REMEDIAL INVESTIGATION REPORT

for

250 WATER STREET
New York, New York
NYSDEC BCP No.: C231127

Prepared For:

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c/o The Howard Hughes Corporation
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TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

LIST OF ACRONYMS

Acronym	Definition
AOC	Area of Concern
ASP	Analytical Services Protocol
BCA	Brownfield Cleanup Agreement
BCP	Brownfield Cleanup Program
bgs	Below Grade Surface
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CAMP	Community Air Monitoring Plan
CEQR	City Environmental Quality Review
CHASP	Construction Health and Safety Plan
COC	Contaminant of Concern
CSM	Conceptual Site Model
CVOC	Chlorinated Volatile Organic Compound
DCE	Dichloroethene
DER	Division of Environmental Remediation
DUSR	Data Usability Summary Report
EIMS	Environmental Information Management System
el	Elevation
ELAP	Environmental Laboratory Approval Program
ESA	Environmental Site Assessment
eV	Electron volt
EPC	Exposure Point Concentration
FDNY	New York City Fire Department
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FWRIA	Fish and Wildlife Resources Impact Analysis
GPR	Ground Penetrating Radar
HASP	Health and Safety Plan
ICP	Inductively Coupled Plasma
IDW	Investigation Derived Waste
LCS	Laboratory Control Sample
LNAPL	Light Non-Aqueous Phase Liquid
mg/kg	Milligrams per Kilogram
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NAVD88	North American Vertical Datum of 1988
NYCDEP	New York City Department of Environmental Protection
NYCRR	New York Codes, Rules and Regulations
NYSDOH	New York State Department of Health
NYSDEC	New York State Department of Environmental Conservation
PAOC	Potential Area of Concern

Acronym	Definition
PBS	Petroleum Bulk Storage
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethene
PFAS	Per- and Polyfluoroalkyl Substances
PID	Photoionization Detector
PM10	Particulate matter less than 10 micrometers in size
PPE	Personal Protective Equipment
ppm	Parts per million
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
RAWP	Remedial Action Work Plan
REC	Recognized Environmental Condition
RI	Remedial Investigation
RIR	Remedial Investigation Report
RIWP	Remedial Investigation Work Plan
RL	Reporting Limit
RSC	Relative Source Contribution
RUC	Restricted Use Commercial
SCO	Soil Cleanup Objective
SGV	Standards and Guidance Values
SMMP	Soil/Materials Management Plan
SMP	Site Management Plan
SSMC	Site-Specific Modeled Concentration
SVOC	Semivolatile Organic Compound
TAL	Target Analyte List
TCA	Trichloroethane
TCE	Trichloroethene
TCL	Target Compound List
TMB	Trimethylbenzene
TOGS	Technical and Operational Guidance Series
UN/DOT	United Nations/Department of Transportation
µg/L	Microgram per Liter
$\mu g/m^3$	Microgram per Cubic Meter
UCL	Upper Confidence Limit
USGS	United States Geological Survey
UST	Underground Storage Tank
UU	Unrestricted Use
VOC	Volatile Organic Compound

CERTIFICATION

I, Michael Burke, certify that I am currently a Qualified Environmental Professional as defined in 6 New York Codes, Rules, and Regulations (NYCRR) Part 375 and that this Remedial Investigation Report was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10) and that all activities were performed in full accordance with the DER-approved work plan and any DER-approved modifications.

Michael D. Burke, PG, CHMM

1.0 INTRODUCTION

This Remedial Investigation Report (RIR) was prepared on behalf of 250 Seaport District, LLC (the Volunteer) for the property located at 250 Water Street in the South Street Seaport neighborhood of New York, New York (the site). The Volunteer was accepted into the New York State Department of Environmental Conservation (NYSDEC) Brownfield Cleanup Program (BCP) to investigate and remediate the site pursuant to the NYSDEC Brownfield Cleanup Agreement (BCA) executed on 1 August 2019 (Index No. C231127-04-19). BCP Site No. C231127 was assigned to the site.

This RIR presents environmental data and findings from a remedial investigation (RI) completed by Langan Engineering, Environmental, Surveying, Landscape Architecture and Geology, D.P.C. (Langan) between 15 June and 12 October 2020. The investigation was conducted in accordance with the NYSDEC-approved 13 May 2020 Remedial Investigation Work Plan (RIWP); Title 6 of the New York Codes, Rules and Regulations (6 NYCRR) Part 375-1, 3.8, 6.8 (Part 375); NYSDEC Division of Environmental Remediation (DER) Program Policy: Technical Guidance for Site Investigation and Remediation (DER-10); and the New York State Department of Health (NYSDOH) Guidance for Evaluating Soil Vapor Intrusion in the State of New York, October 2006, with updates in 2017. The objectives and goals of the RI were to:

- Investigate and characterize the nature and extent of contamination at the site and of any constituents on or emanating from the site
- Generate sufficient data to evaluate remedial action alternatives and prepare a Remedial Action Work Plan (RAWP) to be implemented at the site
- Generate sufficient data to perform a qualitative on- and off-site human health exposure assessment

Sufficient analytical data was gathered during the RI, together with previous studies, to achieve the objectives and goals of this RI. Additional data will be gathered during a remedial design and waste characterization investigation.

The remainder of the RIR is organized as follows:

- Section 2.0 describes the site setting and physical characteristics
- Section 3.0 describes the site background including results of previous investigations and identifies potential areas of concern (PAOC)
- Section 4.0 presents the RI field sampling procedures
- Section 5.0 describes the RI field observations and analytical results
- Section 6.0 presents a qualitative and quantitative assessment of the exposure risks of site contaminants to human, fish, and wildlife receptors
- Section 7.0 presents the nature and extent of contamination in sampled media as determined through the field investigation and analysis of environmental samples
- Section 8.0 summarizes the results of the investigation and presents conclusions based on field observations and analytical results

- Section 9.0 presents the references used in preparation of this report

2.0 SITE PHYSICAL CHARACTERISTICS

2.1 Site Description

The site is approximately 48,057 square feet (1.10 acres) in area and is located at 250 Water Street in the South Street Seaport neighborhood of New York, New York (Block 98, Lot 1 on the Borough of Manhattan tax map). The site occupies the entire city block bordered by Pearl Street to the northwest (project north), Peck Slip to the northeast (project east), Water Street to the southeast (project south), and Beekman Street to the southwest (project west). It is used as an open-air asphalt-covered commercial parking lot; a parking attendant kiosk and temporary storage shed are located near the center of the lot. The perimeter of the site is fenced with one automated barrier ingress/egress gate on Pearl Street.

The "project north" is perpendicular with Water Street and points towards Pearl Street. All directions described herein are referenced to the project north arrow unless otherwise noted. A site location map is provided as Figure 1 and a site plan is provided as Figure 2.

According to the New York City Zoning Map 12b, the site is located in a C6-2A commercial district. The C6-2A district is mapped within the South Street Seaport Subdistrict of the Special Lower Manhattan District. C6 districts allow for a wide range of mixed residential and commercial uses. According to the New York City Landmarks Preservation Commission, the site is located in the South Street Seaport Historic District.

2.1.1 Description of Surrounding Properties

The site is located in an urban setting that is characterized by commercial, institutional, and residential properties. The site is bordered by Pearl Street followed by multiple-story residential buildings (at least one with a first-floor parking garage) known as Southbridge Towers and Bright Beginnings NYC (a preschool and child care facility) to the north, Peck Slip followed by the seven-story Peck Slip School (P.S. 343) building to the east, Water Street followed by multiple five- and six-story residential and commercial buildings and the Blue School Elementary School to the south, and Beekman Street followed by a seven-story residential and commercial building to the west. The following is a summary of surrounding property use:

Direction	Adjoining Properties (across a street from the site)			Nearby Properties
	Block No.	Lot No.	Description	
North, across Pearl Street	94	1	Multiple-story residential buildings (at least one with first-floor parking garage) - Southbridge Towers	Multiple-story residential and commercial buildings, including Bright Beginnings NYC
East, across Peck Slip	106	9	Seven-story institutional building (Peck Slip School - P.S. 343)	Multiple-story residential and commercial buildings
South, across Water Street	97	49, 55, 57, 7501, 7502, and 7505	Blue School Elementary School and multiple five- and six-story residential and commercial buildings	Multiple-story residential and commercial buildings
West, across Beekman Street	95	7501	Seven-story residential and commercial building	Public parkland, multiple-story residential and commercial buildings

Major infrastructure (storm drains, sewers, and underground utility lines) exists within the streets surrounding the site. Land use within a half mile of the site is urbanized and includes mixed-use buildings, subway tunnels, parkland, and school facilities. The closest ecological receptor, the East River, is located about 550 feet south of the site.

Sensitive receptors (as defined in DER-10) located within a half mile of the site are presented on Figure 3 and listed below:

Name (Approximate distance from Site*)	Address	Figure 3: Number ID
The Peck Slip School (approximately 30 feet northeast)	1 Peck Slip New York, NY 10038	1
Blue School (approximately 30 feet southeast)	241 Water Street New York, NY 10038	2
Bright Beginnings NYC (approximately 200 feet northwest)	80 Beekman Street New York, NY 10038	3
St. Margaret's House (approximately 400 feet northwest)	49 Fulton Street New York, NY 10038	4
Smarter Toddler Nursery & Preschool (approximately 700 feet west)	101 John Street New York, NY 10038	5
Kidville FiDi (approximately 700 feet west)	40 Gold Street New York, NY 10038	6
Sitter's Studio (approximately 1,000 feet southwest)	125 Maiden Lane New York, NY 10038	7
Spruce Street School P.S. 397 (approximately 1,100 feet northwest)	8 Spruce Street New York, NY 10038	8
Murry Bergtraum High School For Business Careers (approximately 1,150 feet north)	411 Pearl Street New York, NY 10038	9

Name (Approximate distance from Site*)	Address	Figure 3: Number ID
Montessori School of Manhattan (approximately 1,200 feet west)	2 Gold Street New York, NY 10038	10
Downtown Little School (approximately 1,300 feet northwest)	15 Dutch Street New York, NY 10038	11
New York City Housing Authority's Smith Day Care Center (approximately 1,500 feet east)	10 Catherine Slip New York, NY 10038	12
Hamilton-Madison House (approximately 1,700 feet northeast)	50 Madison Street New York, NY 10038	13
Paradigm Kids (approximately 1,700 feet west)	8 Liberty Place, New York, NY 10045	14
Bright Horizons at 20 Pine (approximately 1,700 feet west)	20 Pine Street 1st floor New York, NY 10005	15
Jacob August Riis P.S. 126 (approximately 1,800 feet northeast)	80 Catherine Street, New York, NY, 10038	16
Alfred E Smith P.S. 001 (approximately 2,000 feet northeast)	8 Henry Street New York, NY 10038	17
The Quad Preparatory School (approximately 2,000 feet west)	25 Pine Street New York, NY 10005	18
Mei Wah Day Care Center (approximately 2,100 feet northeast)	69 Madison Street New York, NY 10002	19
Leman Manhattan Preparatory School (approximately 2,300 feet southwest)	41 Broad Street New York, NY 10004	20
High School of Economics & Finance (approximately 2,500 feet northwest)	100 Trinity Place New York, NY 10006	21
Leadership and Public Service High School (approximately 2,500 feet northwest)	90 Trinity Place New York, NY 10006	22
Downtown Dance Factory (approximately 2,600 feet northwest)	291 Broadway 5th Floor New York, NY 10007	23
Preschool of America (approximately 2,600 feet east)	25 Market Street New York, NY 10002	24
Southbridge Towers (approximately 100 feet northwest)	90 Beekman Street New York, NY 10038	25
The Titus School (approximately 870 feet west)	90 John Street New York, NY 10038	26
Other residences on adjoining streets	Beekman Street, Water Street, Pearl Street, Peck Slip	N/A

* Direction are in reference to true north

2.1.2 Topography

Based on the American Land Title Association (ALTA) and National Society of Professional Surveyors (NSPS) Land Title Survey, prepared by Langan in June 2018, the site elevation ranges from about elevation (el) 7 to el 16 feet NAVD88. The topography of the site slopes downward toward Water Street (south).

The current Federal Emergency Management Agency (FEMA) Advisory Base Flood Elevation Maps include new advisory flood zone boundaries and advisory base flood elevations. This map indicates that the southern portion of the Subject Property falls within the advisory limit of the 0.1 percent Annual Chance Flood Hazard Area "special flood hazard", as defined by the 2014 New York City Building Code.

2.1.3 Wetlands

Wetlands on the site were evaluated by reviewing the National Wetlands Inventory and NYSDEC regulated wetlands map. There are no wetlands located on the site.

2.2 Geology and Hydrogeology

2.2.1 Regional and Site Geology

According to the Sanitary and Topographical Map of the City and Island of New York created by Egbert L. Viele in 1865 (Viele Map), the site is within a former meadow on the edge of the historical shoreline of the East River. The area was infilled for development purposes in the 1700s. According to a historical map obtained from the New York Public Library online Digital Collections[1], the historical shoreline ran through the center of the site, parallel with Water and Pearl Streets.

The United States Geological Survey (USGS) "Bedrock and Engineering Geologic Maps of New York County and Parts of Kings and Queens Counties, New York, and Parts of Bergen and Hudson Counties, New Jersey, dated 1994" indicates that the bedrock underlying the site is Manhattan Schist, and is comprised primarily of gray, medium- to coarse grained, layered sillimanite-muscovite-biotite-kyanite schist and gneiss interlayered with layered tourmaline-garnet-plagioclase-biotite-quartz schist and gneiss with blank amphibolite layers. Bedrock is expected to be about 125 feet below grade surface (bgs).

Site stratigraphy consists of historic fill material underlain by sand with varying amounts of silt, gravel, and clay. Historic fill material, predominantly consisting of grey to brown fine sand with varying proportions of silt, gravel, brick, concrete, wood, ceramic, coal, and ash, was encountered from immediately below the asphalt pavement to depths ranging from about 5 to 17 feet bgs.

[1]Map of original grants and farms: Manhattan Island" The New York Public Library Digital Collections. 1928. http://digitalcollections.nypl.org/items/8164149d-cf46-30ca-e040-e00a180622bb.

2.2.2 Regional and Site Hydrogeology

Groundwater flow is typically topographically influenced, as shallow groundwater tends to originate in areas of topographic highs and flows toward areas of topographic lows, such as rivers, stream valleys, ponds, and wetlands. A broader, interconnected hydrogeological network often governs groundwater flow at depth or in the bedrock aquifer. Groundwater depth and flow direction are also subject to hydrogeologic and anthropogenic variables such as precipitation, evaporation, extent of vegetation cover, and coverage by impervious surfaces. Other factors influencing groundwater flow include depth to bedrock, the presence of artificial fill, and variability in local geology and groundwater sources or sinks. The majority of runoff in this area drains to the city sewers, which connect to one of the several wastewater treatment plants servicing the city. Groundwater in New York City is not used as a potable water source. Potable water provided to New York City is sourced from reservoirs in the Catskill and Delaware watersheds.

Groundwater was observed at elevations ranging from about el -0.55 to -0.81 (about 8 to 15 feet bgs) on 10 October 2020. Groundwater flow direction was evaluated during the RI and was determined to flow to the southeast.

3.0 SITE BACKGROUND

3.1 Environmental History

The site and surrounding area are located in an urban setting historically characterized by residential, commercial, and industrial development. Historical uses of the site include a factory (cast-iron stoves, boilers, radiators, and other unknown uses), an oil company, a printer, a metal works, a chemicals and glue company, a chemical company, thermometer factories/workshops, a garage with two 550-gallon underground storage tanks (UST), a machine shop, and a gasoline service station.

Historical uses of the site listed below are based on the findings of the September 2015 and June 2018 Phase I Environmental Site Assessments (ESAs), prepared by Langan in accordance with the ASTM standards, and utilized supplemental historical resources.

Historical Site Use	Historical Address	Approximate Dates of Occupation
Factories (cast-iron stoves, boilers, radiators, and other unknown uses)	106 to 116 Beekman Street 12 Peck Slip 234 Water Street	1894 and 1927 to 1954
An oil company	306 Pearl Street 254 Water Street 246 Water Street 116 Beekman Street 12 Peck Slip	1920 to 1927
Printers	8-12 Peck Slip	1920 to 1927 and 1950
Metal works	234 Water Street	1923 to 1927
Chemicals and glue company	300 Pearl Street	1927
Chemical company	246 Water Street	1923
Thermometer factory	302 Pearl Street	1868* to 1927
Thermometer factory/workshop*	236 Water Street* 240 Water Street* 298 Pearl Street*	1833* to 1868*
Garage with two 550-gallon USTs	304 to 312 Pearl Street	1950 to 1996
Machine shop	238 Water Street	1950
Gasoline service station	292-294 pearl street	1953

* Historical information was obtained from resources outside of those required by the ASTM E1527-13 Standard for Phase I ESAs.

Historical uses of the site and surrounding properties are shown on Figure 4.

3.2 Proposed Redevelopment Plan

The contemplated project includes construction of a mixed-use commercial and residential building with one cellar level encompassing the site footprint. The proposed uses of each floor are still in the early planning stages; however, the proposed building would likely house a parking garage, utility rooms, storage areas, locker rooms, and property operations offices in the cellar, with commercial and residential spaces on the floors above.

3.3 Previous Environmental Reports

Previous environmental investigations are summarized below:

- *Phase I Environmental Site Assessment, dated September 2015, prepared by Langan*
- *Phase II Environmental Site Investigation Report, dated November 2015, prepared by Langan*
- *Phase I Environmental Site Assessment, dated June 2018, prepared by Langan*

Phase I Environmental Site Assessment, dated September 2015, prepared by Langan

Langan prepared a Phase I ESA for the site in accordance with the ASTM E-1527-13 standard for Peck Slip Associates, LLC, the previous owner of the site. The following summarizes the recognized environmental conditions (RECs) identified in this Phase I ESA:

- Historical use of the site as a factory, an oil company, a printer, a metal works, a chemicals and glue company, a chemical company, a trucking company, a thermometer factory, a garage with two 550-gallon USTs, a machine shop, and a gasoline service station.
- The presence of historic fill at the site.
- Historical use of adjoining and surrounding properties as a metals works, an “oils” facility, trucking companies, a garage, a machine shop, a printer, a substation, an automobile repair facility, a mercury warehouse[2], and facilities with petroleum bulk storage.

Based on additional research conducted by Langan after the completion of the Phase I ESA the historical site use as a trucking company was determined to be located off-site.

Phase II Environmental Site Investigation Report, dated November 2015, prepared by Langan

In preparation for the future sale of the site, the previous owner commissioned a Phase II ESI to investigate the findings of the September 2015 Phase I ESA prepared by Langan. The Phase II ESI was designed as a preliminary due diligence type of investigation to provide some subsurface data to potential future purchasers and was not intended to fully characterize subsurface

[2] The business “Mercury Warehouse & Storage Co Inc” was identified in the Environmental Data Resources Inc. City Directory sourced from R.L. Polk & Company for 245 Water Street in 1920.

conditions on the site. The Phase II ESI included a geophysical survey, advancement and sampling of 10 soil borings (22 soil samples), installation and sampling of 5 temporary groundwater monitoring wells (5 groundwater samples), and installation and sampling of 5 temporary soil vapor points (5 soil vapor and 1 ambient air sample). The following summarizes the findings of the Phase II ESI:

- Stratigraphy – A historic fill layer, predominantly consisting of loose grey to brown fine to medium sand with varying proportions of silt, gravel, brick, concrete, wood and ash, extends from sidewalk grade to depths ranging from about 6 to 14.5 feet bgs. Native soil consisting of sands with varying proportions of gravel and silt underlies the historic fill material.
- Hydrogeology – Groundwater was encountered at depths ranging from about 7 feet bgs in the southeastern portion of the site to about 14 feet bgs in the northwestern portion of the site.
- Potential USTs – The geophysical survey identified an anomaly consistent with an UST inside the eastern boundary of the site along Peck Slip.
- Petroleum Spill – Based on field observations and analytical results from soil and groundwater samples, a spill was reported to the NYSDEC on October 13, 2015 and Spill No. 1507371 was assigned.
- Soil – Petroleum impacts were observed in four soil borings on the eastern portion of the site (near Peck Slip) in the vicinity of the potential UST. Petroleum-related compounds (volatile organic compounds [VOC] and semivolatile organic compounds [SVOC]); total polychlorinated biphenyls (PCB); and nine metals, including mercury, were detected at concentrations above the 6 NYCRR Part 375 Unrestricted Use (UU) Soil Cleanup Objectives (SCOs) and/or Restricted Use Restricted-Residential (RURR) SCOs. The highest detections of mercury (63 milligrams per kilogram [mg/kg] to 120 mg/kg) were identified in one soil boring that, based on historic mapping and the current site survey, was determined to have been advanced within the limits of a historical on-site thermometer factory (302 Pearl Street).
- Groundwater – Petroleum-related VOCs and SVOCs were identified in groundwater at concentrations exceeding NYSDEC Division of Water Technical and Operation Guidance Series (TOGS) 1.1.1 Ambient Water Quality Standards and Guidance Values (SGVs) for Class GA (drinking water) in the eastern and northwestern portions of the site. A total of 14 VOCs and 9 SVOCs were detected above TOGS Class GA SGVs. A petroleum-like odor and sheen were observed in purge water from two monitoring wells. Eleven metals were detected in total concentrations exceeding TOGS Class GA SGVs. Dissolved antimony, iron, magnesium, manganese, and sodium were detected in filtered samples at concentrations exceeding TOGS Class GA SGVs. These metals are likely related to area-wide and naturally-occurring brackish groundwater conditions.

- Soil Vapor – Soil vapor sampling results indicated the presence of several VOCs, including chlorinated solvents and petroleum-related compounds.

Soil, groundwater, and soil vapor sample locations and analytical results from the Phase II ESI are included with the RI results figures and tables.

Phase I Environmental Site Assessment, dated September 2018, prepared by Langan

Langan prepared a Phase I ESA for the site for the current property owner prior to purchase in accordance with ASTM E-1527-13 standards, which took account of the November 2015 Phase II ESI. The following summarizes the findings specific to the site:

- One REC was identified as Hazardous Substances and Petroleum on the site; this was based on the Phase II ESI, which identified the following:
  - A petroleum release in the eastern portion of the site
  - Mercury above regulatory criteria in soil
  - Chlorinated solvents and petroleum-related compounds in soil vapor

  Petroleum, mercury and chlorinated solvent impacts may relate to historical use of the site and/or adjoining properties.

- One Business Environmental Risk was identified as Historic Fill:
  - Contaminants associated with historic fill, specifically SVOCs and metals at potentially hazardous concentrations, were detected in soil across the site.

3.4 Potential Areas of Concern for Investigation

Based on the site history and the findings of previous environmental investigations, these potential AOCs (PAOCs), as presented in the RIWP, were identified and further investigated during the RI. The PAOCs were subsequently updated and revised based on the findings of the RI in section 5.9 (Areas of Concern).

PAOC-1: Historic Fill

Historic fill material, generally consisting of loose, grey and brown, fine to medium sand with varying proportions of silt, gravel, brick, concrete, wood and ash, was observed extending from immediately below the asphalt pavement to depths ranging from 6 to 14.5 feet bgs. Contaminants associated with historic fill material, including SVOCs, PCBs, and metals (arsenic, barium, copper, lead, mercury, nickel, selenium, silver, and zinc), were detected at concentrations above Part 375 UU and RURR SCOs in soil samples collected from the historic fill layer.

PAOC-2: Potential Petroleum UST and Open Spill (Spill No. 1507371)

The geophysical survey conducted during the Phase II ESI identified an anomaly consistent with a UST inside the eastern (Peck Slip) boundary of the site. Visual, olfactory, and instrumental evidence of petroleum impacts were observed in five soil borings on the eastern part of the site (near Peck Slip). Petroleum-related VOCs were detected in soil and groundwater samples at concentrations above Part 375 UU and RURR SCOs and Class GA SGVs, respectively. Petroleum-related VOCs were also detected in soil vapor samples. A spill was reported to the NYSDEC in response to the observed petroleum-like impacts; Spill No. 1507371 was assigned.

PAOC-3: Historical Thermometer Factories/Workshops

Previous historical on-site uses identified in the Phase I ESAs and supplemental historical resources included a thermometer factory, and three additional thermometer factories/workshops previously occupied by the factory owner. The thermometer factory identified in the 1917 city directory listing reviewed for the Phase I ESAs was located in the central portion of the site at 302 Pearl Street. Subsequent to performing the Phase I ESAs, additional historical resources, outside of those required by the ASTM E1527-13 standard, were reviewed and three additional addresses associated with the factory owner were identified: 298 Pearl Street and 236 and 240 Water Street. The factory owner may have lived and/or worked at the three locations from circa 1833 to circa 1868. Around 1868, the factory owner opened the five-story factory at 302 Pearl Street.

Figure 4 shows the site boundary in relation to the 1923 Sanborn map, and the former thermometer factory and three thermometer workshop locations are outlined. The historic lot locations were identified by scaling and superimposing the 1923 Sanborn map onto the ALTA and NSPS Land Title Site Survey. Based on an evaluation of the Sanborn maps, the perimeter of the site fronting Water Street has decreased by about 15 feet (from 348 feet in 1923 to 333 feet on the survey and property deed), the orientation of the site fronting Pearl Street has changed, and the width of Pearl Street has increased by about 45 feet (from about 45 feet in 1923 to about 90 feet on the survey). Therefore, the Sanborn Map was overlaid on the Survey by matching up the corner of Water Street and Beekman, an intersection that appears unchanged on the historical Sanborn maps.

Historical Address	Approximate Dates of Occupation	Historical Site Use	Data Source
236 & 240 Water Street	1833 to 1848	Thermometer workshops	4, 5
298 Pearl Street	1848 to 1868	Thermometer workshop	2, 5
302 Pearl Street	1868 to 1927	Thermometer factory	1, 2, 3, 5

Sources:

1. Langan Phase I Environmental Site Assessments (September 2015 and June 2018)
2. American Nation Biography (https://www.anb.org/)
3. 15th Annual Report of the Factory Inspector of the State of New York, 1901
4. Sixth Annual Report of the American Institute of the City of New York, March 25, 1848
5. The Mechanical News, May 15, 1893

Langan’s 2015 Phase II ESI identified mercury at a maximum concentration of 120 mg/kg at a depth of 13 to 14 feet bgs in soil boring SB4, which, based on historic mapping and the current site survey, was advanced within the former thermometer factory footprint at 302 Pearl Street. This boring was located specifically to investigate potential subsurface impacts related to the former thermometer factory at 302 Pearl Street. Mercury was also identified within the historic fill layer at concentrations exceeding Part 375 UU SCOs across the site and above RURR SCOs in three additional borings on the eastern part of the site where historical thermometer factories/workshops were not identified from 2 to 14 feet bgs.

PAOC-4: Site-Wide Groundwater and Soil Vapor Quality

AOC-4 represents various historical industrial uses of the site and surrounding properties. Additional historical uses of the site include a factory, an oil company, a printer, a metal works, chemicals and glue company, a chemical company, a machine shop, and a gasoline service station. Historical use of the surrounding properties include a metal works, an “oils” facility, trucking companies, a garage, a machine shop, a printer, a substation, an automobile repair facility, a mercury warehouse, and facilities with petroleum bulk storage.

Langan’s 2015 Phase II ESI identified VOCs, SVOCs, and metals in groundwater above Class GA SGVs. Several petroleum-related and chlorinated VOCs were detected at concentrations in soil vapor samples that exceeded the ambient air sample results. Chlorinated VOCs (CVOC), including PCE and TCE were detected in soil vapor samples. The investigation of AOC-4 will evaluate whether on-site historical industrial uses are impacting on- or off-site conditions, and whether off-site historical industrial uses are impacting on-site conditions.

4.0 REMEDIAL INVESTIGATION

The RI was implemented between 15 June and 12 October 2020 to investigate and characterize the nature and extent of environmental impacts at the site, evaluate the nature of any impacts emanating from the site and provide sufficient information to evaluate remedial alternatives.

Except for deviations that are summarized in Section 4.10, the RI was conducted in accordance with the NYSDEC-approved 13 May 2020 RIWP prepared by Langan, 6 NYCRR Part 375, 6.8, DER-10, and the NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York, October 2006, with 2017 updates.

The RI included the following:

<u>Baseline Community Air Monitoring</u>

- Conducted a baseline community air monitoring event before intrusive activities began to establish background concentrations for total VOCs, particulates, and mercury vapor.

<u>Geophysical Survey</u>

- Conducted a geophysical survey to clear drilling locations and identify potential subsurface utilities, structures, and significant subsurface anomalies, as defined in the RIWP.

<u>Soil Investigation</u>

- Advanced 29 site-wide soil borings (SB11 through SB39) to between about 10 and 32 feet bgs. A total of 100 soil samples were collected – 3 to 4 soil samples from each soil boring (including quality assurance/quality control [QA/QC] samples) – for laboratory analysis.
- Advanced 16 mercury delineation soil borings (SB4R, SB24, SB25, SB4N1, SB4N3, SB4E1, SB4E2, SB4S2, SB4S3, SB4W1, SB4W2, SB4W3, SB4NW3, SB4NE3, SB4SE3, and SB4SW3) around Phase II ESI boring SB4 (located within the former 302 Pearl Street lot boundaries). Borings were advanced between 12 and 30 feet bgs. One grab soil sample was collected from every two linear feet of soil recovered until the boring termination depth. A total of 136 samples (including QA/QC samples) were collected and analyzed from these borings.
    - o Soil borings SB24 and SB25 served as both site-wide and mercury delineation soil borings and sampled as described in both bullets above.

<u>Groundwater Investigation</u>

- Installed and developed eleven permanent groundwater monitoring wells.
- Collected one groundwater sample from each monitoring well (plus QA/QC samples) for laboratory analysis.
- Surveyed and gauged monitoring wells to calculate groundwater elevation and establish flow direction.

- Installed pressure transducers in monitoring wells to determine tidal influence on groundwater elevation.
- Developed a groundwater contour map.

<u>Soil Vapor Investigation</u>

- Installed 14 soil vapor points to depths ranging from 7 to 15 feet bgs.
- Installed 3 soil vapor points within void spaces at about 1.5 feet bgs.
- Collected one soil vapor sample (plus QA/QC sample) from each soil vapor point for laboratory analysis.
- Collected one outdoor ambient air sample as a QA/QC measure for laboratory analysis for soil vapor.

RI sample locations are shown on Figure 5 and a sample summary is provided in Table 1.

4.1 Baseline Community Air Monitoring

A baseline community ambient air monitoring event was conducted on 16 June 2020 over an hour period to determine background concentrations for total VOCs, particulate matter less than 10 micrometers in diameter (PM10), and mercury vapor at the site. Seven air monitoring stations were used to measure ambient concentrations. PM10 was monitored using a DustTrak DRX Aerosol Monitor. Total VOCs were monitored using a MiniRAE 3000 PID. Mercury vapor was monitored using a Jerome® J405. Each Station was monitored using real-time, wireless telemetry. The baseline community air monitoring concentrations were used to evaluate the work zone and community air monitoring results during ground-intrusive activities.

4.2 Geophysical Survey

A geophysical survey was conducted by Hager-Richter Geoscience, Inc. (HRG) on 15 and 16 June 2020. HRG surveyed the site and adjoining accessible sidewalks to evaluate potential subsurface utilities, structures, and significant subsurface anomalies (including USTs) and clear boring locations prior to commencing subsurface work. All areas of the site (excluding the parking attendant kiosk and temporary storage shed) and sidewalk (excluding the Citi Bike docking station along Pearl Street) were surveyed. The geophysical survey was completed using a range of geophysical instruments, including electromagnetic (EM) induction, precision utility location (PUL) instruments, and ground-penetrating radar (GPR). The following geophysical equipment was used:

- GPR (GSSI UtilityScan HS using a 350 MHz Hyper Stacking antenna)
- Electromagnetic Subsurface Utility Locator (Radiodetection RD7000)
- Electromagnetic Induction Metal Detector (Geonics EM61-MK2)

The survey results were evaluated and interpreted alongside available information from historical maps and other data sources. Borings were relocated as necessary to avoid subsurface anomalies such as utilities and/or to investigate significant subsurface anomalies. A copy of the geophysical survey report presenting these findings is included in Appendix B.

4.3 Soil Investigation

4.3.1 Drilling and Logging

AARCO Environmental Services Corp (AARCO) advanced 29 site-wide soil borings (SB11 through SB39) and 16 mercury delineation soil borings (SB4R, SB24, SB25, SB4N1, SB4N3, SB4E1, SB4E2, SB4S2, SB4S3, SB4W1, SB4W2, SB4W3, SB4NW3, SB4NE3, SB4SE3, and SB4SW3) between 8 July and 26 August 2020. Borings SB24 and SB25 are included as both site-wide and mercury delineation soil borings. Mercury delineation soil borings SB4N3, SB4S3, SB4W3, SB4NW3, SB4NE3, SB4SE3, and SB4SW3 were added to the proposed RIWP scope to further delineate mercury impacts that were identified over the course of the RI. A direct-push Geoprobe® 7822 DT drilling rig and AMS Power Probe 9580-VTR drill rig were used to advance the soil borings. The borings were advanced between 10 to 32 feet bgs, as summarized below:

- Site-wide soil borings SB11 to SB15, SB17 to SB20, SB23, SB26, SB27, SB28, and SB30 to SB39 were advanced between 20 and 32 feet bgs.
- Site-wide soil borings SB16, SB21, SB22, and SB29 were advanced to refusal between 10 and 15 feet bgs.
- Mercury delineation soil borings SB4R, SB24, SB25, SB4N1, SB4N3, SB4E1, SB4E2, SB4S2, SB4W1, and SB4W2 were advanced to 30 feet bgs.
- Mercury delineation soil borings SB4N3, SB4S3, SB4W3, SB4NW3, SB4NE3, SB4SE3, and SB4SW3 were advanced between 12 and 16 feet bgs.

Soil samples were collected continuously from surface grade to the termination depth at each boring location into 2-inch-diameter, 4- or 5-foot-long MacroCore™ samplers equipped with acetate liners. All soil was screened continuously to the boring termination depth for total organic vapor (TOV) concentration using a photoionization detector (PID) equipped with a 10.6 electron volt (eV) bulb and for visual and olfactory indications of environmental impacts (e.g., staining and odor). Site-wide soil borings and delineation borings SB4R, SB24, SB25, SB4N1, SB4N3, SB4E1, SB4E2, SB4S2, SB4W1, and SB4W2 were screened every two linear feet of recovered soil using a handheld X-ray fluorescence (XRF) analyzer for total mercury. All soil borings, excluding SB12, SB26, SB27, SB30 to SB37, and delineation soil borings SB4N3, SB4S3, SB4W3, SB4NW3, SB4NE3, SB4SE3, and SB4SW3, were screened every two linear feet of recovered soil using a Jerome® J405 (or equivalent) for mercury vapor. Recovered soil was visually characterized for soil type, grain size, color, texture, and moisture content. Boring logs documenting these observations are included in Appendix C.

Following sample collection, 11 borings were converted to groundwater monitoring wells. The remaining borings were backfilled with soil cuttings that were visibly free of environmental impacts (i.e., no staining or odor), clean sand, and/or bentonite and patched with asphalt to match the existing surface. Excess and grossly-contaminated soil cuttings were containerized in 55-gallon drums (discussed in Section 4.8).

4.3.2 Soil Sampling and Analysis

A total of 100 soil samples (including QA/QC samples) were collected for laboratory analysis from site-wide soil borings (not including samples collected from mercury delineation borings). Three to four samples were collected from each site-wide soil boring from the intervals indicated in the list below based on the AOCs each boring was associated with and field observations:

- Surficial soil within the top two feet of the boring
- Top of the native soil layer
- Random interval within the historic fill layer
- Groundwater interface
- Boring termination depth
- Interval exhibiting the greatest degree of impacts (i.e., visual observations, odors, or PID readings above background), if encountered
- Interval with the highest mercury concentration based on XRF readings, if encountered
- One-foot interval below the vertical extents of impacts, if encountered

Rationale for each sample is included in Table 1.

Soil samples were collected in laboratory-supplied containers and were sealed, labeled, placed in an ice-chilled cooler in an effort to maintain a temperature of about 4 ℃, and transported via courier service to Eurofins Lancaster Laboratories Environmental, Inc. (Eurofins), a NYSDOH Environmental Laboratory Approval Program (ELAP)-certified laboratory in Lancaster, Pennsylvania (ELAP No. 10670). Samples submitted for VOC analysis were collected directly from the acetate liner with TerraCore® samplers. Site-wide soil samples were analyzed using one or more of the following United States Environmental Protection Agency (USEPA) methods for NYSDEC Part 375 list and USEPA Target Compound List (TCL)/Target Analyte List (TAL):

- VOCs by USEPA Method 8260C
- SVOCs by USEPA Method 8270D
- Pesticides by USEPA Method 8081B
- Herbicides by USEPA Method 8151A
- Polychlorinated biphenyls (PCBs) by USEPA Method 8082A
- Metals by USEPA Method 6010D/7471B
- Hexavalent/Trivalent Chromium by USEPA Method 7196A
- Total cyanide by USEPA Method 9010C/9012B
- Per- and polyfluoroalkyl substances (PFAS) by USEPA Method 537 Modified
- 1,4-dioxane by USEPA Method 8270 SIM

Samples collected from the one-foot interval below the vertical extents of field-observed petroleum-like impacts were only analyzed for VOCs, SVOCs, and metals. One additional soil sample was collected based on the XRF screening value in the historic fill layer from site-wide soil boring SB26 and analyzed for total mercury.

A total of 144 mercury delineation soil samples (including QA/QC samples) were collected for laboratory analysis from delineation soil borings. One grab soil sample was collected from every two linear feet of soil recovered through the boring termination depth. Samples from 0 to 20 feet bgs were initially analyzed. Samples from 20 to 30 feet bgs were placed on hold pending results from the 0 to 20 feet bgs samples. One sample was analyzed at boring SB4R at 20 to 22 feet bgs due to an exceedance of the RURR SCO at 18 to 20 feet bgs. Mercury delineation soil samples were analyzed for total mercury.

4.3.2.1 Mercury Speciation Sample Analysis

Eight soil samples from PAOC-3 were analyzed for mercury selective sequential extraction to determine the mercury species. Mercury exists in several forms: elemental (or metallic) mercury, inorganic mercury compounds, methylmercury and other organic mercury compounds. Mercury speciation was completed to determine the forms and proportions of mercury present in the subsurface to aid in the preparation of the Qualitative Human Health Exposure Assessment presented in section 6.0. Samples SB4R_2-4, SB4R_10-12, SB4N1_0-2, SB25_4-6, MDUP07_072920 (duplicate of sample SB24_2-4), SB4S2_2-4, SB4W2_2-4, and SB39_8-10 were selected in coordination with NYSDEC and NYSDOH based on the total mercury concentrations, boring location, and sample depth. The six types of mercury species (F-0 to F-6) extracted by USEPA Modified Method 1631 are as follows:

Fraction	Expected Species
F-0	Free elemental mercury
F-1	Water soluble mercury salts such as mercuric chloride [$HgCl_2$] and mercuric nitrate [$Hg(NO_3)_2$]
F-2	Low pH soluble salts of mercury
F-3	Organic bound mercury compounds (Hg(II) bound to sludge or humic matter*)
F-4	All other non-sulfide or silicate bound mercury compounds (can include amalgamated elemental mercury)
F-5	Sulfide bound mercury compounds only
F-6	Silicate or aluminosilicate bound mercury compounds

* Humic matter is the major fraction of the organic content in soil, which is principally the result of digested and decomposed plants and vegetation

4.3.2.2 Remedial Design Sample Analysis

Remedial design samples were collected to support development of a potential in-situ remedy of the known spill condition on the southeastern part of the site. Four remedial design samples were collected and relinquished to Alpha Analytical, Inc., a NYSDOH ELAP-certified laboratory in Mahwah, New Jersey (ELAP No. 11148). Remedial design samples were collected from soil borings SB31 and SB32 and analyzed for total petroleum hydrocarbon (TPH) diesel range organic (DRO) and gasoline range organics (GRO), nitrite, nitrate, ammonia, sulfate, phosphate, iron and manganese, total organic carbon (TOC), chemical oxygen demand (COD), biological oxygen demand (BOD), and alkalinity to support the evaluation of an in-situ remedial alternative. Samples were collected from the interval exhibiting the greatest degree of impacts (i.e., visual observations, odors, or PID readings above background) and the one-foot interval below the vertical extent of impacts from soil borings SB31 and SB32, advanced within PAOC 2.

4.4 Groundwater Investigation

4.4.1 Monitoring Well Installation and Development

Eleven soil borings were converted into groundwater monitoring wells (MW11, MW15, MW17, MW25, MW26, MW28, and MW30 through MW34). The wells were constructed with 2-inch-diameter polyvinyl chloride (PVC) riser pipe attached to 10-foot long, schedule-40, 0.01-inch slotted, 2-inch-diameter PVC screen set to straddle the groundwater table. The annulus of each well was filled with No. 2 sand to about one foot above the top of the screen. A minimum 2-foot-thick hydrated bentonite well seal was installed above the filter sand and backfilled to grade with clean sand and/or bentonite. The wells were finished with flush-mounted metal manhole covers set in concrete.

Following installation, each well was developed by surging and continuously purging via submersible pump until the water became clear. Purged groundwater was containerized in a 55-gallon drum (investigation-derived waste is discussed in Section 4.8). Monitoring well construction logs are included in Appendix D.

4.4.2 Groundwater Sampling and Analysis

Monitoring wells were sampled at least one week after development on 1 and 2 September 2020. Sampling was conducted in accordance with the USEPA's low-flow groundwater sampling procedure to allow for collection of representative samples ("Low Stress Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells," EQASOP-GW 001, January 19, 2010). Prior to sample collection, the depth to water was not measured because of possible PFAS cross contamination from the oil/water interface probe. Ambient and headspace VOC and mercury vapor readings were collected from each monitoring well location with a PID and Jerome J505 mercury vapor analyzer, respectively.

Groundwater was purged from each well until groundwater parameters (pH, conductivity, turbidity, dissolved oxygen, temperature, turbidity, and oxidation-reduction potential) stabilized within a reasonable time frame (about an hour). Each groundwater sample was collected using a peristaltic pump and dedicated high-density polyethylene (HDPE) tubing.

Eleven groundwater samples (plus QA/QC samples) were collected in laboratory-supplied containers and were sealed, labeled, placed in an ice-chilled cooler to maintain a temperature of about 4 °C, and transported via courier service to Alpha. Groundwater samples were analyzed using the following USEPA methods for NYSDEC Part 375 list and USEPA TCL/TAL:

- VOCs by USEPA Method 8260C
- SVOCs by USEPA Method 8270D
- Pesticides by USEPA Method 8081B
- Herbicides by USEPA Method 8151A
- Polychlorinated biphenyls (PCBs) by USEPA Method 8082A
- Metals by USEPA Method 6020B/7471A
- Hexavalent/Trivalent Chromium by USEPA Method 7196A
- Total cyanide by USEPA Method 9010C/9012B
- 1,4-Dioxane by USEPA Method 8270D-SIM
- PFAS by USEPA Method 537

Groundwater sampling logs are included in Appendix E.

4.4.3 Monitoring Well Survey and Synoptic Gauging

The vertical location of each monitoring well, including ground surface elevation, outer casing elevation, and inner casing elevation, was surveyed by Langan on 23 September 2020. Vertical control was established relative to the North American Vertical Datum of 1988 (NAVD88) by a New York State-licensed land surveyor. Elevations of the wells were surveyed to the nearest 0.01 foot. A synoptic gauging event was performed on 10 October 2020.

Pressure transducers were installed in each monitoring well to determine the tidal influence on the groundwater elevation. Pressure transducer data was collected from 10 to 12 October 2020.

Calculated groundwater elevations are presented in Table 2. A groundwater contour map and a chart showing groundwater elevations measured with pressure transducers over a 48-hour period are included as Figures 6A and 6B, respectively

4.5 Soil Vapor Investigation

4.5.1 Soil Vapor Point Installation

Fourteen soil vapor points (SV12, SV14, SV17, SV19, SV21, SV23, SV24, SV28, SV29, SV30, SV32, SV37, SV38, and SV39) were installed from about 7 to 15 feet bgs (a minimum of 2 feet above the groundwater table) in accordance with the NYSDOH Guidance. Each soil vapor point was constructed with a dedicated 1-7/8-inch polyethylene implant threaded into polyethylene tubing that extended to surface grade. At a minimum, a one-foot-thick sand filter pack was placed around the screen implant followed by a one-foot-thick hydrated bentonite seal. The remainder of the annulus was either backfilled with clean sand or bentonite and sealed with bentonite at the surface.

Three soil vapor points (V1, V3, and V5) were installed within void spaces identified during the geophysical survey. The void space soil vapor points were installed using a Bosch RH540M Hammer Drill at about 1.5 feet bgs (depth of void space). Each soil vapor point was constructed with a dedicated 1-7/8-inch polyethylene implant threaded into polyethylene tubing that extended to surface grade and sealed with hydrated bentonite at the surface. Soil vapor points within void spaces were added to the proposed RIWP scope to determine if mercury vapor was collecting in void spaces at the site.

A seal check was performed at each installed soil vapor sample location with a helium tracer gas before and after sample collection. Prior to sampling, at least three tubing volumes were purged from the soil vapor point using a MultiRAE multi-gas monitor with a flow rate of about 200 milliliters per minute. The multi-gas meter and Jerome J505 mercury vapor analyzer were used to screen the sample tubing for the presence of VOCs and mercury vapor.

4.5.2 Soil Vapor Sampling and Analysis

On 9 July 2020, twelve soil vapor samples (plus QA/QC sample) and three void space soil vapor samples were collected following purging. One outdoor ambient air sample (designated AA01) was collected concurrently with the soil vapor samples. Off-site soil vapor samples SV38 and SV39 were installed and collected on 3 August 2020 without a corresponding ambient air sample. Soil vapor and ambient air samples were collected using laboratory-supplied, batch-certified clean, 2.7 or 6-liter air canisters equipped with 2-hour sample interval flow controllers and laboratory provided sorbent tubes and pumps. The ambient air sample was collected at a height of about 3 feet above grade surface. Soil vapor and ambient air samples were sealed, labeled, and transported via courier service to Alpha for analysis. The samples were analyzed for VOCs by USEPA Method TO-15 (air canister) and for mercury vapor by NIOSH Method 6009 (sorbent tube and pump).

Soil vapor point construction and sampling logs are included as Appendix F.

4.6 Quality Assurance/Quality Control Sampling

In accordance with the Quality Assurance Project Plan (QAPP), QA/QC samples were collected during the RI. Collected QA/QC samples are detailed below and in Table 1.

Soil QA/QC Samples

- Fifteen duplicate samples
- Four matrix spike/matrix spike duplicate (MS/MSD) samples
- Fourteen field blank samples
- Eleven equipment blanks
- Eleven trip blank samples

Groundwater QA/QC Samples

- One duplicate sample
- One MS/MSD sample
- One field blank sample
- Two equipment blanks
- Three trip blank samples

Soil Vapor QA/QC Samples

- One duplicate sample
- One field blank sample

Field duplicate samples were collected to assess the precision of the analytical methods relative to the sample matrix. The duplicates were collected from the same material as the primary sample (i.e., parent sample) by splitting the volume of homogenized sample collected in the field into two sample containers. Soil vapor duplicate and parent samples were collected at the same time using two separate soil vapor implants installed within the same borehole.

MS/MSD samples were collected to assess the effect of the sample matrix on the recovery of target compounds or target analytes. Similarly to duplicate samples, MS/MSD samples were collected from the same material as the primary sample by splitting the volume of homogenized sample collected in the field into three sample containers.

Field blanks were collected to determine the cleanliness of unused tubing, nitrile gloves and acetate liners used to collect groundwater and/or soil samples. Field blank samples consisted of deionized, distilled water provided by the laboratory that has passed through the sampling apparatus. Field blank samples were analyzed for the same list of analytes as the corresponding sampling event and sample matrix.

Equipment blanks were collected for quality assurance purposes when soil and groundwater samples are being collected for PFAS at a rate of one per day per media. Equipment blanks consisted of laboratory-demonstrated PFAS-free water that has passed through a decontaminated field equipment following use and implementation of decontamination protocols. Equipment blank samples were be analyzed for the NYSDEC list PFAS.

Trip blank samples were collected to assess the potential for contamination of the sample containers and samples during transport from the laboratory, to the field, and back to the laboratory for analysis. Trip blanks contain about 40 milliliters of acidic water (doped with hydrochloric acid) that is prepared and sealed by the laboratory when the empty sample containers are shipped to the field, and then unsealed and analyzed for VOCs by the laboratory when the sample shipment is received from the field.

4.7 Data Validation

Laboratory analyses of soil, groundwater, soil vapor and air samples were conducted by a NYSDOH ELAP-certified laboratory in accordance with USEPA SW-846 methods and analytical data was reported consistent with the NYSDEC Analytical Services Protocol (ASP) Category B deliverable format. Environmental data was reported electronically using the database software application EQUIS as part of NYSDEC's Environmental Information Management System (EIMS).

The QA/QC procedures required by the NYSDEC ASP and SW-846 methods, including initial and continuing instrument calibrations, surrogate compound spikes, and analysis of other samples (blanks, laboratory control samples, and MS/MSD) were followed. The laboratory provided sample bottles, which were pre-cleaned and preserved in accordance with the SW-846 methods. Where there were differences in the SW-846 and NYSDEC ASP requirements, the NYSDEC ASP took precedence.

Data validation was performed by de maximis Data Management Solutions (DDMS), Inc., a third party data validator, in accordance with the USEPA validation guidelines for organic and metal data review. Validation included the following:

- Verification of QC sample results (both qualitative and quantitative)
- Verification of sample results (both positive hits and non-detects)
- Recalculation of 10 percent of all investigative sample results
- Preparation of Data Usability Summary Reports (DUSR)

Laboratory analytical results from the RI were reported in NYSDEC ASP Category B deliverable format and validated by the Data Validator identified in the QAPP.

4.7.1 Data Usability Summary Report Preparation

A DUSR was prepared for each data package of each sampling matrix by DDMS. The DUSRs present the results of the data validation, including a summary assessment of laboratory data packages, sample preservation and chain of custody procedures, and a summary assessment of precision, accuracy, representativeness, comparability, and completeness for each analytical method.

For soil samples, the following items were assessed:

- Holding times
- Sample preservation
- Sample extraction and digestion
- Instrument tuning
- Instrument calibration
- Laboratory blanks
- Laboratory control samples
- System monitoring compounds
- Internal standard area counts

- MS/MSD recoveries
- Target compound identification and qualification
- Chromatograms
- Overall system performance
- Serial dilutions
- Dual column performance
- Field duplicate and field blanks sample results

For groundwater samples, the following items were assessed:

- Holding times
- Sample preservation
- Instrument tuning
- Instrument calibration
- Laboratory blanks
- Laboratory control samples
- System monitoring compounds
- Internal standard area counts
- MS/MSD recoveries
- Target compound identification and qualification
- Chromatograms
- Overall system performance
- Serial dilutions
- Dual column performance
- Field duplicate, trip blank and field blanks sample results

For the soil vapor and air samples, the following items were assessed:

- Holding times
- Instrument tuning
- Instrument calibration
- Laboratory blanks
- Laboratory control samples
- Internal standard area counts
- Target compound identification and qualification
- Chromatograms
- Overall system performance

Based on the results of data validation, the following qualifiers were assigned to the data in accordance with USEPA's guidelines and best professional judgment:

- "R" – The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the sample.

- "J" – The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
- "J+" – The reported value may be biased high. The actual value is expected to be less than the reported value
- "J-" – The reported value may be biased low. The actual value is expected to be greater than the reported value
- "N" – The analyte has been "tentatively identified" or "presumptively" as present.
- "U" – The analyte was analyzed for but was not detected above the level of the reported sample quantitation limit.
- "UJ" – The analyte was analyzed for but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.

4.8 Field Equipment Decontamination

Reusable down-hole drilling equipment was decontaminated between each boring where petroleum-like impacts were encountered. Decontamination consisted of cleaning the drilling rods by hand using an Alconox-based solution and distilled water.

4.9 Investigation-Derived Waste Management

Investigation derived waste (IDW) generated during the RI included excess and grossly-contaminated soil cuttings, purged groundwater and decontamination water. Soil cuttings were containerized in two labeled United Nations/Department of Transportation (UN/DOT)-approved 55-galllon steel drum. Purged groundwater and decontamination water were containerized in three labeled UN/DOT-approved 55-galllon steel drums. The drums are temporarily staged in a secured area on-site awaiting transport by a licensed waste hauler for disposal at an approved facility.

4.10 Air Monitoring

Air monitoring was conducted for site personnel and the community (Community Air Monitoring Plan [CAMP]) in accordance with the NYSDEC-approved 13 May 2020 RIWP between 8 July and 26 August 2020. Dust emissions were monitored using real-time monitoring equipment capable of measuring PM-10. Organic vapors were monitored with a PID equipped with a 10.6 eV bulb. Mercury vapor was monitored with a Jerome® J405 and J505 mercury vapor analyzer.

4.10.1 Work Zone Air Monitoring

Langan conducted continuous air monitoring concurrently with community air monitoring within the work zone during ground-intrusive activities to evaluate health and safety protection for the field personnel. The work zone monitoring station monitored for VOCs with a PID, dust with a DustTrak, and mercury vapor with a Jerome® J405, in accordance with the Health and Safety Plan (HASP).

4.10.2 Community Air Monitoring Plan

In addition to air monitoring in the worker breathing zone, Langan conducted community air monitoring in accordance with the CAMP contained in the RIWP. A total of six CAMP stations, one weather station, and one handheld mercury vapor analyzer were used for community air monitoring. The weather and community air monitoring stations used a wireless telemetry system to monitor real-time wind direction, temperature, and concentrations. Wind direction was checked and verified each day by Langan using surveyors tape or equivalent. CAMP deployment complied with NYSDEC DER-10 Appendix 1A and 1B.

A portable mercury vapor analyzer (Jerome® J505 or equivalent) was used by dedicated field personnel to capture instantaneous mercury vapor concentrations around the site and downwind from the work zone. The handheld mercury vapor analyzer was used to identify mercury vapor between the work zone and CAMP station and to evaluate sources of any work zone or CAMP action level exceedances.

During non-intrusive work such as the collection of groundwater, Langan conducted periodic monitoring for VOCs and mercury vapor. Periodic monitoring was conducted upon arrival and departure and periodically in between.

4.11 Phased Data Review and Scope Deviations

The RI was completed in a phased approach that included review and evaluation of the RI data in conjunction with the NYSDEC, NYSDOH, and the community consultants in between phases of work. The following is a list of inter-phase meetings among Langan, NYSDEC, NYSDOH, and the community consultants.

Phase 1 Data Review - 30 June 2020

Phase 2 Data Review – 21 June 2020

Phase 3 Data Review – 12 August 2020

Phase 4 and 5 Data Review – 22 September 2020

The follow deviations were made to the proposed scope of work as a result of the agreements made during the inter-phase meetings:

1. Three void space soil vapor samples (V1, V3, and V5) were added to the proposed RIWP scope to identify if mercury vapor accumulated in void spaces beneath the asphalt cover (see Section 4.5.1).
2. Soil boring and monitoring well SB11/MW11 was moved to evaluate a suspected UST near Beekman Street identified by the geophysical survey (about 7 feet north of the approved RIWP location).
3. Soil boring and monitoring well SB33/MW33 was moved to avoid a reinforced concrete area identified by the geophysical survey (about 5 feet closer to Pearl Street from the approved RIWP location).

4. Soil boring and monitoring well SB34/MW34 was moved on site to avoid subsurface utilities identified by the geophysical study (the approved RIWP location was within the Peck Slip sidewalk).
5. Soil vapor point SV12 was moved to avoid the reinforced concrete area identified by the geophysical study (about 2 feet closer to Pearl Street than the approved RIWP location).
6. Soil vapor point SV32 was moved to avoid the reinforced concrete area identified by the geophysical study (about 2 feet closer to Water Street than the approved RIWP location).
7. The proposed monitoring well at boring SB23 was installed at boring SB17 and renamed MW17 based on field observation.
8. Two additional monitoring wells (MW28 and MW30) were installed at soil borings SB28 and SB30 based on soil boring observations and/or soil and soil vapor sample analytical results.
9. Seven additional mercury delineation soil borings SB4N3, SB4S3, SB4W3, SB4NW3, SB4NE3, SB4SE3, and SB4SW3 were added to the proposed RIWP scope to further delineate mercury impacts around the former 302 Pearl Street property boundary.

5.0 FIELD OBSERVATIONS AND ANALYTICAL RESULTS

A complete list of the samples collected during the RI is provided in Table 1. Photographs of the RI activities are in the Daily Field Reports (DFRs) included in Appendix G.

5.1 Baseline and Community Air Monitoring Results

Langan performed an 8-hour baseline air monitoring event on 16 June 2020 for PM10, VOCs, and mercury vapor. Seven air monitoring stations, each equipped with a DustTrak DRX Aerosol Monitor, a MiniRAE 3000 PID, and a Jerome J405 mercury vapor analyzer, were used for the monitoring event. Weather conditions were clear and 65 to 75 degrees Fahrenheit. The predominant wind direction was from the northeast. Daily background concentrations established during the baseline air monitoring event were 0.025 milligrams per cubic meter (mg/m^3) for PM10, 0.5 parts per million (ppm) for VOCs, and 0.0 microgram per cubic meter ($\mu g/m^3$) for mercury vapor.

The action level established for VOCs in the CAMP and HASP was not exceeded during the RI. PM10 action levels were exceeded in the work zone two times during the RI and are summarized as follows:

- On 18 August 2020, the PM10 action level was exceeded at the work zone air monitoring station from 09:18 to 09:33. Elevated particulate concentrations were caused by cutting asphalt to install a monitoring well cover for monitoring well MW28. Work was temporarily stopped. After the fifteen-minute average concentrations at the work zone station dropped below the CAMP action level, work was resumed with increased dust suppression.
- On 19 August 2020, the PM10 action level was exceeded at the work zone air monitoring station from 14:38 to 14:52. Elevated particulate concentrations were caused by sweeping excess quick-dry cement used to set monitoring well covers. Intrusive work was previously completed for the day. Housekeeping (cleaning/sweeping) activities were stopped and the fifteen-minute average concentration dropped below the CAMP action level.

The mercury vapor action level was exceeded one time during the RI; the exceedance is summarized as follows:

- On 27 July 2020, an instantaneous mercury vapor reading of 20.6 $\mu g/m^3$ occurred at the northern CAMP station, located along Pearl Street, at 13:40. The instantaneous reading (readings are collected every minute) caused the fifteen-minute average concentration to exceed the action level. Work was stopped and the dedicated CAMP personnel used a handheld Jerome J505 to collect readings next to the CAMP station. The Jerome J505 readings were non-detect. Instantaneous mercury vapor readings at the CAMP station from before and after the instantaneous spike were all below the detection limit. The maximum Jerome J505 readings collected from soil boring SB4E1, which was completed around 13:40, was 2.48 μg/m^3. The elevated reading likely resulted from an equipment malfunction because Jerome J505 readings collected from the concurrent soil boring were an order of magnitude below the instantaneous reading.

Fugitive dust and vapors were not identified leaving the site during intrusive work. CAMP summary data is included as Appendix H.

5.2 Geophysical Investigation Findings

Multiple subsurface utility lines, subsurface void spaces, former foundation walls, and two areas of anomalies indicative of USTs were identified during the geophysical survey. The geophysical survey findings along with historical maps were used to identify potential former foundation walls. Four potential USTs were identified underneath a reinforced concrete slab near the Peck Slip site boundary, consistent with the location of the suspected UST anomaly identified during the 2015 Phase II ESI. An additional potential UST was identified near the corner of Beekman Street and Water Street. Potential UST locations are shown on Figure 5. Several borings were relocated as described in section 4.11 to avoid these anomalies. A copy of the geophysical survey report is included in Appendix B.

5.3 Geology and Hydrogeology

A groundwater contour map and a chart showing groundwater elevations measured over a 48-hour period are included as Figures 6A and 6B, respectively. Cross-sectional diagrams showing inferred soil profiles are shown on Figure 7 and soil boring logs are provided in Appendix C.

5.3.1 <u>Geology</u>

Site stratigraphy consists of historic fill material underlain by native sand. Historic fill material, characterized as grey to brown fine sand with varying proportions of silt, gravel, brick, concrete, wood, ceramic, and coal, was encountered during the RI beneath the asphalt cover to depths ranging from about 5 to 17 feet bgs. Borings terminated between 10 and 32 feet bgs; the native soil underlying the fill consists of fine-grained sand with varying amounts of silt, gravel and clay. Bedrock was not encountered during this investigation but is expected to be about 125 feet bgs.

5.3.2 <u>Hydrogeology</u>

Groundwater was gauged on 10 October 2020 at depths ranging from about 8.9 to 15.5 feet bgs (water table elevations ranged from about el -0.65 to -1.10). Groundwater flow direction was evaluated and was determined to flow to the southeast. Pressure transducers (Van Essen Micro-Diver) were installed from 10 to 12 October 2020 to determine the tidal influence of the East River on groundwater elevation. Each transducer was placed about 2 to 4 feet below the groundwater table in each of the 11 monitoring wells. One barometric pressure transducer (Van

Essen Baro-Diver) was installed in monitoring well MW26 about 10 feet above the observed groundwater table.

Tidal influence on groundwater is most pronounced in southern and eastern parts of the site in monitoring wells MW17 and MW30 to MW34, where groundwater elevations saw a maximum fluctuation up between about 0.125 to 0.2 feet per cycle. The tidal influence on monitoring wells MW11, MW15, MW26 and MW28 saw a maximum fluctuation of about 0.1 feet per cycle.

5.4 Soil Findings

5.4.1 Field Observations

5.4.1.1 Soil Boring Refusal

Of the 43 site-wide and mercury delineation soil borings advanced at the site, 4 of the site-wide soil borings encountered refusal. Three of the soil borings (SB16, SB21, and SB22) encountered refusal from 10 to 12 feet bgs and were advanced in close proximity to each other near the center of the site. Additional step off borings were attempted around each of the original boring locations. Wood was encountered within the cutting shoe at the refusal depth of each boring. The wood is likely associated with timber piles and/or cribbing that caused the refusal. Timber piles and crib walls were historically used to create usable land when extending a shoreline into a surface water body; these three borings were advanced in a part of the site that was historically underwater. Based on the soil borings advanced in close proximity (SB13, SB17, SB20, SB23, and SB26), the three borings where refusal was encountered terminate at or near the historic fill and native soil interface.

Soil boring SB29 encountered refusal at 15 feet bgs in the northeastern part of the site. Three additional step off borings were attempted around the original boring location. Fractured pieces of rock were encountered within the cutting shoe at the refusal depth. The source of the fractured rock was likely the cause of the refusal. Based on the soil boring advanced in close proximity (SB36), the boring terminates at or near the historic fill and native soil interface.

5.4.1.2 Petroleum- and Creosote-like Impacts

Petroleum- and creosote-like impacts, evidenced by odor, staining, and PID readings above background levels, were observed in 17 of the 43 soil borings at depths ranging from about 2 to 28 feet bgs. Field observations of petroleum-like impacts were attributed to the following known or suspected sources:

- USTs on the eastern side of the site and open NYSDEC Spill No. 1507371
- Historical use of the northeastern portion of the site as an oil company and a garage with two 550-gallon USTs

Field observations of creosote-like impacts were attributed to the presence of historical treated timber cribbing/pilings (the suspected cause of refusals at soil borings SB16, SB21, and SB22) in the central/southern portions of the site. Wood/timber was observed in soil borings SB23 from about 2 to 10 feet bgs (including tar-like impacts at 7 feet bgs), SB35 from about 10 to 15 feet bgs, and the refusal depths of SB16, SB21, and SB22.

Maximum PID readings and field observations with associated depths are summarized in the following table:

Soil Boring ID	Known or Suspected Source	Max. PID Reading and Depth	Field Observations and Depth
SB17	Treated timber pile/cribbing	86 ppm (15 feet bgs)	Odor and/or staining (10 to 28 feet bgs)
SB20		370.4 ppm (20.5 feet bgs)	Odor and/or staining (9.5 to 28 feet bgs)
SB21		68.2 ppm (8 feet bgs)	Odor and/or staining (7 to 8 feet bgs)
SB23		93 ppm (10.5 feet bgs)	Odor and/or staining (0.25 to 24 feet bgs) Tar-like substance (7 feet bgs)
SB27		3.0 ppm (21 feet bgs)	Odor and/or staining (19 to 22 feet bgs)
SB29	Historical site use (oil company and garage with 550-gallon USTs)	162 ppm (2.5 feet bgs)	Odor and/or staining (2 to 4 feet bgs)
SB30		15,000 ppm (17 to 23 feet bgs)	Odor and/or staining (13 to 28 feet bgs)
SB31	Open spill (Spill No. 1507371	1,202 ppm (11 feet bgs)	Odor and/or staining (10 to 32 feet bgs)
SB32		740.1 ppm (17 feet bgs)	Odor and/or staining (10 to 24 feet bgs)
SB33		6.6 ppm (11.5 feet bgs)	Odor and/or staining (10.5 to 14 feet bgs)
SB34		4.2 ppm (13.5 feet bgs)	Odor and/or staining (14 to 16 feet bgs)
SB35	Treated timber pile/cribbing	21.0 ppm (10 feet bgs)	Odor and/or staining (9 to 15 feet bgs)
SB36	Historical site use (oil company and garage with 550-gallon USTs)	26.2 ppm (3 feet bgs)	Odor and/or staining (2 to 6 and 17 to 22 feet bgs)
SB4S2	Treated timber pile/cribbing	42 ppm (18.5 feet bgs)	Odor and/or staining (17 to 21 feet bgs)
SB4NE3		8.2 ppm (13 feet bgs)	Odor and/or staining (12 to 13.5 feet bgs)
SB4S3		102 ppm (16 feet bgs)	Odor and/or staining (14 to 16 feet bgs)
SB4SE3		218 ppm (14 feet bgs)	Odor and/or staining (12 to 16 feet bgs)

5.4.1.3 Mercury

Field observations of free liquid-phase elemental mercury were not identified. All site-wide soil borings and delineation borings SB4R, SB24, SB25, SB4N1, SB4N3, SB4E1, SB4E2, SB4S2, SB4W1, and SB4W2 were screened every two linear feet of recovered soil using a handheld XRF analyzer for total mercury. All soil borings, excluding SB12, SB26, SB27, SB30 to SB37, and delineation soil borings SB4N3, SB4S3, SB4W3, SB4NW3, SB4NE3, SB4SE3, and SB4SW3, were screened every two linear feet of recovered soil using a Jerome® J405 (or equivalent) for mercury vapor. XRF and Jerome screening values were used to guide sample intervals that were submitted for laboratory analysis. The limit of detection (LOD) of the Jerome J505 Mercury vapor analyzer used to screen soil is 0.05 µg/m^3. The LOD of the XRF ranged from 7.7 ppm to 19.9 ppm. XRF and Jerome screening values were compared to analytical results for soil samples that were lab-analyzed.

Jerome mercury vapor screening values did not correlate with lab-reported concentrations (R^2=0.01). The highest lab-reported total mercury concentration of 730 mg/kg in sample MDUP07_072920 (duplicate of sample SB24_2-4) had a mercury vapor screening value of 0.1 µg/m^3. The highest mercury vapor screening value of 6.63 µg/m^3 in sample SB4R_10-12 had a lab-reported total mercury concentration of 43 mg/kg. The moisture content of the soil relative to the ambient air may have impacted soil screening results. See US EPA National Elemental Mercury Response Guidebook (March 2019). There were no detections of elemental mercury vapor in on-site soil vapor samples, and two off-site soil vapor samples had detected concentrations of 0.222 µg/m^3 and 0.271 µg/m^3.

The XRF detected total mercury concentrations above the RURR SCO in 11 soil samples and all 11 samples had lab-reported total concentrations above the RURR SCO. Several soil samples with lab-detected mercury concentrations above the RURR SCO had XRF screening results below the LOD. The detected XRF screening values were typically lower than lab-reported total concentrations but did show a correlation (R^2=0.88), particularly at higher total mercury concentrations. The two highest XRF screening values of 179 ppm and 275 ppm were detected in samples SB4W2_2-4 and MDUP07_072920 (duplicate of sample SB24_2-4) with lab-reported concentrations of 250 and 730 mg/kg, respectively.

5.4.2 Analytical Results

The following sections present a summary of soil sample results from the RI that exceed the UU and/or RURR SCOs and Protection of Groundwater (PGW) SCOs, if applicable, organized by analytical parameter set.

A summary of the site-wide soil sample laboratory results compared to UU and RURR SCOs, mercury delineation laboratory results compared to UU and RURR SCOs, mercury speciation laboratory results, and remedial design sample results are presented in Tables 3A, 3B, 3C and 3D, respectively. Cross-sectional diagrams showing mercury sample results are shown on Figure 7. Site-wide soil sample locations and results that exceed applicable comparison criteria are presented on Figure 8A and the mercury delineation results are presented on Figure 8B. Laboratory analytical data reports are included in Appendix I.

VOCs

One or more of eight (8) VOCs were detected in 43 soil samples collected from surface grade to depths of up 32 feet bgs at concentrations above the UU and PGW SCOs. One VOC was detected one sample from 18 to 20 feet bgs at a concentration above the RURR SCO. The results are summarized in the following table (the number of detections above criteria follow each VOC in parentheses, and the detected concentrations that exceed RURR SCOs are bolded):

Analyte	Min. Concentration above SCOs (mg/kg)	Max. Concentration above SCOs (mg/kg)	UU and RURR SCOs (mg/kg)
1,2,4-Trimethylbenzene (4)	5.1 (SB32_14-16)	**62** (SB31_18-20)	PGW/UU: 3.6 RURR: 52
1,3,5-Trimethylbenzene (1)	16 (SB31_18-20)		PGW/UU: 8.4 RURR: 52
Acetone (37)	0.051 (SB14_8-10 and SB18_18-20)	0.53 (SB22_4-6)	PGW/UU: 0.05 RURR: 100
Benzene (3)	0.062 (SB36_2-4)	0.68 (SB31_18-20)	PGW/UU: 0.06 RURR: 4.8
Ethylbenzene (2)	2.8 (SB36_2-4)	14 (SB31_18-20)	PGW/UU: 1 RURR: 41
n-Propylbenzene (2)	4.0 (SB33_11-13)	7.1 (SB31_18-20)	PGW/UU: 3.9 RURR: 100
Toluene (2)	2.9 (SB36_2-4)	9.9 (SB31_18-20)	PGW/UU: 0.7 RURR: 100
Total Xylenes (4)	0.66 (SB31_30-32)	98 (SB31_18-20)	UU: 0.26 PGW: 1.6 RURR: 100

Acetone, which was detected in 37 soil samples at concentrations above the UU SCO, is a common laboratory contaminant because it is regularly used in some solvent extraction processes. Acetone was detected in the trip blank sample and the field blank sample collected as part of the soil QA/QC sampling. Therefore, the detection of acetone in soil is likely not representative of soil quality.

SVOCs

One or more of eight (8) SVOCs were detected in 31 soil samples collected from surface grade to depths of up 12 feet bgs at concentrations above the UU and/or RURR SCOs as summarized in the following table (the number of detections above criteria follow each SVOC in parentheses, and the detected concentrations that exceed RURR SCOs are bolded):

Analyte	Min. Concentration above SCOs (mg/kg)	Max. Concentration above SCOs (mg/kg)	UU and RURR SCOs (mg/kg)
Benzo(a)anthracene (25)	**1.3** in SB29_7-9	**13** in SB21_9-11 duplicate	UU: 1 RURR: 1

Analyte	Min. Concentration above SCOs (mg/kg)	Max. Concentration above SCOs (mg/kg)	UU and RURR SCOs (mg/kg)
Benzo(a)pyrene (25)	**1.3** in SB29_7-9	**11** in SB21_9-11 duplicate	UU: 1 RURR: 1
Benzo(b)fluoranthene (27)	**1.1** in SB20_0-2	**12** in SB21_9-11 duplicate	UU: 1 RURR: 1
Benzo(k)fluoranthene (20)	0.94 in SB30_0-2 and SB33_0-2	**5.2** in SB21_9-11 duplicate	UU: 0.8 RURR: 3.9
Chrysene (25)	1.1 in SB29_7-9	**13** in SB21_9-11 duplicate	UU: 1 RURR: 3.9
Dibenzo(a,h)anthracene (20)	0.35 in SB26_0-2	**1.8** in SB21_9-11 duplicate	UU: 0.33 RURR: 0.33
Indeno(1,2,3-cd)pyrene (30)	**0.51** in SB20_0-2	**6.3** in SB21_9-11 duplicate	UU: 0.5 RURR: 0.5
Phenol (4)	0.37 in SB36_0-2	1.5 in SB36_2-4	UU: 0.33 RURR: 100

Pesticides

One or more of eight (8) pesticides were detected in 24 soil samples collected from surface grade to depths of up to 28 feet bgs at concentrations above their respective UU and/or RURR SCOs. The results are summarized in the following table (the number of detections above criteria follow each pesticide in parentheses, and the detected concentrations that exceed RURR SCOs are bolded):

Analyte	Min. Concentration above SCOs (mg/kg)	Max. Concentration above SCOs (mg/kg)	UU and RURR SCOs (mg/kg)
4,4’-DDD (9)	0.0051 in SB24_0-2	0.33 in SB36_2-4	UU: 0.0033 RURR: 13
4,4’-DDE (11)	0.0035 in SB13_4-6	0.025 in SB25_0-2	UU: 0.0033 RURR: 8.9
4,4’-DDT (15)	0.0045 in SB33_0-2	3.6 in SB36_2-4	UU: 0.0033 RURR: 7.9
Aldrin (1)	**0.24** in SB36_2-4		UU: 0.005 RURR: 0.097
Alpha BHC (1)	0.35 in SB36_2-4		UU: 0.02 RURR: 0.48
Alpha Chlordane (2)	0.14 in SB29_2-4	0.87 in SB36_2-4	UU: 0.094 RURR: 4.2
Dieldrin (10)	0.006 in SB21_9-11 duplicate	0.78 in SB36_2-4	UU: 0.005 RURR: 0.2
Gamma BHC (1)	0.11 in SB23_0-2		UU: 0.1 RURR: 1.3

Herbicides

Herbicides were not detected in soil samples.

PCBs

Total PCBs were detected in 10 soil samples collected from surface grade to depths of up 15 feet bgs at concentrations above its respective UU, PGW, and/or RURR SCO as summarized in the following table (the number of detections above criteria follow Total PCBs in parentheses, and the detected concentrations that exceed RURR SCOs are bolded):

Analyte	Min. Concentration above SCOs (mg/kg)	Max. Concentration above SCOs (mg/kg)	UU and RURR SCOs (mg/kg)
Total PCBs (10)	0.15 in SB18_0-2	**46** in SB36_2-4	UU: 0.1RURR: 1 PGW: 3.2

Metals

Mercury was detected in 135 soil samples (out of 237) collected during the 2020 remedial investigation from surface grade to depths of up to 22 feet bgs at concentrations above the UU and/or RURR SCOs. One or more of 10 metals, excluding mercury, were detected in 61 soil samples (out of 100) collected from surface grade to depths of up 32 feet bgs at concentrations above the UU, PGW, and/or RURR SCOs as summarized in the following table (the number of detections above criteria follow each metal in parentheses, and the detected concentrations that exceed RURR SCOs are bolded):

Analyte	Min. Concentration above SCOs (mg/kg)	Max. Concentration above SCOs (mg/kg)	UU and RURR SCOs (mg/kg)
Arsenic (6)	14 in SB34_4-6 and SB37_2-4	**60** in SB38_6-8	UU: 13 PGW/RURR: 16
Barium (15)	360 in SB28_4-6	**700** in SB36_2-4	UU: 350 RURR: 400 PGW: 820
Cadmium (4)	3.5 in SB29_2-4	**7.3** in SB36_2-4	UU: 2.5 RURR: 4.3
Chromium, Hexavalent (7)	1.1 in SB24_10-12	16 in SB34_4-6	UU: 1 RURR: 110
Chromium, Trivalent (10)	32 in SB26_0-2	**550** in SB35_26-28	UU: 30 RURR: 180
Copper (36)	56 in SB37_6-8	**930** in SB26_6-8	UU: 50 RURR: 270
Lead (44)	75 in SB21_0-2	**20,000** in SB28_4-6	UU: 63 RURR: 400
Mercury (135)	0.19 in SB4R_20-22 and SB4SE3_8-10	**730** in SB24_2-4 duplicate	UU: 0.18 RURR: 0.81
Nickel (21)	32 in SB24_6-8 and SB28_12-14	180 in SB20_0-2	UU: 30 RURR: 310

Silver (9)	2.1 in SB15_8-10	34 in SB26_6-8	UU: 2 RURR: 180
Zinc (45)	110 in SB11_6-8 and SB34_4-6	2,600 in SB29_7-9	UU: 109 RURR: 10,000

Mercury Selective Sequential Extraction

Eight samples (SB4R_2-4, SB4R_10-12, SB4N1_0-2, SB25_4-6, MDUP07_072920, SB4S2_2-4, SB4W2_2-4, and SB4W2_2-4) from PAOC-3 were analyzed for mercury selective sequential extraction. The table below provides a summary of the minimum, maximum and average percent of each mercury species. The minimum and maximum concentration sample IDs are presented in parentheses. Analytical results of the speciation are provided as Table 3B.

Fraction	Expected Species	% Range		Average %
		Minimum	Maximum	
F-0	Free elemental mercury	0.01% (SB4R_2-4)	10.87% (SB25_4-6)	5.59%
F-1	Water-soluble mercury salts such as $HgCl_2$, $Hg(NO_3)_2$	16.59% (SB4N1_0-2)	47.69% (SB4R_2-4)	33.39%
F-2	Low pH soluble salts of mercury	11.23% (SB4N1_0-2)	30.04% (SB25_4-6)	20.17%
F-3	Organic-bound mercury compounds (Hg(II) bound to sludge or humic matter)	7.75% (SB4W2_2-4)	20.69% (MDUP07_072920)	13.88%
F-4	All other non-sulfide or silicate-bound mercury compounds (can include amalgamated elemental mercury)	12.15% (SB4R_2-4)	35.22% (SB4N1_0-2)	20.57%
F-5	Sulfide-bound mercury compounds only	0.34% (SB4R_2-4)	20.00% (SB4N1_0-2)	5.76%
F-6	Silicate- or aluminosilicate-bound mercury compounds	0.03% (MDUP07_072920)	0.62% (SB4W2_2-4)	0.19%

PFAs

No SCOs exist for PFAS. Perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) concentrations are compared to the NYSDEC guidance document "Sampling, Analysis and Assessment of PFAS under NYSDEC's Part 375 Remedial Programs", dated October 2020, and revised January 2021. PFOS and/or PFOA were detected in 17 soil samples collected from surface grade to depths of up to 15 feet bgs at concentrations above the UU and Protection of Groundwater (PGW) guidance value as summarized in the following table (the number of detections above criteria in parentheses and results above PGW SCOs are underlined). PFOA and PFOS concentrations did not exceed the RURR guidance values:

Analyte	Min. Concentration above UU (µg/kg)	Max. Concentration above UU (µg/kg)	UU and RURR Guidance Value (µg/kg)
PFOS (14)	0.91 in SB39_0-2	5.9 in SB30_0-2	UU: 0.88 RURR: 44 PGW: 3.7
PFOA (7)	0.68 in SB24_0-2	2.8 in SB23_0-2	UU: 0.66 RURR: 33 PGW:1.1

µg/kg = micrograms per kilogram

5.5 Groundwater Findings

5.5.1 Field Observations

The monitoring wells were gauged with an oil-water interface probe prior to sampling. Light non-aqueous phase liquid (LNAPL) was not observed in any monitoring well prior to sampling; however 0.01 inches of LNAPL was observed in monitoring well MW31 prior to installation of the pressure transducer. Petroleum-like odors were observed during purging at wells MW30, MW31, MW32, MW33, and MW34, which are all located in the eastern portion of the site near the suspected USTs. Monitoring well headspace PID measurements ranged from 0.0 to 360.3 ppm (highest reading in MW31).

5.5.2 Analytical Results

Eleven monitoring wells were installed and sampled during the RI. The following sections provide a summary of RI groundwater sample results that exceed the NYSDEC SGVs organized by analytical parameter set.

A summary of the groundwater sample laboratory results compared to NYSDEC SGVs is presented in Table 4. Groundwater sample locations and results that exceed their respective comparison criteria are presented on Figure 9. Laboratory analytical data reports are included in Appendix I.

VOCs

One or more of thirteen (13) VOCs were detected in seven (7) groundwater samples at concentrations above the NYSDEC SGVs as summarized in the following table (number of detections above criteria follow each VOC in parentheses):

Analyte	Min. Concentration above NYSDEC SGVs (micrograms per liter [µg/L])	Max. Concentration above NYSDEC SGVs (µg/L)	NYSDEC SGVs (µg/L)
1,2,4,5-Tetramethylbenzene (6)	11 in MW34_090220	39 in MW33_090220	5
1,2,4-Trimethylbenzene (2)	22 in MW32_090220	550 in MW31_090220	5

1,3,5-Trimethylbenzene (1)	140 in MW31		5
Benzene (5)	1.4 in MW33_090220	53 in MW31_090220	1
Ethylbenzene (4)	5.7 in MW32_090220	390 in MW31_090220	5
Isopropylbenzene (6)	28 in MW32_090220	68 in MW30 duplicate	5
m,p-Xylene (3)	16 in MW30_090220	1,300 in MW31_090220	5
n-Butylbenzene (4)	6.4 in MW30_090220	7.2 in MW30 duplicate	5
n-Propylbenzene (6)	23 in MW32_090220	92 in MW33_090220	5
o-Xylene (1)	390 in MW31_090220		5
Sec-Butylbenzene (5)	5.8 in MW31_090220	11 in MW30 duplicate	5
Toluene (3)	5.4 in MW30 duplicate	290 in MW31_090220	5
Total Xylenes (3)	20 in MW30_090220	1,700 in MW31_090220	5

Comparisons to o-xylene, m-xylene, and p-xylene are provided for reference. Promulgated NYSDEC SGVs are for total xylene.

SVOCs

One or more of ten (10) SVOCs were detected in (5) five groundwater samples at concentrations above the NYSDEC SGVs as summarized in the following table (number of detections above criteria follow each SVOC in parentheses):

Analyte	Min. Concentration above NYSDEC SGVs (µg/L)	Max. Concentration above NYSDEC SGVs (µg/L)	NYSDEC SGVs (µg/L)
2,4-Dimethylphenol (1)	4.9 in MW31_090220		1
Benzo(a)Anthracene (5)	0.03 in MW17_090120	0.16 in MW30_090220	0.002
Benzo(a)Pyrene (3)	0.03 in MW28_090120	0.17 in MW30_090220	0
Benzo(b)Fluoranthene (5)	0.01 in MW11_090120	0.19 in MW30_090220	0.002
Benzo(k)Fluoranthene (3)	0.02 in MW28_090120	0.08 in MW30_090220	0.002
Biphenyl (1)	7.9 in MW31_090220		5
Chrysene (5)	0.02 in MW17_090120	0.14 in MW30_090220	0.002
Indeno(1,2,3-c,d)Pyrene (3)	0.03 in MW28_090120	0.15 in MW30_090220	0.002
Naphthalene (1)	210 in MW31_090220		10
Phenol (1)	2.5 in MW31_090220		1

Six of the SVOCs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and indeno(1,2,3-c,d)pyrene) detected above SGVs have low solubility in water (0.01 mg/l or less) and the turbidity goal of 5 nephelometric turbidity units (NTU) was not achieved in all but two of the wells where these compounds were detected above the SGVs. The detections of these compounds above the SGVs are likely associated with turbidity/entrained historic fill material in groundwater samples or historic fill impacts to groundwater.

Pesticides and Herbicides

Pesticides were not detected above the NYSDEC SGVs and herbicides were not detected in the groundwater samples.

PCBs

Total PCBs were detected in three groundwater samples at concentrations above the NYSDEC SGVs as summarized in the following table (number of detections above criteria follow "Total PCBs" in parentheses):

Analyte	Min. Concentration above NYSDEC SGVs (µg/L)	Max. Concentration above NYSDEC SGVs (µg/L)	NYSDEC SGVs (µg/L)
Total PCBs (3)	0.098 in MW34_090220	0.977 in MW30_090220	0.09

PCBs have low solubility in water and the turbidity goal of 5 NTU was not achieved in two of the three wells where total PCBs were detected above the SGV. The PCB detections in groundwater are likely associated with the impacts identified in soil or entrained sediment in the groundwater samples.

Metals

One or more of seven (7) metals were detected in all groundwater samples at concentrations above the NYSDEC SGVs as summarized in the following table (number of detections above criteria follow each metal in parentheses):

Analyte	Min. Concentration above NYSDEC SGVs (µg/L)	Max. Concentration above NYSDEC SGVs (µg/L)	NYSDEC SGVs (µg/L)
Antimony (3)	4.09 in MW26_090220	40.08 in MW28_090120	3
Antimony (Dissolved) (5)	3.01 in MW33_090220	28.62 in MW28_090120	3
Arsenic (1)	116 in MW28_090120		25
Arsenic (Dissolved) (1)	118.4 in MW28_090120		25
Iron (10)	308 in MW31_090220	8,100 in MW28_090120	300
Iron (Dissolved) (6)	1,020 in MW34_090220	8,010 in MW28_090120	300
Lead (1)	66.74 in MW28_090120		25
Magnesium (4)	37,300 in MW26_090220	84,600 in MW15_090120	35,000
Magnesium (Dissolved) (4)	35,700 in MW26_090220	86,700 in MW15_090120	35,000
Manganese (5)	306.7 in MW11_090120	861.6 in MW28_090120	300
Manganese (Dissolved) (5)	307.9 in MW11_090120	851 in MW28_090120	300
Sodium (12)	35,900 in MW11_090120	511,000 in MW32_090220	20,000
Sodium (Dissolved) (12)	35,200 in MW11_090120	505,000 in MW32_090220	20,000

PFAS (21-compound list) and 1,4-Dioxane

PFAS concentrations in groundwater were compared to the NYSDEC January 2021 Guidance Values for PFAS. The guidance states that further assessment or evaluation may be warranted should the following screening levels be exceeded:

- Concentrations of PFOA or PFOS above the Maximum Contaminant Level (MCL) of 10 nanograms per liter (ng/L) that are determined to be attributable to the site, either by a comparison of upgradient and downgradient levels or the presence of soil source areas, as defined by the PFAS Guidance Values for Anticipated Site Use, presented in the NYSDEC PFAS Guidance (January 2021)

- Concentration of an individual PFAS (excluding PFOA and PFOS) above 100 ng/L or
- Total PFAS concentrations above 500 ng/L

PFOA and PFOS were detected in groundwater samples at concentrations above the NYSDEC MCL as summarized in the following table (number of detections above criteria follow each metal in parentheses):

Analyte	Min. Concentration above MCL (ng/L)	Max. Concentration above MCL (ng/L)	MCL (ng/L)
PFOA (12)	17.5 in MW28_090120	126 in MW30 duplicate	10
PFOS (10)	18 in MW28_090120	103 in MW25_090120	10

Concentrations of individual PFAS (excluding PFOA and PFOS) were not detected in groundwater samples above the 100 ng/L screening level. Total PFAS were not detected in groundwater samples above the 500 ng/L screening level. Total PFAS concentrations in groundwater samples ranged from 60.3 ng/L in MW11_090120 to 427.6 ng/L in GWDUP01_090220, the duplicate sample of MW30_090220.

1,4-dioxane was not detected in groundwater samples.

5.6 Soil Vapor Findings

5.6.1 Analytical Results

Seventeen soil vapor samples, including three void space samples were collected during the RI, and one ambient air sample was collected concurrently with soil vapor samples. Soil vapor and ambient air samples were submitted for laboratory analysis of VOCs by USEPA Method TO-15 and for mercury vapor by NIOSH Method 6009. Soil vapor sample results are summarized in Table 5 and shown on Figure 10.

Mercury vapor was not detected in soil vapor samples collected on-site. Mercury vapor was detected at concentrations of 0.222 µg/m^3 and 0.271 µg/m^3 in the two soil vapor samples collected from beneath the Pearl Street sidewalk adjoining the site.

VOCs detected in soil vapor samples include:

1,1,1-Trichloroethane (1,1,1-TCA)	Chloromethane	n-Heptane
1,2,4-Trimethylbenzene	Cis-1,2-Dichloroethene	n-Hexane
1,3,5-Trimethylbenzene	Cyclohexane	o-Xylene
1,3-Butadiene	Dichlorodifluoromethane	Styrene
2,2,4-Trimethylpentane	Ethanol	Tert-Butyl Alcohol

2-Hexanone	Ethylbenzene	Tetrachloroethene (PCE)
4-Ethyltoluene	Isopropanol	Tetrahydrofuran
Acetone	M,P-Xylene	Toluene
Benzene	Methyl Ethyl Ketone	Total Xylenes
Carbon Disulfide	Methyl Isobutyl Ketone	Trichloroethene (TCE)
Chloroethane	Methylene Chloride	Trichlorofluoromethane
Chloroform		

No applicable standards, criteria, or guidance values currently exist for soil vapor samples in New York State. Total VOC concentrations ranged from about 386 µg/m^3 in SV19 to 39,300 µg/m^3 in SV32. The ambient air total VOC concentration was 38.4 µg/m^3. Petroleum-related compounds, including BTEX, were detected in all soil vapor samples and the ambient air sample. BTEX concentrations detected in soil vapor ranged from 15.8 µg/m^3 in SV17 to 6,030 µg/m^3 in SV32, and BTEX was detected in the ambient air sample at a concentration of 6.84 µg/m^3.

CVOCs, including 1,1,1–TCA, cis-1,2-dichloroethene, methylene chloride, PCE, and TCE, were detected in soil vapor samples and are summarized below.

Analyte	Min. Concentration (µg/m^3)	Max. Concentration (µg/m^3)
1,1,1–TCA (1)	1.51 in SV12_070920	
Cis-1,2-Dichloroethene (1)	3.14 in SV28_070920	
Methylene Chloride (2)	3.05 in SV17 duplicate	3.34 in SV17_070920
PCE (14)	6.39 in SV37_070920	827 in SV28_070920
TCE (7)	1.1 in SV37_070920	27.3 in SV28_070920

CVOCs, including PCE and TCE were detected in soil vapor samples at the highest concentrations from the central part and northeastern corner of the site.

5.7 QA/QC Sample Results

A summary of the QA/QC sample (field, trip, and equipment blanks) laboratory detections is presented in Table 6. One VOC (acetone) was detected in two trip blank sample. One VOC (acetone), two SVOC (naphthalene and phenanthrene), one pesticide (4,4'-DDT), one PCB (aroclor 1248) and 16 metals (arsenic, barium, beryllium, cadmium, calcium, chromium, copper, cyanide, iron, lead, manganese, mercury, nickel, selenium, thallium, sodium, and zinc) were detected in at least one field blank sample. Two PFAS (perfluorohexanoic acid and perfluorooctanesulfonamide) were detected in at least one equipment blank sample.

5.8 Data Usability

Category B laboratory reports for the soil, groundwater, and soil vapor samples were provided by Alpha and Eurofins to the third party data validator, DDMS, for samples collected during the RI. Laboratory analytical data reports are included as Appendix I.

The data were determined to be acceptable. Completeness, defined as the percentage of analytical results that are judged to be valid, is 98.97% for soil samples, 99.55% for groundwater samples, and 100% for soil vapor samples. DDMS performed, to the extent practicable, the data validation in accordance with the analytical method, "DER-10/Technical Guidance for Site Investigation and Remediation" and "Guidelines for Sampling and Analysis of PFAS under NYSDEC's Part 375 Remedial Programs, January 2020'. Professional judgment was applied as necessary and where appropriate.

Some sample results were flagged as unusable, indicating that these results are not sufficiently valid or technically supportable to be used for data interpretation. The majority of analytes flagged as unusable were not detected above reporting limits. Only five analytes in two samples soil were detected above reporting limits and flagged as unusable. However, only one of the unusable results was detected above the applicable SCO. The rejected result was a pesticide, 4,4'-DDT, in the duplicate sample of SB23_26-28.

The predominant analyte group flagged as unusable were pesticides in soil and to a lesser extent SVOCs in soil and groundwater. The results of one VOC sample, SB32_0-2, were rejected. All other data is considered usable, as qualified. Based on the amount and type of data rejected, the analysis and conclusions of this report were not adversely impacted. Additional details of the data validation are provided in the DUSRs included as Appendix J.

5.9 Evaluation of Potential Areas of Concern

This section discusses the RI results with respect to the PAOCs identified prior to the start of the RI (described in Section 3.4) and also includes results from the November 2015 Phase II ESI. AOC locations are shown on Figure 5.

5.9.1 AOC 1: Historic Fill Material

Historic fill material was encountered in all borings beneath the asphalt cover to depths ranging from about 5 to 17 feet bgs.

Findings Summary

Soil

Historic fill material encountered during the Phase II ESI and RI was characterized as grey to brown fine sand with varying proportions of silt, gravel, brick, concrete, wood, ceramic, coal, and ash. The fill layer contains VOCs, SVOCs, PCBs, pesticides, PFAS, and metals at concentrations above UU, PGW, and/or RURR SCOs.

Results of the 11 Phase II ESI and 51 RI samples (62 total) collected from the historic fill interval (excluding mercury delineation samples) are summarized as follows:

- VOCs, except acetone, are attributed to the open spill (AOC 2) and historical use of the site (AOC 4). As discussed in Section 5.4.2, acetone is a common lab contaminant and not representative of soil quality at the site.

- SVOCs were detected at concentrations exceeding the UU SCOs (3-methylphenol/4-methylphenol, dibenzofuran, and phenol) and RURR SCOs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene) in 36 of 48 soil samples collected from the historic fill material interval. SVOCs are attributed to the quality of historic fill material placed at the site and/or to the open spill (AOC 2) and historical use of the site (AOC 4).
- Pesticides were detected at concentrations exceeding the UU SCOs (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, Alpha BHC, Alpha Chlordane, Dieldrin, and Gamma BHC) and RURR (Aldrin) in 22 of 51 soil samples collected from the historic fill material interval. Pesticides are attributed to the quality of historic fill material placed at the site and/or to historical pesticide application at the site.
- Total PCBs were detected at concentrations exceeding UU, PGW, and/or RURR SCOs in 12 of 62 soil samples collected from the historic fill material interval. Total PCB detections above UU SCOs outside of the former oil company/factory footprints (AOC 4) are attributed to historic fill.
- Metals were detected at concentrations exceeding the UU SCOs (hexavalent chromium, nickel, selenium, silver and zinc) and RURR SCOs (arsenic, barium, cadmium, trivalent chromium, copper, lead, and mercury) in 45 of 62 soil samples (excluding mercury delineation samples) collected from the historic fill material interval. Detected metals are attributed to historic fill. Arsenic was detected at concentrations exceeding the PGW SCOs. Mercury detections are also attributed to the historical thermometer factory and workshops at the site (AOC 3).
- PFOA and PFOS were detected at concentrations exceeding the UU SCOs in 14 of 51 soil samples collected from the historic fill material interval. PFAS detections are discussed in AOC 4.

Groundwater

SVOCs were detected at concentrations above NYSDEC SGVs in eight monitoring wells. Total PCBs were detected at concentrations above NYSDEC SGVs in three monitoring wells. Total metals (antimony, arsenic, barium, total chromium, copper, lead, iron, magnesium, manganese, nickel, and sodium) and/or dissolved metals (antimony, arsenic, barium, iron, magnesium, manganese, and sodium) were detected at concentrations above NYSDEC SGVs in all groundwater samples.

Six of the SVOCs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and indeno(1,2,3-c,d)pyrene) detected above SGVs have low solubility in water compared (0.01 mg/l or less) and the turbidity goal of 5 NTU was not achieved in all but two of the wells where these compounds were detected above the SGVs. The detections of these compounds above the SGVs are likely associated with turbidity/entrained historic fill material in groundwater samples or historic fill impacts to groundwater. PCBs have low solubility in water and the turbidity goal of 5 NTU was not achieved in two of the three wells where total PCBs were detected above the SGV. The PCB detections in groundwater are likely associated with the impacts identified in soil or entrained sediment in the groundwater samples. Total metals in unfiltered samples are likely the result of suspended solids in groundwater derived from historic fill as these compounds are not readily dissolvable in groundwater. Dissolved metals, excluding arsenic and barium, are attributed to regional groundwater conditions.

Dissolved arsenic was detected above the SGV in monitoring well MW28, and dissolved barium was detected above the SGVs in temporary monitoring TMW03. The source of arsenic and barium in dissolved groundwater is historic fill material.

Conclusions

Historic fill was identified beneath asphalt to depths up to 17 feet bgs across the site. SVOC, pesticide, PCB, and metal impacts in soil were attributed to the historic fill quality. SVOCs, PCBs, and total metals were detected in groundwater samples above NYSDEC SGVs and are attributed sample turbidity based on several of the samples not meeting the turbidity goal of 5 NTU; however, historic fill material may be a contributing source of dissolved PCBs/SVOCs in groundwater. Dissolved metals, excluding arsenic and barium, are attributed to regional groundwater quality. Dissolved arsenic and barium are associated with historic fill impacting groundwater.

Petroleum-related VOC, PCB, and mercury impacts are also associated with other AOCs and are discussed in the following sections.

5.9.2 AOC 2: Petroleum-Like Impacts and Open Spill (Spill No. 1507371)

The geophysical survey conducted during the Phase II ESI identified an anomaly consistent with a UST on the southeastern part of the site. Petroleum-like impacts were initially identified during Langan's November 2015 Phase II ESI on the eastern part of the site and NYSDEC Spill No. 1507371 was assigned to the site.

During the RI, treated timber piles and/or cribbing and associated impacts were identified in the central portion of the site, and refusals due to wood were encountered in the central portion of the Water Street side of the site. PAOC 2 listed in the Section 3.4 has been modified as a result of investigation findings (PAOC 2: Potential Petroleum UST and Open Spill (Spill No. 1507371) to include discussion of field observations of impacts associated with creosote-treated piles/cribbing. Petroleum-like impacts observed in the northeastern portion of the site are associated with historical site uses (oil company and garage with 550-gallon USTs) and included in the AOC 4 discussion.

Findings Summary

Geophysical Survey

The geophysical survey conducted during the RI further investigated the anomaly identified during the Phase II ESI on the southeastern part of the site. The anomaly was identified as potentially four USTs in parallel beneath a reinforced concrete pad.

The geophysical survey identified an additional suspected UST located near the corner of Beekman Street and Water Street. Soil boring and monitoring well SB11/MW11 was advanced near the suspected UST and no impacts were identified.

Soil

Petroleum-like impacts, as evidenced by staining, odor, elevated PID readings and/or analytical results, attributed to the open spill (Spill No. 1507371) were observed in seven soil borings (SB09, SB10, and SB31 through SB34) within the southeastern part of the site. Field indications of petroleum impacts were primarily observed within the capillary fringe to below the water table. Petroleum-related VOCs (1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, benzene, ethylbenzene, n-butylbenzene, n-propylbenzene, toluene, and/or total xylenes) were detected in soil at concentrations above UU, PGW, and/or RURR SCOs in one unsaturated and five saturated soil samples. SVOCs (3-methylphenol/4-methylphenol, dibenzofuran, naphthalene, and/or phenol) were detected at concentrations above UU SCOs in one sample above the groundwater table and one below the groundwater table in soil boring SB09.

Creosote-like impacts, as evidenced by staining, odor, and/or PID readings above background, attributed to treated timber piles or cribbing, were observed in 11 soil borings (SB3, SB17, SB20, SB21, SB23, SB27, SB35, SB4NE3, SB4S3, SB4SE3, and SB4S2). Wood/timber was observed in soil borings SB23 from about 2 to 10 feet bgs (including tar-like impacts at 7 feet bgs), SB35 from about 10 to 15 feet bgs, and the refusal depths of SB16, SB21, and SB22. Field indications of petroleum impacts were primarily observed within the capillary fringe to below the water table. Petroleum-related VOCs and SVOCs were not detected above the UU SCOs in soil samples collected from these borings.

Petroleum-like impacts in soil borings SB8, SB29, SB30, and SB36 (northeastern portion of the site) are attributed to the historical site uses as an oil company and garage with two 550-gallon USTs and are discussed in AOC 4.

Groundwater

Petroleum-like odors were observed during purging at wells MW31, MW32, MW33, and MW34 and 0.01 inches of LNAPL was observed in monitoring well MW31 during placement of a pressure transducer. Petroleum-related VOCs and SVOCs were detected at concentrations above NYSDEC SGVs in samples collected from these monitoring wells, which surround the suspected USTs.

One VOC, 1,2,4,5-tetramethylbenzene, associated with tar-related impacts was detected in temporary monitoring well TMW03 at concentrations above NYSDEC SGVs. Creosote-related VOCs and SVOCs were not detected in any other monitoring wells installed at or in the vicinity of borings where creosote-treated timber piles or cribbing (MW17, MW25, MW26, and MW28) were encountered.

Petroleum impacts in TMW08 and MW30 are related to the historical site uses as an oil company and garage with two 550-gallon USTs and are discussed in AOC 4.

Soil Vapor

Petroleum-related VOCs were detected in all soil vapor samples. Petroleum-impacts to soil vapor are attributed to the open spill, historical site uses, and/or treated timber piles/cribbing.

<u>*Conclusions*</u>

Petroleum-related VOCs and SVOCs were only detected above UU, PGW and/or RURR SCOs in soil samples collected from four of the five soil borings advanced around the potential USTs near the eastern site boundary (Peck Slip) and two soil borings SB8 and SB36 (hydraulically upgradient from the potential USTs). However, stained or odorous soils were identified across the larger southern and eastern parts of the site. The highest concentrations of petroleum-related VOCs and/or SVOCs above NYSDEC SGVs were identified in TMW09 and MW31 installed to the west of the potential UST and monitoring well MW30 (hydraulically upgradient from the potential USTs). Based on the field observation of petroleum like impacts, petroleum-related VOCs and SVOCs in soil and groundwater, and the inferred groundwater flow directions, three sources of petroleum- and creosote-related contamination exist at the site:

- Petroleum-related impacts to soil, groundwater and soil vapor in the southeastern part of the site (around the potential UST) are attributed to the open spill.
- Petroleum-related impacts to soil, groundwater and soil vapor in the northeastern part of the site (AOC 4) are attributed to historical site use and further discussed in AOC 4 (Section 5.9.4).
- All other occurrences of stained or odorous soil (generally located in the southern half of the site) are likely attributed to treated timber piles or cribbing.

5.9.3 <u>AOC 3: Historical Thermometer Factory/Workshops</u>

Previous historical on-site uses identified in the Phase I ESAs and supplemental historical resources included a thermometer factory and three additional thermometer factories/workshops. Langan's 2015 Phase II ESI identified mercury at a maximum concentration of 120 mg/kg at a depth of 13 to 14 feet bgs within the former thermometer factory footprint at 302 Pearl Street. Mercury in soil associated with historical site uses were identified during the RI.

Findings Summary

Soil

Mercury associated with historical site uses as a thermometer factory and workshops were detected in soil samples at concentrations above UU and RURR SCOs. Mercury impacts were observed primarily within the historical fill layer. Mercury was detected in soil above the RURR SCO in 93 site-wide and/or mercury delineation samples collected throughout the site (out of 22 Phase II ESI and 237 RI soil samples), eight of the 93 samples were collected from native soil.

Mercury concentrations were highest in and around the footprint of the historical thermometer factory at 302 Pearl Street and, to a lesser extent, in the footprints of the three additional thermometer factories/workshops. The highest mercury concentrations were identified within the historic fill layer in soil borings SB4, SB4R, SB24, SB25, SB4N1, SB4S2, SB4W2, SB4S3, and SB39, advanced in and around the former thermometer factory. The table below includes maximum and average mercury concentrations of historic fill samples 1) within and adjacent to 302 Pearl Street; 2) within the three thermometer workshop footprints; and 3) all other site-wide mercury samples collected from the historic fill layer (Figure 4 depicts the location of the thermometer factory and workshops):

Area	Average Hg Conc. (Historic Fill Samples Only)	Maximum Hg Conc.
302 Pearl Street (within and adjacent to)	32.6 mg/kg	730 mg/kg
Three Historical Thermometer Workshops	4.1 mg/kg	13 mg/kg
All Other Site-Wide Samples	1.4 mg/kg	11 mg/kg

Refusal was encountered at about 10 to 12 feet bgs in 3 of the 6 soil borings advanced in the two thermometer factory/workshops fronting Water Street. The refusals at SB16, SB21, and SB22 were attributed to the suspected presence of timber piles or cribbing. The soil borings advanced around the refusal borings (SB2, SB3, SB4S3, SB13, SB14, SB15, SB17, SB20, SB23, SB26, SB28) included 16 samples collected from below the refusal depths, and mercury was not detected in any of the deeper samples at a concentration above UU SCOs.

Mercury selective sequential extraction was completed on eight samples, with total mercury concentrations ranging from 42 to 730 mg/kg. The major mercury species identified was mercury salts (F-1 and F-2). Elemental mercury (F-0), which is the mercury species that is volatile at room temperature, made up 0.01% to 10.87% of the total mercury concentrations in the eight samples. Elemental mercury concentrations in the eight samples ranged from 0.00882 mg/kg to 25.2 mg/kg.

Groundwater

Mercury was not detected above SGVs in groundwater samples collected from temporary monitoring wells during the Phase II ESI. Mercury was not detected in groundwater samples collected from permanent monitoring wells during the RI.

Soil Vapor

Mercury vapor was not detected in on-site soil vapor samples. Mercury vapor was detected at concentrations of 0.222 $\mu g/m^3$ and 0.271 $\mu g/m^3$ in soil vapor samples collected from about 15 feet below the Pearl Street sidewalk adjoining the site.

Conclusions

Mercury was detected in soil samples at concentrations above UU and RURR SCOs across the site, and mercury concentrations were highest in and around the former thermometer factory located at 302 Pearl Street and, to a lesser extent, in the three additional thermometer factories/workshops. Mercury impacts were predominantly limited to the historic fill layer, with maximum concentrations in the 2 to 4 feet bgs interval. The former factory and workshop buildings were likely contaminated by mercury through spills and/or mercury vaporization and absorption onto building materials from the historical use. Historically, when buildings in Manhattan were demolished, the building materials would be re-used to backfill the former lots to grade. The source of mercury contamination is, therefore, suspected to be from the mercury-impacted building material used as backfill within the historic fill layer.

5.9.4 AOC 4: Historical Uses of the Site and Surrounding Properties

PAOC 4 listed in Section 3.4 has been modified as a result of investigation findings (PAOC 4: Site-Wide Groundwater and Soil Vapor Quality). AOC-4 represents various historical uses of the site and surrounding properties not discussed in the other AOCs. Additional historical uses of the site include a factory, oil companies, a garage with two 550-gallon USTs, a printer, a metal works, chemicals and glue company, a chemical company, a machine shop, and a gasoline service station. Historical use of the surrounding properties include a metals works, an "oils" facility, trucking companies, a garage, a machine shop, a printer, a substation, an automobile repair facility, a mercury warehouse, and facilities with petroleum bulk storage. Figure 4 depicts this historical site uses.

Findings Summary

Soil

Previous historical on-site uses included an oil company and garage with two 550-gallon USTs on the northeastern part of the site near the corner of Pearl Street and Peck Slip and an oil company/factory near the site boundary along Beekman Street. Petroleum-related VOC and PCB impacts were identified in these two areas.

- *Pearl Street/Peck Slip corner*: Petroleum-like impacts, as evidenced by staining, odor, elevated PID readings and/or analytical results, attributed to the historical site use as an oil company and garage with two 550-gallon USTs, were observed above and below the water table in four soil borings (SB8, SB29, SB30, and SB36). Petroleum-related VOCs and PCBs were detected in soil samples at concentrations above UU, PGW and/or RURR SCOs in the northeastern part of the site.

  - Petroleum-like impacts were identified in shallow soil (0 to 6 feet bgs) in soil borings SB29 and SB36 and soil at or below the water table in soil borings SB8, SB30, and SB36 from 13 to 28 feet bgs. PCB impacts were observed from 0 to 15 feet bgs in soil borings SB8, SB29, SB30, and SB36.
  - PCB impacts were observed in samples from borings SB8, SB29, SB30, and SB36 between 0 and 15 feet bgs. Refusal was encountered at 15 feet bgs before native soil was encountered at soil boring SB29. PCBs were not detected in samples below 15 feet bgs in borings SB8, SB30, and SB36.
- *Beekman Street side*: PCBs were also detected in soil samples collected from soil borings SB1 and SB37 at concentrations above UU and RURR SCOs near the center of the western site boundary along Beekman Street, within the boundary of the former oil company use. PCB impacts were identified within the historic fill layer, above the groundwater table. Petroleum-like impacts were not identified in this area.

Additionally, PFOS and PFOA were detected throughout the site in soil samples at concentrations above UU guidance value but below the RURR guidance value. PFOS (except for sample SB30_0-2), and PFOA (except for sample SB23_0-2) were below the PGW guidance values. PFAS were first used in firefighting suppression systems in the 1960s. The historical site use as an oil company (circa 1920s) pre-dates the use of PFAS. No historical use consistent with PFAS use was identified for the site. Based on the evaluation of the soil guidance values, per NYSDECs PFAS guidance document, no site source of PFAS was identified.

Groundwater

Petroleum impacts to groundwater were identified in monitoring wells within the former oil company near the Pearl Street/Peck Slip corner. Petroleum-like odors were observed during purging at temporary monitoring well TMW08. Petroleum-related VOCs (1,2,4,5-tetramethylbenzene, benzene, ethylbenzene, isopropylbenzene, m,p-xylene, n-butylbenzene, n-propylbenzene, sec-butylbenzene, toluene, and/or total xylenes) were detected at concentrations above NYSDEC SGVs in samples collected from temporary monitoring well TMW08 and monitoring well MW30 on the northeastern part of the site. Petroleum impacts to groundwater in the northeastern part of the site are attributed to historical uses of the site as an oil company and garage with two 550-gallon USTs.

PFOA and/or PFOS were detected in all of the monitoring wells installed during the RI above the MCL. PFAS were first used in firefighting suppression systems in the 1960s. The historical site use as an oil company (circa 1920s) pre-dates the use of PFAS in firefighting systems. No historical uses consistent with PFAS use was identified for the site or surrounding property. PFAS in groundwater are attributed to regional groundwater conditions and not a site source.

Soil Vapor

Petroleum-related VOCs were detected in all soil vapor samples at the site. Petroleum impacts to soil vapor are attributed to the open spill, historical site uses, and/or treated timber piles/cribbing.

CVOCs, including 1,1,1–TCA, cis-1,2-DCE, methylene chloride, PCE, and TCE, were detected in soil vapor samples. CVOCs were detected in soil vapor samples at the highest concentrations from the central part of the site and northeastern corner of the site. CVOCs were not detected above comparison criteria in soil or groundwater samples. A site source of CVOCs was not identified.

Conclusions

PCBs and petroleum-related VOCs were detected at concentrations above UU, PGW, and RURR SCOs in the northeastern part of the site near the corner of Pearl Street and Peck Slip. PCBs were detected at concentrations above UU, PGW, and RURR SCOs near the Beekman Street site boundary. PCBs and petroleum impacts are attributed to the historical site uses as an oil company and garage with two 550-gallon USTs on the northeastern part of the site near the corner of Pearl Street and Peck Slip, and an oil company/factory near the site boundary along Beekman Street.

PFAS were detected in soil samples at concentrations above the UU and PGW SCOs and in groundwater samples above the NYSDEC screening levels. The two samples with PFAS above the PGW guidance values were detected in surficial soil samples (0 to 2 feet bgs) above the groundwater table. PFAS have been used in various industries and products since the 1940s and the historical site use as an oil company pre-dates the use of PFAS in firefighting systems. No historical use consistent with PFAS use was identified for the site. Based on the evaluation of the soil guidance values, per NYSDECs PFAS guidance document, no site source of PFAS was identified.

CVOCs were not detected in soil above the UU SCOs or in groundwater samples above the SGVs; however, CVOCs, including 1,1,1–TCA, cis-1,2-dichloroethene, methylene chloride, PCE, and TCE, were detected in soil vapor samples. A source of CVOCs in soil vapor was not identified.

6.0 QUALITATIVE HUMAN AND FISH/WILDLIFE EXPOSURE ASSESSMENT

Human health exposure risk was evaluated for both current and future site and off-site conditions, in accordance with DER-10. The assessment includes an evaluation of potential sources and migration pathways of site contamination, potential receptors, exposure media, and receptor intake routes and exposure pathways.

In addition to the human health exposure assessment, DER-10 requires an on-site and off-site Fish and Wildlife Resources Impact Analysis (FWRIA) if certain criteria are met. Based on the requirements stipulated in Section 3.10 and Appendix 3C of DER-10, an FWRIA is not needed for the site. A completed version of the DER-10 Appendix 3C decision key is included as Appendix K.

6.1 Current Conditions

The site occupies the entire city block bordered by Pearl Street to the north, Peck Slip to the east, Water Street to the south, and Beekman Street to the west. It is used as an open-air, asphalt-covered commercial parking lot; a parking attendant kiosk and temporary storage shed are located near the center of the lot. The perimeter of the site is fenced with one automated barrier ingress/egress gate on Pearl Street. The asphalt cover is generally intact, however localized areas of cracking and delamination are apparent and one area (appearing to match the footprint of a former building at 230 Water Street) on the southwestern part of the site is notably depressed due to slow settlement.

One ecological receptor, the East River, is located about 550 feet southeast of the site. Sensitive receptors were identified within 1,000 feet of the site and are listed in the table in Section 2.1.1.

6.2 Proposed Conditions

The contemplated project includes construction of a mixed-use commercial and residential building with one cellar level encompassing the site footprint. The proposed uses of each floor are still in the early planning stages; however, the proposed building would likely house a parking garage, utility rooms, storage areas, locker rooms, and property operations offices in the cellar, and commercial and residential spaces on the floors above. The portion of the building cellar used as a parking garage would be mechanically-ventilated.

Excavation is anticipated to extend to between el 0 to -8 (about 12 to 19 feet bgs) to accommodate the cellar. Deeper excavation (an additional 4 to 6 feet) will occur at areas in the central part of the site to accommodate deeper foundation elements. Groundwater was measured at el -0.65 to -1.10; therefore, dewatering would be necessary to accommodate building foundation construction and the foundation would include a vapor barrier/waterproofing membrane.

6.3 Summary of Environmental Conditions

Based on the source, concentration, frequency, and locations of compounds identified in soil, groundwater and soil vapor across the site, the contaminants of concern (COCs) for the site are VOCs, SVOCs, pesticides, PCBs, and metals.

Soil

Historic fill material was encountered in all borings beneath the asphalt to depths ranging from about 5 to 17 feet bgs. COCs related to historic fill include SVOCs, PCBs, pesticides, and metals (including lead and mercury). However, PCBs and mercury identified in historic fill may also be related to historical site use and pesticides in historic fill may also be related to historical pesticide application at the site.

The highest concentrations of mercury impacts to soil were observed within and adjacent to the former thermometer factory located at 302 Pearl Street and, to a lesser extent, within and adjacent to the three additional historical thermometer workshop footprints. However, lower concentrations of mercury were identified in historic fill at other areas across the site. The table below includes maximum and average mercury concentrations of historic fill samples within and adjacent to 302 Pearl Street, within the three thermometer workshop footprints, and all other site-wide mercury samples collected from the historic fill layer:

Area	Average Hg Conc.	Maximum Hg Conc.
302 Pearl Street (within and adjacent to)	32.6 mg/kg	730 mg/kg
Three Historical Thermometer Workshops	4.1 mg/kg	13 mg/kg
All Other Site-Wide Samples	1.4 mg/kg	11 mg/kg

Based on this distribution, it can be concluded that mercury in soil is present both in historic fill and as the result of historical thermometer factory and workshop use.

Historically, when buildings in Manhattan were demolished, building materials were typically re-used to backfill the former lots to grade. The former factory and workshop building materials were likely impacted through mercury vaporization and absorption and/or releases from historical use of mercury associated with building uses and, C&D debris from these former buildings was likely used as backfill across the site.

Mercury selective sequential extraction was completed on eight samples. The eight samples were selected as described in Section 4.3.2.1. The major mercury species identified were mercury salts (F-1 and F-2). Elemental mercury (F-0), the mercury species that is volatile at room temperature, made up 0.01% to 10.87% of the total mercury concentrations in the eight samples.

Petroleum-like impacts were identified during Langan's November 2015 Phase II ESI near a potential UST on the southeastern part of the site and NYSDEC Spill No. 1507371 was assigned. The UST location and petroleum impacts were confirmed and delineated during the RI. The geophysical survey identified an anomaly consistent with four USTs in the eastern part of the site along Peck Slip. Petroleum-like staining and odor, and PID readings above background were observed in the borings around the potential USTs. Petroleum-related VOCs and SVOCs were detected in historic fill and native material samples in this area, at concentrations above UU, PGW, and RURR SCOs. Petroleum impacts in soil are associated with the on-site spill from the USTs.

Petroleum-related VOCs and SVOCs and PCBs, were detected in soil samples at concentration above UU, PGW, and/or RURR SCOs in the northeastern part of the site near the corner of Pearl Street and Peck Slip. The highest concentration of PCBs were detected within the former footprint of a historical oil company in this area. In addition, PCBs were detected in soil samples at concentrations above UU and RURR SCOs near the center of the Beekman Street site boundary. This area of the site was also historically used as an oil company/factory. Petroleum and PCB impacts in soil in these areas are likely associated with the historical site uses as oil companies/factories.

PFOS and PFOA were detected in soil samples at concentrations above the UU and PGW guidance values but below the RURR guidance values. The two samples with PFAS above the PGW guidance values were detected in surficial soil (0 to 2 feet bgs) samples above the groundwater table. No historical use consistent with PFAS use was identified for the site. Based on the evaluation of the soil guidance values, per NYSDECs PFAS guidance document, no site source of PFAS was identified.

Groundwater

Petroleum-related VOCs and SVOCs were detected in groundwater at concentrations above the TOGS SGVs in eight monitoring wells located on the eastern (fronting Peck Slip) parts of the site and in one monitoring well located near the center of the site. VOC concentrations were highest in monitoring wells located near the suspected UST area near the Peck Slip site boundary. Petroleum impacts in groundwater on the southeastern part of the site are associated with the on-site spill from the USTs. Petroleum impacts in groundwater on the northeastern part of the site are associated with the historical site uses as an oil company and garage with two 550-gallon USTs.

SVOCs and PCBs were detected in groundwater at concentrations above TOGS SGVs. SVOCs and PCBs in unfiltered samples are likely the result of suspended solids in groundwater derived from historic fill as these compounds are not readily dissolvable in groundwater and the turbidity goal of 5 NTU was not achieved in several of the wells where SVOCs and PCBs were detected above the SGV.

Metals (total and dissolved) were detected in groundwater throughout the site at concentrations above TOGS SGVs. Metals with higher total concentrations than dissolved concentrations are likely the result of suspended solids in groundwater derived from historic fill, as these compounds are not readily dissolvable in groundwater and were detected at lower concentrations in filtered samples. Dissolved and total metals impacts to groundwater, including antimony, iron, magnesium, manganese, and sodium, are attributed to regional groundwater quality. The source of dissolved arsenic and barium in groundwater is historic fill.

PFOA and/or PFOS were detected in groundwater samples above the NYSDEC MCL in all monitoring wells sampled during the RI. No historical use consistent with PFAS use was identified for the site. Based on the evaluation of the soil guidance values, per NYSDECs PFAS guidance document, no site source of PFAS was identified.

Soil Vapor

Soil vapor samples collected from the center the northeastern corner of the site contained the highest concentrations of CVOCs, including PCE and TCE. CVOCs were not identified in groundwater or soil above regulatory criteria.

BTEX compounds were identified in soil vapor samples across the site. The highest concentration of BTEX was identified in the sample next to the potential UST area near Peck Slip. The source of petroleum-related VOCs in soil vapor is associated with the potential USTs and historical site uses as an oil company and garage with two 550-gallon USTs.

Mercury vapor was not detected on-site. Mercury vapor was detected in soil vapor samples collected from 15 feet below the Pearl Street sidewalk adjoining the site at concentrations of 0.222 $\mu g/m^3$ and 0.271 $\mu g/m^3$.

6.4 Conceptual Site Model

A conceptual site model (CSM) was developed based on the RI findings and previous investigations to produce a simplified framework for understanding the distribution of impacted materials, potential migration pathways, and potentially complete exposure pathways, as discussed below.

6.4.1 Potential Sources of Contamination

Potential sources of contamination have been identified and include historic fill, potential USTs, and historical uses of the site and surrounding properties. The site-wide presence of historic fill has been established as a source of SVOCs, pesticides, PCBs, and metals including mercury in soil and groundwater. The suspected USTs have been established as a source of petroleum-related VOCs and/or SVOCs in soil, groundwater, and/or soil vapor. Historical site uses as a thermometer factory and workshops have been established as a source of mercury impacts in soil. Historical site uses as an oil company and factory have been established as a source of petroleum and PCBs in soil within the former lot footprints. The uses of adjacent and surrounding properties for industrial and commercial uses are a potential source for CVOCs (PCE and TCE) in soil vapor. Historical use of the site, adjoining, and surrounding properties included various unknown manufacturers and factories; are a potential source for PFAS in soil and groundwater at the site.

6.4.2 Exposure Media

Impacted media include the following:

- Soil: VOCs, SVOCs, PCBs, pesticides, and metals
- Groundwater: VOCs, SVOCs, PCBs, and metals
- Soil vapor: VOCs

6.4.3 Receptor Populations

The site is currently used as an open-air commercial parking lot. Current receptor populations include the parking lot staff, customers, and staff completing inspections or investigations at the site, and the public and pedestrians adjacent to the site.

During site development, human receptors will be limited to construction and remediation workers, authorized guests visiting the site, and the public and pedestrians adjacent to the site.

Under future conditions, receptors will include the residential and commercial use occupants, building employees, and the public and pedestrians adjacent to the site.

6.5 Potential Exposure Pathways – On-Site

6.5.1 Current Conditions

The site is an open-air asphalt-covered commercial parking lot. The asphalt is generally competent across the site, however, several small sinkholes have been filled in and patched recently in the southern part of the site. Groundwater in New York County is not used as a potable water source.

Prior to implementation of intrusive work, an 8-hour baseline air monitoring event was conducted. Air monitoring was also performed during sinkhole repairs, during a recent geotechnical exploration and during the RI. No concentrations of total VOC or mercury vapor were identified above the CAMP action levels during any of these soil intrusive activities. Concentrations of particulates did exceed the CAMP action level at the work zone monitoring station; however the exceedances were not caused by soil handling activities and are described in section 5.1. Exposure to contaminated vapor through inhalation was controlled. Based on these data and the lack of accumulation sources (i.e., buildings, excluding the parking lot kiosk) at the site, no potential for vapor accumulation and exposure to contaminated vapor through inhalation has been identified. Vapor accumulation within the parking lot kiosk is possible; however, the kiosk is not a continuously occupied space and has a loose building envelope (i.e. well ventilated).

In the event of any surficial repairs (none currently planned), potential exposure to soil, groundwater and soil vapor through dermal absorption, inhalation and ingestion are possible without the use of personal protective equipment (PPE) and dust suppression controls.

During any subsurface investigations (none currently planned), where human exposure to contaminated soil, groundwater and soil vapor is possible, the potential exposure pathways (dermal absorption, inhalation and ingestion) would be controlled through use of PPE, implementation of a HASP and CAMP, and through best practices.

6.5.2 Construction/Remediation Condition

Remediation and construction activities are anticipated to include excavation and off-site disposal of impacted soil, localized dewatering of contaminated groundwater, in-situ remediation of petroleum impacts (if necessary based on excavation depth), and construction of foundation components/capping systems. Potential exposure pathways for dermal absorption, ingestion, and/or inhalation during construction/remediation will be monitored and controlled through a variety of engineering controls (i.e., the implementation of a Construction Health and Safety Plan (CHASP), CAMP, Soil/Materials Management Plan (SMMP), and the use of vapor and dust suppression techniques). The controls for the construction and remedial activities will be proposed in the forthcoming RAWP based on the findings of this report.

6.5.3 Proposed Future Conditions

Site remediation is anticipated to include installation of a site-wide cover system (e.g., concrete building slabs) with a waterproofing/vapor barrier membrane. A cover system would prevent direct human exposure to and ingestion of impacted soil and groundwater. Potable water provided to New York County will continue to be sourced from the Delaware, Catskills and Croton watersheds.

The construction of engineering controls including the building foundation slab at or below the groundwater table and the installation of a waterproofing/vapor barrier membrane will mitigate the exposure pathway of VOCs in soil vapor through inhalation. In addition, the portion of the building cellar used as a parking garage will be mechanically-ventilated. A soil vapor evaluation that may include sampling would be conducted after building construction.

6.6 Potential Exposure Pathways – Off-Site

6.6.1 Current Conditions

The potential off-site migration of site contaminants in soil and groundwater is not expected to result in a complete exposure pathway because the site is covered with asphalt and located in an urban area with continuous and relatively impervious surface coverings (i.e., building foundations and concrete and asphalt paving) that eliminates potential points of exposure. The potential off-site migration of site contaminants in soil vapor is not an exposure concern.

During surficial repairs or subsurface investigations, exposure to particulates and VOCs in soil vapor through inhalation is controlled through the implementation of CAMP monitoring and dust suppression. Action levels established for VOCs in the RIWP were not exceeded during the RI. The mercury vapor action level was not exceeded during the RI, with the exception of one instance due to suspected equipment malfunction.

6.6.2 Construction/Remediation Condition

The potential off-site migration of site contaminants in soil, groundwater, and soil vapor is not expected to result in a complete exposure pathway from construction and remediation. The CAMP and a CHASP will monitor and control soil vapor and soil in the form of dust that has the potential to be transported off-site by wind and soil on the tires of vehicles or equipment leaving the site during remediation and development. During site redevelopment and remediation, the following protective measures will be implemented:

- Air monitoring will be conducted during all intrusive activities, including impacted soil and groundwater handling activities, as part of a CAMP. Dust and/or vapor suppression techniques will be employed to mitigate potential for off-site migration of soil and vapors.
- Vehicle tires and undercarriages will be washed as necessary prior to leaving the site to prevent tracking material off-site in accordance with the forthcoming RAWP.
- A soil erosion/sediment control plan will be implemented during construction to control off-site migration of soil.
- Removal of source material will prevent future off-site migration of contaminants.

6.6.3 Proposed Future Conditions

The potential off-site migration of site contaminants in soil, groundwater, and soil vapor is not expected to result in a complete exposure pathway under the proposed future use condition for the following reasons:

- A significant volume of impacted and source material (contaminated soil and groundwater [through dewatering and pre-treatment]) will be removed from the site. Based on the removal of mercury-impacted soil, human health exposure risk to elemental mercury from the site is low.
- A composite cover system (e.g., concrete building foundations and asphalt paving) will be installed, which will eliminate exposure to remaining potentially contaminated soil.
- Any potential on-site source of soil and groundwater contamination to soil vapor will be removed from the site through excavation and dewatering, or mitigated.
- Groundwater in New York City is not used as a potable water source and the nearest ecological receptor, the East River, is located about 550 feet southeast of the site.

6.7 Evaluation of Human Health Exposure

Complete exposure pathways have the following five elements: 1) a contaminant; 2) a contaminant release and transport mechanism; 3) a point of exposure; 4) a route of exposure; and 5) a receptor population. A discussion of the five elements comprising a complete pathway as they pertain to the site is provided below.

6.7.1 Current Conditions

Under current conditions contaminant sources include 1) historic fill with varying levels of SVOCs, pesticides, PCBs, and metals; 2) an on-site spill resulting in petroleum-impacted soil, groundwater and soil vapor; 3) historical site uses, including thermometer factory/workshops and oil companies/factories, resulting in mercury-impacted soil and VOC- and PCB-impacted soil, respectively, 4) Unidentified historical on- or off-site uses that may have contributed to the presence of PFAS in soil and groundwater, and 5) historical uses of the adjacent and surrounding sites that may have contributed CVOCs impacts to soil vapor.

Contaminant release and transport mechanisms from the sources above include contaminated soil transported as dust or overland flow in areas of exposed soil, contaminated groundwater flow and volatilization of contaminants from the soil and groundwater matrices to the soil vapor phase, and transport of existing soil vapor contaminants.

Under the current site conditions, the likelihood of exposure to humans is limited because the points of exposure are controlled by the sites impervious surface, the fact that potable water is obtained from an off-site source, and on-site accumulation sources of soil vapor (i.e., buildings except the parking kiosk) are not present. CAMP action levels were not exceeded during the RI and sinkhole repairs. Subsurface investigations, where exposure to humans is more likely, were conducted in accordance with the RIWP and a HASP to minimize exposure risk. The use of PPE and other controls, including CAMP and vapor mitigation and dust suppression measures, mitigates potential exposure pathways to site workers performing subsurface repairs. There is no complete exposure pathway for mercury vapor under current conditions.

6.7.2 Construction/Remediation Activities

During remediation and/or development, sources of contamination are the same as under the current conditions; however, the points of exposures change due to disturbed and exposed soil during excavation, dust and organic vapors generated during excavation, and contaminated groundwater that may be encountered during excavation and/or localized dewatering operations.

Routes of exposure include ingestion and dermal absorption of contaminated soil and groundwater, inhalation of organic vapors volatilizing from contaminated soil and groundwater (specifically in the areas of petroleum impacts) or impacted vapors already in the vadose zone from an off-site source, and inhalation of dust arising from contaminated soil. The receptor population includes construction and remediation workers, authorized visitors to the site, and the public adjacent to the site.

The implementation of appropriate health and safety measures during construction and remediation, such as air monitoring, using vapor and dust suppression measures, cleaning trucks prior to exiting the site to prevent off-site soil tracking, maintaining site security, and wearing the appropriate personal protective equipment (PPE) will mitigate potential exposure pathways during remediation and/or development.

In accordance with a RAWP, which will include a CHASP, SMMP, and a CAMP, measures such as conducting an air-monitoring program, donning PPE, covering soil stockpiles, altering work sequencing, maintaining a secure construction entrance, proper housekeeping, and applying vapor and dust suppression measures to prevent off-site migration of contaminants during construction will be implemented to prevent completion of these potential on- and off-site exposure pathways.

6.7.3 Proposed Future Conditions

Residual contaminants may remain on-site, depending on the remedy, and will, to a lesser extent, include those listed under current conditions. Contaminant release and transport mechanisms include contaminated soil transported as dust, contaminated groundwater flow and volatilization of contaminants from the soil and groundwater matrices to the soil vapor phase, and transport of existing soil vapor contaminants. However, a composite cover system (e.g., concrete building foundations and asphalt paving) will be installed, which will eliminate exposure to remaining potentially contaminated soil, and groundwater in New York City is not used as a potable water. The use of institutional and/or engineering controls will mitigate points of exposure include potential cracks in the foundation or slab of the proposed development and exposure during any future soil-disturbing activities. Routes of exposure include inhalation of vapors entering the building and direct contact with residual impacted soil during future soil-disturbing activities. The receptor population includes the building occupants and employees, visitors, maintenance workers, and the nearby community, including sensitive receptors. The possible routes of exposure can be addressed or mitigated by proper installation of soil vapor mitigation measures (i.e. sub-slab depressurization system), construction and maintenance of a site cover system (i.e., concrete foundation with a waterproofing/vapor barrier membrane) and implementation of a Site Management Plan (SMP) to manage institutional and engineering controls, if residual contamination is left in place. A soil vapor evaluation that may include sampling would be conducted after building construction.

The potential off-site migration of site contaminants in soil and groundwater is not expected to result in a complete exposure pathway. The potential for off-site migration of site contaminates will be addressed by the removal of the source material in soil and groundwater and/or mitigated by the use of ICs and ECs described above. The potential off-site migration of site contaminants in soil vapor is not an exposure concern.

6.7.4 Human Health Exposure Assessment Conclusions

1. Human exposure to site contaminants is controlled under current conditions on the site because the site is entirely covered by asphalt, groundwater is not potable and there are no on-site accumulation sources of soil vapor (i.e., buildings). There is no exposure risk to mercury vapor under the current conditions. The primary exposure pathways are for dermal contact, ingestion, and inhalation of soil, soil vapor, and/or groundwater by site investigation or repair workers. The exposure risks can be avoided or minimized by

following the appropriate health and safety measures outlined in the site-specific CAMP and HASP during investigation and remedial/ground-intrusive activities and by PPE use by repair workers.

2. In the absence of institutional and engineering controls, there are complete exposure pathways during construction and remediation activities. The primary exposure pathways are:

    a. Dermal contact, ingestion and/or inhalation of contaminated soil, groundwater and/or soil vapor by construction workers.

    b. Dermal contact, ingestion and inhalation of soil (dust) and inhalation of soil vapor by the community in the vicinity of the site.

    These exposure risks can be avoided or minimized by performing community air monitoring and by following the appropriate health and safety, vapor and dust suppression and site security measures outlined in the forthcoming RAWP and site-specific CHASP.

3. The existence of a complete exposure pathway for site contaminants to human receptors during proposed future conditions is unlikely, as a significant volume of contaminant sources will be removed from the site through excavation and dewatering/pre-treatment, the building foundation will be constructed at or below the water table and will include a waterproofing/vapor barrier membrane, the lowest level use of the building includes actively ventilated parking, any exposure to remaining soil and groundwater will be controlled with an impermeable cover, regional groundwater is not used as a potable water source and institutional controls will be in place to maintain engineering controls at the site.

4. Monitoring and control measures will be used during ground-intrusive activities (i.e. investigation and construction) to prevent community exposure to contaminated dust and vapors.

7.0 NATURE AND EXTENT OF CONTAMINATION

This section evaluates the nature and extent of soil, groundwater, and soil vapor contamination. The nature and extent of the contamination is derived from a combination of field observations and analytical data that were discussed in Section 5.0 and in Langan's November 2015 Phase II ESI.

7.1 Soil Contamination

Soil contamination at the site, characterized by field observations and soil sample analytical results exceeding UU, PGW, and/or RURR SCOs, is attributed to the presence of historic fill material, potential USTs, and historical site uses (thermometer factory/workshops, oil company/factory, and industrial/manufacturing). Based on the results of the RI, contaminated soil is not migrating off-site.

7.1.1 <u>Historic Fill Material</u>

Historic fill, predominantly consisting of grey to brown fine grained sand with varying amounts of silt, gravel, brick, concrete, wood, ceramic, ash, and coal, was encountered across the site to depths ranging from about 5 to 17 feet bgs.

The site-wide historic fill impacts include SVOCs, pesticides, PCBs, and metals detected at concentrations above the Part 375 UU, PGW, and/or RURR SCOs. Higher concentrations of mercury and PCBs were identified within the historic fill layer in specific areas associated with historical site uses as oil companies and a thermometer factory, respectively. Historic fill impacts are delineated vertically by native material in RI soil borings, except for borings SB16, SB17, SB21, and SB29 due to refusal. Vertical delineation of borings SB16, SB17, SB21, and SB29 by native material is assumed to be within two feet of the refusal depths at each location based on observations at surrounding soil borings (SB2, SB3, SB4S3, SB10, SB13, SB14, SB15, SB17, SB20, SB23, SB26, SB28, SB26, and SB36).

7.1.2 <u>Petroleum-Impacted Soil</u>

Open Spill (Spill No. 1507371)

Petroleum-like impacts on the southeastern part of the site, evidenced by odor, staining, PID readings above background levels and by petroleum-related VOCs and SVOCs detected above UU, PGW, and/or RURR SCOs in soil, are attributed to the open spill associated with anomalies indicative of four USTs near the Peck Slip site boundary. Petroleum impacts attributed to the open spill were identified in borings SB9, SB10, and SB31 through SB34 at depths ranging from about 7.5 to 28 feet bgs.

The on-site petroleum-impacted area attributed to the open spill is roughly 3,700 square feet. Petroleum-related VOCs and SVOCs detected above UU, PGW, and/or RURR SCOs in soil were delineated vertically in all boring locations, with the exception of boring SB31, where total xylene exceeded the UU SCO at 32 feet bgs (0.66 mg/kg compared to UU SCO of 0.26 mg/kg). The horizontal extent of petroleum-related VOCs and SVOCs detected above UU, PGW, and/or RURR SCOs were delineated to the north by SB7 and SB30; to the east by SB34; to the south by SB10 and SB35; and to the west by SB5, SB6, and SB27.

Historical Site Use

Petroleum-related impacts on the northeastern part of the site, evidenced by odor, staining, and PID readings above background levels and by VOCs detected above UU and/or RURR SCOs in soil, are attributed to the historical site use as an oil company and garage with two 550-gallon USTs. Petroleum-like impacts attributed to this historical site use were observed in soil borings SB8, SB29, SB30, and SB36 at depths ranging from about 2 to 28 feet bgs.

Petroleum-related VOCs detected above UU and/or RURR SCOs in soil were delineated vertically in all boring locations. The horizontal extent of petroleum-related VOCs detected above UU and/or RURR SCOs were delineated to the north and east by the Pearl Street and Peck Slip site boundaries, to the south by SB7, and to the west by SB24 and SB25.

Treated Timber Piles or Cribbing

Creosote-like impacts, evidenced by odor, staining, and PID readings above background levels were attributed to treated timber piles or cribbing in borings SB3, SB17, SB20, SB21, SB23, SB27, SB35, SB4NE3, SB4S3, SB4SE3, and SB4S2 at depths ranging from about 6 to 28 feet bgs. Wood/timber was observed in soil borings SB23 from about 2 to 10 feet bgs (including tar-like impacts at 7 feet bgs), SB35 from about 10 to 15 feet bgs, and the refusal depths of SB16, SB21, and SB22. Petroleum-related VOCs or SVOCs were not detected above UU SCOs in soil borings with odors and stained soils related to treated timber piles or cribbing.

7.1.3 Mercury-impacted Soil from Historical Thermometer Factories/Workshops

Mercury associated with historical on-site uses as a thermometer factory and workshops was generally identified within the historical fill layer in and around the former thermometer factory located at 302 Pearl Street and, to a lesser extent, in the three additional thermometer factories/workshops in soil samples at concentration above UU and RURR SCOs. Evidence of free liquid-phase elemental mercury was not observed during field investigations, however up to 10.87% elemental mercury was identified to be present in soil through speciation. The source of mercury contamination is likely from incidental releases of mercury during historical thermometer factory/workshop operations or from the mercury-impacted building material used as backfill within the historic fill layer. Soil borings associated with the mercury delineation at 302 Pearl Street include SB4, SB4R, SB24, SB25, SB4N1, SB4N3, SB4E1, SB4E2, SB4S2, SB4S3, SB4W1, SB4W2, SB4W3, SB4NW3, SB4NE3, SB4SE3, and SB4SW3. Soil borings advanced within the three former thermometer factory/workshops include SB3, SB16, and SB17 at 236 Water Street; SB18, SB19, SB20, and SB38 at 298 Pearl Street; and SB21, SB22 and SB23 at 240 Water Street.

302 Pearl Street Hot Spot

The highest mercury concentrations were observed within the historic fill layer in soil borings SB4, SB4R, SB24, SB25, SB4N1, SB4S2, SB4W2, SB4S3, and SB39, in and around the former thermometer factory at 302 Pearl Street. Based on the results of mercury selective sequential extraction, mercury salts are the predominant mercury species present. Vertical delineation of the hot spot was achieved at the former thermometer factory located at 302 Pearl Street at all boring locations from about 0 to 20 feet bgs. Horizontal extent of mercury impacts of the hot spot from the former thermometer factory were limited to the historical footprint of 302 Pearl Street (which extends off-site to the north) and to about 20 feet southeast. The horizontal extent of the mercury hot spot is delineated by soil borings SB4N3, SB4E2, SB4W3, SB4NW3, SB4NE3, SB4SE3, SB4SW3, and SB26.

298 Pearl Street and 236 and 240 Water Street

The average mercury concentration from within the three additional thermometer factories/workshops (4.1 mg/kg) was an order of magnitude lower than the average mercury concentration from the thermometer factory at 302 Pearl Street. Vertical delineation of mercury impacts was achieved at all boring locations from about 0 to 15 feet bgs, except for SB16, SB17, and SB21, where refusal was encountered before native soil was reached. Soil samples collected from the native layer within the three footprints demonstrated that mercury impacts are generally confined to the historic fill layer. The horizontal extent of mercury impacts from the former workshops are delineated to the north by soil boring SB38; to the west by SB29, SB36, and SB27; to the south SB17 and SB23; and to the east by SB13, SB14, and SB15.

Other Mercury Results

Mercury was detected at concentrations above UU and RURR SCOs in samples collected from soil borings outside of the former thermometer factory/workshop footprints. The average mercury concentration in historic fill samples outside of the thermometer factory/workshop footprints is 1.4 mg/kg and the highest mercury concentration is 11 mg/kg in soil boring SB26 (near the center of the site). Mercury impacts are delineated vertically in RI soil borings from 0 to 20 feet bgs, except for borings SB16, SB17, and SB21 due to refusal. Vertical delineation of these borings by native material is discussed in Section 7.1.1.

7.1.4 PCB-impacted Soil

Historical on-site uses included an oil company and garage with two 550-gallon USTs on the northeastern part of the site (corner of Peck Slip and Pearl Street) and an oil company/factory near the site boundary along Beekman Street. PCBs were detected at concentrations above UU, PGW, and RURR SCOs in samples collected from soil borings SB1, SB29, SB36, and SB37 from within the two former footprints. Petroleum-like impacts and petroleum-related VOCs were detected at concentrations above UU and RURR SCOs in soil borings SB8 and SB36 near the corner of Pearl Street and Peck Slip.

The vertical extent of petroleum and PCB impacts was delineated in all soil borings from 0 to 15 feet bgs. Soil boring SB29 encountered refusal at 15 feet bgs. Based on soil boring SB36 that was completed in close proximity to SB29, native soil is estimated to be at or near the refusal depth. Horizontal extent of PCB impacts in the northeastern part of the site are delineated to the north the Water Street site boundary; to the east by SB8 and SB30; to the south by SB5; and to the west by SB24 and SB25. Horizontal extent of PCB impacts near the western site boundary are delineated to the north the SB12; to the east by SB13; to the south by SB11 and SB14; and to the west by the Beekman Street site boundary.

7.1.5 PFAS-Impacted Soil

Historical use of the site, adjoining, and surrounding properties included various unknown manufacturers and factories. PFAS were detected at various depths in soil throughout the site at concentrations above UU guidance values but below RURR guidance values. The two samples with PFAS above the PGW guidance values were detected in surficial soil samples (0 to 2 feet bgs) above the groundwater table. PFAS in soil are below the guidance values for the reasonably anticipated site uses.

The vertical extent of PFAS impacts were delineated in all soil borings from 0 to 15 feet bgs, except for borings SB16, SB21, SB22, and SB29 due to refusal. Vertical delineation of borings SB21, SB22, and SB29 by native material is assumed to be within two feet of the refusal depths at each location based on observations at surrounding soil borings (SB3, SB16, SB17, SB20, SB23, SB26, and SB36).

7.2 Groundwater Contamination

Groundwater contamination, characterized by field observations and groundwater sample analytical results exceeding NYSDEC SGVs, is attributed to the potential USTs, historical uses of the site and to off-site sources. Based on the results of the RI, contaminated groundwater has a potential to migrate off-site.

7.2.1 Petroleum-impacted Groundwater

Petroleum-like odors, PID readings above background, and/or petroleum-related VOC and/or SVOC concentrations above SGVs were identified at temporary monitoring wells TMW08, TMW09, TMW10 and monitoring wells MW30, MW31, MW32, MW33, and MW34. 0.01 inches of LNAPL was observed in monitoring well MW31 during placement of a pressure transducer.

Petroleum impacts in TMW08 and MW30 are related to the historical site uses as an oil company and garage with two 550-gallon USTs. Total VOC concentrations were 0.068 mg/l in TMW08 and 0.24 to 0.257 mg/l in the parent and duplicate samples at MW30.

The greatest degree of petroleum impacts to groundwater was observed on the west side of the potential USTs in temporary monitoring well TMW09. Total VOCs in TMW09 (about 32.6 mg/l) were one to two orders of magnitude higher than surrounding monitoring wells (MW31 [4.0 mg/l] and MW32 [about 0.127 mg/l], MW33 [about 0.208 mg/l], and MW34 [about 0.148 mg/l], respectively). The horizontal extent of the open spill is about a 25- to 50-foot radius around the potential USTs.

7.2.2 Metals-Impacted Groundwater

Total and dissolved metals concentrations above SGVs were identified in groundwater samples collected across the site. Total metals in unfiltered samples are likely the result of suspended solids in groundwater derived from historic fill as these compounds are not readily dissolvable in groundwater. Dissolved metals, excluding arsenic and barium, are attributed to regional groundwater conditions. Arsenic and barium in dissolved groundwater samples are likely associated with historic fill impacting groundwater.

7.2.3 PFAS-Impacted Groundwater

PFAS concentrations above SGVs were observed in groundwater samples collected across the site. The highest concentrations of PFOA and PFOS in groundwater were in monitoring wells MW25 and MW30, located on the upgradient side of the site. Historical use of the site, adjoining, and surrounding properties included various unknown manufacturers and factories. PFAS were detected in groundwater above the MCL; however based on the evaluation of the soil guidance values, per NYSDECs PFAS guidance document, no site source of PFAS was identified.

7.3 Soil Vapor Contamination

Twenty-eight VOCs, including petroleum-related VOCs and CVOCs (1,1,1–TCA, cis-1,2-dichloroethene, methylene chloride, PCE, and TCE) were detected in soil vapor samples. Total VOC concentrations ranged from about 386 $\mu g/m^3$ in SV19 to 39,300 µg/m3 in SV32. BTEX concentrations detected in soil vapor ranged from 15.8 $\mu g/m^3$ in SV17 to 6,030 $\mu g/m^3$ in SV32. PCE concentrations detected in soil vapor ranged from 3.36 $\mu g/m^3$ in SV01 to 827 $\mu g/m^3$ in SV28. TCE concentrations detected in soil vapor ranged from 1.09 $\mu g/m^3$ in SV08 to 27.3 $\mu g/m^3$ in SV28. Petroleum-related VOCs are associated with the open spill and timber piles/cribbing and were highest near the UST along the eastern site boundary. Concentrations of TCE and PCE in soil vapor samples were highest in the central part and northeastern corner of the site. Soil and groundwater samples in these areas had detections of CVOCs but were below the soil and groundwater regulatory criteria. An on-site source of CVOCs was not identified in soil or groundwater at the site. Based on the results of the RI, contaminated soil vapor has a potential to migrate off-site.

8.0 CONCLUSIONS

The RI was implemented between 15 June and 12 October 2020 in accordance with the NYSDEC-approved RIWP. The findings of the RI and the 2015 Phase II ESI summarized herein are based on both qualitative (field observations and instrumental readings) and quantitative (laboratory analytical results and modeling) data. The analytical data generated were determined to be 98.97% acceptable for soil samples, 99.55% acceptable for groundwater samples, and 100% acceptable for soil vapor samples by validation and the de minimis amount of unusable/rejected data does not impact the RI findings and conclusions. These findings and conclusions are as follows:

1. Stratigraphy: Site stratigraphy consists of historic fill material underlain by sand with varying amounts of silts, gravel and clay. Historic fill material, characterized as grey to brown fine sand with varying proportions of silt, gravel, brick, concrete, wood, ceramic, and coal, was encountered to depths ranging from about 5 to 17 feet bgs. Bedrock was not encountered and is expected to be about 125 feet bgs. The historical shoreline ran through the center of the site, parallel with Water and Pearl Streets

2. Hydrogeology: Groundwater was observed at elevations ranging from about -0.65 to -1.10 (about 15.5 to 8.9 feet bgs) during the RI. The groundwater flow direction is to the southeast. Based on the results collected from pressure transducers, groundwater does not appear to be significantly tidally influenced. The tidal cycle fluctuation is about ±0.1 feet.

3. Historic Fill: Historic fill material was encountered in all soil borings beneath the asphalt cover to depths ranging from about 5 to 17 feet bgs. Historic fill impacts include SVOCs, pesticides, PCBs, and metals in soil at concentrations above UU, PGW, and/or RURR SCOs.

4. Petroleum- and Tar-Impacts to Soil, Groundwater and Soil Vapor: Petroleum- and tar-related impacts, as evidenced by field observations and/or analytical data, were identified and are attributed to the potential USTs and associated open spill, historical site uses, and treated timber pile/cribbing.

    a. Petroleum impacts attributed to the open spill (Spill No. 1507371) were identified in soil borings SB9, SB10, and SB31 through SB34 and in monitoring wells TMW09 and MW31 through MW34. An anomaly indicative of four USTs was identified in this area. Field observations within the capillary fringe and below the groundwater interface include petroleum-like odor, staining and/or PID readings above background. Petroleum-related VOCs and/or SVOCs were detected in soil samples at concentrations above UU, PGW, and/or RURR SCOs and in groundwater samples at concentrations above NYSDEC SGVs. Petroleum-related VOCs were also detected in all soil vapor samples, with the highest BTEX concentration in soil vapor locations in this area (SV32).

b. Petroleum impacts attributed to the historical site use as an oil company and garage with two 550-gallon USTs were identified in borings SB8, SB29, SB30, and SB36 and monitoring well TMW08 and MW30. Field observations in unsaturated soil, the capillary fringe, and below the groundwater interface include petroleum-like odor, staining and PID readings above background. Petroleum-related VOCs and/or SVOCs were detected in soil samples at concentrations above UU and/or RURR SCOs and in groundwater samples at concentrations above NYSDEC SGVs. Petroleum-related VOCs were detected in soil vapor samples in this area.

c. Creosote impacts attributed to treated timber piles or cribbing were identified in soil borings SB3, SB17, SB20, SB21, SB23, SB27, SB35, SB4NE3, SB4S3, SB4SE3, and SB4S2 and in monitoring well TMW03. Wood/timber was observed in several soil borings. Field observations within the capillary fringe and below the groundwater interface include tar-like odor, staining and/or PID readings above background were observed in soil borings. No petroleum-related VOCs and SVOCs were detected above UU SCOs in the soil borings. One petroleum-related VOC was detected at concentrations above the NYSDEC SGV in temporary monitoring well MW03. Petroleum/creosote-related VOCs were detected in soil vapor samples in this area of the site.

5. <u>Mercury Impacts Related to Historical Site Uses</u>: Mercury impacts to soil are related to historical site use, including a thermometer factory and three additional thermometer factories/workshops. The highest mercury concentrations in soil were detected primarily within the historical fill layer in and around the former thermometer factory located at 302 Pearl Street and, to a lesser extent, within the three additional thermometer factories/workshops. The major mercury species identified were mercury salts. Elemental mercury made up 0.01% to 10.87% of the total mercury concentrations in speciated samples. Mercury was not detected in groundwater samples. Mercury vapor was not detected in on-site soil vapor samples; however mercury vapor was detected in soil vapor samples collected from 15 feet below the Pearl Street sidewalk adjoining the site at concentrations of 0.222 $\mu g/m^3$ in SV39 and 0.271 $\mu g/m^3$ in SV38. The source of mercury contamination in soil is likely from the use of mercury-impacted building materials used as backfill within the historic fill layer in and around the former factory/workshop footprints.

6. <u>PCB Impacts related to Historical Site Uses</u>: PCB-impacted soil was identified in soil and may be related to historical site uses. PCB impacts to soil were observed primarily within the historical fill layer in and around the former oil company in the northeastern part of the site and the former oil company and factory on the western part of the site.

7. <u>CVOC in Soil Vapor</u>: The soil vapor samples collected at the site contained PCE and TCE. Soil vapor samples from the center of the site and from near the northeastern corner of the site contained the highest concentrations of CVOCs. CVOCs were detected in soil

and groundwater sample below regulatory criteria. A site source of CVOCs was not identified.

8. PFAS in Soil and Groundwater: PFAS-impacted soil and groundwater was identified at the site. No historical use consistent with PFAS use was identified for the site. Based on the evaluation of the soil guidance values, per NYSDECs PFAS guidance document, no site source of PFAS was identified.

9. Remedial Action Work Plan: Sufficient analytical data were gathered during the RI, together with previous studies, to determine cleanup objectives and to develop a remedy for the site. Additional data will be gathered during the forthcoming remedial design and waste characterization investigation to further refine impacted areas. The final remedy will be described and evaluated in the forthcoming RAWP to be prepared in accordance with BCP guidelines.

8.1 Conceptual Remedy and Remedial Design Investigation

A RAWP will be prepared in accordance with the NYSDEC Program Policy DER-10: Technical Guidance for Site Investigation and Remediation. The RAWP will include an alternatives analysis, which requires consideration of a Track 1 (Unrestricted Use) remedy. At a minimum, a Track 4 remedy will be proposed for the site. Other remedial tracks may be considered. The remedy will be fully outlined in the RAWP and is anticipated to consist of the following conceptual remedial elements:

- Implementation of a Construction Health and Safety Plan (CHASP) and CAMP for the protection of site workers, the community, and the environment during the remediation phase of development;
- Decommissioning and removal of USTs;
- Site-wide excavation and off-site disposal of impacted soil to approximately 15 feet bgs (subject to change based on final foundation design and selected remedy);
- Hotspot excavation below 15 feet bgs of material that is a source of petroleum contamination;
- Dewatering and treatment of groundwater to allow for remedial excavation below the groundwater table and remediation of on-site groundwater impacts;
- In-situ treatment of residual petroleum-impacted groundwater and/or soil following source removal;
- Incorporation of a waterproofing/vapor barrier membrane that is compatible with chlorinated and petroleum-related compounds into future building foundations and use of the lowest level of the building for ventilated parking;

- Installation of a cover system (e.g., concrete building slabs) over the site footprint to eliminate exposure to remaining contaminated soil;
- Establishment of use restrictions, as necessary;
- Recording of an environmental easement referencing engineering controls and institutional controls (EC/ICs to prevent future exposure to remaining contamination at the site;
- Publication of a Site Management Plan for long-term management of remaining contamination as may be required by the environmental easement, including plans for: 1) EC/ICs, 2) monitoring, 3) operation and maintenance, and 4) reporting.
- Completion of a soil vapor intrusion evaluation in all the future site buildings.

Prior to the start of remediation, a Remedial Design Investigation (RDI) will be implemented. The RDI is anticipated to consist of the following:

- Supplemental site-wide waste characterization sampling to further define contaminant source areas and obtain data sufficient for off-site disposal facility approvals; and
- Collection of soil and groundwater samples to support and perform a bench-scale treatability study to inform the in-situ remedy of petroleum impacts.

Following the RDI implementation, a Remedial Design Memorandum will be prepared that will describe the results of the RDI.

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