ATLANTIC CHESTNUT – LOT 1

3264 FULTON STREET
BROOKLYN, NEW YORK

Interim Remedial Measure Work Plan

NYSDEC BCP Site Number: C224234
AKRF Project Number: 12492

Prepared for:

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LIST OF ACRONYMS

Acronym	Definition
1,1-DCE	1,1-dichloroethylene
1,4-Dx	1,4-dioxane
ADF	Air Discharge Facility
AGV	Air Guidance Value
AOC	Area of Concern
AST	Aboveground Storage Tank
AWQS	Ambient Water Quality Standard
BCP	Brownfield Cleanup Program
Cis-1,2-DCE	Cis-1,2-dichloroethylene
CBS	Chemical Bulk Storage
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CVOC	Chlorinated Volatile Organic Compound
DER-10	Division of Environmental Remediation Technical Guide 10
DOT	Department of Transportation
EC	Engineering Control
EM	Electromagnetic
eV	Electron Volt
EPA	United States Environmental Protection Agency
GPR	Ground Penetrating Radar
GPS	Global Positioning System
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
IC	Institutional Control
LIRR	Long Island Railroad
MTA	Metropolitan Transit Authority
NGVD	National Geodetic Vertical Datum
ELAP	Environmental Laboratory Accreditation Program
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OSHA	Occupational Safety and Health Administration
PBS	Petroleum Bulk Storage
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethylene
PE	Professional Engineer
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctane Sulfonate
PGWSCO	Protection of Groundwater Soil Cleanup Objective
PID	Photoionization Detector

Acronym	**Definition**
QHHEA	Qualitative Human Health Exposure Assessment
QEP	Qualified Environmental Professional
RA	Remedial Action
RAWP	Remedial Action Work Plan
RDI	Remedial Design Investigation
RDIR	Remedial Design Investigation Report
RI	Remedial Investigation
RIR	Remedial Investigation Report
RIWP	Remedial Investigation Work Plan
RRSCO	Restricted Residential Soil Cleanup Objective
SCO	Soil Cleanup Objective
SIM	Selective Ion Monitoring
SVOC	Semivolatile Organic Compound
TAL	Target Analyte List
TCE	Trichloroethylene
TOGS	Technical and Operational Guidance Series
Trans-1,2-DCE	Trans-1,2-dichloroethylene
TRIS	Toxic Release Inventory System
UST	Underground Storage Tank
UUSCO	Unrestricted Use Soil Cleanup Objective
VOC	Volatile Organic Compound

1.0 INTRODUCTION

This Interim Remedial Measure (IRM) Work Plan (IRMWP) has been prepared by AKRF, Inc. (AKRF) on behalf of Atlantic Chestnut Affordable Housing LLC (the Volunteer) for the Atlantic Chestnut – Lot 1 site, located at 3264 Fulton Street in Brooklyn, New York, hereafter referred to as the "Site". The Site is identified on the New York City Tax Map as Brooklyn Tax Block 4143, Lot 1. Historically, Lot 1 encompassed the entirety of Block 4143, but was apportioned into three lots (Lots 1, 2, and 3) in 2016. A Site Location Map is provided as Figure 1.

Atlantic Chestnut Affordable Housing LLC entered into a Brownfield Cleanup Agreement (BCA) (BCA Index No. C224234-05-16) with the New York State Department of Environmental Conservation (NYSDEC) on May 26, 2016. The Site is identified as Brownfield Cleanup Program (BCP) Site No. C224234. A Remedial Investigation (RI) was completed at the Site and an RI Report (RIR) was submitted to NYSDEC and approved in a November 24, 2017 NYSDEC-issued letter; and a Remedial Design Investigation (RDI) was completed at the Site between August and December 2017 and an RDIR is currently being prepared. Based on an evaluation of the data and information from the RI and RDI, there is contaminated soil, groundwater, and soil vapor present at the Site, including polycyclic aromatic hydrocarbons (PAHs), metals, and trichloroethylene (TCE) in soil; chloroform, TCE, and tetrachloroethylene (PCE) in groundwater; and petroleum-related volatile organic compounds (VOCs) and the chlorinated VOCs (CVOCs) PCE and TCE in soil vapor. Previous on-site investigations, summarized in Section 3.0, are sufficient to delineate the nature and extent of contamination at the Site.

In a May 16, 2017 letter, the New York State Department of Health (NYSDOH) determined that the Site poses a significant threat to human health and the environment based on the potential for soil vapor intrusion into off-site buildings. This IRMWP has been prepared to address the potential for off-site migration of VOCs in soil vapor until a remedy can be implemented under a NYSDEC-approved Remedial Action Work Plan (RAWP), currently anticipated to occur in January 2020.

The Health and Safety Plan (HASP) and Community Air Monitoring Plan (CAMP), provided as Appendix A, will be implemented during activities outlined in this IRMWP. The quality assurance/quality control (QA/QC) protocol detailed in the Quality Assurance Project Plan (QAPP), provided as Appendix B, will be strictly adhered to for the field work and sampling described in the following sections.

2.0 SITE DESCRIPTION AND HISTORY

2.1 Site Description and Surrounding Land Use

The Site consists of an approximately 65,944-square foot concrete- and asphalt-paved parcel formerly developed with vacant, interconnected, fire-damaged factory buildings that extended across the two south-adjoining properties [254 Euclid Avenue (BCP Site No. 224235) and 275 Chestnut Street (BCP Site No. 224236)]. The buildings were demolished between July and December 2016. The elevated J and Z Metropolitan Transit Authority (MTA) subway tracks are located above Fulton Street to the north and the Long Island Railroad (LIRR) tracks are located beneath Atlantic Avenue to the south. The surrounding area is developed primarily with residential, commercial, religious, manufacturing, transportation, and industrial uses. A Site Location Map is provided as Figure 1.

2.2 Site Geology, Hydrogeology, and Subsurface Characteristics

The stratigraphy of the Site, from the surface down, generally consists of fill comprising sand, silt, and gravel with varying amounts of concrete, brick, coal ash, clay, and asphalt up to approximately 12 feet below grade, underlain by apparent native sand, gravel, clay, and silt to boring termination depths (up to 80 feet below grade). A Site and Sample Location Plan showing the locations of the RI and RDI sample locations is provided as Figure 2.

The western and central portions of the Site lie at an elevation of approximately 39 to 41 feet above national geodetic vertical datum (NGVD), an approximate of mean sea level. The former cellar located on the eastern portion of the Site along Euclid Avenue lies at an elevation of approximately 31 feet above NGVD.

Groundwater beneath the Site is approximately 30.5 feet to 32.7 feet below sidewalk grade or 8.6 to 8.7 feet above NGVD, an approximate of mean sea level, on the northern and southern portions of the Site, respectively. Shallow groundwater flows in a southerly direction and intermediate and deep groundwater flow in a southwesterly direction beneath the Site. Groundwater in this part of Brooklyn is not used as a potable source and there are no surface water bodies on or immediately adjacent to the Site. Groundwater elevation contour maps for shallow, intermediate, and deep groundwater are provided as Figures 3, 4, and 5, respectively.

2.3 Site History and Previous Owners

Historic records indicate that the Site was developed with residences and a road in 1887 and with industrial and manufacturing uses, including the Columbia Machine Works and Malleable Iron Company, the Columbia Cable and Electric Corporation, Blue Ridge Farms, Inc., and Chloe Foods Corp. between 1908 and 2012. Blue Ridge Farms, Inc. and Chloe Foods Corp. are listed on multiple federal and state databases, as discussed in Section 3.0. Prior uses that appear to have led to Site contamination include blacksmithing and stamping, a brass foundry, wood working, a machine shop, tank and engine rooms, an iron works, wire braiding, and cable manufacturing. The Site has remained vacant since a July 2012 fire caused severe structural damage to the former Site buildings. Demolition of the Site buildings was completed between July and December 2016.

Past owners of Block 4143, Lot 1 include: Columbia Electric Realty, Inc. in 1980; Avnal, Inc. from 1980 to 1984; Blue Ridge Farms, Inc. from 1984 to 2004; 3301 Atlantic Avenue, LLC from 2004 to 2013; Sapphire Luxury Estates, LLC from 2013 to 2014; Atlantic Chestnut, LLC from 2014 to 2015; and Atlantic Chestnut Affordable Housing, LLC from 2015 to present. It is noted that Block 4143 formerly comprised Lot 1, but has subsequently been divided into three lots (Lots 1, 2, and 3).

2.4 Proposed Development

The proposed development is still being finalized, but is currently anticipated to consist of a new 8 to 14-story mixed-use building comprising approximately 415,000 gross square feet. The building will contain two partial cellars on the eastern and western portions and two crawlspaces on the northern and southern portions; approximately 2,000-square feet of residential amenities, approximately 19,500-square feet of retail space, and four affordable residential units on the ground floor with an approximately 17,300-square foot central landscaped courtyard; and 399 affordable residential units on the second through 14th floors. The 9th floor will also have roof access and additional community space.

2.5 Proposed Project Schedule

Based on the proposed project schedule detailed in Section 7.0, an IRM was required to address the potential for off-site migration of soil vapor until a remedy can be implemented under a NYSDEC-approved Remedial Action Work Plan (RAWP), currently anticipated to occur in January 2020. The proposed SVE system, described in this IRMWP, will be operational by December 2018. The SVE system will run 24 hours a day, 7 days a week, 365 days a year until NYSDEC determines it can be turned off.

3.0 PREVIOUS ENVIRONMENTAL REPORTS

Subsurface (Phase II) Investigation Report – Blue Ridge Farms, 3301 Atlantic Avenue, 84 Dinsmore Place, and 111 Dinsmore Place, Brooklyn, New York, AKRF, Inc. (AKRF), May 2001

AKRF conducted a Subsurface (Phase II) Investigation of a larger area including the Site in May 2001. At the time of the investigation, the Site was developed with food processing and storage buildings. The Subsurface (Phase II) Investigation included the performance of a geophysical survey across exterior portions of the Site and the advancement of four soil borings with the collection and analysis of soil samples, and the installation of temporary groundwater monitoring wells with the collection and analysis of groundwater samples. The scope of the investigation was based on a December 2000 Phase I Environmental Site Assessment (ESA) of the Site by IVI Environmental, Inc.

Due to reported reinforced concrete across the Site, the geophysical survey was inconclusive. Soil consisted of fill material (brick, concrete, asphalt, clay, silt, sand, and gravel) up to 6 feet below grade, underlain by native soil (sand, gravel, silt, and clay) to 16 feet below grade. Groundwater was reportedly encountered at approximately 32 feet below grade.

Petroleum-related volatile organic compounds (VOCs) and the semivolatile organic compound (SVOC) naphthalene were detected in soil above NYSDEC Recommended Soil Cleanup Objectives (RSCOs) listed in the NYSDEC Technical and Administrative Guidance Memorandum (TAGM), the applicable soil cleanup objectives at the time of the investigation. Solvent and petroleum-related VOCs and metals were detected above their respective Ambient Water Quality Standards (AWQSs) and Guidance Values listed in the NYSDEC Division of Water Technical and Operational Guidance Series (TOGS) Memo in the groundwater samples collected from the south-adjacent properties (BCP Site Nos. C224235 and C224236). VOCs were detected above TOGS in pre- and post- process water samples. Based on elevated photoionization detector (PID) detections and laboratory analytical data from the soil borings surrounding the tank system on the southern portion of the Site block (BCP Site No. C224236), Spill No. 0101620 was assigned to the historic address 3301 Atlantic Avenue.

AKRF recommended the preparation of a work plan to be submitted to the NYSDEC to further delineate, excavate, and dispose of petroleum-contaminated soil at BCP Site No. C224236 to close Spill No. 0101620.

Phase I Environmental Site Assessment (ESA) – 3301 Atlantic Avenue, 3238 Fulton Street, 226-296 Euclid Avenue, and 215-279 Chestnut Street, Brooklyn, New York, Property Solutions, Inc. (PSI), June 2010

PSI conducted a Phase I ESA of a larger area including the Site in April 2014. The Phase I ESA identified historical uses at the Site including: a machine and iron works facility, an electrical cable manufacturer, and a food processing plant; records indicating that five underground storage tanks (USTs) were previously located on-site; and Historic Recognized Environmental Conditions (HRECs) at the Site, including the Site's listing in the Leaking Underground Storage Tank (LUST) and Spills databases. PSI recommended conducting a Subsurface (Phase II) Investigation, including a geophysical survey, to investigate the potential impacts associated with historic operations and fuel oil storage at the Site. It is noted that some of these RECs/HRECs are likely related to the south-adjacent property(ies) BCP Site Nos. C224235 and/or C224236.

Asbestos Investigation and Bulk Sample/Laboratory Analysis – 3301 Atlantic Avenue, Brooklyn, New York, Safety Environmental, Co. of NY, Inc. (Safety), July 2013

Safety conducted an asbestos survey of the former buildings located on the Site and south-adjacent properties (BCP Site Nos. C224235 and C224236) in July 2013. A total of 131 samples were collected for laboratory analysis from on- and off-site portions of the buildings. Asbestos-containing material (ACM) was identified within the following portions of the former buildings suspected to be located on-site: boiler No. 4 door insulation, boiler No. 3 caulking, first floor pipe insulation, roof transite shingles, roof membranes, roof flashing, and roof vent membranes. It is not known how many of the samples were collected on-site and on the south-adjacent properties. Safety recommended removal of all ACM prior to demolition of the former on- and off-site buildings.

Phase I Environmental Site Assessment (ESA) – 3301 Atlantic Avenue (Block 4143, Lot 1), Brooklyn, New York, Legette, Brashears, & Graham, Inc. (LBG), March 2014

LBG conducted a Phase I ESA of the Site and the south-adjoining lots (BCP Site Nos. C224235 and C224236) in April 2014. The Phase I ESA identified RECs associated with former uses at the Site, including: blacksmithing and stamping, a machine and iron works shop, an electric cable manufacturer, a gasoline filling station, and listings in the Spills database. The report noted the following *de Minimis* conditions: nearby hazardous materials/waste storage, use, and/or releases; and the potential presence of ACM, lead based paint (LBP), and fluorescent lighting at the Site. LBG recommended that any contaminated soil discovered during redevelopment of the Site be handled according to applicable federal, state, and local regulations.

Chain of Title Summary Report – 3301 Atlantic Avenue and 242 Chestnut Street, Brooklyn, New York, Phipps Houses, 2015

A Chain of Title Summary Report was compiled by Phipps Houses, which outlined ownership of the Site, and south-adjacent and nearby properties between 2004 and 2015. The report showed the transfer of ownership from Blue Ridge Farms, Inc. to 3301 Atlantic Avenue, LLC in May 2004; from 3301 Atlantic Avenue, LLC to Sapphire Luxury Estates, LLC in July 2013; a foreclosure and sale judgment for the Site and north-adjacent properties to be sold at public auction in September 2013; and an agreement for assignment of rights and claims from Blue Ridge Farms, Inc. to 3301 Atlantic Partners, LLC in March 2014.

Phase I Environmental Site Assessment (ESA) – 3301 Atlantic Avenue and 242 Chestnut Street, Brooklyn, New York, AKRF, Inc. (AKRF), September 2015

AKRF conducted a Phase I ESA of a larger area including the Site in September 2015. The Phase I ESA identified the following RECs at the Site:

- Historic on-site industrial operations, including the Columbia Machine Works and Malleable Iron Company, and the Columbia Cable and Electric Corporation. It was concluded that undocumented releases from historic industrial uses may have affected subsurface conditions at the Site.
- The address 3301 Atlantic Avenue was formerly associated with the entirety of Block 4143. At the time of the Phase I ESA, 3301 Atlantic Avenue was listed in the following databases: PBS database for the storage of several USTs and aboveground storage tanks (ASTs); Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS); chemical bulk storage (CBS); Spill database for Spill No. 0101620; Toxic Release Inventory System (TRIS); and Air Discharge Facility (ADF) databases. It was reported that these listings may have been related to the Site and/or south-adjoining property(ies).
- The former interconnected factory buildings were damaged by a fire in 2012. Abundant debris, including metal, wood, and ash were observed throughout the buildings during the Site inspection. Based on the documented storage of petroleum and chemicals, it was concluded that undocumented discharges due to the fire may have affected subsurface conditions at the Site, including high concentrations of metals and SVOCs in the ash.
- Two July 2013 Asbestos Reports identified ACM throughout the former buildings' interiors and on exterior built-up roofing materials. Interior and exterior building materials were observed to be in fair to poor condition, with the majority of the eastern portion of the former Site buildings damaged by fire. Observed painted surfaces were generally in fair to poor condition. Based on the age of the

> former Site buildings, it was concluded that LBP may have been present and the fluorescent lighting fixtures and remaining electrical equipment may have contained mercury and/or polychlorinated biphenyls (PCBs). No evidence of leaks or stains from these fixtures and equipment was observed; however, it was noted that releases may have occurred during the fire that were not able to be investigated due to inaccessibility and/or debris observed during the inspection.

AKRF recommended a Subsurface (Phase II) Investigation to characterize subsurface conditions of soil, groundwater, and soil vapor across the Site prior to redevelopment.

Subsurface (Phase II) Investigation Report – 3264 Fulton Street, Brooklyn, New York, AKRF, Inc. (AKRF), January 2016

AKRF conducted a Subsurface (Phase II) Investigation at the Site in December 2015, which was based on the September 2015 Phase I ESA by AKRF. The Subsurface (Phase II) Investigation included the advancement of 3 soil borings with the collection and laboratory analysis of 6 soil samples; the installation of 1 temporary groundwater monitoring well at 1 of the boring locations with the collection and laboratory analysis of 1groundwater sample; and the installation of 1 temporary soil vapor point with the collection and laboratory analysis of 1 soil vapor sample. An ambient air sample was collected for comparison and QA/QC purposes.

Soil beneath the Site consisted of fill material (sand, gravel, silt, concrete, brick, ash, and asphalt) to depths up to approximately 11 feet below grade, underlain by apparent native soil (sand and gravel) up to 40 feet below grade (the extent of the soil borings). Groundwater was encountered at approximately 30 feet below grade.

The VOC TCE was detected in two soil samples at concentrations above its Unrestricted Use Soil Cleanup Objective (UUSCO). Arsenic, copper, lead, and zinc were detected in soil samples at concentrations above their respective Unrestricted Use Soil Cleanup Objectives (UUSCOs) and/or Restricted Residential Soil Cleanup Objectives (RRSCOs). The VOC chloroform was detected in the groundwater sample at a concentration slightly above its AWQS. Sodium was detected in the unfiltered and filtered groundwater sample at concentrations above its AWQS. VOCs associated with petroleum were detected in soil vapor samples at individual concentrations up to 161 micrograms per cubic meter ($\mu g/m^3$) and solvent-related VOCs were detected at individual concentrations up to 903 $\mu g/m^3$. AKRF concluded that the soil, groundwater, and soil vapor contaminants appear to be associated with former industrial operations at the Site.

Remedial Investigation (RI) Report (RIR) – Atlantic Chestnut – Lot 1, 3264 Fulton Street, Brooklyn, New York, AKRF, Inc. (AKRF), April 2017

AKRF conducted an RI at the Site in December 2016 in accordance with the NYSDEC-approved November 2015 RI Work Plan (RIWP). The RI included: the performance of a geophysical survey across accessible portions of the Site; the advancement of 14 soil borings and the collection of 26 soil samples for chemical analysis; the installation of 5 permanent, 2-inch diameter groundwater monitoring wells and the collection of 5 groundwater samples for chemical analysis; the installation of 6 temporary soil vapor probes across the Site and the collection of 6 soil vapor samples and 1 ambient air samples for chemical analysis; and the survey of groundwater monitoring well elevations on the Site and south-adjoining lots to develop Site-specific and local groundwater contour maps to determine groundwater flow beneath the Site and surrounding area.

The stratigraphy of the Site, from the surface down, generally consisted of fill comprising sand, silt, gravel, concrete, brick, and metal up to a maximum depth of 6 feet below grade, underlain by apparent native sand with varying amounts of gravel and silt to boring termination depths (up to 35 feet below grade). Groundwater was encountered at depths ranging from approximately 30.5 feet to 32.7 feet below sidewalk grade or 8.6 to 8.7 feet above national geodetic vertical datum (NGVD), an approximate of mean sea level in groundwater monitoring wells on the northern and southern portions of the Site, respectively. Based on the well elevation survey, groundwater flows in a southerly direction beneath the Site and surrounding area.

The RIR concluded that contaminated soil, groundwater, and soil vapor present at the Site were likely attributable to historic Site usage, including the former industrial and manufacturing uses. The presence of copper, hexavalent chromium, lead, mercury, and zinc in shallow fill and the elevated detections of polycyclic aromatic hydrocarbons (PAHs) in soil were attributed to historic filling, undocumented discharges due to a fire in 2012, and/or historic operations at the Site. The presence of petroleum-related compounds in soil vapor were likely related to the former storage tanks and/or historic Site usage. The presence of the chlorinated solvent-related compounds TCE in soil, groundwater, and soil vapor; PCE in groundwater and soil vapor; chloroform in groundwater; and carbon tetrachloride in soil vapor were likely related to the historic manufacturing operations at the Site.

Draft Remedial Action Work Plan – Atlantic Chestnut – Lot 1, 3264 Fulton Street, Brooklyn, New York, AKRF, Inc., September 2017

AKRF prepared a Draft Remedial Action Work Plan (RAWP) in September 2017. The RAWP outlined the Remedial Action Objectives (RAOs), which established procedures and cleanup objectives for the protection of public health and the environment. The RAWP established Track 4 Restricted Residential Soil Cleanup Objectives (RRSCOs) and soil handling procedures, required the installation of a vapor barrier and an active sub-slab depressurization system (SSDS) to address potential vapor intrusion into the proposed building, a Site-wide composite cover system to prevent direct exposure to residual contamination in soil, and outlined a project schedule for construction. The RAWP included a Site-specific HASP and CAMP for Site worker and community safety.

Remedial Design Investigation – Atlantic Chestnut – Lot 1, 3264 Fulton Street, Brooklyn, New York, AKRF, Inc. August, November, & December 2017

AKRF conducted an RDI between August 11 and 16, 2017, and on November 15 and December 20, 2017 in accordance with the July 2018 NYSDEC-approved RDI Work Plan. The RDI included the installation of 25 soil borings with the collection and laboratory analysis of 90 soil samples; the installation of 4 permanent, 2-inch diameter nested groundwater monitoring wells; the collection of 17 groundwater samples for chemical analysis from the nested monitoring wells and the monitoring wells installed during the RI to evaluate groundwater quality; and the performance of a groundwater monitoring well survey to develop Site-specific groundwater contour maps and confirm groundwater flow beneath the Site. The RDI Report (RDIR) is currently being prepared.

CVOC soil sample concentrations above NYSDEC UUSCOs, RRSCOs, and PGWSCOs are shown on Figure 6. CVOC groundwater concentrations above NYSDEC AWQSs are shown on Figure 7. RI soil vapor concentrations are shown on Figure 8.

4.0 NATURE AND EXTENT OF CONTAMINATION

4.1 Conceptual Model of Site Contamination

Site contamination, present in shallow soil, groundwater, and soil vapor across the Site, appears to be related to the Site's historic industrial and manufacturing uses. The elevated detections of PAHs and metals in shallow fill are most likely attributable to historic filling, undocumented discharges due to the fire in 2012, and/or historic operations at the Site. The presence of petroleum-related compounds in soil vapor may be related to the former storage tank(s). The presence of the chlorinated solvents TCE (in soil, groundwater, and soil vapor), PCE (in groundwater and soil vapor), chloroform (in groundwater), and carbon tetrachloride (in soil vapor) are likely related to the historic manufacturing operations at the Site. Based on Site-specific and local groundwater flow, the contaminants in shallow groundwater could be migrating to the south. Additionally, when organic compounds are exposed to air, contamination can partition from soil and groundwater and migrate in a vapor phase through the pore spaces in unsaturated soil. The vapors can accumulate beneath structures such as pavement and building foundations. The affected media for the existing or potential future releases at the Site include soil, groundwater, and soil vapor.

4.2 Contaminated Media

AKRF's 2015 Subsurface (Phase II) Investigation, 2016 RIR, and 2017 RDI concluded that contaminated soil, groundwater, and soil vapor are present at the Site. Elevated concentrations of the CVOCs, including TCE, PCE, and carbon tetrachloride, were detected in soil vapor across the Site. Elevated concentrations of TCE and PCE on the southern portion of the Site and chloroform on the northeastern portion of the Site were detected in groundwater. Elevated concentrations of TCE were detected in soil up to one foot below grade on the western side of the Site and between grade and the water table (approximately 30 feet below grade) on the southern portion of the Site. Additionally, elevated concentrations of PAHs and heavy metals (arsenic, lead, and copper) were detected in soil up to 15 feet below grade on the northern, western, and southern portions of the Site.

4.3 Qualitative Human Health Exposure Assessment (QHHEA)

A QHHEA was completed as part of the RAWP. The results of the QHHEA indicated that existing soil and groundwater conditions do not pose a threat to human health, as the Site is undeveloped and fully capped with concrete and asphalt and groundwater is not used as a source of drinking water in this part of Brooklyn. However, the QHHEA concluded that there is a potential exposure pathway from soil vapor emanating from the subsurface to enter into the adjoining buildings as a result of any basement floor or lower wall openings/cracks. The indoor air quality at the adjoining properties could be susceptible to contamination from subsurface vapor intrusion.

5.0 INTERIM REMEDIAL MEASURE (IRM): SOIL VAPOR EXTRACTION (SVE) SYSTEM

This section describes the proposed IRM for the Site, which includes the installation, startup, and operation and maintenance of an SVE system around the Site perimeter to mitigate the potential for off-site migration of CVOCs in soil vapor until a Site-wide remedy can be implemented under a NYSDEC-approved RAWP, currently anticipated in January 2020. The SVE system will target the northern, eastern, and western Site boundaries. Off-site soil vapor migration to the south will be addressed by SVE systems installed on the south-adjacent properties (NYSDEC BCP Site #s C224235 and C224236), which will be operational by the end of 2018.

A pilot study will be conducted prior to final design and installation of the full-scale SVE system. After installation and start-up, the SVE system will apply a negative pressure (vacuum) to the subsurface to recover and treat vapor beneath the Site boundaries. Recovered vapors will be directed to an aboveground vapor treatment system consisting of granular-activated carbon (GAC), and will be subsequently discharged to the atmosphere in accordance with 6NYCRR Part 212.

5.1 Treatment Area

The target area for the SVE system is the vadose (unsaturated) zone comprising approximately 730 linear feet along the northern, eastern, and western Site boundaries. The proposed treatment area is shown on Figure 10.

5.2 SVE Pilot Test

5.2.1 Pilot Test SVE Well Installation

To conduct the pilot test, two SVE wells, denoted as L1-SVE-6 and L1-SVE-8, will be installed at the approximate locations shown on Figure 9. The SVE wells will be installed to 15 feet below grade using a hollow-stem auger (HSA) truck-mounted rotary rig with 6.25-inch outside diameter augers. The wells will be installed with 4-inch diameter Schedule 40 polyvinyl chloride (PVC) pipe, with a 10-foot length of 0.020-inch slotted screen and solid riser. A No. 2 sand filter pack will be installed around and to 2 feet above the top of the well screen(s). Approximately 2 feet of hydrated bentonite will be installed above the sand filter pack and a non-shrinking bentonite-cement grout will be used to fill the annular space to approximately 1 foot below grade. Each SVE well will be finished with a locking cap flush-with-grade curb box set in a concrete box with an apron around the curb box to direct run-off away from the well. Well construction logs will be prepared and included as an appendix to the IRM Report (IRMR).

Drill cuttings will be inspected by AKRF field personnel for evidence of contamination (e.g., odors and staining) and screened for VOCs with a PID equipped with an 11.7 electron volt (eV) lamp. The PID will be calibrated in accordance with manufacturer's specifications prior to screening. Drill cuttings will be managed in accordance with the requirements detailed in Section 5.7.

5.2.2 Vapor Monitoring Point Installation

Twelve vapor monitoring points (denoted as L1-VMP-1 through L1-VMP-12) will be installed using a direct-push probe (DPP) rig at the locations shown on Figure 9. Each vapor monitoring point will be installed with a probe set at the approximate depth of the screened interval of the corresponding pilot test well. The vapor monitoring points will be generally installed 20 feet north, south, east, and west of each SVE well and 40 feet north, south, east, and west of each SVE well to the extent practicable, based on Site constraints due to the proposed SVE wells' proximity to the Site boundaries and the partial cellar.

At each monitoring point, the six-inch stainless steel screen implants will be connected to Teflon™-lined tubing and installed to the target depths of the screened intervals of each SVE well. The sampling tubing will extend from the end of the screen to above grade. The annular space around the point and tubing will be backfilled with clean silica sand to between approximately 3 and 6 inches above the screen. Hydrated bentonite will be used to fill the remaining void around the sampling tubing to approximately 1 foot below grade and a non-shrinking cement-grout mixture will fill the void to grade. The vapor monitoring points will be finished with flush-mounted locking well covers.

5.2.3 Baseline Monitoring

Baseline monitoring will be conducted to provide data for static conditions prior to initiating the pilot test. The measurements from each of the SVE and vapor monitoring points will include the following:

- Vacuum/pressure of well headspace using a magnehelic gauge;
- VOCs of well headspace using a PID; and
- Oxygen (O_2) of well headspace using an O_2 meter.

Each monitoring point will be fitted with an expandable well cap that will be pre-drilled with a hose fitting and connected to a section of sampling hose to allow for headspace readings (vacuum/pressure, VOCs, O_2) within the well. Magnehelic gauges measuring a range of 0 to 5 inches of water will be utilized during the baseline monitoring to measure vacuum and/or pressure at the observations wells.

5.2.4 Blower Calibration

A skid-mounted regenerative blower with a capacity of 100 cubic feet per minute (cfm) at a vacuum of 40 inches of water (in H_2O), will be utilized for the pilot test. The system will be equipped with a variable frequency drive (VFD), flow meter, and vacuum gauge. The blower specifications and blower curve for a typical blower that may be used during the pilot test is provided in Appendix C. The actual blower make and model will depend on availability at the time of the pilot test.

Following installation of the SVE blower assembly, the blowers, gauges, and monitoring equipment will be checked for functionality. The SVE blower will be operated initially to determine the maximum flow rate and applied vacuum. The system will then be shut off.

5.2.5 Pilot Test Implementation

In order to specify design details for the proposed SVE system, a bench-scale pilot test will be performed to confirm the radius of influence (ROI) around each SVE well and to evaluate the appropriate blower sizing. Effluent vapor sampling will also be conducted to determine the change out schedule and sizing of the proposed granular activated carbon (GAC) vapor treatment prior to discharge into the atmosphere.

The pilot test will be performed at both of the SVE pilot test wells in step tests utilizing three increasing air flow rates as a percentage (25%, 50%, and 100%) of the maximum blower capacity without inducing significant upwelling and/or water entrainment. The maximum capacity will be determined as part of the blower calibration described in Section 5.2.4.

5.2.6 SVE Well Installation

The scope of work (SOW) described herein consists of: the installation of 10 SVE wells and 12 vapor monitoring points; pilot and communication testing; the collection and laboratory analysis of one influent and one effluent vapor sample to establish carbon breakthrough thresholds; the completion of an SVE system location survey; and system startup, operation, and maintenance.

The preliminary design is based upon an assumed ROI of 40 feet for each SVE well. Based upon these ROI, the SVE wells will be spaced on 70- to 80-foot centers, as shown on Figure 10. The proposed full-scale SVE system design described in the following sections are based on anticipated design parameters and the design will be reevaluated and finalized based upon the pilot test. Design parameters will be confirmed with NYSDEC prior to finalizing system design.

The proposed SVE well locations and rationales are summarized in Table 1.

Table 1
Soil Vapor Extraction System Well Locations and Rationale

SVE Well ID	On-Site Location	Screened Interval(s)	Rationale
SVE-1	Southwestern	5-15’ below grade	To prevent off-site migration of soil vapor to the north and west
SVE-2	West-central	5-15’ below grade	To prevent off-site migration of soil vapor to the west
SVE-3	Northwestern	5-15’ below grade	To prevent off-site migration of soil vapor to the west
SVE-4	Northern	5-15’ below grade	To prevent off-site migration of soil vapor to the north
SVE-5	Northern	5-15’ below grade	To prevent off-site migration of soil vapor to the north
SVE-6*	Northern	5-15’ below grade	To prevent off-site migration of soil vapor to the north
SVE-7$^+$	Southeastern	5-15’ below grade	To prevent off-site migration of soil vapor to the east
SVE-8*$^+$	East-central	5-15’ below grade	To prevent off-site migration of soil vapor to the east
SVE-9$^+$	East-central	5-15’ below grade	To prevent off-site migration of soil vapor to the east
SVE-10$^+$	Northeastern	5-15’ below grade	To prevent off-site migration of soil vapor to the north and east

Note:
* SVE system wells SVE-6 and SVE-8 will be installed for use during the bench-scale pilot test.
$^+$ SVE well is located within the former building cellar, approximately 8-10 feet below sidewalk grade.

The following sections describe the methods that will be used to complete the aforementioned SOW.

5.3 Soil Vapor Extraction (SVE) System Set Up

Soil vapor sampling conducted during the RI identified individual CVOC concentrations up to 3,650 µg/m^3 and petroleum-related compounds at concentrations up to 56.5 µg/m^3, as shown on Figure 8. The elevated concentrations were detected across the Site, with the greatest concentrations across the down-gradient (i.e., southern) portion of the Site.

5.3.1 Pilot Test Soil Vapor Extraction (SVE) Well Communication Testing

After the pilot test SVE wells are constructed, they will be connected to a blower and the corresponding sub-slab negative pressure will be measured using magnehelic differential pressure gauges at soil vapor points in the vicinity of the extraction well. The communication testing will be used to establish the necessary quantity and location of extraction wells for a full-scale SVE system. Throughout the pilot test, extraction air flow rate and applied vacuum will be measured at the SVE pilot test wells, induced vacuum will be measured at the observation points, and total VOC concentrations will be measured in both the extraction wells and observation wells using a PID. The data will be recorded on pilot test data sheets, included as an appendix to the IRMR, and graphically plotted to aid in optimizing the system design.

Monitoring will consist of measuring vacuum at each point with a magnehelic differential pressure gauge during full system operation. A vacuum reading of 0.1 inches of water column will be utilized at the minimum induced vacuum target for the monitoring points during the SVE communication testing to establish the design ROI for the respective extraction well.

The blower will be attached to the extraction well with a two-inch diameter hose or PVC piping, and a dilution valve will be installed to adjust the flow rate and vacuum of the blower. This will allow the applied vacuum to be adjusted by bleeding in ambient air through a bypass valve. The blower will be equipped with a moisture separator, flow meter, and a vacuum gauge. One GAC filter equipped with a minimum of 175 pounds of carbon will be used to treat recovered vapors during the pilot test. Sampling ports will be provided to determine the influent VOC concentrations. The vacuum monitoring points will be used to measure observed vacuum at varying distances from the pilot test wells. The effective ROI will be evaluated for both of the extraction wells by plotting the observed vacuum versus distance from each extraction well from each of the three observation wells.

This iterative design approach of SVE well installation with communication testing ensures a continuous zone of extraction with adequate vacuum to mobilize and/or contain target contamination. The capacity (vacuum and flow) at each SVE well will also be evaluated for use in the final system design, including the potential need for additional SVE wells, blower specifications, and components.

5.3.2 Pilot Test Monitoring Parameters and Procedure

Three step tests will be conducted at varying flow rates and vacuums described in Section 4.3.3. During each test, the parameters listed in Table 2 will be measured in the SVE wells and vapor monitoring points.

Table 2
Soil Vapor Extraction System Pilot Test Monitoring Parameters

Extraction Well	Vapor Monitoring Points
• Applied Vacuum • Air Flow • VOC concentration (influent, intermediate, effluent) • O_2 (influent)	• Induced vacuum (well cap) • VOCs (well cap) • O_2 (well cap)

Data will be collected at approximate 30 minute intervals for a minimum period of two hours and until steady state conditions are reached. A vacuum reading of 0.1 in H_2O column will be utilized as the minimum induced vacuum target for the monitoring points during the SVE pilot testing to establish the design ROI for the respective SVE extraction well. The data will be recorded on pilot test data sheets and subsequently plotted graphically to aid in optimizing the system design.

Atmospheric conditions, including barometric pressure, humidity, and wind direction and speed, will be collected at the start of the day and periodically throughout the test. During each step test, the extraction wells will be monitored for the following parameters: applied vacuum, air flow, and influent and effluent VOC concentrations. Observation points will be monitored for induced vacuum and VOC concentrations.

This iterative design approach of SVE well installation with communication testing ensures a continuous zone of extraction with adequate vacuum to mobilize and/or contain target contamination. The capacity (vacuum and flow) at each SVE well will be evaluated for use in the final system design, including the potential need for additional SVE wells, blower specifications, and components.

5.3.3 Vapor Sampling

One influent and one effluent air sample will be collected during each step test for laboratory analysis of VOCs by EPA Method TO-15 to determine VOC mass loading and associated treatment requirements as part of the design for a full-scale SVE system. The laboratory sample collected during the pilot testing will be collected in a Tedlar® bag and analyzed by a NYSDOH-certified laboratory using Category B deliverables.

5.4 Full-Scale Soil Vapor Extraction (SVE) Well Installation

After completion of the pilot test, the effective ROIs for L1-SVE-6 and L1-SVE-8 will be evaluated by plotting the observed vacuum versus distance from each extraction well from each of the observation wells. Based on the results of the pilot test, SVE wells L1-SVE-1 through L1-SVE-5, L1-SVE-7, L1-SVE-9, and L1-SVE-10 will be installed at the approximate locations shown on Figure 10. The proposed full-scale SVE system design described in the following sections are based on anticipated design parameters and the design will be reevaluated and finalized based upon the pilot test (described in Section 5.2).

5.5 Soil Vapor Extraction (SVE) Well Location Survey

The SVE wells will be surveyed by a New York State-licensed surveyor to determine their accurate location. The locations will be plotted graphically and will be included in the IRMR.

5.6 Decontamination Procedures

All non-dedicated sampling equipment will be decontaminated between discrete locations using the following procedure:

1. Scrub equipment with a bristle brush using a tap water/Alconox® solution.
2. Rinse with tap water.
3. Scrub again with a bristle brush using a tap water/Alconox® solution.
4. Rinse with tap water.
5. Rinse with distilled water.
6. Air-dry the equipment.

5.7 Management of Investigation-Derived Waste (IDW)

Soil cuttings will be containerized in properly labeled Department of Transportation (DOT)-approved 55-gallon drums for future off-site disposal at a permitted facility. The drums will be sealed at the end of each work day and labeled with the date, the SVE well ID(s), the type of waste (i.e., drill cuttings) and the name of an AKRF point-of-contact. All drums will be labeled "pending analysis" until laboratory data is available. All IDW will be disposed of or treated according to applicable local, state, and federal regulations. Disposable sampling equipment, including spoons, gloves, bags, paper towels, etc. that come in contact with environmental media will be double bagged and disposed of as municipal trash in a facility trash dumpster as non-hazardous refuse.

5.8 System Location and Components

The proposed layout of the SVE system is shown on Figure 11 and a conceptual process and instrumentation diagram (P&ID) detailing the SVE system components, is provided as Figure 12. The layout of the proposed system will be confirmed or altered, based on the results of the pilot test. Each SVE well will be connected to the system via a horizontal leg of aboveground, 4-inch diameter Schedule 40 PVC, which will be insulated and wrapped with heat tape. The piping will be sloped at least 1% toward the SVE well.

Tentatively, the proposed SVE system is composed of the following:

- Ten 4-inch diameter PVC SVE wells along the northern, western, and eastern Site boundaries.
- Ancillary equipment, including flow meters, vacuum gauges, throttling vales, etc.
- One appropriately-sized blower to extract soil vapor, with a variable-frequency drive (VFD) to throttle blower operation to appropriate conditions (vacuum and air flow rate). The blower will be selected based on the results of the pilot test.
- A dedicated, centrally-located equipment shed.
- A control panel equipped with a telemetry system to notify select personnel of alarm conditions.
- A carbon treatment unit comprised of two 400-pound carbon units in series.
- An effluent stack consisting of an 8-inch pipe extending from the equipment shed on the central portion of the Site through the roof and terminating a minimum of 10 feet from any building intakes or operable windows.

The three individual SVE lines on the western portion of the Site (from SVE wells L1-SVE-1 through L1-SVE-3) will be manifolded into a single 6-inch line (L1-SVE-A); the three individual SVE lines on the northern portion of the Site (from SVE wells L1-SVE-4 through L1-SVE-6 will be manifolded into single 6-inch line (L1-SVE-B), and the four individual SVE lines from SVE wells L1-SVE-7 through L1-SVE-10 will be manifolded into a single 6-inch line (L1-SVE-C). These three lines will be manifolded again into a single 6-inch inlet line inside the system shed, leading into a moisture separator tank with associated transfer pump and a 55-gallon drum with a high-level alarm. The outlet of the moisture separator will be connected to a particulate filter, and dilution valve with fresh air intake, followed by the SVE blower with VFD. The VFD would be used to throttle the blower during SVE system balancing. Pre- and post-blower pressure gauges will be installed to monitor strain across the blower. The outlet of the SVE blower will lead directly to the influent port of the carbon treatment system. The proposed SVE system will also include a remote telemetry system and automated shutdown conditions to prevent equipment breakdown.

The carbon treatment system will comprise two 400-pound GAC units, connected in series. Influent, intermediate, and effluent sample ports and pressure gauges will be installed on the carbon system for monitoring purposes. The outlet of the second GAC unit in series will lead to an effluent stack, with a final discharge point located a minimum of 12 feet above grade and at a minimum of 10 feet from any operable windows, adjoining or adjacent buildings, HVAC intakes, or supply registers. The proposed blower and GAC unit cut sheets are included in Appendix C.

6.0 REPORTING REQUIREMENTS

6.1 Interim Remedial Measure Report (IRMR)

Upon completion of all field work and receipt of laboratory analytical results, an IRMR will be prepared that will document field activities; present field and laboratory data; discuss conclusions and recommendations drawn from the results of the investigation; and detail the soil and groundwater remedies. The IRMR will include a summary of the pilot testing and finalized design details for the proposed full-scale system.

6.2 System Operation, Maintenance, and Monitoring (OM&M) Plan

Upon completion of the SVE pilot test and finalization of system design, an O&M Plan will be prepared that will describe the measures necessary to operate, monitoring, and maintain the mechanical components of the proposed SVE system. The O&M plan will include directions for typical O&M of the proposed SVE system and an O&M contingency plan, and will be updated periodically to reflect any Site changes.

7.0 SCHEDULE

Table 3
Project Schedule

Activity	**Time To Complete**
Draft IRMWP Submitted to NYSDEC	April 16, 2018
NYSDEC Issues Comments on IRMWP	May 4, 2018
Final IRMWP Submitted to NYSDEC	July 2, 2018
NYSDEC Approves IRMWP	July 2018
Draft Remedial Design Investigation Repot (RDIR) Submitted to NYSDEC	July 2018
NYSDEC Issues Comments on RDIR	July/August 2018
IRM Implementation – SVE System Pilot Test	July/August 2018
NYSDEC Approves RDIR	August/September 2018
IRM Implementation – SVE System Equipment Procurement, Installation, and Startup	August - November 2018
Draft IRM Report and Operations, Maintenance, and Monitoring (OM&M) Plan Submitted to NYSDEC	December 2018/January 2019
Revised Draft Remedial Action Work Plan (RAWP) Submitted to NYSDEC	March 2019
Public Comment Period for RAWP Initiated	April 2019
Public Comment Period for RAWP Ends	June 2019
Final RAWP Submitted	July/August 2019
NYSDEC Approves RAWP and Issues Decision Document	September 2019
Issue Remedial/Construction Notice Fact Sheet	December 2019
Begin Redevelopment/RAWP Implementation	January 2020
Draft Site Management Plan (SMP) Submitted to NYSDEC	July 2021
Execution of Environmental Easement	August 2021
Draft Final Engineering Report and Fact Sheet	September 2021
Certificate of Completion and Fact Sheet	December 2021
Completion of Building	December 2023

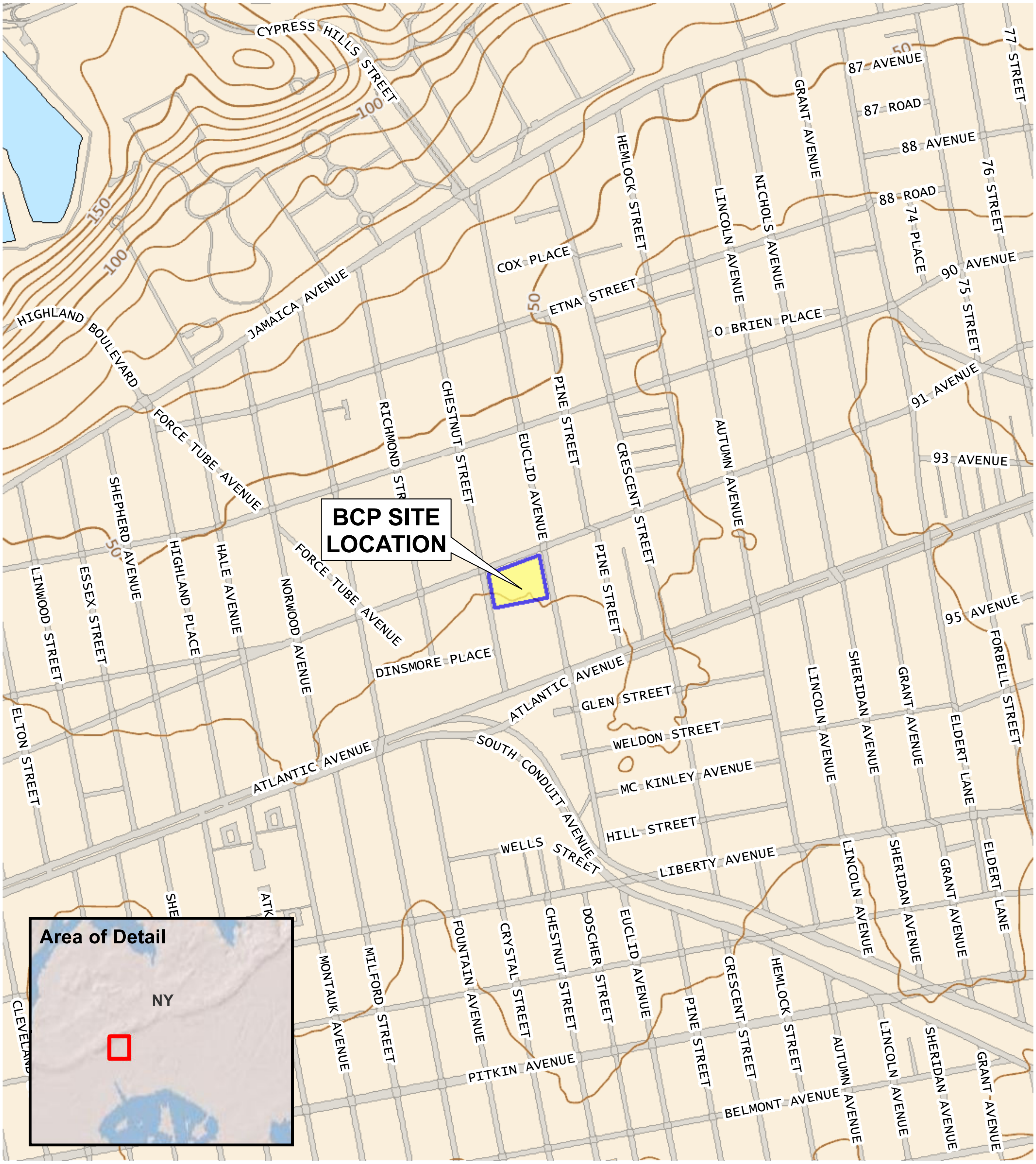
8.0 CERTIFICATION

I, Michelle Lapin, P.E., certify that I am currently a NYS registered Professional Engineer as defined in 6 NYCRR Part 375 and that this Interim Remedial Measure Work Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

I certify that all information and statements in this certification are true. I understand that a false statement made herein is punishable as Class "A" misdemeanor, pursuant to Section 210.45 of the Penal Law.

Michelle Lapin, P.E.		July 2, 2018
Name	***Signature***	***Date***

FIGURES



SOURCE
USGS: Copyright:© 2014 Esri, USGS The National Map:

0 800 1,600 Feet

©2018 AKRF W:\Projects\12492 - PHIPPS ATLANTIC CHESTNUT - LOT 1\Technical\Hazmat\Phase II\3264 Fulton Street (North Lot)\GIS\12492 Fig 1 site loc map.mxd3/16/2018 10:17:59 AM mveilleux

AKRF
440 Park Avenue South, New York, NY 10016

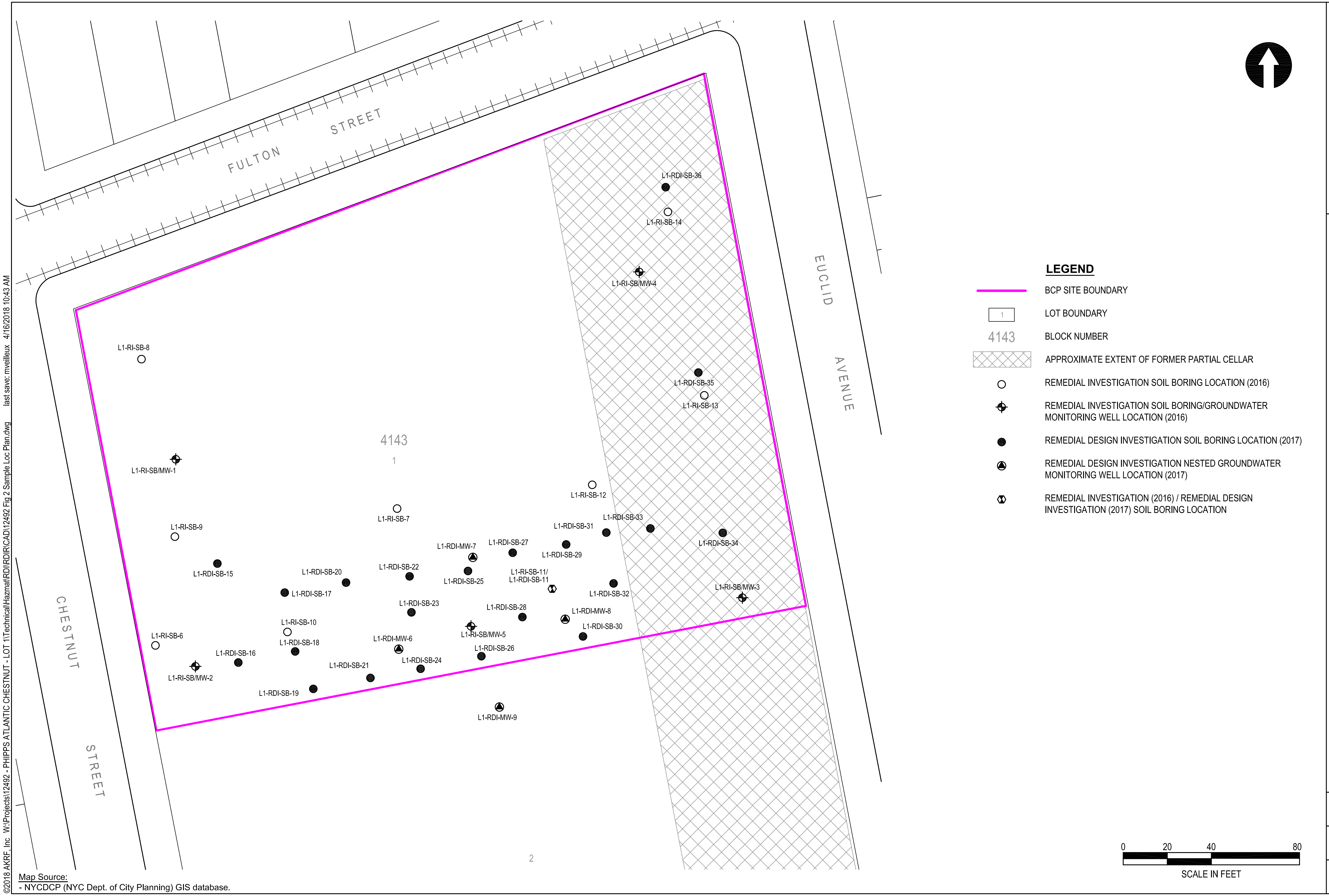
Atlantic Chestnut - Lot 1
3264 Fulton Street
Brooklyn, New York

BROWNFIELD CLEANUP PROGRAM
SITE LOCATION MAP

DATE
3/16/2018

PROJECT NO.
12492

FIGURE
1



LEGEND

▬	BCP SITE BOUNDARY
☐ 1	LOT BOUNDARY
4143	BLOCK NUMBER
▨	APPROXIMATE EXTENT OF FORMER PARTIAL CELLAR
○	REMEDIAL INVESTIGATION SOIL BORING LOCATION (2016)
⊕	REMEDIAL INVESTIGATION SOIL BORING/GROUNDWATER MONITORING WELL LOCATION (2016)
●	REMEDIAL DESIGN INVESTIGATION SOIL BORING LOCATION (2017)
▲	REMEDIAL DESIGN INVESTIGATION NESTED GROUNDWATER MONITORING WELL LOCATION (2017)
⊗	REMEDIAL INVESTIGATION (2016) / REMEDIAL DESIGN INVESTIGATION (2017) SOIL BORING LOCATION

Map Source:
- NYCDCP (NYC Dept. of City Planning) GIS database.

©2018 AKRF, Inc W:\Projects\12492 - PHIPPS ATLANTIC CHESTNUT - LOT 1\Technical\Hazmat\RDIR\RDIR\CAD\12492 Fig 2 Sample Loc Plan.dwg last save: mveilleux 4/16/2018 10:43 AM

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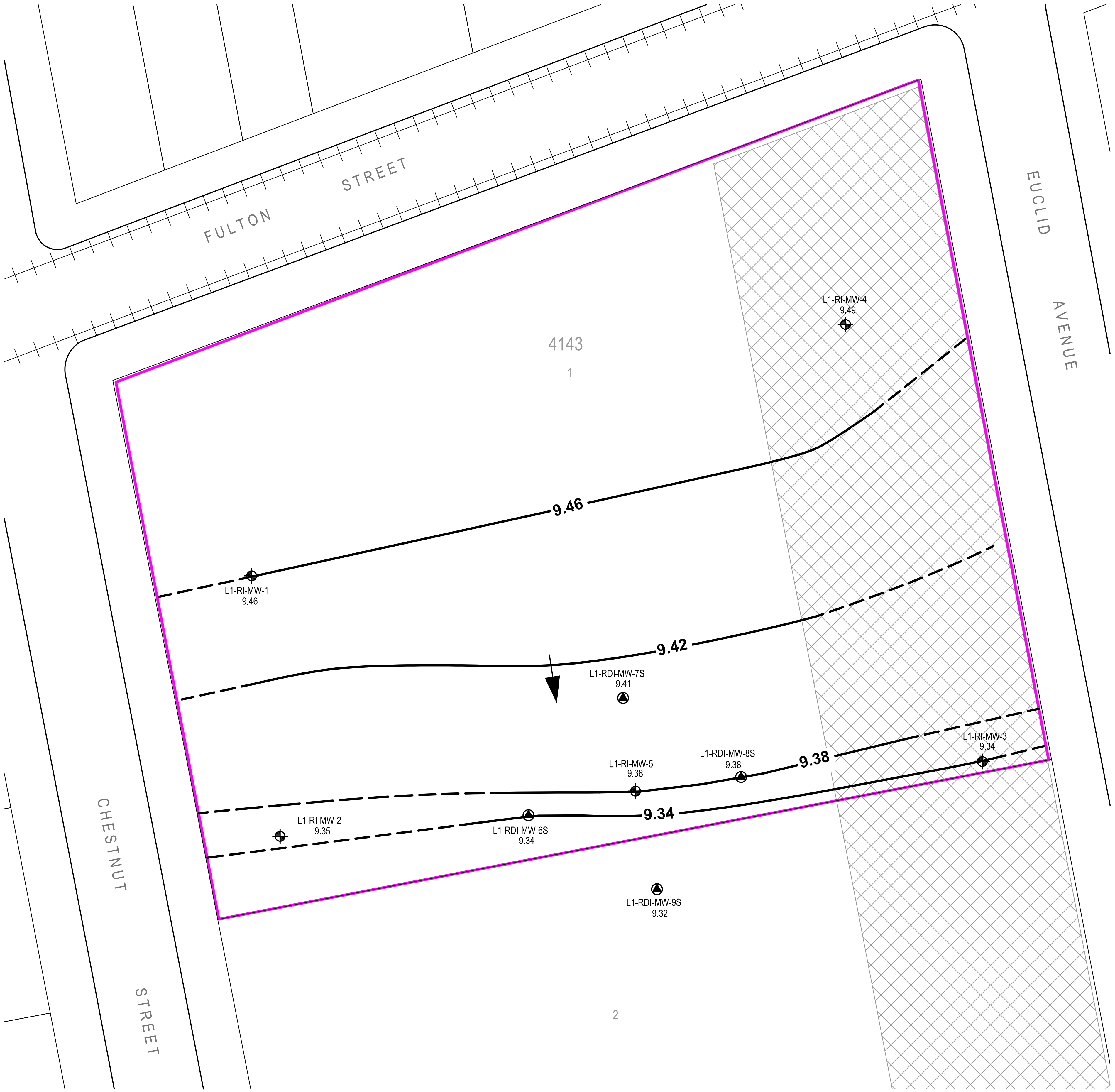
SITE AND SAMPLE LOCATION PLAN

DATE
4/16/2018

PROJECT NO.
12492

FIGURE
2



Map Source:
- NYCDCP (NYC Dept. of City Planning) GIS database.

LEGEND

―	BCP SITE BOUNDARY
☐ 1	LOT BOUNDARY
4143	BLOCK NUMBER
┼┼┼┼┼┼┼	MTA RAILROAD ELEVATED TRACKS
▨	APPROXIMATE EXTENT OF FORMER PARTIAL CELLAR
⊕	REMEDIAL INVESTIGATION GROUNDWATER MONITORING WELL LOCATION (2016)
▲	REMEDIAL DESIGN INVESTIGATION NESTED GROUNDWATER MONITORING WELL LOCATION (2017)
9.49	WATER TABLE ELEVATION IN FEET
9.30 ―	GROUNDWATER ELEVATION CONTOUR IN FEET (DASHED WHERE INFERRED)
↓	GROUNDWATER FLOW DIRECTION

Groundwater Monitoring Well ID	Top of Casing	Depth to Groundwater (feet below TOC)	Groundwater Elevation (feet)
L1-RI-MW-1	39.05	29.59	9.46
L1-RI-MW-2	38.60	29.25	9.35
L1-RI-MW-3	34.88	25.54	9.34
L1-RI-MW-4	35.93	26.44	9.49
L1-RI-MW-5	41.00	31.62	9.38
L1-RDI-MW-6S	41.04	31.70	9.34
L1-RDI-MW-7S	40.43	31.02	9.41
L1-RDI-MW-8S	40.94	31.56	9.38
L1-RDI-MW-9S	40.79	31.47	9.32

Notes:

All elevations are referenced to the North American Vertical Datum of 1988 (NAVD88).

TOC - Top of Casing

0 20 40 80

SCALE IN FEET

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SHALLOW GROUNDWATER CONTOUR MAP - AUGUST 28, 2017

DATE
4/16/2018

PROJECT NO.
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FIGURE
3

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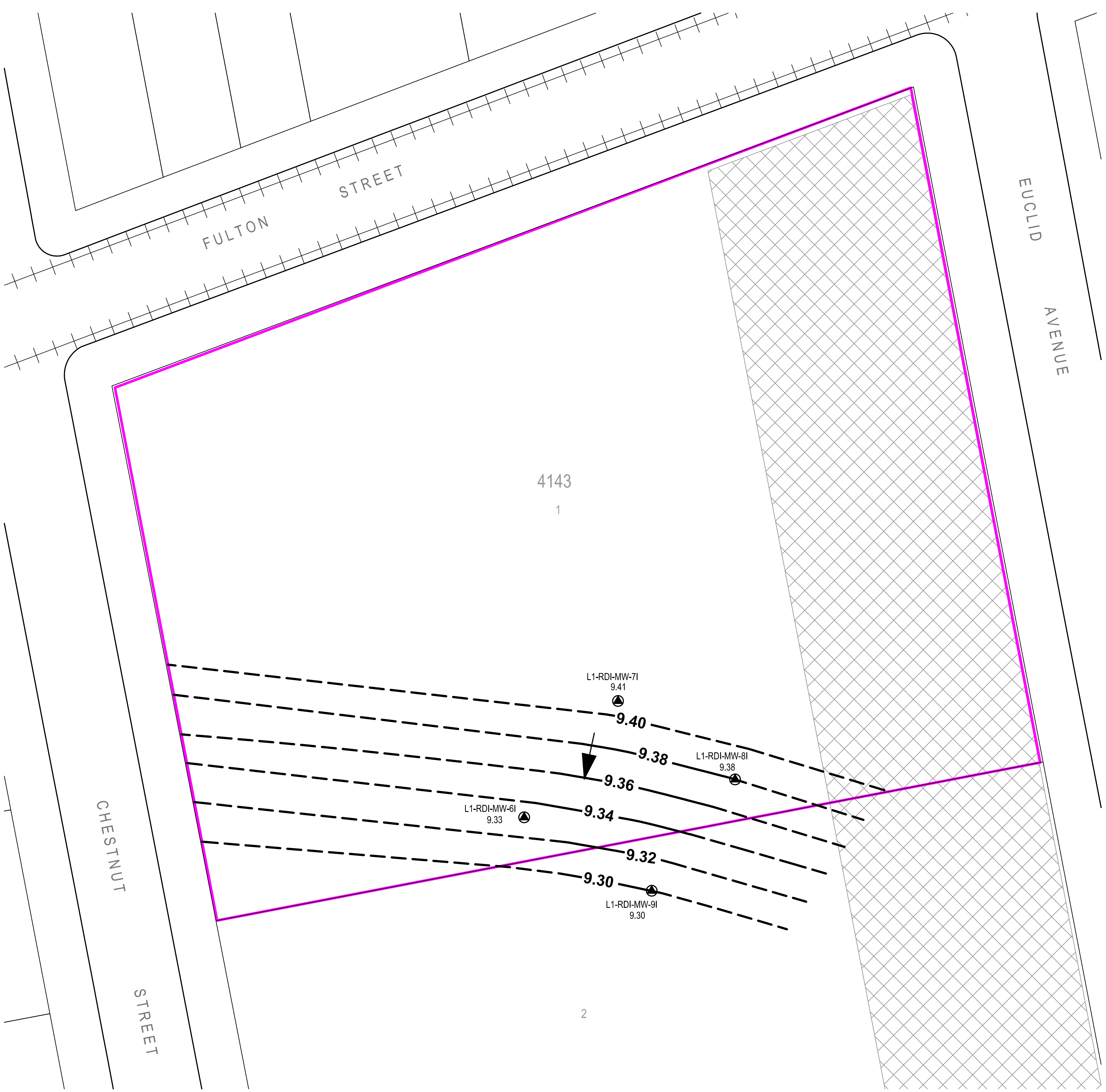

LEGEND

▬	BCP SITE BOUNDARY
☐ 1	LOT BOUNDARY
4143	BLOCK NUMBER
┼┼┼┼┼┼┼	MTA RAILROAD ELEVATED TRACKS
▨	APPROXIMATE EXTENT OF FORMER PARTIAL CELLAR
▲	REMEDIAL DESIGN INVESTIGATION NESTED GROUNDWATER MONITORING WELL LOCATION (2017)
9.33	WATER TABLE ELEVATION IN FEET
9.32 ──	GROUNDWATER ELEVATION CONTOUR IN FEET (DASHED WHERE INFERRED)
↙	GROUNDWATER FLOW DIRECTION

Groundwater Monitoring Well ID	Top of Casing	Depth to Groundwater (feet below TOC)	Groundwater Elevation (feet)
L1-RDI-MW-6I	41.05	31.72	9.33
L1-RDI-MW-7I	40.46	31.05	9.41
L1-RDI-MW-8I	40.95	31.57	9.38
L1-RDI-MW-9I	40.82	31.52	9.30

Notes:

All elevations are referenced to the North American Vertical Datum of 1988 (NAVD88).

TOC - Top of Casing

0 20 40 80
SCALE IN FEET

Map Source:
- NYCDCP (NYC Dept. of City Planning) GIS database.

©2018 AKRF, Inc. W:\Projects\12492 - PHIPPS ATLANTIC CHESTNUT - LOT 1\Technical\Hazmat\RDI\RDIR\CAD\12492 Fig 4 Intermediate GW Contour Map.dwg last save: mveilleux 4/16/2018 11:08 AM

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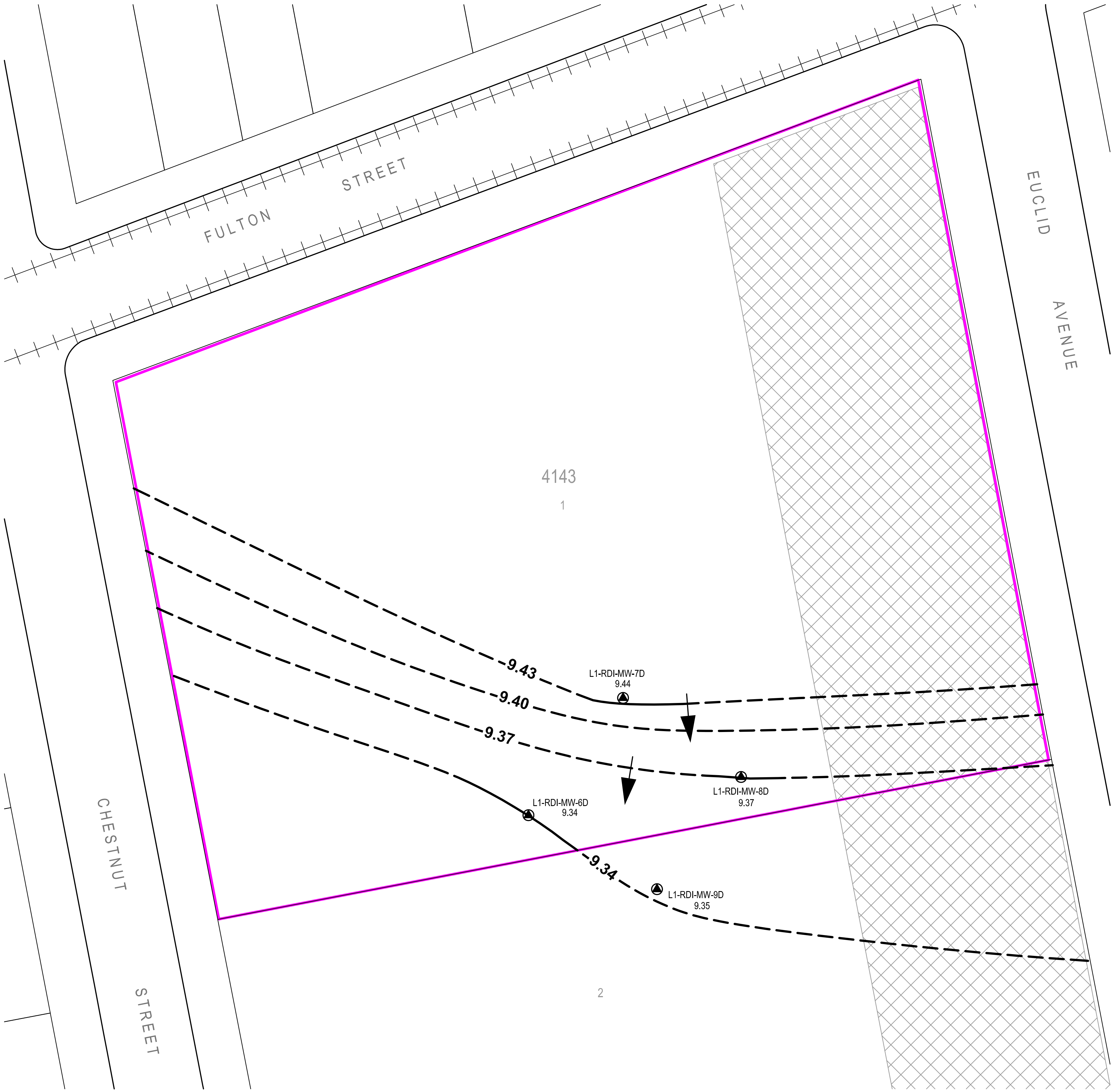
Brooklyn, New York

INTERMEDIATE GROUNDWATER CONTOUR MAP - AUGUST 28, 2017

DATE
4/16/2018

PROJECT NO.
12492

FIGURE
4



Map Source:
- NYCDCP (NYC Dept. of City Planning) GIS database.

LEGEND

━	BCP SITE BOUNDARY
☐ 1	LOT BOUNDARY
4143	BLOCK NUMBER
┼┼┼┼┼┼┼┼	MTA RAILROAD ELEVATED TRACKS
▨	APPROXIMATE EXTENT OF FORMER PARTIAL CELLAR
▲	REMEDIAL DESIGN INVESTIGATION NESTED GROUNDWATER MONITORING WELL LOCATION (2017)
9.33	WATER TABLE ELEVATION IN FEET
9.37 ━	GROUNDWATER ELEVATION CONTOUR IN FEET (DASHED WHERE INFERRED)
↓	GROUNDWATER FLOW DIRECTION

Groundwater Monitoring Well ID	Top of Casing	Depth to Groundwater (feet below TOC)	Groundwater Elevation (feet)
L1-RDI-MW-6D	41.05	31.71	9.34
L1-RDI-MW-7D	40.47	31.03	9.44
L1-RDI-MW-8D	40.92	31.55	9.37
L1-RDI-MW-9D	40.87	31.52	9.35

Notes:

All elevations are referenced to the North American Vertical Datum of 1988 (NAVD88).

TOC - Top of Casing

0 20 40 80
SCALE IN FEET

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DEEP GROUNDWATER CONTOUR MAP - AUGUST 28, 2017

DATE
4/16/2018

PROJECT NO.
12492

FIGURE
5

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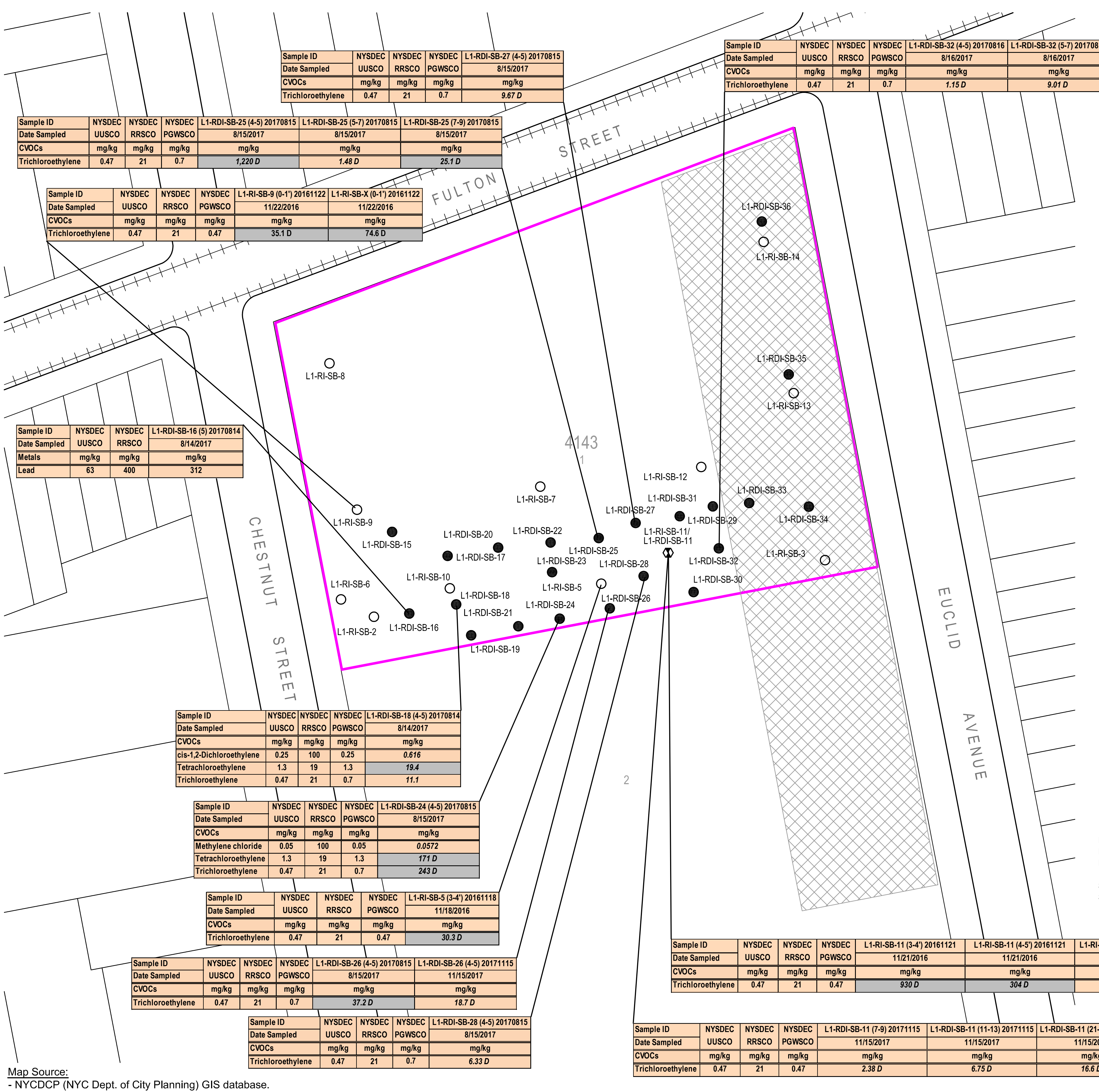

Sample ID	NYSDEC	NYSDEC	NYSDEC	L1-RDI-SB-27 (4-5) 20170815
Date Sampled	UUSCO	RRSCO	PGWSCO	8/15/2017
CVOCs	mg/kg	mg/kg	mg/kg	mg/kg
Trichloroethylene	0.47	21	0.7	*9.67 D*

Sample ID	NYSDEC	NYSDEC	NYSDEC	L1-RDI-SB-32 (4-5) 20170816	L1-RDI-SB-32 (5-7) 20170816
Date Sampled	UUSCO	RRSCO	PGWSCO	8/16/2017	8/16/2017
CVOCs	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Trichloroethylene	0.47	21	0.7	*1.15 D*	*9.01 D*

Sample ID	NYSDEC	NYSDEC	NYSDEC	L1-RDI-SB-25 (4-5) 20170815	L1-RDI-SB-25 (5-7) 20170815	L1-RDI-SB-25 (7-9) 20170815
Date Sampled	UUSCO	RRSCO	PGWSCO	8/15/2017	8/15/2017	8/15/2017
CVOCs	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Trichloroethylene	0.47	21	0.7	*1,220 D*	*1.48 D*	*25.1 D*

Sample ID	NYSDEC	NYSDEC	NYSDEC	L1-RI-SB-9 (0-1') 20161122	L1-RI-SB-X (0-1') 20161122
Date Sampled	UUSCO	RRSCO	PGWSCO	11/22/2016	11/22/2016
CVOCs	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Trichloroethylene	0.47	21	0.47	35.1 D	74.6 D

Sample ID	NYSDEC	NYSDEC	L1-RDI-SB-16 (5) 20170814
Date Sampled	UUSCO	RRSCO	8/14/2017
Metals	mg/kg	mg/kg	mg/kg
Lead	63	400	312

Sample ID	NYSDEC	NYSDEC	NYSDEC	L1-RDI-SB-18 (4-5) 20170814
Date Sampled	UUSCO	RRSCO	PGWSCO	8/14/2017
CVOCs	mg/kg	mg/kg	mg/kg	mg/kg
cis-1,2-Dichloroethylene	0.25	100	0.25	*0.616*
Tetrachloroethylene	1.3	19	1.3	*19.4*
Trichloroethylene	0.47	21	0.7	*11.1*

Sample ID	NYSDEC	NYSDEC	NYSDEC	L1-RDI-SB-24 (4-5) 20170815
Date Sampled	UUSCO	RRSCO	PGWSCO	8/15/2017
CVOCs	mg/kg	mg/kg	mg/kg	mg/kg
Methylene chloride	0.05	100	0.05	*0.0572*
Tetrachloroethylene	1.3	19	1.3	*171 D*
Trichloroethylene	0.47	21	0.7	*243 D*

Sample ID	NYSDEC	NYSDEC	NYSDEC	L1-RI-SB-5 (3-4') 20161118
Date Sampled	UUSCO	RRSCO	PGWSCO	11/18/2016
CVOCs	mg/kg	mg/kg	mg/kg	mg/kg
Trichloroethylene	0.47	21	0.47	*30.3 D*

Sample ID	NYSDEC	NYSDEC	NYSDEC	L1-RDI-SB-26 (4-5) 20170815	L1-RDI-SB-26 (4-5) 20171115
Date Sampled	UUSCO	RRSCO	PGWSCO	8/15/2017	11/15/2017
CVOCs	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Trichloroethylene	0.47	21	0.7	*37.2 D*	*18.7 D*

Sample ID	NYSDEC	NYSDEC	NYSDEC	L1-RDI-SB-28 (4-5) 20170815
Date Sampled	UUSCO	RRSCO	PGWSCO	8/15/2017
CVOCs	mg/kg	mg/kg	mg/kg	mg/kg
Trichloroethylene	0.47	21	0.7	*6.33 D*

Sample ID	NYSDEC	NYSDEC	NYSDEC	L1-RI-SB-11 (3-4') 20161121	L1-RI-SB-11 (4-5') 20161121	L1-RI-SB-11 (31-32') 20161121
Date Sampled	UUSCO	RRSCO	PGWSCO	11/21/2016	11/21/2016	11/21/2016
CVOCs	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Trichloroethylene	0.47	21	0.47	*930 D*	*304 D*	*2.26 D*

Sample ID	NYSDEC	NYSDEC	NYSDEC	L1-RDI-SB-11 (7-9) 20171115	L1-RDI-SB-11 (11-13) 20171115	L1-RDI-SB-11 (21-23) 20171115
Date Sampled	UUSCO	RRSCO	PGWSCO	11/15/2017	11/15/2017	11/15/2017
CVOCs	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Trichloroethylene	0.47	21	0.47	*2.38 D*	*6.75 D*	*16.6 D*

Map Source:
- NYCDCP (NYC Dept. of City Planning) GIS database.

LEGEND

▬	BCP SITE BOUNDARY
1	LOT BOUNDARY
4143	BLOCK NUMBER
┼┼┼┼┼┼┼┼	MTA RAILROAD ELEVATED TRACKS
▨	APPROXIMATE EXTENT OF FORMER PARTIAL CELLAR
○	REMEDIAL INVESTIGATION SOIL BORING LOCATION (2016)
●	REMEDIAL DESIGN INVESTIGATION SOIL BORING LOCATION (2017)
⊗	REMEDIAL INVESTIGATION (2016) / REMEDIAL DESIGN INVESTIGATION (2017) SOIL BORING LOCATION

Sample ID	NYSDEC	NYSDEC	NYSDEC	L1-RDI-SB-27 (4-5) 20170815
Date Sampled	UUSCO	RRSCO	PGWSCO	8/15/2017
CVOCs	mg/kg	mg/kg	mg/kg	mg/kg
Trichloroethylene	0.47	21	0.7	*9.67 D*

Sample ID
Sample Date
Concentration
Analyte/Compound

Part 375 Soil Cleanup Objectives (SCOs) : SCOs listed in New York State Department of Environmental Conservation (NYSDEC) Part 375 Regulations (6 NYCRR Part 375).

D : The reported concentration is the result of a diluted sample analysis.

CVOC: chlorinated volatile organic compound
mg/kg : milligrams per kilogram = parts per million (ppm)

Exceedances of Part 375 Unrestricted Use Soil Cleanup Objectives (UUSCOs) are highlighted in bold font.
Exceedances of Part 375 Restricted Residential Soil Cleanup Objectives (RRSCOs) are highlighted in gray.
Exceedances of Part 375 Protection of Groundwater Soil Cleanup Objectives (PGWSCOs) are highlighted in italic font.

Soil borings denoted as L1-RI-SB-# were advanced during AKRF's 2016 Remedial Investigation
Soil borings denoted as L1-RDI-SB-# were advanced during AKRF's 2017 Remedial Design Investigation.

0 30 60 120
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CVOC SOIL SAMPLE CONCENTRATIONS ABOVE NYSDEC UUSCOs, RRSCOs, AND/OR PGWSCOs

DATE
4/16/2018
PROJECT NO.
12492
FIGURE
6

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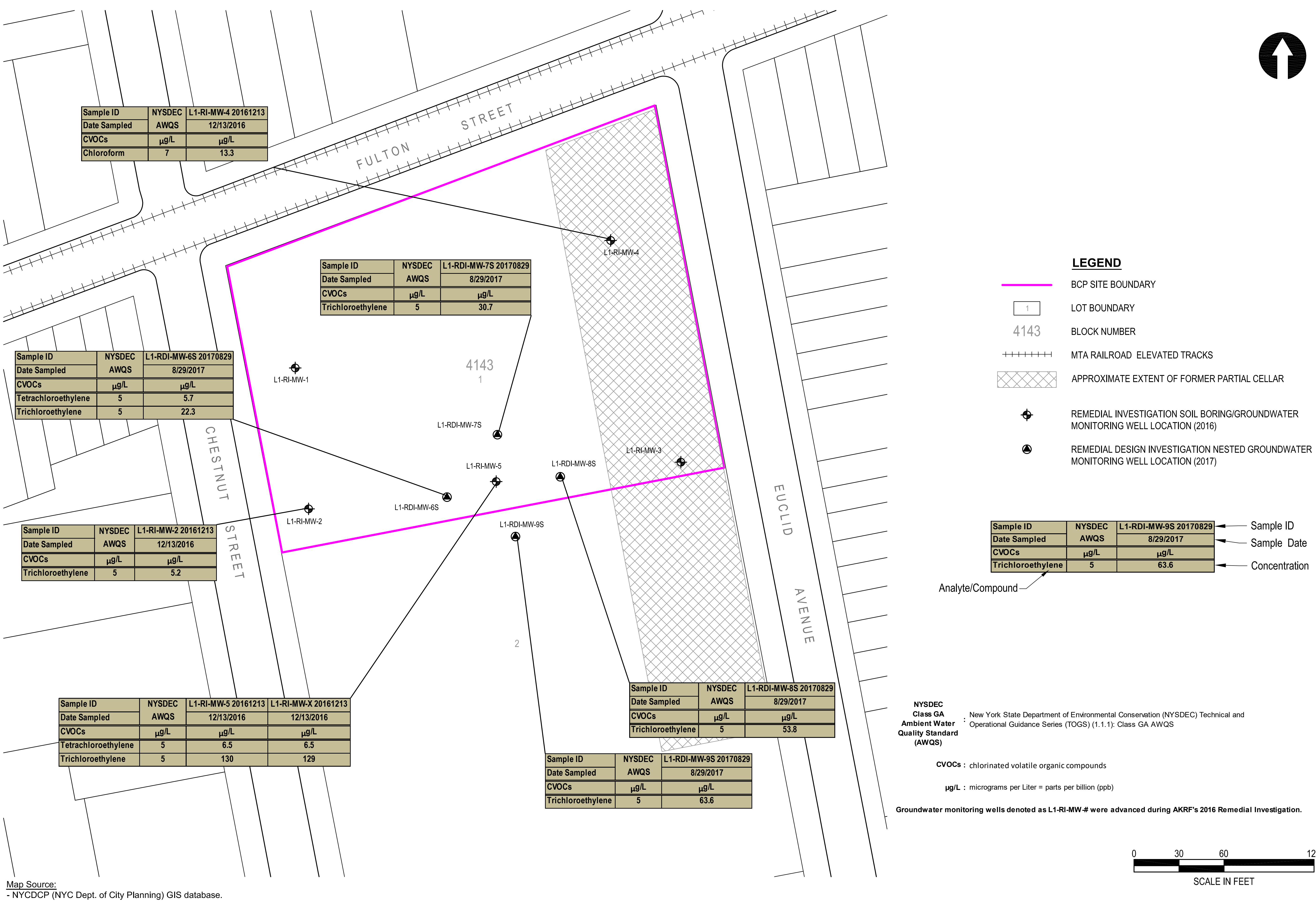

Sample ID	NYSDEC	L1-RI-MW-4 20161213
Date Sampled	AWQS	12/13/2016
CVOCs	µg/L	µg/L
Chloroform	7	13.3

Sample ID	NYSDEC	L1-RDI-MW-7S 20170829
Date Sampled	AWQS	8/29/2017
CVOCs	µg/L	µg/L
Trichloroethylene	5	30.7

Sample ID	NYSDEC	L1-RDI-MW-6S 20170829
Date Sampled	AWQS	8/29/2017
CVOCs	µg/L	µg/L
Tetrachloroethylene	5	5.7
Trichloroethylene	5	22.3

Sample ID	NYSDEC	L1-RI-MW-2 20161213
Date Sampled	AWQS	12/13/2016
CVOCs	µg/L	µg/L
Trichloroethylene	5	5.2

Sample ID	NYSDEC	L1-RI-MW-5 20161213	L1-RI-MW-X 20161213
Date Sampled	AWQS	12/13/2016	12/13/2016
CVOCs	µg/L	µg/L	µg/L
Tetrachloroethylene	5	6.5	6.5
Trichloroethylene	5	130	129

Sample ID	NYSDEC	L1-RDI-MW-9S 20170829
Date Sampled	AWQS	8/29/2017
CVOCs	µg/L	µg/L
Trichloroethylene	5	63.6

Sample ID	NYSDEC	L1-RDI-MW-8S 20170829
Date Sampled	AWQS	8/29/2017
CVOCs	µg/L	µg/L
Trichloroethylene	5	53.8

LEGEND

▬	BCP SITE BOUNDARY
☐ 1	LOT BOUNDARY
4143	BLOCK NUMBER
┼┼┼┼┼┼┼	MTA RAILROAD ELEVATED TRACKS
▨	APPROXIMATE EXTENT OF FORMER PARTIAL CELLAR
⊕	REMEDIAL INVESTIGATION SOIL BORING/GROUNDWATER MONITORING WELL LOCATION (2016)
▲	REMEDIAL DESIGN INVESTIGATION NESTED GROUNDWATER MONITORING WELL LOCATION (2017)

Sample ID	NYSDEC	L1-RDI-MW-9S 20170829
Date Sampled	AWQS	8/29/2017
CVOCs	µg/L	µg/L
Trichloroethylene	5	63.6

NYSDEC Class GA Ambient Water Quality Standard (AWQS) : New York State Department of Environmental Conservation (NYSDEC) Technical and Operational Guidance Series (TOGS) (1.1.1): Class GA AWQS

CVOCs : chlorinated volatile organic compounds

µg/L : micrograms per Liter = parts per billion (ppb)

Groundwater monitoring wells denoted as L1-RI-MW-# were advanced during AKRF's 2016 Remedial Investigation.

Map Source:
- NYCDCP (NYC Dept. of City Planning) GIS database.

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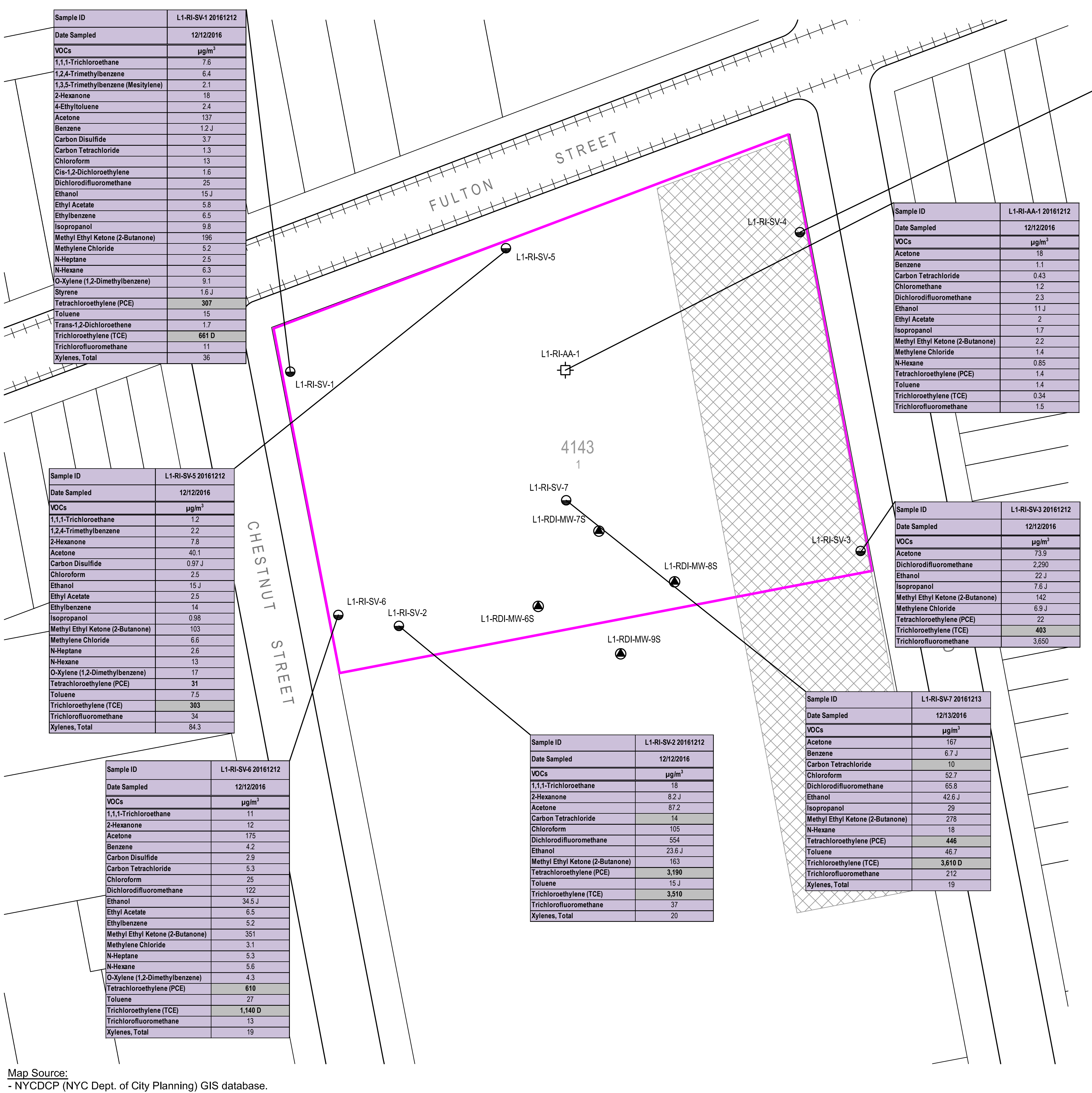
CVOC GROUNDWATER CONCENTRATIONS ABOVE AWQSs

DATE
4/16/2018

PROJECT NO.
12492

FIGURE
7



Sample ID	L1-RI-SV-1 20161212
Date Sampled	12/12/2016
VOCs	µg/m^3
1,1,1-Trichloroethane	7.6
1,2,4-Trimethylbenzene	6.4
1,3,5-Trimethylbenzene (Mesitylene)	2.1
2-Hexanone	18
4-Ethyltoluene	2.4
Acetone	137
Benzene	1.2 J
Carbon Disulfide	3.7
Carbon Tetrachloride	1.3
Chloroform	13
Cis-1,2-Dichloroethylene	1.6
Dichlorodifluoromethane	25
Ethanol	15 J
Ethyl Acetate	5.8
Ethylbenzene	6.5
Isopropanol	9.8
Methyl Ethyl Ketone (2-Butanone)	196
Methylene Chloride	5.2
N-Heptane	2.5
N-Hexane	6.3
O-Xylene (1,2-Dimethylbenzene)	9.1
Styrene	1.6 J
Tetrachloroethylene (PCE)	**307**
Toluene	15
Trans-1,2-Dichloroethene	1.7
Trichloroethylene (TCE)	**661 D**
Trichlorofluoromethane	11
Xylenes, Total	36

Sample ID	L1-RI-SV-5 20161212
Date Sampled	12/12/2016
VOCs	µg/m^3
1,1,1-Trichloroethane	1.2
1,2,4-Trimethylbenzene	2.2
2-Hexanone	7.8
Acetone	40.1
Carbon Disulfide	0.97 J
Chloroform	2.5
Ethanol	15 J
Ethyl Acetate	2.5
Ethylbenzene	14
Isopropanol	0.98
Methyl Ethyl Ketone (2-Butanone)	103
Methylene Chloride	6.6
N-Heptane	2.6
N-Hexane	13
O-Xylene (1,2-Dimethylbenzene)	17
Tetrachloroethylene (PCE)	**31**
Toluene	7.5
Trichloroethylene (TCE)	**303**
Trichlorofluoromethane	34
Xylenes, Total	84.3

Sample ID	L1-RI-SV-6 20161212
Date Sampled	12/12/2016
VOCs	µg/m^3
1,1,1-Trichloroethane	11
2-Hexanone	12
Acetone	175
Benzene	4.2
Carbon Disulfide	2.9
Carbon Tetrachloride	5.3
Chloroform	25
Dichlorodifluoromethane	122
Ethanol	34.5 J
Ethyl Acetate	6.5
Ethylbenzene	5.2
Methyl Ethyl Ketone (2-Butanone)	351
Methylene Chloride	3.1
N-Heptane	5.3
N-Hexane	5.6
O-Xylene (1,2-Dimethylbenzene)	4.3
Tetrachloroethylene (PCE)	**610**
Toluene	27
Trichloroethylene (TCE)	**1,140 D**
Trichlorofluoromethane	13
Xylenes, Total	19

Sample ID	L1-RI-SV-2 20161212
Date Sampled	12/12/2016
VOCs	µg/m^3
1,1,1-Trichloroethane	18
2-Hexanone	8.2 J
Acetone	87.2
Carbon Tetrachloride	14
Chloroform	105
Dichlorodifluoromethane	554
Ethanol	23.6 J
Methyl Ethyl Ketone (2-Butanone)	163
Tetrachloroethylene (PCE)	**3,190**
Toluene	15 J
Trichloroethylene (TCE)	**3,510**
Trichlorofluoromethane	37
Xylenes, Total	20

Sample ID	L1-RI-SV-7 20161213
Date Sampled	12/13/2016
VOCs	µg/m^3
Acetone	167
Benzene	6.7 J
Carbon Tetrachloride	10
Chloroform	52.7
Dichlorodifluoromethane	65.8
Ethanol	42.6 J
Isopropanol	29
Methyl Ethyl Ketone (2-Butanone)	278
N-Hexane	18
Tetrachloroethylene (PCE)	**446**
Toluene	46.7
Trichloroethylene (TCE)	**3,610 D**
Trichlorofluoromethane	212
Xylenes, Total	19

Sample ID	L1-RI-SV-3 20161212
Date Sampled	12/12/2016
VOCs	µg/m^3
Acetone	73.9
Dichlorodifluoromethane	2,290
Ethanol	22 J
Isopropanol	7.6 J
Methyl Ethyl Ketone (2-Butanone)	142
Methylene Chloride	6.9 J
Tetrachloroethylene (PCE)	22
Trichloroethylene (TCE)	**403**
Trichlorofluoromethane	3,650

Sample ID	L1-RI-AA-1 20161212
Date Sampled	12/12/2016
VOCs	µg/m^3
Acetone	18
Benzene	1.1
Carbon Tetrachloride	0.43
Chloromethane	1.2
Dichlorodifluoromethane	2.3
Ethanol	11 J
Ethyl Acetate	2
Isopropanol	1.7
Methyl Ethyl Ketone (2-Butanone)	2.2
Methylene Chloride	1.4
N-Hexane	0.85
Tetrachloroethylene (PCE)	1.4
Toluene	1.4
Trichloroethylene (TCE)	0.34
Trichlorofluoromethane	1.5

Sample ID	L1-RI-SV-4 20161212
Date Sampled	12/12/2016
VOCs	µg/m^3
1,2,4-Trimethylbenzene	1.3 J
2-Hexanone	3.8
Acetone	60.8
Benzene	0.86 J
Dichlorodifluoromethane	58.8
Ethanol	15 J
Ethyl Acetate	56.5
Ethylbenzene	2.4
Isopropanol	2.7
Methyl Ethyl Ketone (2-Butanone)	123
Methylene Chloride	3.8
N-Heptane	1.2 J
N-Hexane	3.4
O-Xylene (1,2-Dimethylbenzene)	3
Tetrachloroethylene (PCE)	17
Toluene	6
Trichloroethylene (TCE)	**672 D**
Trichlorofluoromethane	391
Xylenes, Total	12

LEGEND

▬	BCP SITE BOUNDARY
☐ 1	LOT BOUNDARY
4143	BLOCK NUMBER
┼┼┼┼┼┼┼	MTA RAILROAD ELEVATED TRACKS
▨	APPROXIMATE EXTENT OF FORMER PARTIAL CELLAR
◓	TEMPORARY SOIL VAPOR POINT LOCATION
⌖	AMBIENT AIR SAMPLE LOCATION

Sample ID	L1-RI-SV-4 20161212
Date Sampled	12/12/2016
VOCs	µg/m^3
1,2,4-Trimethylbenzene	1.3 J
2-Hexanone	3.8
Acetone	60.8
Benzene	0.86 J
Dichlorodifluoromethane	58.8
Ethanol	15 J
Ethyl Acetate	56.5
Ethylbenzene	2.4
Isopropanol	2.7
Methyl Ethyl Ketone (2-Butanone)	123

Sample ID
Sample Date
Concentration
Analyte/Compound

NYSDOH Soil Vapor Intrusion AGVs and Matrix Values : NYSDOH Air Guideline Values (AGVs) in the Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York, dated October 2006 ("NYSDOH Vapor Intrusion Guidance Document"), updated September 2013 for change of AGV for PCE, August 2015 for TCE, and the May 2017 NYSDOH Matrices A, B, and C for PCE, TCE, c1,2-DCE, 1,1-DCE, carbon tetrachloride, 1,1,1-TCA, methylene chloride, and vinyl chloride. The matrix values listed are the sub-slab soil vapor concentration where mitigation is recommended regardless of the indoor air

Exceedances of NYSDOH AGVs are shown in bold font.
Exceedances of NYSDOH Matrices are highlighted in gray.

µg/m^3 : micrograms per cubic meter
J : The result is an estimated quantity
D : The reported sample quantitation limit is the result of a diluted sample analysis
NS : A standard has not been established for the analyte

0 30 60 120
SCALE IN FEET

Map Source:
- NYCDCP (NYC Dept. of City Planning) GIS database.

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SOIL VAPOR CONCENTRATIONS

DATE
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12492
FIGURE
8

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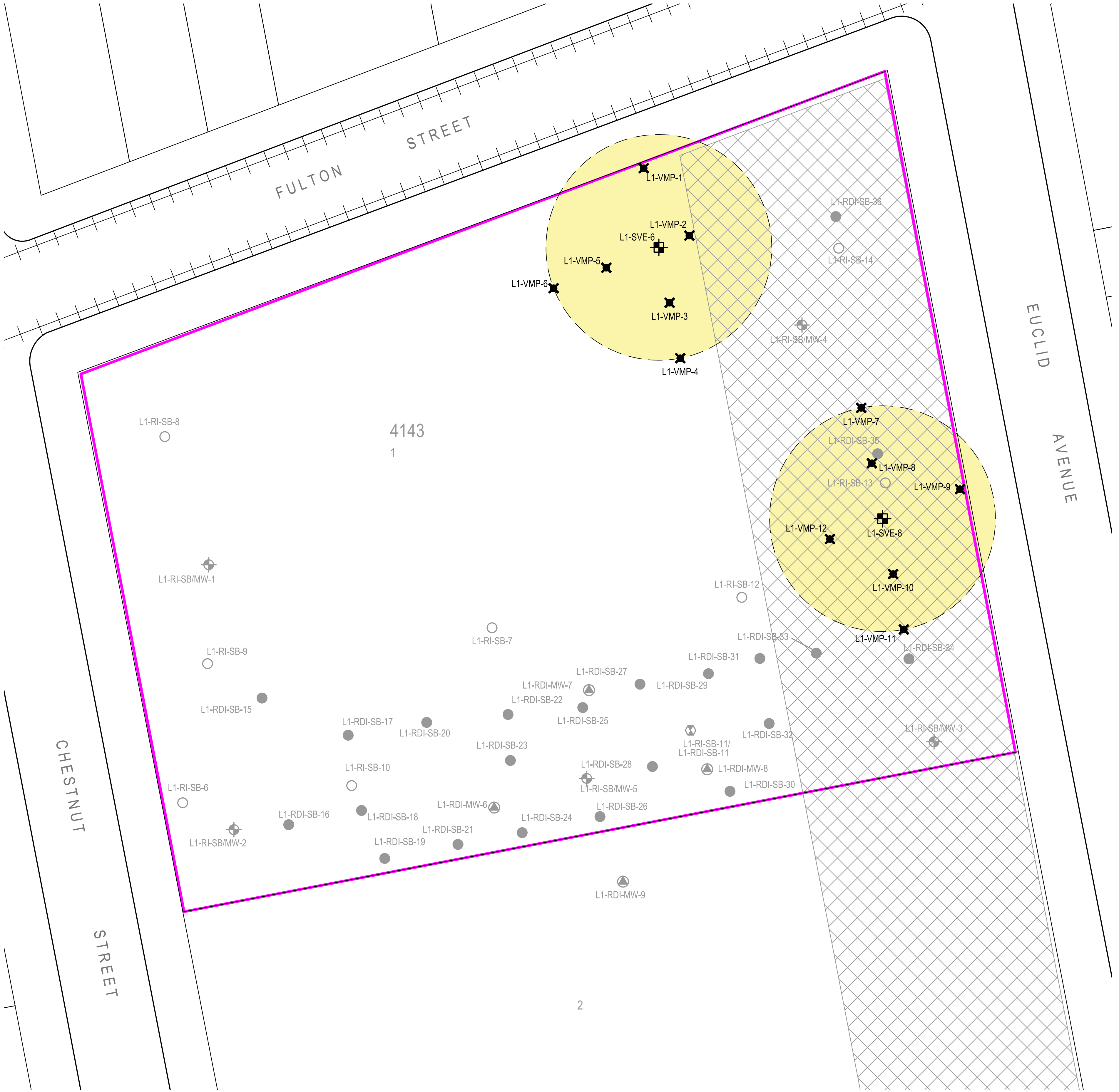

LEGEND

━	BCP SITE BOUNDARY
☐ 1	LOT BOUNDARY
4143	BLOCK NUMBER
▨	APPROXIMATE EXTENT OF FORMER PARTIAL CELLAR
○	REMEDIAL INVESTIGATION SOIL BORING LOCATION (2016)
⌖	REMEDIAL INVESTIGATION SOIL BORING/GROUNDWATER MONITORING WELL LOCATION (2016)
●	REMEDIAL DESIGN INVESTIGATION SOIL BORING LOCATION (2017)
◬	REMEDIAL DESIGN INVESTIGATION NESTED GROUNDWATER MONITORING WELL LOCATION (2017)
⌬	REMEDIAL INVESTIGATION (2016) REMEDIAL DESIGN INVESTIGATION (2017) SOIL BORING LOCATION
⊕	PROPOSED INTERIM REMEDIAL MEASURE SOIL VAPOR EXTRACTION PILOT TEST WELL LOCATION WITH 40' RADIUS OF INFLUENCE
✖	PROPOSED VAPOR MONITORING POINT

0 20 40 80
SCALE IN FEET

Map Source:
- NYCDCP (NYC Dept. of City Planning) GIS database.

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PROPOSED SOIL VAPOR EXTRACTION (SVE) PILOT TEST PLAN

DATE
6/8/2018
PROJECT NO.
12492
FIGURE
9

Map Source:
- NYCDCP (NYC Dept. of City Planning) GIS database.

LEGEND

▬	BCP SITE BOUNDARY
☐ 1	LOT BOUNDARY
4143	BLOCK NUMBER
▨	APPROXIMATE EXTENT OF FORMER PARTIAL CELLAR
○	REMEDIAL INVESTIGATION SOIL BORING LOCATION (2016)
⊕	REMEDIAL INVESTIGATION SOIL BORING/GROUNDWATER MONITORING WELL LOCATION (2016)
●	REMEDIAL DESIGN INVESTIGATION SOIL BORING LOCATION (2017)
▲	REMEDIAL DESIGN INVESTIGATION NESTED GROUNDWATER MONITORING WELL LOCATION (2017)
⬡	REMEDIAL INVESTIGATION (2016) REMEDIAL DESIGN INVESTIGATION (2017) SOIL BORING LOCATION
⊕	PROPOSED INTERIM REMEDIAL MEASURE SOIL VAPOR EXTRACTION WELL LOCATION WITH 40' RADIUS OF INFLUENCE
✖	PROPOSED VAPOR MONITORING POINT

0 20 40 80
SCALE IN FEET

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PROPOSED SOIL VAPOR EXTRACTION (SVE) WELL LOCATION PLAN

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FIGURE
10

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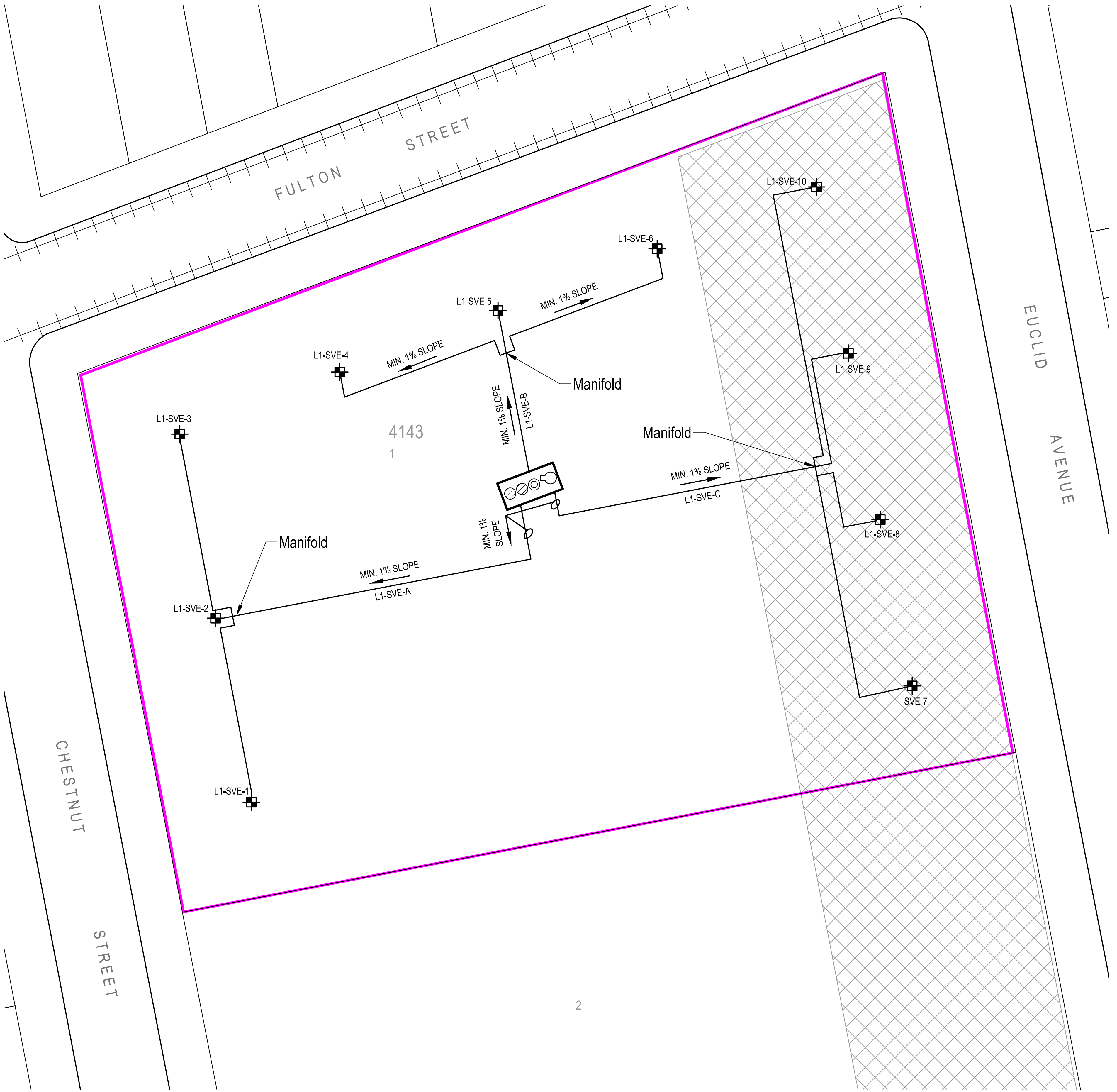

LEGEND

🟪	BCP SITE BOUNDARY
1	LOT BOUNDARY
4143	BLOCK NUMBER
▨	APPROXIMATE EXTENT OF FORMER PARTIAL CELLAR
✚	PROPOSED SOIL VAPOR EXTRACTION WELL LOCATION
☐	PROPOSED SOIL VAPOR EXTRACTION SYSTEM SHED WITH CONTROL PANEL AND EXHAUST STACK
○	BLOWER
⊘	GRANULAR ACTIVATED CARBON UNIT
◎	MOISTURE KNOCK OUT DRUM
MIN. 1% SLOPE ←	SCHEDULE 40 SOLID PVC PIPING (MIN. 1% SLOPE TOWARDS SVE WELLS)

NOTE: SVE SYSTEM ACCESSORIES (VACUUM GAUGES, FLOW METER, DILUTION VALVE, ETC) LOCATED IN SHED NOT SHOWN (SEE FIGURE 12).

0 20 40 80
SCALE IN FEET

Map Source:
- NYCDCP (NYC Dept. of City Planning) GIS database.

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PROPOSED SOIL VAPOR EXTRACTION (SVE) SYSTEM PLAN

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12492

FIGURE
11

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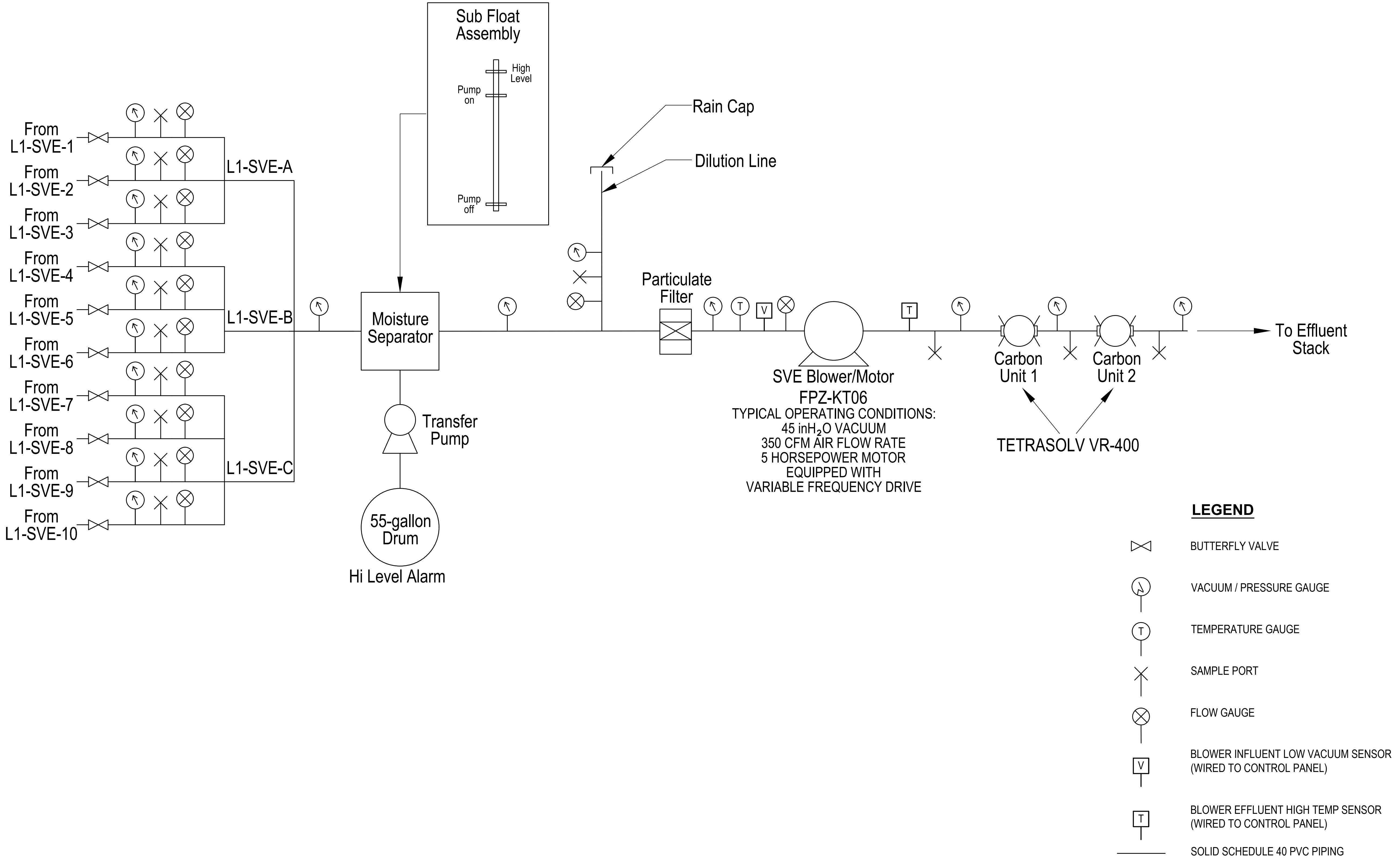

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Brooklyn, New York

PROPOSED SOIL VAPOR EXTRACTION SYSTEM PROCESS AND INSTRUMENTATION DIAGRAM

DATE
5/16/2018
PROJECT NO.
12492
FIGURE
12

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APPENDIX A

HEALTH AND SAFETY PLAN (HASP) AND COMMUNITY AIR MONITORING PLAN (CAMP)

ATLANTIC CHESTNUT – LOT 1
3264 FULTON STREET
BROOKLYN, NEW YORK

Health and Safety Plan and Community Air Monitoring Plan

AKRF Project Number: 12492
BCP Site Number: C224234

Prepared for:

NYSDEC Region 2
1 Hunter's Point Plaza
47-40 21st Street
Long Island City, New York 11101

On Behalf Of:

Atlantic Chestnut Affordable Housing LLC
902 Broadway, 13th Floor
New York, New York 10010

Prepared by:

AKRF, Inc.
440 Park Avenue South
New York, New York 10016
(212) 696-0670

MAY 2018

TABLE OF CONTENTS

FIGURE

TABLES

APPENDICES

1.0 INTRODUCTION

This Health and Safety Plan (HASP) and Community Air Monitoring Plan (CAMP) were prepared by AKRF, Inc. (AKRF) on behalf of Atlantic Chestnut Affordable Housing LLC (the Volunteer) for the Atlantic Chestnut – Lot 1 site located at 3264 Fulton Street in the East New York neighborhood of Brooklyn, New York, herein referred to as “the Site”. The Site is also defined as Brooklyn Borough Tax Block 4143, Lot 1. Historically, Lot 1 encompassed the entirety of Block 4143, but was apportioned into three lots (Lots 1, 2, and 3) in 2016. The Site is currently enrolled in the New York State Department of Environmental Conservation (NYSDEC) Brownfield Cleanup Program (BCP) (BCP Site No. C224234).

The Site comprises a concrete- and asphalt-paved vacant lot, with a former cellar area on the eastern portion along Euclid Avenue. The Site is abutted to the north by Fulton Street and the elevated J and Z Metropolitan Transit Authority (MTA) subway tracks, to the east by Euclid Avenue, to the south by vacant (BCP Site Nos. C224235 and C224236), and to the west by Chestnut Street. The surrounding area is developed primarily with residential, commercial, manufacturing, transportation, and industrial uses. The Long Island Railroad (LIRR) tracks are located beneath Atlantic Avenue to the south.

Historic records indicated that the Site was developed with residences and a road in 1887 and with industrial and manufacturing uses, including the Columbia Machine Works and Malleable Iron Company, the Columbia Cable and Electric Corporation, Blue Ridge Farms, Inc., and Chloe Foods Corp. between 1908 and 2012. Blue Ridge Farms, Inc. and Chloe Foods Corp. are listed on multiple federal and state databases. Prior uses that appear to have led to Site contamination include blacksmithing and stamping, a brass foundry, wood working, a blacksmith, a machine shop, tank and engine rooms, an iron works, wire braiding, and cable manufacturing. The Site has been vacant since a July 2012 fire caused severe structural damage to the former Site buildings, which were demolished between July and December 2016.

Based on an evaluation of the data and information from the investigation, there is contaminated soil, groundwater, and soil vapor present at the Site that is likely attributable to historic Site usage, including industrial and manufacturing uses. The presence of copper, hexavalent chromium, lead, mercury, and zinc in shallow fill and the elevated detections of polycyclic aromatic hydrocarbons (PAHs), a class of semivolatile organic compounds (SVOCs), are most likely attributable to historic filling, undocumented discharges due to a fire in 2012, and/or historic operations at the Site. The presence of petroleum-related compounds in soil vapor may be related to the former storage tank(s). The presence of the solvent-related compounds TCE (in soil, groundwater, and soil vapor), PCE (in groundwater and soil vapor), chloroform (in groundwater) and carbon tetrachloride (in soil vapor) are likely related to the historic manufacturing operations at the Site.

2.0 HEALTH AND SAFETY GUIDELINES AND PROCEDURES

2.1 Hazard Evaluation

2.1.1 Hazards of Concern

Table 1
Hazards of Concern

X	Organic Chemicals	X	Inorganic Chemicals		Radiological
	Biological	X	Explosive/Flammable		Oxygen Deficient Atm.
X	Heat Stress	X	Cold Stress		Carbon Monoxide
Comment: No personnel without confined space entry permits may to enter confined spaces.					

2.1.2 Physical Characteristics

Table 2
Physical Characteristics

X	Liquid	X	Solid		Sludge
X	Vapors		Unknown		Other

2.1.3 Hazardous Materials

Table 3
Hazardous Materials

Chemicals		**Solids**		**Solvents**		**Oils**	
	Acids	X	Ash		Halogens		Transformer
	Caustics	X	Asbestos		Petroleum		Motor
X	Pesticides		Tailings	X	Chlorinated Solvents	X	Hydraulic
X	Petroleum	X	Fill			X	Gasoline
	Inks					X	Fuel
	PCBs						Waste
X	Metals						
X	SVOCs						
	Ammonia						

2.1.4 Chemicals of Concern

Table 4
Chemicals Of Concern

Chemicals	REL/PEL/STEL (ppm)	Health Hazards
Arsenic	REL = 0.002 mg/m^3 PEL = 0.01 mg/m^3	Ulceration of nasal septum, dermatitis, gastrointestinal disturbances, peripheral neuropathy, respiratory irritation, hyperpigmentation of skin; potential occupational carcinogen.
Benzene	REL = 0.1 ppm PEL = 1 ppm STEL = 5 ppm	Irritation eyes, skin, nose, respiratory system; dizziness; headache, nausea, staggered gait; anorexia, lassitude, dermatitis; bone marrow depression, potential occupational carcinogen.
Copper	REL = 0.1 mg/m^3 PEL = 0. 1 mg/m^3	Irritation eyes, upper respiratory system; metal fume fever: chills, muscle ache, nausea, fever, dry throat, cough, lassitude (weakness, exhaustion); metallic or sweet taste; discoloration skin, hair.
Ethylbenzene	REL = 100 ppm PEL = 100 ppm	Irritation eyes, skin, mucous membrane; headache; dermatitis; narcosis, coma.
Fuel Oil	REL = 350 mg/m^3 PEL = 400 ppm	Nausea, irritation – eyes, hypertension, headache, light-headedness, loss of appetite, poor coordination; long-term exposure – kidney damage, blood clotting problems; potential carcinogen.
Chromium	REL = 0.5 mg/m^3 PEL = 0.5 mg/m^3	Irritation eyes; sensitization dermatitis.
Lead	REL = 0.05 mg/m^3 PEL = 0.05 mg/m^3	Lassitude (weakness, exhaustion), insomnia; facial pallor; anorexia, weight loss, malnutrition; constipation, abdominal pain, colic; anemia; gingival lead line; tremor; paralysis wrist, ankles; encephalopathy; kidney disease; irritation eyes; hypertension.
Mercury	REL = 0.1 mg/m^3 PEL = 0.05 mg/m^3	Irritation eyes, skin; cough, chest pain, dyspnea (breathing difficulty), bronchitis, pneumonitis; tremor, insomnia, irritability, indecision, headache, lassitude (weakness, exhaustion); stomatitis, salivation; gastrointestinal disturbance, anorexia, weight loss; proteinuria.
Polycyclic Aromatic Hydrocarbons (PAHs)	PEL = 5 mg/m^3	Harmful effects to skin, bodily fluids, and ability to fight disease, reproductive problems; [potential occupational carcinogen].
Trichloroethylene (TCE)	PEL = 100 ppm	Lassitude (weakness, exhaustion), dizziness, tremor, drowsiness, nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia; liver injury; [potential occupational carcinogen].
Tetrachloroethylene (PCE)	PEL = 100 ppm STEL = 200 ppm	Irritation eyes, skin, nose, throat, respiratory system; nausea; flush face, neck; dizziness, poor coordination; headache, drowsiness; skin erythema (skin redness); liver damage; potential occupational carcinogen.
Toluene	REL = 100 ppm PEL = 200 ppm STEL = 300 ppm	Irritation eyes, nose; lassitude, confusion, euphoria, dizziness, headache; dilated pupils, lacrimation (discharge of tears); anxiety, muscle fatigue, insomnia; paresthesia

Table 4
Chemicals Of Concern

Chemicals	REL/PEL/STEL (ppm)	Health Hazards
		(skin tingling or numbness); dermatitis; liver, kidney damage.
Xylenes	REL = 100 ppm PEL = 100 ppm	Irritation eyes, skin, nose, throat; dizziness, excitement, drowsiness, poor coordination, staggering gait; corneal vacuolization; anorexia, nausea, vomiting, abdominal pain; dermatitis.
Zinc	REL = 5 mg/m^3 PEL = 5 mg/m^3	Metal fume fever: chills, muscle ache, nausea, fever, dry throat, cough; lassitude (weakness, exhaustion); metallic taste; headache; blurred vision; low back pain; vomiting; malaise (vague feeling of discomfort); chest tightness; dyspnea (breathing difficulty), rales, decreased pulmonary function.
Particulates	PEL = 15 mg/m^3 (total) PEL = 5 mg/m^3 (respirable)	Irritation eyes, skin, throat, upper respiratory system.

Notes:
REL = National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limit
PEL = OSHA Permissible Exposure Limit
STEL = OSHA Short Term Exposure Limit

2.2 Designated Personnel

AKRF will appoint one of its on-site personnel as the Site Safety Officer (SSO). This individual will be responsible for the implementation of this HASP. The SSO will have a 4-year college degree in occupational safety or a related science/engineering field, and experience in implementation of air monitoring and hazardous materials sampling programs. Health and safety training required for the SSO and all field personnel is outlined in Section 2.3 of this HASP.

2.3 Training

All personnel who enter the work area while intrusive activities are being performed will have completed a 40-hour training course that meets OSHA requirements of 29 CFR Part 1910, Occupational Safety and Health Standards. In addition, all personnel will have up-to-date 8-hour refresher training. The training will allow personnel to recognize and understand the potential hazards to health and safety. All field personnel must attend a training program, whose purpose is to:

- Make them aware of the potential hazards they may encounter;
- Provide the knowledge and skills necessary for them to perform the work with minimal risk to health and safety;
- Make them aware of the purpose and limitations of safety equipment; and
- Ensure that they can safely avoid or escape from emergencies.

Each member of the field crew will be instructed in these objectives before he/she goes onto the Site. A Site safety meeting will be conducted at the start of the project. Additional meetings shall be conducted, as necessary, for new personnel working at the Site.

2.4 Medical Surveillance Program

All AKRF and subcontractor personnel performing field work involving subsurface disturbance at the Site are required to have passed a complete medical surveillance examination in accordance with 29 CFR 1910.120 (f). A physician's medical release for work will be confirmed by the SSO before an employee can begin Site activities. The medical release shall consider the type of work to be performed and the required personal protective equipment (PPE). The medical examination will, at a minimum, be provided annually and upon termination of hazardous waste Site work.

2.5 Site Work Zones

During any activities involving subsurface disturbance, the work area must be divided into various zones to prevent the spread of contamination, ensure that proper protective equipment is donned, and provide an area for decontamination.

The Exclusion Zone is defined as the area where exposure to impacted media could be encountered. The Contamination Reduction Zone (CRZ) is the area where decontamination procedures take place and is located next to the Exclusion Zone. The Support Zone is the area where support facilities such as vehicles, fire extinguisher, and first aid supplies are located. The emergency staging area (part of the Support Zone) is the area where all workers on-site would assemble in the event of an emergency. A summary of these areas is provided below. These zones may changed by SSO, depending on that day's activities. All field personnel will be informed of the location of these zones before work begins.

Appropriate barriers will be set up to secure the area and prevent any unauthorized personnel from approaching within 15 feet of the work area.

Table 5
Site Work Zones

Task	Exclusion Zone	CRZ	Support Zone
SVE Well Installation	15 feet from drill rig	15 feet from drill rig	As Needed

2.6 Air Monitoring Program

The purpose of the air monitoring program is to identify any exposure of the field personnel to potential environmental hazards in the soil and soil vapor. Results of the air monitoring will be used to determine the appropriate response action, if needed.

2.6.1 Work Zone Air Monitoring

Real time air monitoring of volatile organic compounds (VOCs) and particulates will be performed in the work zone during all intrusive Site activities. Work zone air monitoring for VOCs will be performed with a photoionization detector (PID). The PID will be calibrated with 100 parts per million (ppm) isobutylene standard in accordance with the manufacturer's instructions at the start of each work day. Work zone air monitoring for particulates will be conducted using a MIE 1000 Personal DataRam or equivalent to measure the concentration of airborne respirable particulates less than 10 micrometers in size (PM_{10}).

The SSO shall set up the equipment and confirm that it is working properly. His/her designee may oversee the air measurements during the day. Measurements will be taken prior to commencement of work and continuously during the work. Measurements will be made as close to the workers as practicable and at the breathing height of the workers. The action levels and required responses are listed in the following table:

Table 6
Work Zone Air Monitoring Action Levels

Instrument	Action Level	Response Action
PID	Less than 10 ppm in breathing zone	Level D or D-Modified
	Between 10 ppm and 50 ppm	Level C
	More than 50 ppm	Stop work. Resume work when readings are less than 50 ppm
Particulate Monitor (MIE 1000 Personal DataRam™ or equivalent)	Less than 1.25 µg/m^3 above background in breathing zone	Level D or D-Modified
	More than 1.25 µg/m^3 above background in breathing zone	Stop work. Resume work when readings are less than 1.25 mg/m^3.
Notes: µg/m^3 = micrograms per cubic meter; ppm = parts per million		

2.6.2 Community Air Monitoring Plan

Community air monitoring will be conducted during all intrusive Site activities in compliance with the New York State Department of Health (NYSDOH) Generic Community Air Monitoring Plan (CAMP). Real-time air monitoring for volatile compounds and dust at the perimeter of the exclusion zone will be performed as described below.

2.6.2.1. Roving Air Monitoring

VOC Monitoring

Periodic monitoring for VOCs will be conducted during non-intrusive activities such as the collection of excavation endpoint soil samples. Periodic monitoring may include obtaining measurements upon arrival at a location and upon leaving the location.

Continuous monitoring for VOCs will be conducted during all ground intrusive activities, including excavation and tank removal (if any) activities. Upwind concentrations will be measured at the start of each workday and periodically thereafter to establish background concentrations. VOCs will be monitored continuously at the downwind perimeter of the exclusion zone. Monitoring will be conducted with a PID equipped with an 11.7 eV lamp capable of calculating 15-minute running average concentrations.

More frequent intervals of monitoring will be conducted if required as determined by the SSO. All PID readings will be recorded and available for NYSDEC and NYSDOH personnel to review. Instantaneous readings, if any, will also be recorded.

Particulate Monitoring

Continuous monitoring for particulates will be conducted during all ground intrusive activities, which will involve the measurement of respirable dust. Community air monitoring for dust particulates will be conducted using a MIE 1000 Personal DataRam or equivalent to measure the concentration of airborne respirable particulates less than 10 micrometers in size (PM_{10}). The particulate monitor will be capable of calculating 15-minute running average concentrations and equipped with an audible alarm to indicate exceedance of action levels. Background readings and any readings that trigger response actions will be recorded in the project logbook, which will be available on site for NYSDOH and/or NYSDEC review.

2.6.3 Personal Protection Equipment (PPE)

The PPE required for various kinds of Site investigation tasks are based on 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response, Appendix B, “General Description and Discussion of the Levels of Protection and Protective Gear.”

AKRF field personnel and other Site personnel shall wear, at a minimum, Level D PPE. The protection will be based on the air monitoring described in this section.

Table 7
Personal Protection Equipment Requirements

LEVEL OF PROTECTION & PPE		**All Tasks**
Level D (**X**) Steel Toe Shoes (**X**) Hard Hat (within 25 ft. of excavator) (**X**) Work Gloves	(**X**) Safety Glasses ( ) Face Shield (**X**) Ear Plugs (within 25 ft. of excavator) (**X**) Nitrile Gloves (**X**) Tyvek for tank contractor if NAPL present	Yes
Level C ***(in addition to Level D)*** (**X**) Half-Face Respirator (**X**) Full Face Respirator ( ) Full-Face PAPR	( ) Particulate Cartridge ( ) Organic Cartridge (**X**) Dual Organic/ Particulate Cartridge	If PID > 10 ppm or particulate > 5 µg/m^3 in breathing zone
Comments: Cartridges to be changed out at least once per shift unless warranted beforehand (e.g., more difficult to breath or any odors detected). PAPR = powered air purifying respirator		

2.7 General Work Practices

To protect health and safety, all field personnel will adhere to the guidelines listed below during activities involving subsurface disturbance:

- Eating, drinking, chewing gum or tobacco, and smoking are prohibited except in designated areas on the Site. These areas will be designated by the SSO.
- Workers must wash their hands thoroughly on leaving the work area and before eating, drinking, or any other such activity.
- The workers should shower as soon as possible after leaving the Site. Contact with contaminated or suspected surfaces should be avoided.
- The buddy system should always be used; each buddy should watch for signs of fatigue, exposure, and heat/cold stress.

3.0 EMERGENCY PROCEDURES AND EMERGENCY RESPONSE PLAN

The field crew will be equipped with emergency equipment, such as a first aid kit and disposable eye washes. In the case of a medical emergency, the SSO will determine the nature of the emergency and he/she will have someone call for an ambulance, if needed. If the nature of the injury is not serious, i.e., the person can be moved without expert emergency medical personnel, he/she should be driven to the Brookdale University Hospital by on-site personnel. Directions to the hospital are provided below, and a hospital route map is provided as Figure 1.

3.1 Hospital Directions

Table 8
Hospital Directions

Hospital Name:	Brookdale University Hospital
Phone Number:	718-240-5363
Address/Location:	1 Brookdale Plaza, Brooklyn, New York 11212
Directions:	1. Head east on Fulton Street towards Euclid Avenue. 2. Turn right onto Euclid Avenue. 3. Turn right onto Atlantic Avenue. 4. Make a U-turn at Logan Street. 5. Use the right lane to continue on South Conduit Boulevard West. 6. Slight right onto Euclid Avenue. 7. Continue on Linden Boulevard to East 98th Street/Brookdale Plaza. 8. Turn right onto Linden Boulevard. 9. Slight left onto Linden Boulevard. 10. Turn right at the first cross street onto Thomas S Boyland Street. 11. Turn left onto Hegeman Avenue. 12. Turn left onto East 98th Street/Brookdale Plaza. 13. Destination will be on the right.

3.2 Emergency Contacts

Table 9
Emergency Contacts

Company	Individual Name	Title	Contact Number
AKRF	Michelle Lapin, P.E.	Remedial Engineer	646-388-9520 (office)
	Deborah Shapiro, QEP	Project Manager and Project Director	646-388-9544 (office)
	Amy Jordan	Project Manager Alternate	646-388-9864 (office)
	George Kokaliaris	Site Safety Officer (SSO)	440-867-8810 (cell)
	Victor Chang	Alternate SSO	718-864-6329
Atlantic Chestnut Affordable Housing LLC	Michael Wadman	Client Representative	646-388-8216
Ambulance, Fire Department, & Police Department	-	-	911
NYSDEC Spill Hotline		-	800-457-7362

4.0 APPROVAL & ACKNOWLEDGMENTS OF HASP

Signed: ________________________________ Date: ________________________________

AKRF Project Manager

Signed: ________________________________ Date: ________________________________

AKRF Health and Safety Officer

Below is an affidavit that must be signed by all workers who enter the site. A copy of the HASP must be on-site at all times and will be kept by the SSO.

AFFIDAVIT

I,________________________(name), of______________________________(company name), have read the HASP for the Atlantic Chestnut – Lot 1 Site located at 3264 Fulton Street in Brooklyn, New York. I agree to conduct all on-site work in accordance with the requirements set forth in this HASP and understand that failure to comply with this HASP could lead to my removal from the Site.

Signed: ________________________ Company: ______________________ Date: _________
Signed: ________________________ Company: ______________________ Date: _________
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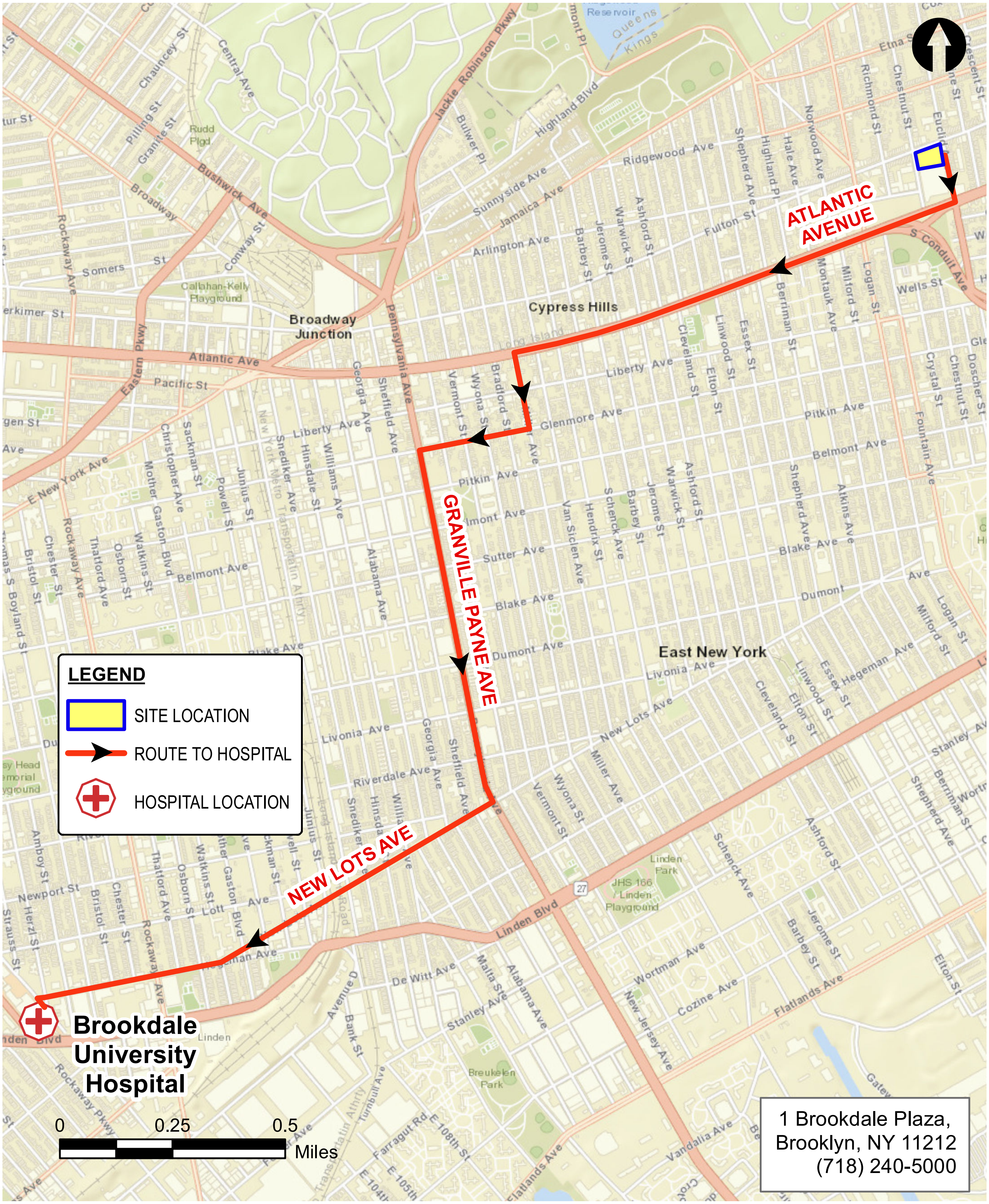
FIGURE



1 Brookdale Plaza,
Brooklyn, NY 11212
(718) 240-5000

©2018 AKRF W:\Projects\12492 - PHIPPS ATLANTIC CHESTNUT - LOT 1\Technical\GIS and Graphics\Hazmat\12492 Fig 1 Route to Hospital.mxd5/17/2018 2:04:35 PM jszalus

AKRF
440 Park Avenue South, New York, NY 10016

Atlantic Chestnut - Lot 1
3264 Fulton Street
Brooklyn, New York

HOSPITAL ROUTE MAP

DATE	**5/17/2018**
PROJECT NO.	**12492**
FIGURE	**1**

ATTACHMENT A

POTENTIAL HEALTH EFFECTS FROM ON-SITE CONTAMINANTS

ATSDR
AGENCY FOR TOXIC SUBSTANCES
AND DISEASE REGISTRY

ARSENIC
CAS # 7440-38-2

Division of Toxicology ToxFAQs™ December 2003

This fact sheet answers the most frequently asked health questions (FAQs) about arsenic. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to higher than average levels of arsenic occurs mostly in the workplace, near hazardous waste sites, or in areas with high natural levels. At high levels, inorganic arsenic can cause death. Exposure to lower levels for a long time can cause a discoloration of the skin and the appearance of small corns or warts. Arsenic has been found at 1,014 of the 1,598 National Priority List sites identified by the Environmental Protection Agency (EPA).

What is arsenic?

Arsenic is a naturally occurring element widely distributed in the earth's crust. In the environment, arsenic is combined with oxygen, chlorine, and sulfur to form inorganic arsenic compounds. Arsenic in animals and plants combines with carbon and hydrogen to form organic arsenic compounds.

Inorganic arsenic compounds are mainly used to preserve wood. Organic arsenic compounds are used as pesticides, primarily on cotton plants.

What happens to arsenic when it enters the environment?

☐ Arsenic cannot be destroyed in the environment. It can only change its form.
☐ Arsenic in air will settle to the ground or is washed out of the air by rain.
☐ Many arsenic compounds can dissolve in water.
☐ Fish and shellfish can accumulate arsenic, but the arsenic in fish is mostly in a form that is not harmful.

How might I be exposed to arsenic?

☐ Eating food, drinking water, or breathing air containing arsenic.
☐ Breathing contaminated workplace air.
☐ Breathing sawdust or burning smoke from wood treated with arsenic.
☐ Living near uncontrolled hazardous waste sites containing arsenic.
☐ Living in areas with unusually high natural levels of arsenic in rock.

How can arsenic affect my health?

Breathing high levels of inorganic arsenic can give you a sore throat or irritated lungs. Ingesting high levels of inorganic arsenic can result in death. Lower levels of arsenic can cause nausea and vomiting, decreased production of red and white blood cells, abnormal heart rhythm, damage to blood vessels, and a sensation of "pins and needles" in hands and feet.

Ingesting or breathing low levels of inorganic arsenic for a long time can cause a darkening of the skin and the appearance of small "corns" or "warts" on the palms, soles, and torso.

Skin contact with inorganic arsenic may cause redness and swelling.

Organic arsenic compounds are less toxic than inorganic arsenic compounds. Exposure to high levels of some organic arsenic compounds may cause similar effects as inorganic arsenic.

How likely is arsenic to cause cancer?

Several studies have shown that inorganic arsenic can increase the risk of lung cancer, skin cancer, bladder cancer, liver cancer, kidney cancer, and prostate cancer. The World Health Organization (WHO), the Department of Health and Human Services (DHHS), and the EPA have determined that inorganic arsenic is a human carcinogen.

How can arsenic affect children?

We do not know if exposure to arsenic will result in birth defects or other developmental effects in people. Birth defects have been observed in animals exposed to inorganic arsenic.

It is likely that health effects seen in children exposed to high amounts of arsenic will be similar to the effects seen in adults.

How can families reduce the risk of exposure to arsenic?

☐ If you use arsenic-treated wood in home projects, you should wear dust masks, gloves, and protective clothing to decrease exposure to sawdust.
☐ If you live in an area with high levels of arsenic in water or soil, you should use cleaner sources of water and limit contact with soil.

Is there a medical test to show whether I've been exposed to arsenic?

There are tests to measure the level of arsenic in blood, urine, hair, or fingernails. The urine test is the most reliable test for arsenic exposure within the last few days. Tests on hair and fingernails can measure exposure to high levels or arsenic over the past 6-12 months. These tests can determine if you have been exposed to above-average levels of arsenic. They cannot predict how the arsenic levels in your body will affect your health.

Has the federal government made recommendations to protect human health?

EPA has set limits on the amount of arsenic that industrial sources can release to the environment and has restricted or canceled many uses of arsenic in pesticides. EPA has set a limit of 0.01 parts per million (ppm) for arsenic in drinking water.

The Occupational Safety and Health Administration has set limits of 10 µg arsenic per cubic meter of workplace air (10 $\mu g/m^3$) for 8 hour shifts and 40 hour work weeks.

Source of Information

Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological Profile for Arsenic. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs™ Internet address is http://www.atsdr.cdc.gov/toxfaq.html . ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES
AND DISEASE REGISTRY

BENZENE
CAS # 71-43-2

Agency for Toxic Substances and Disease Registry ToxFAQs **September 1997**

This fact sheet answers the most frequently asked health questions (FAQs) about benzene. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Benzene is a widely used chemical formed from both natural processes and human activities. Breathing benzene can cause drowsiness, dizziness, and unconsciousness; long-term benzene exposure causes effects on the bone marrow and can cause anemia and leukemia. Benzene has been found in at least 813 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is benzene?
(Pronounced bĕn′zēn′)

Benzene is a colorless liquid with a sweet odor. It evaporates into the air very quickly and dissolves slightly in water. It is highly flammable and is formed from both natural processes and human activities.

Benzene is widely used in the United States; it ranks in the top 20 chemicals for production volume. Some industries use benzene to make other chemicals which are used to make plastics, resins, and nylon and synthetic fibers. Benzene is also used to make some types of rubbers, lubricants, dyes, detergents, drugs, and pesticides. Natural sources of benzene include volcanoes and forest fires. Benzene is also a natural part of crude oil, gasoline, and cigarette smoke.

What happens to benzene when it enters the environment?

☐ Industrial processes are the main source of benzene in the environment.

☐ Benzene can pass into the air from water and soil.

☐ It reacts with other chemicals in the air and breaks down within a few days.

☐ Benzene in the air can attach to rain or snow and be carried back down to the ground.

☐ It breaks down more slowly in water and soil, and can pass through the soil into underground water.

☐ Benzene does not build up in plants or animals.

How might I be exposed to benzene?

☐ Outdoor air contains low levels of benzene from tobacco smoke, automobile service stations, exhaust from motor vehicles, and industrial emissions.

☐ Indoor air generally contains higher levels of benzene from products that contain it such as glues, paints, furniture wax, and detergents.

☐ Air around hazardous waste sites or gas stations will contain higher levels of benzene.

☐ Leakage from underground storage tanks or from hazardous waste sites containing benzene can result in benzene contamination of well water.

☐ People working in industries that make or use benzene may be exposed to the highest levels of it.

☐ A major source of benzene exposures is tobacco smoke.

How can benzene affect my health?

Breathing very high levels of benzene can result in death, while high levels can cause drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion, and unconsciousness. Eating or drinking foods containing high levels of benzene can cause vomiting, irritation of the stomach, dizziness, sleepiness, convulsions, rapid heart rate, and death.

The major effect of benzene from long-term (365 days or longer) exposure is on the blood. Benzene causes harmful effects on the bone marrow and can cause a decrease in red blood cells leading to anemia. It can also cause excessive bleeding and can affect the immune system, increasing the chance for infection.

Some women who breathed high levels of benzene for many months had irregular menstrual periods and a decrease in the size of their ovaries. It is not known whether benzene exposure affects the developing fetus in pregnant women or fertility in men.

Animal studies have shown low birth weights, delayed bone formation, and bone marrow damage when pregnant animals breathed benzene.

How likely is benzene to cause cancer?

The Department of Health and Human Services (DHHS) has determined that benzene is a known human carcinogen. Long-term exposure to high levels of benzene in the air can cause leukemia, cancer of the blood-forming organs.

Is there a medical test to show whether I've been exposed to benzene?

Several tests can show if you have been exposed to benzene. There is test for measuring benzene in the breath; this test must be done shortly after exposure. Benzene can also be measured in the blood, however, since benzene disappears rapidly from the blood, measurements are accurate only for recent exposures.

In the body, benzene is converted to products called metabolites. Certain metabolites can be measured in the urine. However, this test must be done shortly after exposure and is not a reliable indicator of how much benzene you have been exposed to, since the metabolites may be present in urine from other sources.

Has the federal government made recommendations to protect human health?

The EPA has set the maximum permissible level of benzene in drinking water at 0.005 milligrams per liter (0.005 mgL). The EPA requires that spills or accidental releases into the environment of 10 pounds or more of benzene be reported to the EPA.

The Occupational Safety and Health Administration (OSHA) has set a permissible exposure limit of 1 part of benzene per million parts of air (1 ppm) in the workplace during an 8-hour workday, 40-hour workweek.

Glossary

Anemia: A decreased ability of the blood to transport oxygen.

Carcinogen: A substance with the ability to cause cancer.

CAS: Chemical Abstracts Service.

Chromosomes: Parts of the cells responsible for the development of hereditary characteristics.

Metabolites: Breakdown products of chemicals.

Milligram (mg): One thousandth of a gram.

Pesticide: A substance that kills pests.

References

This ToxFAQs information is taken from the 1997 Toxicological Profile for Benzene (update) produced by the Agency for Toxic Substances and Disease Registry, Public Health Service, U.S. Department of Health and Human Services, Public Health Service in Atlanta, GA.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop E-29, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 404-498-0093. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES
AND DISEASE REGISTRY

CHROMIUM

CAS # 7440-47-3

Division of Toxicology and Environmental Medicine ToxFAQs™ **September 2008**

This fact sheet answers the most frequently asked health questions (FAQs) about chromium. For more information, call the ATSDR Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to chromium occurs from ingesting contaminated food or drinking water or breathing contaminated workplace air. Chromium(VI) at high levels can damage the nose and cause cancer. Ingesting high levels of chromium(VI) may result in anemia or damage to the stomach or intestines. Chromium(III) is an essential nutrient. Chromium has been found in at least 1,127 of the 1,669 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is chromium?

Chromium is a naturally occurring element found in rocks, animals, plants, and soil. It can exist in several different forms. Depending on the form it takes, it can be a liquid, solid, or gas. The most common forms are chromium(0), chromium(III), and chromium(VI). No taste or odor is associated with chromium compounds.

The metal chromium, which is the chromium(0) form, is used for making steel. Chromium(VI) and chromium(III) are used for chrome plating, dyes and pigments, leather tanning, and wood preserving.

What happens to chromium when it enters the environment?

❏ Chromium can be found in air, soil, and water after release from the manufacture, use, and disposal of chromium-based products, and during the manufacturing process.
❏ Chromium does not usually remain in the atmosphere, but is deposited into the soil and water.
❏ Chromium can easily change from one form to another in water and soil, depending on the conditions present.
❏ Fish do not accumulate much chromium in their bodies from water.

How might I be exposed to chromium?

❏ Eating food containing chromium(III).
❏ Breathing contaminated workplace air or skin contact during use in the workplace.
❏ Drinking contaminated well water.
❏ Living near uncontrolled hazardous waste sites containing chromium or industries that use chromium.

How can chromium affect my health?

Chromium(III) is an essential nutrient that helps the body use sugar, protein, and fat.

Breathing high levels of chromium(VI) can cause irritation to the lining of the nose, nose ulcers, runny nose, and breathing problems, such as asthma, cough, shortness of breath, or wheezing. The concentrations of chromium in air that can cause these effects may be different for different types of chromium compounds, with effects occurring at much lower concentrations for chromium(VI) compared to chromium(III).

The main health problems seen in animals following ingestion of chromium(VI) compounds are irritation and ulcers in the stomach and small intestine and anemia. Chromium(III) compounds are much less toxic and do not appear to cause these problems.

Sperm damage and damage to the male reproductive system have also been seen in laboratory animals exposed to chromium(VI).

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, Public Health Service
Agency for Toxic Substances and Disease Registry

Skin contact with certain chromium(VI) compounds can cause skin ulcers. Some people are extremely sensitive to chromium(VI) or chromium(III). Allergic reactions consisting of severe redness and swelling of the skin have been noted.

How likely is chromium to cause cancer?

The Department of Health and Human Services (DHHS), the International Agency for Reseach on Cancer (IARC), and the EPA have determined that chromium(VI) compounds are known human carcinogens. In workers, inhalation of chromium(VI) has been shown to cause lung cancer. Chromium(VI) also causes lung cancer in animals. An increase in stomach tumors was observed in humans and animals exposed to chromium(VI) in drinking water.

How can chromium affect children?

It is likely that health effects seen in children exposed to high amounts of chromium will be similar to the effects seen in adults.

We do not know if exposure to chromium will result in birth defects or other developmental effects in people. Some developmental effects have been observed in animals exposed to chromium(VI).

How can families reduce the risks of exposure to chromium?

☐ Children should avoid playing in soils near uncontrolled hazardous waste sites where chromium may have been discarded.

☐ Chromium is a component of tobacco smoke. Avoid smoking in enclosed spaces like inside the home or car in order to limit exposure to children and other family members.

☐ Although chromium(III) is an essential nutrient, you should avoid excessive use of dietary supplements containing chromium.

Is there a medical test to determine whether I've been exposed to chromium?

Since chromium(III) is an essential element and naturally occurs in food, there will always be some level of chromium in your body. Chromium can be measured in hair, urine, and blood.

Higher than normal levels of chromium in blood or urine may indicate that a person has been exposed to chromium. However, increases in blood and urine chromium levels cannot be used to predict the kind of health effects that might develop from that exposure.

Has the federal government made recommendations to protect human health?

The EPA has determined that exposure to chromium in drinking water at concentrations of 1 mg/L for up to 10 days is not expected to cause any adverse effects in a child.

The FDA has determined that the chromium concentration in bottled drinking water should not exceed 1 mg/L.

The Occupational Health and Safety Administration (OSHA) has limited workers' exposure to an average of 0.0005 mg/m^3 chromium(VI), 0.5 mg/m^3 chromium(III), and 1.0 mg/m^3 chromium(0) for an 8-hour workday, 40-hour workweek.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2008. Toxicological Profile for Chromium (Draft for Public Comment). Atlanta, GA: U.S. Department of Public Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Environmental Medicine, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-800-232-4636, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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COPPER

CAS # 7440-50-8

Division of Toxicology ToxFAQs™ **September 2002**

This fact sheet answers the most frequently asked health questions (FAQs) about copper. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Copper is a reddish metal that occurs naturally in the environment. It also occurs naturally in plants and animals. Low levels of copper are essential for maintaining good health. High levels can cause harmful effects such as irritation of the nose, mouth and eyes, vomiting, diarrhea, stomach crumps, and nausea. Copper has been found in at least 884 of the 1,613 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is copper?

Copper is a reddish metal that occurs naturally in rocks, soil, water, and air. Copper also occurs naturally in plants and animals.

Metallic copper can be easily molded or shaped. Metallic copper can be found in the U.S. penny, electrical wiring, and some water pipes. Metallic copper is also found in mixtures (called alloys) with other metals such as brass and bronze. Copper is also found as part of other compounds forming salts. Copper salts occur naturally, but are also manufactured. The most common copper salt is copper sulfate. Most copper compounds are blue-green in color. Copper compounds are commonly used in agriculture to treat plant diseases like mildew, for water treatment and, as preservatives for wood, leather, and fabrics.

What happens to copper when it enters the environment?

☐ Copper can enter the environment from the mining of copper and other metals and from factories that make or use metallic copper or copper compounds.
☐ It can also enter the environment through domestic waste water, combustion of fossil fuels and wastes, wood production, phosphate fertilizer production, and natural sources (e.g., windblown dust from soils, volcanoes, decaying vegetation, forest fires, and sea spray).
☐ Copper in soil strongly attaches to organic material and minerals.
☐ Copper that dissolves in water becomes rapidly bound to particles suspended in the water.
☐ Copper does not typically enter groundwater.
☐ Copper carried by particles emitted from smelters and ore processing plants is carried back to the ground by gravity or in rain or snow.
☐ Copper does not break down in the environment.

How might I be exposed to copper?

☐ Breathing air, drinking water, eating food, and by skin contact with soil, water, or other copper-containing substances.
☐ Some copper in the environment can be taken up by plants and animals.
☐ Higher exposure may occur if your water is corrosive and you have copper plumbing and brass water fixtures. ☐ You may be exposed to higher amounts of copper if you drink water or swim in lakes or reservoirs recently treated with copper to control algae or receive cooling water from a power plant that may have high amounts of dissolved copper.
☐ Using some garden products (e.g., fungicides) to control plant diseases.
☐ Living near bronze and brass production facilities may expose you to higher copper levels in soil.
☐ You may breathe copper-containing dust or have skin contact if you work in the industry of mining copper or

processing the ore. You may breathe high levels if you grind or weld copper metal.

How can copper affect my health?

Copper is essential for good health, but high amounts can be harmful. Long-term exposure to copper dust can irritate your nose, mouth, and eyes, and cause headaches, dizziness, nausea, and diarrhea.

Drinking water with higher than normal levels of copper may cause vomiting, diarrhea, stomach cramps, and nausea. Intentionally high intakes of copper can cause liver and kidney damage and even death.

How likely is copper to cause cancer?

We do not know whether copper can cause cancer in humans. The EPA has determined that copper is not classifiable as to carcinogenicity.

How can copper affect children?

Exposure to high levels of copper will result in the same type of effects in children and adults. Studies in animals suggest that the young children may have more severe effects than adults; we do not know if this would also be true in humans. There is a very small percentage of infants and children who are unusually sensitive to copper.

We do not know if copper can cause birth defects or other developmental effects in humans. Studies in animals suggest that ingestion of high levels of copper may cause a decrease in fetal growth.

How can families reduce the risk of exposure to copper?

☐ The greatest potential source of copper exposure is through drinking water, especially in water that is first drawn in the morning after sitting in copper pipes and brass faucets overnight.

☐ To reduce exposure, run the water for at least 15-30 seconds before using it.

☐ If you are exposed to copper at work, you may carry copper home on your skin, clothes, or tools. You can avoid this by showering, and changing clothing before leaving work, and your work clothes should be kept separate from other clothes and laundered separately.

Is there a medical test to show whether I've been exposed to copper?

Copper is normally found in all tissues of the body, blood, urine, feces, hair, and nails. High levels of copper in these samples can show that you have been exposed to higher than normal levels of copper. Tests to measure copper levels in the body are not routinely available at the doctor's office because they require special equipment. These tests cannot tell the extent of exposure or whether you will experience harmful effects.

Has the federal government made recommendations to protect human health?

The EPA has determined that drinking water should not contain more than 1.3 milligrams of copper per liter of water (1.3 mg/L).

The Occupational Safety and Health Administration (OSHA) has set a limit of 0.1 mg per cubic meter (0.1 mg/m^3) of copper fumes (vapor generated from heating copper) and 1 mg/m^3 of copper dusts (fine metallic copper particles) and mists (aerosol of soluble copper) in workroom air during an 8-hour work shift, 40-hour workweek.

The Food and Nutrition Board of the Institute of Medicine recommends dietary allowances (RDAs) of 340 micrograms (340 µg) of copper per day for children aged 1-3 years, 440 µg/day for children aged 4-8 years, 700 µg/day for children aged 9-13 years, 890 µg/day for children aged 14-18 years, and 900 µg/day for adults.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2002. Toxicological Profile for Copper (Draft for Public Comment). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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ETHYLBENZENE

CAS # 100-41-4

Agency for Toxic Substances and Disease Registry ToxFAQs **June 1999**

This fact sheet answers the most frequently asked health questions (FAQs) about ethylbenzene. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Ethylbenzene is a colorless liquid found in a number of products including gasoline and paints. Breathing very high levels can cause dizziness and throat and eye irritation. Ethylbenzene has been found in at least 731 of the 1,467 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is ethylbenzene?

(Pronounced ĕth′ əl bĕn′ zēn′)

Ethylbenzene is a colorless, flammable liquid that smells like gasoline. It is found in natural products such as coal tar and petroleum and is also found in manufactured products such as inks, insecticides, and paints.

Ethylbenzene is used primarily to make another chemical, styrene. Other uses include as a solvent, in fuels, and to make other chemicals.

What happens to ethylbenzene when it enters the environment?

- ☐ Ethylbenzene moves easily into the air from water and soil.
- ☐ It takes about 3 days for ethylbenzene to be broken down in air into other chemicals.
- ☐ Ethylbenzene may be released to water from industrial discharges or leaking underground storage tanks.
- ☐ In surface water, ethylbenzene breaks down by reacting with other chemicals found naturally in water.
- ☐ In soil, it is broken down by soil bacteria.

How might I be exposed to ethylbenzene?

- ☐ Breathing air containing ethylbenzene, particularly in areas near factories or highways.
- ☐ Drinking contaminated tap water.
- ☐ Working in an industry where ethylbenzene is used or made.
- ☐ Using products containing it, such as gasoline, carpet glues, varnishes, and paints.

How can ethylbenzene affect my health?

Limited information is available on the effects of ethylbenzene on people's health. The available information shows dizziness, throat and eye irritation, tightening of the chest, and a burning sensation in the eyes of people exposed to high levels of ethylbenzene in air.

Animals studies have shown effects on the nervous system, liver, kidneys, and eyes from breathing ethylbenzene in air.

How likely is ethylbenzene to cause cancer?

The EPA has determined that ethylbenzene is not classifiable as to human carcinogenicity.

No studies in people have shown that ethylbenzene exposure can result in cancer. Two available animal studies suggest that ethylbenzene may cause tumors.

How can ethylbenzene affect children?

Children may be exposed to ethylbenzene through inhalation of consumer products, including gasoline, paints, inks, pesticides, and carpet glue. We do not know whether children are more sensitive to the effects of ethylbenzene than adults.

It is not known whether ethylbenzene can affect the development of the human fetus. Animal studies have shown that when pregnant animals were exposed to ethylbenzene in air, their babies had an increased number of birth defects.

How can families reduce the risk of exposure to ethylbenzene?

Exposure to ethylbenzene vapors from household products and newly installed carpeting can be minimized by using adequate ventilation.

Household chemicals should be stored out of reach of children to prevent accidental poisoning. Always store household chemicals in their original containers; never store them in containers children would find attractive to eat or drink from, such as old soda bottles. Gasoline should be stored in a gasoline can with a locked cap.

Sometimes older children sniff household chemicals, including ethylbenzene, in an attempt to get high. Talk with your children about the dangers of sniffing chemicals.

Is there a medical test to show whether I've been exposed to ethylbenzene?

Ethylbenzene is found in the blood, urine, breath, and some body tissues of exposed people. The most common way to test for ethylbenzene is in the urine. This test measures substances formed by the breakdown of ethylbenzene. This test needs to be done within a few hours after exposure occurs, because the substances leave the body very quickly.

These tests can show you were exposed to ethylbenzene, but cannot predict the kind of health effects that might occur.

Has the federal government made recommendations to protect human health?

The EPA has set a maximum contaminant level of 0.7 milligrams of ethylbenzene per liter of drinking water (0.7 mg/L).

The EPA requires that spills or accidental releases into the environment of 1,000 pounds or more of ethylbenzene be reported to the EPA.

The Occupational Safety and Health Administration (OSHA) has set an occupational exposure limit of 100 parts of ethylbenzene per million parts of air (100 ppm) for an 8-hour workday, 40-hour workweek.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1999. Toxicological profile for ethylbenzene. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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FUEL OILS

CAS # 8008-20-6, 70892-10-3, 68476-30-2, 68476-34-6, 68476-31-3

Agency for Toxic Substances and Disease Registry ToxFAQs September 1996

This fact sheet answers the most frequently asked health questions (FAQs) about fuel oils. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

SUMMARY: Fuel oils are liquid mixtures produced from petroleum, and their use mostly involves burning them as fuels. Drinking or breathing fuel oils may cause nausea or nervous system effects. However, exposure under normal use conditions is not likely to be harmful. Fuel oils have been found in at least 26 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What are fuel oils?

(Pronounced fyo͞o′əl oilz)

Fuel oils are a variety of yellowish to light brown liquid mixtures that come from crude petroleum. Some chemicals found in fuel oils may evaporate easily, while others may more easily dissolve in water.

Fuel oils are produced by different petroleum refining processes, depending on their intended uses. Fuel oils may be used as fuel for engines, lamps, heaters, furnaces, and stoves, or as solvents.

Some commonly found fuel oils include kerosene, diesel fuel, jet fuel, range oil, and home heating oil. These fuel oils differ from one another by their hydrocarbon compositions, boiling point ranges, chemical additives, and uses.

What happens to fuel oils when they enter the environment?

- ☐ Some chemicals found in fuel oils may evaporate into the air from open containers or contaminated soil or water.
- ☐ Some chemicals found in fuel oils may dissolve in water after spills to surface waters or leaks from underground storage tanks.
- ☐ Some chemicals found in fuel oils may stick to particles in water, which will eventually cause them to settle to the bottom sediment.
- ☐ Some of the chemicals found in fuel oils may be broken down slowly in air, water, and soil by sunlight or small organisms.
- ☐ Some of the chemicals found in fuel oils may build up significantly in plants and animals.

How might I be exposed to fuel oils?

- ☐ Using a home kerosene heater or stove, or using fuel oils at work.
- ☐ Breathing air in home or building basements that has been contaminated with fuel oil vapors entering from the soil.
- ☐ Drinking or swimming in water that has been contaminated with fuel oils from a spill or a leaking underground storage tank.
- ☐ Touching soil contaminated with fuel oils.
- ☐ Using fuel oils to wash paint or grease from skin or equipment.

How can fuel oils affect my health?

Little information is available about the health effects that may be caused by fuel oils. People who use kerosene stoves for cooking do not seem to have any health problems related to their exposure.

Breathing some fuel oils for short periods may cause nausea, eye irritation, increased blood pressure, headache, lightheadedness, loss of appetite, poor coordination, and difficulty concentrating. Breathing diesel fuel vapors for long periods may cause kidney damage and lower your blood's ability to clot.

Drinking small amounts of kerosene may cause vomiting, diarrhea, coughing, stomach swelling and cramps, drowsiness, restlessness, painful breathing, irritability, and unconsciousness. Drinking large amounts of kerosene may cause convulsions, coma, or death. Skin contact with kerosene for short periods may cause itchy, red, sore, or peeling skin.

How likely are fuel oils to cause cancer?

The International Agency for Research on Cancer (IARC) has determined that some fuel oils (heavy) may possibly cause cancer in humans, but for other fuel oils (light) there is not enough information to make a determination. IARC has also determined that occupational exposures to fuel oils during petroleum refining are probably carcinogenic in humans.

Some studies with mice have suggested that repeated contact with fuel oils may cause liver or skin cancer. However, other mouse studies have found this not to be the case. No studies are available in other animals or in people on the carcinogenic effects of fuel oils.

Is there a medical test to show whether I've been exposed to fuel oils?

There is no medical test that shows if you have been exposed to fuel oils. Tests are available to determine if some of the chemicals commonly found in fuel oils are in your blood. However, the presence of these chemicals in blood may not necessarily mean that you have been exposed to fuel oils.

Has the federal government made recommendations to protect human health?

The Occupational Safety and Health Administration (OSHA) and the Air Force Office of Safety and Health (AFOSH) have set a permissible exposure level (PEL) of 400 parts of petroleum distillates per million parts of air (400 ppm) for an 8-hour workday, 40-hour workweek.

The National Institute for Occupational Safety and Health (NIOSH) recommends that average workplace air levels not exceed 350 milligrams of petroleum distillates per cubic meter of air (350 mg/m^3) for a 40-hour workweek.

The Department of Transportation (DOT) lists fuel oils as hazardous materials and, therefore, regulates their transportation.

Glossary

Carcinogenic: Able to cause cancer.

CAS: Chemical Abstracts Service.

Evaporate: To change into a vapor or a gas.

Hydrocarbon: Any compound made up of hydrogen and carbon.

Milligram (mg): One thousandth of a gram.

ppm: Parts per million.

Sediment: Mud and debris that have settled to the bottom of a body of water.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1995. Toxicological profile for fuel oils. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop E-29, Atlanta, GA 30333. Phone:1-888-422-8737, FAX: 404-498-0093. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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LEAD

CAS # 7439-92-1

Division of Toxicology and Environmental Medicine ToxFAQs™ August 2007

This fact sheet answers the most frequently asked health questions (FAQs) about lead. For more information, call the ATSDR Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to lead can happen from breathing workplace air or dust, eating contaminated foods, or drinking contaminated water. Children can be exposed from eating lead-based paint chips or playing in contaminated soil. Lead can damage the nervous system, kidneys, and reproductive system. Lead has been found in at least 1,272 of the 1,684 National Priority List sites identified by the Environmental Protection Agency (EPA).

What is lead?

Lead is a naturally occurring bluish-gray metal found in small amounts in the earth's crust. Lead can be found in all parts of our environment. Much of it comes from human activities including burning fossil fuels, mining, and manufacturing.

Lead has many different uses. It is used in the production of batteries, ammunition, metal products (solder and pipes), and devices to shield X-rays. Because of health concerns, lead from paints and ceramic products, caulking, and pipe solder has been dramatically reduced in recent years. The use of lead as an additive to gasoline was banned in 1996 in the United States.

What happens to lead when it enters the environment?

❏ Lead itself does not break down, but lead compounds are changed by sunlight, air, and water.

❏ When lead is released to the air, it may travel long distances before settling to the ground.

❏ Once lead falls onto soil, it usually sticks to soil particles.

❏ Movement of lead from soil into groundwater will depend on the type of lead compound and the characteristics of the soil.

How might I be exposed to lead?

❏ Eating food or drinking water that contains lead. Water pipes in some older homes may contain lead solder. Lead can leach out into the water.

❏ Spending time in areas where lead-based paints have been used and are deteriorating. Deteriorating lead paint can contribute to lead dust.

❏ Working in a job where lead is used or engaging in certain hobbies in which lead is used, such as making stained glass.

❏ Using health-care products or folk remedies that contain lead.

How can lead affect my health?

The effects of lead are the same whether it enters the body through breathing or swallowing. Lead can affect almost every organ and system in your body. The main target for lead toxicity is the nervous system, both in adults and children. Long-term exposure of adults can result in decreased performance in some tests that measure functions of the nervous system. It may also cause weakness in fingers, wrists, or ankles. Lead exposure also causes small increases in blood pressure, particularly in middle-aged and older people and can cause anemia. Exposure to high lead levels can severely damage the brain and kidneys in adults or children and ultimately cause death. In pregnant women, high levels of exposure to lead may cause miscarriage. High-level exposure in men can damage the organs responsible for sperm production.

How likely is lead to cause cancer?

We have no conclusive proof that lead causes cancer in humans. Kidney tumors have developed in rats and mice that had been given large doses of some kind of lead compounds. The Department of Health and Human Services

(DHHS) has determined that lead and lead compounds are reasonably anticipated to be human carcinogens and the EPA has determined that lead is a probable human carcinogen. The International Agency for Research on Cancer (IARC) has determined that inorganic lead is probably carcinogenic to humans and that there is insufficient information to determine whether organic lead compounds will cause cancer in humans.

How can lead affect children?

Small children can be exposed by eating lead-based paint chips, chewing on objects painted with lead-based paint, or swallowing house dust or soil that contains lead.

Children are more vulnerable to lead poisoning than adults. A child who swallows large amounts of lead may develop blood anemia, severe stomachache, muscle weakness, and brain damage. If a child swallows smaller amounts of lead, much less severe effects on blood and brain function may occur. Even at much lower levels of exposure, lead can affect a child's mental and physical growth.

Exposure to lead is more dangerous for young and unborn children. Unborn children can be exposed to lead through their mothers. Harmful effects include premature births, smaller babies, decreased mental ability in the infant, learning difficulties, and reduced growth in young children. These effects are more common if the mother or baby was exposed to high levels of lead. Some of these effects may persist beyond childhood.

How can families reduce the risks of exposure to lead?

❑ Avoid exposure to sources of lead.

❑ Do not allow children to chew or mouth surfaces that may have been painted with lead-based paint.

❑ If you have a water lead problem, run or flush water that has been standing overnight before drinking or cooking with it.

❑ Some types of paints and pigments that are used as make-up or hair coloring contain lead. Keep these kinds of products away from children

❑ If your home contains lead-based paint or you live in an area contaminated with lead, wash children's hands and faces often to remove lead dusts and soil, and regularly clean the house of dust and tracked in soil.

Is there a medical test to determine whether I've been exposed to lead?

A blood test is available to measure the amount of lead in your blood and to estimate the amount of your recent exposure to lead. Blood tests are commonly used to screen children for lead poisoning. Lead in teeth or bones can be measured by X-ray techniques, but these methods are not widely available. Exposure to lead also can be evaluated by measuring erythrocyte protoporphyrin (EP) in blood samples. EP is a part of red blood cells known to increase when the amount of lead in the blood is high. However, the EP level is not sensitive enough to identify children with elevated blood lead levels below about 25 micrograms per deciliter (μg/dL). These tests usually require special analytical equipment that is not available in a doctor's office. However, your doctor can draw blood samples and send them to appropriate laboratories for analysis.

Has the federal government made recommendations to protect human health?

The Centers for Disease Control and Prevention (CDC) recommends that states test children at ages 1 and 2 years. Children should be tested at ages 3–6 years if they have never been tested for lead, if they receive services from public assistance programs for the poor such as Medicaid or the Supplemental Food Program for Women, Infants, and Children, if they live in a building or frequently visit a house built before 1950; if they visit a home (house or apartment) built before 1978 that has been recently remodeled; and/or if they have a brother, sister, or playmate who has had lead poisoning. CDC considers a blood lead level of 10 μg/dL to be a level of concern for children.

EPA limits lead in drinking water to 15 μg per liter.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2007. Toxicological Profile for lead (Update). Atlanta, GA: U.S. Department of Public Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Environmental Medicine, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-800-232-4636, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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MERCURY
CAS # 7439-97-6

Agency for Toxic Substances and Disease Registry ToxFAQs April 1999

This fact sheet answers the most frequently asked health questions (FAQs) about mercury. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to mercury occurs from breathing contaminated air, ingesting contaminated water and food, and having dental and medical treatments. Mercury, at high levels, may damage the brain, kidneys, and developing fetus. This chemical has been found in at least 714 of 1,467 National Priorities List sites identified by the Environmental Protection Agency.

What is mercury?
(Pronounced mũr′kyə-rē)

Mercury is a naturally occurring metal which has several forms. The metallic mercury is a shiny, silver-white, odorless liquid. If heated, it is a colorless, odorless gas.

Mercury combines with other elements, such as chlorine, sulfur, or oxygen, to form inorganic mercury compounds or "salts," which are usually white powders or crystals. Mercury also combines with carbon to make organic mercury compounds. The most common one, methylmercury, is produced mainly by microscopic organisms in the water and soil. More mercury in the environment can increase the amounts of methylmercury that these small organisms make.

Metallic mercury is used to produce chlorine gas and caustic soda, and is also used in thermometers, dental fillings, and batteries. Mercury salts are sometimes used in skin lightening creams and as antiseptic creams and ointments.

What happens to mercury when it enters the environment?

- ☐ Inorganic mercury (metallic mercury and inorganic mercury compounds) enters the air from mining ore deposits, burning coal and waste, and from manufacturing plants.
- ☐ It enters the water or soil from natural deposits, disposal of wastes, and volcanic activity.
- ☐ Methylmercury may be formed in water and soil by small organisms called bacteria.
- ☐ Methylmercury builds up in the tissues of fish. Larger and older fish tend to have the highest levels of mercury.

How might I be exposed to mercury?

- ☐ Eating fish or shellfish contaminated with methylmercury.
- ☐ Breathing vapors in air from spills, incinerators, and industries that burn mercury-containing fuels.
- ☐ Release of mercury from dental work and medical treatments.
- ☐ Breathing contaminated workplace air or skin contact during use in the workplace (dental, health services, chemical, and other industries that use mercury).
- ☐ Practicing rituals that include mercury.

How can mercury affect my health?

The nervous system is very sensitive to all forms of mercury. Methylmercury and metallic mercury vapors are more harmful than other forms, because more mercury in these forms reaches the brain. Exposure to high levels of metallic, inorganic, or organic mercury can permanently damage the brain, kidneys, and developing fetus. Effects on brain functioning may result in irritability, shyness, tremors, changes in vision or hearing, and memory problems.

Short-term exposure to high levels of metallic mercury vapors may cause effects including lung damage, nausea, vomiting, diarrhea, increases in blood pressure or heart rate, skin rashes, and eye irritation.

How likely is mercury to cause cancer?

There are inadequate human cancer data available for all forms of mercury. Mercuric chloride has caused increases in several types of tumors in rats and mice, and methylmercury has caused kidney tumors in male mice. The EPA has determined that mercuric chloride and methylmercury are possible human carcinogens.

How can mercury affect children?

Very young children are more sensitive to mercury than adults. Mercury in the mother's body passes to the fetus and may accumulate there. It can also can pass to a nursing infant through breast milk. However, the benefits of breast feeding may be greater than the possible adverse effects of mercury in breast milk.

Mercury's harmful effects that may be passed from the mother to the fetus include brain damage, mental retardation, incoordination, blindness, seizures, and inability to speak. Children poisoned by mercury may develop problems of their nervous and digestive systems, and kidney damage.

How can families reduce the risk of exposure to mercury?

Carefully handle and dispose of products that contain mercury, such as thermometers or fluorescent light bulbs. Do not vacuum up spilled mercury, because it will vaporize and increase exposure. If a large amount of mercury has been spilled, contact your health department. Teach children not to play with shiny, silver liquids.

Properly dispose of older medicines that contain mercury. Keep all mercury-containing medicines away from children.

Pregnant women and children should keep away from rooms where liquid mercury has been used.

Learn about wildlife and fish advisories in your area from your public health or natural resources department.

Is there a medical test to show whether I've been exposed to mercury?

Tests are available to measure mercury levels in the body. Blood or urine samples are used to test for exposure to metallic mercury and to inorganic forms of mercury. Mercury in whole blood or in scalp hair is measured to determine exposure to methylmercury. Your doctor can take samples and send them to a testing laboratory.

Has the federal government made recommendations to protect human health?

The EPA has set a limit of 2 parts of mercury per billion parts of drinking water (2 ppb).

The Food and Drug Administration (FDA) has set a maximum permissible level of 1 part of methylmercury in a million parts of seafood (1 ppm).

The Occupational Safety and Health Administration (OSHA) has set limits of 0.1 milligram of organic mercury per cubic meter of workplace air (0.1 mg/m^3) and 0.05 mg/m^3 of metallic mercury vapor for 8-hour shifts and 40-hour work weeks.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1999. Toxicological profile for mercury. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)

Agency for Toxic Substances and Disease Registry ToxFAQs September 1996

This fact sheet answers the most frequently asked health questions (FAQs) about polycyclic aromatic hydrocarbons (PAHs). For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

SUMMARY: Exposure to polycyclic aromatic hydrocarbons usually occurs by breathing air contaminated by wild fires or coal tar, or by eating foods that have been grilled. PAHs have been found in at least 600 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What are polycyclic aromatic hydrocarbons?

(Pronounced pŏl′ĭ-sī′klĭk ăr′ə-măt′ĭk hī′drə-kar′bənz)

Polycyclic aromatic hydrocarbons (PAHs) are a group of over 100 different chemicals that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat. PAHs are usually found as a mixture containing two or more of these compounds, such as soot.

Some PAHs are manufactured. These pure PAHs usually exist as colorless, white, or pale yellow-green solids. PAHs are found in coal tar, crude oil, creosote, and roofing tar, but a few are used in medicines or to make dyes, plastics, and pesticides.

What happens to PAHs when they enter the environment?

- PAHs enter the air mostly as releases from volcanoes, forest fires, burning coal, and automobile exhaust.
- PAHs can occur in air attached to dust particles.
- Some PAH particles can readily evaporate into the air from soil or surface waters.
- PAHs can break down by reacting with sunlight and other chemicals in the air, over a period of days to weeks.
- PAHs enter water through discharges from industrial and wastewater treatment plants.
- Most PAHs do not dissolve easily in water. They stick to solid particles and settle to the bottoms of lakes or rivers.
- Microorganisms can break down PAHs in soil or water after a period of weeks to months.
- In soils, PAHs are most likely to stick tightly to particles; certain PAHs move through soil to contaminate underground water.
- PAH contents of plants and animals may be much higher than PAH contents of soil or water in which they live.

How might I be exposed to PAHs?

- Breathing air containing PAHs in the workplace of coking, coal-tar, and asphalt production plants; smokehouses; and municipal trash incineration facilities.
- Breathing air containing PAHs from cigarette smoke, wood smoke, vehicle exhausts, asphalt roads, or agricultural burn smoke.
- Coming in contact with air, water, or soil near hazardous waste sites.
- Eating grilled or charred meats; contaminated cereals, flour, bread, vegetables, fruits, meats; and processed or pickled foods.
- Drinking contaminated water or cow's milk.

☐ Nursing infants of mothers living near hazardous waste sites may be exposed to PAHs through their mother's milk.

How can PAHs affect my health?

Mice that were fed high levels of one PAH during pregnancy had difficulty reproducing and so did their offspring. These offspring also had higher rates of birth defects and lower body weights. It is not known whether these effects occur in people.

Animal studies have also shown that PAHs can cause harmful effects on the skin, body fluids, and ability to fight disease after both short- and long-term exposure. But these effects have not been seen in people.

How likely are PAHs to cause cancer?

The Department of Health and Human Services (DHHS) has determined that some PAHs may reasonably be expected to be carcinogens.

Some people who have breathed or touched mixtures of PAHs and other chemicals for long periods of time have developed cancer. Some PAHs have caused cancer in laboratory animals when they breathed air containing them (lung cancer), ingested them in food (stomach cancer), or had them applied to their skin (skin cancer).

Is there a medical test to show whether I've been exposed to PAHs?

In the body, PAHs are changed into chemicals that can attach to substances within the body. There are special tests that can detect PAHs attached to these substances in body tissues or blood. However, these tests cannot tell whether any health effects will occur or find out the extent or source of your exposure to the PAHs. The tests aren't usually available in your doctor's office because special equipment is needed to conduct them.

Has the federal government made recommendations to protect human health?

The Occupational Safety and Health Administration (OSHA) has set a limit of 0.2 milligrams of PAHs per cubic meter of air (0.2 mg/m^3). The OSHA Permissible Exposure Limit (PEL) for mineral oil mist that contains PAHs is 5 mg/m^3 averaged over an 8-hour exposure period.

The National Institute for Occupational Safety and Health (NIOSH) recommends that the average workplace air levels for coal tar products not exceed 0.1 mg/m^3 for a 10-hour workday, within a 40-hour workweek. There are other limits for workplace exposure for things that contain PAHs, such as coal, coal tar, and mineral oil.

Glossary

Carcinogen: A substance that can cause cancer.

Ingest: Take food or drink into your body.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1995. Toxicological profile for polycyclic aromatic hydrocarbons. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES
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TRICHLOROETHYLENE
CAS # 79-01-6

Division of Toxicology ToxFAQs™ **July 2003**

This fact sheet answers the most frequently asked health questions (FAQs) about trichloroethylene. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Trichloroethylene is a colorless liquid which is used as a solvent for cleaning metal parts. Drinking or breathing high levels of trichloroethylene may cause nervous system effects, liver and lung damage, abnormal heartbeat, coma, and possibly death. Trichloroethylene has been found in at least 852 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is trichloroethylene?

Trichloroethylene (TCE) is a nonflammable, colorless liquid with a somewhat sweet odor and a sweet, burning taste. It is used mainly as a solvent to remove grease from metal parts, but it is also an ingredient in adhesives, paint removers, typewriter correction fluids, and spot removers.

Trichloroethylene is not thought to occur naturally in the environment. However, it has been found in underground water sources and many surface waters as a result of the manufacture, use, and disposal of the chemical.

What happens to trichloroethylene when it enters the environment?

❑ Trichloroethylene dissolves a little in water, but it can remain in ground water for a long time.

❑ Trichloroethylene quickly evaporates from surface water, so it is commonly found as a vapor in the air.

❑ Trichloroethylene evaporates less easily from the soil than from surface water. It may stick to particles and remain for a long time.

❑ Trichloroethylene may stick to particles in water, which will cause it to eventually settle to the bottom sediment.

❑ Trichloroethylene does not build up significantly in plants and animals.

How might I be exposed to trichloroethylene?

❑ Breathing air in and around the home which has been contaminated with trichloroethylene vapors from shower water or household products such as spot removers and typewriter correction fluid.

❑ Drinking, swimming, or showering in water that has been contaminated with trichloroethylene.

❑ Contact with soil contaminated with trichloroethylene, such as near a hazardous waste site.

❑ Contact with the skin or breathing contaminated air while manufacturing trichloroethylene or using it at work to wash paint or grease from skin or equipment.

How can trichloroethylene affect my health?

Breathing small amounts may cause headaches, lung irritation, dizziness, poor coordination, and difficulty concentrating.

Breathing large amounts of trichloroethylene may cause impaired heart function, unconsciousness, and death. Breathing it for long periods may cause nerve, kidney, and liver damage.

Drinking large amounts of trichloroethylene may cause nausea, liver damage, unconsciousness, impaired heart function, or death.

Drinking small amounts of trichloroethylene for long periods may cause liver and kidney damage, impaired immune system function, and impaired fetal development in pregnant women, although the extent of some of these effects is not yet clear.

Skin contact with trichloroethylene for short periods may cause skin rashes.

How likely is trichloroethylene to cause cancer?

Some studies with mice and rats have suggested that high levels of trichloroethylene may cause liver, kidney, or lung cancer. Some studies of people exposed over long periods to high levels of trichloroethylene in drinking water or in workplace air have found evidence of increased cancer. Although, there are some concerns about the studies of people who were exposed to trichloroethylene, some of the effects found in people were similar to effects in animals.

In its 9th Report on Carcinogens, the National Toxicology Program (NTP) determined that trichloroethylene is "reasonably anticipated to be a human carcinogen." The International Agency for Research on Cancer (IARC) has determined that trichloroethylene is "probably carcinogenic to humans."

Is there a medical test to show whether I've been exposed to trichloroethylene?

If you have recently been exposed to trichloroethylene, it can be detected in your breath, blood, or urine. The breath test, if it is performed soon after exposure, can tell if you have been exposed to even a small amount of trichloroethylene.

Exposure to larger amounts is assessed by blood and urine tests, which can detect trichloroethylene and many of its breakdown products for up to a week after exposure. However, exposure to other similar chemicals can produce the same breakdown products, so their detection is not absolute proof of exposure to trichloroethylene. This test isn't available at most doctors' offices, but can be done at special laboratories that have the right equipment.

Has the federal government made recommendations to protect human health?

The EPA has set a maximum contaminant level for trichloroethylene in drinking water at 0.005 milligrams per liter (0.005 mg/L) or 5 parts of TCE per billion parts water.

The EPA has also developed regulations for the handling and disposal of trichloroethylene.

The Occupational Safety and Health Administration (OSHA) has set an exposure limit of 100 parts of trichloroethylene per million parts of air (100 ppm) for an 8-hour workday, 40-hour workweek.

Glossary

Carcinogenicity: The ability of a substance to cause cancer.
CAS: Chemical Abstracts Service.
Evaporate: To change into a vapor or gas.
Milligram (mg): One thousandth of a gram.
Nonflammable: Will not burn.
ppm: Parts per million.
Sediment: Mud and debris that have settled to the bottom of a body of water.
Solvent: A chemical that dissolves other substances.

References

This ToxFAQs information is taken from the 1997 Toxicological Profile for Trichloroethylene (update) produced by the Agency for Toxic Substances and Disease Registry, Public Health Service, U.S. Department of Health and Human Services, Public Health Service in Atlanta, GA.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs™ Internet address is http://www.atsdr.cdc.gov/toxfaq.html . ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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TETRACHLOROETHYLENE
CAS # 127-18-4

Agency for Toxic Substances and Disease Registry ToxFAQs **September 1997**

This fact sheet answers the most frequently asked health questions (FAQs) about tetrachloroethylene. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Tetrachloroethylene is a manufactured chemical used for dry cleaning and metal degreasing. Exposure to very high concentrations of tetrachloroethylene can cause dizziness, headaches, sleepiness, confusion, nausea, difficulty in speaking and walking, unconsciousness, and death. Tetrachloroethylene has been found in at least 771 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is tetrachloroethylene?

(Pronounced tĕt′rə-klôr′ ō-ĕth′ə-lēn′)

Tetrachloroethylene is a manufactured chemical that is widely used for dry cleaning of fabrics and for metal-degreasing. It is also used to make other chemicals and is used in some consumer products.

Other names for tetrachloroethylene include perchloroethylene, PCE, and tetrachloroethene. It is a nonflammable liquid at room temperature. It evaporates easily into the air and has a sharp, sweet odor. Most people can smell tetrachloroethylene when it is present in the air at a level of 1 part tetrachloroethylene per million parts of air (1 ppm) or more, although some can smell it at even lower levels.

What happens to tetrachloroethylene when it enters the environment?

☐ Much of the tetrachloroethylene that gets into water or soil evaporates into the air.

☐ Microorganisms can break down some of the tetrachloroethylene in soil or underground water.

☐ In the air, it is broken down by sunlight into other chemicals or brought back to the soil and water by rain.

☐ It does not appear to collect in fish or other animals that live in water.

How might I be exposed to tetrachloroethylene?

☐ When you bring clothes from the dry cleaners, they will release small amounts of tetrachloroethylene into the air.

☐ When you drink water containing tetrachloroethylene, you are exposed to it.

How can tetrachloroethylene affect my health?

High concentrations of tetrachloroethylene (particularly in closed, poorly ventilated areas) can cause dizziness, headache, sleepiness, confusion, nausea, difficulty in speaking and walking, unconsciousness, and death.

Irritation may result from repeated or extended skin contact with it. These symptoms occur almost entirely in work (or hobby) environments when people have been accidentally exposed to high concentrations or have intentionally used tetrachloroethylene to get a "high."

In industry, most workers are exposed to levels lower than those causing obvious nervous system effects. The health effects of breathing in air or drinking water with low levels of tetrachloroethylene are not known.

Results from some studies suggest that women who work in dry cleaning industries where exposures to tetrachloroethylene can be quite high may have more menstrual problems and spontaneous abortions than women who are not exposed. However, it is not known if tetrachloroethylene was responsible for these problems because other possible causes were not considered.

Results of animal studies, conducted with amounts much higher than those that most people are exposed to, show that tetrachloroethylene can cause liver and kidney damage. Exposure to very high levels of tetrachloroethylene can be toxic to the unborn pups of pregnant rats and mice. Changes in behavior were observed in the offspring of rats that breathed high levels of the chemical while they were pregnant.

How likely is tetrachloroethylene to cause cancer?

The Department of Health and Human Services (DHHS) has determined that tetrachloroethylene may reasonably be anticipated to be a carcinogen. Tetrachloroethylene has been shown to cause liver tumors in mice and kidney tumors in male rats.

Is there a medical test to show whether I've been exposed to tetrachloroethylene?

One way of testing for tetrachloroethylene exposure is to measure the amount of the chemical in the breath, much the same way breath-alcohol measurements are used to determine the amount of alcohol in the blood.

Because it is stored in the body's fat and slowly released into the bloodstream, tetrachloroethylene can be detected in the breath for weeks following a heavy exposure.

Tetrachloroethylene and trichloroacetic acid (TCA), a breakdown product of tetrachloroethylene, can be detected in the blood. These tests are relatively simple to perform. These tests aren't available at most doctors' offices, but can be performed at special laboratories that have the right equipment.

Because exposure to other chemicals can produce the same breakdown products in the urine and blood, the tests for breakdown products cannot determine if you have been exposed to tetrachloroethylene or the other chemicals.

Has the federal government made recommendations to protect human health?

The EPA maximum contaminant level for the amount of tetrachloroethylene that can be in drinking water is 0.005 milligrams tetrachloroethylene per liter of water (0.005 mg/L).

The Occupational Safety and Health Administration (OSHA) has set a limit of 100 ppm for an 8-hour workday over a 40-hour workweek.

The National Institute for Occupational Safety and Health (NIOSH) recommends that tetrachloroethylene be handled as a potential carcinogen and recommends that levels in workplace air should be as low as possible.

Glossary

Carcinogen: A substance with the ability to cause cancer.

CAS: Chemical Abstracts Service.

Milligram (mg): One thousandth of a gram.

Nonflammable: Will not burn.

References

This ToxFAQs information is taken from the 1997 Toxicological Profile for Tetrachloroethylene (update) produced by the Agency for Toxic Substances and Disease Registry, Public Health Service, U.S. Department of Health and Human Services, Public Health Service in Atlanta, GA.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone:1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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TOLUENE
CAS # 108-88-3

Division of Toxicology ToxFAQs™ **February 2001**

This fact sheet answers the most frequently asked health questions (FAQs) about toluene. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to toluene occurs from breathing contaminated workplace air, in automobile exhaust, some consumer products paints, paint thinners, fingernail polish, lacquers, and adhesives. Toluene affects the nervous system. Toluene has been found at 959 of the 1,591 National Priority List sites identified by the Environmental Protection Agency

What is toluene?

Toluene is a clear, colorless liquid with a distinctive smell. Toluene occurs naturally in crude oil and in the tolu tree. It is also produced in the process of making gasoline and other fuels from crude oil and making coke from coal.

Toluene is used in making paints, paint thinners, fingernail polish, lacquers, adhesives, and rubber and in some printing and leather tanning processes.

What happens to toluene when it enters the environment?

❏ Toluene enters the environment when you use materials that contain it. It can also enter surface water and groundwater from spills of solvents and petrolieum products as well as from leasking underground storage tanks at gasoline stations and other facilities.

❏ When toluene-containing products are placed in landfills or waste disposal sites, the toluene can enter the soil or water near the waste site.

❏ Toluene does not usually stay in the environment long.

❏ Toluene does not concentrate or buildup to high levels in animals.

How might I be exposed to toluene?

❏ Breathing contaminated workplace air or automobile exhaust.

❏ Working with gasoline, kerosene, heating oil, paints, and lacquers.

❏ Drinking contaminated well-water.

❏ Living near uncontrolled hazardous waste sites containing toluene products.

How can toluene affect my health?

Toluene may affect the nervous system. Low to moderate levles can cause tiredness, confusion, weakness, drunken-type actions, memory loss, nausea, loss of appetite, and hearing and color vision loss. These symptoms usually disappear when exposure is stopped.

Inhaling High levels of toluene in a short time can make you feel light-headed, dizzy, or sleepy. It can also cause unconsciousness, and even death.

High levels of toluene may affect your kidneys.

How likely is toluene to cause cancer?

Studies in humans and animals generally indicate that toluene does not cause cancer.

The EPA has determined that the carcinogenicity of toluene can not be classified.

How can toluene affect children?

It is likely that health effects seen in children exposed to toluene will be similar to the effects seen in adults.
Some studies in animals suggest that babies may be more sensitive than adults.

Breathing very high levels of toluene during pregnancy can result in children with birth defects and retard mental abilities, and growth. We do not know if toluene harms the unborn child if the mother is exposed to low levels of toluene during pregnancy.

How can families reduce the risk of exposure to toluene?

❏ Use toluene-containing products in well-ventilated areas.

❏ When not in use, toluene-containing products should be tightly covered to prevent evaporation into the air.

Is there a medical test to show whether I've been exposed to toluene?

There are tests to measure the level of toluene or its breakdown products in exhaled air, urine, and blood. To determine if you have been exposed to toluene, your urine or blood must be checked within 12 hours of exposure. Several other chemicals are also changed into the same breakdown products as toluene, so some of these tests are not specific for toluene.

Has the federal government made recommendations to protect human health?

EPA has set a limit of 1 milligram per liter of drinking water (1 mg/L).

Discharges, releases, or spills of more than 1,000 pounds of toluene must be reported to the National Response Center.

The Occupational Safety and Health Administration has set a limit of 200 parts toluene per million of workplace air (200 ppm).

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological Profile for Toluene. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs™ Internet address is http://www.atsdr.cdc.gov/toxfaq.html . ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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XYLENE

CAS # 1330-20-7

Agency for Toxic Substances and Disease Registry ToxFAQs **September 1996**

This fact sheet answers the most frequently asked health questions (FAQs) about xylene. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

SUMMARY: Exposure to xylene occurs in the workplace and when you use paint, gasoline, paint thinners and other products that contain it. People who breathe high levels may have dizziness, confusion, and a change in their sense of balance. This substance has been found in at least 658 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is xylene?

(Pronounced zī′lēn)

Xylene is a colorless, sweet-smelling liquid that catches on fire easily. It occurs naturally in petroleum and coal tar and is formed during forest fires. You can smell xylene in air at 0.08–3.7 parts of xylene per million parts of air (ppm) and begin to taste it in water at 0.53–1.8 ppm.

Chemical industries produce xylene from petroleum. It's one of the top 30 chemicals produced in the United States in terms of volume.

Xylene is used as a solvent and in the printing, rubber, and leather industries. It is also used as a cleaning agent, a thinner for paint, and in paints and varnishes. It is found in small amounts in airplane fuel and gasoline.

What happens to xylene when it enters the environment?

- Xylene has been found in waste sites and landfills when discarded as used solvent, or in varnish, paint, or paint thinners.
- It evaporates quickly from the soil and surface water into the air.
- In the air, it is broken down by sunlight into other less harmful chemicals.
- It is broken down by microorganisms in soil and water.
- Only a small amount of it builds up in fish, shellfish, plants, and animals living in xylene-contaminated water.

How might I be exposed to xylene?

- Breathing xylene in workplace air or in automobile exhaust.
- Breathing contaminated air.
- Touching gasoline, paint, paint removers, varnish, shellac, and rust preventatives that contain it.
- Breathing cigarette smoke that has small amounts of xylene in it.
- Drinking contaminated water or breathing air near waste sites and landfills that contain xylene.
- The amount of xylene in food is likely to be low.

How can xylene affect my health?

Xylene affects the brain. High levels from exposure for short periods (14 days or less) or long periods (more than 1 year) can cause headaches, lack of muscle coordination, dizziness, confusion, and changes in one's sense of balance. Exposure of people to high levels of xylene for short periods can also cause irritation of the skin, eyes, nose, and throat; difficulty in breathing; problems with the lungs; delayed reaction time; memory difficulties; stomach discomfort; and possibly changes in the liver and kidneys. It can cause unconsciousness and even death at very high levels.

Studies of unborn animals indicate that high concentrations of xylene may cause increased numbers of deaths, and delayed growth and development. In many instances, these same concentrations also cause damage to the mothers. We do not know if xylene harms the unborn child if the mother is exposed to low levels of xylene during pregnancy.

How likely is xylene to cause cancer?

The International Agency for Research on Cancer (IARC) has determined that xylene is not classifiable as to its carcinogenicity in humans.

Human and animal studies have not shown xylene to be carcinogenic, but these studies are not conclusive and do not provide enough information to conclude that xylene does not cause cancer.

Is there a medical test to show whether I've been exposed to xylene?

Laboratory tests can detect xylene or its breakdown products in exhaled air, blood, or urine. There is a high degree of agreement between the levels of exposure to xylene and the levels of xylene breakdown products in the urine. However, a urine sample must be provided very soon after exposure ends because xylene quickly leaves the body. These tests are not routinely available at your doctor's office.

Has the federal government made recommendations to protect human health?

The EPA has set a limit of 10 ppm of xylene in drinking water.

The EPA requires that spills or accidental releases of xylenes into the environment of 1,000 pounds or more must be reported.

The Occupational Safety and Health Administration (OSHA) has set a maximum level of 100 ppm xylene in workplace air for an 8-hour workday, 40-hour workweek.

The National Institute for Occupational Safety and Health (NIOSH) and the American Conference of Governmental Industrial Hygienists (ACGIH) also recommend exposure limits of 100 ppm in workplace air.

NIOSH has recommended that 900 ppm of xylene be considered immediately dangerous to life or health. This is the exposure level of a chemical that is likely to cause permanent health problems or death.

Glossary

Evaporate: To change from a liquid into a vapor or a gas.

Carcinogenic: Having the ability to cause cancer.

CAS: Chemical Abstracts Service.

ppm: Parts per million.

Solvent: A liquid that can dissolve other substances.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1995. Toxicological profile for xylenes (update). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop E-29, Atlanta, GA 30333. Phone:1-888-422-8737, FAX: 404-498-0093. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES
AND DISEASE REGISTRY

ZINC

CAS # 7440-66-6

Division of Toxicology ToxFAQs™ **August 2005**

This fact sheet answers the most frequently asked health questions (FAQs) about zinc. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Zinc is a naturally occurring element. Exposure to high levels of zinc occurs mostly from eating food, drinking water, or breathing workplace air that is contaminated. Low levels of zinc are essential for maintaining good health. Exposure to large amounts of zinc can be harmful. It can cause stomach cramps, anemia, and changes in cholesterol levels. Zinc has been found in at least 985 of the 1,662 National Priority List sites identified by the Environmental Protection Agency (EPA).

What is zinc?

Zinc is one of the most common elements in the earth's crust. It is found in air, soil, and water, and is present in all foods. Pure zinc is a bluish-white shiny metal.

Zinc has many commercial uses as coatings to prevent rust, in dry cell batteries, and mixed with other metals to make alloys like brass, and bronze. A zinc and copper alloy is used to make pennies in the United States.

Zinc combines with other elements to form zinc compounds. Common zinc compounds found at hazardous waste sites include zinc chloride, zinc oxide, zinc sulfate, and zinc sulfide. Zinc compounds are widely used in industry to make paint, rubber, dyes, wood preservatives, and ointments.

What happens to zinc when it enters the environment?

❑ Some is released into the environment by natural processes, but most comes from human activities like mining, steel production, coal burning, and burning of waste.
❑ It attaches to soil, sediments, and dust particles in the air.
❑ Rain and snow remove zinc dust particles from the air.
❑ Depending on the type of soil, some zinc compounds can move into the groundwater and into lakes, streams, and rivers.
❑ Most of the zinc in soil stays bound to soil particles and does not dissolve in water.
❑ It builds up in fish and other organisms, but it does not build up in plants.

How might I be exposed to zinc?

❑ Ingesting small amounts present in your food and water.
❑ Drinking contaminated water or a beverage that has been stored in metal containers or flows through pipes that have been coated with zinc to resist rust.
❑ Eating too many dietary supplements that contain zinc.
❑ Working on any of the following jobs: construction, painting, automobile mechanics, mining, smelting, and welding; manufacture of brass, bronze, or other zinc-containing alloys; manufacture of galvanized metals; and manufacture of machine parts, rubber, paint, linoleum, oilcloths, batteries, some kind of glass, ceramics, and dyes.

How can zinc affect my health?

Zinc is an essential element in our diet. Too little zinc can cause problems, but too much zinc is also harmful.

Harmful effects generally begin at levels 10-15 times higher than the amount needed for good health. Large doses taken by mouth even for a short time can cause stomach cramps, nausea, and vomiting. Taken longer, it can cause anemia and decrease the levels of your good cholesterol. We do not know if high levels of zinc affect reproduction in humans. Rats that were fed large amounts of zinc became infertile.

Inhaling large amounts of zinc (as dusts or fumes) can cause a specific short-term disease called metal fume fever. We do not know the long-term effects of breathing high levels of zinc.

Putting low levels of zinc acetate and zinc chloride on the skin of rabbits, guinea pigs, and mice caused skin irritation. Skin irritation will probably occur in people.

How likely is zinc to cause cancer?

The Department of Health and Human Services (DHHS) and the International Agency for Research on Cancer (IARC) have not classified zinc for carcinogenicity. Based on incomplete information from human and animal studies, the EPA has determined that zinc is not classifiable as to its human carcinogenicity.

How can zinc affect children?

Zinc is essential for proper growth and development of young children. It is likely that children exposed to very high levels of zinc will have similar effects as adults. We do not know whether children are more susceptible to the effects of excessive intake of zinc than the adults.

We do not know if excess zinc can cause developmental effects in humans. Animal studies have found decreased weight in the offspring of animals that ingested very high amounts of zinc.

How can families reduce the risks of exposure to zinc?

❏ Children living near waste sites that contain zinc may be exposed to higher levels of zinc through breathing contaminated air, drinking contaminated drinking water, touching or eating contaminated soil.

❏ Discourage your children from eating soil or putting their hands in their mouths and teach them to wash their hands frequently and before eating.

❏ If you use medicines or vitamin supplements containing zinc, make sure you use them appropriately and keep them out of the reach of children.

Is there a medical test to determine whether I've been exposed to zinc?

There are tests available to measure zinc in your blood, urine, hair, saliva, and feces. These tests are not usually done in the doctor's office because they require special equipment. High levels of zinc in the feces can mean high recent zinc exposure. High levels of zinc in the blood can mean high zinc consumption and/or high exposure. Tests to measure zinc in hair may provide information on long-term zinc exposure; however, the relationship between levels in your hair and the amount of zinc you were exposed to is not clear.

Has the federal government made recommendations to protect human health?

The EPA recommends that drinking water should contain no more than 5 milligrams per liter of water (5 mg/L) because of taste. The EPA requires that any release of 1,000 pounds (or in some cases 5,000 pounds) into the environment be reported to the agency.

To protect workers, the Occupational Safety and Health Administration (OSHA) has set an average limit of 1 mg/m^3 for zinc chloride fumes and 5 mg/m^3 for zinc oxide (dusts and fumes) in workplace air during an 8-hour workday, 40-hour workweek.

Similarly, the National Institute for Occupational Safety and Health (NIOSH) has set the same standards for up to a 10-hour workday over a 40-hour workweek.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2005. Toxicological Profile for Zinc (Update). Atlanta, GA: U.S. Department of Public Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATTACHMENT B

WEST NILE VIRUS/ST. LOUIS ENCEPHALITIS PREVENTION

WEST NILE VIRUS/ST. LOUIS ENCEPHALITIS PREVENTION

The following section is based upon information provided by the Center for Disease Control (CDC) Division of Vector-Borne Infectious Diseases. Symptoms of West Nile Virus include fever, headache, and body aches, occasionally with skin rash and swollen lymph glands, with most infections being mild. More severe infection may be marked by headache, high fever, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, paralysis, and, rarely, death. Most infections of St. Louis encephalitis are mild without apparent symptoms other than fever with headache. More severe infection is marked by headache, high fever, neck stiffness, stupor, disorientation, coma, tremors, occasional convulsions (especially infants) and spastic (but rarely flaccid) paralysis. The only way to avoid infection of West Nile Virus and St. Louis Encephalitis is to avoid mosquito bites. To reduce the chance of mosquito contact:

- Stay indoors at dawn, dusk, and in the early evening.
- Wear long-sleeved shirts and long pants whenever you are outdoors.
- Spray clothing with repellents containing permethrin or DEET (N, N-diethyl-meta-toluamide), since mosquitoes may bite through thin clothing.
- Apply insect repellent sparingly to exposed skin. An effective repellent will contain 35% DEET. DEET in high concentrations (greater than 35%) provides no additional protection.
- Repellents may irritate the eyes and mouth.
- Whenever you use an insecticide or insect repellent, be sure to read and follow the manufacturer's directions for use, as printed on the product.

ATTACHMENT C

REPORT FORMS

WEEKLY SAFETY REPORT FORM

Week Ending: ________________ Project Name/Number: Atlantic Chestnut – Lot

Report Date: ________________ Project Manager Name: Deborah Shapiro/Amy Jordan

Summary of any violations of procedures occurring that week:

Summary of any job related injuries, illnesses, or near misses that week:

Summary of air monitoring data that week (include and sample analyses, action levels exceeded, and actions taken):

Comments:

Name: ______________________________ Company: ______________________________

Signature: ______________________________ Title: ______________________________

INCIDENT REPORT FORM

Date of Report: ______________________________

Injured: ______________________________

Employer: ______________________________

Site: Atlantic Chestnut – Lot 1 Site Location: 3264 Fulton Street, Brooklyn, NY

Report Prepared By: ____________________ ____________________
Signature Title

ACCIDENT/INCIDENT CATEGORY (check all that applies)

___Injury
__ Property Damage
__ On-site Equipment
__ Mechanical
___ Illness
___ Fire
___ Motor Vehicle
___ Spill
___ Near Miss
___ Chemical Exposure
___ Electrical
___ Other

DATE AND TIME OF ACCIDENT/INCIDENT: Narrative report of accident/incident: Identify: 1) actions leading to or contributing to the accident/incident; 2) the accident/incident occurrence; and 3) actions following the accident/incident.

____
____
____
____
____
____
____
____
____
____

WITNESS TO ACCIDENT/INCIDENT:

Name: ____________________ Company: ____________________
Address: ____________________ Address: ____________________
Phone No.: ____________________ Phone No.: ____________________
Name: ____________________ Company: ____________________
Address: ____________________ Address: ____________________
Phone No.: ____________________ Phone No.: ____________________

INJURED - ILL:

Name: ____________________ SSN: ____

Address: ____________________ Age: ____

Length of Service: ____________________ Time on Present Job: _____________________________

Time/Classification: ____

SEVERITY OF INJURY OR ILLNESS:

____ Disabling

____ Medical Treatment

___ Non-disabling

___ First Aid Only

___ Fatality

ESTIMATED NUMBER OF DAYS AWAY FROM JOB: _______________________________

NATURE OF INJURY OR ILLNESS: ____

____

____

____

CLASSIFICATION OF INJURY:

__ Abrasions

__ Bites

__ Blisters

__ Bruises

__ Chemical Burns

__ Cold Exposure

__ Concussion

__ Lacerations

_____ Dislocations

_____ Faint/Dizziness

_____ Fractures

_____ Frostbite

_____ Heat Burns

_____ Heat Exhaustion

_____ Heat Stroke

____ Punctures

____ Radiation Burns

____ Respiratory Allergy

____ Sprains

____ Toxic Resp. Exposure

____ Toxic Ingestion

____ Dermal Allergy

Part of Body Affected: ____

Degree of Disability: ____

Date Medical Care was Received: ____

Where Medical Care was Received: ____

Address (if off-site): ____

(If two or more injuries, record on separate sheets)

PROPERTY DAMAGE:

Description of Damage: ______________________________

____

Cost of Damage: $ ______________________________

ACCIDENT/INCIDENT LOCATION: ______________________________

ACCIDENT/INCIDENT ANALYSIS: Causative agent most directly related to accident/incident (Object, substance, material, machinery, equipment, conditions)

____

____

____

____

Was weather a factor?:______________________________

____

Unsafe mechanical/physical/environmental condition at time of accident/incident (Be specific):

____

____

____

Personal factors (Attitude, knowledge or skill, reaction time, fatigue):

____

____

ON-SITE ACCIDENTS/INCIDENTS:

Level of personal protection equipment required in Site Safety Plan:

____

____

Modifications:

____

Was injured using required equipment?:

____

____

If not, how did actual equipment use differ from plan?:

____

____

ACTION TAKEN TO PREVENT RECURRENCE: (Be specific. What has or will be done? When will it be done? Who is the responsible party to insure that the correction is made?

ACCIDENT/INCIDENT REPORT REVIEWED BY:

SSO Name Printed SSO Signature

OTHERS PARTICIPATING IN INVESTIGATION:

Signature Title

Signature Title

Signature Title

ACCIDENT/INCIDENT FOLLOW-UP: Date:

Outcome of accident/incident:

Physician's recommendations:

Date injured returned to work:
Follow-up performed by:

Signature Title

ATTACH ANY ADDITIONAL INFORMATION TO THIS FORM

ATTACHMENT D

EMERGENCY HAND SIGNALS

EMERGENCY SIGNALS

In most cases, field personnel will carry portable radios for communication. If this is the case, a transmission that indicates an emergency will take priority over all other transmissions. All other site radios will yield the frequency to the emergency transmissions.

Where radio communications is not available, the following air-horn and/or hand signals will be used:

EMERGENCY HAND SIGNALS

OUT OF AIR, CAN'T BREATH!	 **Hand gripping throat**
LEAVE AREA IMMEDIATELY, NO DEBATE!	**(No Picture) Grip partner's wrist or place both hands around waist**
NEED ASSISTANCE!	 **Hands on top of head**
OKAY! – I'M ALL RIGHT! **- I UNDERSTAND!**	 **Thumbs up**
NO! - NEGATIVE!	 **Thumbs down**

APPENDIX B

QUALITY ASSURANCE PROJECT PLAN (QAPP)

ATLANTIC CHESTNUT – LOT 1
3264 FULTON STREET
BROOKLYN, NEW YORK

Quality Assurance Project Plan

AKRF Project Number: 12492
BCP Site Number: C224234

Prepared for:

NYSDEC Region 2
1 Hunter's Point Plaza
47-40 21st Street
Long Island City, New York 11101

On Behalf Of:

Atlantic Chestnut Affordable Housing LLC
902 Broadway, 13th Floor
New York, New York 10010

Prepared by:

AKRF

AKRF, Inc.
440 Park Avenue South
New York, New York 10016
(212) 696-0670

MAY 2018

TABLE OF CONTENTS

IN-TEXT TABLES

ATTACHMENT

1.0 INTRODUCTION

This Draft Quality Assurance Project Plan (QAPP) describes the protocols and procedures that will be followed during implementation of the Interim Remedial Measure (IRM) under the IRM Work Plan (IRMWP) at the Atlantic Chestnut – Lot 1 site, hereafter referred to as the Site. The Site is an approximately 65,994-square foot parcel located at 3264 Fulton Street in the East New York neighborhood of Brooklyn, New York. The Site is legally identified as Brooklyn Borough Tax Block 4143, Lot 1.

The objective of this QAPP is to provide for Quality Assurance (QA) and maintain Quality Control (QC) of IRM under the New York State Department of Environmental Conservation (NYSDEC) oversight in the Brownfield Cleanup Program (BCP) (BCP Site No. C224234). Adherence to this QAPP will ensure that defensible data will be obtained during IRM implementation at the Site.

2.0 PROJECT TEAM

The project team will be drawn from AKRF professional and technical personnel, and AKRF's subcontractors. All field personnel and subcontractors will have completed a 40-hour training course and updated 8-hour refresher course that meet the Occupational Safety and Health Administration (OSHA) requirements of 29 CFR Part 1910. The following sections describe the key project personnel and their responsibilities.

2.1 Quality Assurance/Quality Control (QA/QC) Officer

Marcus Simons will serve as the QA/QC officer and will be responsible for adherence to this QAPP. The QA/QC officer will review the procedures with all personnel prior to commencing any fieldwork and will conduct periodic Site visits to assess implementation of the procedures. Mr. Simons' resume is included in Attachment A.

2.2 Remedial Engineer

Michelle Lapin, P.E. will serve as the remedial engineer. As the remedial engineer, Ms. Lapin will oversee the design of IRM and oversee all startup, maintenance, and operation of the SVE system. Ms. Lapin's resume is included in Attachment A.

2.3 Project Manager/Project Director

Deborah Shapiro, QEP will serve as the project manager. The project manager will be responsible for directing and coordinating all elements of the RAWP. The project manager will prepare reports and participate in meetings with the Site owner/Volunteer, and/or the NYSDEC. As project director, Ms. Shapiro will also be responsible for the general oversight of all aspects of the project, including scheduling, budgeting, data management, and field program decision-making. The project director will communicate regularly with all members of the AKRF and NYSDEC project teams to ensure a smooth flow of information between involved parties. Ms. Shapiro's resume is included in Attachment A.

2.4 Project Manager Alternate

Amy Jordan will serve as the project manager alternate. The project manager alternate will be responsible for assisting the project manager. The project manager alternate will help prepare reports and will participate in meetings with the Site owner/Volunteer, and/or the NYSDEC. Ms. Jordan's resume is included in Attachment A.

2.5 Field Team Leader, Field Technician, and Site Safety Officer (SSO)

The field team leader will be responsible for supervising the daily sampling and health and safety activities in the field and will ensure adherence to the work plan and Health and Safety Plan (HASP), included as Appendix A. The field team leader will also act as the field technician and SSO, and will report to the project manager or project manager alternate on a regular basis regarding daily progress and any deviations from the work plan. The field team leader will be a qualified and responsible person able to act professionally and promptly during environmental work at the Site. George Kokaliaris will be the field team leader and the field team leader alternate will be Victor Chang. Mr. Kokaliaris' and Mr. Chang's, resumes are included in Attachment A.

2.6 Laboratory Quality Assurance/Quality Control (QA/QC) Officer

The laboratory QA/QC officer will be responsible for quality control procedures and checks in the laboratory and ensuring adherence to laboratory protocols. The QA/QC officer will track the movement of samples from the time they are checked in at the laboratory to the time that analytical results are issued, and will conduct a final check on the analytical calculations and sign off on the laboratory reports. The laboratory QA/QC officer will be Nick Straccione of SGS Accutest Inc. (Accutest), the New York State Department of Health (NYSDOH) Environmental Laboratory Accreditation Program (ELAP)-certified laboratory being employed for all environmental sampling at the Site.

3.0 STANDARD OPERATING PROCEDURES (SOPS)

The following sections describe the SOPs for the remedial activities included in the IRMWP. During these operations, safety monitoring will be performed as described in the HASP, included as Appendix A of the IRMWP.

3.1 Soil Vapor Extraction (SVE) Well Installation

The SVE wells will be installed according to the following procedure:

Advance borings using a hollow-stem auger (HSA) truck-mounted rotary rig with 6.25-inch outside diameter augers.

- Install a 4-inch diameter Schedule 40 polyvinyl chloride (PVC) pipe, with a length of 0.020-inch slotted screen and solid riser into the borehole through the hollow-stem auger.
- Install No. 2 sand filter pack around the well screen to a depth of two feet above the top of the screen.
- Install a bentonite seal to a depth of 2 feet above the filter pack.
- Backfill the remainder of the annular space using a bentonite-cement grout.
- Complete the well with a locking cap flush-with-grade curb box set in concrete. Provide a concrete apron around the curb box to direct run-off away from the well.
- Decontaminate the augers prior to and following installation of each well as described in Section 3.4 of this QAPP.
- Document well installation data (location, depth, construction details, water level measurements) in the field logbook or on field data sheets.

3.2 Decontamination of Sampling Equipment

All equipment will be either dedicated or decontaminated between sampling locations. Decontamination will be conducted on plastic sheeting (or equivalent) that is bermed to prevent discharge to the ground. The decontamination procedure will be as follows:

1. Scrub using tap water/Alconox® mixture and bristle brush.
2. Rinse with tap water.
3. Scrub again with tap water/Alconox® mixture and bristle brush.
4. Rinse with tap water.
5. Rinse with distilled water.
6. Air-dry the equipment, if possible.

3.3 Management of Investigation-Derived Waste (IDW)

IDW will be containerized in New York State Department of Transportation (NYSDOT)-approved 55-gallon drums. The drums will be sealed at the end of each work day and labeled with the date, the excavation grid(s), the type of waste (i.e., drill cuttings), and the name and phone number of an AKRF point of contact. All IDW will be disposed of or treated according to applicable local, state, and federal regulations.

4.0 FIELD TESTING PROCEDURES

4.1 Soil Vapor Extraction (SVE) Pilot Test

The SVE pilot test will consist of extracting vapor from the two SVE pilot test wells in sequence, and measuring the resulting vacuum response at monitoring points at varying distances and directions. Testing will be conducted according to the following procedure:

1. Connect a skid-mounted regenerative blower equipped with a moisture separator, a flow meter, and a vacuum gauge to one of the SVE pilot test well, using a two-inch diameter vacuum hose. A granular-activated carbon (GAC) vessel will be used to control VOC emissions to the atmosphere during the test.
2. Attach a magnahelic gauge to the two pilot test SVE wells (SVE-6 and SVE-8).
3. Adjust the applied vacuum at one SVE pilot test well to 2 inches of mercury (inHg) by bleeding in ambient air through a bypass valve.
4. Measure the vacuum, flow rate, and effluent vapor concentrations at each observation and pilot test SVE well.
5. Continue the test until a steady state has been reached.
6. Repeat steps 1 through 4 with the other pilot test SVE well.
7. Repeat steps 1 through 6 at an applied vacuum pressure of 1 inHg for the other SVE pilot test well.

5.0 SAMPLING AND LABORATORY PROCEDURES

5.1 Soil Vapor Sampling

Soil vapor sampling will be conducted according to the following procedures:

- Field screen the sample for evidence of contamination (e.g., odors, staining,) using visual and olfactory methods and screen for volatile organic compounds (VOCs) using a photoionization detector (PID) equipped with an 11.7 electron Volt (eV) lamp.
- Collect sample in laboratory-supplied container, label the sample in accordance with Section 4.4.1, Table 3 of this QAPP, and place in a container for shipment to the laboratory.
- Complete the proper chain of custody paperwork and seal the cooler.
- Record observations (evidence of contamination, PID readings, etc.) in field log book and boring log data sheet, if applicable.
- Decontaminate equipment between sample locations as described in Section 3.1 of this QAPP.

5.2 Laboratory Methods

Table 1 summarizes the laboratory methods that will be used to analyze field samples and the sample container type, preservation, and applicable holding times. Accutest of Dayton, New Jersey, a NYSDOH ELAP-certified laboratory subcontracted to AKRF, will be used for all chemical analyses in accordance with the Division of Environmental Remediation (DER)-10 2.1(b) and 2.1(f) with Category B Deliverables.

Table 1
Laboratory Analytical Methods

Matrix	Analysis	EPA Method	Bottle Type	Preservative	Hold Time
Soil Vapor	CVOCs	TO-15	Tedlar™ Bag	None	14 days

5.3 Sample Handling

5.3.1 Sample Identification

All samples will be consistently identified in all field documentation, chain of custody (COC) documents, and laboratory reports. All samples will be amended with the collection date at the end of the sample same in a year, month, day (YYYYMMDD) format. Special characters, including primes/apostrophes ('), will not be used for sample nomenclature.

Sample Labeling and Shipping

All sample containers will be provided with labels containing the following information:

- Project identification, including Site name, BCP Site number, Site address
- Sample identification
- Date and time of collection
- Analysis(es) to be performed
- Sampler's initials

Once the samples are collected and labeled, they will be placed in coolers and stored in a cool area away from direct sunlight to await shipment to the laboratory. All samples will be shipped to the laboratory at least twice per week.

The samples will be prepared for shipment by placing each sample in laboratory-supplied containers and into cartons for shipment to the laboratory. The COC will be properly completed by the sampler in ink, and all sample shipment transactions will be documented with signatures, and the date and time of custody transfer. Samples will be shipped overnight (e.g., Federal Express) or transported by a laboratory courier. All coolers shipped to the laboratory will be sealed with mailing tape and a COC seal to ensure that the samples remain under strict COC protocol.

Sample Custody

Field personnel will be responsible for maintaining the sample coolers in a secured location until they are picked up and/or sent to the laboratory. The record of possession of samples from the time they are obtained in the field to the time they are delivered to the laboratory or shipped off-site will be documented on the COC. The COC will contain the following information: project name; names of sampling personnel; sample number; date and time of collection and matrix; and signatures of individuals involved in sample transfer, and the dates and times of transfers. Laboratory personnel will note the condition of the custody seal and sample containers at sample check-in.

5.4 Field Instrumentation

Field personnel will be trained in the proper operation of all field instruments at the start of the field program. Instruction manuals for the equipment will be on file at the Site for referencing proper operation, maintenance, and calibration procedures. The equipment will be calibrated according to manufacturer specifications at the start of each day of fieldwork. If an instrument fails calibration, the project manager or QA/QC officer will be contacted immediately to obtain a replacement instrument. A calibration log will be maintained to record the date of each calibration, any failure to calibrate and corrective actions taken. The PID will be equipped with an 11.7 electron volt (eV) lamp and will be calibrated each day using 100 parts per million (ppm) isobutylene standard gas in accordance with the manufacturer's standards.

ATTACHMENT A

RESUMES OF QA/QC OFFICER PROJECT DIRECTOR, PROJECT MANAGER, PROJECT MANAGER ALTERNATE, AND FIELD TEAM LEADER

MARCUS SIMONS

SENIOR VICE PRESIDENT

Marcus Simons is a Senior Vice President of AKRF with 20 years of environmental consulting experience, specializing in the assessment and cleanup of contaminated sites, including federal and state superfund, RCRA, TSCA, brownfield, voluntary cleanup and spill sites. His expertise includes health risk assessment, development of sampling plans, economic evaluations of remedial alternatives, and regulatory analysis. He is also AKRF's Health and Safety Officer with extensive experience of Hazardous Waste Operations and Emergency Response Standard (HAZWOPER) issues during sampling and remediation of contaminated sites.

Mr. Simons directs much of AKRF environmental due diligence work (recently managing environmental due diligence on Tishman/Blackrock's Peter Cooper/Stuyvesant Town acquisition, reportedly the largest real estate transaction in US history), including supervising preparation of numerous Phase I and Phase II Environmental Site Assessments, as well as more complex multi-site and litigation-related projects. Mr. Simons manages preparation of the contaminated-materials portions of AKRF's Environmental Impact Statements and Environmental Assessments and has experience with procedures for hazardous material requirements under NEPA and New York SEQRA/CEQR and E-designation programs. He also has extensive experience in statistics, selection of sites for controversial facilities, and federal and state wetland regulations and waterfront permitting. In addition to analytical work, Mr. Simons has considerable experience in presenting results to regulatory agencies and the general public.

Mr. Simons has managed some of the most complex cleanup sites in New York State including: the recently completed cleanup of a 12-acre PCB-contaminated former utility property in Flushing, Queens where a 3 million square foot retail/residential building is nearing completion (remediation was performed under the State Brownfield Cleanup Program, though the site was also subject to City jurisdiction under its E-Designation program); cleanup of the nation's largest former dental factory in Staten Island for reuse as single family housing; the investigation of several former manufactured gas plants; and the investigation and remediation associated with the reconstruction of the West Side Highway and Hudson River Park in Manhattan (from the Battery to 59th Street). Mr. Simons also has extensive experience with transportation projects (Second Avenue Subway, MTA/LIRR East Side Access, Cross Harbor Freight Movement Study, Route 9A Reconstruction), large-scale rezoning projects (Long Island City, Downtown Brooklyn, Jamaica) and public and private redevelopment work (Atlantic Yards, School Construction Authority, Queens West).

BACKGROUND

Education

M.S., Engineering and Public Policy, Carnegie-Mellon University, 1988

M.A. and B.A. (Honors), Mathematics/Engineering, Cambridge University, England, 1986

Certifications

Hazardous Waste Operations and Emergency Response Standard (HAZWOPER) – 40 Hour Site Worker and 8 Hour Site Supervisor

Years of Experience

Year started in company: 1995

Year started in industry: 1988

RELEVANT EXPERIENCE

CE Flushing Site, Flushing, NY

Mr. Simons directed the remediation of a former industrial site in Flushing, Queens, NY prior to its redevelopment as a 3 million square foot retail/residential complex. The property was cleaned up under the NYS Department of Environmental Conservation Brownfield Cleanup Program and the NYC Department of Environmental Protection's E-Designation requirements. The remedial measures included the removal of aboveground and underground storage tanks, excavation and off-site disposal of TSCA, RCRA and non-hazardous wastes, NAPL removal, and removal and investigation of on-site drainage structures. The remediation and subsequent construction involved obtaining (or obtaining waivers from) numerous permits including those for NYSDEC Tidal Wetlands, NYSDEC Long Island Wells, NYSDEC SPDES/Stormwater and NYCDEP Sewer Use.

Peter Cooper Village/Stuyvesant Town, New York, NY

Mr. Simons directed the purchaser's environmental due diligence efforts for the bidding and subsequent acquisition of this 80-acre property in Manhattan. Much of the 110-building complex is underlain by former manufactured gas plants and Con Edison entered the site into NYSDEC's Voluntary Cleanup Program. Going forward Mr. Simons will manage oversight of activities that involve disturbance of MGP-contaminated soils, as well as future testing and potentially remediation.

MTA New York City Transit Manhattan East Side Transit Alternative (MESA)/Second Avenue Subway, New York, NY

Mr. Simons directed the contaminated material assessment for this multi-billion dollar transit initiative that would provide subway service to Manhattan's East Side. The assessment identified several hundred facilities along the alignment that could have impacted soil and/or groundwater and could require special materials handling and enhanced health and safety procedures. Additional evaluation of these sites is underway.

Ferry Point Park, Bronx, NY

Mr. Simons developed the material acceptance criteria (soil standards for capping materials) for the development of Ferry Point Park (including a golf course) in the Bronx. The New York City Department of Environmental Protection DEP and the New York State Departments of Health (DOH) and Environmental Conservation (DEC) agreed for the first time to relax their strict (TAGM 4046) criteria for clean soil, based on statistical analyses of background conditions and risk-based modeling.

Prince's Point, Staten Island, NY

Mr. Simons managed the complex cleanup (including the relocation of a contaminated tidal creek) of the nation's largest former dental factory site on Staten Island's waterfront. The site was on the State Superfund list. The future use of the site as single-family residential property entailed extensive negotiations with NYSDEC and NYSDOH. The project required obtaining (or obtaining waivers from) numerous permits including those for NYSDEC Tidal and Fresh Water Wetlands, USACOE (Nationwide) Permits, NYSDEC Coastal Erosion Hazard Area, NYSDEC SPDES and Stormwater, FEMA Modifications to Land in Floodplain, and USEPA Notification of PCB Waste Activity.

Route 9A Reconstruction, New York, NY

AKRF directed extensive studies for the reconstruction in Lower Manhattan proposed by the New York State Department of Transportation (NYSDOT) in cooperation with the Federal Highway Administration (FHWA). The project is arguably the most complex environmental analyses performed for a federally funded transportation project in New York City in the last 10 years. The firm was responsible for all environmental tasks as well as the preparation for the Draft, Supplementary, and Final Environmental Impact Statements (EISs) and Section 4(f) Evaluation for this 5-mile $250 million reconstruction of Route 9A as part of the recovery effort following the events of September 11th, 2001. Mr. Simons managed the extensive hazardous materials investigations and prepared the contract specifications for contaminated soil and tank removal, including Health and Safety oversight.

Hudson River Park, New York, NY

Mr. Simons is managing hazardous materials issues for the ongoing Hudson River Park construction, located adjacent to the Route 9A roadway. Construction is ongoing and Mr. Simons directs health and safety oversight and remediation during construction.

Jamaica Rezoning, Queens, NY

As part of the preparation of an Environmental Impact Statement, Mr. Simons managed the hazardous materials assessment of a multi-block area. In addition to conducting the assessment, Mr. Simons made recommendation as to the properties where "E-Designations" (city-recorded institutional controls on future development) should be placed.

Outlet City, Long Island City, Queens, NY

In Long Island City, Mr. Simons managed the investigation and interim remediation of an old factory complex where large volumes of creosote were spilled. The investigations and interim remedial measures (IRMs) took place under the New York State's Voluntary Cleanup Program (VCP).

MTA/LIRR East Side Access Project, New York, NY

Mr. Simons managed the hazardous materials investigations for multiple sites in the Bronx, Manhattan, and Queens associated with the Environmental Impact Statement (EIS) for the Long Island Rail Road connection to Grand Central Terminal. Mr. Simons continues to be involved in health and safety oversight related to the construction of the project.

New York City Department of Transportation, Lead Paint Removal and Disposal on Bridges Project, New York, NY

Mr. Simons conducted a regulatory analysis of related to the removal of lead paint from nearly 800 bridges. This analysis included an evaluation of the regulatory compliance of various proposed procedures with federal and state hazardous and solid waste management requirements.

American Felt and Filter Company, New Windsor, NY

Mr. Simons prepared a Remedial Investigation (including exposure assessment) and Feasibility Study for the country's oldest active felt manufacturing facility, located in Orange County. This solvent-contaminated site is on the State Superfund List.

MICHELLE LAPIN, P.E.

SENIOR VICE PRESIDENT

Michelle Lapin is a Senior Vice President with more than 25 years of experience in the assessment and remediation of hazardous waste issues. She leads the firm's Hazardous Materials group and offers extensive experience providing strategic planning and management for clients. Ms. Lapin has been responsible for the administration of technical solutions to contaminated soil, groundwater, air and geotechnical problems. Her other duties have included technical and report review, proposal writing, scheduling, budgeting, and acting as liaison between clients and regulatory agencies, and project coordination with federal, state, and local authorities.

Ms. Lapin's hydrogeologic experience includes groundwater investigations, formulation and administration of groundwater monitoring programs and remediation throughout the Northeast. Her experience with groundwater contamination includes Level B hazardous waste site investigations; leaking underground storage tank studies, including hazardous soil removal and disposal and associated soil and water issues; soil gas/vapor intrusion surveys; and wetlands issues. Ms. Lapin is experienced in coordinating and monitoring field programs concerning hazardous waste cell closures. She has directed hundreds of Phase I, Phase II, and Phase III investigations and remediations, many of them in conjunction with developers, law firms, lending institutions, and national retail chains. She is also experienced in the cleanup of contaminated properties under Brownfield Cleanup Program (BCP) regulations.

BACKGROUND

Education

M.S., Civil Engineering, Syracuse University, 1985

B.S., Civil Engineering, Clarkson University, 1983

Professional Licenses/Certifications

New York State P.E.

State of Connecticut P.E.

Professional Memberships

Member, National Society of Professional Engineers (NSPE), National and CT Chapters

Member, American Society of Civil Engineers (ASCE), National and CT Chapters

Member, Connecticut Business & Industry Association (CBIA), CBIA Environmental Policies Council (EPC)

Board Member, New York City Brownfield Partnership

Years of Experience

Year started in company: 1994

Year started in industry: 1986

RELEVANT EXPERIENCE

West 61st Street Rezoning/Residential Development, New York, NY

Ms. Lapin is directing the firm's hazardous materials work for this mixed-use development in Manhattan. The Algin Management Company hired AKRF to prepare an environmental impact statement (EIS) for the proposed rezoning of the western portion of the block between West 60th and 61st Streets, between Amsterdam and West End Avenues. The purpose of the proposed action was to facilitate the development of two 30-story residential towers with accessory parking spaces, and landscaped open space. The EIS examined a "worst case" condition for rezoning the block, which allowed Algin to build a residential building of approximately 375,000 square feet at their site. The building now contains 475 apartments, 200 accessory parking spaces, a health club, and community facility space. This site, with the services of AKRF, entered into New York State's Brownfield Cleanup Program (BCP). On-site issues included underground storage tanks remaining from previous on-site buildings, petroleum contamination from these tanks and possibly from off-site sources, and other soil contaminants (metals, semi-volatile organic compounds, etc.) from fill materials and previous on-site buildings. AKRF oversaw the adherence to the Construction Health and Safety Plan (HASP), which was submitted to and approved by the New York State Department of Environmental Conservation (NYSDEC), and monitored the waste streams, to ensure that the different types of waste were disposed of at the correct receiving facilities. This oversight also included confirmation and characteristic soil sampling for the receiving facilities and NYSDEC. A "Track 1" Clean up of the majority of the property (the portion including the buildings) was completed and the final Engineering Report was approved by the NYSDEC. AKRF has also completed a smaller portion of the property as a "Track 4" cleanup, which includes a tennis court and landscaped areas.

Hudson River Park, New York, NY

Ms. Lapin is directing AKRF's hazardous materials work during construction of Hudson River Park, a five-mile linear park along Manhattan's West Side. As the Hudson River Park Trust's (HRPT's) environmental consultant, AKRF is overseeing preparation and implementation of additional soil and groundwater investigations (working with both NYSDEC and the New York City Department of Environmental Protection (NYCDEP)), all health and safety activities, and removal of both known underground storage tanks and those encountered during construction. Previously, the firm performed hazardous materials assessments as part of the environmental impact statement (EIS) process, including extensive database and historical research, and soil and groundwater investigations. Ms. Lapin has been the senior consultant for the soil and groundwater investigations and remediation, and the asbestos investigations and abatement oversight.

Fiterman Hall Deconstruction and Decontamination Project, New York, NY

The 15-story Fiterman Hall building, located at 30 West Broadway, originally constructed as an office building in the 1950s, had served as an extension of the City University of New York (CUNY) Borough of Manhattan Community College (BMCC) since 1993. The building was severely damaged during the September 11, 2001, World Trade Center (WTC) attack when 7 WTC collapsed and struck the south façade of the building, resulting in the partial collapse of the southwest corner of the structure. The building was subsequently stabilized, with breaches closed and major debris removed. Because extensive mold and WTC dust contaminants remain within the building, it must be taken down. The project required the preparation of two environmental assessment statements (EASs)—one for the deconstruction and decontamination of Fiterman Hall and one for the construction of a replacement building on the site. AKRF prepared the EAS for the Deconstruction and Decontamination project, which included the decontamination of the interior and exterior of the building, the removal and disposal of all building contents, and the deconstruction of the existing, approximately 377,000-gross-square-foot partially collapsed structure. Ms. Lapin reviewed the EAS's deconstruction and decontamination plans. The cleanup plan was submitted to the United States Environmental Protection Agency (USEPA).

Columbia University Manhattanville Academic Mixed-Use Development, New York, NY

Ms. Lapin served as Hazardous Materials Task Leader on this EIS for approximately 4 million square feet of new academic, research and neighborhood uses to be constructed north of Columbia University's existing Morningside campus. The Hazardous Materials work included Phase I Environmental Site Assessments for the properties within the site boundaries, and estimates for a Subsurface (Phase II) Investigation of the entire development area. The firm's Hazardous Materials group has performed over 30 individual Phase I Environmental Site Assessments for properties within the development area. In addition, a Preliminary Environmental Site Assessment (PESA) was completed in conjunction with the EIS. Based on the Phase I studies, AKRF conducted a subsurface (Phase II) investigation in accordance with an NYCDEP-approved investigative work plan and health and safety plan. Subsurface activities included the advancement of soil borings, groundwater monitor wells, and the collection of soil and groundwater samples for laboratory analysis. This study estimated costs to remediate contaminated soil, groundwater and hazardous building materials, including lead-based paint and asbestos-containing materials.

Yonkers Waterfront Redevelopment Project, Yonkers, NY

For this redevelopment along Yonkers' Hudson River waterfront, Ms. Lapin headed the remedial investigation and remediation work that included Phase I assessments of 12 parcels, investigations of underground storage tank removals and associated soil remediation, remedial alternatives reports, and remedial work plans for multiple parcels. Several of the city-owned parcels were remediated under a Voluntary Cleanup Agreement; others were administered with state Brownfields grants. Hazardous waste remediation was completed on both brownfield and voluntary clean-up parcels, which enabled construction of mixed-use retail, residential development, and parking.

East 75th/East 76th Street Site, New York, NY

Ms. Lapin served as Senior Manager for this project that encompassed coordination and direct remediation efforts of this former dry cleaning facility and parking garage prior to the sale of the property and its ultimate redevelopment for use as a private school. A preliminary site investigation identified 20 current and former petroleum and solvent tanks on the property. A soil and groundwater testing program was designed and implemented to identify the presence and extent of contamination resulting from potential tank spills. This investigation confirmed the presence of subsurface petroleum contamination in the soil and solvent contamination from former dry cleaning activities in the bedrock. AKRF completed oversight of the remediation under the State's Voluntary Cleanup Program. Remediation, consisting of tank removals and excavation of contaminated soil and the removal of solvent-contaminated bedrock down to 30 feet below grade, has been completed. AKRF completed oversight of the pre-treatment of groundwater prior to discharge to the municipal sewer system and an off-site study to determine impacts to groundwater in downgradient locations.

Avalon on the Sound, New Rochelle, NY

For Avalon Bay Communities, Ms. Lapin managed the investigations and remediation of two luxury residential towers and an associated parking garage. Remediation of the first phase of development (the first residential tower and the parking garage) included gasoline contamination from a former taxi facility, fuel oil contamination from multiple residential underground storage tanks, and chemical contamination from former on-site manufacturing facilities. The remediation and closure of the tank spills was coordinated with the New York State Department of Environmental Conservation (NYSDEC). The initial investigation of the Phase II development—an additional high-rise luxury residential building—detected petroleum contamination. A second investigation was conducted to delineate the extent of the contamination and estimate the costs for remediation. AKRF oversaw the remediation and conducted the Health and Safety monitoring. The remediation was completed with closure and approvals of the NYSDEC.

East River Science Park, New York, NY

Originally, New York University School of Medicine (NYUSOM) retained the firm to prepare a full Environmental Impact Statement (EIS) for its proposed East River Science Park (ERSP). As originally contemplated, the proposed complex was to occupy a portion of the Bellevue Hospital campus between East 30th Street and approximately East 28th Street and would have included a clinical practice, research, and biotech facilities, housing units, a child care center, and a conference center and parking.

Ms. Lapin managed the Phase I Environmental Site Assessment and other hazardous materials-related issues. Events relating to September 11, 2001 delayed the project for several years. When it resurfaced with a new developer and a diminished scope, Ms. Lapin updated the hazardous materials issues and consulted with the new developer regarding remediation strategies and involvement of regulatory agencies. For the actual remediation/development, the city requested oversight by AKRF to represent its interests (the city is retaining ownership of the land). Ms. Lapin completed directing the remediation oversight on behalf of the City of New York for the remediation of this former psychiatric hospital building, laundry building and parking areas. The new 550,000 square-foot development includes a biotechnology center, street level retail, and an elevated plaza.

DEBORAH SHAPIRO, QEP

SENIOR TECHNICAL DIRECTOR

Deborah Shapiro is a Senior Technical Director with more than 17 years of experience in the assessment and remediation of hazardous waste issues. Ms. Shapiro supervises project teams and manages all aspects of assessment and remediation projects. Ms. Shapiro works with developers, non-profit organizations, architects, local community groups, local businesses, and government agencies. Her projects fall under the regulatory oversight of NYSDEC, NYCDEP, and NYCOER including the New York State Brownfield Cleanup Program (BCP), New York City Voluntary Cleanup Program (VCP), NYSDEC petroleum spills program, RCRA/UIC closures, and NYCOER's E-designation program. Ms. Shapiro has also assisted commercial and industrial property owners with maintaining the integrity of their portfolios by providing compliance related cleanup and chemical storage management services.

Ms. Shapiro manages all aspects of redevelopment projects from the initial Phase I ESA, Phase II, and remediation through post-remedial site management. In addition, her experience includes groundwater investigations, monitoring, and sampling programs; Brownfield and hazardous waste site investigations; In-Situ Chemical Oxidation; underground storage tank studies, including soil contamination delineation, classification, removal and disposal; waste characterization sampling; exposure assessments; on-going remedial action (especially AS/SVE), and permitting.

Prior to joining AKRF, Ms. Shapiro was a Senior Project Manager at CA RICH Consultants, Inc. in Plainview, New York. She was responsible for the design, implementation, and management of environmental assessment, investigation and remediation projects on Long Island and across the New York Metropolitan Area. Ms. Shapiro has also been a moderator and panelist at numerous conferences.

BACKGROUND

Education

M.S., Environmental Science, American University, 2001
B.A., Environmental Studies, American University, 1998

Professional Licenses/Certifications

Qualified Environmental Professional
Health and Safety Operations at Hazardous Materials Sites 29 CFR 1910.120
OSHA 10 Hour Occupational Construction Safety and Health

Professional Memberships

Past President, New York City Brownfield Partnership
Board Member, Residents for a More Beautiful Port Washington
Member, Institute of Professional Environmental Practitioners (IPEP)

Awards

Big Apple Brownfield Award recipient as part of the Courtlandt Crescent redevelopment team 2013
Big Apple Brownfield Award recipient as part of the Via Verde redevelopment team 2012
Big Apple Brownfield Award recipient as part of the Cornerstone B1 (LaTerraza) redevelopment team 2011

Years of Experience

Year started in company: 2013
Year started in industry: 1998

Relevant Experience

Elton Crossing, Bronx, NY

AKRF provided environmental consulting services in connection with the purchase and redevelopment of the Elton Crossing site at 899 Elton Avenue in the Bronx, NY. The work initially involved the preparation of a Phase II subsurface investigation including soil and soil vapor testing to determine if the site would be eligible for the New York State Brownfield Cleanup Program (NYSBCP). Upon completion of the investigation, AKRF prepared a NYCBCP Application and the site was accepted in to the NYSBCP. AKRF prepared an updated Phase I Environmental Site Assessment Report. AKRF managed all aspects of the brownfield cleanup including; development of a Supplemental Investigation Work Plan, performing a Supplemental Remedial Investigation and preparing a Supplemental Investigation Report, preparation of a Citizen Participation Plan, distribution of public notices, and preparation of a Remedial Action Work Plan (RAWP). AKRF is in the midst of implementing the remediation, which includes the removal of numerous underground oil tanks and waste characterization and disposal of soil with contaminants including hazardous lead, petroleum, and pesticides. AKRF oversees excavation and conducts community air monitoring in accordance with the RAWP. The project will be completed in 2016 with the preparation of a Final Engineering Report to document the remedial activities and installation of institutional controls including a vapor barrier and AKRF designed sub-slab depressurization system.

Second Farms, Bronx, NY

AKRF, Inc. was contracted by the New York City Office of Environmental Remediation (NYCOER) to conduct a subsurface investigation of a 1.12-acre parcel in the Bronx, New York under the United States Environmental Protection Agency (USEPA) Brownfield Assessment Grant program. The investigation included a geophysical survey and utility mark-outs, and the collection and analysis of soil, groundwater, soil vapor, indoor air and ambient air samples.

Bradhurst Cornerstone II Residences, Manhattan, NY

AKRF, Inc. prepared a Part 58 Environmental Assessment and a City Environmental Quality Review Environmental Assessment Statement for the Bradhurst Cornerstone II Apartments project. Issues of concern for the environmental review included the identification of project commitments for certain of the four sites related to historic resources, hazardous materials, air quality, and building attenuation. As part of the mitigation of hazardous materials, AKRF conducted a Phase II investigation, and prepared a Remedial Action Plan and Construction Health and Safety Plan.

Lambert Houses, Bronx, NY

AKRF performed a Phase I ESA of the Lambert Houses affordable housing complex located in the West Farms section of the Bronx, NY. Lambert Houses consisted of multi-story apartment buildings, parking garage, and a multi-tenant retail/commercial building alongside the elevated NYC subway. AKRF also conducted a vapor intrusion screen of the Property to satisfy HUD's vapor intrusion requirements. The Phase I and vapor intrusion screens were prepared in accordance with ASTM E1527-05, ASTM E2600, and EPA's All Appropriate Inquiry (AAI) rule.

Brook 156, Bronx, NY

AKRF was retained by Phipps Houses to provide environmental consulting services in connection with the purchase and development of two lots located at 740 Brook Avenue in the Bronx, NY. AKRF prepared a Phase I Environmental Site Assessment (ESA) of the NYC-owned former gasoline service station and a former railroad. A Tier 1 Vapor Encroachment Screening was also conducted to satisfy HUD's vapor intrusion requirements. AKRF prepared a Remedial Investigation Work Plan (RIWP) and conducted a Remedial Investigation (RI) at the site, which included the collection and analysis of soil, soil vapor, and groundwater. The results of the RI, which were documented in a Remedial Investigation Report (RIR), were used to prepare a New York City Brownfield Cleanup

Program (NYCBCP) application. The site was accepted into the New York State Brownfield Cleanup Program (NYSBCP). AKRF prepared a Citizen Participation Plan (CPP), distributed public notices, and is in the process of preparing a Supplemental Remedial Investigation Work Plan (SRIWP) to further investigate soil, soil vapor, and groundwater at the site prior to redevelopment.

AMY T. JORDAN

GEOLOGIST

Amy Jordan is a Geologist with 5 years of environmental consulting experience related to site assessment and remediation. Ms. Jordan works with non-profit organizations, affordable housing developers, for-profit developers, and government agencies under the regulatory oversight of NYSDEC, NYCDEP, and NYCOER. She works with projects enrolled in the New York State Brownfield Cleanup Program (BCP), the New York City Voluntary Cleanup Program (VCP), NYSDEC petroleum spills program, and NYCOER's E-designation program. Ms. Jordan conducts and manages all aspects of redevelopment projects from the initial Phase I ESA, Phase II, and remediation through post-remedial site management.

BACKGROUND

Education

B.A. Geosciences, Franklin and Marshall College, Lancaster, PA, 2011

Licenses/Certifications

40 Hour OSHA HAZWOPER Certified

OSHA 10 Hour Occupational Construction Safety and Health

NYSDEC Erosion and Sediment Control Inspector

Years of Experience

Year started in company: 2012
Year started in industry: 2011

RELEVANT EXPERIENCE

12 Eckford Street, Brooklyn, New York

AKRF is providing environmental consulting services in connection with the redevelopment of the New 470 Project into a mix of affordable and market-rate residences located at 12 Eckford Street in Brooklyn, New York. Ms. Jordan developed and conducted several investigations at the property under the oversight of NYCOER. Ms. Jordan is currently preparing a BCP Application and designing the remedial action for the site, which will include the design and installation of a sub-slab depressurization system (SSDS) and soil vapor extraction (SVE) system; hazardous waste delineation and disposal; construction oversight; and ongoing remedial monitoring under the oversight of the NYSDEC. The work will culminate with a Final Engineering Report to document the completion of remedial actions and to establish protocol for site monitoring.

Elton Crossing, Bronx, New York

AKRF provided environmental consulting services in connection with the purchase and redevelopment of the Elton Crossing site at 899 Elton Avenue in the Bronx, New York. The work initially involved the preparation of a

Phase II subsurface investigation including soil and soil vapor testing to determine if the site would be eligible for the BCP under NYSDEC oversight. Upon completion of the investigation, Ms. Jordan prepared a NYCBCP Application and the site was accepted in to the NYSBCP. Ms. Jordan prepared an updated Phase I Environmental Site Assessment Report and managed all aspects of the brownfield cleanup including development of a Supplemental Investigation Work Plan, performing a Supplemental Remedial Investigation and preparing a Supplemental Investigation Report, preparation of a Citizen Participation Plan, distribution of public notices, and preparation of a Remedial Action Work Plan (RAWP). AKRF oversaw all remediation at the Site, which included the removal of numerous underground oil tanks, and waste characterization and disposal of soil with contaminants including hazardous lead, petroleum, and pesticides. The project will be completed in Fall 2016 with the preparation of a Final Engineering Report to document the remedial activities and installation of institutional controls including a vapor barrier and AKRF-designed sub-slab depressurization system.

3363 and 3365 Third Avenue, Bronx, New York

AKRF is providing environmental consulting services in connection with the purchase and redevelopment of this property into affordable housing units under NYCOER's VCP. Ms. Jordan prepared two Phase I ESAs in accordance with New York City Acquisition Fund (NYCAF) protocol; conducted several subsurface investigations and waste classification sampling; prepared a VCP Application; and manages all aspects of the construction phase of this project.

Atlantic Chestnut Lots 1, 2, and 3, Brooklyn, New York

AKRF is providing environmental consulting services in connection with the purchase and redevelopment of these three lots from a burned factory into affordable housing units. For this project, Ms. Jordan prepared a Phase I ESA, conducted three subsurface investigations, and prepared three BCP Applications. Ms. Jordan will oversee the redevelopment, remediation, and ongoing remedial monitoring for these three sites comprising an entire city block.

New York City School Construction Authority, Various Locations, New York City

Under an on-call contract, AKRF provides the New York City School Construction Authority (NYCSCA) with hazardous materials consulting services. Ms. Jordan is involved with various due diligence and environmental assessment projects including Phase I Environmental Site Assessments (ESAs); Phase II (Subsurface) Environmental Site Investigations (soil, groundwater and soil vapor intrusion investigations); Indoor Air Quality (IAQ) Assessments; Underground Storage Tank (UST) and Aboveground Storage Tank (AST) inspections relating to boiler conversions; and peer review of other consultant's due diligence reports.

GEORGE KOKALIARIS, EIT

ENVIRONMENTAL ENGINEER

Mr. Kokaliaris is an Environmental Engineer at AKRF and chemical engineering graduate from Villanova University. He is currently pursuing his graduate degree part-time in Water Resources and Environmental Engineering at Villanova. His primary experience includes remediation system operations and maintenance (O&M), remedial technologies including soil vapor extraction (SVE), subsurface depressurization systems (SSDS), and groundwater treatment systems, urban and groundwater hydrology, construction and installation oversight, and health and safety.

BACKGROUND

Education

Candidate for M.S., Water Resources and Environmental Engineering, Villanova University
B.S., Chemical Engineering, Villanova University, 2015
Fordham University, 2011-2012

Licenses & Certifications

Engineer-in-Training
Amtrak Track Training
HAZWOPER-40
OSHA-10 Hour Occupational Construction Health and Safety
Loss Prevention System Supervisor
NYSDEC Erosion and Sediment Control Inspector

Years of Experience

Year started in company: 2018
Year started in industry: 2015

RELEVANT EXPERIENCE

145 West Street, Greenpoint, NY

At the former Huxley Envelope site in Greenpoint, Brooklyn, Mr. Kokaliaris assisted with the post remediation efforts including park construction oversight. Mr. Kokaliaris is ensuring compliance with the Site Management Plan (SMP) and assisted with the site inspection for the Periodic Review Report (PRR).

Roux Associates, Inc., Islandia, NY

While at another firm, Mr. Kokaliaris served as a Staff Engineer. He was primarily responsible for operations, maintenance, and management of remediation systems, groundwater treatment systems, soil vapor extraction systems, and subsurface depressurization systems (SSDS). Additional responsibilities included ensuring regulatory compliance with city and state regulators, performing construction and installation oversight, community air monitoring program, performing groundwater, soil, and soil-vapor investigations, and evaluating health and safety metrics across Roux portfolio.

Multimillion-gallon Petroleum Hydrocarbon Release from Former Refinery and Storage Terminal, Greenpoint, NY

While at another firm, Mr. Kokaliaris served as a Staff Engineer overseeing the operations and maintenance of two groundwater treatment and one soil vapor extraction system. His responsibilities included obtaining and analyzing field data to optimize system performance and quantify free-product recovery, draft and update process and instrumentation diagrams (P&ID) and process flow diagrams, coordinate system maintenance and upgrades, correlate iron concentration with turbidity to evaluate iron removal and quantify mass loading across treatment system, and oversee vacuum-enhanced recovery (VER) pilot study at several dual pump liquid-extraction recovery wells. Additional responsibilities included quantifying stormwater runoff that merged with treatment system effluent/discharge, prepare discharge monitoring reports for submittal to NYSDEC, ensure regulatory compliance with State Pollution Discharge Elimination System (SPDES) permit, manage markout requests for underground utilities, and evaluating health and safety metrics across Roux portfolio.

Vapor Mitigation System Installation, Woodridge, NJ

While at another firm, Mr. Kokaliaris served as the field manager for the installation of a vapor mitigation system (VMS) to relieve chlorinated solvents present in the subsurface of a 1.5 million ft^2 commercial warehouse in Woodridge, NJ. Primary responsibilities included designing piping layout to encompass plume and optimize blower efficiency, performing initial head loss calculations for piping layouts design, installation oversight of 620 vapor extraction points across multiple tenant spaces, and scheduling and coordinating multiple subcontractors.

VICTOR CHANG, EIT

ENVIRONMENTAL ENGINEER

Mr. Chang is an Environmental Engineer in AKRF's Hazmat department with two years of environmental consulting experience in site assessment and remediation. At AKRF, Mr. Chang conducts aspects of redevelopment projects from the initial Phase I ESA, Phase II Site Investigation, and remediation through post-remedial site management. His field work experience includes environmental site assessments and investigations (surface water, groundwater, soil, indoor air, and soil vapor), energy audits, construction oversight, safety supervisor, and waste management.

BACKGROUND

Education

Pursuing Masters of Engineering, Environmental Engineering, Stevens Institute of Technology, Hoboken, NJ

B.S., Environmental Engineering, *cum laude*, University at Buffalo, The State University of New York, UB School of Engineering and Applied Sciences, 2015

Certifications

Engineer-in-Training

OSHA 40-Hour Hazwoper

OSHA 30-Hour Construction

OSHA 8-Hour Supervisor

First Aid/CPR/AED

Years of Experience

Year started in company: 2017

Year started in industry: 2015

RELEVANT EXPERIENCE

AKRF – Various Projects, NY

Since joining AKRF, Mr. Chang has provided environmental consulting services on various projects. Mr. Chang has been involved with various environmental projects including Phase I Environmental Site Assessments (ESAs); Phase II (Subsurface) Environmental Site Investigations (soil, groundwater, and soil vapor intrusion investigations); Indoor Air Quality (IAQ) Assessments, and Construction Oversight (including community air monitoring, vapor barrier/SSDS installations, waste classification and delineation), as well as the proposals, work plans, and reporting associated with these tasks.

Merck OER and ACM Removal Project

While at another employer, Mr. Chang served as Site Superintendent, where his responsibilities included:

- Providing management and safety oversight for obsolete equipment and asbestos removal project;
- Assisting project manager with plans, schedules, costs, and overseeing sub-contractors;

- Participating actively in meetings, presentations, and Merck safety culture to foster client relationships; and
- Overseeing environmental compliance and monitoring (stormwater, waste management, air monitoring, excavation/confined spaces).

O'Brien & Gere Edison, NJ

While at another employer, Mr. Chang served as a Staff Environmental Engineer, where his responsibilities included:

- Supporting engineering projects through providing remedial oversight, calculations, and data analysis;
- Facilitating execution and supporting remediation projects including proposals, reports, designs, and workplans; and
- Performing and supervising field work (sampling, investigation, monitoring) for soil, vapor intrusion, groundwater, surface water.

En-Power Group Manhattan, NY

While at another employer, Mr. Chang served as an Energy Analysis and Field Intern, where his responsibilities included:

- Assisting lead engineers in the field conducting complete energy audits for multi-family buildings;
- Performing and evaluating feasibility, energy savings, and cost-benefit analysis for energy efficiency measures; and
- Producing energy efficiency reports including level I, II, and III audits for clients and the city.

Go Solar Green NY Queens, NY

While at another employer, Mr. Chang served as a Solar Design and Marketing Intern, where his responsibilities included:

- Applying solar theory and design to residential and commercial spaces;
- Performing cost and energy production estimates for small-scale solar systems; and
- Qualifying and contacting prospective clients for distribution of marketing materials.

APPENDIX C

PROPOSED SOIL VAPOR EXTRACTION (SVE) SYSTEM BLOWER AND CARBON CUT SHEETS, AND CARBON SIZING DESIGN

SERIES K-TS MOR

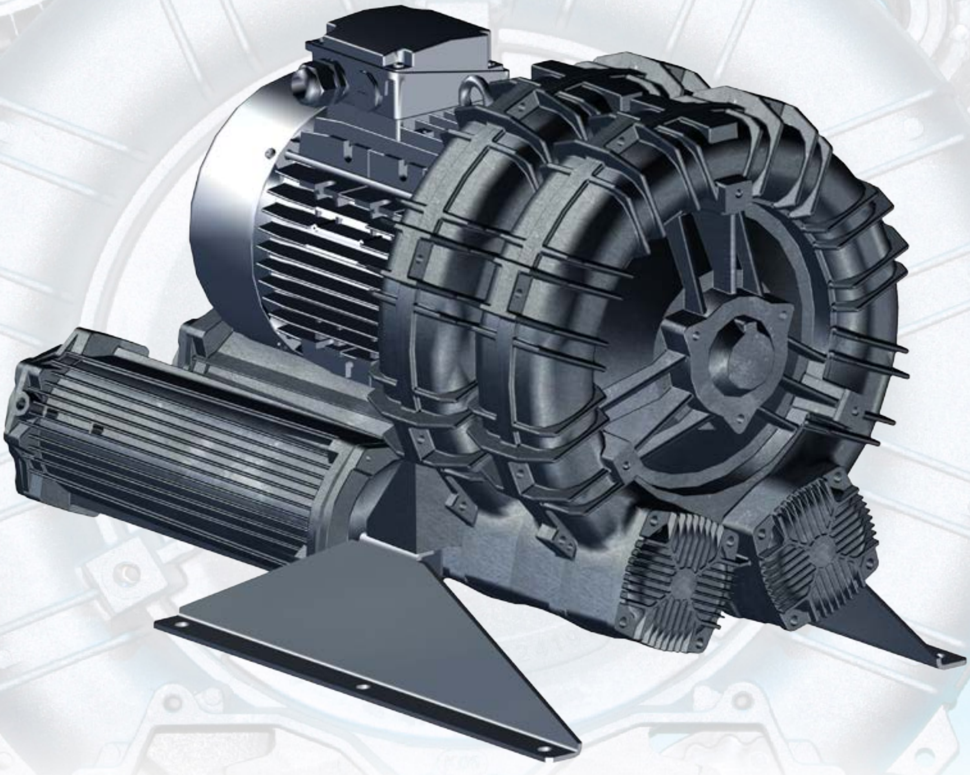
IE2 VERSION

TECHNICAL CHARACTERISTICS

- **Aluminium alloy construction**
- **High efficiency impeller**

OPTIONS

- **Special Voltages (IEC 60038)**
- **Surface treatments**
- **Increased seal version**



Data sheet

LATERAL CHANNEL BLOWER-EXHAUSTER

COMPANY WITH QUALITY MANAGEMENT
SYSTEM CERTIFIED BY DNV
= ISO 9001:2008 =

SERIES **TS** – RANGE **MOR**

IE2 VERSION

PRESSURE

Model	N 2900 rpm [kW]	N 3500 rpm [kW]	Q max 2900 rpm [m^3/h]	Q max 3500 rpm [m^3/h]	ΔP max 2900 rpm [hPa](mbar)	ΔP max 3500 rpm [hPa](mbar)	Leq[1] 2900 rpm (Lp)[dB(A)]	Leq[1] 3500 rpm (Lp)[dB(A)]	Weight[2] max [kg]
K05-TS	**3**	3,4	409	493	175	140	71,5	73,5	50
	4	4,6	409	493	250	210	73,5	75,5	56
K06-TS	**4**	4,6	563	679	130	100	75,2	77,2	64
	5,5	6,3	563	679	200	175	75,5	77,5	68
	7,5	8,6	563	679	300	275	75,8	77,8	85
K07-TS	**5,5**	6,3	827	998	150	110	81,9	83,9	99
	7,5	8,6	827	998	225	200	82,2	84,2	106,5
	9,2	10,6	827	998	275	250	82,5	84,5	109,5
K08-TS	**7,5**	8,6	1007	1215	160	120	78,9	80,9	110
	9,2	10,6	1007	1215	210	170	80,1	82,1	113
K09-TS	**11**	12,6	1325	1600	190	150	81	83	151,5
	15	17,2	1325	1600	270	240	83	85	179
	18,5	21,2	1325	1600	360	275	85	87	180
K10-TS	**15**	17,2	1539	1858	225	180	86,1	88,1	187
	18,5	21,2	1539	1858	275	260	86,4	88,4	188
K11-TS	**15**	17,2	1765	2130	160	105	86,7	88,7	194
	18,5	21,2	1765	2130	220	165	87,4	89,4	195
K12-TS	**18,5**	-	1985	-	150	-	87,9	-	199,5

VACUUM

Model	N 2900 rpm [kW]	N 3500 rpm [kW]	Q max 2900 rpm [m^3/h]	Q max 3500 rpm [m^3/h]	ΔP max 2900 rpm [hPa](mbar)	ΔP max 3500 rpm [hPa](mbar)	Leq[1] 2900 rpm (Lp)[dB(A)]	Leq[1] 3500 rpm (Lp)[dB(A)]	Weight[2] max [kg]
K05-TS	**3**	3,4	409	493	175	140	71,1	73,1	50
	4	4,6	409	493	225	210	73,1	75,1	56
K06-TS	**4**	4,6	563	679	130	100	74,8	76,8	64
	5,5	6,3	563	679	200	175	75,1	77,1	68
	7,5	8,6	563	679	250	250	75,4	77,4	85
K07-TS	**5,5**	6,3	827	998	150	110	82,5	84,5	99
	7,5	8,6	827	998	225	200	82,8	84,8	106,5
	9,2	10,6	827	998	275	250	83,1	85,1	109,5
K08-TS	**7,5**	8,6	1007	1215	160	120	79,2	81,2	110
	9,2	10,6	1007	1215	210	170	80,7	82,7	113
K09-TS	**11**	12,6	1325	1600	190	150	82,2	84,2	151,5
	15	17,2	1325	1600	270	240	84,1	86,2	179
	18,5	21,2	1325	1600	300	275	86,1	88,1	180
K10-TS	**15**	17,2	1539	1858	225	180	87,4	89,4	187
	18,5	21,2	1539	1858	275	260	87,7	89,7	188
K11-TS	**15**	17,2	1765	2130	160	105	88	90	194
	18,5	21,2	1765	2130	220	165	88,7	90,7	195
K12-TS	**18,5**	-	1985	-	150	-	89,2	-	199,5

ELECTRIC MOTORS IE2: 3phase motor only, starting from 0,75KW

INSTALLATION

- For proper use, the blower should be equipped with inlet FILTER and Flow Relief VALVE; other accessories available on request.
- Ambient temperature from -15° to +40°C (+5° to +104° F).
- Specifications subject to change without notice.
- Before installation read carefully all instructions.

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[1] Noise measured at 1 m distance with inlet and outlet ports piped, in accordance to ISO 3744

[2] Value refers to the weight of the machine with 3 Phase motor if MOR range, without motor if GOR or GVR range.

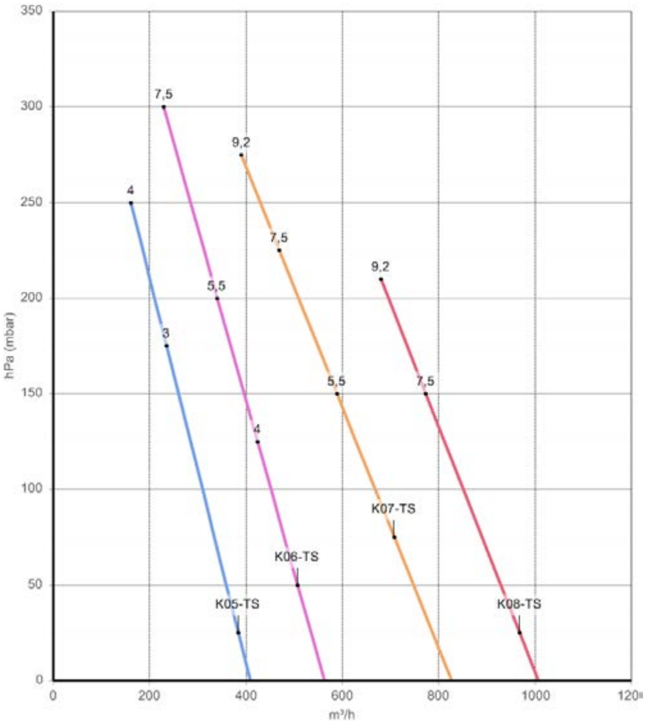
N: Installed motor power Q: Flow rate P: Differential pressure Leq: Noise

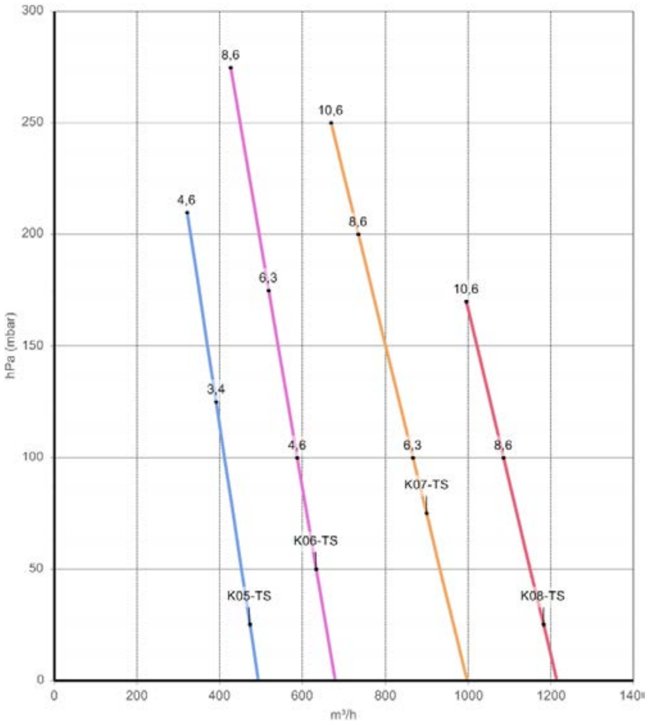
PRESSURE

2900 rpm (50 Hz)

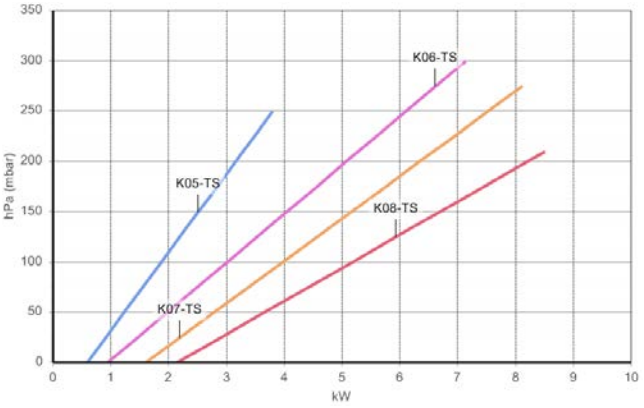
3500 rpm (60 Hz)

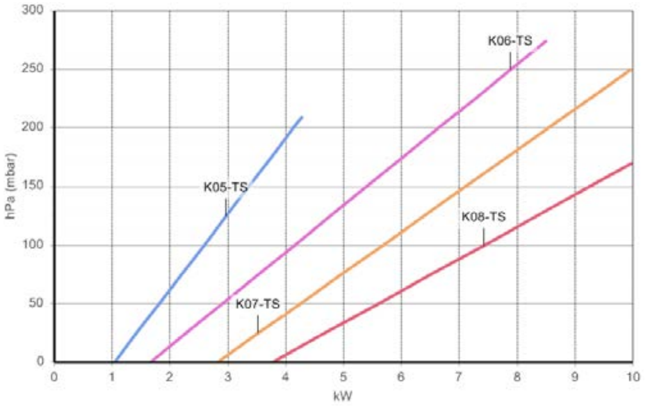
FLOW RATE



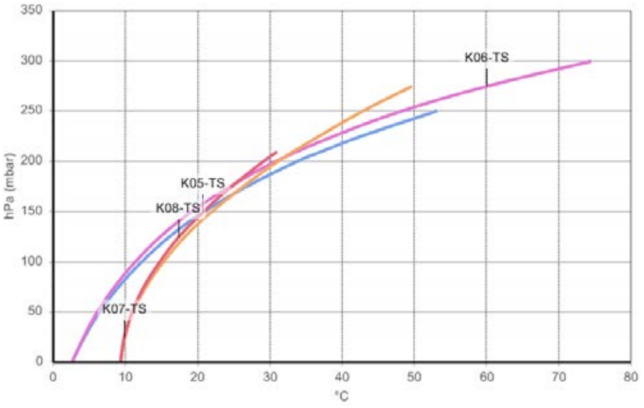


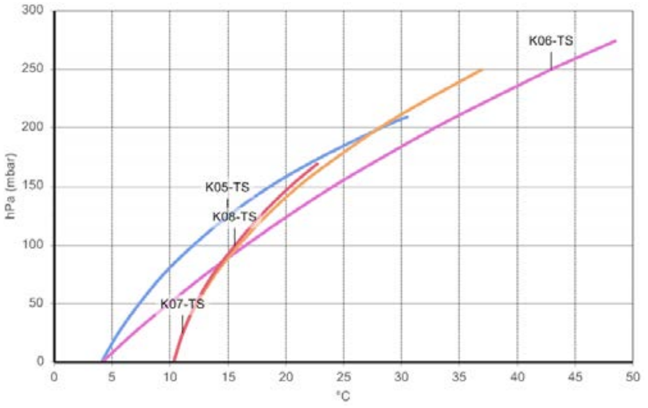
ABSORBED POWER





TEMPERATURE INCREASE





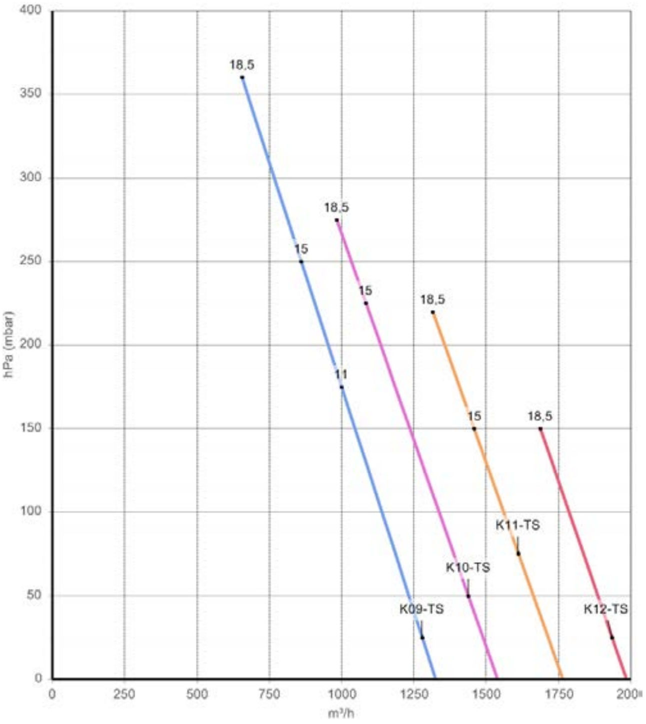
Curves refer to air at 20°C (68° F) temperature and 1013 mbar (29.92 In Hg) atmospheric pressure (abs) measured at inlet port.
Values for flow, power consumption and temperature rise: ±10% tolerance
Data can change without prior notice

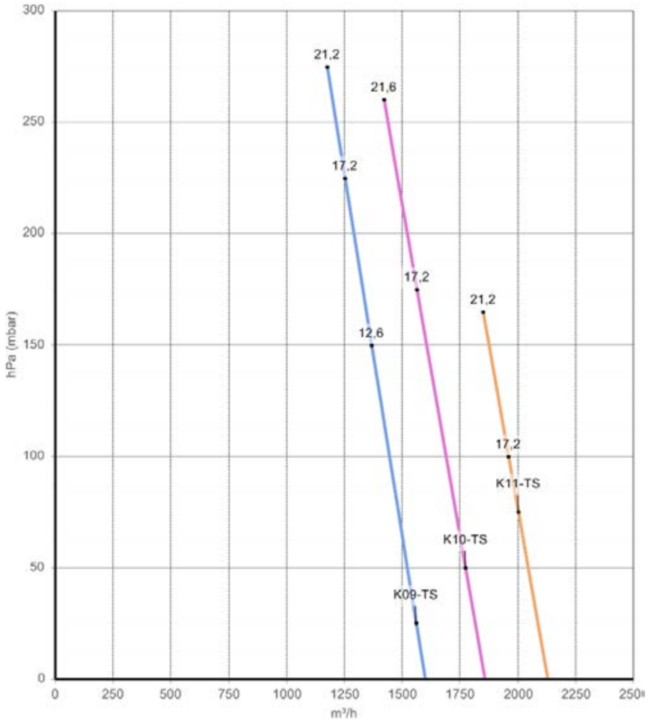
PRESSURE

2900 rpm (50 Hz)

3500 rpm (60 Hz)

FLOW RATE





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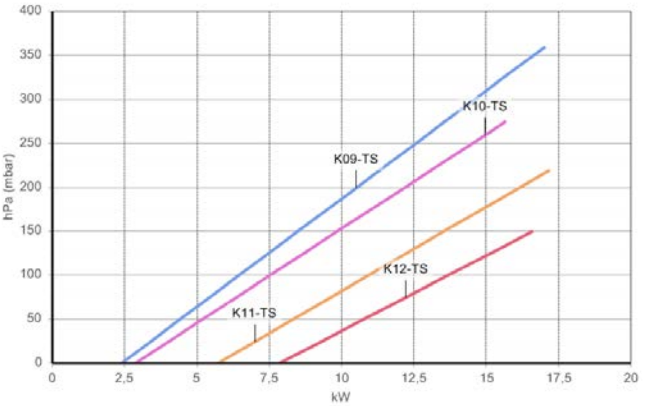
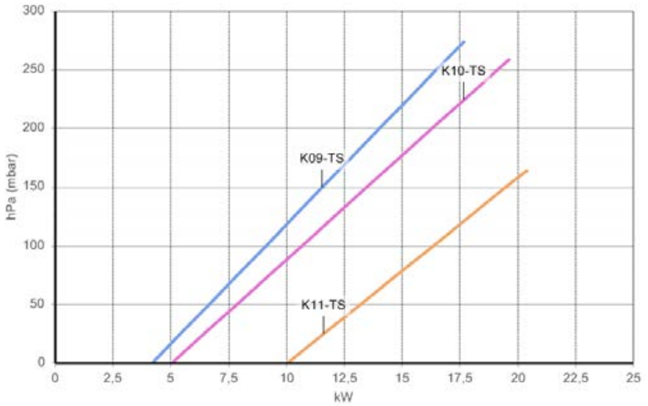
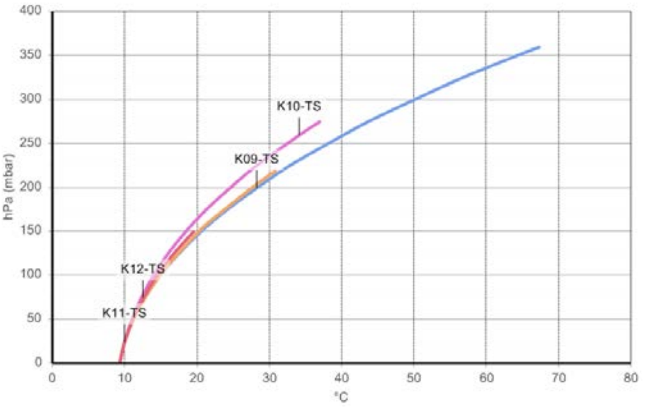
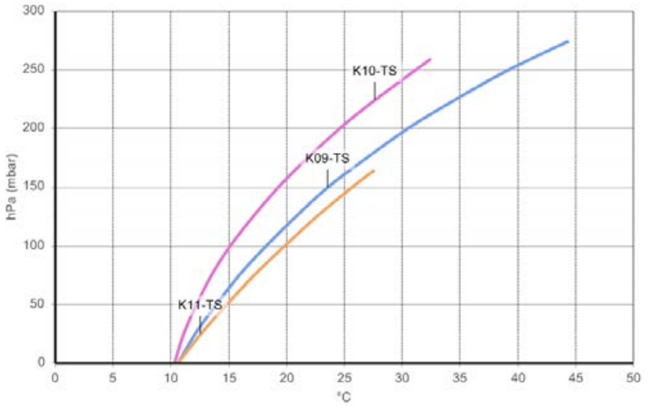




TEMPERATURE INCREASE





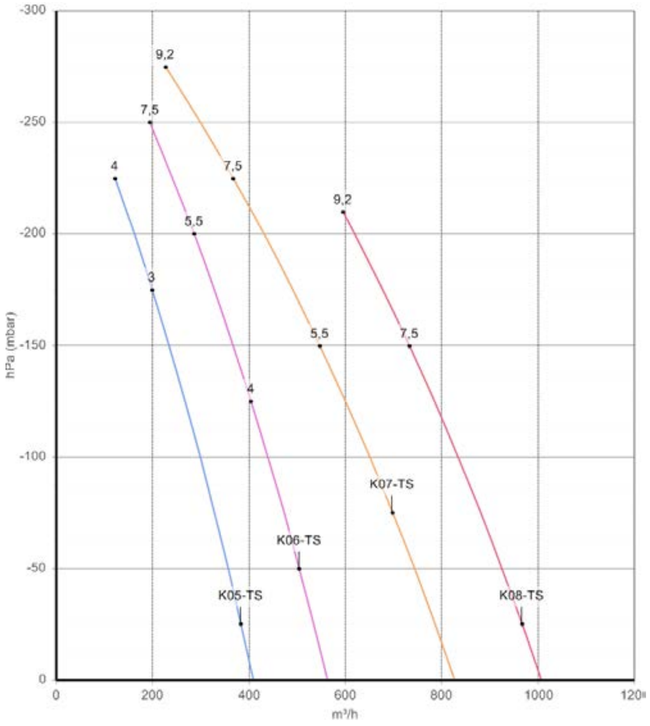
Curves refer to air at 20°C (68° F) temperature and 1013 mbar (29.92 In Hg) atmospheric pressure (abs) measured at inlet port.
Values for flow, power consumption and temperature rise: ±10% tolerance
Data can change without prior notice.

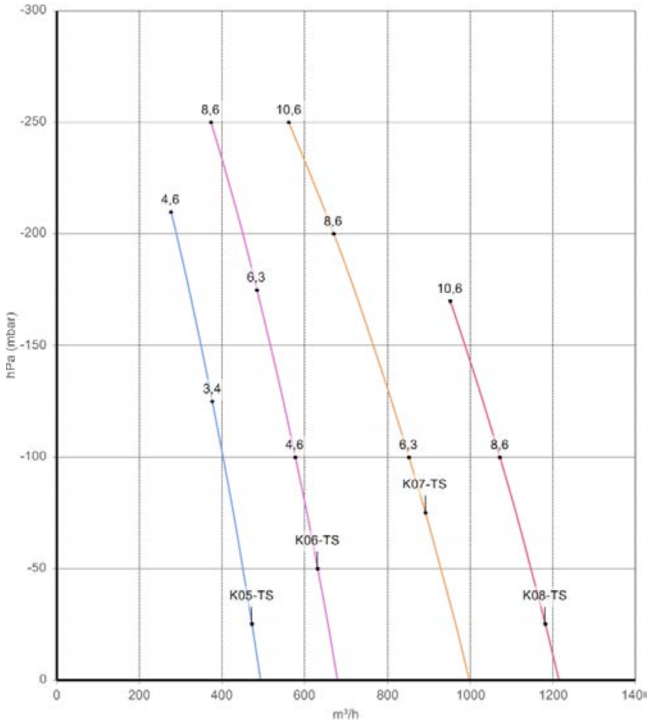
VACUUM

2900 rpm (50 Hz)

3500 rpm (60 Hz)

FLOW RATE





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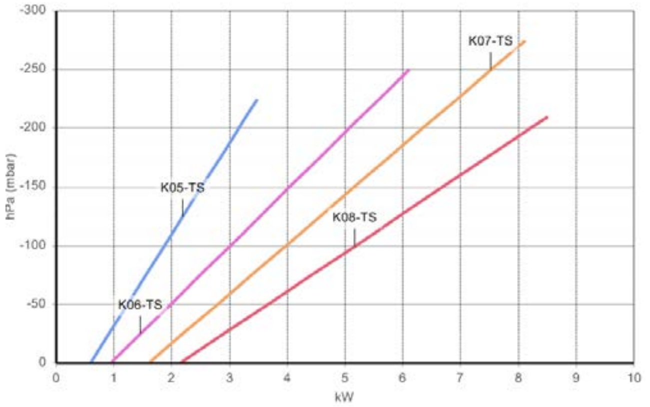
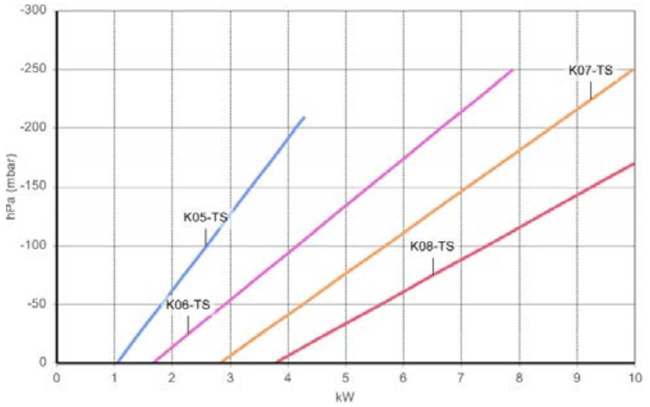
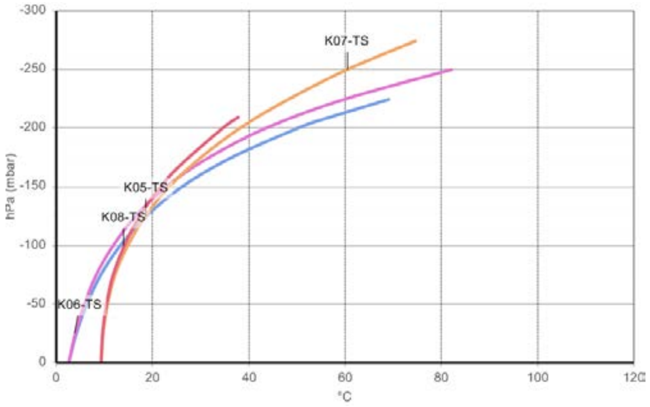
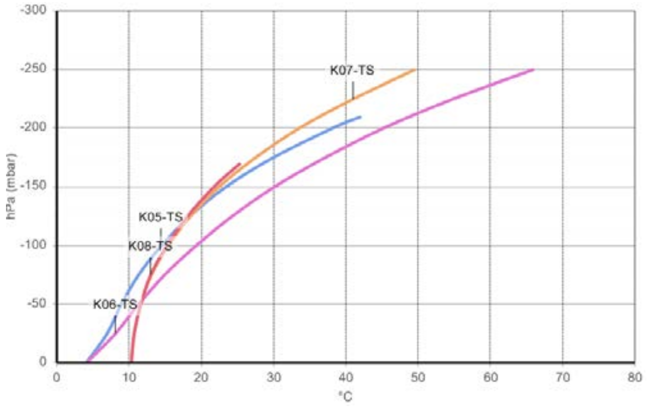




TEMPERATURE INCREASE



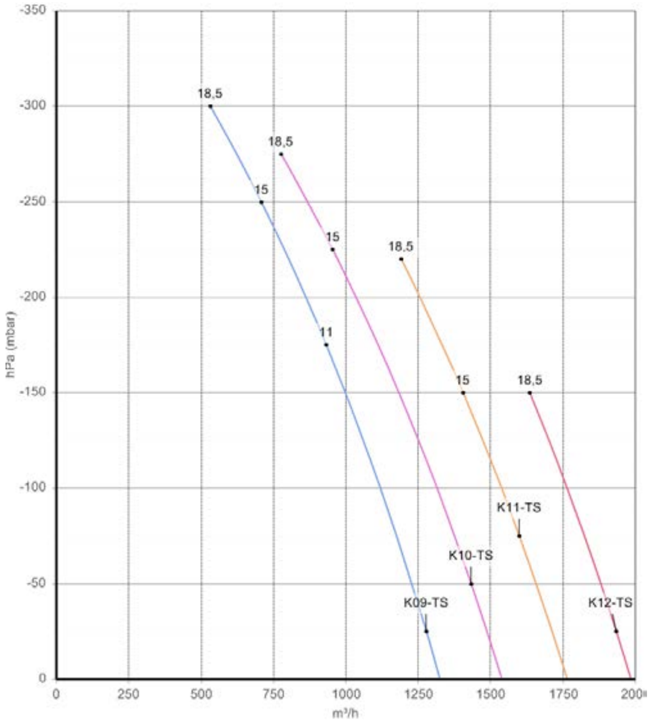


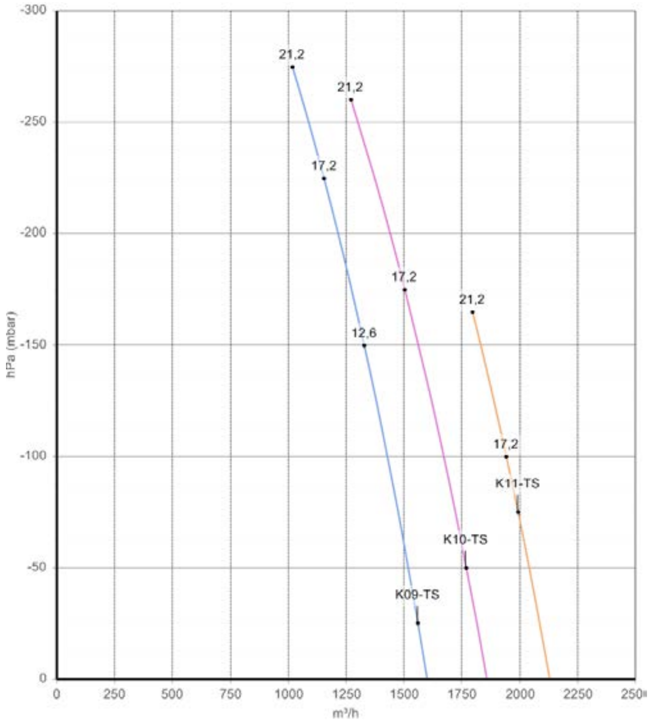
Curves refer to air at 20°C (68° F) temperature, measured at inlet port and 1013 mbar (29.92 In Hg) atmospheric backpressure (abs).
Values for flow, power consumption and temperature rise: ± 10% tolerance
Data can change without prior notice.

VACUUM

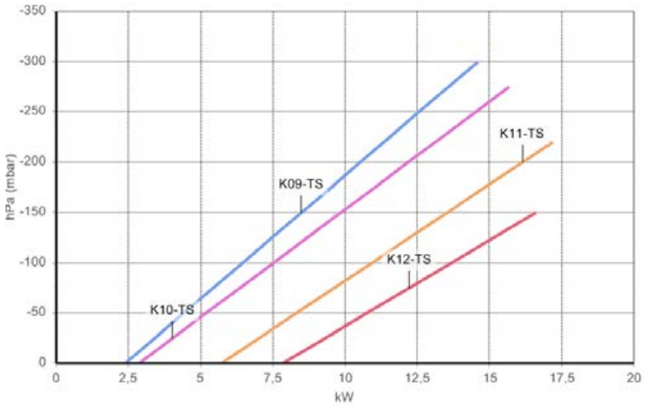
2900 rpm (50 Hz) / 3500 rpm (60 Hz)

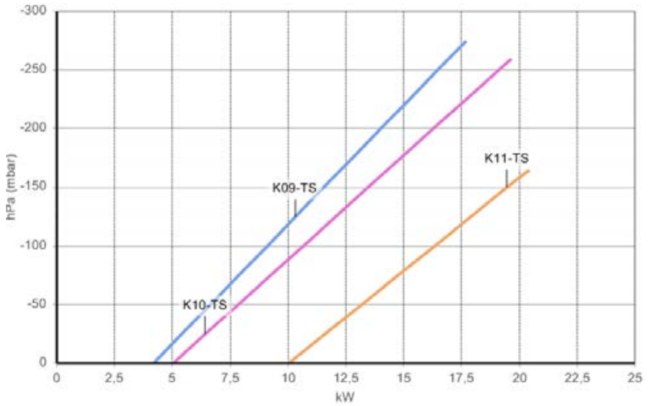
FLOW RATE



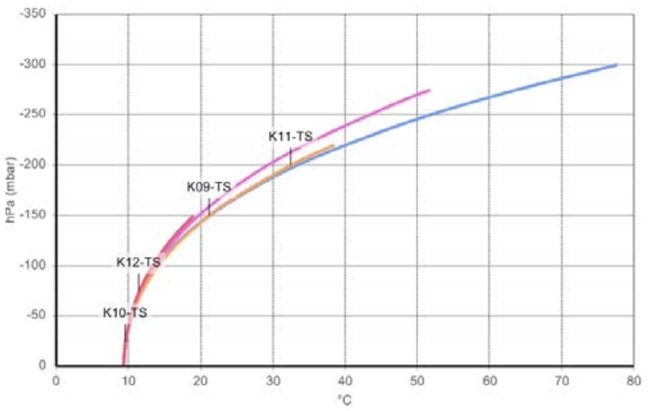


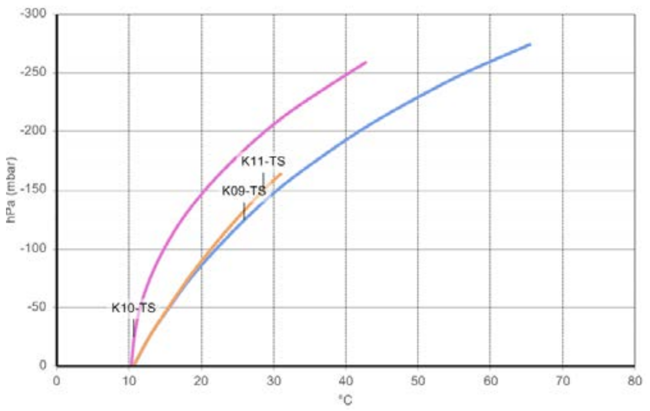
ABSORBED POWER





TEMPERATURE INCREASE





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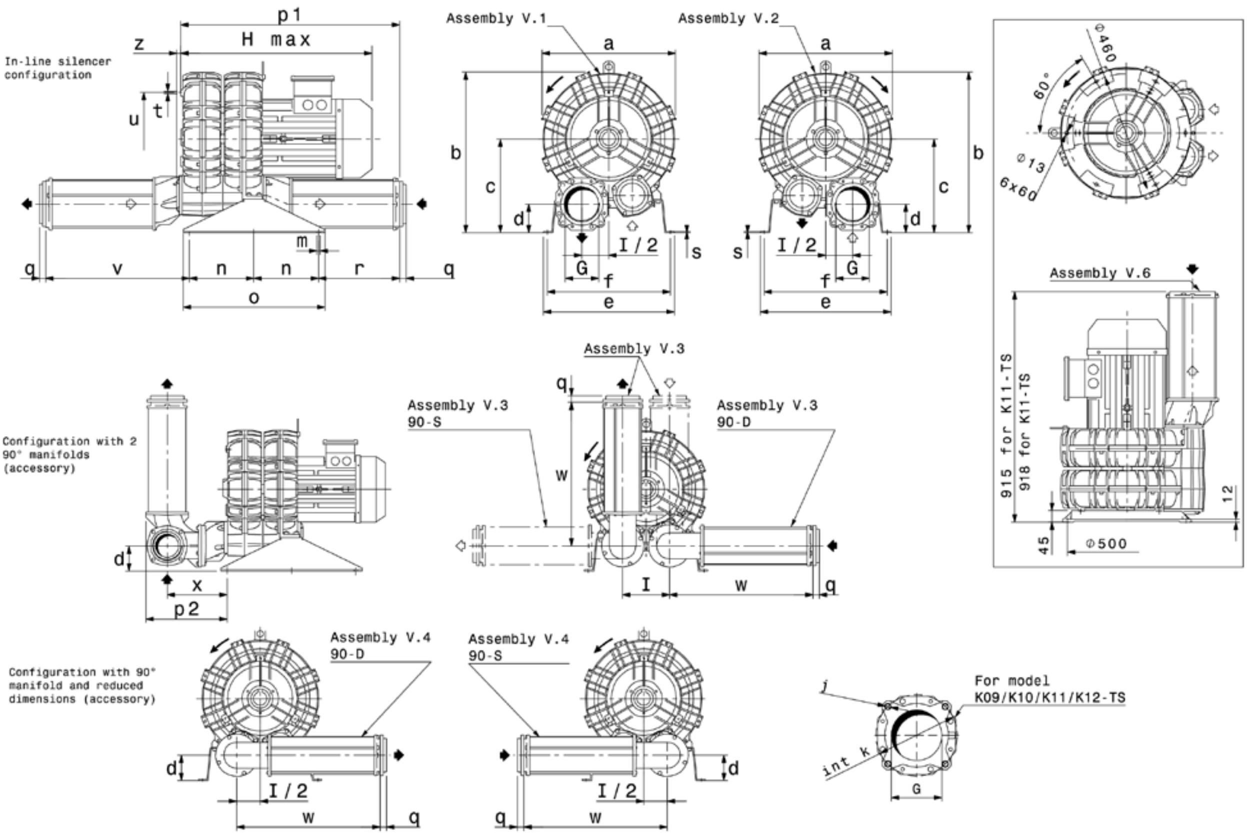
Values for flow, power consumption and temperature rise: ± 10% tolerance
Data can change without prior notice.

DIMENSIONS (K05-TS/K06-TS/K07-TS/K08-TS/K09-TS/K10-TS/K11-TS/K12-TS)



Dimensions in mm - FOR REFERENCE ONLY

Model	a	b	c	d	e	f	G	H
K05-TS	327	422	258	77	404	374	G 3"	495
K06-TS	376	450	262	75	404	374	G 3"	580
K07-TS	424	531	319	98	468	438	G 4"	625
K08-TS	457	548	319	98	478	448	G 4"	625
K09-TS	492	610	365	112	508	478	130	760
K10-TS	516	623	365	112	508	478	130	760
K11-TS	542	650	380	106	540	510	130	775
K12-TS	548	652	380	106	540	510	130	780

Model	i	j	k	m	n	o	p1	p2	q
K05-TS	150	-	-	13	300	345	634	249	25
K06-TS	155	-	-	13	300	345	662	268	25
K07-TS	182	-	-	13	250	550	802	315	25
K08-TS	182	-	-	13	250	550	802	315	25
K09-TS	210	M16	210	13	250	550	850	447	-
K10-TS	210	M16	210	13	250	550	850	447	-
K11-TS	228	M16	210	13	250	550	870	462	-
K12-TS	228	M16	210	13	250	550	873	462	-

SERIES **TS** – RANGE **MOR**

IE2 VERSION

Model	r	s	t	u	v	w	x	z
K05-TS	328	4	M8	200	436	481	176	19
K06-TS	335	4	M8	240	455	481	195	19
K07-TS	299	5	M8	295	522	581	276	16
K08-TS	299	5	M8	310	522	581	276	16
K09-TS	315	5	M8	360	558	608	337	16
K10-TS	315	5	M8	360	558	608	337	16
K11-TS	320	5	M8	390	573	608	352	16
K12-TS	320	5	M8	390	573	608	352	16

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Liquid Filters

Vapor Filters

VFD Series

- VFD-30
- VFD-55
- VFD-85
- VFD-110

VFV Series

- VFV-250
- VFV-500
- VFV-1000
- VFV-2000
- VFV-3000
- VFV-5000
- VFV-10000

VF Series

- VF-500
- VF-1000
- VF-2000
- VF-3000
- VF-5000
- VF-10000

VR Series

- VR-140
- VR-170
- VR-225
- VR-400
- VR-700
- VR-1600
- VR-2600

Filtration Media

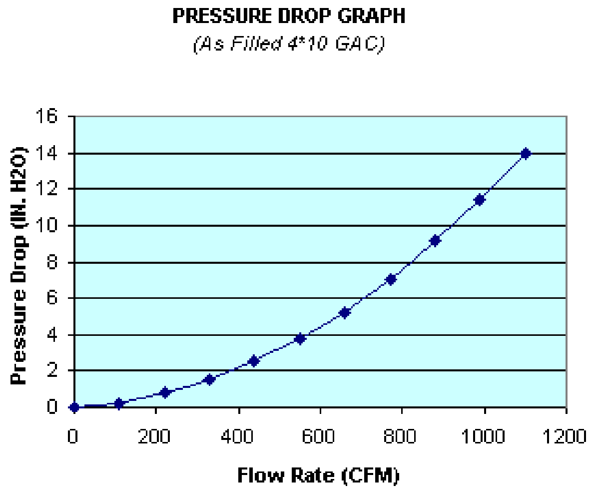
Special Products

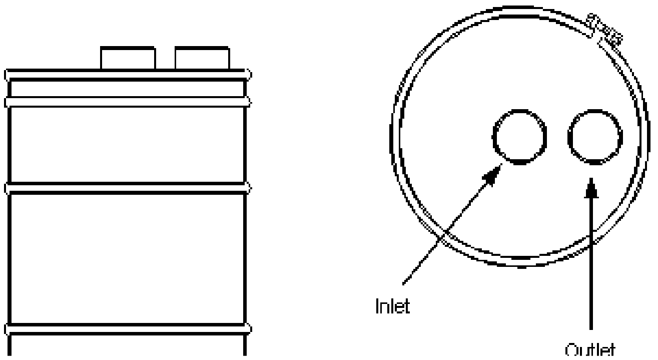
MODEL VR-400

Picture Not Available

The VR-400 filter is a radial flow filter vessel designed to treat vapor streams where pressure drop is a strong concern. With the radial design in certain applications the user can obtain higher flow rates than could be obtained in similar upflow filters. Some applications include:

- Soil Vapor Extraction Treatment
- Air Stripper Off Gas Treatment
- Odor Removal System
- Storage Tank Purge Vapor Treatment
- Industrial Process Treatment





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VR-400 SPECIFICATIONS			
Overall Height	3'11"	Vessel/Internal Piping Materials	CS/ SCH 40 PVC
Diameter	30"	Internal Coating	Polyamide Epoxy Resin
Inlet / Outlet (FNPT)	6"	External Coating	Urethane Enamel
Drain / Vent (FNPT)	OPT	Maximum Pressure / Temp	2 PSIG / 150º F
GAC Fill (lbs)	400	Cross Sectional Bed Area	8.8 FT^2
Shipping / Operational Weight (lbs)	500/575	Bed Depth/Volume	11.7 IN / 14.25 FT^3