential source of contamination, with concentrations decreasing to the north and northeast. The southern, eastern, and western extent of the plume originating near SG-049 has not been delineated. This plume is at the southern extent of the soil-gas plume identified south of Meeker Avenue.
- Results from soil-gas sample SG-043 indicated a potential source of PCE and TCE near this location. SG-043 is found on the southwest corner of the intersection of Vandervoort Avenue and Beadel Street and is located next to a former dry cleaner that was found in the block bound by Beadel Street and Division Place between Morgan and Vandervoort Avenues. SG-043 appears to be located at or near a potential source of contamination, due to the significant increase in the concentrations at these points when compared to soil-gas locations south of these points. This plume is at the center of the soil-gas plume identified south of Meeker Avenue and appears to have merged with the plume originating from near SG-049. The extent of this plume appears to be delineated.

Soils

The soil at the site has adversely been impacted by chlorinated solvents at only one location. Based on the analytical results of soil samples from DEC-016 and SB-08, there appears to be a shallow source of impacted soil in the vicinity of the northeast corner of the building located at 86 Anthony Street. The impacted soil may be adversely impacting the groundwater in the vicinity of DEC-016. The horizontal extent of impacted soil has not fully been determined, however the shallow

source appears to be within the northeast corner of the building and on the property adjacent to the northeast corner building.

Groundwater

Dissolved phase chlorinated solvents have adversely impacted the groundwater at the site. There appears to be five potential source areas within the site boundary as shown on Figures 9 and 10. The horizontal extent of impacted groundwater has not fully been determined at four of the five potential sources. The vertical extent of impacted groundwater has not been investigated at this time. The five potential sources are discussed below, as are the potential data gaps.

- Groundwater samples from north of Meeker Avenue indicated that groundwater has been impacted by PCE and TCE. A potential source appears to be near DEC-024. DEC-024 is adjacent to a former dry cleaner/dye works that was located on the southwest corner of Kingsland and Norman Avenues. The southern, eastern, and western extent of the plume originating near DEC-024 has not been delineated. In addition, the vertical extent of impacted groundwater near DEC-024 has not been assessed.
- To the south of Meeker Avenue, groundwater samples indicated a potential source of PCE and TCE is near DEC-018. DEC-018 is located on the north east corner of the intersection of Varick Avenue and Lombardy Street, adjacent to a former lacquer storage and soap manufacturer. Phased II direct-push groundwater samples have partially delineated the extent of impacted groundwater found in the vicinity of DEC-018. The concentration of PCE in the groundwater immediately downgradient of DEC-018 is two orders of magnitude greater than those upgradient of DEC-018, which may indicate the source of the PCE in the groundwater is near DEC-018. The concentrations of PCE in the groundwater decrease to the north and northeast. The northern extent of impacted groundwater associated with DEC-018 appears to be moving north beneath the Brooklyn-Queens Expressway (BQE) and into the Off-Site Plume Area. The western extent of the impacted groundwater associated with DEC-018 appears to extend approximately 150 feet west of DEC-017. The eastern extent of impacted groundwater

associated with DEC-018 has not been delineated. The vertical extent of impacted groundwater near DEC-018 has not been assessed.

- Groundwater samples indicated a potential source of PCE is near DEC-016. DEC-016 is located near the northeast corner of the building located at 72 Anthony Street. Phase II direct-push groundwater samples have partially delineated the extent of impacted groundwater found in the vicinity of DEC-016. The southern extent of impacted groundwater associated with DEC-016 has not been delineated. The vertical extent of impacted groundwater near DEC-016 has not been assessed.
- Groundwater samples indicated a potential source of TCE is near DEC-005. DEC-005 is located on the east side of Vandervoort Avenue between Anthony and Lombardy Streets and is located adjacent to a former and current metal working facility. The horizontal extent of the TCE in the vicinity of DEC-005 appears to have been delineated. The vertical extent of impacted groundwater near DEC-005 has not been assessed.
- Groundwater samples indicated a potential source of PCE is near DEC-031. DEC-031 is located on the southwest corner of the intersection of Vandervoort Avenue and Richardson Street and is located next to a former dry cleaner that was found in the block bound by Richardson and Frost Streets between Morgan and Vandervoort Avenues. DEC-031 appears to be located at or near a potential source of contamination, with concentrations decreasing to the north and northeast. The northeastern, southwestern, and eastern extent of impacted groundwater associated with DEC-031 has not been delineated. The vertical extent of impacted groundwater near DEC-031 has not been assessed.

1.3 Phase III Project Scope

In accordance with the NYSDEC Scope of Work (NYSDEC, February 1, 2007) URS prepared a Project Management Work Plan (PMWP) and budget estimate (Final, April 2007), a Field Activities Plan (FAP, April 2007) which includes the Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP), and a Health and Safety Plan (HASP, April 2007).

The work assignment provided by the NYSDEC indicates that the fieldwork associated with the Meeker Avenue Site Characterization will proceed in four phases (or time periods) in order to help identify the PCE and TCE source areas.

The purpose of the Phase III fieldwork was to fill any data gaps identified in the Phase II Final Data Summary Report (URS, April 2008) concerning the horizontal extent of impacted soil-gas at three of the five potential source areas; the horizontal extent of impacted soils at one potential source area; the horizontal extent of impacted groundwater at four of the five potential sources; and to assess the vertical extent of impacted groundwater at each of the five potential sources. In addition, the Department directed URS to assess and delineate any chlorinated solvent impacts to soil and groundwater in the vicinity of EPM soil boring located at southeast intersection of Gardner Avenue and Thomas Street, which detected PCE at a concentration of 7,760 µg/kg in the 0-4 foot sample (Section 1.1.2).

Tasks performed during the Phase III field investigation included:

- Submitted Freedom of Information Law (FOIL) requests to the New York City (NYC) Fire Department (FDNY), NYC Department of Buildings (DOB) and, NYC Department of Environmental Protection (DEP) for records on suspected sources;
- Obtaining utility clearances and permits;
- Utility locating by Radar Solutions International of Waltham, MA;
- Installation of 14 permanent soil-gas conduits by Zebra Environmental Corporation of Lynbrook, NY (Zebra);
- Advancement of 24 direct-push soil borings by Zebra;
- Advancement of 20 direct-push groundwater sample locations by Zebra;
- Manual and/or Vac-Tron® utility clearance for monitoring well installation by Aquifer Drilling and Testing, Inc., of New Hyde Park, NY (ADT);
- Installation of 16 shallow and 8 deep groundwater monitoring wells by ADT;

- Collection of 14 soil-gas samples from newly installed soil-gas conduits for analysis by Con-Test Analytical Laboratory, of East Longmeadow, MA (Con-Test);
- Collection of 21 soil samples from 24 direct-push soil borings for analysis by Hampton-Clarke, Inc – Veritech Laboratory, of Fairfield, NJ (HC-V);
- Collection of 20 groundwater samples from 20 direct-push groundwater sample locations for analysis by HC-V;
- Collection of 17 soil samples from 24 monitoring well borings for analysis by HC-V;
- Collection of 59 groundwater samples from 24 newly installed and 35 existing monitoring wells for analysis by HC-V;
- Collection of one dense non-aqueous phase liquid (DNAPL) sample for analysis by HC-V;
- Daily pick-up of investigation derived waste for disposal through Frank's Vacuum Truck Service of Niagara Falls, NY (Frank's); and
- Site survey by NAIK Consulting Group, P.C. of Edison, NJ.

1.4 Data Presentation

This Data Summary Report has six sections. Section 2.0 includes a description of field activities that occurred during the Phase III fieldwork. Section 3.0 includes a description of the subsurface conditions that have been found at the site. Section 4.0 includes a description and summary of the analytical results for the soil-gas, subsurface soils, direct-push groundwater and groundwater samples from monitoring wells collected during the Phase III fieldwork. Section 5.0 consists of the conclusions derived from the Phase I, Phase II, and Phase III analytical results, a source characterization, and also includes recommendations for the next phase of fieldwork (Phase IV). Section 6.0 contains a list of references cited. Tables, Figures, Plate and Appendices follow the text.

2.0 FIELD ACTIVITIES

Field activities performed during Phase III of the site characterization are discussed below.

2.1 Freedom of Information Law Request

In July 2008, URS submitted FOIL requests to the FDNY, NYC DOB and, NYC DEP for records on suspected sources. A separate FOIL request was submitted for each suspected source address to each of these agencies. The following addresses were subject to FOIL requests:

- 72 Anthony Street
- 315 Kingsland Avenue
- 95 Lombardy Street
- 171 Lombardy Street
- 420 Morgan Avenue
- 364 Richardson Street
- 478 Vandervoort Avenue

The following information was requested from each of the agencies:

FDNY

- Violations

NYC DOB

- Certificates of Occupancy; and
- Environmental Control Board Violations, Complaints and Actions.

NYC DEP

- Hazardous materials emergency response (BEC);
- Right to Know (BEC);
- Environmental Review/SEQRA (BEPA);
- Industrial Pretreatment/Sewer Discharge Violations (BTW); and
- Watershed Area Incident Reports (DEP PD).

At the time of this Draft report preparation, URS has received responses to the information requests from all of the agencies listed above, however, not all the requests have been processed by the agencies. None of the information provided has contributed to the identification of suspected PCE and/or TCE sources. Any additional information that is received will be incorporated in the Final report preparation or, if the information is not available for the Final report, it will be submitted to the NYSDEC as a separate Final report addendum. FOIL request submittals and responses received to date are provided in Appendix B.

2.2 Utility Clearance

Prior to site work, each subcontractor arranged for all appropriate utility clearances. This included (but was not limited to) contacting the NYC Departments of Environmental Protection and Transportation, the Transit Authority, Consolidated Edison, Keyspan, and Verizon, in addition to using the Dig-Safely number for New York City – 811 or (800) 272-4480.

2.3 Geophysical Survey for Utility Markouts

On May 5, 2008, Radar Solutions International (RSI) mobilized a crew with ground penetrating radar (GPR) and electromagnetic (EM) induction equipment to the site for the purpose of screening for and identifying the presence of underground utilities in areas where drilling for monitoring well installations, direct-push borings (e.g., Geoprobe®), and soil-gas conduit installations were proposed.

A 10-foot square reference grid was established around each monitoring well and direct-push boring location prior to collecting the geophysical data. A GSSI SIR-2000 digital radar system was used to perform the GPR survey. GPR data were acquired along lines spaced 1.0 to 2.5 feet apart. The EM induction equipment used to determine the location of buried utilities was a Ditch Witch 950 RT locating system, which consists of a locator and a transmitter.

RSI marked utilities and anomalies by spray-painting the outline on the pavement as soon as they were located. A URS geologist supervised and assisted RSI. RSI's report is provided in Appendix C. A photograph of a completed RSI utility mark out can be found in Appendix D.

2.4 Soil-Gas Conduit Installation

Prior to any intrusive activities, the subcontractor obtained all necessary permits (i.e., NYC DOT street opening permits) for conducting intrusive activities. Fourteen permanent soil-gas conduits (SG-050 through SG-063) were installed on May 15 and 19, 2008 by Zebra, under the direction of a NYSDEC representative and a URS geologist. The locations of the soil-gas conduits are shown on Figure 11. All locations were installed through sidewalks. Rotary concrete drill bits were used to drill through the concrete sidewalk. A track-mounted Geoprobe® 6620 DT hydraulic push unit was utilized to advance a 1.5 inch outer diameter (OD) rod with an expendable point to a depth of approximately 8 feet below ground surface (bgs). No soil samples were collected.

A 6-inch long double woven stainless steel Geoprobe® vapor sampling implant was inserted through the rod and connected to an anchor, positioning the implant at the bottom of the probe hole. Polyethylene tubing ($^{3}/_{8}$ inch OD) connected to the implant was extended to the top of each conduit, where it was cut above the ground surface. The annular space around the implant (screen) was backfilled with #1 silica sand to 6 inches above the implant. A bentonite slurry was placed immediately above the sand for the seal, and extended to the ground surface. The conduits were completed with 3-inch diameter aluminum flush-mount protective casings, secured with approximately 1 foot of concrete. Each flush mount casing cover was secured with a $^{9}/_{16}$-inch bolt. All downhole equipment was decontaminated with a non-phosphate detergent and potable water between each soil-gas conduit location. No investigation derived wastes (IDW) were generated

during the soil-gas conduit installation. A photograph of a sampling implant and a completed soil-gas conduit can be found in Appendix D. A typical soil-gas conduit construction log is provided in Appendix E. Copies of the daily field notes are provided in Appendix F.

2.5 Soil-Gas Sampling

Between May 20 and 21, 2008, soil-gas samples were collected from 13 new DEC soil-gas conduits (SG-050 through SG-052 and SG-054 through SG-063) plus quality assurance/quality control (QA/QC) samples. There was no loss in the Summa® canister vacuum pressure in the attempt to collect a sample at location SG-053. During Phase II soil-gas sampling, there was no loss in the Summa® canister vacuum pressure in the attempt to collect a sample at locations SG-012B, SG-013B, SG-026, SG-028 and SG-029, all of which are in the general vicinity of SG-053. Geologic information gathered during the installation of monitoring wells DEC-023, DEC-024, DEC-025, DEC-035, and DEC-038 has indicated the presence of a stiff to hard clayey silt in the vicinity of SG-053 from approximately 2 to 29 feet below ground surface (bgs). The presence of the stiff to hard clayey silt may have prevented migration of soil-gas to the above mentioned soil-gas conduit.

The soil-gas samples were collected in accordance with the procedures outlined in the FAP (URS, April 2007) using laboratory evacuated 6-liter Summa® canisters with 1 hour flow regulators (i.e., calibrated at the flow rate of approximately 0.08 L per minute) provided by Con-Test. Per *New York State Department of Health (NYSDOH) Guidance for Evaluating Soil Vapor Intrusion in the State of New York* (October 2006), a helium tracer gas was utilized during the sampling of each soil-gas conduit. The tracer gas was used to verify that the infiltration of outdoor (ambient) air was not occurring during sample collection. A two-quart enclosure was placed over the well head. The well tubing was run through an outlet and plumber's putty was used to seal the interface between the tubing and the enclosure. The enclosure was then sealed at the ground surface with a polyurethane foam gasket. A tank containing ultra high purity (UHP) helium (99.999%) was connected to the side port of the enclosure and enough helium was released to displace any ambient air and to maintain a positive pressure within the enclosure. Following the application of the tracer gas, one to three volumes were purged from the soil-gas conduit using a Gillian GilAir-3 air sample pump.

A Dielectric MGD-2002 helium detector was used to check for the presence of the tracer gas in the purged soil vapor; if less that 10% of the tracer gas was detected, a sample was collected. Following the collection of the soil-gas sample, the helium detector was re-connected to the tubing to check for the presence of the tracer gas in the soil vapor; if less than 10% of the tracer gas was detected, the sample was acceptable for analyses. No elevated concentrations of helium were detected prior to or following the sample collection from any of the soil-gas conduits.

Outdoor (ambient) air samples were collected from points upwind of the sample locations. The outdoor ambient air sample was collected by opening a summa canister fitted with a one-hour flow controller and drawing in the ambient air. Field duplicate samples were collected using stainless steel 'T' fittings. Copies of the completed Summa Canister Sampling Field Data Sheets from the sampling event are provided in Appendix G.

A chain-of-custody (COC) form was maintained and accompanied the samples, which were shipped, via Federal Express, to Con-Test, a NYSDOH Environmental Laboratory Approval Program (ELAP) accredited laboratory. The samples were analyzed for the target compound list (TCL) volatile organic compounds (VOCs) listed in Table 1, following United States Environmental Protection Agency (USEPA) Method TO-15.

2.6 Direct-Push Soil Borings

Prior to any intrusive activities, the subcontractor obtained all necessary permits (i.e., NYC DOT street opening permits) for conducting intrusive activities. Twenty four direct-push soil borings (SB-12 through SB-22 and SB-27 through SB-39) were advanced on May 13 - 15, 2008 and June 24 - 25, 2008, by Zebra, under the direction of a NYSDEC representative and a URS geologist. The locations of the direct-push soil borings are shown on Figure 11. Soil borings SB-23 through SB-26 were to be advanced using a track-mounted drill rig at previously drilled locations (SB-22, SB-19, SB-020 and DEC-013 respectively) that previously had shallow refusals or where additional information was desired. However, the soil borings were cancelled by the Department due to time constraints and subsurface conditions (i.e., presence of cobbles/boulders in the subsurface).

All boring locations were installed through sidewalks. Rotary concrete drill bits were used to drill through the concrete sidewalk. A track-mounted Geoprobe® 6620 DT hydraulic push unit was utilized to advance a 2-inch outside diameter (OD) by 5-foot long acetate lined Macrocore sampler to a maximum of 40 feet bgs. A URS geologist scanned each Macrocore sample with a MiniRae 2000 photoionization detector (PID) at one-foot intervals, and described the subsurface materials encountered. Descriptions of the cores and related information from each boring were recorded on soil boring logs (Appendix H). All downhole equipment was decontaminated with a non-phosphate detergent and potable water between each sample collected. Upon completion, the boreholes were backfilled with bentonite pellets; the surface was repaired with concrete patch; and the location was marked with spray paint.

Up to two soil samples were collected from each boring; one soil sample was collected from the interval just above water table, the second sample was collected from the interval exhibiting odors, staining, or the highest PID reading. If no odors, staining, or elevated PID reading were encountered, then only one sample from the interval just above water table was collected. All IDW generated from the soil boring was containerized in DOT approved 55-gallon drums and picked up by Frank's on a daily basis for off-site disposal at a permitted facility. Site photographs are provided in Appendix D, copies of the daily field notes are provided in Appendix F and soil boring logs are provided in Appendix H.

A COC form was maintained and accompanied the sample containers to HC-V, which is a NYSDOH ELAP accredited laboratory. The soil samples were analyzed for target compound list TCL VOCs as listed in Table 1 plus tentatively identified compounds (TICs) following USEPA SW846 Method 8260B.

2.7 Direct-Push Groundwater Sampling

Prior to any intrusive activities, the subcontractor obtained all necessary permits (i.e., NYC DOT street opening permits) for conducting intrusive activities. Twenty direct-push groundwater sample locations (GW-16 through GW-22 and SB-27 through SB-39) were completed on May 12-13,

2008 and June 24-25, 2008 by Zebra, under the direction of a NYSDEC representative and a URS geologist. The locations of the direct-push groundwater sample locations are shown on Figure 12.

All boring locations were installed through sidewalks. Rotary concrete drill bits were used to drill through the concrete sidewalk. A track-mounted Geoprobe® 6620 DT hydraulic push unit was utilized to advance a screen point sampler to approximately one-foot below the water table which was encountered up to a depth of 54 feet bgs. The screen point was threaded into the leading end of a probe rod. While the sampler was driven to the desired depth, O-ring seals at the drive head and expendable drive points provided a watertight seal. At the desired depth, chase rods were used to enable the retraction of the tool string while the screen was held in place. Groundwater was purged (a small volume to ensure that the sample is representative of the zone being sampled) and then collected using dedicated/disposable high-density polyethylene (HDPE) tubing and a check valve. Upon the completion of the sampling, the screen point sampler was removed; the borehole backfilled with bentonite pellets; the surface was repaired with concrete; and the location marked with spray paint.

One groundwater sample was collected from each boring. All IDW generated from the groundwater sampling was containerized in DOT approved 55-gallon drums and picked up by Frank's on a daily basis for off-site disposal at a permitted facility. Site photographs are provided in Appendix D and copies of the daily field notes are provided in Appendix F.

A COC form was maintained and accompanied the sample containers to HC-V. The samples were analyzed for TCL VOCs as listed in Table 1, plus TICs following USEPA SW846 Method 8260B.

2.8 Groundwater Monitoring Well Installation

The following sections describe the monitoring well installation program for the Phase III fieldwork.

2.8.1 Pre-Boring Clearing

Prior to any intrusive activities, the subcontractor obtained all necessary permits (i.e., NYC DOT street opening permits) for conducting intrusive activities. On May 5, 2007, ADT mobilized a Vac-Tron® unit to perform location specific utility clearance at each of the proposed monitoring well locations. A total of 22 monitoring well locations were cleared between May 5 and 13, 2008. On June 13, 2008, ADT re-mobilized two Vac-Tron® units to perform additional location specific utility clearance at two additional well locations (DEC-049 and DEC-049D) and four additional soil boring locations (SB-023 through SB-026). At each location, a two-foot square (four square feet) area of the sidewalk was cut. An approximately one foot diameter by five-foot deep hole was excavated using post-hole diggers, pry bars, an air knife, and hand digging along with the Vac-Tron® unit. After the location was cleared for drilling, the hole was backfilled flush with the sidewalk using the excavated spoils (small rocks and debris removed) and if necessary, temporarily patched with blacktop patch or concrete.

2.8.2 Soil Borings

During the period of May 5 through July 3, 2008, ADT utilized a Central Mine Equipment Company (CME) 55LC track-mounted drill rig for the installation of 24 monitoring wells (DEC-034 through DEC-049, DEC-003D, DEC-005D, DEC-006D, DEC-016D, DEC-018D, DEC-024D, DEC-031D and DEC-049D) at the locations shown on Figure 12. This drill rig is a dual-purpose hollow-stem augers (HSA)/mud rotary rig designed to work in areas requiring low clearance. In addition, a CME-85 truck-mounted drill rig was mobilized to the site on June 3, 2008 and operated until June 23, 2003, to assist in the installation of the monitoring wells. The CME-85 was also a dual-purpose HSA/mud rotary rig.

Of the 24 monitoring wells installed during Phase III, 16 were water table (shallow wells) and the remaining 8 were deep wells. Of the 8 deep wells, six (DEC-005D, DEC-016D, DEC-018D, DEC-024D, DEC-031D and DEC-049D) were installed to assess the vertical extent of impacted groundwater at potential source areas and two (DEC-003D and DEC-006D) were installed to

determine if the groundwater encountered in the shallow wells at these locations were perched or represents the true potentiometric surface.

The soil borings were advanced using 4 ¼-inch inside diameter (ID) HSAs or 4-inch ID drive and wash with mud rotary drilling methods. Split spoon samples were collected continuously using standard penetration techniques (ASTM D1586-84) unless an obstruction was encountered that required the advancement of the augers to drill past the obstruction. The final boring depths ranged from 32 to 100 feet bgs. At deep well locations, the HSAs or 4-inch spin casing used during drive and wash drilling were advanced past the bottom of the corresponding shallow well before split spoons were collected. During the advancement of the 4-inch spin casing, the casing was driven to refusal or the desired interval (during split spoon sampling) and then washed out to the bottom of the casing before continued driving of the casing. All IDW generated from the monitoring well installation was containerized in DOT approved 55-gallon drums and picked up by Frank's on a daily basis for off-site disposal at a permitted facility.

Each split spoon sample was screened with a PID. Up to two soil samples were collected from each boring; one soil sample was collected from the interval just above water table, the second sample was collected from the interval exhibiting odors, staining, or the highest PID reading. If no odors, staining, or elevated PID reading were encountered, then only one sample from the interval just above water table was collected. Soil samples were generally not collected for the deep well locations unless significant PID readings were encountered or if staining was observed below the water table. Site photographs are provided in Appendix D, copies of the daily field notes are provided in Appendix F and soil boring logs are provided in Appendix H.

A COC form was maintained and accompanied the sample containers to HC-V. The samples were analyzed for TCL VOCs as listed in Table 1, plus TICs following USEPA SW846 Method 8260B. The sample from location DEC-048 was also analyzed for TCL SVOCs plus TICs following USEPA Method 8270C because of the heavy staining observed during sampling.

2.8.3 Well Construction

The monitoring wells were constructed with 10 to 15 feet of 2-inch ID, Schedule 40 polyvinyl chloride (PVC) 0.010-inch slot screen and riser. In water table (shallow) wells, the screen was nominally set between 5 feet above and 10 feet below the water table at most locations. At deep well locations, a 10-foot screen was set below a localized confining layer (DEC-003D and DEC-006D), at the top of an impervious layer (DEC-005D and DEC-024D), or approximately 25 to 35 feet below the adjacent shallow wells screen (DEC-016D, DEC-018D, DEC-024D, DEC-031D and, DEC-049D). A 10 to 20 mesh size sand pack was installed from the bottom of the well up to 2 feet above the top of the well screen. A bentonite slurry was then installed around the riser to an elevation of 1-foot below grade via tremie pipe. Each monitoring well was finished with a locking well cap, a 2-foot square concrete apron, and a flush-mounted curb box. Security bolts were installed in the well covers to minimize unauthorized well access. The concrete apron thickness was consistent with the thickness of the existing pavement/sidewalk. Site photographs are provided in Appendix D, monitoring well construction logs are provided in Appendix I.

2.9 Monitoring Well Development

At least 24 hours after the monitoring wells were installed, the wells were developed by URS personnel with the pump and surge development method using a Wattera Inertial Hydrolift pump with dedicated/disposable HDPE tubing and dedicated/disposable HDPE check valves. Prior to well development, a 100-foot long Solonist oil/water interface probe was used to check for the presence/ thickness of any free product. During well development, water quality parameters (pH, specific conductivity, temperature and turbidity) were measured using a Hanna 991301 Multiparameter Meter and a Lamotte 2020 turbidimeter and recorded. A monitoring well was considered developed when a minimum of 5 well volumes was removed, and water quality parameters had stabilized. Well development logs may be found in Appendix J. Well development water was collected into DOT approved 55-gallon drums and picked up daily by Frank's for off-site disposal at a permitted facility.

2.10 Dense Non-Aqueous Phase Liquid Sampling

On May 27, 2008, a strong odor and a dark amber colored DNAPL was encountered while developing monitoring well DEC-024D. Small DNAPL blobs were noticed in the bottom of the parameter cup used to collect a sample aliquot for water quality measurements. The development water from DEC-024D was collected into a DOT approved 55-gallon drum and picked up that day by Frank's for off-site disposal at a permitted hazardous waste facility.

On May 29, 2008, a DNAPL sample was collected from DEC-024D by URS personnel and a Department representative using Level C personal protective equipment (PPE). Prior to sampling, the headspace readings at the well were measured with a MiniRae 2000 PID for VOCs. The headspace of the well indicated a VOC concentration of >10,000 parts per million (ppm) however, VOC readings in the breathing zone were 0.0 ppm. A sample collected from the bottom of the well using a weighted dedicated/disposable HDPE bailer with nylon rope indicated the presence of a dark amber colored DNAPL. An aliquot of the DNAPL was collected for analyses. Site photographs are provided in Appendix D and copies of the daily field notes are provided in Appendix F.

A COC form was maintained and accompanied the sample containers to HC-V. The sample was analyzed for: TCL VOCs plus TICs by 8260B and TCL SVOCs plus TICs by 8270C. The parameter list is provided in Table 1.

2.11 Groundwater Sampling

From July 14 through July 24, 2008, URS collected samples from 59 (24 newly installed DEC wells, 27 existing DEC wells and 8 existing ExxonMobil) monitoring wells using low-flow sampling procedures plus QA/QC samples. Roux Associates acting on behalf of ExxonMobil, provided URS with split-samples from the eight ExxonMobil locations (MW-023, MW-030, MW-081, MW-083, MW-085, MW-092, MW-095 and MW-098).

Prior to sample collection, standing water was purged from each well with a QED SamplePro Micropurge bladder pump using dedicated/disposable bladders and HDPE tubing. Wells were

purged at a rate of 1-liter per minute or less and the purge rate was adjusted to minimize draw down. During the purging of the well, water quality parameters (pH, specific conductivity, temperature, dissolved oxygen, turbidity) were measured using a Horiba U-22 Multi-parameter Instrument with a flow-through cell and documented on a purge log. Samples were collected after the water quality parameters stabilized. Purge logs are provided in Appendix K. Purge water was collected into DOT approved 55-gallon drums, and was picked up daily by Frank's for proper disposal.

All samples were transported under COC via laboratory courier to HC-V. The samples were analyzed for TCL VOCs as listed in Table 1, plus TICs following USEPA SW846 Method 8260B.

2.12 Monitoring Well Maintenance

During Phase III fieldwork, well maintenance was performed on all DEC wells. Every well cover was removed and all the bolt holes were tapped out and lubricated with an anti-seize paste. All DEC wells were equipped with tamper proof bolts. In addition, the flush-mount curb box and well pad were replaced on DEC-011 because the well pad had heaved and was a tripping hazard.

2.13 Investigation Derived Waste Disposal

Frank's was contracted for the daily pick-up and disposal of all drummed IDW at a permitted disposal facility. Copies of the non-hazardous bills of lading and hazardous waste manifests are provided in Appendix L.

2.14 Site Survey

NAIK Consulting Group surveyed the area, including all new monitoring well, soil-gas conduit, direct-push soil boring, and direct-push groundwater sampling locations for location and elevation. The survey provides 100-scale mapping and does not include elevated roadways and expressways (i.e., BQE). All surveying was performed under the supervision of a New York State licensed land surveyor. All vertical control points were referenced to the North American Vertical

Datum 1988 (NAVD 1988). Horizontal datum was referenced to the North American Datum of 1983 (NAD83), New York State Plane Coordinate System, Long Island Zone. Copies of survey field notes and site sketches are provided in Appendix M. A site survey drawing is provided in Appendix N.

3.0 SUBSURFACE CONDITIONS

3.1 Site Geology

The topography of the site investigation area varies from approximately 6 feet above mean sea level (amsl) at the bulkhead along Newtown Creek to approximately 56 feet amsl in the central part of the site. The site is located on an unconfined surficial glacial aquifer system consisting of outwash deposits that are underlain by a confining unit. Based upon subsurface data obtained during this and previous investigations, the site is underlain in most areas from the surface downward by: a fill unit, a sand unit, a discontinuous till unit and, a discontinuous clay/silt unit.

The fill unit varies from approximately 0 to 9 feet thick and consists of a heterogeneous mixture of sand, silt, clay and varying amounts of construction and demolition debris (i.e., bricks, concrete, coal, slag, etc.) and has been found at most boring locations. The sand unit has been found underlying the fill unit at most boring locations and is represented by stratified sands of varying textures containing some to no fines. The entire thickness of the sand unit has not been penetrated, however it was found to be approximately 100 feet thick at location DEC-016 (Anthony Street between Porter and Varick Avenues). The discontinuous till unit was noted in borings in the western and southwestern portion of the site (i.e., west of Morgan Avenue north of Meeker Avenue and west of Porter Avenue south of Meeker Avenue) and consists of a heterogeneous mixture of sand, silt, and clay and varying amounts of gravel, cobbles and boulders. The discontinuous clay/silt unit has been observed as an inclusive unit within the sand unit and has been observed in most of the borings at the site except in the central northeast portion of the site where it is absent. The thickness of the clay/silt unit, where present, varies from 0.5 to over 10 feet thick. The presence of the less permeable clay/silt unit at well location DEC-024D has resulted in the accumulation DNAPL at the interface between the sand unit and the inclusive clay/silt unit (approximately 50 feet bgs).

Figure 13 depicts the locations of cross-sections A-A', B-B', C-C', D-D', and E-E' which are shown on Figure 14 through Figure 18.

3.2 Investigation Area Hydrogeology

The primary hydrogeologic unit identified beneath the investigation area is the surficial aquifer present in the sand unit. Perched groundwater has been found in some site borings (DEC-004, DEC-006, DEC-007, DEC-015, DEC-017, DEC-22, DEC-30, SB-008, and SB-011) where less permeable units are present above the sand unit (i.e., till and or clay/silt unit). The water table surface may be found between approximately 11 and 54 feet bgs depending on the well location. The water table on the northern portion of the site has been influenced by the operation of the Off-Site System operated by ExxonMobil since approximately 1995. The operation of the Off-Site System has produced localized cones of depression resulting in an inward hydraulic gradient around the perimeter of the Off-Site Plume area, which has prevented the expansion of the Off-Site Plume.

On May 14, 2008, a round of synoptic groundwater level measurements were obtained from 69 monitoring wells (58 DEC wells and 11 ExxonMobil wells). Groundwater level measurements were not obtained from ExxonMobil wells MW-018 and MW-019 because the tamper proof bolts could not be removed from the wells. The water level measurements are provided in Table 2. A potentiometric surface map based on the water level measurements using a 2.0-foot contour interval is provided in Figure 19. A potentiometric surface map showing the southern portion of the site west of Porter Avenue using 0.1-foot contour interval is provided in Figure 20. A smaller contour interval was used to examine the southern portion of the site west of Porter Avenue due to the very shallow gradient found in this area. It should be noted that the groundwater level measurements from DEC-006 and DEC-022 were not used in the contouring on Figures 19 and 20 because they represent perched groundwater levels and not the actual potentiometric surface. In addition, the groundwater level measurements from DEC-003D, DEC-005D, DEC-016D, DEC-018D, DEC-024D, DEC-031D and DEC-049D not used in the contouring on Figures 19 and 20 because they are not screened across the water table surface. Historic water level measurements are also included in Table 2.

The groundwater flow in the study area north of Meeker Avenue is east to northeastwards towards the Off-Site System with a groundwater mound at DEC-002 and MW-020. The horizontal hydraulic gradient on the northern portion of the site ranges from 0.004 to 0.019 foot per foot (ft/ft).

The gradient is the steepest between the groundwater mounds at DEC-002 and MW-020 and surrounding wells (0.035 ft/ft and 0.019 ft/ft, respectively).

The groundwater flow in the area south of Meeker Avenue generally appears to be flowing north to northeast towards the Off-Site System. The horizontal gradient on the southern portion of the site east of Porter Avenue is generally towards the Off-Site System at 0.005 ft/ft to 0.012 ft/ft. The gradient is steepest between DEC-018 and DEC-017 (0.018 ft/ft). The hydraulic gradient on the southern portion of the site west of Porter Avenue is generally very shallow with a general flow direction to the northeast towards the Off-Site System at < 0.001 ft/ft to 0.004 ft/ft, as shown on Figure 20. The steepest gradient east of Porter Avenue is between DEC-011 and DEC-033 and surrounding wells (0.002 ft/ft to 0.004 ft/ft respectively).

The vertical hydraulic gradients in well pairs varied in direction across the site. A flat vertical gradient was found in well pair DEC-005/005D. Vertical hydraulic gradients in well pairs DEC-018/018D and DEC-024/024D are slightly positive or upwards based upon the water level information shown in Table 2. Vertical hydraulic gradients in well pairs DEC-016/016D, DEC-013/031D, and DEC-049/049D are very slightly negative or downwards based upon the water level information shown in Table 2.

4.0 ANALYTICAL RESULTS

The following sections discuss the results of the soil gas, soil, and groundwater sample analyses for the Meeker Avenue Plume Trackdown site.

4.1 Soil-Gas Analytical Results

A summary of detected VOCs in the Phase III soil-gas and outdoor air samples is presented in Table 3. The location of chlorinated hydrocarbons detected during Phase III which includes concentrations of PCE and its breakdown products, are shown on Figure 21. There are no current promulgated criteria for contaminants in soil-gas samples. Table 4 provides a historical summary of the detected parameters for all samples collected by URS since Phase I. Table 5 provides a statistical summary of the detected parameters for all samples collected by URS since Phase I as follows: the number of detections; the minimum, maximum and average values; and the location of the maximum value. The complete validated analytical results from the December soil-gas sampling are presented in the DUSR in Appendix O. The Form Is and data summary tables provided in the DUSR include the reporting limit for each non-detected compound.

4.1.1 PCE Soil-Gas Detections

Phase II Results

In the southern portion of the site investigation area (i.e., south of Meeker Avenue) along Vandervoort Avenue and Beadel Street between Lombardy Street and Division Place, PCE was detected at concentrations ranging from 1.2 micrograms per cubic meter ($\mu g/m^3$) to 310,000 $\mu g/m^3$. The highest concentrations were found at locations SG-023 (5,100 $\mu g/m^3$), SG-048 (5,400 $\mu g/m^3$), SG-043 (6,800 $\mu g/m^3$), and SG-049 (310,000 $\mu g/m^3$). SG-049, located at the southwest corner of the intersection of Richardson Street and Vandervoort Avenue, appears to be located at or near a potential source of contamination, which is the dry cleaner located in the block bound by Richardson and Frost Streets between Morgan and Vandervoort Avenues. The soil-gas concentrations of PCE

decrease in a northward direction from SG-049 and appears to mimic groundwater flow. The PCE concentrations at locations SG-043 and SG-023 and at SG-038 suggest additional sources of soil-gas contamination, based on the significant increase in concentration when compared to results from soil-gas locations to the south. SG-043 is located at the southwest corner of the Beadel Street and Vandervoort Avenue intersection and is adjacent to a former metal working facility. SG-023 is on the north side of Beadel Street approximately 100 feet west of SG-043. A dry cleaner and rug cleaner were also located in the buildings within the block of Beadel Street to Division Place between Vandervoort and Morgan Avenues. SG-038 is located on the west side of Vandervoort Avenue midway between Anthony and Lombardy Streets and is located adjacent to a former and current metal working facility.

In the northern portion of the site investigation area (i.e., north of Meeker Avenue), PCE contamination was centered around locations SG-008 and SG-027 (150 $\mu g/m^3$ and 270 $\mu g/m^3$, respectively). SG-008 is located adjacent to a former metal working facility and research lab. Both locations are southeast of a former dry cleaner identified on the Sanborn maps, located on the southwest side of the Kingsland and Norman Avenues intersection.

Phase III Results

In the southern portion of the site investigation area, PCE was detected in all 10 of the soil-gas samples colleted. The concentrations of PCE ranged from 8.5 $\mu g/m^3$ to 11,000 $\mu g/m^3$. The highest concentrations were found at locations SG-056 (6,100 $\mu g/m^3$), SG-058 (4,600 $\mu g/m^3$), and SG-060 (11,000 $\mu g/m^3$) as shown on Figure 22. In order to illustrate the extent of impacted soil-gas, the Phase III soil-gas results along with the highest soil-gas results at existing soil-gas locations from all previous phases of sampling were plotted on Figure 23. Figure 24 depicts the Phase III and highest historical PCE soil-gas results with the results of the historical record review.

In the northern portion of the site investigation area, PCE was detected in all 3 of the soil gas samples collected. The concentrations of PCE ranged from 85 $\mu g/m^3$ to 200 $\mu g/m^3$, with the highest concentration found at location SG-051 (200 $\mu g/m^3$).

4.1.2 TCE Soil-Gas Detections

Phase II Results

TCE was detected in the same general areas where PCE was found. Concentrations ranged from 0.38 µg/m^3 to 19,000 µg/m^3, with the highest concentration at SG-049 (19,000 µg/m^3), located at the southwest corner of the Richardson Street and Vandervoort Avenue intersection. SG-049 also had the highest PCE concentration of the soil-gas samples collected. The soil-gas concentrations of TCE decrease in a northward direction from SG-049 and appear to mimic groundwater flow. The concentration at location SG-038 suggests the presence of separate source of soil-gas contamination due to the significant increase in the concentration at this location in comparison to upgradient soil-gas locations. In addition, the concentration of TCE is significantly higher than that of PCE at this location, which also suggests a source, and not the result of the PCE degradation.

In the northern portion of the site investigation area, the highest concentration of TCE contamination was centered around locations SG-007 and SG-027 (380 µg/m^3 and 240 µg/m^3, respectively). Both locations are found southeast of a former dry cleaner/dye works identified on the Sanborn maps at the southwest side of the Kingsland and Norman Avenues intersection.

Phase III Results

In the southern portion of the site investigation area, TCE was detected in 8 of the 10 soil-gas samples colleted. The concentrations of TCE ranged from 0.72 µg/m^3 to 1,400 µg/m^3. The highest concentrations were found at locations SG-054 (350 µg/m^3), SG-056 (1,400 µg/m^3) and SG-060 (650 µg/m^3), as shown on Figure 25. In addition to the Phase III soil-gas results, the highest soil-gas results at existing soil-gas locations from the previous phases of sampling for the existing soil-gas locations were plotted on Figure 26 to illustrate the extent of impacted soil-gas. Figure 27 depicts the Phase III and highest historical PCE soil-gas results with the results of the historical record review.

In the northern portion of the site investigation area, PCE was detected in all 3 of the soil gas samples collected. The concentrations of PCE ranged from 2.6 $\mu g/m^3$ to 21 $\mu g/m^3$, with the highest concentration found at location SG-052 (21 $\mu g/m^3$).

4.1.3 PCE and TCE Degradation Product Detections

Phase II Results

The presence of PCE and TCE degradation products have also been detected in the soil-gas samples. Both cis-1,2-dichloroethene (cis-1,2-DCE) and trans-1,2-dichloroethene (trans-1,2-DCE) have been detected in the soil-gas samples. Concentrations of cis-1,2-DCE ranged from 0.28 $\mu g/m^3$ to 39,000 $\mu g/m^3$, with the highest concentration at SG-049. Concentrations of trans -1,2-DCE ranged from 0.48 $\mu g/m^3$ to 790 $\mu g/m^3$, with the highest concentration also at SG-049. Vinyl chloride has also been detected in the soil-gas samples, concentrations ranged from 1.1$\mu g/m^3$ to 180 $\mu g/m^3$, with the highest concentration at SG-016. SG-016 is located on the north side of Beadel Street between Morgan and Vandervoort Avenues and is north of a former dry cleaner that was located on Morgan Avenue between Beadel Street and Division Place.

Phase III Results

The presence of the PCE and TCE degradation products cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride were also detected in the Phase III soil-gas samples. Cis-1,2-DCE was detected in 10 of the 13 samples collected at concentrations ranging from 0.68 $\mu g/m^3$ to 2,800 $\mu g/m^3$, with the highest concentration at SG-056. Trans-1,2-DCE was detected in 3 of the 13 samples collected at concentrations ranging from 4.9 $\mu g/m^3$ to 51 $\mu g/m^3$, with the highest concentration at SG-056. Vinyl chloride was detected in 5 of the 13 samples collected at concentrations ranging from 0.56 $\mu g/m^3$ to 7.6 $\mu g/m^3$, with the highest concentration at SG-060.

4.1.4 Additional Chlorinated Hydrocarbon Detections

Phase II Results

1,1,1-Trichloroethane (1,1,1-TCA), which is not a degradation product of PCE or TCE, was detected in a significant number of samples, with concentrations ranging from 0.33 µg/m^3 to 6,600 µg/m^3. The highest concentrations were centered along Vandervoort Avenue between Lombardy and Beadle Streets at locations SG-023 (1,000µg/m^3), SG-022 (2,800µg/m^3), SG-042 (3,000µg/m^3), and SG-040 (6,600 µg/m^3). A former drum storage area and a current scrap metal recycling facility is located on the southeast corner of the intersection of Vandervoort Avenue and Lombardy Street. No significant levels of 1,1,1-TCA in soil-gas were found in the northern portion of the site investigation area.

1,1-Dichloroethane (1,1-DCA), which is a degradation product associated with PCE, TCE, and 1,1,1-TCA was detected in a significant number of samples, with concentrations ranging from 0.24 µg/m^3 to 2,000 µg/m^3. 1,1-DCA is also used as a solvent and degreaser. The highest concentration of 1,1-DCA was found at location SG-040 (2,000 µg/m^3), which is adjacent to the drum storage area at the southeast intersection of Vandervoort Avenue and Lombardy Street. Location SG-040 also had a high concentration of cis-1,2-DCE (2,700 µg/m^3) in comparison to the PCE and TCE levels (76 µg/m^3 and 350 µg/m^3, respectively), while 1,1,1-TCA was not detected. No significant levels of 1,1-DCA in soil-gas were found in the northern portion of the site investigation area.

Phase III Results

Low levels of chlorinated hydrocarbons not associated with the degradation of PCE and TCE were also detected in the Phase III soil-gas samples. 1,1,1-TCA was detected in 8 of the 13 samples collected at concentrations ranging from 2.5 µg/m^3 to 180µg/m^3, with the highest concentration at SG-060, which is adjacent to the dry cleaner, clothing warehouse and printing plate manufacturer building(s) located on Vandervoort Avenue between Richardson and Frost Streets. 1,1-DCA was

detected in 6 of the 13 samples collected at concentrations ranging from 0.70 µg/m^3 to 22 µg/m^3, with the highest concentration at SG-063, located on Withers Street between Morgan and Vandervoort Avenues, approximately 500 feet southwest of SG-060.

4.2 Soil Analytical Results

The soil sample results were compared to Technical and Administrative Guidance Memorandum (TAGM) #4046, *Determination of Soil Cleanup Objectives and Cleanup Levels* (January 24, 1994). A summary of the detected TCL VOCs in the Phase III soil samples is presented in Table 6 with results exceeding TAGM 4046 criteria indicated with a circle. Table 7 provides a historical summary of the detected parameters for all soil samples collected by URS since Phase I. Table 8 provides a statistical summary of the detected parameters for all samples collected by URS since Phase I as follows: the number of detections; the minimum, maximum and average values; and the location and depth of the maximum value. The complete validated analytical results from the Phase III soil samples are presented in the DUSR in Appendix O. The Form Is and data summary tables provided in the DUSR include the reporting limit for each non-detected compound.

Phase II Results

The only soil sample from the Phase II sampling that had detections exceeding TAGM 4046 criteria was from location SB-08, which is located at the northeast corner of the building located on 72-86 Anthony Street between Porter and Varick Avenues, as shown in Figure 28. A total of three soil samples [3-4, 9-10 and 17-18 feet bgs) were taken from the SB-08 location, however only the sample from 3-4 feet bgs contained compounds that exceeded criteria. Five VOCs were detected above their respective criteria: ethylbenzene [5.6 milligrams per kilogram (mg/kg)], isopropylbenzene (9.8 mg/kg), PCE (130 mg/kg), TCE (0.79 mg/kg) and, xylene (280 mg/kg). For the building located at 72-86 Anthony Street, a brass foundry was identified at that location until the 1992 Sanborn maps, and a junkyard occupies the property on the north side of Anthony Street (111 Anthony Street).

Also shown on Figure 28 are results for sample location DEC-016 collected during Phase I fieldwork. DEC-016 is located approximately 20 feet to the west of SB-08 and contained 220 mg/kg

of PCE in the 5-6 foot bgs sample. Three additional samples collected from DEC-016 (21-22, 37-38, and 52-53 feet bgs) had detections for PCE, but none that exceeded criteria. Based on the results from locations DEC-016 and SB-08, there appears to be a shallow source of adversely impacted soil in the vicinity of the northeast corner of the building located at 72-86 Anthony Street. This soil may be providing a continuing source impacting groundwater found in DEC-016.

Phase III Results

A total of five out of 38 soil samples collected from three areas sampled during the Phase III fieldwork had detections exceeding TAGM 4046 criteria as shown in Figure 28. At soil boring location SB-037, acetone (0.27 mg/kg) slightly exceeded criteria in the 8.0-9.0 foot bgs sample and isopropylbenzene (3.7 mg/kg), xylene (7.4 mg/kg), and total VOCs (53.0 mg/kg) exceeded their respective criteria in the 17.0-18.0 foot bgs sample. At DEC-034, isopropylbenzene (2.4 mg/kg) slightly exceeded criteria in the 14.0-15.0 foot bgs sample. At DEC-049D, isopropylbenzene (5.5 mg/kg and 5.7 mg/kg), xylene (16.0 mg/kg and 13.0 mg/kg), and total VOCs (155.2 mg/kg and 248.2 mg/kg) exceeded their respective criteria in the 27.0-29.0 and 29.0-31.0 foot bgs samples. The soil sample from DEC-048, which was also analyzed for SVOCs, did not have any detections above TAGM 4046 criteria.

4.3 Direct-Push Groundwater Analytical Results

A summary of the detected TCL VOCs in the Phase III direct-push groundwater samples is presented in Table 9 with results exceeding Division of Water Technical and Operational Guidance Series (TOGS) No. 1.1.1 Class GA groundwater criteria indicated with a circle. The locations of detected VOCs that have exceeded their respective criteria are shown on Figure 29. Concentrations of PCE and TCE in the direct-push groundwater samples are shown on Figures 30 and 31, respectively. A historical summary of the detected TCL VOCs in all direct-push groundwater samples is presented in Table 10. Table 11 provides a statistical summary of the detected parameters for all samples collected by URS since Phase I as follows: the number of detections; the minimum, maximum and average values; and the location of the maximum value. The complete validated analytical results from the direct-push groundwater samples are presented in the DUSR in Appendix

O. The Form Is and data summary tables provided in the DUSR include the reporting limit for each non-detected compound.

4.3.1 Direct-Push Groundwater PCE Detections

Phase II Results

PCE was detected in the direct-push groundwater samples with concentrations exceeding groundwater criteria at 12 of the 14 direct-push groundwater locations. The detected concentrations ranged from 2.5 micrograms per liter (µg/L) to 4,800 µg/L. The highest concentrations were centered along Varick Avenue between Anthony and Lombardy Streets at locations GW-08 (4,800 µg/L) and GW-10 (3,000 µg/L). Both GW-08 and GW-10 are located downgradient of DEC-018, which was suspected to be near a source of contamination during the Phase I investigation. DEC-018 is located adjacent to a former lacquer storage/soap manufacturer, which is at the northeast corner of the Varick Avenue and Lombardy Street intersection. Based on the direct-push sample results, the concentration of PCE in the groundwater immediately downgradient of DEC-018 (i.e., GW-10 and GW-08) is two orders of magnitude greater than those upgradient of DEC-018 (i.e., GW-12, GW-13, GW-14, and GW-15), which suggests the source of the PCE in the groundwater in the vicinity of DEC-018 is from the former lacquer storage/soap manufacturer. The concentrations of PCE in the groundwater decrease to the north and northeast. The pattern of the PCE plume in the groundwater may reflect the influence of the Off-Site Recovery system on the potentiometric surface.

Phase III Results

PCE was detected in the direct-push groundwater samples with concentrations exceeding groundwater criteria at 2 of the 20 Phase III direct-push groundwater locations. The detected concentrations were 6,700 µg/L at GW-16 and 94 µg/L at GW-22. The direct-push groundwater samples located east of DEC-018/018D (GW-17, -18, -19, and –20) indicate that groundwater has not been impacted by this potential source. However, the PCE concentration at GW-16 indicates a possible new potential source since direct-push boring located upgradient from this location (GW-17 and GW-18) did not have PCE detections. A previously advanced direct-push groundwater sample

location to the west of GW-16 (i.e., GW-04) had a concentration of PCE one order of magnitude lower (710 µg/L) and a monitoring well to the east of GW-16 (i.e., DEC-021) did not have PCE detected during Phase II groundwater sampling.

4.3.2 Direct-Push Groundwater TCE Detections

Phase II Results

TCE was detected at concentrations exceeding groundwater criteria at 11 of the 14 direct-push groundwater locations. Concentrations ranged from 2.5 µg/L to 200 µg/L. The highest concentrations were centered along Varick Avenue between Cherry and Lombardy Streets at locations GW-01 (130 µg/L), GW-08 (200 µg/L) and GW-10 (100 µg/L). Based on the direct-push sample results, the concentration of TCE in the groundwater immediately downgradient of DEC-018 (i.e., GW-10 and GW-08) is one order of magnitude greater than those upgradient of DEC-018 (i.e., GW-12, GW-13, GW-14, and GW-15). The concentrations of TCE in the groundwater decrease to the north and northeast of DEC-018 and may be related to PCE degradation. The pattern of the TCE plume in the groundwater may reflect the influence of the Off-Site Recovery system on the potentiometric surface.

Phase III Results

TCE was detected at concentrations exceeding groundwater criteria at only 1 of the 20 Phase III direct-push groundwater locations. TCE was detected at GW-16 at a concentration of 86 µg/L.

4.3.3 Direct-Push Groundwater Chlorinated Hydrocarbon Degradation Product Detections

Phase II Results

The presence of PCE and TCE degradation products have also been detected in the direct-push groundwater samples. Concentrations ranged from a high of 250 µg/L of cis-1,2-DCE at GW-03 to a low of 1.3 µg/L of 1,1-dichloroethene (1,1-DCE) at GW-08. Concentrations of these compounds suggest their presence is directly related to chemical degradation.

Phase III Results

PCE and TCE degradation products were detected at concentrations exceeding groundwater criteria at only 2 of the 20 Phase III direct-push groundwater locations. Cis-1,2-DCE (50 µg/L) was detected at GW-16 and 1,1-DCA (6.6 µg/L) was detected at GW-18.

4.4 DNAPL Sample Analytical Results

The results from the DNAPL sample collected from monitoring well DEC-024D shows tetrachloroethene at a concentration 700,000 [milligrams per kilogram (mg/kg)] or 70%. 1,2,4-Trichlorbenzene, 1,1-biphenyl and bis(2-ethylhexyl)phthalate were also detected, at significantly lower concentrations (0.025% or lower), as shown on Table 12. The tentatively identified compounds found in the semivolatile fraction indicate the presence of hydrocarbons. The greatest use of 1,2,4-trichlorobenzene is primarily as a dye carrier. It is also used to make herbicides and other organic chemicals; as a solvent; in wood preservatives; in abrasives. It was once used as a soil treatment for termite control (source: http://www.epa.gov/ogwdw/contaminants/dw_contamfs/124-tric.html). The primary use of biphenyl is in the formulation of dye carriers for textile dyeing. Biphenyl is used as an intermediate for polychlorinated biphenyls and as a paper impregnant for citrus fruit where it acts as a fungicide. In the past, a major use of biphenyl has been as a component

of heat-transfer fluids. (source: http://www.epa.gov/chemfact/biphe-sd.txt). The phthalate is suspected to be from the sample handling/collection equipment.

4.5 Groundwater Analytical Results

A summary of the detected TCL VOCs in the Phase III groundwater samples collected from monitoring wells is presented in Table 13 with results exceeding TOGS No. 1.1.1 Class GA groundwater criteria indicated with a circle. The locations of detected VOCs that have exceeded their respective criteria are shown on Plate 1. Isoconcentration contours of PCE and TCE in the Phase II groundwater samples are shown on Figures 32 and 34, respectively. Table 14 provides a statistical summary of the detected parameters for the Phase III groundwater samples as follows: the number of detections; the minimum, maximum and average values; and the location of the maximum value. Table 15 provides a historical summary of the detected parameters for all groundwater samples collected by URS since Phase I. Table 16 provides a statistical summary of the detected parameters for all samples collected by URS since Phase I as follows: the number of detections; the minimum, maximum and average values; and the location of the maximum value. The complete validated analytical results from the Phase III groundwater samples are presented in the DUSR in Appendix O. The Form Is and data summary tables provided in the DUSR including the reporting limit for each non-detected compound.

It should be noted that the concentrations of PCE and TCE, when compared to the Phase II round of sampling (December 2007), were consistently lower during the Phase III sampling event, in some cases by up to two orders of magnitude.

4.5.1 Groundwater PCE Detections

Phase II Results

PCE was detected in 32 of the 44 groundwater samples collected, at concentrations exceeding groundwater criteria, with concentrations ranging from 1.5 µg/L to 39,000 µg/L. Figure 9

depicts the Phase II PCE in groundwater results. In the southern portion of the site investigation area (i.e., south of Meeker Avenue), the highest concentrations of PCE were detected at DEC-031 (33,000 µg/L), DEC-013 (7,800 µg/L), DEC-029 (7,200 µg/L), DEC-018 (7,000 µg/L), DEC-016 (6,100 µg/L), DEC-014 (5,900 µg/L), and DEC-030 (4,400 µg/L). DEC-031, which is located at the southwest corner of Vandervoort Avenue and Richardson Street, is adjacent to a former dry cleaner and printing plate manufacturer. Based on the sample results, the concentration of PCE in the groundwater downgradient of DEC-031 (i.e., DEC-014 and DEC-030) is two to three orders of magnitude greater than those upgradient and sidegradient of DEC-031 (i.e., DEC-032 and DEC-033). This suggests the source of the PCE in the groundwater is near DEC-031. The concentrations of PCE in the groundwater decrease to the north and northeast of DEC-031. Based on the PCE isoconcentration contours, DEC-016, located on Anthony Street between Porter and Varick Avenues adjacent to a former brass foundry and DEC-018, located on the north east corner of the intersection of Varick Avenue and Lombardy Streets adjacent to a former lacquer storage and soap manufacturer, do not appear to be associated with the source near DEC-031. DEC-016 and adjacent sample SB-08 were the locations with high concentrations of PCE detected in soil. DEC-018 and DEC-016 appear to be near one or more sources of PCE with concentrations decreasing to the north and northeast.

In the northern portion of the site investigation area, PCE contamination was centered around DEC-024, which had a concentration of 39,000 µg/L. DEC-024 is located adjacent to a former dry cleaner that was located on the southwest corner of Kingsland and Norman Avenues. Based on the sample results, the concentration of PCE in the groundwater downgradient of DEC-024 (i.e., DEC-025 and DEC-003) is one to two orders of magnitude greater than those upgradient /sidegradient of DEC-024 (i.e., DEC-023), which suggests the source of the PCE in the groundwater is near DEC-024.

Phase III Results

PCE was detected in 45 of the 59 Phase III groundwater samples collected, at concentrations exceeding groundwater criteria, with concentrations ranging from 6.0 µg/L to 24,000 µg/L (Figure 32). In the southern portion of the site investigation area (i.e., south of Meeker Avenue), the highest concentrations of PCE were detected at DEC-031 (24,000 µg/L), DEC-029 (7,600 µg/L), DEC-013

(7,800 µg/L), DEC-016 (3,700 µg/L), DEC-018 (3,700 µg/L), DEC-013 (3,600 µg/L), and DEC-044 (3,600 µg/L). Potential source areas for PCE noted in the previous Phases are still apparent (DEC-016, DEC-018, and DEC-031), as is a potential new source near well pair DEC-049/049D (i.e., light fixture manufacturer/foundry) located on the south side of Cherry Street between Stewart and Gardner Avenues.

In the northern portion of the site investigation area, PCE contamination was centered around well pair DEC-024/024D, with DNAPL being present in DEC-024D. DEC-036, which is located approximately 50 feet downgradient of well pair DEC-024/024D had a concentration of 5,900 µg/L and was the next highest concentration of PCE in the northern portion of the site. Concentrations of PCE decreased orders of magnitude moving down and sidegradient from well pair DEC-024/024D. Figure 33 depicts the potential sources of PCE in groundwater with isoconcentration contours from Phase III data.

4.5.2 Groundwater TCE Detections

Phase II Results

TCE was detected in 33 of the 44 groundwater samples collected, at concentrations exceeding groundwater criteria, with concentrations ranging from 1.4 µg/L to 66,000 µg/L. Figure 10 depicts the Phase II TCE in groundwater results. In the southern portion of the site investigation area, the highest concentrations of TCE were detected at DEC-005 (66,000 µg/L) and DEC-018 (1,800 µg/L). The concentrations of TCE at location DEC-005 suggests the presence of an additional source of contamination due to the significant increase in the concentrations at this point when compared to well locations upgradient from this point (DEC-004, DEC-027, DEC-008). In addition, the concentration of TCE is four orders of magnitude higher than the reporting limit of PCE at this location (PCE was not detected at this location), which may also indicate TCE is from a potential source, and not the result of PCE degradation. As noted with the direct push groundwater results, the concentration of TCE in relation to the PCE concentration found at DEC-018 is indicative of PCE degradation at this location and not a separate source.

In the northern portion of the site investigation area, TCE contamination was centered around DEC-024, located on Kingsland Avenue, just south of Norman Avenue, with a concentration of 500 µg/L. Concentrations of TCE decrease to the east, which mimics groundwater flow. The concentration of TCE in relation to the PCE concentration at DEC-024 and downgradient wells is indicative of PCE degradation and not a separate source.

Phase III Results

TCE was detected in 39 of the 59 Phase III groundwater samples collected, at concentrations exceeding groundwater criteria, with concentrations ranging from 5.6 µg/L to 70,000 µg/L (Figure 34). In the southern portion of the site investigation area, the highest concentrations of TCE were detected at DEC-005D (70,000 µg/L), DEC-005 (35,000 µg/L), DEC-016D (12,000 µg/L), DEC-026 (2,700 µg/L), and DEC-018 (1,200 µg/L). Potential source areas for PCE noted in the previous Phases are still apparent (DEC-005/005D and DEC-018), as is a potential new source(s) near well pair DEC-016/016D (i.e., drum storage and brass foundry) between Porter and Varick Avenues south of Anthony Street.

In the northern portion of the site investigation area, TCE contamination was centered around DEC-036 (2,400 µg/L), which is located approximately 50 feet downgradient of well pair DEC-024/024D. Concentrations of PCE decreased orders of magnitude moving downgradient and sidegradient from DEC-036. Figure 35 depicts the potential sources of TCE in groundwater with isoconcentration contours from Phase III data.

4.5.3 PCE and TCE Degradation Product Detections

Phase II Results

The presence of PCE and TCE degradation products has also been detected in the Phase II groundwater samples. Cis-1,2-DCE has been detected in 27 of the 44 Phase II groundwater samples. Concentrations of cis-1,2-DCE ranged from 7.3 µg/L to 1,200 µg/L, with the highest concentration

at DEC-005. Vinyl Chloride was detected in five Phase II groundwater samples with concentrations ranging from 7.8 µg/L to 40 µg/L. The highest concentration of vinyl chloride was detected at DEC-024.

Phase III Results

The presence of PCE and TCE degradation products has also been detected in the Phase III groundwater samples at concentrations exceeding groundwater criteria. Cis-1,2-DCE was detected in 38 of the 59 Phase III groundwater samples. Concentrations of cis-1,2-DCE ranged from 5.2 µg/L to 3,800 µg/L, with the highest concentration at DEC-036. Trans-1,2-DCE was detected in 3 of the 59 Phase III groundwater samples. Concentrations of trans-1,2-DCE ranged from 5.1 µg/L to 210 µg/L, with the highest concentration at DEC-005D. Vinyl Chloride was detected in 9 of the 59 Phase III groundwater samples with concentrations ranging from 2.3 µg/L to 140 µg/L. The highest concentration of vinyl chloride was detected at DEC-036.

4.5.4 Additional Chlorinated Hydrocarbon Detections

Phase II Results

1,1,1-TCA, which is not a degradation product of PCE or TCE, was only detected in one groundwater sample with concentration of 46 µg/L, at DEC-016, located on Anthony Street between Porter and Varick Avenues. This location is approximately 700 feet northeast of SG-040, which is the location where the highest concentration of 1,1,1-TCA was found in soil gas. SG-040 is located near the southeast intersection of Vandervoort Avenue and Lombardy Street, near a former drum storage area and a current scrap metal recycling facility.

Phase III Results

Two chlorinated hydrocarbons were detected in groundwater samples at concentrations exceeding groundwater criteria. 1,1,1-TCA was detected in 5 of the 59 Phase III groundwater

samples. Concentrations of 1,1,1-TCA ranged from 6.6 µg/L to 35 µg/L, with the highest concentration at DEC-016. 1,1-DCA has been detected in 6 of the 59 Phase III groundwater samples. Concentrations of 1,1-DCA ranged from 7.1 µg/L to 23 µg/L, with the highest concentration at DEC-040.

4.5.5 Deep Well Sampling

Seven well pairs (DEC-003/003D, DEC-005/005D, DEC-006/DEC-006D, DEC-016/016D, DEC-018/018D, DEC-031/031D and DEC-049/049D) were sampled during Phase III to assess the vertical extent of impacted groundwater at potential source areas. The concentrations of contaminants present in the shallow wells in relation to the concentration in the corresponding deep well were not consistent across the site. At well pairs DEC-003/003D, DEC-005/005D, DEC-006/006D, DEC-016/016D, and DEC-049/049D, the deep wells contained higher concentrations of contaminants, up to three orders of magnitude when compared to the shallow well. In contrast, well pairs DEC-018/018D and DEC-031/031D contained higher concentrations of contaminants in the shallow wells when compared to the deep well, by up to three orders of magnitude. For well pair DEC-024/024D located on Kingsland Avenue south of Norman Avenue, groundwater from the deep well was not sampled because DNAPL was encountered. The DNAPL contained 70% PCE in the deep well versus 130 µg/L (or 0.000013%) PCE in the shallow well. The horizontal and vertical extent of contamination in the vicinity of DEC-024/024D has not been delineated. The presence of DNAPL in the deeper well (DEC-024D) indicates that PCE is migrating to deeper stratigraphic levels from its source. The dissolved phase plume of PCE and related contaminants is also likely more widespread (i.e., laterally and vertically) beyond where DNAPL was identified.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Based upon the results of the three Phases of the investigation, the following conclusions are provided:

Soil-Gas

Based on the data gathered during the three Phases of the investigation, the soil-gas at the site has adversely been impacted by chlorinated solvents. Only the new soil gas conduit locations installed during Phase III were sampled during Phase III. In order to identify the horizontal extent of soil gas contamination, the conclusions drawn below are based on the Phase III soil-gas results along with the highest soil-gas results at existing soil-gas locations from all previous phases of sampling.. It should be noted that several locations have been sampled multiple times, with the concentrations between sampling events varying by up to two orders of magnitude in some cases.

There appear to be five areas of elevated soil-gas concentrations within the site boundary. The horizontal extent of impacted soil-gas has not fully been delineated at two of the five areas. The five areas of elevated soil-gas concentrations are discussed below, as are any potential data gaps.

- Soil-gas samples from north of Meeker Avenue indicate that PCE and TCE have impacted soil-gas quality at most locations sampled, with the highest historical concentrations found in the vicinity of SG-008 and MP-018D. SG-008 is approximately 400 feet southeast of a former dry cleaner located on the southwest corner of Kingsland and Norman Avenues and adjacent to a former metal working facility and research lab that was located on Sutton Avenue between Norman and Nassau Avenues. To the east of SG-008 was a manufacturer of motor vehicle parts and accessories and automotive electrical equipment (Eur-Pac Corp). MP-018D is approximately 400 feet southeast of SG-008. The western portion of the impacted soil-gas area has not been delineated. An attempt was made to determine the western extent however, attempts to obtain samples

from SG-012, SG-013, SG-028, SG–029, and SG-53 were unsuccessful presumably due to the presence of clayey silt in the subsurface. It should be noted that additional soil-gas points were installed at SG-012 and SG–013 (SG-012B and SG–013B) during Phase II in an unsuccessful attempt to obtain soil-gas samples from these locations. The eastern extent of the elevated soil-gas area (i.e., east of Morgan Avenue) cannot be delineated because monitoring points were not installed within the area of the petroleum free product plume shown on Figure 2.

- To the south of Meeker Avenue, soil-gas samples from SG-038 indicate that an area of elevated concentrations of PCE and TCE are centered near this location. SG-038 is found on the east side of Vandervoort Avenue between Anthony and Lombardy Streets and is located adjacent to a former and current metal working facility. The concentrations at location SG-038 may indicate that this location is at the center of an impacted area and not just associated with another impacted area due to the significant increase in the concentrations at this location when compared to soil-gas locations south and west of this location (Figures 24 and 26). In addition, the concentration of TCE is significantly higher than that of PCE at this location, which may also indicate that TCE is the primary cause of the elevated concentrations, and not the result of PCE degradation. To the north, concentrations decrease. The eastern portion (i.e., south of Meeker Avenue towards Porter Avenue) of the impacted area has not been fully delineated.

- Results from a soil-gas sample collected at location SG-042 indicate elevated concentrations of 1,1,1-TCA and 1,1-DCA near this location. SG-042 is found on the east side of Vandervoort Avenue between Lombardy and Beadel Streets and is located adjacent to a former drum storage area and current metal recycling facility. SG-042 appears to be at the center of the 1,1,1-TCA and 1,1-DCA impacted area. The extent of the 1,1,1-TCA and 1,1-DCA has been delineated within the area of Vandervoort Avenue between Lombardy and Beadel Streets. The extent of impacted soil-gas associated with location SG-042 appears to be delineated.

- Results from soil-gas samples collected at locations SG-023 and SG-043 indicate that an area of elevated concentrations of PCE and TCE is centered near these locations. SG-023 is found on Beadel Street just west of the intersection with Vandervoort Avenue and

SG-043 is found on the southwest corner of the intersection of Vandervoort Avenue and Beadel Street. Both locations are located next to a former dry cleaner that was found in the block bound by Beadel Street and Division Place between Morgan and Vandervoort Avenues. SG-023 and SG-043 appear to be at the center of an impacted area and not the result of migration from other impacted areas, due to the significant increase in the concentrations at these points when compared to soil-gas locations south of these points. The extent of impacted soil-gas associated with locations SG-023 and SG-042 appears to be delineated.

- Results from a soil-gas sample collected at location SG-049 indicate that an area of elevated concentrations of PCE and TCE is centered near this location. SG-049 is located on the southwest corner of the intersection of Vandervoort Avenue and Richardson Street. SG-049 is next to a former dry cleaner that was identified in the block bound by Richardson and Frost Streets between Morgan and Vandervoort Avenues. SG-049 appears to be at the center of an impacted area and not the result of migration from other impacted areas, with concentrations decreasing to the north and northeast. Concentrations are three to five orders of magnitude lower south of SG-049. The western extent of the impacted soil-gas area originating near SG-049 has not been fully delineated.

Soils

Based on the data gathered during the three Phases of the investigation, the soil at the site has adversely been impacted by chlorinated solvents at only one location. Based on the results from the samples collected from the soil borings at DEC-016 and SB-08, PCE impacted soil exists in the vicinity of the northeast corner of the building located at 72 Anthony Street. The contaminated soil may be adversely impacting the groundwater in the vicinity of DEC-016 and SB-08 and may represent a continuing source of PCE. The horizontal extent of impacted soil has not fully been determined, however the shallow source appears to be around the northeast corner of the building located on Anthony Street and Porter Avenue and on the adjacent property to the east.

During Phase III, soil borings performed in the vicinity of EPM soil boring located at southeast intersection of Gardner Avenue and Thomas Street did not indicate the presence of impacted soils in this area.

Groundwater

Based on the data gathered during the three Phases of the investigation, the groundwater at the site has adversely been impacted by dissolved phase chlorinated solvents. The investigation to date has allowed URS and the Department to identify four sources. In addition, there are potentially two other sources, but sufficient information has not been gathered to positively identify these locations as sources without additional investigation. The horizontal extent of impacted groundwater has not fully been determined at the two potential source areas. The vertical extent of impacted groundwater has been investigated at all four source areas and two potential source areas. The four source areas and two potential source areas are discussed below, as are the potential data gaps.

- Groundwater samples from north of Meeker Avenue indicate that groundwater has been impacted by PCE, TCE and their degradation products. A source is located at well pair DEC-024/024D, as evident by the presence of DNAPL in DEC-024D. DEC-024/024D are located adjacent to a former dry cleaner/dye works that was located on the southwest corner of Kingsland and Norman Avenues. The horizontal extent of the dissolved phase plume appears to have been delineated. The dissolved phase plume associated with DEC-024/024D appears to be bound by Norman Avenue on the north, Morgan Avenue on the east, Nassau Avenue on the south and Monitor Street to the west (Figures 32 and 34). The presence of DNAPL in the deep well (DEC-024D) indicates that PCE is migrating to deeper stratigraphic levels from its source. The dissolved phase plume of PCE and related contaminants is also likely more widespread (i.e., laterally and vertically) beyond where DNAPL was identified. The horizontal extent of contamination in this portion of the site is influenced by the anisotropic nature of the geologic conditions as seen in the soil boring logs and geologic cross sections.
- To the south of Meeker Avenue, groundwater samples indicate a potential source of PCE and TCE is near well pair DEC-018/018D. DEC-018/018D are located on the north east corner of the intersection of Varick Avenue and Lombardy Street, adjacent to a former

lacquer storage and soap manufacturer. Phased II and Phase III direct-push groundwater samples have partially delineated the extent of dissolved phase plume found in the vicinity of DEC-018/018D. The concentration of PCE in the groundwater immediately downgradient of DEC-018/018D is two to three orders of magnitude greater than those upgradient and sidegradient of DEC-018/018D, which indicates the source of the PCE in the groundwater is near DEC-018/018D. The concentrations of PCE in the groundwater decrease to the north and northeast. The horizontal extent of the dissolved phase plume associated with DEC-018/018D appears to be bound by Stewart Avenue on the east, Lombardy Street on the south and half way between Porter Avenue and Varick Avenue to the west (Figures 32 and 34). The northern extent of impacted groundwater associated with DEC-018/018D appears to be moving north to northeast beneath the BQE and into the Off-Site Plume Area. The vertical extent of impacted groundwater near DEC-018/018D appears to be limited to the upper water table. Concentrations of detected contaminants were an order of magnitude lower in the deeper well when compared to the shallow well.

- Groundwater samples indicate a source of PCE and TCE is near well pair DEC-016/016D. DEC-016/016D are located near the northeast corner of the building located at 86 Anthony Street, which was formerly a brass foundry. Phase II direct-push groundwater samples delineated the northern, eastern, and western extent of impacted groundwater found in the vicinity of DEC-016/016D. Phase III groundwater samples indicate that the concentrations of PCE south of DEC-016/016D are less that half that found at DEC-016/016D. The horizontal extent of the TCE in the vicinity of DEC-016/016D appears to have been delineated. The concentration of TCE in DEC-016D is up to two orders of magnitude greater than surround wells indicating a potential TCE source also. The horizontal extent of the shallow dissolved phase plume associated with DEC-016/016D appears to be bound by Cherry Street on the north, half way between Porter Avenue and Varick Avenue to the east, Anthony Street on the south, and Porter Avenue on the west (Figures 32 and 34). The vertical extent of impacted groundwater near DEC-016/016D appears to not be defined, although data indicates that contamination has vertically migrated downwards and has possibly migrated deeper. While the concentration of PCE was an order of magnitude higher in DEC-016 when

compared to DEC-016D, the concentration of TCE in DEC-016D was two orders of magnitude higher than that in DEC-016.

- Groundwater samples indicate a source of TCE is near well pair DEC-005/005D. DEC-005/005D are located on the east side of Vandervoort Avenue between Anthony and Lombardy Streets and are located adjacent to a former and current metal working facility. The horizontal extent of the TCE in the vicinity of DEC-005/005D appears to have been delineated. The horizontal extent of the shallow dissolved phase plume associated with DEC-005/005D appears to be bound by Cherry Street on the north, Porter Avenue to the east, Lombardy Street on the south, and Vandervoort Avenue on the west (Figure 34). The vertical extent of impacted groundwater near DEC-005/005D appears to not be defined, although data indicates that contamination has vertically migrated downwards and has possibly migrated deeper. The concentration of TCE in DEC-005D was two times that found in DEC-005.

- Groundwater samples indicate a source of PCE is near well pair DEC-031/031D. DEC-031/031D are located on the southwest corner of the intersection of Vandervoort Avenue and Richardson Street and are located next to a former dry cleaner that was found in the block bound by Richardson and Frost Streets between Morgan and Vandervoort Avenues. DEC-031/031D appears to be located at or near a potential source of contamination, with concentrations decreasing to the north and northeast following groundwater flow. The horizontal extent of the TCE in the vicinity of DEC-031/031D appears to have been delineated. The horizontal extent of the shallow dissolved phase plume associated with DEC-031/031D appears to be bound by Lombardy Street on the north, half way between Porter Avenue and Varick Avenue to the east, Frost Street on the south, and Morgan Avenue on the west (Figure 32). The vertical extent of impacted groundwater near DEC-031/031D appears to be limited to the upper water table. Concentrations of detected contaminants were three orders of magnitude lower in the deeper well when compared to the shallow well.

- Groundwater samples indicate a potential source of PCE is near well pair DEC-049/049D. DEC-049/049D are located on the north side of Cherry Street near its intersection with Stewart Avenue and are located across from a former light fixture manufacturer that was found in the block bound by Stewart and Gardner Avenues

between Cherry and Anthony Streets. DEC-049/049D appears to be located at or near a potential source of contamination, with concentrations decreasing to the north and northeast following groundwater flow. The horizontal extent of the TCE in the vicinity of DEC-049/049D was not fully delineated. The horizontal extent of the dissolved phase plume associated with DEC-049/049D appears to be bound by Gardner Street on the east, Anthony Street on the south and Stewart Avenue to the west (using data from GW-04). The northern extent of impacted groundwater associated with DEC-049/049D appears to be moving north beneath the BQE and into the Off-Site Plume Area. The vertical extent of impacted groundwater near DEC-049/049D was not defined, although data indicates that contamination has vertically migrated downwards and has possibly migrated deeper. The concentration of PCE in DEC-049D was two orders of magnitude greater than that found in DEC-049.

5.2 Source Characterization

Using data obtained during the three Phases of the investigation performed by URS [i.e., historical information (e.g., Sanborn maps, EDR reports, and business directories) soil-gas, soil and groundwater data] four sources and two potential sources of PCE and TCE contamination have been identified within the study area. The description and location of the four sources and two potential sources are discussed below.

Sources

- The former Spic and Span Cleaners and Dyers, Inc. [a.k.a. Eastern District Dye Works (1916 Sanborn) and Norman Cleaners and Dyers Inc. (1942 Sanborn)], located at 315 Kingsland Avenue (Brooklyn Tax District, Block 02657, Lot 0009) has been identified as source of groundwater contamination. Based on Sanborn map data, this facility has been located at the above address from the early 1900's until the mid 1960's. DNAPL containing 700,000 mg/kg (i.e., 70%) PCE was identified in monitoring well DEC-024D. DEC-024D is located on Kingsland Avenue adjacent to the southeast building corner of the former facility. Although PCE, TCE and their associated degradation products have been found in groundwater samples from DEC-024 and surrounding downgradient and sidegradient wells, the concentrations are one to two orders of

magnitude lower than in DEC-024D. The decreasing concentrations found in surrounding monitoring wells indicate there are no other potential sources in the area.

- The former and current metal works located at 95 Lombardy (Brooklyn Tax District, Block 02819, Lot 0008) has been identified as a source of groundwater contamination. Based on Sanborn map data, the facility has been utilized from the 1930's to the present as a metal fabricator and painting facility. ACME Steel is listed in the EDR report as a generator of F001 waste (spent halogenated solvents used in degreasing) for this facility. Monitoring wells DEC-005 and DEC-005D are located on the west end of the building on Vandervoort Avenue. Groundwater samples from these wells indicate significant TCE contamination and the likely presence of DNAPL given the increasing TCE concentrations with depth. Although PCE, TCE and their associated degradation products have been found in groundwater samples from surrounding upgradient, downgradient and sidegradient wells, the concentrations are one to two orders of magnitude lower than in DEC-005D. Soil-gas samples also indicated the presence of elevated levels of PCE and TCE, centered on location SG-038, which is located adjacent to DEC-005/005D.

- A former brass foundry located at 72 Anthony Street (Brooklyn Tax District, Block 02820, Lot 0005) has been identified as source of soil and groundwater contamination. Based on Sanborn map data, the facility had been utilized as a brass foundry from the mid 1960's to approximately 1993. ACME Steel is listed in the EDR report as a generator of F001 waste (spent halogenated solvents used in degreasing) for this facility. Soil samples from DEC-016 and SB-08, located at the northeast corner of the facility along Anthony Street indicate PCE contamination adjacent to this facility. Monitoring wells DEC-016 and DEC-016D are located on the Anthony Street (north) side of the facility. Groundwater samples from these wells indicate significant PCE and TCE contamination. The PCE contamination is in the shallow groundwater zone, indicating the contamination is near its source. Although PCE, TCE and their associated degradation products have been found in groundwater samples from surrounding upgradient, downgradient and sidegradient wells, the concentrations are one to two orders of magnitude lower than in DEC-016/016D.

- The former Klink Cosmo Cleaners, located at 364 Richardson Street (Tax District of Brooklyn, Block 02860, Lot 0001) has been identified as a source of groundwater contamination. The facility is shown on Sanborn Maps to be a clothing warehouse from the mid 1950's until some time after 1995. Klink Cosmo Cleaners is listed in the EDR report as a generator of F002 waste (spent halogenated solvents) for this facility. Monitoring wells DEC-031 and DEC-031D are located on the southwest corner of Vandervoort Avenue and Richardson Street (northeast building corner). Groundwater samples from these wells indicate significant PCE and TCE contamination that decrease with depth. The PCE contamination is in the shallow groundwater zone, indicating the contamination is near its source. Although PCE, TCE and their associated degradation products have been found in groundwater samples from surrounding upgradient, downgradient and sidegradient wells, the concentrations are one to two orders of magnitude lower than in DEC-031/031D. Soil-gas samples also indicated the presence of elevated levels of PCE and TCE in the vicinity of this building. The highest concentration was at soil-gas point SG-049, located adjacent to monitoring wells DEC-031/031D on the corner of Richardson Street and Vandervoort Avenue.

Potential Sources

- The facility that contained a former soap manufacturer and lacquer storage, located at 171 Lombardy Street (Brooklyn Tax District, Block 02821, Lot 0001) is a potential source of groundwater contamination.. Based on Sanborn map data, the facility has been utilized during the 1930's for lacquer storage and as a soap powered manufacture from the early 1950s to 1989. Monitoring wells DEC-018 and DEC-018D are located on the Varick Avenue or west side of the building, near Lombardy Street. Groundwater samples from these wells indicate significant PCE and TCE contamination. The PCE concentration decreases with depth while the TCE concentration increases with depth. Although PCE, TCE and their associated degradation products have been found in groundwater samples from surrounding upgradient, downgradient and sidegradient wells, the concentrations are one to two orders of magnitude lower than in DEC-018/018D. The PCE contamination is in the shallow groundwater zone, suggesting the contamination is near its source.. Field efforts during Phase IV will assist in determining

if the impacted groundwater at DEC-049 and DEC-049D is related to the plume in the vicinity from DEC-018/018D or from a separate source.

- The former Curtis Electro N.Y. Inc. facility located at 126 Cherry Street (Brooklyn Tax District, Block 02814, Lot 0010) is a potential source of groundwater contamination. Based on Sanborn map data, the facility has been utilized as a light fixture manufacturer from the mid 1960's until some time after 1995. Monitoring wells DEC-049 and DEC-049D are located adjacent to the facility on the corner of Stewart Avenue and Cherry Street. Groundwater samples these wells indicate significant PCE and TCE contamination that increase with depth. Although PCE, TCE and their associated degradation products have been found in groundwater samples from surrounding upgradient, downgradient and sidegradient wells, the concentrations are one to two orders of magnitude lower than in DEC-049/049D. Field efforts during Phase IV will assist in determining if the contamination found at DEC-049/049D is related to the plume in the vicinity from DEC-018/018D or if it is from a separate source.

5.3 Recommendations

The following recommendations are offered for consideration by the Department:

- Up to four (4) Membrane Interface Probes (MIP) should be installed using a direct-push unit at the locations shown on Figure 36 to further delineate the horizontal and vertical extent of impacted groundwater downgradient of well pair DEC-018/018D. The MIP locations will also assist in determining if the impacted groundwater found at well pair DEC-049/049D is associated with the dissolved phase plume originating from near DEC-018/018D or a separate source. The MIP will be driven at approximately 100 feet bgs or to within the top 5 feet of a less permeable unit (i.e., till and or clay/silt unit).
- Three (3) additional water table (shallow) monitoring wells should be installed at the locations shown on Figure 36 to further delineate the horizontal extent of impacted groundwater in the vicinity of well pair DEC-049/049D. The wells should be advanced to approximately 10 feet below the water table at each location. Split spoon samples

should be collected continuously to the bottom of the boring depth (estimated depths ranging from 35 to 45 feet bgs). The wells should be constructed with a 15-foot screen.

- Five (5) additional deep monitoring wells should be installed at the locations shown on Figure 36 to assist in the delineation of the deeper groundwater in the vicinity of well pair DEC-049/049D. The deep wells should be advanced approximately 35 feet below the bottom of the existing well at each location or to the top of a less permeable unit (i.e., till and or clay/silt unit). Split spoon samples should be collected continuously from the bottom of the existing borings to approximately 35 feet below the bottom of the existing well at each location or to the top of a less permeable unit. The wells should be constructed with a 10-foot screen.
- A complete round of groundwater samples should be collected during Phase IV from all new and existing DEC wells and all previously sampled Exxon/Mobil wells located east of, but not including DEC-016/016D and DEC-040 (between Porter and Varick Avenues), in addition to the locations listed below, for a total of 22 wells.
- Exxon/Mobil wells MW-022 and MW-097 should be added to the Phase IV groundwater sampling event. These monitoring wells are located sidegradient and downgradient of DEC-049/049D. These wells will potentially assist in delineating the northern extent of the PCE plume centered on DEC-049/049D.

6.0 REFERENCES

Environmental Planning & Management, Inc. (EPM). January 2006. Draft-Contaminated Material Investigation Findings Report, Kosciuszko Bridge Project, Kings & Queens Counties, New York, P.I. N. X729.77.123

New York State Department of Environmental Conservation (NYSDEC). January 24, 1994. Technical and Administrative Guidance Memorandum (TAGM) #4046, Determination of Soil Cleanup Objectives and Cleanup Levels. (Revised), including the STARS Memo #1 compounds as per the NYSDEC Memorandum dated December 20, 2000.

NYSDEC, Division of Water. April 2000. Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations. Technical and Operational Guidance Series (TOGS) No. 1.1.1, Class GA.

New York State Department of Health (NYSDOH). October 2006. Guidance for Evaluating Soil Vapor Intrusion in the State of New York

Roux Associates, Inc. (Roux). October 14, 2005. Off-Site Soil Vapor Investigation, Phase I & II Report, Greenpoint, Brooklyn, NY

Roux. October 31, 2006. 3rd Quarter of 2006 Progress Report, Off-Site Free-Product Recovery System, Greenpoint, Brooklyn, New York

Roux. October 31, 2006. 3rd Quarter of 2006 Progress Report, Recovery and Containment System, Greenpoint, Brooklyn, New York

Roux. November 10, 2006. Phase IV Soil Vapor Report, Off-Site Commercial/Industrial/Residential Area, Brooklyn, New York

Roux. April 30, 2007. 1st Quarter of 2007 Progress Report, Brooklyn Terminal Free-Product Recovery System, ExxonMobil Brooklyn Terminal, Greenpoint, Brooklyn, New York

Roux. July 30, 2007. 2nd Quarter of 2007 Progress Report, Off-Site Free-Product Recovery System, Greenpoint, Brooklyn, New York

Roux. October 31, 2007. 3rd Quarter of 2007 Progress Report, Off-Site Free-Product Recovery System, Greenpoint, Brooklyn, New York

Roux. July 31, 2008. 2nd Quarter of 2008 Progress Report, Off-Site Free-Product Recovery System, Greenpoint, Brooklyn, New York

URS Corporation (URS). April 2007a. Final - Project Management Work Plan (PMWP) and Budget Estimate.

URS. April 2007b. Final - Field Activities Plan (FAP)

URS. October 2007. Final – Site Characterization, Phase I Data Summary Report.

URS. April 2008. Final – Site Characterization, Phase II Data Summary Report.