965 Mamaroneck Avenue
Remedial Action Work Plan

965 Mamaroneck Avenue
Westchester County TaxID No. 8-20-244
BCP Site #C360189

Submitted to:
New York State Department of Environmental Conservation
Division of Environmental Remediation
Remedial Bureau B
625 Broadway, 12th Floor
Albany, NY 12233-7016

Prepared for:
1946 Holding Corp.
43 Robins Road
New Rochelle, NY 10801

Prepared by:
Matthew M. Carroll, P.E.
&

TENEN ENVIRONMENTAL
10 CELEBRATING 10 YEARS OF EXCELLENCE

121 West 27th Street, Suite 702
New York, NY 10001

July 2024

CERTIFICATIONS

I, Matthew M. Carroll, certify that I am currently a registered professional engineer licensed by the State of New York and that this Remedial Action 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) and DER Green Remediation (DER-31).

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

091629		
NYS Professional Engineer #	Date	Matthew M. Carroll, P.E. Signature

It is a violation of Article 145 of New York State Education Law for any person to alter this document in any way without the express written verification of adoption by any New York State licensed engineer in accordance with Section 7209(2), Article 145, New York State Education Law.

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AGV	NYSDOH Air Guidance Value
AOC	area of concern
AS	air sparging
BCA	Brownfield Cleanup Agreement
BCP	Brownfield Cleanup Program
ECL	Environmental Conservation Law
BTEX	benzene, toluene, ethylbenzene and xylenes
CAMP	Community Air Monitoring Program
C&D	construction and demolition
CDS	construction dewatering system
Class GA Standards	NYSDEC TOGS 1.1.1 Class GA Ambient Water Quality Standards and Guidance Values
CEQR	City Environmental Quality Review
CFR	Code of Federal Regulations
CPP	Citizen Participation Plan
COC	Certificate of Completion
DCE	dichloroethylene
DER-10	NYSDEC Division of Environmental Remediation (DER), DER-10 / Technical Guidance for Site Investigation and Remediation
DRO	diesel range organics
DOC	dissolved organic carbon
DUSR	Data Usability Summary Report
EC	engineering control
ESA	Environmental Site Assessment
EZ	exclusion zone
FB	field blanks
FER	Final Engineering Report
ft-bs	feet below building slab
ft-bg	feet below sidewalk grade
ft-msl	feet above mean sea level
GPM	Gallons per minute
HASP	Health and Safety Plan
HSA	Hollow Stem Auger
HSO	Health and Safety Officer
IC	institutional control
ISCO	*in-situ* chemical oxidation
IRM	Interim Remedial Measure
MW	monitoring well
NAVD	North American Vertical Datum of 1988
NGVD	National Geodetic Vertical Datum of 1929
NIOSH	National Institute for Occupational Safety and Health
NYCDEP	New York City Department of Environmental Protection
NYCDEP Limits	NYCDEP Limitations for Effluent to Sanitary or Combined Sewers
NYCDOB	New York City Department of Buildings
NYCDOT	New York City Department of Transportation
NYCRR	New York Codes, Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation

NYSDOH	New York State Department of Health
NYSDOH-ELAP	NYSDOH Environmental Laboratory Approval Program
O&M Plan	Operations and Maintenance Plan
OSHA	Occupational Safety and Health Association
PCB	polychlorinated biphenyl
PCE	perchloroethylene, aka tetrachloroethylene
PID	photoionization detector
PGWSCOs	6 NYCRR 375-6.8(b) and CP-51 Protection of Groundwater Soil Cleanup Objectives
PP Metals	Priority Pollutant Metals
PPE	personal protective equipment
QA/QC	quality assurance / quality control
QAPP	Quality Assurance Project Plan
RAWP	Remedial Action Plan
RCNY	Rules of the City of New York
RAO	Remedial Action Objective
RE	Remedial Engineer
RI	remedial investigation
RSCOs	Recommended Soil Cleanup Objectives
RUSCOs	6 NYCRR 375-6.8(b) and CP-51 Track 2 – Commercial Use Soil Cleanup Objectives
SB	soil boring
SCGs	Standards, Criteria and Guidance
SV	soil vapor
SMP	Site Management Plan
SMMP	Soil/Material Management Plan
SSDS	sub-slab depressurization system
SVE	soil vapor extraction
SVOC	semi-volatile organic compound
TAL	Target Analyte List
TAGM 4046	NYSDEC Technical and Administrative Guidance Memorandum #4046
TB	trip blanks
TCE	trichloroethylene
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TCLP Limits	USEPA Maximum Concentrations of Contaminants for the Toxicity Characteristic
TOC	total organic carbon
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UST	underground storage tank
UUSCOs	6 NYCRR 375-6.8(a) Track 1 Unrestricted Use Soil Cleanup Objectives
VOC	volatile organic compound

REMEDIAL ACTION WORK PLAN

1.0 INTRODUCTION

Tenen Environmental LLC and Matthew Carroll, PE (collectively "Tenen") have prepared this Remedial Action Work Plan (RAWP) on behalf of 1946 Holding Corp. for the property located at 965 Mamaroneck Avenue (Westchester County Tax ID No. 8-20-244) in the Village and Town of Mamaroneck, NY (Site). The Site is currently enrolled in the New York State Brownfield Cleanup Program (BCP), Site #C360189. 1946 Holding Corp. entered into a Brownfield Cleanup Agreement (BCA) as a Participant with the New York State Department of Environmental Conservation (NYSDEC) on December 27, 2019, to investigate and remediate the Site, an approximately 22,520 square feet (SF) (0.517 acre) property located in the Village and Town of Mamaroneck, New York.

The Site is improved with a single-story commercial building that is currently occupied by a liquor store. Previously, the Site was occupied by a dry cleaner until 2018 when operations ceased. The Participant is not proposing to change the commercial use of the Site. To date, no redevelopment is contemplated.

This RAWP summarizes the nature and extent of contamination present on and off the Site, as determined from data gathered during Remedial Investigation (RI) activities, supplemental RI activities, and offsite soil vapor investigations (SVIs) conducted between March 2020 and April 2022.

This RAWP addresses the specific requirements of the BCP catalogued in Part 375-3 of Title 6 of the Official Compilation of New York Codes, Rules and Regulations (NYCRR). This document provides an analysis of a Track 1 Unrestricted Use remedy (Alternative 1) and a Track 4 Restricted Commercial Use remedy with a management of material in place component (Alternative 2).

The purpose of this RAWP is to evaluate two remedies with respect to site-specific conditions, cost, protection of human health and the environment, and consistency with relevant NYSDEC guidance and applicable Federal, State and local laws, regulations and requirements. The overall objective of this RAWP is to recommend a cost-effective remedial alternative that satisfies the remedial action objectives (RAOs) established for the Site.

1.1 Site Location and Description

The Site is located at 965 Mamaroneck Avenue in the Village and Town of Mamaroneck, New York. The Site is a 22,520 SF irregularly-shaped parcel located on the southeast corner of the intersection of Mamaroneck Avenue and North Barry Avenue Extension and is bound to the north by North Barry Avenue Extension, to the south by commercial buildings followed by Hillside Avenue, to the east by single-family residential homes followed by Lester Avenue, and to the west by Mamaroneck Avenue. A location map for the Site is provided as Figure 1.

The Site is currently improved with a single-story, slab on grade, commercial building that occupies approximately 3,600-SF of the total Site area. The remainder of the Site consists of an asphalt parking lot and landscaped areas. The Site is currently utilized as a commercial liquor store. A detailed map of the current Site layout is included as Figure 2.

1.2 Site History

The Site was initially developed sometime prior to 1950 with the southwestern portion of the existing single-story building. Sometime prior to 1988, one-story additions were constructed on the northern and eastern sides of the original structure. The Site operated as a dry cleaning facility for 46 years until 2018 when operations ceased.

1.3 Physical Setting

The Site incorporates approximately 0.517 acres of relatively level land situated in the Village and Town of Mamaroneck, Westchester County, New York. The Site is mapped on the *Mamaroneck* Quadrant 7.5 Minute Topographic Map, published by the United States Geological Survey (USGS). Review of the topographic map indicates that the Site is positioned approximately 27 feet above sea level (NAVD 88).

1.3.1 Geologic Setting

The Site is underlain by a continuous layer of historic fill material that ranges in thickness from three to nine feet and generally consists of fine to medium silty or clayey sand mixed with gravel and fragments of concrete. The fill layer is underlain by intermixed layers of native fine to medium grained sand and soft sandy silt. Bedrock was not encountered during the course of the RI or any subsequent investigations.

1.3.2 Hydrogeologic Setting

Groundwater has been measured at depths ranging from approximately 8 to 11 feet below grade (ft-bg). The topography of the Site is relatively flat and gently slopes downward to the east. No wetlands or surface water bodies are present at the Site. Based on an elevation survey performed as part of the RI, local groundwater flow direction has been determined to flow east towards the Mamaroneck River (approximately 350 feet east of the Site) with a northern component likely influenced by subsurface infrastructure. A groundwater flow map is presented as Figure 3.

1.4 Proposed Site Plan

The Remedial Actions proposed in this RAWP are intended to make the Site protective of human health and the environment consistent with the DER-10 and New York State Department of Health (NYSDOH) Soil Vapor Intrusion Decision Matrices and the contemplated end use of the Site. At this time, the Participant is not proposing to change the future use of the Site and is not contemplating redevelopment of the Site.

1.5 Description of Surrounding Property

The surrounding area is generally commercial and residential. The Site is bound by commercial buildings to the north, west, and south and residential buildings to the east. The Site is located in a C-1 zoning district, a designation that denotes commercial use.

2.0 DESCRIPTION OF REMEDIAL INVESTIGATION FINDINGS

The Site was investigated in accordance with the scope of work described in the January 2020 Remedial Investigation Work Plan (RIWP), which was approved by NYSDEC in February 2020. This section presents a summary of previous investigations conducted onsite as well as the findings of the 2020 RI and Supplemental Investigations performed by Tenen.

Investigations and sampling efforts conducted at the Site are described in detail within the following reports:

- *Phase I Environmental Site Assessment, 965 Mamaroneck Avenue, Mamaroneck, NY 10543,* J.C. Broderick & Associates, Inc., February 2019.
- *Phase II Environmental Site Assessment, 965 Mamaroneck Avenue, Mamaroneck, NY 10543,* J.C. Broderick & Associates, Inc., March 2019.
- *Soil Vapor Investigation, 965 Mamaroneck Avenue, Mamaroneck, NY 10543,* Tenen Environmental, LLC, June 2019.
- *Remedial Investigation Report, 965 Mamaroneck Avenue, Mamaroneck, NY 10543,* Tenen Environmental, LLC, February 2022.
- *Remedial Investigation Report Addendum, 965 Mamaroneck Avenue, Mamaroneck, NY 10543,* Tenen Environmental, LLC, August 30, 2022.

A Phase I Environmental Site Assessment (ESA) was completed at the Site by J.C. Broderick & Associates, Inc. (JCB) in 2019 consisting of a Site visit, historical research, and review of regulatory databases. The following Recognized Environmental Conditions (RECs) were identified in the Phase I ESA:

- The historical use of the subject property as a dry cleaner;
- The possibility of volatile organic compounds (VOCs) impacting the subject property from known spill incidences at the north, east, and west adjoining properties; and,
- The possibility of volatile vapor intrusion affecting the occupants of the subject property.

In January 2019 JCB conducted soil and groundwater sampling as part of a Phase II ESA to investigate the potential for contamination associated with the RECs identified in the Phase I ESA. The soil and groundwater sampling included the advancement of three soil borings, the collection of three shallow soil samples, the installation of three temporary wells and the collection of three groundwater samples. Based on the results of the groundwater sampling, JCB returned to the Site in February 2019 to conduct additional groundwater sampling as part of the Phase II ESA. The February mobilization included the installation of six additional temporary monitoring wells and the collection of six groundwater samples (three from the groundwater interface [8 ft-bg] and three from the deeper groundwater interval [17-21 ft-bg]).

The soil results indicated that no VOCs were detected in exceedance of NYSDEC's Unrestricted Use Soil Cleanup Objectives (UUSCOs) as listed in 6 NYCRR Part 375-6.8(a) in any soil samples. However, the chlorinated VOC (cVOC), tetrachloroethene (PCE), was detected at low concentrations below its respective UUSCO in all three samples collected from 0 to 3 ft-bg.

The groundwater results indicated concentrations of PCE in exceedance of its NYSDEC Technical and Operation Guidance Series (TOGS) 1.1.1 Ambient Water Quality Standards and Guidance Values (Class GA Standards) in eight of nine samples collected. Trichloroethene (TCE), a breakdown product of PCE, was also detected in exceedance of its Class GA Standard in two of nine samples collected, both of which were collected from the deeper groundwater interval (17-21 ft-bg). In general, the highest concentrations of PCE and TCE were detected in the three samples collected from the deeper interval of the aquifer.

A soil vapor investigation was conducted at the Site by Tenen in 2019 to investigate potential impacts to onsite soil vapor from known chlorinated solvent impacts to groundwater identified during the 2019 Phase

II ESA. The soil vapor investigation included the installation of three temporary soil vapor points along the eastern Site perimeter where residential buildings exist and the collection of three soil vapor samples.

The soil vapor results indicated concentrations of PCE in all three soil vapor samples, with the highest concentration (93.6 micrograms per cubic meter [ug/m3] in SV-1) occurring in the sample collected from the southeastern corner of the Site. A variety of other cVOCs were detected at low concentrations in soil vapor, including carbon tetrachloride, cis-1,2-dichloroethene, vinyl chloride and chloroform. TCE was not detected in any soil vapor sample collected. Low levels of petroleum-related VOCs, including benzene, toluene, ethylbenzene, xylenes, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene were detected in all three soil vapor samples.

2.1 Remedial Investigation

The scope of work of the RI, supplemental RIs, and offsite soil vapor investigations included the following tasks:

1. Installation of sixteen (16) soil borings, nineteen (19) monitoring wells, four (4) sub-slab soil vapor points and one (1) exterior soil vapor point within and surrounding the Site;
2. Installation of three (3) offsite sub-slab soil vapor points within residential or commercial buildings adjoining the Site to the south and east;
3. Collection of twenty-five (25) soil samples, twenty (20) groundwater samples, seven (7) sub-slab soil vapor samples, one (1) exterior soil vapor sample, seven (7) co-located indoor air samples, two (2) standalone indoor air samples and three (3) ambient air samples within and surrounding the Site [sample quantities exclude QA/QC samples];

2.2 Summary of RI Findings

2.2.1 Soil

The results of the RI and supplemental RIs indicated the presence of metals and pesticides in exceedance of Unrestricted Use SCOs, but below Protection of Groundwater and Restricted Commercial Use SCOs, in soil samples collected from the parking lot. In addition, per- and polyfluoroalkyl substances (PFAS), specifically perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA), were detected in soil samples collected from the southeastern portion of the Site in exceedance of the proposed Unrestricted Use and Protection of Groundwater SCOs, but below the proposed Restricted Commercial Use SCOs. No cVOCs were detected in exceedance of Unrestricted Use, Protection of Groundwater, or Restricted Commercial Use SCOs in any soil samples analyzed; however, low concentrations of PCE were detected in onsite soil samples collected from the eastern perimeter of the parking lot and in offsite, up/cross-gradient soil samples. The results of the RI soil sampling indicate that a soil source of cVOC impacts is not present onsite.

2.2.2 Groundwater

Groundwater results from samples collected on and offsite (cross-gradient/west) as part of the RI indicate exceedances of Class GA Standards for semivolatile organic compounds (SVOCs), total and dissolved metals, and pesticides. The RI confirmed the presence of cVOC impacts to the shallow (5-15 ft-bg) and intermediate (17-22 ft-bg) aquifer across the Site and to the shallow (5-15 ft-bg) aquifer cross-gradient (west) of the Site, with the highest concentrations occurring in the offsite, cross-gradient monitoring well installed within the sidewalk along Mamaroneck Avenue adjacent to the Site building. cVOCs in groundwater collected from the deep aquifer (35-40 ft-bg) and down/cross-gradient of the Site to the north and east were detected at levels below the Class GA Standards. Analysis of PFAS in groundwater as part of this investigation indicated concentrations of PFOS and PFOA in exceedance of Class GA Standards on and offsite. Generally, the highest concentrations of PFAS were detected in the southeastern corner of the Site, consistent with the highest concentrations of PFAS found in soil. Only two onsite, shallow groundwater monitoring wells and one offsite and upgradient shallow groundwater monitoring well did not contain concentrations of PFAS in exceedance of Class GA Standards.

2.2.3 Soil Vapor

Sub-slab soil vapor and co-located indoor air results from the RI and offsite SVIs indicate low concentrations of chlorinated solvents at all four onsite sampling locations and all three offsite sampling locations. No chlorinated solvents were detected in on or offsite indoor air at concentrations exceeding NYSDOH Soil Vapor Intrusion Air Guidance Values (AGVs). Comparison of cVOC concentrations in the sub-slab soil vapor and co-located indoor air samples to applicable NYSDOH Decision Matrices indicates that no further action is necessary at any locations for any analytes on or offsite. Chlorinated solvents were detected in exterior, offsite, and cross-gradient (west) soil vapor samples in exceedance of ambient air concentrations. Petroleum-related VOCs were detected at low concentrations in all soil vapor, sub-slab soil vapor, and indoor air samples. Based on the results of the RI and offsite SVIs, a soil vapor intrusion condition does not exist at the Site building, the south adjoining commercial and residential buildings or the east adjoining residential buildings.

RI findings are discussed in detail in the Remedial Investigation Report and RIR Addendum approved by NYSDEC in February 2022 and November 2022, respectively. Data maps are included as Figures 6 through 13 of the RIR and as Figure 3 of the RIR Addendum.

2.2.4 Qualitative Environmental Assessment

The following potential exposure routes were identified: direct contact with surface soils, inhalation (and incidental ingestion), ingestion of groundwater, direct contact with groundwater and inhalation of vapors. Potential impacts from these exposure routes can be mitigated through the implementation of Health and Safety Plan (HASP) and Community Air Monitoring Program (CAMP) during ground-intrusive activities, current Site caps (concrete building foundation and asphalt/concrete parking lot) and through Site remediation performed under an approved remedial action work plan.

2.3 Significant Threat

The NYSDEC and NYSDOH have determined that the Site does not pose a significant threat to human health. The RI for this Site did not identify fish and wildlife resources.

3.0 CONTAMINATION CONDITIONS

3.1 Conceptual Model of Site Contamination

The Site is currently operating as a commercial liquor store, but was previously operated as a dry cleaner for 46 years until 2018 when operations ceased. The Site operated as a dry cleaner for the entirety of its history prior to 2018.

Based on the results of the RI, the contaminants of concern at the Site are cVOCs, specifically PCE and its breakdown product, TCE, and PFAS, specifically PFOS and PFOA. Some historic fill-related pesticides and metals were also detected above the Unrestricted Use SCOs in soil at the Site. PCE was detected at elevated concentrations in the shallow (5-15 ft-bg) and intermediate (17-22 ft-bg) aquifer. PCE was detected in groundwater above the Class GA Standards across the Site and cross-gradient (west) of the Site, with the highest concentrations detected cross-gradient (west) of the Site. PFOS and PFOA were detected at elevated concentrations in the southeastern corner of the Site exceeding the proposed Unrestricted Use and Protection of Groundwater SCOs in soil and exceeding the Class GA Standards in groundwater.

A cVOC soil source area was not identified onsite during the course of the RI or previous investigations. While cVOC concentrations are present at elevated concentrations in onsite groundwater and in monitoring wells installed adjacent to the Site, they do not appear to be migrating across Mamaroneck Avenue, across North Barry Avenue Extension, or to Lester Avenue to an actionable extent. Soil vapor and co-located indoor air results indicate that a soil vapor intrusion condition does not exist within the Site building, the south adjoining commercial and residential buildings, or the east adjoining residential buildings.

Table 1 presents the Part 375 Unrestricted Use SCOs. Table 2 presents the Part 375 Restricted Commercial Use and Protection of Groundwater SCOs. Table 3 presents the TOGS 1.1.1 Ambient Class GA Water Quality Standards. Figures 4 and 5 presents isopleths for PCE and PFAS concentrations in groundwater, respectively. Refer to the Final RIR dated January 2022 for tables and figures of soil, groundwater and soil vapor exceedances.

4.0 ENVIRONMENTAL AND PUBLIC HEALTH ASSESSMENTS

4.1 Qualitative Human Health Exposure Assessment

A qualitative exposure assessment (QHHEA) has been completed in accordance with Section 3.3(c)4 of DER-10 and the NYSDOH guidance for performing a qualitative EA (NYSDEC DER-10; Technical Guidance for Site Investigation and Remediation; Appendix 3 B). The qualitative exposure assessment evaluates the potential for populations to be exposed to Site contaminants.

An exposure pathway describes the means by which an individual may be exposed to contaminants originating from a site. An exposure pathway has five elements: (1) a contaminant source; (2) contaminant release and transport mechanisms to an exposed population; (3) a receptor population; (4) a route of exposure; and (5) a point of exposure to a receptor population. Potential contaminant receptors include the following populations:

- Site workers (primarily environmental professionals and contractors)
- Construction workers, visitors or trespassers
- Future building occupants, tenants, commercial workers, and patrons
- Future on-Site workers and utility workers
- Off-Site residents/building occupants
- Off-Site maintenance workers

The following potential exposure routes are considered incomplete:

Groundwater Ingestion

The Village and Town of Mamaroneck receives its potable water from the Catskill and Delaware watersheds of the New York City water system. Groundwater at the Site is not used, nor will it be used, for potable purposes. This pathway is incomplete.

Inhalation of Vapors by Future Building Employees

There is no vapor intrusion condition onsite.

Remediation will include treatment of PCE in groundwater.

The following potential exposure routes are considered complete:

Inhalation of Vapors and Particulates by On-Site Environmental and Construction Workers (and incidental ingestion).

During slab penetrations, onsite personnel and construction workers may be exposed to dust and vapors via inhalation. This exposure would be mitigated by adherence to the Site-Specific Health and Safety Plan (HASP), included in Appendix B, during ground intrusive activities.

Dermal Contact with Soil by On-Site Environmental and Construction Workers

During slab penetrations and/or soil disturbance activities conducted during site remediation, onsite personnel and construction workers may be exposed to contaminants in soil via dermal contact. This exposure would be mitigated by adherence to the HASP, included in Appendix B, during ground intrusive activities.

Dermal Contact with Groundwater by On-Site Environmental and Construction Workers

Dermal exposure to contaminants in groundwater should be limited to environmental professionals collecting groundwater samples for environmental analysis or treating the groundwater through injection wells. This exposure would be mitigated by adherence to the HASP, included in Appendix B, during sampling activities.

Inhalation of Vapors and Particulates by Off-Site Residents/Building Workers

Work during exterior slab penetrations may generate dust and vapors that could be inhaled by offsite residents/building occupants and maintenance personnel.

The above potential exposures are limited to the remediation phase of the proposed remedial action. Adherence to health and safety protocols will address environmental and construction worker exposure to contaminated soil vapors, particulates and groundwater. Potential exposure of offsite residents and building occupants will be addressed by implementation of the Site-Specific Community Air Monitoring Plan (CAMP) referenced in Section 7.4 of this RAWP and included as Appendix A.

4.2 Remedial Action Objectives

The goals of remediation are to remove (to the extent practicable) chlorinated solvent and PFAS impacts onsite to allow for the Site's continued commercial use and reduce the concentrations of contaminants in soil vapor, soil and groundwater to levels below applicable Standards, Criteria and Guidance (SCGs) on and offsite. Based on the results of the remedial investigations conducted at the Site, the following Remedial Action Objectives (RAOs) have been identified:

4.2.1 Soil

PFAS, specifically PFOS and PFOA, were detected in exceedance of the proposed Unrestricted Use SCOs and Protection of Groundwater SCOs, but below the proposed Restricted Commercial Use SCOs in the southeastern portion of the Site. Metals and pesticides typically associated with historic fill were detected at concentrations in exceedance of Unrestricted Use SCOs, but below Protection of Groundwater and Restricted Commercial Use SCOs in the parking lot of the Site.

RAOs for Public Health Protection

- Prevent ingestion/direct contact with contaminated soil.

RAOs for Environmental Protection

- Prevent migration of contaminants that would result in groundwater or surface water contamination.

4.2.2 Groundwater

Chlorinated solvents, specifically PCE, were detected in groundwater in the shallow (5-15 ft-bg) and intermediate (17-22 ft-bg) aquifer across the Site above applicable SCGs. PFAS, specifically PFOS and PFOA, were detected in exceedance of applicable SCGs in the southeastern portion of the Site, consistent with the highest concentrations of PFAS detected in soil. SVOCs, pesticides, and total and dissolved metals, consistent with typical earth metals attributable to the conditions of the aquifer, have also been detected above applicable SCGs.

RAOs for Public Health Protection

- Prevent ingestion of groundwater containing contaminant levels exceeding drinking water standards.
- Prevent contact with, or inhalation of, volatiles emanating from contaminated groundwater.

5.0 DESCRIPTION OF REMEDIAL ACTION WORK PLAN

5.1 Evaluation of Remedial Alternatives

The alternatives considered to address contamination in soil and groundwater are discussed below.

5.1.1 Soil

Two remedial alternatives were considered to address fill-related impacts in the soil.

Alternative 1 – Track 1 Hotspot Excavations. Excavation of all soil with concentrations above the Unrestricted Use SCOs would be completed. Based on previous investigations completed at the Site, this alternative would include four hot spot excavations: three in the exterior portion of the Site and one within the Site building. One pesticide hotspot in the vicinity of RI soil boring SB-5 would be excavated to a minimum depth of eleven ft-bg; one copper hotspot in the vicinity of RI soil boring SB-8 would be excavated to a minimum depth of ten ft-bg; one PFAS/chromium hotspot in the vicinity of RI soil boring SB-4 would be excavated to a minimum depth of 35 ft-bg; and, one PFAS hotspot in the vicinity of RI soil boring SB-3 would be excavated to a minimum depth of eleven ft-bg. The excavated areas would be backfilled with clean soil and capped with asphalt or concrete. All imported fill material will be sampled and analyzed prior to importation to Site to ensure that the material meets applicable Unrestricted Use SCOs.

End-point samples will be collected to confirm Unrestricted Use SCOs have been met and to document the condition of soil left in place. End-point samples would be collected from the bottom and sidewalls of the hotspot excavations at a rate of one bottom sample for every 900 square feet (SF) and one sidewall sample every 30 linear feet (LF). All end-point samples will be analyzed for Part 375 VOCs, SVOCs, target analyte list (TAL) metals, pesticides, PCBs, 1,4-dioxane, and PFAS. If the end-point sample concentrations do not meet the Unrestricted Use SCOs, excavation and additional end-point sampling would continue until the appropriate SCOs are met.

The extent of the excavation is depicted on Figure 6. Post excavation end-point sample locations are depicted on Figure 7.

A CAMP (Appendix A) and Soil/Materials Management Plan would be implemented during the invasive Site activities to prevent or minimize potential impacts to human health and the environment. End-point samples will confirm the removal of soil to concentrations below applicable Unrestricted Use SCOs.

Alternative 2 – Track 4 Management of Soil in Place*.* The entirety of the Site is currently improved with a one-story building, concrete slab on grade, and asphalt/concrete parking lot. Implementation of Alternative 1 to accomplish the goal of removal of soil exceeding Unrestricted Use SCOs would be very costly and difficult to implement, given excavation would be required within the Site building to a depth of eleven ft-bg and within the exterior portions of the Site to depths up to 35 ft-bg. Soil across the Site currently meets Restricted Commercial Use SCOs. Alternative 2 would manage all onsite soil in place beneath the existing composite cover system. The existing composite cover system consists of a four-inch thick building slab within the building footprint, a four-inch thick concrete slab in the southeastern corner of the exterior portion of the Site and two-inch thick paved asphalt across the remainder of the Site. Under this alternative, the composite cover system that currently exists on the Site would be left in place and would be required to remain in place as a long-term Engineering Control (EC) at the Site.

Soil Alternative 2 is the preferred remedy as it is the most feasible and cost-effective alternative and is protective of public health and the environment.

5.1.2 Groundwater

One remedial alternative for groundwater was evaluated to address cVOC and PFAS impacts in groundwater below and emanating from the Site.

Alternative 1 – Chemical treatment of groundwater. This alternative consists of chemical treatment of the groundwater via a combination of in-situ chemical injections and encapsulated reactant cylinders. In-situ chemical injections into the subsurface will be completed, via a newly installed injection well network, to remediate PFAS contaminants and break down chlorinated solvent contaminants into less toxic degradation products. A typical chemical used to treat co-mingled PFAS and cVOC plumes is PlumeStop® liquid activated carbon. Additionally, an in-situ chemical oxidation (ISCO) reagent will be introduced into the aquifer via an encapsulated reactant cylinder emplaced into three existing groundwater monitoring wells (MW-3, MW-5S, and MW-7). These monitoring wells were chosen as they contained the highest concentrations of PCE in samples collected during the Remedial Investigation. The encapsulating matrix, benign paraffin wax, is biodegradable and insoluble in water, but is soluble in chlorinated solvents such as PCE. This results in the oxidant being released very slowly in water from the encapsulating matrix while releasing rapidly into PCE. The release of the oxidant is typically characterized by an initial rapid release (less than ten minutes) followed by a sustained release for the remaining life cycle of the cylinder. A typical oxidant used to treat cVOC plumes is potassium permanganate. Encapsulated reactant technology enables the oxidant, solid form potassium permanganate, to provide years of controlled oxidant release in saturated soils and groundwater.

In-situ chemical injections are a viable alternative for remediation of PFAS and cVOCs in groundwater and ISCO is a viable alternative for remediation of cVOCs in groundwater. Long term engineering controls would include groundwater monitoring. Figure 9 depicts the proposed locations of injection wells and treatment wells.

Post-remedial groundwater sampling will be performed in accordance with a Site Management Plan (SMP). Post-remedial groundwater samples will be collected from a total of twelve existing on- and offsite monitoring wells: two upgradient monitoring wells (MW-11S and MW-11D), five treatment-area monitoring wells (MW-3, MW-4S, MW-4D, MW-5S, and MW-7), and five downgradient monitoring wells (MW-6-C1, MW-6-C2, MW-9, MW-12, and MW-13) in order to evaluate the efficacy of the treatment. Post-remedial monitoring well sample locations are shown on Figure 10. The first round of post-remedial groundwater sampling will occur 30 days after the completion of groundwater injections and will occur quarterly for a minimum of two years thereafter. Prior to implementation of the groundwater remedy, baseline samples will be collected from the post-remedial monitoring well network. Based upon the results of previous sampling conducted as part of the RI, groundwater samples will be analyzed for cVOCs and/or PFAS: monitoring wells MW-3, MW-4S, MW-4D, MW-5S, MW-6-C1, MW-6-C2, MW-7, MW-11S, and MW-11D will be analyzed for both cVOCs and PFAS; monitoring wells MW-9 and MW-12 will be analyzed for PFAS only; and, monitoring well MW-13 will be analyzed for cVOCs only.

A minimum of five rounds of quarterly post-remedial groundwater monitoring will be conducted. If the results of the fourth and fifth rounds of post-remedial groundwater sampling indicate that cVOC concentrations have decreased below applicable standards, NYSDEC will be asked to consider the groundwater remedy complete.

The regulations surrounding PFAS remedial goals and protocols are currently in flux and require additional/ongoing research. Groundwater in the Village and Town of Mamaroneck is not used as a potable (drinking) water source. Tenen is proposing a maximum post remedial monitoring plan showing a PFAS concentration reduction within four quarters, after which the PFAS remedy will be considered complete.

This alternative is the preferred remedy as it is appropriate for both the detected concentrations and lithology of the Site.

5.2 Standards, Criteria and Guidance (SCGs)

The Remedial Action SCGs are listed below.

SCG	Scope / Application
NYSDEC Brownfield Cleanup Program Guide (draft 2004)	General program guidance
NYSDEC CP-51 / Soil Cleanup Guidance (2010)	Restricted Use SCOs for soil
NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation (2010)	End-point sampling methodology; underground storage tank (UST) closure
NYSDEC DER-31 Green Remediation (2011)	Green remediation components
NYSDEC TOGS 1.1.1 Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations (1998)	Class GA Standards for groundwater
NYSDOH Guidance for Evaluating Soil Vapor Intrusions in the State of New York (2006)	Soil vapor guidance
NYSDOH Generic Community Air Monitoring Plan	Plan for monitoring dust and volatile organics resulting from construction activities
New York State Codes, Rules and Regulations (NYCRR) Title 6 Part 360 – Solid Waste Management Facilities	Off-site disposal of waste for facilities in NYC
New York State Codes, Rules and Regulations (NYCRR) Title 6 Part 364 – Waste Transporter Permits	Transporter requirements for off-site disposal of waste
6 NYCRR Part 370 – Hazardous Waste Management System	Disposal of hazardous waste, if encountered
6 NYCRR Part 375 – Environmental Remediation Programs (December 2006)	General administrative guidance
6 NYCRR Part 376 – Land Disposal Restrictions	Disposal of hazardous waste, if encountered
6 NYCRR Part 750 – State Pollutant Discharge Elimination System (SPDES) Regulations	Discharge of wastewater and stormwater
Code of Federal Regulations (CFR) Title 29 Part 1910.120 - Hazardous Waste Operations and Emergency Response Standard	Worker safety
29 CFR Title 29 Part 1926 - Safety and Health Regulations for Construction	Worker safety
40 CFR Parts 144 and 146 – Underground Injection Control Program	Injection of chemicals into the groundwater
Title 15, Rules of the City of New York (RCNY), Chapter 19 - Use of the Public Sewers	Discharge of groundwater to the municipal sewer system
NYCDEP Limitations for Effluent to Sanitary or Combined Sewers	Discharge of groundwater to the municipal sewer system

5.3 Evaluation of Alternatives

The remedial alternatives for soil and groundwater are discussed below. Each alternative was evaluated based on the following remedy selection factors (as defined in DER-10, Section 4.2):

- Protection of human health and the environment
- Conformance with standards, criteria and guidelines

- Short-term effectiveness and performance
- Long-term effectiveness and performance
- Reduction in toxicity, mobility or volume
- Implementability
- Cost effectiveness
- Community acceptance
- Land use

5.3.1 Protection of Human Health and the Environment

Each alternative would be protective of human health and the environment. Soil/fill in exceedance of the most stringent SCOs would be removed with Soil Alternative 1 and impacted soil would be managed in place beneath an existing composite cover system under Soil Alternative 2. Groundwater in this area is not used as a source of drinking water.

A HASP, including monitoring/management for particulates and volatiles will be implemented during remedial activities.

5.3.2 Conformance with Standards, Criteria and Guidelines

Each alternative would conform to the SCGs. Soil Alternative 1 would remove the bulk of soil impacts. Soil Alternative 2 would manage soil impacts in place beneath an existing composite cover system.

On-site construction safety will conform to the HASP requirements, which incorporate Occupational Safety and Health Administration (OSHA) requirements.

5.3.3 Short-Term Effectiveness and Performance

Soil Alternatives 1 and 2 would be effective over a short-term time horizon and are consistent with the proposed use. Soil Alternative 1 (Track 1 SCOs) is associated with the most significant short-term impacts, related to the increased duration associated with more extensive and deeper soil removal. These impacts include the potential for particulate and volatile impacts and additional truck traffic. Soil Alternative 2 (Track 4 SCOs) would have the no short-term impacts and is the most cost-efficient soil alternative. These potential impacts are addressed in the various control plans included in this RAWP.

5.3.4 Long-Term Effectiveness and Performance

Each alternative would be effective over a long-term time horizon. Soil alternative 2 and the groundwater alternative would be consistent with the proposed use with long-term engineering controls. Groundwater in this area is not used as a source of drinking water and the source of potential impacts to soil vapor would be remediated.

5.3.5 Reduction in Toxicity, Mobility or Volume

Each alternative would reduce the toxicity, mobility and volume of the contaminants present onsite. In particular, Soil Alternatives 1 (Track 1 SCOs) would remove the bulk of the non-cVOC related impacts (cVOCs are not present in soil above SCGs) and Groundwater Alternative 1 (Chemical Treatment) would remove the bulk of CVOC and PFAS impacts across the Site..

5.3.6 Implementability

Soil Alternative 1 is not implementable without significant support of excavation and structural stability of the existing building, which would not be required with Soil Alternative 2. Groundwater Alternative 1 (Chemical Treatment) can be implemented as part of the Site remedial action utilizing standard environmental and construction means and methods.

5.3.7 Cost Effectiveness

The implementation of Soil Alternative 2 (Track 4 SCOs) and Groundwater Alternative 1 (Chemical Treatment) is estimated at approximately $120,000, as shown in Table 4. Additional reporting and long-term monitoring costs, approximately $140,000, would also be incurred. The costs to implement Soil Alternative 1 (Track 1 SCOs) would be significantly higher due to excavation both by area and depth in the existing building and parking lot area, sheeting and shoring that would be required for excavation and the structural stability measures required for excavation within and adjacent to the existing onsite building.

5.3.8 Community Acceptance

Each alternative eliminates potential exposure pathways and will result in a decrease in toxicity, mobility and volume (see Section 5.3.5). These considerations, in conjunction with the continued commercial use of the Site and acknowledgement that groundwater is not used as a potable source of water in the Village and Town of Mamaroneck, should result in acceptance by the community.

The selected remedy will be subject to a 45-day public comment period in accordance with the Citizen Participation Plan. Any substantive public comments received will be addressed before the remedy is approved.

5.3.9 Land Use

Each of the proposed alternatives is compatible with the proposed land use at the Site, which has been documented in the BCP Application and in Section 1.3.

The following findings, based on a review of previous environmental and public documents, support the compatibility of the proposed Site land use with that of the surrounding area:

1. The use proposed for the Site conforms to applicable zoning laws or maps or the reasonably anticipated future use of the Site.
2. The proposed use conforms to historical and/or recent development patterns in the area.
3. The Site does not fall within the boundaries of an existing Brownfield Opportunity Area (BOA).
4. According to the New York City Planning Commission Zoning Map, the Site is located in an C-1 zoning district; a designation that denotes commercial use.
5. The Site is located in an urban setting characterized by residential and commercial uses. There are no areas zoned for agricultural use in the proximity of the Site.

6. According to the NYSDEC database for environmental justice concerns, the Site is not part of a Potential Environmental Justice Area (PEJA).
7. There are no federal or state land designations.
8. The population growth patterns and projections support the proposed land use.
9. The Site is accessible to existing infrastructure.
10. The Site is not located in close proximity to important federal, state or local natural resources, including waterways, wildlife refuges, wetlands, or critical habitats of endangered or threatened species.
11. Municipal water supply wells are not present in the Town and Village of Mamaroneck; therefore, groundwater from the Site cannot affect municipal water supply wells or recharge areas. The Federal Emergency Management Agency (FEMA) flood insurance rate map for the Site (Map Number 361190353F) indicates that the Site is located within the 0.2% annual chance floodplain (500-year flood).

5.4 Selection of the Preferred Remedial Actions

The preferred Track 4 remedy, intended to address all environmental issues associated with the Site, consists of the following: Soil Alternative 2 (Track 4 SCOs) and Groundwater Alternative 1 (Chemical Treatment). The preferred remedy is further described below:

- Management of all onsite soil in place beneath the existing composite cover system (concrete building slab and asphalt/concrete parking lot);
- Inspection and repair of the existing composite cover system, as necessary;
- Completion of groundwater treatment via chemical injections and encapsulated reactant cylinders. PlumeStop®, a colloidal form of activated carbon, is the proposed chemical to be utilized for the injections for treatment of cVOCs and PFAS in groundwater, and solid form potassium permanganate is the proposed oxidant to be utilized in the encapsulated reactant cylinders for treatment of cVOCs in groundwater;
- Quarterly post-remedial groundwater sampling to confirm the efficacy of the groundwater remedy, beginning approximately 30 days after the first round of injections and quarterly thereafter;
- Preparation of a Final Engineering Report (FER) to document the implemented remedial actions; and
- Development of a Site Management Plan (SMP) for long term management of residual contamination as required by an Environmental Easement, including plans for: (1) Institutional and Engineering Controls, (2) monitoring, and (3) reporting.

Remedial activities will be performed at the Site in accordance with this NYSDEC-approved RAWP, RA Engineering Design Document and the Department-issued Decision Document. All deviations from the above mentioned documents will be promptly reported to NYSDEC for approval and fully explained in the FER. Soil onsite will be managed in place by the existing composite cover system and groundwater impacts will be mitigated by chemical treatment via injections into a newly installed system of injection wells and encapsulated reactant cylinders placed into existing wells.

The following land-use factors were considered in selecting these remedial measures. Land Use Factor	Remedy Evaluation Result
Zoning	Remedy is consistent
Applicable comprehensive community master plans or land use plans	Remedy is consistent (not within a Brownfield Opportunity Area)
Surrounding property uses	Remedy is consistent
Citizen participation	Remedy is consistent; CPP requirements implemented regardless of selected remedy
Environmental justice concerns	Remedy is consistent
Land use designations	Remedy is consistent
Populations growth patterns	Remedy is consistent
Accessibility to existing infrastructure	Remedy is consistent
Proximity to cultural resources	None identified
Proximity to natural resources	None identified
Off-Site groundwater impacts	Remedy remediates impacted groundwater. Groundwater will be monitored onsite following implementation of the remedy.
Proximity to floodplains	Site is within the 500 year flood zone.
Geography and geology of the Site	Remedy is consistent
Current Institutional Controls	None currently present

Green remediation principles and techniques will be implemented to the extent feasible in the design, implementation, and site management of the remedy as per DER-31. The major green remediation components are as follows;

- Considering the environmental impacts of treatment technologies and remedy stewardship over the long term;
- Reducing direct and indirect greenhouse gases and other emissions;
- Increasing energy efficiency and minimizing use of non-renewable energy;
- Conserving and efficiently managing resources and materials;
- Reducing waste, increasing recycling and increasing reuse of materials which would otherwise be considered a waste;
- Maximizing habitat value and creating habitat when possible;
- Fostering green and healthy communities and working landscapes which balance ecological, economic and social goals; and,
- Integrating the remedy with the end use where possible.

As part of the remedial design program, to evaluate the remedy with respect to green and sustainable remediation principles, an environmental footprint analysis will be completed and included in the Final Engineering Report (FER). The environmental footprint analysis will be completed using SEFA (Spreadsheets for Environmental Footprint Analysis, USEPA), which is a NYSDEC-accepted tool. Goals for the project related to these green and sustainable remediation metrics, as well as for minimizing community impacts, protecting habitats and natural and cultural resources, and promoting environmental justice, are incorporated into the remedial design program, as appropriate. The project design specifications will include detailed requirements to achieve the green and sustainable remediation goals. Further, progress with respect to green and sustainable remediation metrics will be tracked during implementation of the remedial action and reported in the FER, including a comparison to the goals established during the remedial design program.

Additionally, the remedial design program includes a climate change vulnerability assessment, to evaluate the impact of climate change on the project Site and the proposed remedy. Potential vulnerabilities associated with extreme weather events (e.g., hurricanes, lightning, heat stress, and drought), flooding, and sea level rise will be identified, and the remedial design program will incorporate measures to minimize the impact of climate change on potential identified vulnerabilities. Climate change is not expected to have a significant impact on the remedial systems or engineering controls/institutional controls (ECs/ICs) at the Site. There are no mechanical ECs proposed for the Site, the only EC at the Site is the existing composite cover system, consisting of a concrete slab within the onsite building footprint and asphalt or concrete slabs outside of the building footprint. The primary threat from climate change is likely to be associated with sea level rise. However, since sea level rise is estimated to be approximately 1.4 inches per decade, and the Site is located at an elevation of 27 feet above mean sea level, flooding does not appear to be likely. If the frequency and intensity of storm events increases due to climate change, it is possible that heavy rains could occur more frequently at the Site. However, the Site and surrounding area are generally level and significant amounts of surface water are not known to have accumulated on the ground surface at the Site.

6.0 REMEDIAL ACTION PROGRAM

6.1 Governing Documents

6.1.1 Site Specific Health and Safety Plan

A Site-specific HASP has been created for the Site and is included in Appendix B. All remedial work performed under this plan will be in full compliance with governmental requirements, including Site and worker safety requirements mandated by Federal OSHA. An emergency contact sheet with names and phone numbers is included in Table 1 of the HASP and defines the specific project contacts for use by NYSDEC and NYSDOH in the case of a day or night emergency. The HASP and requirements defined in this RAWP pertain to all remedial and invasive work performed at the Site until the issuance of a Certificate of Completion.

6.1.2 Quality Assurance Project Plan

A Quality Assurance Project Plan (QAPP) has been created for the Site to address quality control and quality assurance procedures for all Site sampling, including post-remedial groundwater sampling, and is included in Appendix C.

6.1.3 Community Air Monitoring Plan

The purpose of the Community Air Monitoring Plan (CAMP) is to protect downwind receptors (e.g., residences, businesses, schools, nearby workers, and the public) from potential airborne contaminants released as a direct result of the Remedial Action being performed at the Site. The Site-Specific CAMP is included in Appendix A.

6.1.4 Citizen Participation Plan

The Citizen Participation Plan (CPP) enables citizens to participate more fully in decisions that affect their health, environment, and social well-being. The CPP was approved by NYSDEC in December 2019 and will be updated throughout the Remedial Action in response to any community feedback. The CPP is included in Appendix D.

6.1.5 Site Operations Plan

The Remedial Engineer is responsible to ensure that all submittals for this remedial project, including contractor and sub-contractor document submittals, are in compliance with this RAWP. All remedial documents will be submitted to NYSDEC and NYSDOH in a timely manner and prior to the start of work.

6.2 General Remedial Construction Information

6.2.1 Project Organization and Emergency Contacts

The following are the principal personnel who will be assist in the management, oversight and completion of this project:

<u>Remedial Engineer</u>
Matthew M. Carroll, PE
1085 Sackett Avenue
Bronx, NY 10461

(917) 510-6767
Tenen Environmental, LLC
121 West 27th Street, Suite 702, New York, NY 10001
(646) 606-2332

- Alana Carroll, Professional Geologist: responsible for overall coordination and management of the project.
- Mohamed Ahmed, Professional Geologist: responsible for quality assurance of sampling procedures and laboratory data.
- Ashley Platt, Environmental Scientist: responsible for the day-to-day field monitoring activities, including injection well installation. Report preparation will be the function of an Environmental Scientist from Tenen.

Subcontractors

Laboratory:
Alpha Analytical, Inc., 8 Walkup Drive in Westborough, MA
(800) 624-9220
NYSDOH Environmental Laboratory Approval Program (ELAP) Certification No. 11148 for solid and hazardous waste

Driller:
AARCO Environmental, 50 Gear Avenue, Lindenhurst, NY 11757
(631) 586-5900

Groundwater Remedy Design and Implementation:
Regenesis®, 1011 Calle Sombra, San Clemente, CA 92673

Data Validation:
L.A.B Validation Corp., 14 West Point Drive, East Northport, NY 11731
(516) 523-7891

Remedial Party:
1946 Holding Corp.
43 Robins Road, New Rochelle, NY 10801
Attn: Frank P. Allegretti, Esq.
914-235-2757

Resumes of key personnel involved in the Remedial Action are presented in the QAPP, included as Appendix C.

6.2.2 Remedial Engineer

The Remedial Engineer (RE) for this project will be Matthew M. Carroll, P.E. The RE is a registered professional engineer (PE) licensed by the State of New York. The RE will have primary direct responsibility for implementation of the remedial program for the 965 Mamaroneck Avenue site (NYSDEC BCA Index No. C360189-12-19; Site No. C360189). The RE will certify in the Final Engineering Report (FER) that the remedial activities were observed by qualified environmental professionals under his supervision and that the remediation requirements set forth in the RAWP and any other relevant provisions of ECL 27-1419 have been achieved in conformance with that Plan. Other RE certification requirements are listed throughout this RAWP.

The RE will coordinate the work of other contractors and subcontractors involved in all aspects of remedial construction, including injection well installation, in-situ chemical injections, and emergency spill response. The RE will be responsible for all appropriate communication with NYSDEC and NYSDOH.

The RE will review all pre-remedial plans submitted by contractors for compliance with this RAWP and will certify compliance in the FER.

6.2.3 Remedial Action Construction Schedule

A general and estimated Remedial Action construction schedule is included in Table 6.

6.2.4 Work Hours

The hours for operation of remedial construction will conform to the New York City Department of Buildings construction code requirements or according to specific variances issued by that agency. NYSDEC will be notified by the Participant of any variances issued by the Department of Buildings. NYSDEC reserves the right to deny alternate remedial construction hours.

6.2.5 Mobilization

Mobilization includes field personnel orientation, equipment mobilization (including CAMP equipment), and utility mark-outs. Each field team member will attend an orientation meeting to become familiar with the general operation of the Site, health and safety requirements, and field procedures. The contractor will mobilize all necessary materials and equipment on Site directly prior to the initiation of any remedial activities. Material staging and equipment decontamination areas will be designated.

6.2.6 Erosion and Sedimentation Controls

Excavation and stockpiling of soil and/or fill material will not take place as part of this RA.

6.2.7 Equipment and Material Staging

All equipment and materials will be stored and staged in a manner that complies with applicable laws and regulations. There will be no specific material or equipment staging area; any staging will be in areas where space permits.

6.2.8 Demobilization

Disturbed areas resulting from remediation activities will be restored or addressed during construction activities. Restoration of disturbed access areas to pre-remediation conditions will include decommissioning any temporary curb supports for equipment access, if applicable.

Equipment decontamination will take place onsite in order to prevent dispersion of any contaminating materials.

All remediation and construction materials will be disposed of in accordance with the applicable rules and regulations. General refuse will be handled in accordance with the rules and regulations of the New York City Department of Sanitation.

6.2.9 Utility Markout and Easement Layout

The Participant and its contractors are solely responsible for the identification of utilities that might be affected by work under the RAWP and implementation of all required, appropriate, or necessary health and safety measures during performance of work under this RAWP. The Participant and its contractors are solely responsible for safe execution of all invasive and other work performed under this RAWP. The Participant and its contractors must obtain any local, State or Federal permits or approvals pertinent to such work that may be required to perform work under this RAWP. Approval of this RAWP by NYSDEC does not constitute satisfaction of these requirements.

6.2.10 Required Permits

A complete list of all local, regional and national governmental permits, certificates or other approvals or authorizations required to perform the remedial and development work is included as Table 5. This list includes a citation of the law, statute or code to be complied with, the originating agency, and a contact name and phone number in that agency. This list will be updated in the FER.

6.2.11 Site Security

Access to the Site will be limited to construction personnel and onsite workers.

6.2.12 Pre-Construction Meeting with NYSDEC

The NYSDEC project manager will be invited to attend a pre-remedial action meeting at the Site with all parties involved in the remedial process prior to implementation of the RAWP.

6.2.13 Estimated Remedial Action Costs

The estimated cost to implement the Remedial Action is approximately $120,000. Additional costs, approximately $140,000, would be incurred for reporting and long-term monitoring. An itemized summary of estimated costs is included as Table 4. This table will be revised based on actual costs and included in the FER.

6.2.14 Deviations from the Remedial Action Plan

During the implementation of the RAWP, any material deviation from the RAWP will be noted and immediately brought to the attention of the RE. The RE or his representative will contact the NYSDEC Project Manager and determine if the deviation necessitates a formal RAWP modification and NYSDEC approval. If no formal RAWP modification is required, the deviation will be noted in the Site reports and explained in the FER.

6.3 Reporting

6.3.1 Daily Reporting

Daily reports will be submitted to the NYSDEC Project Manager by the end of each day following the reporting period and will include:

- An update of progress made during each day;
- Locations of work;

- A figure showing placement of CAMP stations;
- Photographs of Site work completed each day;
- A summary of any and all complaints with relevant details (names, phone numbers);
- A summary of CAMP findings, including excursions, if any; and,
- An explanation of notable Site conditions.

Daily reporting will be conducted during active Site remediation periods including injection well installation.

Daily reports are not intended to be the mode of communication for notification to the NYSDEC of emergencies (accident, spill, etc.), requests for changes to the Remedial Action Plan or other sensitive or time critical information. However, such conditions must also be included in the daily reports. Emergency conditions and changes to the Remedial Action Plan will be addressed directly to NYSDEC Project Manager via personal communication.

Daily reports will include a description of daily activities keyed to a map for the Site that identifies work areas. These reports will include a summary of progress made during the day and any complaints received from the public. All complaints received will immediately be reported to NYSDEC.

The NYSDEC assigned project number will appear on all reports.

6.3.2 Monthly Reporting

Monthly reports will be submitted to NYSDEC Project Manager by the 10th day of the following month and will include:

- Activities relative to the Site during the previous reporting period and those anticipated for the next reporting period;
- Photographs of the work completed during the reporting period;
- Description of approved activity modifications, including changes to work scope and/or schedule;
- Sampling results received following internal data review and validation, as applicable; and,
- An update of the remedial schedule including the percentage of project completion, unresolved delays encountered or anticipated that may affect the future schedule, and efforts made to mitigate such delays.

6.3.3 Other Reporting

Photographs will be taken of all remedial activities and submitted to NYSDEC in digital (JPEG) format. Photos will illustrate all remedial program elements and will be of acceptable quality. Representative photos of the Site prior to any Remedial Actions will be provided. Representative photos will be provided of each contaminant source, source area and Site structures before, during and after remediation. Photos will be included in the daily reports as needed, and a comprehensive collection of photos will be included in the Final Engineering Report.

Job-site record keeping for all remedial work will be appropriately documented. These records will be maintained on-Site at all times during the project and be available for inspection by NYSDEC staff.

7.0 REMEDIAL ACTION IMPLEMENTATION: SOIL REMEDY – MANAGEMENT OF SOIL IN PLACE WITH EXISTING COVER SYSTEM

As discussed in Section 5.3, the components of the remedial action include the management of soil in place beneath the existing cover system at the Site. The existing cover system will be a permanent engineering control for the Site.

No redevelopment is currently proposed for the Site and continued use of the Site for commercial purposes will remain for the foreseeable future. As further described below, the major components of Soil Alternative 2 include management of soil in place under the existing cover system.

7.1 Cover System

Exposure to residual contaminated soil and groundwater would be prevented by the continued maintenance of an existing engineered cover system. The cover system is a permanent Engineering control for the Site. The cover system consists of a four-inch thick building slab, a four-inch thick concrete slab in the southeastern exterior portion of the Site, and two-inches of paved asphalt across the remainder of the Site. The cover system will be inspected and any cracks or openings will be repaired. Any penetrations made through the existing slab during the implementation of the remedial action will be promptly repaired. The extents of the cover system are shown on Figure 8.

7.2 Community Air Monitoring Plan (CAMP)

The main goal of the CAMP is to keep objectionable odors, VOCs and/or particulates from reaching the surrounding community. The NYSDOH Generic CAMP, which includes monitoring for VOCs and particulates, will be implemented during the course of all exterior invasive work (well installation, etc.). CAMP will not be implemented during interior invasive work.

Should objectionable odors be produced during the Remedial Action, the area to be disturbed at any one time will be limited and, if necessary, work will be halted until odors, VOCs and/or particulates have decreased below actionable levels (see CAMP, Appendix A).

7.3 Materials Transport and Disposal Offsite

Soil spoils are not expected to be generated as a result of this Remedial Action. As such, a Soils/Materials Management Plan (SMMP) will not be required. If soil spoils are generated, they will be contained in 55-gallon drums and sampled prior to offsite disposal. All transport and disposal of materials will be performed in accordance with appropriate local, state, and federal regulations.

7.4 Dewatering and Fluids Management

Groundwater at the Site is approximately eight to eleven ft-bg and is not anticipated to be encountered in a way requiring management or disposal during the course of the remedy.

7.5 Import of Materials

Import of material to the Site is not anticipated as part of the Remedial Action, However, if material is imported to Site, it will be in compliance with: (1) the Part 375-6.7(d) and (2) all Federal, State and local rules and regulations for handling and transport of material.

8.0 REMEDIAL ACTION IMPLEMENTATION: GROUNDWATER REMEDY – CHEMICAL TREATMENT

As discussed in Section 5.3, the components of the remedial action to address groundwater impacts includes a combination of chemical injections via the installation of an injection well system in the southeastern portion of the Site to address cVOC and PFAS contamination present in groundwater and ISCO treatment via encapsulated reactant cylinders emplaced into the existing groundwater monitoring well network. PlumeStop®, a colloidal form of activated carbon, will be utilized for the chemical injections. PlumeStop® is designed to physically remove contaminants from the aqueous phase, preventing further migration of the plume and removing the inherent risk associated with dissolved phase contaminants. Potassium permanganate is the oxidant that will be utilized in the encapsulated reactant cylinders. Reagent manufacturer specifications for PlumeStop® and the potassium permanganate encapsulated reactant cylinders are included in Appendix E. The PlumeStop® design summary sheet prepared for the Site by Regenesis® is included in Appendix F.

8.1 Design Verification Testing

Prior to the installation of injection wells, design verification testing (DVT) will be conducted to verify that subsurface conditions at the selected application location match the conditions used in the design prepared by Regenesis®. DVT will include one round of sampling at the Site. Three groundwater samples will be collected from previously installed permanent groundwater monitoring wells MW-3, MW-4S and MW-4D and analyzed for chloride and sulfate anions, dissolved gases (methane, ethene, and ethane), total alkalinity, nitrite-nitrogen, nitrate-nitrogen, sulfide, total organic carbon, oxidant demand, ferrous iron, ferric iron, and total iron. These wells contained the highest cVOC and PFAS concentrations onsite in the shallow (5-15 ft-bg) and intermediate (17-22 ft-bg) aquifer during the most recent sampling event. Given the lithology, soil oxidant demand will be estimated based on soil type.

The objective of DVT is to gain information sufficient to confirm or update the PlumeStop® liquid activated carbon remedial design prepared by Regenesis®. The dosing of the injections and/or addition of injections wells will be updated (if necessary) after completion of DVT.

Site-specific data will be collected in order to confirm and update the following:

- Lateral spacing for injection points;
- The volume and concentration of PlumeStop® liquid activated carbon to be injected; and,
- The potential for rebound of chemical concentrations following one injection of PlumeStop® liquid activated carbon in order to evaluate the solution strength and frequency of additional injections (if needed) during the full-scale implementation.

The DVT will be developed based on Tenen's understanding of the contaminant mass in the groundwater at the Site. The proposed injection area will be selected to target the area of highest PFAS concentrations while also addressing the cVOC concentrations in groundwater across the Site concurrently (see Figure 9 for proposed injection well locations and target treatment area).

8.2 Groundwater Remedy Implementation – In-Situ Chemical Injections

The goal of the in-situ chemical treatment for the Site is to sorb PFAS and cVOC contaminants from groundwater to halt the flow of contaminants and to break down cVOCs into less toxic compounds through biodegredation.

PlumeStop® liquid activated carbon will be utilized to treat PFAS and cVOC contaminants in groundwater. PlumeStop® liquid activated carbon sorbs contaminants from groundwater rapidly (within hours of application). Contaminants partition directly into the PlumeStop® particles that are sorbed to the soil formation, removing the contaminants from groundwater. Once sorbed to the soil and with contaminants partitioned onto its surface, PlumeStop® is colonized by contaminant-degrading bacteria. These bacteria may be naturally present or applied as an inoculum. PlumeStop® essentially halts the flow of contaminants, while still allowing them to be degraded by bacteria, preventing further movement of contaminants in the subsurface.

In general, the chemical treatment will include the advancement of 16 injection wells within the approximately 400 SF treatment area. Each injection well will be screened from eight to 22 ft-bg. Approximately 666 gallons of PlumeStop® will be mixed with 5,870 gallons of water, for a total injection volume of approximately 6,536 gallons of PlumeStop® mixture (409 gallons per injection point). Reagent manufacturer specifications for PlumeStop® are included in Appendix E. The PlumeStop® design summary sheet for the Site is included in Appendix F.

The application of chemical injection, regardless of the method, is considered a Class V Well under the EPA Underground Injection Control (UIC) Program. Class V Wells are "used to inject non-hazardous fluids underground." A UIC Permit will be obtained prior to application of PlumeStop®.

8.3 Groundwater Remedy Implementation – ISCO Encapsulated Reactant Cylinders

The goal of the in-situ chemical oxidation treatment for the Site is to break down contaminant cVOCs into less toxic compounds through the introduction of oxidants into the subsurface via an encapsulated reactant cylinder emplaced into three existing groundwater monitoring wells (MW-3, MW-5S, and MW-7). Each cylinder is 1.35-inches in diameter and is two-feet long, with approximately 2.6 pounds of solid form crystalline particles of the oxidant potassium permanganate, mixed with a benign paraffin wax. The cylinders are manufactured by Hepure and the specifications are included in Appendix E.

Paraffin wax is biodegradable and insoluble in water, but is soluble in chlorinated solvents such as PCE. This results in the potassium permanganate being released very slowly into water from the encapsulating matrix while releasing rapidly into PCE. The release of potassium permanganate is typically characterized by an initial rapid release (less than ten minutes) followed by a sustained release for the remaining life cycle of the cylinder. Two cylinders will be placed in a PVC holder and lowered within the full, saturated screen interval (approximately five feet) of monitoring wells MW-3, MW-5S, and MW-7. Based upon the size of the PCE plume, it is anticipated that cylinders will only need to be placed within these monitoring wells to effectively remediate the Site in combination with the chemical injections detailed in Section 8.2. The cylinders will remain within the wells for their life cycle, other than for sampling (typically between two and five years depending upon the groundwater flow).

8.4 Remedial Performance Evaluation (Post-Remedial Groundwater Sampling)

Post-remedial groundwater sampling will be completed in accordance with a SMP. Post-remedial groundwater sampling will be performed at the Site following the completion of the Remedial Action. The first round of post-remedial groundwater sampling will occur 30 days after the completion of the injections is expected to continue quarterly for a minimum of two years. Prior to implementation of the groundwater remedy, baseline groundwater samples will be collected from the post-remedial groundwater monitoring network. Post-remedial groundwater samples will be collected from a total of twelve existing on- and offsite monitoring wells: two upgradient monitoring wells (MW-11S and MW-11D), five treatment-area monitoring wells (MW-3, MW-4S, MW-4D, MW-5S, and MW-7), and five downgradient monitoring wells (MW-6-C1, MW-6-C2, MW-9, MW-12, and MW-13). Based upon the results of previous sampling conducted as part of the RI, groundwater samples will be analyzed for cVOCs and/or PFAS: monitoring wells MW-3, MW-4S, MW-4D, MW-5S, MW-6-C1, MW-6-C2, MW-7, MW-11S, and MW-11D will be analyzed for both cVOCs and PFAS; monitoring wells MW-9 and MW-12 will be analyzed for PFAS only; and, monitoring well MW-13 will be analyzed for cVOCs only. Proposed post-remedial groundwater monitoring well locations are shown on Figure 10.

A minimum of five rounds of quarterly post-remedial groundwater monitoring will be conducted. If the results of the fourth and fifth rounds of post-remedial groundwater sampling indicate that cVOC concentrations have decreased below applicable standards, NYSDEC will be asked to consider the groundwater remedy complete.

The regulations surrounding PFAS remedial goals and protocols are currently in flux and require additional/ongoing research. Groundwater in the Village and Town of Mamaroneck is not used as a potable (drinking) water source. Tenen is proposing a maximum post remedial monitoring plan showing a PFAS concentration reduction within four quarters, after which the PFAS remedy will be considered complete.

Reporting

Samples will be collected in accordance with the QAPP and results will be reported in quarterly monitoring reports to NYSDEC and in the Annual Report required by the SMP, as detailed in Section 12.2 of this RAWP.

8.5 Data Usability Summary Report (DUSR)

A qualified data validator will prepare a Data Usability Report (DUSR) for all post-remedial groundwater samples collected. The DUSR will be prepared according to the guidelines contained in Appendix 2B of DER-10.

8.6 Monitoring Well Decommissioning

Existing monitoring wells that will not be part of the long-term monitoring will be decommissioned in accordance with NYSDEC Groundwater Monitoring Well Decommissioning Policy (CP-43), dated November 3, 2009.

9.0 RESIDUAL CONTAMINATION TO REMAIN ON-SITE

The successful implementation of the Remedial Action will result in the following:

- Residual contamination will remain in soil and groundwater, but the bulk of the cVOC and PFAS contaminant mass will be removed utilizing the groundwater chemical treatment;
- Soil will be managed in place beneath the existing composite cover system present across the Site;
- Groundwater will be treated using chemical treatments with a design goal of meeting the Class GA Standards for cVOCs and PFAS.

Since residual contaminated soil and groundwater may remain after the remedy is complete, Engineering and Institutional Controls (ECs and ICs) are required to protect human health and the environment. Long-term management of ECs/ICs and of residual contamination will be executed under a Site-specific SMP that will be developed and included in the FER. Any future proposed redevelopment or soil disturbance activated will be performed in accordance with the Soil Excavation Plan, included as part of the SMP.

ECs will be implemented to protect public health and the environment by appropriately managing residual contamination. The Controlled Property (the Site) will have four primary EC systems. This is:

- Cover System (currently existing); and,
- Post-Remedial Groundwater Monitoring.

The cover system would be a long-term EC. While post-remedial groundwater monitoring is part of the selected remedy, it is presented as an EC because it will continue after the FER and SMP are submitted. The FER will report residual contamination on the Site in tabular and map form, including any exceedances of the Class GA Standards.

10.0 ENGINEERING CONTROLS

10.1 Engineering Control Systems

As discussed above, two engineering controls (ECs) will be utilized at the Site: a cover system and post-remedial groundwater monitoring. The ECs will be memorialized in an Environmental Easement assigned to the property by the titleholder and will be implemented under a SMP. The post-remedial groundwater monitoring is considered an EC only because it will be implemented following submittal of the FER. The conceptual approach, general system design, maintenance and monitoring (OM&M) requirements and criteria for termination of each of these systems are described below.

10.1.1 Description of Engineering Controls

10.1.1.1 Cover System

Exposure to residual contaminated soil, groundwater, and soil vapor would be prevented by the continued maintenance of an existing engineered cover system. The cover system consists of a four-inch thick building slab, a four-inch thick concrete slab in the southeastern portion of the Site, and 2-inches of paved asphalt across the remainder of the Site. As part of the remedial action, the composite cover will be inspected and any cracks or openings will be repaired. Any penetrations made through the existing slab during the implementation of the remedial action will be promptly repaired.

The locations of the existing cover system is shown on Figure 7. The SMP will outline the procedures required in the event the cover system and underlying residual contamination are disturbed and planned inspections of the cover system.

10.1.1.2 Post-Remedial Groundwater Monitoring

Elevated levels of cVOCs and PFAS have been detected in the groundwater at the Site. Residual contaminants may remain following implementation of the remedial action and, if necessary, the groundwater will be treated with additional injections of chemicals to destroy the bulk of any remaining contaminants.

Groundwater will be monitored by sampling existing permanent monitoring wells as shown on Figure 10. Post-remedial groundwater samples will be collected from a total of twelve existing on- and offsite monitoring wells as part of each monitoring event: two upgradient monitoring wells (MW-11S and MW-11D), five treatment-area monitoring wells (MW-3, MW-4S, MW-4D, MW-5S, and MW-7), and five downgradient monitoring wells (MW-6-C1, MW-6-C2, MW-9, MW-12, and MW-13).

Post-remedial groundwater monitoring will begin approximately 30 days after the first groundwater injection. Prior to implementation of the groundwater remedy, baseline groundwater samples will be collected from the post-remedial groundwater monitoring network. All sampling equipment will be decontaminated prior to use. Prior to sampling, water levels will be measured using an electronic product-water level indicator. Samples will be collected using low-flow techniques in accordance with EPA Region 1 Low-Stress (Low-Flow) Purging and Sampling Procedures for the Collection of Groundwater Samples from Monitoring Wells (EQASOP-GW 001 Revision 3 dated July 30, 1996 Revised: January 19, 2010).

Long-term monitoring (quarterly for a minimum of five quarters) of the groundwater will be conducted to determine the efficacy of the Remedial Action. Based upon the results of previous sampling conducted as part of the RI, groundwater samples will be analyzed for cVOCs and/or PFAS: monitoring wells MW-3, MW-4S, MW-4D, MW-5S, MW-6-C1, MW-6-C2, MW-7, MW-11S, and MW-11D will be analyzed for both cVOCs and PFAS; monitoring wells MW-9 and MW-12 will be analyzed for PFAS only; and, monitoring well MW-13 will be analyzed for cVOCs only.

10.2 Criteria for Termination of Remedial Systems

10.2.1 Cover System

The cover system is a long-term EC and will be maintained throughout the life of the building. Any breaches of the cover system will be repaired in accordance with the SMP.

10.2.2 Post-Remedial Groundwater Monitoring

Groundwater monitoring to assess the efficacy of the Remedial Action is planned for a minimum of five quarters after the completion of the Remedial Action.

Monitoring will continue until permission to discontinue is granted in writing by NYSDEC and NYSDOH. Monitoring activities will be outlined in the SMP.

11.0 INSTITUTIONAL CONTROLS

An Institutional Control (IC) will be required to manage residual contamination onsite and to ensure that the Site ECs remain protective of public health and the environment. The ICs consist of two elements designed to ensure continual and proper management of residual contamination in perpetuity: an Environmental Easement and a Site Management Plan.

A Site-specific Environmental Easement, as defined in Article 71 Title 36 of the Environmental Conservation Law, will be recorded with Westchester County to provide an enforceable means of ensuring the continual and proper management of residual contamination and protection of public health and the environment in perpetuity or until released in writing by NYSDEC. It requires that the grantor of the Environmental Easement and the grantor's successors and assigns adhere to all Engineering and Institutional Controls (ECs/ICs) placed on this Site by this NYSDEC-approved remedy. ICs provide restrictions on Site usage and mandate operation, maintenance, monitoring, and reporting measures for all ECs and ICs. The SMP describes appropriate methods and procedures to ensure compliance with all ECs and ICs that are required by the Environmental Easement. Once the SMP has been approved by the NYSDEC, compliance with the SMP is required by the grantor of the Environmental Easement and grantor's successors and assigns.

11.1 Environmental Easement

The Environmental Easement renders the Site a Controlled Property. The Environmental Easement must be recorded with the Queens County Office of the City Register before the Certificate of Completion can be issued by NYSDEC. A series of Institutional Controls are required under this remedy to implement, maintain, and monitor these Engineering Control systems, prevent future exposure to residual contamination by controlling disturbances of the subsurface soil and restricting the use of the Site to commercial or industrial use(s) only. These Institutional Controls are requirements or restrictions placed on the Site that are listed in, and required by, the Environmental Easement. Institutional Controls can, generally, be subdivided between controls and support Engineering Controls, and those that place general restrictions on Site usage or other requirements. Institutional Controls in both of these groups are closely integrated with the Site Management Plan, which provides all of the methods and procedures to be followed to comply with this remedy.

The Institutional Controls that support Engineering Controls are:

- Compliance with the Environmental Easement by the Grantee and the Grantee's successors and adherence of all elements of the SMP is required;
- All Engineering Controls must be operated and maintained as specified in the SMP;
- All Engineering Controls on the Controlled Property must be inspected and certified at a frequency and in a manner defined in the SMP;
- Groundwater and other environmental or public health monitoring must be performed as defined in the SMP;
- Data and information pertinent to Site Management for the Controlled Property must be reported at the frequency and in a manner defined in the SMP;
- Onsite environmental monitoring devices, including but not limited to groundwater monitoring wells, must be protected and replaced as necessary to ensure proper functioning in the manner specified in the SMP; and
- Engineering Controls may not be discontinued without an amendment or extinguishment of the Environmental Easement.

Adherence to the Institutional Controls for the Site is mandated by the Environmental Easement and will be implemented under the Site Management Plan (discussed in the next section). The Controlled Property (Site) will also have a series of Institutional Controls in the form of Site restrictions and requirements. The Site restrictions that apply to the Controlled Property are:

- Use of groundwater underlying the Controlled Property is prohibited without treatment rendering it safe for intended purpose;
- All future activities on the Controlled Property that will disturb residual contaminated material are prohibited unless they are conducted in accordance with the soil management provisions in the Site Management Plan;
- The Controlled Property may be used for commercial or industrial use only, provided the long-term Engineering and Institutional Controls included in the Site Management Plan are employed;
- The Controlled Property may not be used for a higher level of use, such as unrestricted use without an amendment or extinguishment of the Environmental Easement;
- Grantor agrees to submit to NYSDEC a written statement that certifies, under penalty of perjury, that: (1) controls employed at the Controlled Property are unchanged from the previous certification or that any changes to the controls were approved by the NYSDEC; and (2) nothing has occurred that impairs the ability of the controls to protect public health and environment or that constitutes a violation or failure to comply with the SMP. NYSDEC retains the right to access such Controlled Property at any time in order to evaluate the continued maintenance of any and all controls. This certification shall be submitted annually, or at an alternate period of time that NYSDEC may allow. This annual statement must be certified by an expert that the NYSDEC finds acceptable.

The Environmental Easement will incorporate the ICs required to implement, maintain, and monitor the ECs, prevent future exposure to residual contamination by controlling disturbances of the subsurface soil and restrict the use of the Site to commercial and industrial uses only, unless discontinued or modified with the approval of NYSDEC.

The Environmental Easement for the Controlled Property will include the following requirements:

- Requires the remedial party or Site owner to complete and submit to NYSDEC a periodic certification of institutional and engineering controls in accordance with Part 375-1.8 (h)(3);
- Allow the use and development of the Controlled Property for commercial and industrial uses as defined in Part 375-1.8(g), although land use is subject to local zoning laws;
- Restricts the use of groundwater as a source of potable or process water, without necessary water quality treatment as determined by the NYSDOH or the New York City Department of Health (NYCDOH); and
- Require compliance with the NYSDEC-approved SMP.

11.2 Site Management Plan

Site Management is the last phase of remediation and begins with the approval of the Final Engineering Report and issuance of the Certificate of Completion (COC) for the Remedial Action. The SMP is submitted as part of the FER, but will be written as a complete and independent document. Site management requirements continue in perpetuity or until released in writing by NYSDEC. The property owner is responsible to ensure that all Site management responsibilities defined in the Environmental Easement and SMP are performed.

The SMP must include methods to incorporate and track Green Site Remediation (GSR). Measures should be taken to maintain a cost-effective, protective remedy that remains conscious of the Site's environmental footprint. At a minimum, the following will be assessed: waste generation, energy usage, emissions, and water usage.

The SMP is intended to provide a detailed description of the procedures required to manage residual contamination left in place at the Site following completion of the Remedial Action in accordance with the BCA with the NYSDEC. This includes: (1) development, implementation, and management of all Engineering and Institutional Controls; (2) development of a plan to operate and maintain any treatment, collection, containment, or recovery systems (including, where appropriate, preparation of an Operation and Maintenance Manual; and (3) submittal of Site Management Reports, performance of inspections and certification of results, and demonstration of proper communications of Site information to NYSDEC.

To address these needs, this SMP will include four plans: (1) an Engineering and Institutional Control Plan for implementation and management of EC/ICs; (2) a Monitoring Plan for implementation of Site monitoring; (3) an Operation and Maintenance (O&M) Plan for implementation of remedial containment systems; and (4) a Site Management Reporting Plan for submittal of data, information, recommendations, and certifications to NYSDEC.

Site management activities, reporting, and EC/IC certification will be scheduled on a certification period basis. The certification period will be annually. The Periodic Review Report (PRR) submitted under the SMP will be based on a calendar year. The first PRR will be submitted to the NYSDEC within 15 months after the date of COC issuance. Any lapses in the engineering or institutional controls noted in the PRR will be required to be corrected expeditiously and the NYSDEC notified of the correction. The SMP will include the following:

1. Introduction with purpose, summary of remediation, and Site conditions;
2. Institutional and Engineering Control Plan;
3. O&M Plan;
4. Site Monitoring Plan;
5. Site maintenance requirements;
6. Citizen Participation Plan;
7. Personnel organization and responsibilities;
8. Health and Safety Plan;
9. Records and forms;
10. Emergency Contingency Plan; and
11. Copies of Environmental Easement and applicable Site plans, including electronic versions.

The Institutional and Engineering Control Plan will include, but is not limited to:

- Descriptions of the provisions of the environmental easement including any land use and groundwater use restrictions;
- A provision for evaluation of the potential for soil vapor intrusion for any buildings developed on the Site, including a provision for implementing actions recommended to address exposures related to soil vapor intrusion;
- Provisions for the management and inspection of the identified engineering controls; and
- Maintaining Site access controls and NYSDEC notification; and the steps necessary for the periodic reviews and certification of the institutional and/or engineering controls.

The O&M Plan will include, but is not limited to:

- Compliance monitoring of treatment systems to ensure proper O&M as well as providing the data for any necessary permit or permit equivalent reporting;
- Maintaining Site access controls for Department notification; and
- Providing NYSDEC access to the Site and O&M records.

The Site Monitoring Plan will include, but is not limited to:

- Monitoring of groundwater to assess the performance and effectiveness of the remedy; and
- A schedule of monitoring and frequency of submittals to NYSDEC.

The Site Management Reporting Plan will include, but is not limited to:

- Details regarding post-COC reporting requirements, including a schedule; and
- The contents of the annual report; including:
    - An evaluation of the ECs/ICs, EC/IC certifications, results of periodic Site inspections and deliverable to be generated;
    - Frequency and type of the EC/IC and Site inspections;
    - Inspection forms, sampling data, and maintenance reports;
    - An evaluation of records and reporting; and
    - Corrective measure plans.

12.0 FINAL ENGINEERING REPORT

A Final Engineering Report (FER) will be submitted to the NYSDEC Project Manager within 90 days of completing the remedial action. The FER provides the documentation that the remedial work required under this RAWP has been completed and has been performed in compliance with this plan. The FER will provide a comprehensive account of the locations and characteristics of all material removed from the Site including the surveyed map(s) of all sources. The Final Engineering Report will include as-built drawings for all constructed elements, calculation and manufacturer documentation for treatment systems, certifications, manifests, bills of lading as well as the complete Site Management Plan (formerly the Operation and Maintenance Plan). The FER will provide a description of the changes in the Remedial Action from the elements provided in the RAWP. The FER will provide a tabular summary of all performance evaluation sampling results and all material characterization results and other sampling and chemical analysis performed as part of the Remedial Action. The FER will provide test results demonstrating that all mitigation and remedial systems are functioning properly. The FER will be prepared in conformance with DER-10.

The Final Engineering Report will include written and photographic documentation of all remedial work performed under this remedy. Photographs will be taken of all remedial activities and submitted to NYSDEC in digital format after completion of active Site remediation. Photos will illustrate all remedial program elements and will be of acceptable quality. Representative photos of the Site prior to any Remedial Actions will be provided. Representative photos will be provided of each contaminant source, source area and Site structures before, during and after remediation. Photos will be submitted to NYSDEC on CD or other acceptable electronic media and will be sent to NYSDEC's Project Manager (2 copies) and to NYSDOH's Project Manager (1 copy). Each CD will have a label and a general file inventory structure that separates photos into directories and sub-directories according to logical Remedial Measure components. A photo log keyed to photo file ID numbers will be prepared to provide explanation for all representative photos.

The FER will include an itemized tabular description of actual costs incurred during all aspects of the Remedial Action.

The FER will provide a thorough summary of all remaining contamination left on the Site after the remedy is complete. Remaining contamination includes all contamination that exceeds the Track 2 Restricted Commercial Use SCOs in 6NYCRR Part 375-6. A table that shows exceedances of the above referenced SCOs for all soil/fill remaining at the Site after the Remedial Action and a map that shows the location and summarizes the exceedances for all soil/fill remaining at the Site after the Remedial Action will be included in the FER.

The Final Engineering Report will include an accounting of the destination of all material removed from the Site, including excavated contaminated soil, historic fill, solid waste, hazardous waste, non-regulated material, and fluids. Documentation associated with disposal of all material must also include records and approvals for receipt of the material. It will provide an accounting of the origin and chemical quality of all material imported onto the Site.

This FER will include the following:

1. Certification by the RE that the data generated is useable and meets the remedial requirements;
2. Certification by the RE that any financial assurance mechanisms required by the NYSDEC have been executed;
3. Certification by the RE that the remedial work conformed to the RAWP;
4. Certification by the RE that dust, odor, and vapor control measures were implemented during invasive work and conformed with the RAWP;

5. Certification by the RE that all the remedial waste was transported and disposed in accordance with the RAWP;
6. Certification by the RE that the source approval and sampling of imported acceptable fill was completed in a manner consistent with the methodology of the RAWP;
7. Summary of the remedy and all remedial actions completed;
8. Description of any problems encountered and their resolutions;
9. Description of the deviations from the approved RAWP;
10. Listing of waste streams, quantity of materials disposed, and where they were disposed;
11. Analytical QA/QC completed for the environmental media sampling during the remedial activities, including DUSR or other data validation;
12. List of the remediation standards applied to the remedial actions;
13. List of all applicable local, regional, and national governmental permits, certificates, or other approvals required for the remedial and development work;
14. Tables and figures containing all pre- and post-remedial data, including volumes of soil removed (as applicable);
15. Description of source and quality of fill (as applicable);
16. "As-built" drawings including remediation areas;
17. Air quality and dust monitoring data, including any supporting documentation on the decisions made based on the data;
18. Copies of all the submitted periodic reports; and
19. Copies of all manifests of off-site transport of waste material.

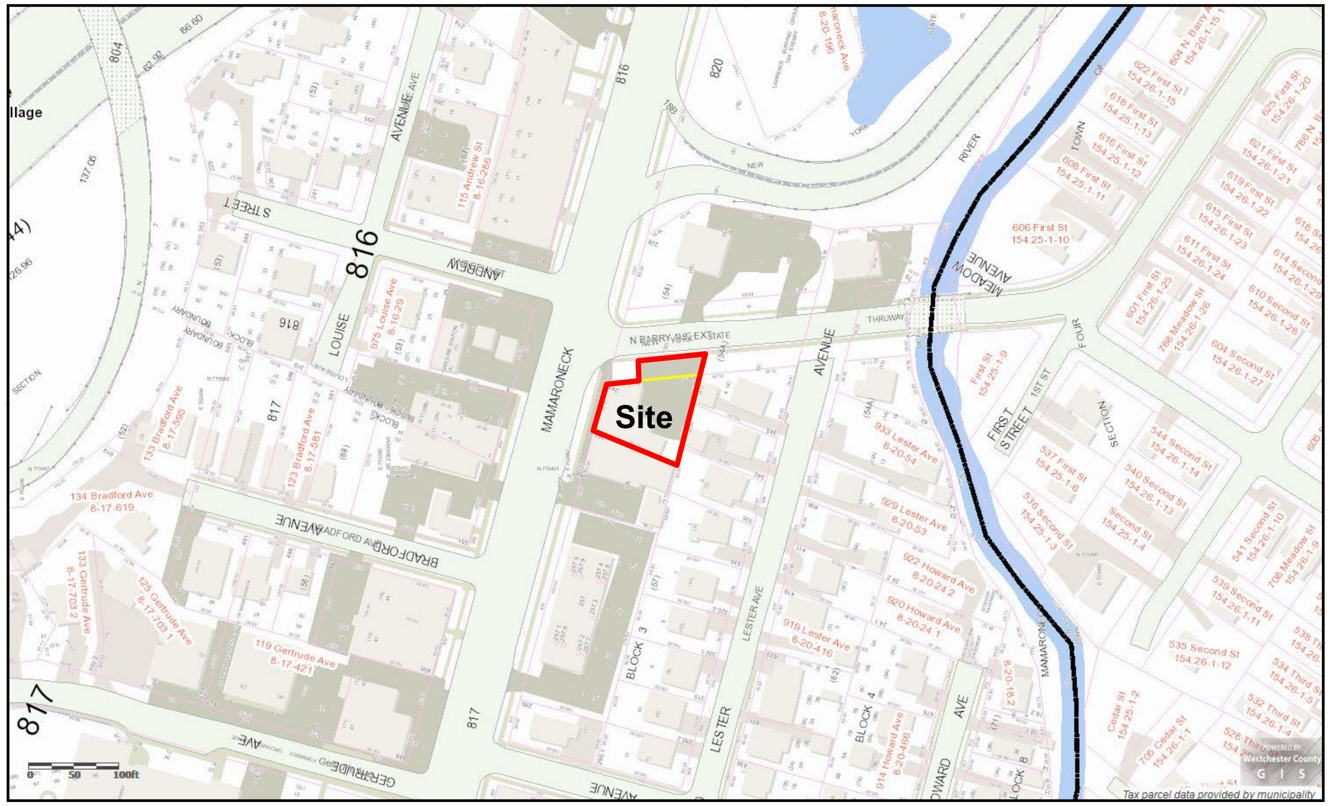
Before approval of a FER and issuance of a Certificate of Completion, all documents and reports will be submitted to the NYSDEC will be in both hard copy and in digital format on CD. These digital documents shall be in PDF form and, where appropriate, supplemented by photos and Microsoft Excel files. Laboratory analytical data will be submitted in an electronic data deliverable (EDD) format that complies with the NYSDEC's electronic data warehouse standards.

Figures

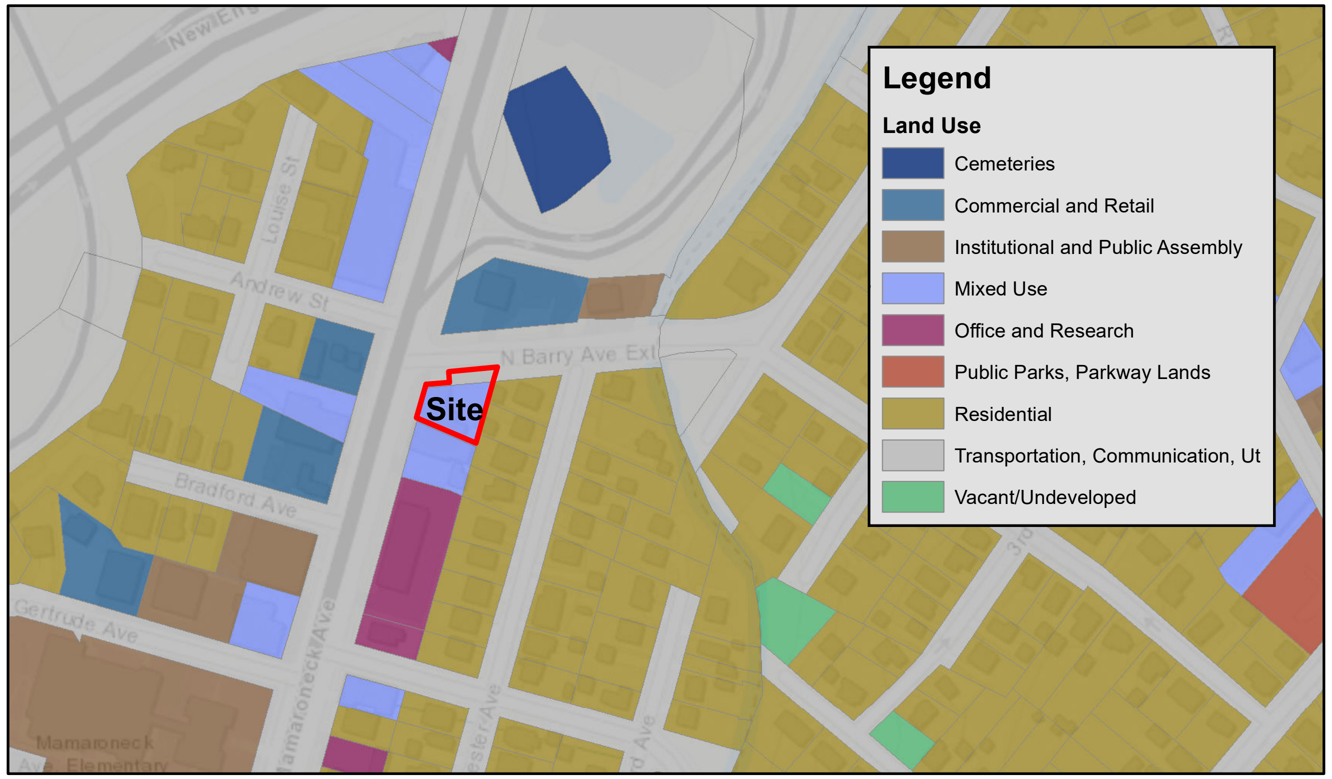
Basemap: ESRI World Topo Map

Site Location

0 1,000 2,000 4,000 Feet



Municipal Tax Parcel Viewer
Westchester County Geographic Information Systems



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
NYC Department of City Planning, Information Technology Division

Westchester County Dept. of Planning Parcel Based Land Use

0 150 300 600 Feet

Site

Remedial Action Work Plan
965 Mamaroneck Avenue
Mamaroneck, New York
BCP Site No. C360189

TENEN ENVIRONMENTAL

Tenen Environmental, LLC
121 West 27th Street
Suite 702
New York, NY 10001
O: (646) 606-2332
F: (646) 606-2379

Drawn By	LM
Checked By	AP
Date	April 2020
Scale	As Noted

Drawing Title
Site Location Map

Drawing No
Figure 1

Service Layer Credits: NYS ITS GIS Program Office

Site

Remedial Action Work Plan
965 Mamaroneck Avenue
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Tenen Environmental, LLC
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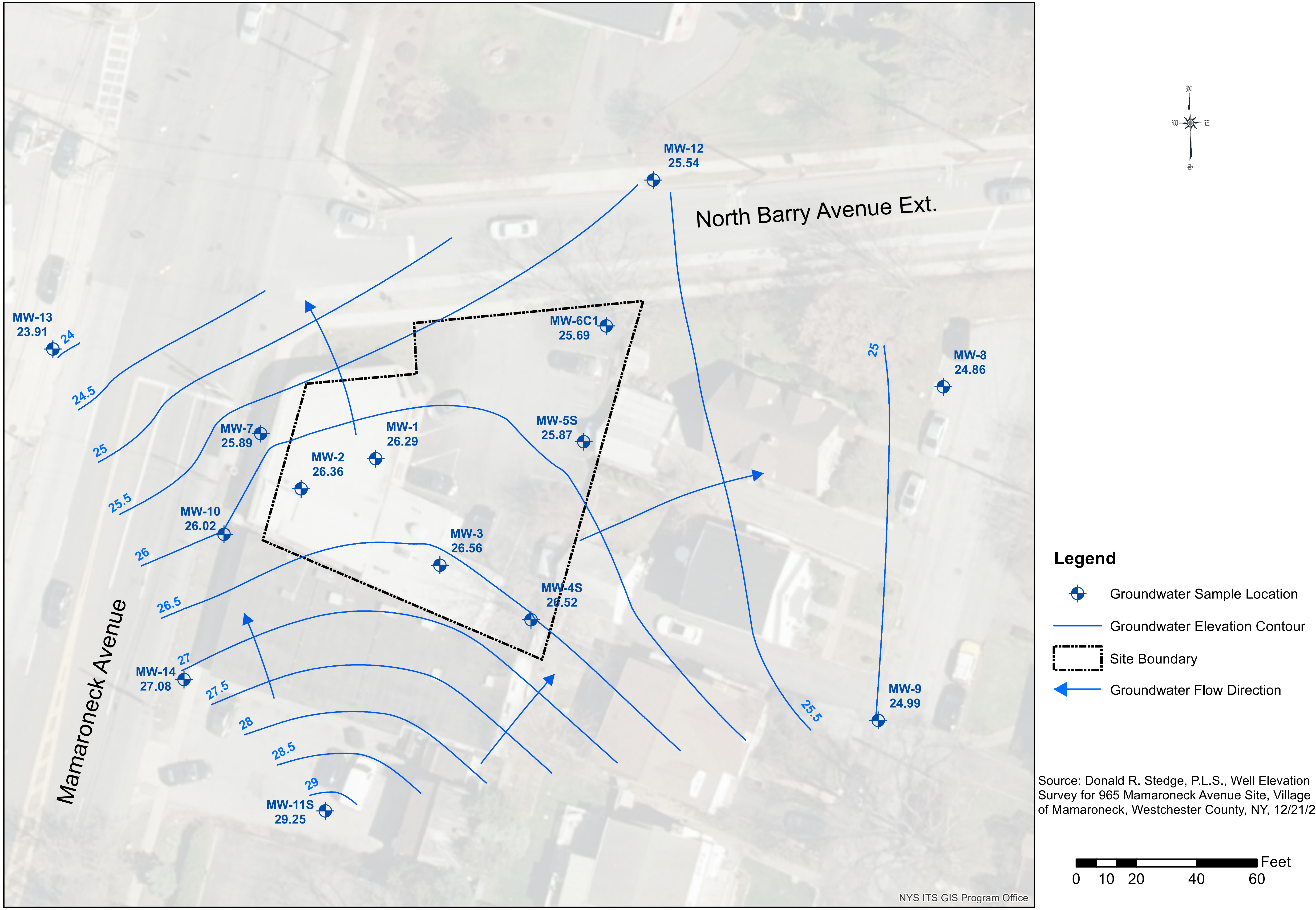
Suite 702
New York, NY 10001
O: (646) 606-2332
F: (646) 606-2379

Drawn By	LM
Checked By	AP
Date	December 2022
Scale	As Noted

Drawing Title
Site Plan

Drawing No
Figure 2



Source: Donald R. Stedge, P.L.S., Well Elevation Survey for 965 Mamaroneck Avenue Site, Village of Mamaroneck, Westchester County, NY, 12/21/20

Site

Remedial Action Work Plan
965 Mamaroneck Avenue
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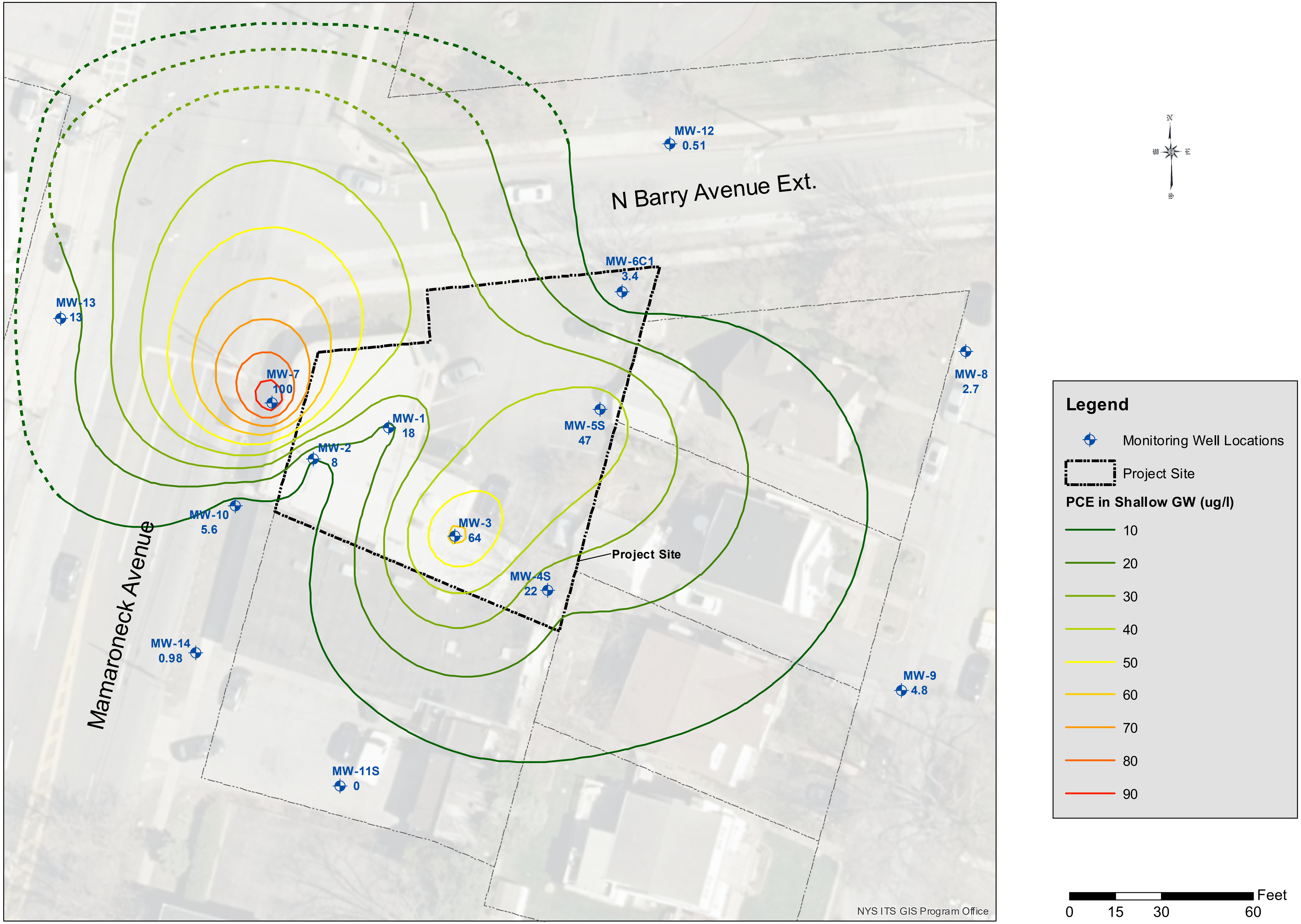
Tenen Environmental, LLC
121 West 27th Street
Suite 702
New York, NY 10001
O: (646) 606-2332
F: (646) 606-2379

Drawn By	LM
Checked By	AP
Date	December 2020
Scale	As Noted

Drawing Title
Groundwater Flow Direction
December 2020

Drawing No
Figure 3



Site

Remedial Action Work Plan
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Mamaroneck, New York
BCP Site No. C360189

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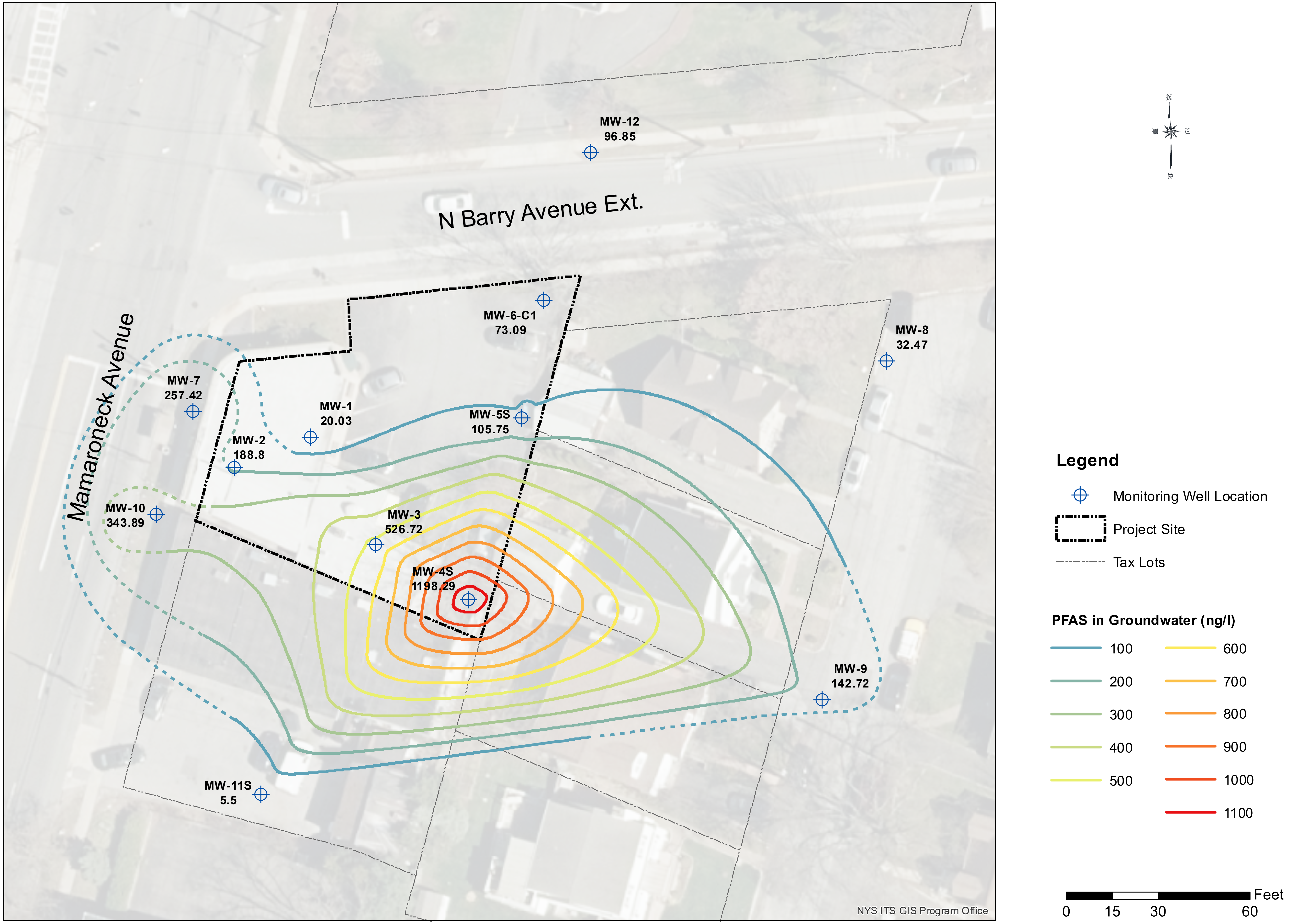
Tenen Environmental, LLC
121 West 27th Street
Suite 702
New York, NY 10001
O: (646) 606-2332
F: (646) 606-2379

Drawn By	Checked By	Date	Scale
LM	AP	February 2023	As Noted

Drawing Title
PCE in Shallow Groundwater Isopleth

Drawing No
Figure 4



Site

Remedial Action Work Plan
965 Mamaroneck Avenue
Mamaroneck, New York
BCP Site No. C360189

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Tenen Environmental, LLC
121 West 27th Street
Suite 702
New York, NY 10001
O: (646) 606-2332
F: (646) 606-2379

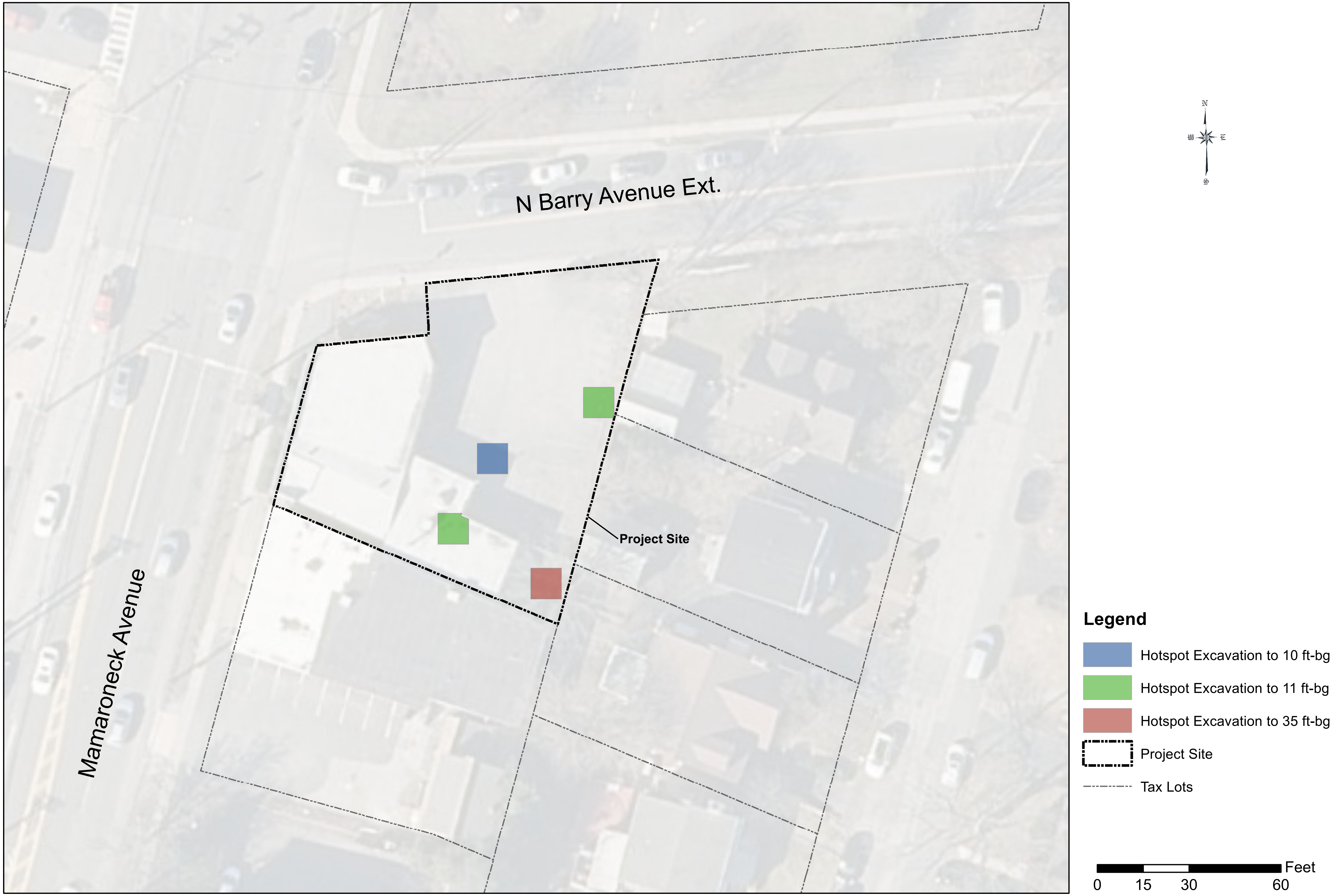
Drawn By	Checked By	Date	Scale
LM	AP	February 2023	As Noted

Drawing Title

PFAS in Groundwater Isopleth

Drawing No

Figure 5



Service Layer Credits: NYS ITS GIS Program Office

Site

Remedial Action Work Plan
965 Mamaroneck Avenue
Mamaroneck, New York
BCP Site No. C360189

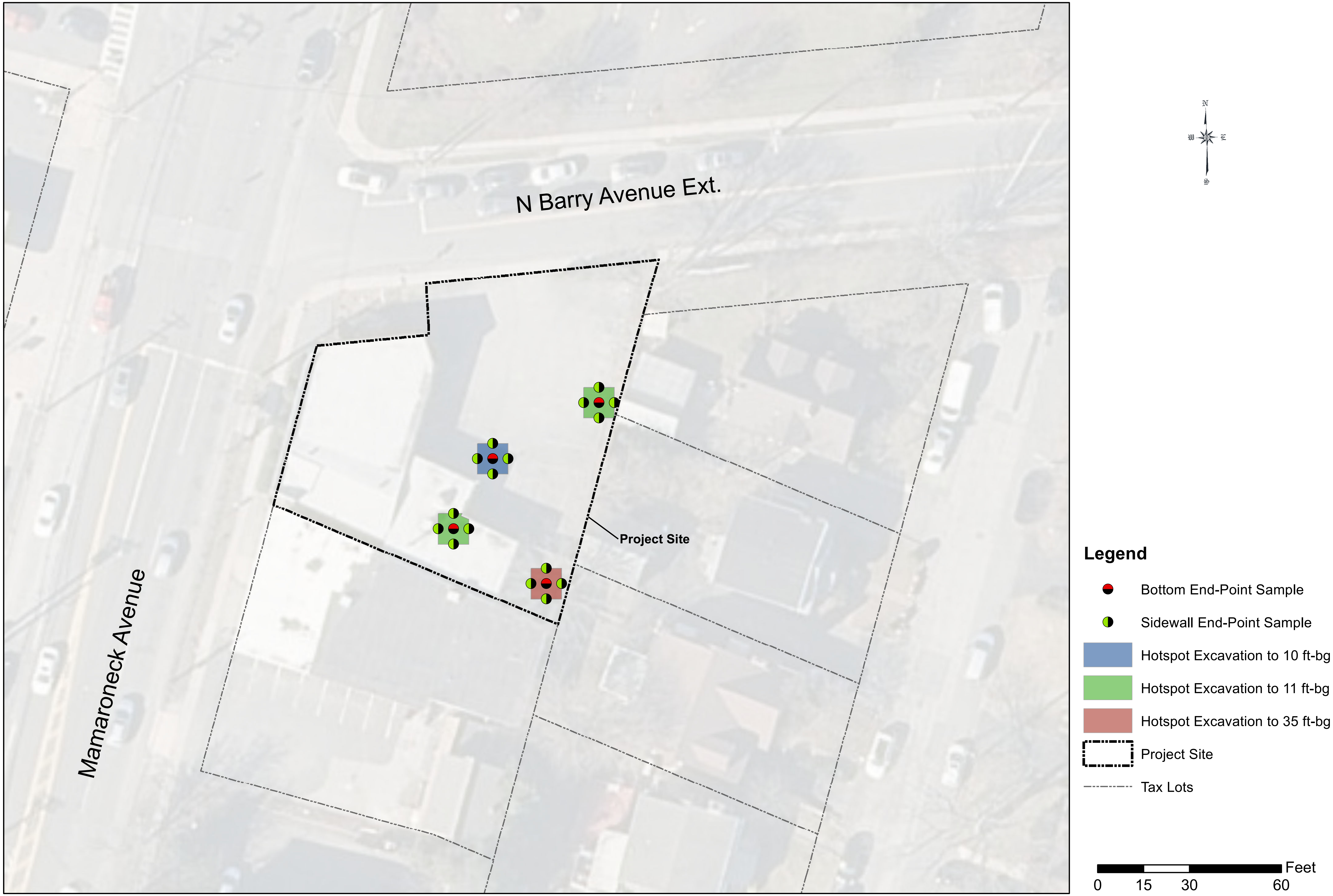
TENEN ENVIRONMENTAL

Tenen Environmental, LLC
121 West 27th Street
Suite 702
New York, NY 10001
O: (646) 606-2332
F: (646) 606-2379

Drawn By	LM
Checked By	AP
Date	December 2022
Scale	As Noted

Drawing Title
Proposed Remedial Excavation Extent (Alternative 1)

Drawing No
Figure 6



Service Layer Credits: NYS ITS GIS Program Office

Site

Remedial Action Work Plan
965 Mamaroneck Avenue
Mamaroneck, New York
BCP Site No. C360189

TENEN ENVIRONMENTAL

Tenen Environmental, LLC
121 West 27th Street
Suite 702
New York, NY 10001
O: (646) 606-2332
F: (646) 606-2379

Drawn By	Checked By	Date	Scale
LM	AP	December 2022	As Noted

Drawing Title
Proposed End-Point Sample Locations (Alternative 1)

Drawing No
Figure 7

Service Layer Credits: NYS ITS GIS Program Office

Site

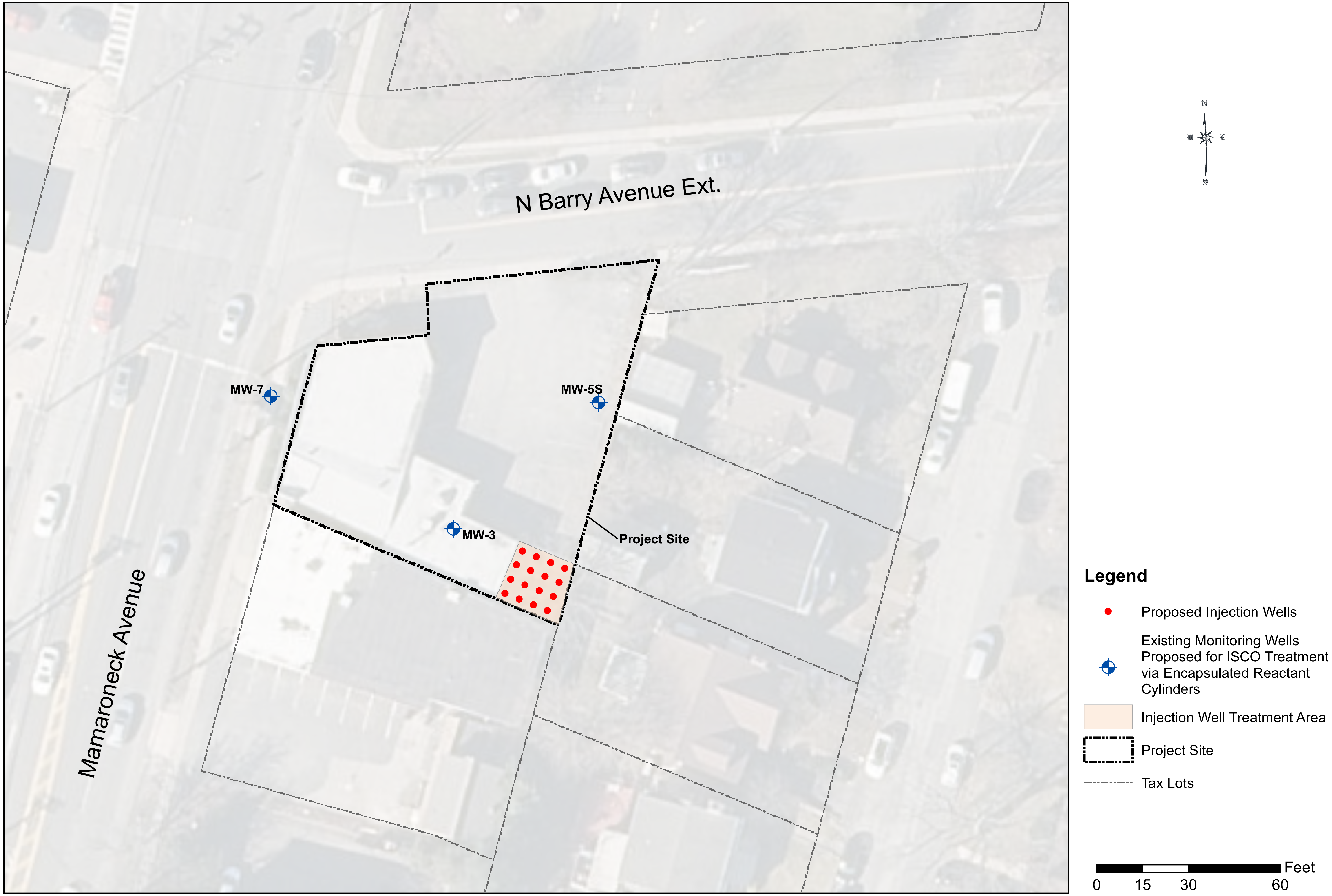
Remedial Action Work Plan
965 Mamaroneck Avenue
Mamaroneck, New York
BCP Site No. C360189

Tenen Environmental, LLC
121 West 27th Street
Suite 702
New York, NY 10001
O: (646) 606-2332
F: (646) 606-2379

Drawn By	LM
Checked By	AP
Date	December 2022
Scale	As Noted

Drawing Title
Composite Cover System Locations

Drawing No
Figure 8



Service Layer Credits: NYS ITS GIS Program Office

Site
Remedial Action Work Plan
965 Mamaroneck Avenue
Mamaroneck, New York
BCP Site No. C360189

TENEN ENVIRONMENTAL
Tenen Environmental, LLC
121 West 27th Street
Suite 702
New York, NY 10001
O: (646) 606-2332
F: (646) 606-2379

Drawn By LM
Checked By AP
Date September 2023
Scale As Noted

Drawing Title
Proposed Groundwater Remedy

Drawing No
Figure 9

Service Layer Credits: NYS ITS Geospatial Services

Notes:

1. Monitoring wells MW-3, MW-4S, MW-4D, MW-5S, MW-6-C1, MW-6-C2, MW-7, MW-11S, and MW-11D will be analyzed for cVOCs and PFAS.
2. Monitoring wells MW-9 and MW-12 will be analyzed for PFAS only.
3. Monitoring well MW-13 will be analyzed for cVOCs only.

Legend

●	Post-Remedial Groundwater Sample Locations
▭	Project Site
-·-·-	Tax Lots

0 15 30 60 Feet

Site

Remedial Action Work Plan
965 Mamaroneck Avenue
Mamaroneck, New York
BCP Site No. C360189

TENEN ENVIRONMENTAL

Tenen Environmental, LLC
121 West 27th Street
Suite 702
New York, NY 10001
O: (646) 606-2332
F: (646) 606-2379

Drawn By LM

Checked By AP

Date May 2024

Scale As Noted

Drawing Title

Proposed Post Remedial Groundwater Sample Locations

Drawing No

Figure 10

Tables

Table 1.
Unrestricted Use Soil Cleanup Objectives
Remedial Action Work Plan
965 Mamaroneck Avenue
BCP #C360189

From Table 375-6.8(a) Unsrestricted Use Soil Cleanup Objectives

Contaminant	CAS Number	SCO
Metals		
Arsenic	7440-38-2	13[c]
Barium	7440-39-3	350[c]
Beryllium	7440-41-7	7.2
Cadmium	7440-43-9	2.5[c]
Chromium, hexavalent[e]	18540-29-9	1[b]
Chromium, trivalent[e]	16065-83-1	30[c]
Copper	7440-50-8	50
Total Cyanide[e,f]		27
Lead	7439-92-1	63[c]
Manganese	7439-96-5	1,600[c]
Total Mercury		0.18[c]
Nickel	7440-02-0	30
Selenium	7782-49-2	3.9[c]
Silver	7440-22-4	2
Zinc	7440-66-6	109[c]
PCBs/Pesticides		
2,4,5-TP Acid (Silvex)[f]	93-72-1	3.8
4,4'-DDE	72-55-9	0.0033[b]
4,4'-DDT	50-29-3	0.0033[b]
4,4'-DDD	72-54-8	0.0033[b]
Aldrin	309-00-2	0.005[c]
alpha-BHC	319-84-6	0.02
beta-BHC	319-85-7	0.036
Chlordane (alpha)	5103-71-9	0.094
delta-BHC[g]	319-86-8	0.04
Dibenzofuran[f]	132-64-9	7
Dieldrin	60-57-1	0.005[c]
Endosulfan I[d,f]	959-98-8	2.4
Endosulfan Ii[d,f]	33213-65-9	2.4
Endosulfan sulfate[d,f]	1031-07-8	2.4
Endrin	72-20-8	0.014
Heptachlor	76-44-8	0.042
Lindane	58-89-9	0.1
Polychlorinated biphenyls	1336-36-3	0.1

Contaminant	CAS Number	SCO
Semivolatiles		
Acenaphthene	83-32-9	20
Acenapthylene[f]	208-96-8	100[a]
Anthracene[f]	120-12-7	100[a]
Benz(a)anthracene[f]	56-55-3	1[c]
Benzo(a)pyrene	50-32-8	1[c]
Benzo(b)fluoranthene[f]	205-99-2	1[c]
Benzo(g,h,i)perylene[f]	191-24-2	100
Benzo(k)fluoranthene[f]	207-08-9	0.8[c]
Chrysene[f]	218-01-9	1[c]
Dibenz(a,h)anthracene[f]	53-70-3	0.33[b]
Fluoranthene[f]	206-44-0	100[a]
Fluorene[f]	86-73-7	30
Indeno(1,2,3-cd)pyrene[f]	193-39-5	0.5[c]
m-Cresol[f]	108-39-4	0.33[b]
Naphthalene[f]	91-20-3	12
o-Cresol[f]	95-48-7	0.33[b]
p-Cresol[f]	106-44-5	0.33[b]
Pentachlorophenol	87-86-5	0.8[b]
Phenanthrene[f]	85-01-8	100
Phenol	108-95-2	0.33[b]
Pyrene[f]	129-00-0	100
Volatiles		
1,1,1-Trichloroethane[f]	71-55-6	0.68
1,1-Dichloroethane[f]	75-34-3	0.27
1,1-Dichloroethene[f]	75-35-4	0.33
1,2-Dichlorobenzene[f]	95-50-1	1.1
1,2-Dichloroethane	107-06-2	0.2[c]
cis-1,2-Dichloroethene[f]	156-59-2	0.25
trans-1,2-Dichloroethene[f]	156-60-5	0.19
1,3-Dichlorobenzene[f]	541-73-1	2.4
1,4-Dichlorobenzene	106-46-7	1.8
1,4-Dioxane	123-91-1	0.1[b]
Acetone	67-64-1	0.05
Benzene	71-43-2	0.06
n-Butylbenzene[f]	104-51-8	12
Carbon tetrachloride[f]	56-23-5	0.76
Chlorobenzene	108-90-7	1.1
Chloroform	67-66-3	0.37
Ethylbenzene[f]	100-41-4	1
Hexachlorobenzene[f]	118-74-1	0.33[b]
Methyl ethyl ketone	78-93-3	0.12
Methyl tert-butyl ether[f]	1634-04-4	0.93
Methylene chloride	75-09-2	0.05
n-Propylbenzene[f]	103-65-1	3.9
sec-Butylbenzene[f]	135-98-8	11
tert-Butylbenzene[f]	98-06-6	5.9
Tetrachloroethene	127-18-4	1.3
Toluene	108-88-3	0.07
Trichloroethene	79-01-6	0.47
1,2,4-Trimethylbenzene[f]	95-63-6	3.6
1,3,5- Trimethylbenzene[f]	108-67-8	8.4
Vinyl chloride[f]	75-01-4	0.02
Xylene (mixed)	1330-20-7	0.26

Notes:
All soil cleanup objectives (SCOs) are in parts per million (ppm). NS=Not specified.
Footnotes (designations are from Table in Part 375). See Technical Support Document (TSD).
a The SCOs for unrestricted use were capped at a maximum value of 100 ppm. See TSD section 9.3.
b For constituents where the calculated SCO was lower than the contract required quantitation limit (CRQL), the CRQL is used as the Track 1 SCO value.
c For constituents where the calculated SCO was lower than the rural soil background concentration, as determined by the Department and Department of Health rural soil survey, the rural soil background concentration is used as the Track 1 SCO value for this use of the site.
d SCO is the sum of endosulfan I, endosulfan II and endosulfan sulfate.
e The SCO for this specific compound (or family of compounds) is considered to be met if the analysis for the total species of this contaminant is below the specific SCO.
f Protection of ecological resources SCOs were not developed for contaminants identified in Table 375-6.8(b) with "NS". Where such contaminants appear in Table 375-6.8(a), the applicant may be required by the Department to calculate a protection of ecological resources SCO according to the TSD.

Table 2.
Restricted Commercial Use Soil Cleanup Objectives
Remedial Action Work Plan
965 Mamaroneck Avenue
BCP #C360189

From Table 375-6.8(b) or CP-51 Table 1: Restricted Commercial Use Soil Cleanup Objectives.

Contaminant	CAS Number	Restricted Commercial
Metals		
Arsenic	7440-38-2	16[f]
Barium	7440-39-3	400
Beryllium	7440-41-7	590
Cadmium	7440-43-9	9.3
Chromium, hexavalent[h]	18540-29-9	400
Chromium, trivalent[h]	16065-83-1	1,500
Copper	7440-50-8	270
Total Cyanide[h]		27
Lead	7439-92-1	1,000
Manganese	7439-96-5	10,000[d]
Total Mercury		2.8[j]
Nickel	7440-02-0	310
Selenium	7782-49-2	1,500
Silver	7440-22-4	1,500
Zinc	7440-66-6	10,000[d]
PCBs/Pesticides		
2,4,5-TP Acid (Silvex)	93-72-1	500[b]
4,4'-DDE	72-55-9	62
4,4'-DDT	50-29-3	47
4,4'-DDD	72-54-8	92
Aldrin	309-00-2	0.68
alpha-BHC	319-84-6	3.4
beta-BHC	319-85-7	3
Chlordane (alpha)	5103-71-9	24
delta-BHC	319-86-8	500[b]
Dibenzofuran	132-64-9	350
Dieldrin	60-57-1	1.4
Endosulfan I	959-98-8	200[i]
Endosulfan II	33213-65-9	200[i]
Endosulfan sulfate	1031-07-8	200[i]
Endrin	72-20-8	89
Heptachlor	76-44-8	15
Lindane	58-89-9	9.2
Polychlorinated biphenyls	1336-36-3	1

Contaminant	CAS Number	Restricted Commercial
Semivolatiles		
Acenaphthene	83-32-9	500[b]
Acenapthylene	208-96-8	500[b]
Anthracene	120-12-7	500[b]
Benz(a)anthracene	56-55-3	6
Benzo(a)pyrene	50-32-8	1[f]
Benzo(b)fluoranthene	205-99-2	6
Benzo(g,h,i)perylene	191-24-2	500[b]
Benzo(k)fluoranthene	207-08-9	56
Chrysene	218-01-9	56
Dibenz(a,h)anthracene	53-70-3	1
Fluoranthene	206-44-0	500[b]
Fluorene	86-73-7	500[b]
Indeno(1,2,3-cd)pyrene	193-39-5	6
m-Cresol	108-39-4	500[b]
Naphthalene	91-20-3	500[b]
o-Cresol	95-48-7	500[b]
p-Cresol	106-44-5	500[b]
Pentachlorophenol	87-86-5	6.7
Phenanthrene	85-01-8	500[b]
Phenol	108-95-2	500[b]
Pyrene	129-00-0	500[b]

Contaminant	CAS Number	Restricted Commercial
Volatiles		
1,1,1-Trichloroethane	71-55-6	500[b]
1,1-Dichloroethane	75-34-3	240
1,1-Dichloroethene	75-35-4	500[b]
1,2-Dichlorobenzene	95-50-1	500[b]
1,2-Dichloroethane	107-06-2	30
cis-1,2-Dichloroethene	156-59-2	500[b]
trans-1,2-Dichloroethene	156-60-5	500[b]
1,3-Dichlorobenzene	541-73-1	280
1,4-Dichlorobenzene	106-46-7	130
1,4-Dioxane	123-91-1	130
Acetone	67-64-1	500[b]
Benzene	71-43-2	44
n-Butylbenzene	104-51-8	500[b]
Carbon tetrachloride	56-23-5	22
Chlorobenzene	108-90-7	500[b]
Chloroform	67-66-3	350
Ethylbenzene	100-41-4	390
Hexachlorobenzene	118-74-1	6
Methyl ethyl ketone	78-93-3	500[b]
Methyl tert-butyl ether	1634-04-4	500[b]
Methylene chloride	75-09-2	500[b]
n-Propylbenzene	103-65-1	500[b]
sec-Butylbenzene	135-98-8	500[b]
tert-Butylbenzene	98-06-6	500[b]
Tetrachloroethene	127-18-4	150
Toluene	108-88-3	500[b]
Trichloroethene	79-01-6	200
1,2,4-Trimethylbenzene	95-63-6	190
1,3,5- Trimethylbenzene	108-67-8	190
Vinyl chloride	75-01-4	13
Xylene (mixed)	1330-20-7	500[b]

Notes:

All soil cleanup objectives (SCOs) are in parts per million (ppm). NS=Not specified.

Footnotes (designations are from Table in Part 375). See Technical Support Document (TSD).

b the SCOs for commercial use were capped at a maximum value of 500 ppm. See TSD section 9.3.

d The SCOs for metals were capped at a maximum value of 10,000 ppm. See TSD section 9.3.

e For constituents where the calculated SCO was lower than the contract required quantitation limit (CRQL), the CRQL is used as the SCO value.

f For constituents where the calculated SCO was lower than the rural soil background concentration as determined by the Department and Department of Health rural soil survey, the rural soil background concentration is used as the Track 2 SCO value for this use of the site.

i This SCO is for the sum of endosulfan I, endosulfan II, and endosulfan sulfate.

j This SCO is the lower of the values for mercury (elemental) or mercury (inorganic salts). See TSD Table 5.6-1.

Table 3.
NYSDEC Division of Water TOGS 1.1.1 Class GA Standards
Remedial Action Work Plan
965 Mamaroneck Avenue
BCP #C360189

From Table 1: New York State Ambient Water Quality Standards and Guidance Values
(Division of Water Technical and Operational Guidance Series (1.1.1), June 1998)

Contaminant	CAS Number	Class GA Standard
Volatiles		
1,1,1,2-Tetrachloroethane	630-20-6	5*
1,1,1-Trichloroethane	71-55-6	5*
1,1,2,2-Tetrachloroethane	79-34-5	5*
1,1,2-Trichloroethane	79-00-5	1
1,1-Dichloroethane	75-34-3	5*
1,1-Dichloroethene	75-35-4	5*
1,1-Dichloropropene	563-58-6	5*
1,2,3-Trichloropropane	96-18-4	0.04
1,2,4,5-Tetramethylbenzene	95-93-2	5*
1,2,4-Trimethylbenzene	95-63-6	5*
1,2-Dibromo-3-chloropropane	96-12-8	0.04
1,2-Dichlorobenzene	95-50-1	3
1,2-Dichloroethane	107-06-2	0.6
1,2-Dichloropropane	78-87-5	1
1,3,5-Trimethylbenzene	108-67-8	5*
1,3-Dichlorobenzene	541-73-1	3
1,3-Dichloropropane	142-28-9	5*
1,4-Dichlorobenzene	106-46-7	3
2,2-Dichloropropane	594-20-7	5*
2-Hexanone	591-78-6	50**
Acetone	67-64-1	50**
Acrylonitrile	107-13-1	5*
Benzene	71-43-2	1
Bromobenzene	108-86-1	5*
Bromochloromethane	74-97-5	5*
Bromodichloromethane	75-27-4	50**
Bromoform	75-25-2	50**
Bromomethane	74-83-9	5*
Butylbenzene	104-51-8	5*
Carbon tetrachloride	56-23-5	5
Chlorobenzene	108-90-7	5*
Chloroethane	75-00-3	5*
Chloroform	75-34-3	7
Chloromethane (Methyl Chloride)	74-87-3	5*
cis-1,2-Dichloroethene	156-59-2	5*
Dibromochloromethane	124-48-1	50**
Dibromomethane	74-95-3	5*
Dichlorodifluoromethane	75-71-8	5*
Ethylbenzene	100-41-4	5*
Hexachlorobenzene	87-68-3	0.04
Hexachlorobutadiene	87-68-3	0.5
Isopropylbenzene	98-82-8	5*
Methylene chloride	75-09-2	5*
m-Xylene (1,3-Xylene)	108-38-3	5*
Naphthalene	91-20-3	10**
n-Propylbenzene	103-65-1	5*
o-Chlorotoluene	95-49-8	5*
o-Xylene (1,2-Xylene)	95-47-6	5*
p-Chlorotoluene	106-43-4	5*
p-Isopropyltoluene	99-87-6	5*
p-Xylene (1,4-Xylene)	106-42-3	5*
sec-Butylbenzene	135-98-8	5*
Styrene	100-42-5	5*
tert-Butylbenzene	98-06-6	5*
Tetrachloroethene	127-18-4	5*
Toluene	108-88-3	5*
Total 1,3-Dichloropropene	542-75-6	0.4 (1)
trans-1,2-Dichloroethene	156-60-5	5*
trans-1,4-Dichloro-2-butene	110-57-6	5*
Trichloroethene	79-01-6	5*
Trichlorofluoromethane	75-69-4	5*
Vinyl chloride	75-01-4	2

Per- and Polyfluoroalkyl Substances		
Perfluorooctanesulfonic Acid (PFOS)	1763-23-1	0.0027
Perfluorooctanoic Acid (PFOA)	335-67-1	0.0067

Notes:
All Class GA Standards are in micrograms per liter (ug/l). Compounds without standards or guideline values are not shown.
*The principal organic contaminant standard for groundwater of 5 ug/l applies to this substance.
** The value shown is a Guidance Value
(1) refers to sum of cis- and trans-1,3-dichloropropene.

Table 4. Estimated Remedial Costs
965 Mamaroneck Avenue - Village of Mamaroneck, NY
Remedial Action Work Plan
BCP #C360189

Alternative 2: Restricted Commercial Soil Cleanup Objectives (SCOs) with Groundwater Remediation		
Remedial Tasks		
Pre-Design Groundwater Sampling	$10,000	Groundwater sampling and injection well network design
Injection Well Installation and Injections	$50,000	Installation of approximately 16 injection wells and chemical injections
Groundwater Remediation Product (6,000 lbs PlumeStop®)	$55,000	Chemicals for groundwater injections
Groundwater Remediation Product (Permanganate Candles)	$5,000	Potassium permanganate candles for installation in three existing monitoring wells
Post-Remedial Reporting and Long-term Groundwater Monitoring		
Reporting (FER, SMP)	$40,000	Reporting
Long-term Groundwater Monitoring	$100,000	Twelve quarters of groundwater sampling for CVOCs and PFAS from eight wells; annual reporting

Estimated Remedial Costs	$120,000
Estimated Reporting and Long-Term Monitoring Costs	$140,000
Total Estimated Remedial Costs	$260,000

Table 5. Required Permits
965 Mamaroneck Avenue
Remedial Action Work Plan
BCP #C360189

Permit	Law, Statute or Code	Contact
Underground Injection Control (UIC) Permit	40 CFR 144-147	USEPA Region 2, Nicole Kraft, (212) 637-3093

Table 6. Remedial Action Construction Schedule
965 Mamaroneck Avenue
Remedial Action Work Plan
BCP #C360189

Milestone	Weeks from Remedial Action Start	Duration (weeks)	Estimated Date
Approval of RAWP	--	0	7/1/2024
Fact Sheet Announcing Start of Remedial Action	0	1	7/8/2024
Mobilization	2	1	7/15/2024
Remedial Action (Groundwater Treatment)	3	1	7/22/2024
Initial Groundwater Sampling	7	--	8/19/2024
Submittal of Draft Site Management Plan (SMP)	9	--	9/2/2024
Submittal of Draft Final Engineering Report (FER)	9	--	9/2/2024
Second Round of Groundwater Sampling	19	--	11/11/2024
Submit Final Engineering Report (FER)	23	--	12/9/2024
Obtain Certificate of Completion (COC)	25	--	12/23/2024

Appendix A

Site-Specific Community Air Monitoring Plan

Community Air Monitoring Plan (CAMP)

for
965 Mamaroneck Avenue Remedial Action Work Plan

965 Mamaroneck Avenue
Village of Mamaroneck, New York
BCP Site # C360189

Submitted to:
New York State Department of Environmental Conservation
Division of Environmental Remediation
Remedial Bureau B
625 Broadway, 12th Floor
Albany, NY 12233-7016

Prepared for:
1946 Holding Corp.
43 Robins Road
New Rochelle, NY 10801

Prepared by:
TENEN ENVIRONMENTAL
121 West 27th Street, Suite 702
New York, NY 10001

May 2024

New York State Department of Health Generic Community Air Monitoring Plan

Overview

A Community Air Monitoring Plan (CAMP) requires real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) at the downwind perimeter of each designated work area when certain activities are in progress at contaminated sites. The CAMP is not intended for use in establishing action levels for worker respiratory protection. Rather, its intent is to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that work activities did not spread contamination off-site through the air.

The generic CAMP presented below will be sufficient to cover many, if not most, sites. Specific requirements should be reviewed for each situation in consultation with NYSDOH to ensure proper applicability. In some cases, a separate site-specific CAMP or supplement may be required. Depending upon the nature of contamination, chemical- specific monitoring with appropriately-sensitive methods may be required. Depending upon the proximity of potentially exposed individuals, more stringent monitoring or response levels than those presented below may be required. Special requirements will be necessary for work within 20 feet of potentially exposed individuals or structures and for indoor work with co-located residences or facilities. These requirements should be determined in consultation with NYSDOH.

Reliance on the CAMP should not preclude simple, common-sense measures to keep VOCs, dust, and odors at a minimum around the work areas.

Community Air Monitoring Plan

Depending upon the nature of known or potential contaminants at each site, real-time air monitoring for VOCs and/or particulate levels at the perimeter of the exclusion zone or work area will be necessary. Most sites will involve VOC and particulate monitoring; sites known to be contaminated with heavy metals alone may only require particulate monitoring.

If radiological contamination is a concern, additional monitoring requirements may be necessary per consultation with appropriate DEC/NYSDOH staff.

Continuous monitoring will be required for all ground intrusive activities and during the demolition of contaminated or potentially contaminated structures. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells.

Periodic monitoring for VOCs will be required during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells. Periodic monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence.

VOC Monitoring, Response Levels, and Actions

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

1. If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.

2. If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.

3. If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown.

4. All 15-minute readings must be recorded and be available for State (NYSDEC and NYSDOH) personnel to review. These readings will be provided on a weekly basis, with all exceedances reported to NYSDEC and NYSDOH the same day (or next business day if after hours), along with the reason for the exceedance, what was done to correct it, and if it was effective. Instantaneous readings, if any, used for decision purposes should also be recorded.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations should be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring should be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment must be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration should be visually assessed during all work activities.

1. If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m^3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m^3 above the upwind level and provided that no visible dust is migrating from the work area.

2. If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m^3 above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust

suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m^3 of the upwind level and in preventing visible dust migration.

3. All readings must be recorded and be available for State (NYSDEC and NYSDOH) and County Health personnel to review. These readings will be provided on a weekly basis, with all exceedances reported to NYSDEC and NYSDOH the same day (or next business day if after hours), along with the reason for the exceedance, what was done to correct it, and if it was effective.

Special Requirements for Work Within 20 Feet of Potentially Exposed Individuals or Structures

When work areas are within 20 feet of potentially exposed populations or occupied structures, the continuous monitoring locations for VOCs and particulates must reflect the nearest potentially exposed individuals and the location of ventilation system intakes for nearby structures. The use of engineering controls such as vapor/dust barriers, temporary negative-pressure enclosures, or special ventilation devices should be considered to prevent exposures related to the work activities and to control dust and odors.

Consideration should be given to implementing the planned activities when potentially exposed populations are at a minimum, such as during weekends or evening hours in non-residential settings.

If total VOC concentrations opposite the walls of occupied structures or next to intake vents exceed 1 ppm, monitoring should occur within the occupied structure(s). Background readings in the occupied spaces must be taken prior to commencement of the planned work. Any unusual background readings should be discussed with NYSDOH prior to commencement of the work.

If total particulate concentrations opposite the walls of occupied structures or next to intake vents exceed 150 mcg/m^3, work activities should be suspended until controls are implemented and are successful in reducing the total particulate concentration to 150 mcg/m^3 or less at the monitoring point.

Depending upon the nature of contamination and remedial activities, other parameters (e.g., explosivity, oxygen, hydrogen sulfide, carbon monoxide) may also need to be monitored. Response levels and actions should be pre-determined, as necessary, for each site.

Special Requirements for Indoor Work with Occupied Co-Located Residences or Facilities

Unless a self-contained, negative-pressure enclosure with proper emission controls will encompass the work area, all individuals not directly involved with the planned work must be absent from the room in which the work will occur. Monitoring requirements shall be as stated above under “Special Requirements for Work Within 20 Feet of Potentially Exposed Individuals or Structures” except that in this instance “nearby/occupied structures” would be adjacent occupied rooms. Additionally, the location of all exhaust vents in the room and their discharge points, as well as potential vapor pathways (openings, conduits, etc.) relative to adjoining rooms, should be understood and the monitoring locations established accordingly. In these situations, it is strongly recommended that exhaust fans or other engineering controls be used to create negative air pressure within the work area during remedial activities. Additionally, it is strongly recommended that the planned work be implemented during hours (e.g. weekends or evenings) when building occupancy is at a minimum.

Appendix B

Construction Health and Safety Plan

Health and Safety Plan

for
965 Mamaroneck Avenue
Remedial Action Work Plan

965 Mamaroneck Avenue
Mamaroneck, NY 10543
Westchester County
Westchester County TaxID No. 8-20-244
Site No. C360189

Submitted to:
New York State Department of Environmental Conservation
Division of Environmental Remediation
Remedial Bureau C
625 Broadway, 12th Floor
Albany, NY 12233-7016

Prepared for:
1946 Holding Corp.
43 Robins Road
New Rochelle, NY 10801

Prepared by:
TENEN ENVIRONMENTAL
CELEBRATING 10 YEARS OF EXCELLENCE
121 West 27th Street
New York, NY 10001

May 2024

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1.0 INTRODUCTION

This Health and Safety Plan (HASP) has been prepared in conformance with the Occupational Safety and Health Administration (OSHA) standards and guidance that govern site investigation activities, other applicable regulations, and Tenen Environmental LLC (Tenen) health and safety policies and procedures. The purpose of this HASP is the protection of Tenen field personnel and others during the implementation of a Remedial Action Work Plan.

The Site, located at 965 Mamaroneck Avenue in the Village and Town of Mamaroneck, New York, is an irregularly-shaped parcel consisting of 22,520-square feet (0.517 acre) situated on the east side of Mamaroneck Avenue, between Hillside Avenue and North Barry Avenue Extended. The tax map designation of the property is Westchester County TaxID No. 8-20-244. The property is currently developed with one commercial building that is occupied by a dry cleaner. Historically, the Site operated as a dry cleaning facility for its entire history until 2018.

1.1 Scope of HASP

This HASP includes safety procedures to be used by Tenen staff during the following activities:

- Installation of injection wells and application of groundwater injections; and
- Collection of groundwater samples from permanent monitoring wells.

Subcontractors will ensure that performance of the work is in compliance with this HASP and applicable laws and regulations.

2.0 PROJECT SAFETY AUTHORITY

The following personnel are responsible for project health and safety under this HASP.

- Project Manager, Alana Carroll
- Health and Safety Officer (HSO), Ashley Platt

In addition, each individual working at the Site will be responsible for compliance with this HASP and general safe working practices. All Site workers will have the authority to stop work if a potentially hazardous situation or event is observed.

2.1 Designated Personnel

The Project Manager is responsible for the overall operation of the project, including compliance with the HASP and general safe work practices. The Project Manager may also act as the Health and Safety Officer (HSO) for this project.

Tenen will appoint one of its on-site personnel as the on-site HSO. This individual will be responsible for the implementation of the HASP. The HSO will have a 4-year college degree in occupational safety or a related science/engineering field, and at least two (2) years of experience in implementation of air monitoring and hazardous materials sampling programs. The HSO will have completed a 40-hour training course that meets OSHA requirements of 29 CFR Part 1910, Occupational Safety and Health Standards.

The HSO will be present on-site during all field operations involving drilling or other subsurface disturbance, and will be responsible for all health and safety activities and the delegation of duties to the field crew. The HSO has stop-work authorization, which he/she will execute on his/her determination of an imminent safety hazard, emergency situation, or other potentially dangerous situation. If the HSO must be absent from the field, a replacement who is familiar with the Construction Health and Safety Plan, air monitoring and personnel protective equipment (PPE) will be designated.

3.0 HAZARD ASSESSMENT AND CONTROL MEASURES

The Site was initially developed sometime prior to 1950 with the southwestern portion of the existing single-story building. Sometime prior to 1988, one-story additions were constructed on the northern and eastern sides of the original structure. The Site operated as a dry cleaning facility for 46 years until its recent closing in 2018. The Site is currently occupied by a liquor store. The following previous investigations summarize contaminants of concern detected on the Site:

Phase I Environmental Site Assessment, 965 Mamaroneck Avenue, Mamaroneck, NY 10543, J.C. Broderick & Associates, Inc., February 2019.

J.C. Broderick & Associates, Inc. (JCB) conducted a Phase I Environmental Site Assessment (ESA) at the property in February 2019. The following environmental concerns in relation to the Site were identified in the Phase I ESA:

- The historical use of the subject property as a dry cleaner;
- The possibility of volatile organic compounds (VOCs) impacting the subject property from known spill incidences at the north, east, and west adjoining properties; and,
- The possibility of volatile vapor intrusion affecting the occupants of the subject property.

Phase II Environmental Site Assessment, 965 Mamaroneck Avenue, Mamaroneck, NY 10543, J.C. Broderick & Associates, Inc., March 2019.

JCB conducted a soil and groundwater investigation at the Site in March 2019, which included the collection of three (3) soil samples and nine (9) groundwater samples (six at the groundwater interface and three intermediate groundwater) for laboratory analysis. The results were as follows:

- VOCs were not detected in any soil samples in exceedance of Unrestricted Use Soil Cleanup Objectives (SCOs). However, the chlorinated solvent tetrachloroethene (PCE) was detected at low concentrations below Unrestricted Use SCOs in all three soil samples;
- PCE was detected in eight of nine groundwater samples in exceedance of NYSDEC Technical and Operational Guidance Series (TOGS) 1.1.1 Ambient Water Quality Standards and Guidance Values (Class GA Standards). Trichloroethene (TCE), a breakdown product of PCE, was detected in two of nine groundwater samples in exceedance of its Class GA Standard, both of which were collected from the intermediate groundwater; and,
- In general, the highest concentrations of PCE and TCE were detected in the three samples collected from the intermediate groundwater.

Soil Vapor Investigation, 965 Mamaroneck Avenue, Mamaroneck, NY 10543, Tenen Environmental, LLC, June 2019.

Tenen conducted a soil vapor investigation at the Site in June 2019, which included the installation of three (3) soil vapor points along the eastern perimeter of the Site and the collection of three (3) soil vapor samples. The results were as follows:

- Elevated levels of PCE were detected in all three soil vapor samples with the highest concentration [93.6 micrograms per cubic meter (ug/m3) in SV-1] occurring in the sample collected from the northeastern corner of the Site. TCE was not detected in any soil vapor samples collected;
- A variety of other chlorinated VOCs (cVOCs) were detected at low concentrations in soil vapor, including carbon tetrachloride, cis-1,2-dichloroethene, vinyl chloride, and chloroform; and,

- Low levels of petroleum-related VOCs were detected in soil vapor, including benzene, toluene, ethylbenzene, xylenes, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene.

Remedial Investigation Report, 965 Mamaroneck Avenue, Mamaroneck, NY 10543, Tenen Environmental, LLC, February 2022.

A Remedial Investigation (RI) and two Supplemental RIs, and an Offsite Soil Vapor Investigation (SVI) was performed at the Site by Tenen between March 2020 and March 2021, and the results detailed in the February 2022 Remedial Investigation Report (RIR). The RI, two supplemental RIs, and Offsite SVI included the installation of eight onsite and eight offsite soil borings, the collection of 26 soil samples, the installation of ten onsite and nine offsite permanent monitoring wells, the collection of groundwater samples from 19 newly installed wells, the installation of five sub-slab soil vapor points and one exterior soil vapor point, and the collection of five sub-slab soil vapor samples (four onsite, one offsite), five co-located indoor air samples (four onsite, one offsite), one exterior and offsite soil vapor sample, one standalone and offsite indoor air sample, and two ambient air samples. The results were as follows:

- cVOCs were not detected in exceedance of Unrestricted Use, Protection of Groundwater, or Commercial Use SCOs in any soil samples analyzed; however, low concentrations of PCE were detected in onsite soil samples collected from the eastern perimeter of the parking lot and in offsite, up/cross-gradient soil samples;
- Metals and pesticides were detected in exceedance of Unrestricted Use SCOs, but below Protection of Groundwater and Commercial Use SCOs, in soil samples collected from the parking lot of the Site;
- PFAS, specifically PFOS and PFOA, were detected in soil samples collected from the southeastern portion of the Site in exceedance of the proposed Unrestricted Use and Protection of Groundwater SCOs, but below Commercial Use SCOs;
- cVOCs, specifically PCE and its degradation products, were detected in exceedance of Class GA Standards in the shallow (5-15 ft-bg) and intermediate (17-21 ft-bg) aquifer across the Site and in the shallow (5-15 ft-bg) aquifer up/cross-gradient of the Site, with the highest concentrations occurring in the offsite well adjacent to the western perimeter of the Site. cVOCs in groundwater collected from the deep aquifer (35-40 ft-bg) and downgradient of the Site were detected at levels below the Class GA Standards;
- SVOCs, total and dissolved metals, and pesticides were detected at concentrations exceeding Class GA Standards in groundwater samples collected from onsite wells and the offsite, up/cross-gradient well;
- PFAS were detected in exceedance of the NYSDEC PFAS Guidelines in shallow (5-15 ft-bg), intermediate (17-21 ft-bg), and deep (35-40 ft-bg) wells across the Site and offsite, which the highest concentrations detected in the southeast portion of the Site, consistent with the highest concentrations of PFAS detected in soil.
- Low concentrations of cVOCs were detected at all five sub-slab soil vapor and co-located indoor air sampling locations. However, comparison of cVOC concentrations in sub-slab soil vapor and co-located indoor air samples to applicable NYSDOH Decision Matrices indicates that no further action is necessary at any on- or offsite locations for any analytes;
- Low concentrations of cVOCs were detected in the standalone and offsite indoor air sample below the NYSDOH AGVs;
- Chlorinated solvents were detected in the exterior, offsite and up/cross-gradient soil vapor sample and correlate to cVOC concentrations in the groundwater sample collected from the co-located monitoring well.

Remedial Investigation Report Addendum, 965 Mamaroneck Avenue, Mamaroneck, NY 10543, Tenen Environmental, LLC, August 30, 2022.

An additional Offsite SVI was performed at an offsite property adjoining the Site to the south by Tenen in April 2022, and the results detailed in the August 2022 RIR Addendum. April 2022 offsite SVI included the installation of two sub-slab soil vapor points and the collection of two offsite sub-slab soil vapor samples, two offsite co-located indoor air samples, one standalone and offsite indoor air sample, and one ambient air sample. The results were as follows:

- Low concentrations of cVOCs were detected at one sub-slab soil vapor and both co-located indoor air sampling locations. However, comparison of cVOC concentrations in sub-slab soil vapor and co-located indoor air samples to applicable NYSDOH Decision Matrices indicates that no further action is necessary at either offsite location for any analytes;
- Low concentrations of cVOCs were detected in the standalone indoor air sample below the NYSDOH AGVs.

3.1 Human Exposure Pathways

The media of concern at the Site include potentially-impacted groundwater. Potential exposure pathways include dermal contact, incidental ingestion and inhalation of vapors. The risk of dermal contact and incidental ingestion will be minimized through general safe work practices, a personal hygiene program and the use of PPE.

3.2 Chemical Hazards

Based on historic uses and previously-completed investigations, the following contaminants of concern may be present at the Site:

Chlorinated Solvents
- PCE
- TCE

PFAS
- PFOA
- PFOS

Material Safety Data Sheets (MSDSs) for each contaminant of concern are included in Appendix C. All personnel are required to review the MSDSs included in this HASP.

3.3 Physical Hazards

The physical hazards associated with the field activities likely present a greater risk of injury than the chemical constituents at the Site. Activities within the scope of this project shall comply with New York State and Federal OSHA construction safety standards.

<u>Head Trauma</u>
To minimize the potential for head injuries, field personnel will be required to wear National Institutes of Occupational Safety and Health (NIOSH)-approved hard hats during field activities. Hats must be worn properly and not altered in any way that would decrease the degree of protection provided.

Foot Trauma
To avoid foot injuries, field personnel will be required to wear steel-toed safety shoes while field activities are being performed. To afford maximum protection, all safety shoes must meet American National Standards Institute (ANSI) standards.

Eye Trauma
Field personnel will be required to wear eye protection (safety glasses with side shields) while field activities are being performed to prevent eye injuries caused by contact with chemical or physical agents.

Noise Exposure
Field personnel will be required to wear hearing protection (ear plugs or muffs) in high noise areas (noise from heavy equipment) while field activities are being performed.

Buried Utilities and Overhead Power Lines
Boring locations will be cleared by an underground utility locator service. In addition, prior to intrusive activities, the drilling subcontractor will contact the One Call Center to arrange for a utility mark-out, in accordance with New York State requirements. Protection from overhead power lines will be accomplished by maintaining safe distances of at least 15 feet at all times.

Thermal Stress
The effects of ambient temperature can cause physical discomfort, personal injury, and increase the probability of accidents. In addition, heat stress due to lack of body ventilation caused by protective clothing is an important consideration. Heat-related illnesses commonly consist of heat stroke and heat exhaustion.

The symptoms of heat stroke include: sudden onset; change in behavior; confusion; dry, hot and flushed skin; dilated pupils; fast pulse rate; body temperature reaching 105° or more; and/or, deep breathing later followed by shallow breathing.

The symptoms of heat exhaustion include: weak pulse; general weakness and fatigue; rapid shallow breathing; cold, pale and clammy skin; nausea or headache; profuse perspiration; unconsciousness; and/or, appearance of having fainted.

Heat-stress monitoring will be conducted if air temperatures exceed 70 degrees Fahrenheit. The initial work period will be set at 2 hours. Each worker will check his/her pulse at the wrist for 30 seconds early in each rest period. If the pulse rate exceeds 110 beats per minute, the next work period will be shortened by one-third.

One or more of the following precautions will reduce the risk of heat stress on the Site:

- Provide plenty of liquids to replace lost body fluids; water, electrolytic drinks, or both will be made available to minimize the risk of dehydration and heat stress
- Establish a work schedule that will provide appropriate rest periods
- Establish work regimens consistent with the American Conference of Governmental Industrial Hygienists (ACGIH) guidelines
- Provide adequate employee training on the causes of heat stress and preventive measures

In the highly unlikely event of extreme low temperatures, reasonable precautions will be made to avoid risks associated with low temperature exposure.

Traffic
Field activities will occur near public roadways. As a result, vehicular traffic will be a potential hazard

during these activities and control of these areas will be established using barricades or traffic cones. Additional staff will be assigned, as warranted, for the sole purpose of coordinating traffic. Personnel will also be required to wear high-visibility traffic vests while working in the vicinity of the public roadways and local requirements for lane closure will be observed as needed. All work in public rights-of-way will be coordinated with local authorities and will adhere to their requirements for working in traffic zones.

Hazardous Weather Conditions
All Site workers will be made aware of hazardous weather conditions, specifically including extreme heat, and will be requested to take the precautions described herein to avoid adverse health risks. All workers are encouraged to take reasonable, common sense precautions to avoid potential injury associated with possible rain or high wind, sleet, snow or freezing.

Slip, Trip and Fall
Areas at the Site may be slippery from mud or water. Care should be taken by all Site workers to avoid slip, trip, and fall hazards. Workers shall not enter areas that do not have adequate lighting. Additional portable lighting will be provided at the discretion of the HSO.

Biological Hazards
Drugs and alcohol are prohibited from the Site. Any on-site personnel violating this requirement will be immediately expelled from the site.

Any worker or oversight personnel with a medical condition that may require attention must inform the HSO of such condition. The HSO will describe appropriate measures to be taken if the individual should become symptomatic.

Due to the Site location in an urban area, it is highly unlikely that poisonous snakes, spiders, plants and insects will be encountered. However, other animals (dogs, cats, etc.) may be encountered and care should be taken to avoid contact.

4.0 COVID-19 HEALTH AND SAFETY

The following requirements apply to all Tenen employees working on project sites for the duration of the COVID-19 pandemic. These guidelines are based on information provided by the Centers for Disease Control, the Occupational Safety and Health Administration and the New York State "New York Forward" Covid-19 management plans. Information regarding the health status of Tenen employees will be kept confidential, with the exception of required notifications to health authorities. The following are guidelines. **As with any potential workplace hazard, employees should report any concerns related to potential Covid-19 exposure to the Project Manager.**

Communication/Reporting:

Employees should not report to work and should notify the Project Manager immediately in the event of the following:

- You are exhibiting flu-like symptoms (fever, body aches, cough, difficulty breathing). Contact your health care provider and follow their instructions.
- You do not exhibit symptoms but have a sick (i.e., diagnosed with Covid-19 or exhibiting flu-like symptoms) family member at home. Remember that the virus can be spread by asymptomatic individuals.
- You have been exposed to someone who has been diagnosed with Covid-19.

In each of the above cases, inform your Project Manager regarding others who may have been exposed in order to facilitate any necessary notification or contact tracing efforts.

Hygiene

- Wash hands frequently with soap and water for at least 20 seconds or use hand sanitizer with at least 60% alcohol if soap and water are not available. Key times for employees to clean their hands include:
  - Before and after work shifts
  - Before and after work breaks
  - After blowing the nose, coughing, or sneezing
  - After using the restroom
  - Before eating or preparing food
  - After putting on, touching, or removing face coverings
- Avoid touching the eyes, nose, and mouth with unwashed hands.
- Practice good respiratory etiquette, including covering coughs and sneezes.
- To the extent possible, avoid sharing tools and sampling equipment. Shared tools and equipment should be regularly disinfected.

Physical Distancing

- Minimize contact with others, maintaining a distance of at least six feet to the extent possible
- Employees should wear masks over their nose and mouth to prevent spread of the virus; this is especially important when a minimum 6-foot distance cannot be maintained.
- Maintain the 6-foot distance to the extent possible during sampling efforts and pickup and delivery of sampling equipment and containers.

- Keep job site meetings to a minimum and of short duration; limit the number of people involved and maintain social distance.

5.0 AIR MONITORING

The New York State Department of Health (NYSDOH) Generic Community Air Monitoring Plan (CAMP), included as Appendix 1A of DER-10, will be implemented during all ground-intrusive remedial activities associated with chlorinated solvent-impacted groundwater. Continuous monitoring will be implemented during all soil handling activities and will be recorded at a 15-minute basis.

VOC Monitoring, Response Levels, and Actions
Volatile organic compounds (VOCs) must be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a 15-minute basis or as otherwise specified. Upwind concentrations should be measured at the start of each workday and periodically thereafter to establish background conditions, particularly if wind direction changes. The monitoring should be performed using equipment appropriate for the types of contaminants known or suspected to be present. The equipment should be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment should be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

1. If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.
2. If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.
3. If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shut down.
4. All 15-minute readings must be recorded and be available for New York City Department of Environmental Protection (NYCDEP) personnel to review. Instantaneous readings, if any, used for decision purposes should also be recorded.

Particulate Monitoring, Response Levels, and Actions
Particulate concentrations should be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a 15-minute basis or as otherwise specified. Upwind concentrations should be measured at the start of each workday and periodically thereafter to establish background conditions, particularly if wind direction changes. The particulate monitoring should be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment must be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration should be visually assessed during all work activities.

1. If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m3 above the upwind level and provided that no visible dust is migrating from the work area.

2. If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m3 above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m3 of the upwind level and in preventing visible dust migration.
3. All readings must be recorded and be available for NYCDEP personnel to review.

6.0 PERSONAL PROTECTIVE EQUIPMENT

The personal protection equipment required for various kinds of site investigation tasks is based on 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response, "General Description and Discussion of the Levels of Protection and Protective Gear" and the Centers for CDC COVID-19 "Guidelines on How to Protect Yourselves and Others".

Tenen field personnel and other site personnel will wear Modified Level D-1 personal protective equipment. During activities such as drilling, well installation, or sampling, where there is a chance of contact with contaminated materials, Modified Level D-2 equipment will be worn. The protection will be upgraded to Level C if warranted by the results of the air monitoring. A six-foot minimum distance between individuals (both workers and non-workers) will be maintained at all times. A description of the personnel protective equipment for Levels D and C is provided below.

Modified Level D-1
Respiratory Protection: Cloth face covering
Protective Clothing: Hard hat, steel-toed shoes, long pants, nitrile gloves

Modified Level D-2
Respiratory Protection: Cloth face covering
Protective Clothing: Hard hat, steel-toed shoes, coveralls/tyvek, nitrile gloves

Level C
Respiratory Protection: Air purifying respirator with organic vapor cartridges and filters.
Protective Clothing: Same as Modified Level D-2

7.0 EXPOSURE MONITORING

7.1 Hazardous Materials

Selective monitoring of workers in the exclusion area may be conducted, as determined by the HSO, if sources of hazardous materials are identified. Personal monitoring may be conducted in the breathing zone at the discretion of the Project Manager or HSO. All monitoring will comply with the CDCs Guidance on Social Distancing.

7.2 COVID-19

For any employee that may have come into contact with a person who has COVID-19, a 14-day quarantine will be imposed for that individual and any employee that individual was in contact with.

8.0 SITE ACCESS

The Site is currently vacant. Access to the Site during the remedial action will be controlled by the Project Manager or HSO. Access to the off-site work areas will be cordoned off. Unauthorized personnel will not be allowed access to the Site or off-site work areas during the investigation.

9.0 WORK AREAS

During any activities involving drilling or other subsurface disturbance, the work area must be divided into various zones to prevent the spread of contamination, clarify the type of protective equipment needed, and provide an area for decontamination.

The Exclusion Zone is defined as the area where potentially contaminated materials are generated as the result of drilling, sampling, or similar activities. The Contamination Reduction Zone (CRZ) is the area where decontamination procedures take place and is located adjacent to the Exclusion Zone. The Support Zone is the area where support facilities such as vehicles, a field phone, fire extinguisher and/or first aid supplies are located. The emergency staging area (part of the Support Zone) is the area where all Site workers will assemble in the event of an emergency. These zones shall be designated daily, depending on that day's activities. All field personnel will be informed of the location of these zones before work begins.

Control measures such as "Caution" tape and traffic cones will be placed around the perimeter of the work area when work is being done in the areas of concern (i.e., areas with exposed soil) to prevent unnecessary access.

10.0 DECONTAMINATION PROCEDURES

Personnel Decontamination

Personnel decontamination (decon), if deemed necessary by the HSO, will take place in the designated decontamination area delineated for each sampling location. Personnel decontamination will consist of the following steps:

- Soap and potable water wash and potable water rinse of gloves;
- Tyvek removal;
- Glove removal;
- Disposable clothing removal; and
- Field wash of hands and face.

Equipment Decontamination

Sampling equipment, such as split-spoons and bailers, will be decontaminated in accordance with U.S. Environmental Protection Agency methodologies, as described in the work plan. Because site soil is considered essentially non-hazardous, there is no need to decontaminate vehicles used for transporting equipment and personnel over the Site.

Disposal of Materials

Purged well water, water used to decontaminate any equipment and well cuttings will be containerized and disposed off-site in accordance with federal, state and local regulations.

11.0 GENERAL SAFE WORK PRACTICES

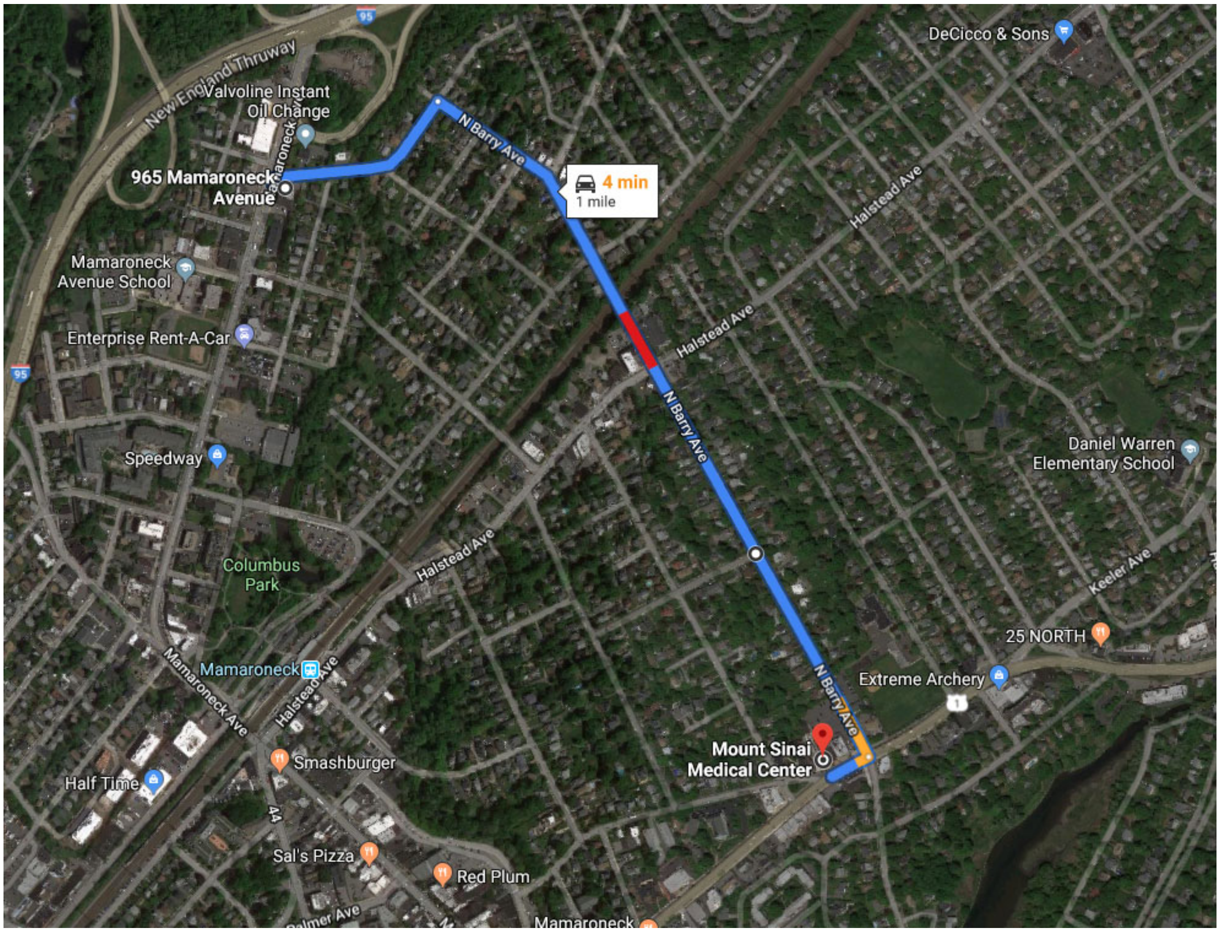
To protect the health and safety of the field personnel, all field personnel will adhere to the guidelines listed below during activities involving subsurface disturbance.

- Eating, drinking, chewing gum or tobacco, and smoking are prohibited, except in designated areas on the site. These areas will be designated by the HSO.
- Workers must wash their hands and face 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.
- Removal of potential contamination from PPE and equipment by blowing, shaking or any means that may disperse materials into the air is prohibited.
- 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 stress.
- Personnel will be cautioned to inform each other of symptoms of chemical exposure such as headache, dizziness, nausea, and irritation of the respiratory tract and heat stress.
- No excessive facial hair that interferes with a satisfactory fit of the face-piece of the respirator to the face will be allowed on personnel required to wear respiratory protective equipment.
- On-site personnel will be thoroughly briefed about the anticipated hazards, equipment requirements, safety practices, emergency procedures, and communications methods.

12.0 EMERGENCY PROCEDURES

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 HSO will determine the nature of the emergency and 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—onsite personnel should drive him to a hospital. **The nearest emergency room is at Mount Sinai Medical Center located at 620 East Boston Post Road, Mamaroneck, NY 10543. The phone number is (914) 885-2525.** The route to the hospital is shown and detailed on the next page.

12.1 Route to Hospital



Driving directions to **Mount Sinai Medical Center** from **965 Mamaroneck Avenue, Mamaroneck, NY 10543:**

1. Head north on Mamaroneck Avenue towards North Barry Avenue Extended.
2. Turn right on North Barry Avenue Extended.
3. Continue for 0.2 miles and turn right onto North Barry Avenue.
4. Continue for 0.7 miles and turn right onto East Boston Post Road. The emergency room entrance will be on the right.

12.2 Emergency Contacts

There will be an on-site field phone. Emergency and contact telephone numbers are listed below:

Table 1 – Emergency Contacts

Ambulance	911
Emergency Room	(914) 885-2525
NYSDEC Spill Hotline	(800) 457-7362
NYSDEC Project Manager, Rachel Savarie	(845) 633-5457
Tenen PM, Alana Carroll	(917) 428-2094
On-site Field Phone, Ashley Platt	(908) 892-1354
Client Representative, Frank P. Allegretti, Esq.	(914) 921-5644

13.0 TRAINING

All personnel performing the field activities described in this HASP will have received the initial safety training required by 29 CFR, 1910.120. Current refresher training status also will be required for all personnel engaged in field activities.

All those who enter the work area while intrusive activities are being performed must recognize and understand the potential hazards to health and safety. All field personnel must attend a training program covering the following areas:

- potential hazards that may be encountered;
- the knowledge and skills necessary for them to perform the work with minimal risk to health and safety;
- the purpose and limitations of safety equipment; and
- protocols to enable field personnel to safely avoid or escape from emergencies.

Each member of the field crew will be instructed in the above objectives before he/she goes onto the site. The HSO will be responsible for conducting the training program.

14.0 MEDICAL SURVEILLANCE

All Tenen and subcontractor personnel performing field work involving drilling or other subsurface disturbance at the site are required to have passed a complete medical surveillance examination in accordance with 29 CFR 1910.120 (f). The medical examination for Tenen employees will, at a minimum, be provided annually and upon termination of hazardous waste site work.

Appendix A

Acknowledgement of HASP

ACKNOWLEDGMENT OF HASP

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

AFFIDAVIT

I have read the Construction Health and Safety Plan (HASP) for the 965 Mamaroneck Avenue Site in the Village and Town of Mamaroneck, NY. 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.

Signature: ________________________________ Date: _________________
Signature: ________________________________ Date: _________________
Signature: ________________________________ Date: _________________
Signature: ________________________________ Date: _________________
Signature: ________________________________ Date: _________________

Appendix B

Injury Reporting Form (OSHA Form 300)

How to Fill Out the Log

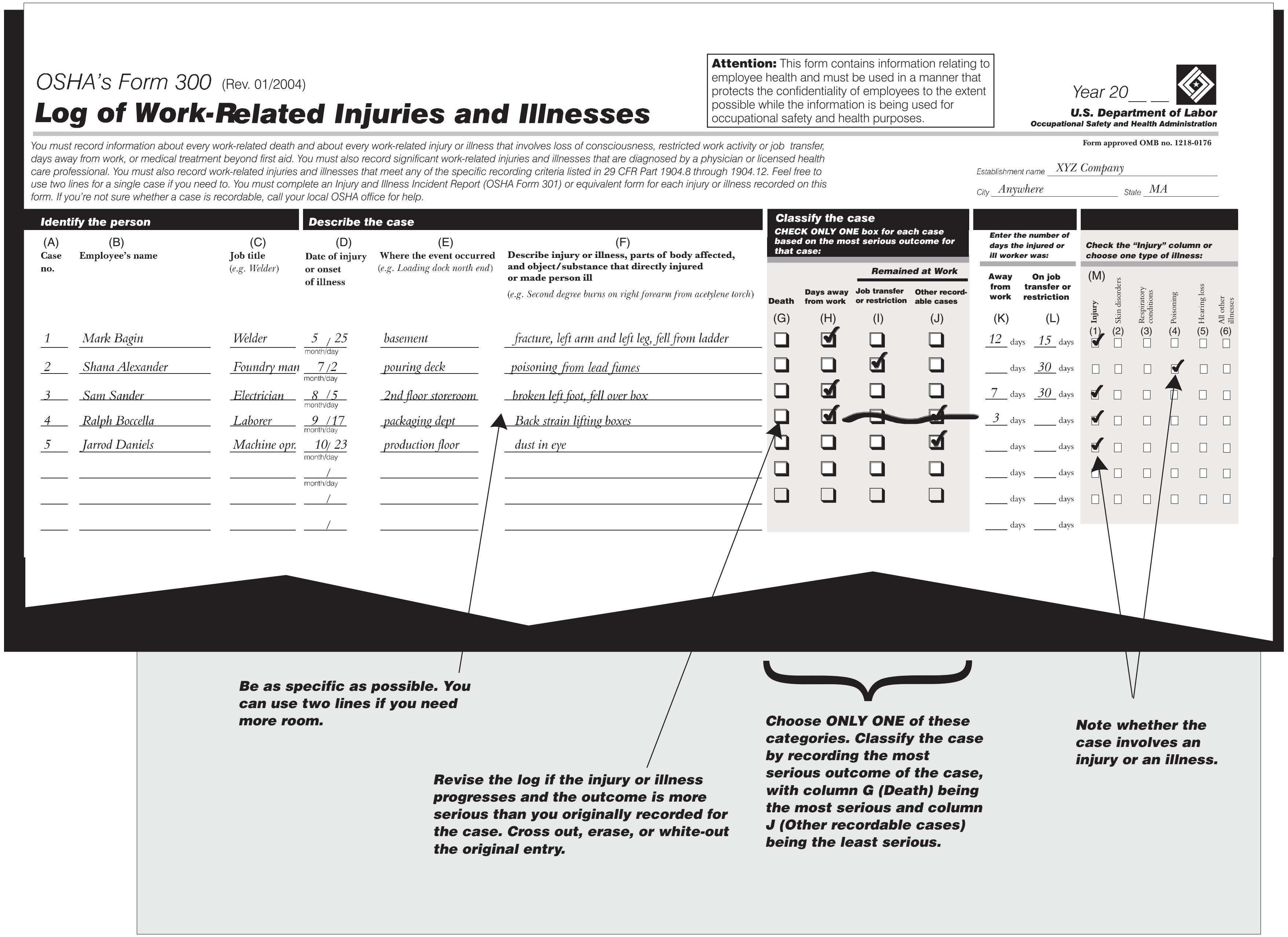
The *Log of Work-Related Injuries and Illnesses* is used to classify work-related injuries and illnesses and to note the extent and severity of each case. When an incident occurs, use the *Log* to record specific details about what happened and how it happened.

If your company has more than one establishment or site, you must keep separate records for each physical location that is expected to remain in operation for one year or longer.

We have given you several copies of the *Log* in this package. If you need more than we provided, you may photocopy and use as many as you need.

The *Summary* — a separate form — shows the work-related injury and illness totals for the year in each category. At the end of the year, count the number of incidents in each category and transfer the totals from the *Log* to the *Summary*. Then post the *Summary* in a visible location so that your employees are aware of injuries and illnesses occurring in their workplace.

You don't post the Log. You post only the Summary at the end of the year.



OSHA's Form 300 (Rev. 01/2004)

Log of Work-Related Injuries and Illnesses

Attention: This form contains information relating to employee health and must be used in a manner that protects the confidentiality of employees to the extent possible while the information is being used for occupational safety and health purposes.

Year 20__ __

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

You must record information about every work-related death and about every work-related injury or illness that involves loss of consciousness, restricted work activity or job transfer, days away from work, or medical treatment beyond first aid. You must also record significant work-related injuries and illnesses that are diagnosed by a physician or licensed health care professional. You must also record work-related injuries and illnesses that meet any of the specific recording criteria listed in 29 CFR Part 1904.8 through 1904.12. Feel free to use two lines for a single case if you need to. You must complete an Injury and Illness Incident Report (OSHA Form 301) or equivalent form for each injury or illness recorded on this form. If you're not sure whether a case is recordable, call your local OSHA office for help.

Establishment name *XYZ Company*
City *Anywhere* State *MA*

Identify the person			**Describe the case**			**Classify the case** CHECK ONLY ONE box for each case based on the most serious outcome for that case:				Enter the number of days the injured or ill worker was:		Check the "Injury" column or choose one type of illness:						
								Remained at Work				(M)						
(A) Case no.	(B) Employee's name	(C) Job title (e.g. Welder)	(D) Date of injury or onset of illness	(E) Where the event occurred (e.g. Loading dock north end)	(F) Describe injury or illness, parts of body affected, and object/substance that directly injured or made person ill (e.g. Second degree burns on right forearm from acetylene torch)	Death (G)	Days away from work (H)	Job transfer or restriction (I)	Other record-able cases (J)	Away from work (K)	On job transfer or restriction (L)	Injury (1)	Skin disorders (2)	Respiratory conditions (3)	Poisoning (4)	Hearing loss (5)	All other illnesses (6)
1	Mark Bagin	Welder	5 / 25 month/day	basement	fracture, left arm and left leg, fell from ladder	☐	☑	☐	☐	12 days	15 days	☑	☐	☐	☐	☐	☐
2	Shana Alexander	Foundry man	7 /2 month/day	pouring deck	poisoning from lead fumes	☐	☐	☑	☐	___ days	30 days	☐	☐	☐	☑	☐	☐
3	Sam Sander	Electrician	8 /5 month/day	2nd floor storeroom	broken left foot, fell over box	☐	☑	☐	☐	7 days	30 days	☑	☐	☐	☐	☐	☐
4	Ralph Boccella	Laborer	9 /17 month/day	packaging dept	Back strain lifting boxes	☐	☑	~~☐~~	~~☑~~	3 days	___ days	☑	☐	☐	☐	☐	☐
5	Jarrod Daniels	Machine opr.	10/ 23 month/day	production floor	dust in eye	☐	☐	☐	☑	___ days	___ days	☑	☐	☐	☐	☐	☐
___	___	___	/ month/day	___	___	☐	☐	☐	☐	___ days	___ days	☐	☐	☐	☐	☐	☐
___	___	___	/	___	___	☐	☐	☐	☐	___ days	___ days	☐	☐	☐	☐	☐	☐
___	___	___	/	___	___					___ days	___ days						

Be as specific as possible. You can use two lines if you need more room.

Revise the log if the injury or illness progresses and the outcome is more serious than you originally recorded for the case. Cross out, erase, or white-out the original entry.

Choose ONLY ONE of these categories. Classify the case by recording the most serious outcome of the case, with column G (Death) being the most serious and column J (Other recordable cases) being the least serious.

Note whether the case involves an injury or an illness.

U.S. Department of Labor
Occupational Safety and Health Administration

OSHA's Form 300 (Rev. 01/2004)

Log of Work-Related Injuries and Illnesses

Attention: This form contains information relating to employee health and must be used in a manner that protects the confidentiality of employees to the extent possible while the information is being used for occupational safety and health purposes.

Year 20__ __

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

You must record information about every work-related death and about every work-related injury or illness that involves loss of consciousness, restricted work activity or job transfer, days away from work, or medical treatment beyond first aid. You must also record significant work-related injuries and illnesses that are diagnosed by a physician or licensed health care professional. You must also record work-related injuries and illnesses that meet any of the specific recording criteria listed in 29 CFR Part 1904.8 through 1904.12. Feel free to use two lines for a single case if you need to. You must complete an Injury and Illness Incident Report (OSHA Form 301) or equivalent form for each injury or illness recorded on this form. If you're not sure whether a case is recordable, call your local OSHA office for help.

Establishment name ______________________

City ______________ *State* __________

Identify the person			**Describe the case**			**Classify the case** CHECK ONLY ONE box for each case based on the most serious outcome for that case:				**Enter the number of days the injured or ill worker was:**		**Check the "Injury" column or choose one type of illness:**					
								Remained at Work				(M)					
(A) Case no.	(B) Employee's name	(C) Job title (*e.g., Welder*)	(D) Date of injury or onset of illness	(E) Where the event occurred (*e.g., Loading dock north end*)	(F) Describe injury or illness, parts of body affected, and object/substance that directly injured or made person ill (*e.g., Second degree burns on right forearm from acetylene torch*)	**Death** (G)	**Days away from work** (H)	**Job transfer or restriction** (I)	**Other record-able cases** (J)	**Away from work** (K)	**On job transfer or restriction** (L)	Injury (1)	Skin disorder (2)	Respiratory condition (3)	Poisoning (4)	Hearing loss (5)	All other illnesses (6)
____	____	____	___/___ month/day	____	____	☐	☐	☐	☐	____ days	____ days	☐	☐	☐	☐	☐	☐
____	____	____	___/___ month/day	____	____	☐	☐	☐	☐	____ days	____ days	☐	☐	☐	☐	☐	☐
____	____	____	___/___ month/day	____	____	☐	☐	☐	☐	____ days	____ days	☐	☐	☐	☐	☐	☐
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____	____	____	___/___ month/day	____	____	☐	☐	☐	☐	____ days	____ days	☐	☐	☐	☐	☐	☐
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____	____	____	___/___ month/day	____	____	☐	☐	☐	☐	____ days	____ days	☐	☐	☐	☐	☐	☐
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____	____	____	___/___ month/day	____	____	☐	☐	☐	☐	____ days	____ days	☐	☐	☐	☐	☐	☐
____	____	____	___/___ month/day	____	____	☐	☐	☐	☐	____ days	____ days	☐	☐	☐	☐	☐	☐
					Page totals➤	____	____	____	____	____	____	____	____	____	____	____	____
												Injury (1)	Skin disorder (2)	Respiratory condition (3)	Poisoning (4)	Hearing loss (5)	All other illnesses (6)

Be sure to transfer these totals to the Summary page (Form 300A) before you post it.

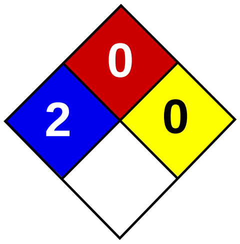
Page ___ ***of*** ___

Public reporting burden for this collection of information is estimated to average 14 minutes per response, including time to review the instructions, search and gather the data needed, and complete and review the collection of information. Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number. If you have any comments about these estimates or any other aspects of this data collection, contact: US Department of Labor, OSHA Office of Statistical Analysis, Room N-3644, 200 Constitution Avenue, NW, Washington, DC 20210. Do not send the completed forms to this office.

Appendix C

Material Safety Data Sheets (MSDS)
(on cd)

Science Lab.com
Chemicals & Laboratory Equipment



Health	2
Fire	0
Reactivity	0
Personal Protection	G

Material Safety Data Sheet

Tetrachloroethylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Tetrachloroethylene

Catalog Codes: SLT3220

CAS#: 127-18-4

RTECS: KX3850000

TSCA: TSCA 8(b) inventory: Tetrachloroethylene

CI#: Not available.

Synonym: Perchloroethylene; 1,1,2,2-Tetrachloroethylene; Carbon bichloride; Carbon dichloride; Ankilostin; Didakene; Dilatin PT; Ethene, tetrachloro-; Ethylene tetrachloride; Perawin; Perchlor; Perclene; Perclene D; Percosolvel; Tetrachloroethene; Tetraleno; Tetralex; Tetravec; Tetroguer; Tetropil

Chemical Name: Ethylene, tetrachloro-

Chemical Formula: C2-Cl4

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Tetrachloroethylene	127-18-4	100

Toxicological Data on Ingredients: Tetrachloroethylene: ORAL (LD50): Acute: 2629 mg/kg [Rat]. DERMAL (LD): Acute: >3228 mg/kg [Rabbit]. MIST(LC50): Acute: 34200 mg/m 8 hours [Rat]. VAPOR (LC50): Acute: 5200 ppm 4 hours [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of inhalation. Slightly hazardous in case of skin contact (permeator), of eye contact (irritant), of ingestion.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH. Classified 2A (Probable for human.) by IARC, 2 (anticipated carcinogen) by NTP. MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to kidneys, liver, peripheral nervous system, respiratory tract, skin, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Absorb with an inert material and put the spilled material in an appropriate waste disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Do not ingest. Do not breathe gas/fumes/ vapor/spray. Avoid contact with skin. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents, metals, acids, alkalis.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value.

Personal Protection:
Safety glasses. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 25 (ppm) from OSHA (PEL) [United States] TWA: 25 STEL: 100 (ppm) from ACGIH (TLV) [United States] TWA: 170 (mg/m3) from OSHA (PEL) [United States] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Ethereal.

Taste: Not available.

Molecular Weight: 165.83 g/mole

Color: Clear Colorless.

pH (1% soln/water): Not available.

Boiling Point: 121.3°C (250.3°F)

Melting Point: -22.3°C (-8.1°F)

Critical Temperature: 347.1°C (656.8°F)

Specific Gravity: 1.6227 (Water = 1)

Vapor Pressure: 1.7 kPa (@ 20°C)

Vapor Density: 5.7 (Air = 1)

Volatility: Not available.

Odor Threshold: 5 - 50 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 3.4

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:
Miscible with alcohol, ether, chloroform, benzene, hexane. It dissolves in most of the fixed and volatile oils. Solubility in water: 0.015 g/100 ml @ 25 deg. C It slowly decomposes in water to yield Trichloroacetic and Hydrochloric acids.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents, metals, acids, alkalis.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Oxidized by strong oxidizing agents. Incompatible with sodium hydroxide, finely divided or powdered metals such as zinc, aluminum, magnesium, potassium, chemically active metals such as lithium, beryllium , barium. Protect from light.

Special Remarks on Corrosivity: Slowly corrodes aluminum, iron, and zinc.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 2629 mg/kg [Rat]. Acute dermal toxicity (LD50): >3228 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 5200 4 hours [Mouse].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH. Classified 2A (Probable for human.) by IARC, 2 (Some evidence.) by NTP. MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. May cause damage to the following organs: kidneys, liver, peripheral nervous system, upper respiratory tract, skin, central nervous system (CNS).

Other Toxic Effects on Humans:
Hazardous in case of skin contact (irritant), of inhalation. Slightly hazardous in case of skin contact (permeator), of ingestion.

Special Remarks on Toxicity to Animals:
Lowest Publishe Lethal Dose/Conc: LDL [Rabbit] - Route: Oral; Dose: 5000 mg/kg LDL [Dog] - Route: Oral; Dose: 4000 mg/kg LDL [Cat] - Route: Oral; Dose: 4000 mg/kg

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects and birth defects(teratogenic). May affect genetic material (mutagenic). May cause cancer.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Causes skin irritation with possible dermal blistering or burns. Symtoms may include redness, itching, pain, and possible dermal blistering or burns. It may be absorbed through the skin with possible systemic effects. A single prolonged skin exposure is not likely to result in the material being absorbed in harmful amounts. Eyes: Contact causes transient eye irritation, lacrimation. Vapors cause eye/conjunctival irritation. Symptoms may include redness and pain. Inhalation: The main route to occupational exposure is by inhalation since it is readily absorbed through the lungs. It causes respiratory tract irritation, . It can affect behavior/central nervous system (CNS depressant and anesthesia ranging from slight inebriation to death, vertigo, somnolence, anxiety, headache, excitement, hallucinations, muscle incoordination, dizziness, lightheadness, disorentiation, seizures, enotional instability, stupor, coma). It may cause pulmonary edema Ingestion: It can cause nausea, vomiting, anorexia, diarrhea, bloody stool. It may affect the liver, urinary system (proteinuria, hematuria, renal failure, renal tubular disorder), heart (arrhythmias). It may affect behavior/central nervous system with symptoms similar to that of inhalation. Chronic Potential Health Effects: Skin: Prolonged or repeated skin contact may result in excessive drying of the skin, and irritation. Ingestion/Inhalation: Chronic exposure can affect the liver(hepatitis,fatty liver degeneration), kidneys, spleen, and heart (irregular heartbeat/arrhythmias, cardiomyopathy, abnormal EEG), brain, behavior/ central nervous system/peripheral nervous system (impaired memory, numbness of extremeties, peripheral neuropathy and other

Section 12: Ecological Information

Ecotoxicity:
Ecotoxicity in water (LC50): 18.4 mg/l 96 hours [Fish (Fatthead Minnow)]. 18 mg/l 48 hours [Daphnia (daphnia)]. 5 mg/l 96 hours [Fish (Rainbow Trout)]. 13 mg/l 96 hours [Fish (Bluegill sunfish)].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 6.1: Poisonous material.

Identification: : Tetrachloroethylene UNNA: 1897 PG: III

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Tetrachloroethylene California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Tetrachloroethylene Connecticut hazardous material survey.: Tetrachloroethylene Illinois toxic substances disclosure to employee act: Tetrachloroethylene Illinois chemical safety act: Tetrachloroethylene New York release reporting list: Tetrachloroethylene Rhode Island RTK hazardous substances: Tetrachloroethylene Pennsylvania RTK: Tetrachloroethylene Minnesota: Tetrachloroethylene Michigan critical material: Tetrachloroethylene Massachusetts RTK: Tetrachloroethylene Massachusetts spill list: Tetrachloroethylene New Jersey: Tetrachloroethylene New Jersey spill list: Tetrachloroethylene Louisiana spill reporting: Tetrachloroethylene California Director's List of Hazardous Substances: Tetrachloroethylene TSCA 8(b) inventory: Tetrachloroethylene TSCA 8(d) H and S data reporting: Tetrachloroethylene: Effective date: 6/1/87; Sunset date: 6/1/97 SARA 313 toxic chemical notification and release reporting: Tetrachloroethylene CERCLA: Hazardous substances.: Tetrachloroethylene: 100 lbs. (45.36 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS D-1B: Material causing immediate and serious toxic effects (TOXIC). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R40- Possible risks of irreversible effects. R51/53- Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. S23- Do not breathe gas/fumes/vapour/spray S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S37- Wear suitable gloves. S61- Avoid release to the environment. Refer to special instructions/Safety data sheets.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 0

Reactivity: 0

Personal Protection: g

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Safety glasses.

Section 16: Other Information

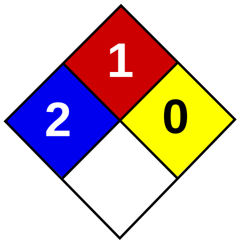
References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:29 PM

Last Updated: 05/21/2013 12:00 PM

ScienceLab.com
Chemicals & Laboratory Equipment



Health	2
Fire	1
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Trichloroethylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Trichloroethylene

Catalog Codes: SLT3310, SLT2590

CAS#: 79-01-6

RTECS: KX4560000

TSCA: TSCA 8(b) inventory: Trichloroethylene

CI#: Not available.

Synonym:

Chemical Formula: C2HCl3

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Trichloroethylene	79-01-6	100

Toxicological Data on Ingredients: Trichloroethylene: ORAL (LD50): Acute: 5650 mg/kg [Rat]. 2402 mg/kg [Mouse]. DERMAL (LD50): Acute: 20001 mg/kg [Rabbit].

Section 3: Hazards Identification

Potential Acute Health Effects: Hazardous in case of skin contact (irritant, permeator), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified + (PROVEN) by OSHA. Classified A5 (Not suspected for human.) by ACGIH. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to kidneys, the nervous system, liver, heart, upper respiratory tract. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: 420°C (788°F)

Flash Points: Not available.

Flammable Limits: LOWER: 8% UPPER: 10.5%

Products of Combustion: These products are carbon oxides (CO, CO2), halogenated compounds.

Fire Hazards in Presence of Various Substances: Not available.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Absorb with an inert material and put the spilled material in an appropriate waste disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/

spray. Wear suitable protective clothing In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes

Storage:
Keep container dry. Keep in a cool place. Ground all equipment containing material. Carcinogenic, teratogenic or mutagenic materials should be stored in a separate locked safety storage cabinet or room.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 50 STEL: 200 (ppm) from ACGIH (TLV) TWA: 269 STEL: 1070 (mg/m3) from ACGIH Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Not available.

Taste: Not available.

Molecular Weight: 131.39 g/mole

Color: Clear Colorless.

pH (1% soln/water): Not available.

Boiling Point: 86.7°C (188.1°F)

Melting Point: -87.1°C (-124.8°F)

Critical Temperature: Not available.

Specific Gravity: 1.4649 (Water = 1)

Vapor Pressure: 58 mm of Hg (@ 20°C)

Vapor Density: 4.53 (Air = 1)

Volatility: Not available.

Odor Threshold: 20 ppm

Water/Oil Dist. Coeff.: The product is equally soluble in oil and water; log(oil/water) = 0

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, methanol, diethyl ether, acetone.

Solubility:
Easily soluble in methanol, diethyl ether, acetone. Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity:
Extremely corrosive in presence of aluminum. Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
Acute oral toxicity (LD50): 2402 mg/kg [Mouse]. Acute dermal toxicity (LD50): 20001 mg/kg [Rabbit].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified + (PROVEN) by OSHA. Classified A5 (Not suspected for human.) by ACGIH. The substance is toxic to kidneys, the nervous system, liver, heart, upper respiratory tract.

Other Toxic Effects on Humans: Hazardous in case of skin contact (irritant, permeator), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Passes through the placental barrier in human. Detected in maternal milk in human.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 6.1: Poisonous material.

Identification: : Trichloroethylene : UN1710 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Trichloroethylene California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Trichloroethylene Pennsylvania RTK: Trichloroethylene Florida: Trichloroethylene Minnesota: Trichloroethylene Massachusetts RTK: Trichloroethylene New Jersey: Trichloroethylene TSCA 8(b) inventory: Trichloroethylene CERCLA: Hazardous substances.: Trichloroethylene

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS D-1B: Material causing immediate and serious toxic effects (TOXIC). CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R36/38- Irritating to eyes and skin. R45- May cause cancer.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 1

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 1

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:54 PM

Last Updated: 05/21/2013 12:00 PM

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1 Identification

· **Product identifier**

· **Trade name: Perfluorooctanoic Acid (PFOA)**

· **Part number:** N-1588
· **CAS Number:**
335-67-1
· **EC number:**
206-397-9
· **Index number:**
607-704-00-2
· **Application of the substance / the mixture** Reagents and Standards for Analytical Chemical Laboratory Use

· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
Agilent Technologies, Inc.
5301 Stevens Creek Blvd.
Santa Clara, CA 95051 USA

· **Information department:**
Telephone: 800-227-9770
e-mail: pdl-msds_author@agilent.com
· **Emergency telephone number:** CHEMTREC®: 1-800-424-9300

*

2 Hazard(s) identification

· **Classification of the substance or mixture**

GHS08 Health hazard

Carc. 2	H351	Suspected of causing cancer.
Repr. 1B	H360	May damage fertility or the unborn child.
STOT RE 1	H372	Causes damage to the liver through prolonged or repeated exposure.

GHS05 Corrosion

Eye Dam. 1	H318	Causes serious eye damage.

GHS07

Acute Tox. 4	H302	Harmful if swallowed.
Acute Tox. 4	H332	Harmful if inhaled.

· **Label elements**
· **GHS label elements** The substance is classified and labeled according to the Globally Harmonized System (GHS).

(Contd. on page 2)

(Contd. of page 1)

· **Hazard pictograms**


GHS05


GHS07


GHS08

· **Signal word** Danger

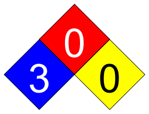
· **Hazard-determining components of labeling:**
perfluorooctanoic acid (PFOA)

· **Hazard statements**
Harmful if swallowed or if inhaled.
Causes serious eye damage.
Suspected of causing cancer.
May damage fertility or the unborn child.
Causes damage to the liver through prolonged or repeated exposure.

· **Precautionary statements**
Obtain special instructions before use.
Do not handle until all safety precautions have been read and understood.
Do not breathe dust/fume/gas/mist/vapors/spray.
Wash thoroughly after handling.
Do not eat, drink or smoke when using this product.
Use only outdoors or in a well-ventilated area.
Wear protective gloves/protective clothing/eye protection/face protection.
If swallowed: Call a poison center/doctor if you feel unwell.
Rinse mouth.
IF INHALED: Remove person to fresh air and keep comfortable for breathing.
If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do.
Continue rinsing.
Immediately call a poison center/doctor.
IF exposed or concerned: Get medical advice/attention.
Get medical advice/attention if you feel unwell.
Store locked up.
Dispose of contents/container in accordance with local/regional/national/international regulations.

· **Classification system:**

· **NFPA ratings (scale 0 - 4)**



Health = 3
Fire = 0
Reactivity = 0

· **HMIS-ratings (scale 0 - 4)**

HEALTH	*3
FIRE	0
REACTIVITY	0

Health = *3
Fire = 0
Reactivity = 0

· **Other hazards**

· **Results of PBT and vPvB assessment**

· **PBT:** Not applicable.

(Contd. on page 3)

(Contd. of page 2)

· **vPvB:** Not applicable.

3 Composition/information on ingredients

· **Chemical characterization: Substances**
· **CAS No. Description**
335-67-1 perfluorooctanoic acid (PFOA)
· **Identification number(s)**
· **EC number:** 206-397-9
· **Index number:** 607-704-00-2

4 First-aid measures

· **Description of first aid measures**
· **General information:**
Symptoms of poisoning may even occur after several hours; therefore medical observation for at least 48 hours after the accident.
· **After inhalation:**
Supply fresh air. If required, provide artificial respiration. Keep patient warm. Consult doctor if symptoms persist.
In case of unconsciousness place patient stably in side position for transportation.
· **After skin contact:** Generally the product does not irritate the skin.
· **After eye contact:** Rinse opened eye for several minutes under running water. Then consult a doctor.
· **After swallowing:** Immediately call a doctor.
· **Information for doctor:**
· **Most important symptoms and effects, both acute and delayed** No further relevant information available.
· **Indication of any immediate medical attention and special treatment needed**
No further relevant information available.

5 Fire-fighting measures

· **Extinguishing media**
· **Suitable extinguishing agents:** Use fire fighting measures that suit the environment.
· **Special hazards arising from the substance or mixture**
During heating or in case of fire poisonous gases are produced.
· **Advice for firefighters**
· **Protective equipment:** Mouth respiratory protective device.

6 Accidental release measures

· **Personal precautions, protective equipment and emergency procedures**
Mount respiratory protective device.
Wear protective equipment. Keep unprotected persons away.
· **Environmental precautions:** Do not allow to enter sewers/ surface or ground water.
· **Methods and material for containment and cleaning up:**
Use neutralizing agent.
Dispose contaminated material as waste according to item 13.
Ensure adequate ventilation.

(Contd. on page 4)

(Contd. of page 3)

· **Reference to other sections**
See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.

· **Protective Action Criteria for Chemicals**

· **PAC-1:**
1.1 mg/m³

· **PAC-2:**
12 mg/m³

· **PAC-3:**
75 mg/m³

7 Handling and storage

· **Handling:**
· **Precautions for safe handling**
Thorough dedusting.
Ensure good ventilation/exhaustion at the workplace.
Open and handle receptacle with care.
· **Information about protection against explosions and fires:** Keep respiratory protective device available.

· **Conditions for safe storage, including any incompatibilities**
· **Storage:**
· **Requirements to be met by storerooms and receptacles:** No special requirements.
· **Information about storage in one common storage facility:** Not required.
· **Further information about storage conditions:** Keep receptacle tightly sealed.
· **Specific end use(s)** No further relevant information available.

* 8 Exposure controls/personal protection

· **Additional information about design of technical systems:** No further data; see item 7.

· **Control parameters**
· **Components with limit values that require monitoring at the workplace:** Not required.
· **Additional information:** The lists that were valid during the creation were used as basis.

· **Exposure controls**
· **Personal protective equipment:**
· **General protective and hygienic measures:**
Keep away from foodstuffs, beverages and feed.
Immediately remove all soiled and contaminated clothing.
Wash hands before breaks and at the end of work.
Store protective clothing separately.
Avoid contact with the eyes.
Avoid contact with the eyes and skin.
· **Breathing equipment:**
When used as intended with Agilent instruments, the use of the product under normal laboratory conditions and with standard practices does not result in significant airborne exposures and therefore respiratory protection is not needed.
Under an emergency condition where a respirator is deemed necessary, use a NIOSH or equivalent approved device/equipment with appropriate organic or acid gas cartridge.

(Contd. on page 5)

(Contd. of page 4)

· **Protection of hands:**
Although not recommended for constant contact with the chemicals or for clean-up, nitrile gloves 11-13 mil thickness are recommended for normal use. The breakthrough time is 1 hr. For cleaning a spill where there is direct contact of the chemical, butyl rubber gloves are recommended 12-15 mil thickness with breakthrough times exceeding 4 hrs. Supplier recommendations should be followed.

· **Material of gloves**
For normal use: nitrile rubber, 11-13 mil thickness
For direct contact with the chemical: butyl rubber, 12-15 mil thickness
The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer.

· **Penetration time of glove material**
For normal use: nitrile rubber: 1 hour
For direct contact with the chemical: butyl rubber: >4 hours

· **Eye protection:**

Tightly sealed goggles

9 Physical and chemical properties

· **Information on basic physical and chemical properties**	
· **General Information**	
· **Appearance:**	
Form:	Solid
Color:	Not determined.
· **Odor:**	Characteristic
· **Odor threshold:**	Not determined.
· **pH-value:**	Not applicable.
· **Change in condition**	
Melting point/Melting range:	55-56 °C (131-132.8 °F)
Boiling point/Boiling range:	190 °C (374 °F)
· **Flash point:**	Not applicable.
· **Flammability (solid, gaseous):**	Product is not flammable.
· **Decomposition temperature:**	Not determined.
· **Auto igniting:**	Not determined.
· **Danger of explosion:**	Product does not present an explosion hazard.
· **Explosion limits:**	
Lower:	Not determined.
Upper:	Not determined.
· **Vapor pressure at 20 °C (68 °F):**	0.69 hPa (0.5 mm Hg)
· **Density at 20 °C (68 °F):**	0.9 g/cm^3 (7.5105 lbs/gal)
· **Relative density**	Not determined.
· **Vapor density**	Not applicable.

(Contd. on page 6)

(Contd. of page 5)

· **Evaporation rate**	Not applicable.
· **Solubility in / Miscibility with** **Water at 20 °C (68 °F):**	3.4 g/l
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not applicable.
Kinematic:	Not applicable.
VOC content:	0.00 % 0.0 g/l / 0.00 lb/gal
Solids content:	100.0 %
· **Other information**	No further relevant information available.

10 Stability and reactivity

· **Reactivity** No further relevant information available.
· **Chemical stability**
· **Thermal decomposition / conditions to be avoided:** No decomposition if used according to specifications.
· **Possibility of hazardous reactions** No dangerous reactions known.
· **Conditions to avoid** No further relevant information available.
· **Incompatible materials:** No further relevant information available.
· **Hazardous decomposition products:** No dangerous decomposition products known.

11 Toxicological information

· **Information on toxicological effects**
· **Acute toxicity:**

· **LD/LC50 values that are relevant for classification:**		
ATE (Acute Toxicity Estimate)		
Oral	LD50	500 mg/kg
Inhalative	LC50/4 h	1.5 mg/L

· **Primary irritant effect:**
· **on the skin:** No irritant effect.
· **on the eye:** Strong irritant with the danger of severe eye injury.
· **Sensitization:** No sensitizing effects known.
· **Additional toxicological information:**

· **Carcinogenic categories**

· **IARC (International Agency for Research on Cancer)**	
	2B

· **NTP (National Toxicology Program)**
Substance is not listed.

(Contd. on page 7)

(Contd. of page 6)

· **OSHA-Ca (Occupational Safety & Health Administration)**

Substance is not listed.

12 Ecological information

· **Toxicity**
· **Aquatic toxicity:** No further relevant information available.
· **Persistence and degradability** No further relevant information available.
· **Behavior in environmental systems:**
· **Bioaccumulative potential** No further relevant information available.
· **Mobility in soil** No further relevant information available.
· **Additional ecological information:**
· **General notes:**
Water hazard class 2 (Assessment by list): hazardous for water
Do not allow product to reach ground water, water course or sewage system.
Must not reach bodies of water or drainage ditch undiluted or unneutralized.
Danger to drinking water if even small quantities leak into the ground.
· **Results of PBT and vPvB assessment**
· **PBT:** Not applicable.
· **vPvB:** Not applicable.
· **Other adverse effects** No further relevant information available.

13 Disposal considerations

· **Waste treatment methods**
· **Recommendation:**
Must not be disposed of together with household garbage. Do not allow product to reach sewage system.

· **Uncleaned packagings:**
· **Recommendation:** Disposal must be made according to official regulations.

14 Transport information

· **UN-Number**	
· **DOT, IMDG, IATA**	UN3261
· **UN proper shipping name**	
· **DOT**	Corrosive solid, acidic, organic, n.o.s. (perfluorooctanoic acid (PFOA))
· **IMDG, IATA**	CORROSIVE SOLID, ACIDIC, ORGANIC, N.O.S. (perfluorooctanoic acid (PFOA))

(Contd. on page 8)

(Contd. of page 7)

· Transport hazard class(es)

· IATA

· Class	8 Corrosive substances
· Label	8
· Environmental hazards:	Not applicable.
· Special precautions for user	Warning: Corrosive substances
· Danger code (Kemler):	80
· EMS Number:	F-A,S-B
· Segregation groups	Acids
· Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code	Not applicable.

· Transport/Additional information:

· DOT	
· Quantity limitations	On passenger aircraft/rail: 25 kg On cargo aircraft only: 100 kg
· IMDG	
· Limited quantities (LQ)	5 kg
· Excepted quantities (EQ)	Code: E1 Maximum net quantity per inner packaging: 30 g Maximum net quantity per outer packaging: 1000 g
· UN "Model Regulation":	UN 3261 CORROSIVE SOLID, ACIDIC, ORGANIC, N.O.S. (PERFLUOROOCTANOIC ACID (PFOA)), 8, III

15 Regulatory information

· Safety, health and environmental regulations/legislation specific for the substance or mixture

· Sara

· Section 355 (extremely hazardous substances):

Substance is not listed.

· Section 313 (Specific toxic chemical listings):

Substance is not listed.

· TSCA (Toxic Substances Control Act):

Substance is listed.

· Proposition 65

· Chemicals known to cause cancer:

Substance is not listed.

· Chemicals known to cause reproductive toxicity for females:

Substance is not listed.

(Contd. on page 9)

(Contd. of page 8)

· **Chemicals known to cause reproductive toxicity for males:**
Substance is not listed.

· **Chemicals known to cause developmental toxicity:**
Substance is listed.

· **Carcinogenic categories**

· **EPA (Environmental Protection Agency)**
Substance is not listed.

· **TLV (Threshold Limit Value established by ACGIH)**
Substance is not listed.

· **NIOSH-Ca (National Institute for Occupational Safety and Health)**
Substance is not listed.

· **Chemical safety assessment:** A Chemical Safety Assessment has not been carried out.

*

16 Other information

The information contained in this document is based on Agilent's state of knowledge at the time of preparation. No warranty as to its accurateness, completeness or suitability for a particular purpose is expressed or implied.

· **Date of preparation / last revision** 03/23/2019 / 1

· **Abbreviations and acronyms:**
ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
ACGIH: American Conference of Governmental Industrial Hygienists
EINECS: European Inventory of Existing Commercial Chemical Substances
CAS: Chemical Abstracts Service (division of the American Chemical Society)
NFPA: National Fire Protection Association (USA)
HMIS: Hazardous Materials Identification System (USA)
VOC: Volatile Organic Compounds (USA, EU)
LC50: Lethal concentration, 50 percent
LD50: Lethal dose, 50 percent
PBT: Persistent, Bioaccumulative and Toxic
vPvB: very Persistent and very Bioaccumulative
NIOSH: National Institute for Occupational Safety
OSHA: Occupational Safety & Health
TLV: Threshold Limit Value
PEL: Permissible Exposure Limit
REL: Recommended Exposure Limit
Acute Tox. 4: Acute toxicity – Category 4
Eye Dam. 1: Serious eye damage/eye irritation – Category 1
Carc. 2: Carcinogenicity – Category 2
Repr. 1B: Reproductive toxicity – Category 1B
STOT RE 1: Specific target organ toxicity (repeated exposure) – Category 1

· *** Data compared to the previous version altered.**

SYNQUEST LABORATORIES

Perfluorooctanesulfonic acid

Safety Data Sheet 6164308

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Date of issue: 12/10/2015 Version: 1.0

SECTION 1: Identification

1.1. Identification

Product form : Substance

Substance name : Perfluorooctanesulfonic acid

CAS No : 1763-23-1

Product code : 6164-3-08

Formula : C8HF17O3S

Synonyms : 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-Heptadecafluorooctane-1-sulfonic acid

Other means of identification : MFCD00042454

1.2. Relevant identified uses of the substance or mixture and uses advised against

Use of the substance/mixture : Laboratory chemicals
Manufacture of substances
Scientific research and development

1.3. Details of the supplier of the safety data sheet

SynQuest Laboratories, Inc.
P.O. Box 309
Alachua, FL 32615 - United States of America
T (386) 462-0788 - F (386) 462-7097
info@synquestlabs.com - www.synquestlabs.com

1.4. Emergency telephone number

Emergency number : (844) 523-4086 (3E Company - Account 10069)

SECTION 2: Hazard(s) identification

2.1. Classification of the substance or mixture

Classification (GHS-US)

Acute Tox. 4 (Oral)	H302 -	Harmful if swallowed
Skin Corr. 1B	H314 -	Causes severe skin burns and eye damage
Eye Dam. 1	H318 -	Causes serious eye damage
STOT SE 3	H335 -	May cause respiratory irritation

Full text of H-phrases: see section 16

2.2. Label elements

GHS-US labeling

Hazard pictograms (GHS-US) :


GHS05


GHS07

Signal word (GHS-US) : Danger

Hazard statements (GHS-US) : H302 - Harmful if swallowed
H314 - Causes severe skin burns and eye damage
H335 - May cause respiratory irritation

Precautionary statements (GHS-US) : P260 - Do not breathe dust, mist, spray
P264 - Wash skin thoroughly after handling
P270 - Do not eat, drink or smoke when using this product
P271 - Use only outdoors or in a well-ventilated area
P280 - Wear protective gloves/protective clothing/eye protection/face protection
P301+P312 - If swallowed: Call a POISON CENTER or doctor/ physician if you feel unwell
P301+P330+P331 - If swallowed: rinse mouth. Do NOT induce vomiting
P303+P361+P353 - If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
P304+P340 - If inhaled: Remove person to fresh air and keep comfortable for breathing
P305+P351+P338 - If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P310 - Immediately call a POISON CENTER or doctor/ physician
P321 - Specific treatment (see supplemental first aid instructions on this label)
P330 - Rinse mouth

P363 - Wash contaminated clothing before reuse
P403+P233 - Store in a well-ventilated place. Keep container tightly closed
P405 - Store locked up
P501 - Dispose of contents/container to an approved waste disposal plant

2.3. Other hazards

No additional information available

2.4. Unknown acute toxicity (GHS US)

Not applicable

SECTION 3: Composition/information on ingredients

3.1. Substance

Substance type : Mono-constituent

Name	Product identifier	%	Classification (GHS-US)
Perfluorooctanesulfonic acid (Main constituent)	(CAS No) 1763-23-1	<= 100	Acute Tox. 4 (Oral), H302 Skin Corr. 1B, H314 Eye Dam. 1, H318 STOT SE 3, H335

Full text of H-phrases: see section 16

3.2. Mixture

Not applicable

SECTION 4: First aid measures

4.1. Description of first aid measures

First-aid measures general : In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). Move the affected personnel away from the contaminated area.

First-aid measures after inhalation : Remove person to fresh air and keep comfortable for breathing. If not breathing, give artificial respiration. Get immediate medical advice/attention.

First-aid measures after skin contact : Wash with plenty of soap and water. Remove contaminated clothing and shoes. Get immediate medical advice/attention.

First-aid measures after eye contact : Immediately flush eyes thoroughly with water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get immediate medical advice/attention.

First-aid measures after ingestion : Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth out with water. Get immediate medical advice/attention.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms/injuries : The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11.

Symptoms/injuries after inhalation : Material is destructive to tissue of the mucuous membranes and upper respiratory tract. Cough, shortness of breath, headache, nausea.

4.3. Indication of any immediate medical attention and special treatment needed

Treat symptomatically.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media : Alcohol resistant foam. Carbon dioxide. Dry powder. Water spray. Use extinguishing media appropriate for surrounding fire.

5.2. Special hazards arising from the substance or mixture

Fire hazard : Thermal decomposition generates: Carbon oxides. Hydrogen fluoride. Sulfur oxides.

5.3. Advice for firefighters

Firefighting instructions : In case of fire: Evacuate area.

Protection during firefighting : Wear gas tight chemically protective clothing in combination with self contained breathing apparatus. For further information refer to section 8: "Exposure controls/personal protection".

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

General measures : Evacuate unnecessary personnel. Ensure adequate air ventilation. Do not breathe dust.

6.1.1. For non-emergency personnel

Emergency procedures : Only qualified personnel equipped with suitable protective equipment may intervene.

6.1.2. For emergency responders

Protective equipment	: Do not attempt to take action without suitable protective equipment. For further information refer to section 8: "Exposure controls/personal protection".

6.2. Environmental precautions

Avoid release to the environment. Notify authorities if product enters sewers or public waters.

6.3. Methods and material for containment and cleaning up

For containment	: Stop leak if safe to do so.
Methods for cleaning up	: Sweep or shovel spills into appropriate container for disposal. Minimize generation of dust.
Other information	: For disposal of solid materials or residues refer to section 13 : "Disposal considerations".

6.4. Reference to other sections

No additional information available

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for safe handling	: Do not handle until all safety precautions have been read and understood. Ensure good ventilation of the work station. Do not breathe dust, mist, spray. Wear personal protective equipment. Avoid contact with skin and eyes.
Hygiene measures	: Handle in accordance with good industrial hygiene and safety procedures. Do not eat, drink or smoke when using this product. Always wash hands after handling the product.

7.2. Conditions for safe storage, including any incompatibilities

Technical measures	: Comply with applicable regulations.
Storage conditions	: Keep container closed when not in use. Hygroscopic. Keep contents under inert gas.
Incompatible materials	: Refer to Section 10 on Incompatible Materials.
Storage area	: Store in dry, cool, well-ventilated area.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

No additional information available

8.2. Exposure controls

Appropriate engineering controls	: Ensure good ventilation of the work station. Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure.
Hand protection	: Protective gloves. 29 CFR 1910.138: Hand Protection.
Eye protection	: Chemical goggles or safety glasses. Face shield. 29 CFR 1910.133: Eye and Face Protection.
Skin and body protection	: Wear suitable protective clothing.
Respiratory protection	: In case of inadequate ventilation wear respiratory protection. 29 CFR 1910.134: Respiratory Protection.
Other information	: Safety shoes. 29 CFR 1910.136: Foot Protection.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state	: Solid
Color	: No data available
Odor	: No data available
Odor threshold	: No data available
pH	: No data available
Melting point	: No data available
Freezing point	: No data available
Boiling point	: 145 °C (@ 10 mm Hg)
Flash point	: No data available
Relative evaporation rate (butyl acetate=1)	: No data available
Flammability (solid, gas)	: No data available
Explosion limits	: No data available
Explosive properties	: No data available

Oxidizing properties	: No data available
Vapor pressure	: No data available
Relative density	: 1.25 (@ 25 °C)
Relative vapor density at 20 °C	: No data available
Molecular mass	: 500.13 g/mol
Solubility	: No data available
Log Pow	: No data available
Auto-ignition temperature	: No data available
Decomposition temperature	: No data available
Viscosity	: No data available
Viscosity, kinematic	: No data available
Viscosity, dynamic	: No data available

9.2. Other information

No additional information available

SECTION 10: Stability and reactivity

10.1. Reactivity

No additional information available

10.2. Chemical stability

The product is stable at normal handling and storage conditions.

10.3. Possibility of hazardous reactions

No additional information available

10.4. Conditions to avoid

Keep away from heat, sparks and flame.

10.5. Incompatible materials

Strong bases. Strong oxidizing agents.

10.6. Hazardous decomposition products

Under normal conditions of storage and use, hazardous decomposition products should not be produced. Hazardous decomposition products in case of fire, see Section 5.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity	: Oral: Harmful if swallowed.
Skin corrosion/irritation	: Causes severe skin burns and eye damage.
Serious eye damage/irritation	: Causes serious eye damage.
Respiratory or skin sensitization	: Not classified
Germ cell mutagenicity	: Not classified
Carcinogenicity	: Not classified
Reproductive toxicity	: Not classified
Specific target organ toxicity (single exposure)	: May cause respiratory irritation.
Specific target organ toxicity (repeated exposure)	: Not classified
Aspiration hazard	: Not classified
Symptoms/injuries after inhalation	: Material is destructive to tissue of the mucuous membranes and upper respiratory tract. Cough, shortness of breath, headache, nausea.

SECTION 12: Ecological information

12.1. Toxicity

No additional information available

12.2. Persistence and degradability

No additional information available

12.3. Bioaccumulative potential

No additional information available

12.4. Mobility in soil

No additional information available

12.5. Other adverse effects

No additional information available

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Waste treatment methods	:	Remove to an authorized incinerator equipped with an afterburner and a flue gas scrubber.
Waste disposal recommendations	:	Dispose of contents/container in accordance with licensed collector’s sorting instructions.
Additional information	:	Recycle the material as far as possible.

SECTION 14: Transport information

Department of Transportation (DOT)

In accordance with DOT

Transport document description	:	UN3261 Corrosive solid, acidic, organic, n.o.s., 8, II
UN-No.(DOT)	:	UN3261
Proper Shipping Name (DOT)	:	Corrosive solid, acidic, organic, n.o.s.
Transport hazard class(es) (DOT)	:	8 - Class 8 - Corrosive material 49 CFR 173.136
Hazard labels (DOT)	:	8 - Corrosive 
Packing group (DOT)	:	II - Medium Danger
DOT Packaging Non Bulk (49 CFR 173.xxx)	:	212
DOT Packaging Bulk (49 CFR 173.xxx)	:	240
DOT Symbols	:	G - Identifies PSN requiring a technical name
DOT Special Provisions (49 CFR 172.102)	:	IB8 - Authorized IBCs: Metal (11A, 11B, 11N, 21A, 21B, 21N, 31A, 31B and 31N); Rigid plastics (11H1, 11H2, 21H1, 21H2, 31H1 and 31H2); Composite (11HZ1, 11HZ2, 21HZ1, 21HZ2, 31HZ1 and 31HZ2); Fiberboard (11G); Wooden (11C, 11D and 11F); Flexible (13H1, 13H2, 13H3, 13H4, 13H5, 13L1, 13L2, 13L3, 13L4, 13M1 or 13M2). IP2 - When IBCs other than metal or rigid plastics IBCs are used, they must be offered for transportation in a closed freight container or a closed transport vehicle. IP4 - Flexible, fiberboard or wooden IBCs must be sift-proof and water-resistant or be fitted with a sift-proof and water-resistant liner. T3 - 2.65 178.274(d)(2) Normal............ 178.275(d)(2) TP33 - The portable tank instruction assigned for this substance applies for granular and powdered solids and for solids which are filled and discharged at temperatures above their melting point which are cooled and transported as a solid mass. Solid substances transported or offered for transport above their melting point are authorized for transportation in portable tanks conforming to the provisions of portable tank instruction T4 for solid substances of packing group III or T7 for solid substances of packing group II, unless a tank with more stringent requirements for minimum shell thickness, maximum allowable working pressure, pressure-relief devices or bottom outlets are assigned in which case the more stringent tank instruction and special provisions shall apply. Filling limits must be in accordance with portable tank special provision TP3. Solids meeting the definition of an elevated temperature material must be transported in accordance with the applicable requirements of this subchapter.
DOT Packaging Exceptions (49 CFR 173.xxx)	:	154
DOT Quantity Limitations Passenger aircraft/rail (49 CFR 173.27)	:	15 kg
DOT Quantity Limitations Cargo aircraft only (49 CFR 175.75)	:	50 kg

DOT Vessel Stowage Location : B - (i) The material may be stowed ‘‘on deck’’ or ‘‘under deck’’ on a cargo vessel and on a passenger vessel carrying a number of passengers limited to not more than the larger of 25 passengers, or one passenger per each 3 m of overall vessel length; and (ii) ‘‘On deck only’’ on passenger vessels in which the number of passengers specified in paragraph (k)(2)(i) of this section is exceeded.

Other information : No supplementary information available.

TDG

No additional information available

Transport by sea

UN-No. (IMDG) : 3261
Proper Shipping Name (IMDG) : CORROSIVE SOLID, ACIDIC, ORGANIC, N.O.S.
Class (IMDG) : 8 - Corrosive substances
Packing group (IMDG) : II - substances presenting medium danger

Air transport

UN-No. (IATA) : 3261
Proper Shipping Name (IATA) : Corrosive solid, acidic, organic, n.o.s.
Class (IATA) : 8 - Corrosives
Packing group (IATA) : II - Medium Danger

SECTION 15: Regulatory information

15.1. US Federal regulations

Perfluorooctanesulfonic acid (1763-23-1)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory	
EPA TSCA Regulatory Flag	S - S - indicates a substance that is identified in a proposed or final Significant New Uses Rule.

All components of this product are listed, or excluded from listing, on the United States Environmental Protection Agency Toxic Substances Control Act (TSCA) inventory

This product or mixture does not contain a toxic chemical or chemicals in excess of the applicable de minimis concentration as specified in 40 CFR §372.38(a) subject to the reporting requirements of section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.

15.2. International regulations

CANADA

Perfluorooctanesulfonic acid (1763-23-1)
Listed on the Canadian NDSL (Non-Domestic Substances List)

EU-Regulations

No additional information available

National regulations

Perfluorooctanesulfonic acid (1763-23-1)
Listed on IECSC (Inventory of Existing Chemical Substances Produced or Imported in China) Listed on the Japanese ENCS (Existing & New Chemical Substances) inventory Japanese Pollutant Release and Transfer Register Law (PRTR Law) Listed on INSQ (Mexican national Inventory of Chemical Substances)

15.3. US State regulations

California Proposition 65 - This product does not contain any substances known to the state of California to cause cancer and/or reproductive harm

SECTION 16: Other information

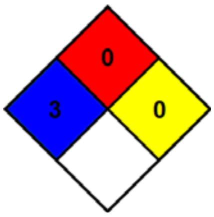
Full text of H-phrases:

Acute Tox. 4 (Oral)	Acute toxicity (oral) Category 4
Eye Dam. 1	Serious eye damage/eye irritation Category 1
Skin Corr. 1B	Skin corrosion/irritation Category 1B
STOT SE 3	Specific target organ toxicity (single exposure) Category 3
H302	Harmful if swallowed
H314	Causes severe skin burns and eye damage
H318	Causes serious eye damage
H335	May cause respiratory irritation

NFPA health hazard : 3 - Short exposure could cause serious temporary or residual injury even though prompt medical attention was given.

NFPA fire hazard : 0 - Materials that will not burn.

NFPA reactivity : 0 - Normally stable, even under fire exposure conditions, and are not reactive with water.



HMIS III Rating

Health : 3 Serious Hazard - Major injury likely unless prompt action is taken and medical treatment is given

Flammability : 0 Minimal Hazard - Materials that will not burn

Physical : 0 Minimal Hazard - Materials that are normally stable, even under fire conditions, and will NOT react with water, polymerize, decompose, condense, or self-react. Non-Explosives.

SDS US (GHS HazCom 2012)

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is offered solely for your consideration, investigation, and verification. It does not represent any guarantee of the properties of the product nor that the hazard precautions or procedures described are the only ones which exist. SynQuest shall not be held liable or any damage resulting from handling or from contact with the above product.

Appendix C
Quality Assurance Project Plan

Appendix C
Quality Assurance Project Plan

for
965 Mamaroneck Avenue
Remedial Action Work Plan

965 Mamaroneck Avenue
Village and Town of Mamaroneck, NY 10543
Westchester County
Westchester County TaxID No. 8-20-244
Site No. C360189

Submitted to:
New York State Department of Environmental Conservation
Division of Environmental Remediation
Remedial Bureau B
625 Broadway, 12th Floor
Albany, NY 12233-7016

Prepared for:
1946 Holding Corp.
43 Robins Road
New Rochelle, NY 10801

Prepared by:
TENEN ENVIRONMENTAL
CELEBRATING 10 YEARS OF EXCELLENCE
121 West 27th Street, Suite 1004
New York, NY 10001

July 2024

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Appendices

1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) has been developed for the Remedial Action Work Plan (RAWP) prepared for 965 Mamaroneck Avenue property (the Site).

The Site, located at 965 Mamaroneck Avenue, Village and Town of Mamaroneck, New York, is an irregularly-shaped parcel consisting of 22,520 square feet (0.517 acres) situated on the southeast corner of the intersection of Mamaroneck Avenue and North Barry Avenue Extension. The tax map designation of the property is Westchester County Tax ID No. 8-20-244.

The property is currently developed with a single-story commercial building that occupies approximately 3,600 square feet of the total Site area. The remainder of the Site consists of an asphalt parking lot and landscaped areas. The Site is currently occupied by a liquor store but was historically operated by a dry cleaner until 2018.

1.1 Project Scope and QAPP Objective

The proposed scope of work includes the following:

- Installation of injection wells; and
- collection of quarterly groundwater monitoring samples from existing permanent monitoring wells.

The objective of the QAPP is to detail the policies, organization, objectives, functional activities and specific quality assurance/quality control activities designed to achieve the data quality goals or objectives of the Remedial Action Work Plan. This QAPP addresses how the acquisition and handling of samples and the review and reporting of data will be documented for quality control (QC) purposes. Specifically, this QAPP addresses the following:

- The procedures to be used to collect, preserve, package, and transport samples;
- Field data collection and record keeping;
- Data management;
- Chain-of-custody procedures; and,
- Determination of precision, accuracy, completeness, representativeness, decision rules, comparability and level of quality control effort.

2.0 PROJECT ORGANIZATION

The personnel detailed are responsible for the implementation of the QAPP. Tenen Environmental, LLC (Tenen) will implement the RAWP on behalf of 1946 Holding Corp. (the Participant) once it has been approved by the New York State Department of Environmental Conservation (NYSDEC).

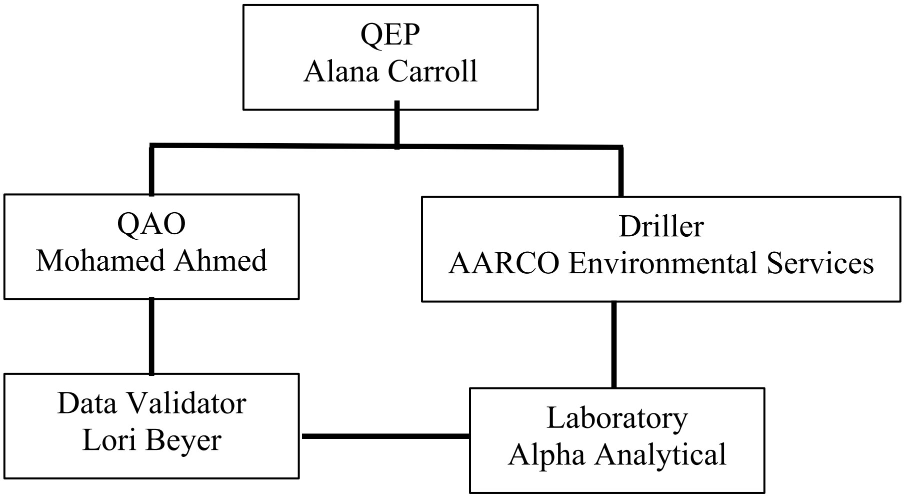
The Project Manager and Qualified Environmental Professional (QEP) will be Mrs. Alana Carroll, CPG, managing scientist at Tenen. Mrs. Carroll is a certified professional geologist with experience in all aspects of site assessment, development and implementation of remedial strategies. Her experience involves projects from inception through investigation, remediation and closure. Her expertise includes soil, soil vapor and groundwater remediation; remedial selection and design; field/health and safety oversight and preparation of work plans and reports to satisfy the requirements of various regulatory agencies. Mrs. Carroll received her BS in Geology from Hofstra University; her resume is included in Appendix A.

The Quality Assurance Officer will be Mohamed Ahmed, Ph.D., CPG, principal at Tenen. Dr. Ahmed is a certified professional geologist with over 20 years of experience in the New York City metropolitan area. He has designed and implemented subsurface investigations and is proficient in groundwater modeling, design of groundwater treatment systems, and soil remediation. He has managed numerous projects focused on compliance with the requirements of the New York State Brownfield Cleanup Program and spills programs and the New York City E-designation program. Dr. Ahmed also has extensive experience in conducting regulatory negotiations with the New York State Department of Environmental Conservation, the New York City Department of Environmental Protection, the NYC Office of Housing Preservation and Development, and the Mayor’s Office of Environmental Remediation. Dr. Ahmed holds advanced degrees in geology and Earth and Environmental Sciences from Brooklyn College and the Graduate Center of the City University of New York; his resume is included in Appendix A.

In addition, Tenen will utilize subcontractors for drilling (AARCO Environmental of Lindenhurst, NY), laboratory services (Alpha Analytical Laboratories of Westborough, MA) and data validation (L.A.B. Validation Corp. of East Northport, NY). The resume for the DUSR preparer, Ms. Lori Beyer, is included in Appendix A.

Contact Information
Remedial Party (1946 Holding Corp.), Frank P. Allegretti, Esq., 914.921.5644
Tenen Environmental, Alana Carroll or Mohamed Ahmed, 646.606.2332

An organization chart for the implementation of the Remedial Action Work Plan and QAPP is below.



3.0 SAMPLING AND DECONTAMINATION PROCEDURES

A detailed description of the procedures to be used during this program for collection of the groundwater samples is provided below. Proposed sample locations are shown on Figure 9 of the Work Plan. An Analytical Methods/Quality Assurance Summary is provided in Table 1, included in Section 3.11.

3.1 Level of Effort for QC Samples

Field blank, trip blank, field duplicate and matrix spike (MS) / matrix spike duplicate (MSD) samples will be analyzed to assess the quality of the data resulting from the field sampling and analytical programs. Each type of QC sample is discussed below.

- Field and trip blanks consisting of distilled water will be submitted to the analytical laboratories to provide the means to assess the quality of the data resulting from the field-sampling program. Field (equipment) blank samples are analyzed to check for procedural chemical constituents that may cause sample contamination. Trip blanks are used to assess the potential for contamination of samples due to contaminant migration during sample shipment and storage.

- Duplicate samples are analyzed to check for sampling and analytical reproducibility.

- MS/MSD samples provide information about the effect of the sample matrix on the digestion and measurement methodology.

The general level of QC effort will be one (1) field duplicate and one (1) field blank (when non-dedicated equipment is used) for every 20 or fewer investigative samples of a given matrix. Additional sample volume will also be provided to the laboratory to allow one (1) site-specific MS/MSD for every 20 or fewer investigative samples of a given matrix. One (1) trip blank will be included along with each sample delivery group of volatile organic compound (VOC) samples.

The analytical laboratory, Alpha Analytical, is certified under the New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP) as LabIDs 11148 and 11627. NYSDEC Analytical Services Protocol (ASP) Category B deliverables will be prepared by the laboratory.

3.2 Sample Handling

Samples will either be picked up by the laboratory, delivered to the laboratory in person by the sampler, or transported to the laboratory by overnight courier. All samples will be shipped to the laboratory to arrive within 48 hours after collection, and the laboratory will adhere to the analytical holding times for these analyses, as listed in the current version of the New York State ASP.

3.3 Custody Procedures

Sample custody will be controlled and maintained through the chain-of-custody procedures. The chain of custody is the means by which the possession and handling of samples is tracked from the site to the laboratory. Sample containers will be cleaned and preserved at the laboratory before shipment to the Site. The following sections (Sections 3.4 and 3.5) describe procedures for maintaining sample custody from the time samples are collected to the time they are received by the analytical laboratory.

3.4 Sample Storage

Samples will be stored in secure limited-access areas. Walk-in coolers or refrigerators will be maintained at 4°C, ± 2°C, or as required by the applicable regulatory program. The temperatures of all refrigerated storage areas are monitored and recorded a minimum of once per day. Deviations of temperature from the applicable range require corrective action, including moving samples to another storage location, if necessary.

3.5 Sample Custody

Sample custody is defined by this QAPP as the following:

- The sample is in someone's actual possession;
- The sample is in someone's view after being in his or her physical possession;
- The sample was in someone's possession and then locked, sealed, or secured in a manner that prevents unsuspected tampering; or,
- The sample is placed in a designated and secured area.

Samples will be removed from storage areas by the sample custodian or laboratory personnel and transported to secure laboratory areas for analysis. Access to the laboratory and sample storage areas is restricted to laboratory personnel and escorted visitors only; all areas of the laboratory are therefore considered secure.

Laboratory documentation used to establish chain of custody and sample identification may include the following:

- Field chains of custody or other paperwork that arrives with the sample;
- Laboratory chain of custody;
- Sample labels or tags attached to each sample container;
- Sample custody seals;
- Sample preparation logs (i.e., extraction and digestion information) recorded in hardbound laboratory books, filled out in legible handwriting, and signed and dated by the chemist;
- Sample analysis logs (e.g., metals, GC/MS, etc.) information recorded in hardbound laboratory books that are filled out in legible handwriting, and signed and dated by the chemist;
- Sample storage log (same as the laboratory chain of custody); and,
- Sample disposition log, which documents sample disposal by a contracted waste disposal company.

3.6 Sample Tracking

All samples will be maintained in the appropriate coolers prior to and after analysis. Laboratory analysts will remove and return their samples, as needed. Samples that require internal chain of custody procedures will be relinquished to the analysts by the sample custodians. The analyst and sample custodian will sign the original chain of custody relinquishing custody of the samples from the sample custodian to the analyst. When the samples are returned, the analyst will sign the original chain of custody returning sample custody to the sample custodian. Sample extracts will be relinquished to the instrumentation analysts by the preparatory analysts. Each preparation department will track internal chain of custody through their logbooks/spreadsheets.

Any change in the sample during the time of custody will be noted on the chain of custody (e.g., sample breakage or depletion).

3.7 Quarterly Groundwater Sampling

Prior to sample collection, static water levels will be measured and recorded from all monitoring wells. Monitoring wells will also be gauged for the presence of light non-aqueous phase liquid (LNAPL). In the event that LNAPL is detected, Tenen will record the thickness and will not collect a sample. If LNAPL is not detected, Tenen will purge and sample monitoring wells using low-flow/minimal drawdown purge and sample collection procedures (peristaltic pump). Prior to sample collection, groundwater will be evacuated from each well at a low-flow rate (typically less than 0.1 L/min). Field measurements for pH, temperature, turbidity, dissolved oxygen, specific conductance, oxidation-reduction potential and water level, as well as visual and olfactory field observations, will be periodically recorded and monitored for stabilization. Purging will be considered complete when pH, specific conductivity, dissolved oxygen and temperature stabilize and when turbidity measurements fall below 50 Nephelometric Turbidity Units (NTU) or become stable above 50 NTU. If stabilization does not occur or the well has been purged and recovery cannot maintain the pace of low flow purging, a sample will be collected and a notation will be made in the field book.

Stability is defined as variation between field measurements of 10 percent or less and no overall upward or downward trend in the measurements. Upon stabilization of field parameters, groundwater samples will be collected and analyzed as discussed below.

Wells will be purged and sampled using dedicated pump tubing following low-flow/minimal drawdown purge and sample collection procedures, as described above. The pump will be decontaminated between samples and the tubing will be replaced.

Groundwater samples will be collected for laboratory analysis through dedicated tubing. Prior to, and immediately following collection of groundwater samples, field measurements for pH, specific conductance, temperature, dissolved oxygen, turbidity and depth-to-water, as well as visual and olfactory field observations will be recorded. All collected groundwater samples will be placed in pre-cleaned, pre-preserved laboratory provided sample bottles, cooled to 4°C in the field, and transported under chain-of-custody command to the designated laboratory for analysis.

Post-remedial groundwater sampling will be completed in accordance with a Site Management Plan (SMP). It is anticipated that groundwater samples will be collected from twelve previously installed wells beginning approximately 30 days after the groundwater remedy described in Section 5.1.2 of the RAWP is implemented and quarterly for a minimum of five quarters. Proposed post-remedial groundwater sample locations are shown on Figure 10 of the RAWP.

Based upon the results of previous sampling conducted as part of the RI, groundwater samples will be analyzed for chlorinated VOCs (cVOCs) by EPA Method 8260C and/or per- and polyfluoroalkyl substances (PFAS) by EPA Method 1633 with a reporting limit of two nanograms per liter (ng/l) for PFAS. Monitoring wells MW-3, MW-4S, MW-4D, MW-5S, MW-6-C1, MW-6-C2, MW-7, MW-11S, and MW-11D will be analyzed for both cVOCs and PFAS; monitoring wells MW-9 and MW-12 will be analyzed for PFAS only; and, monitoring well MW-13 will be analyzed for cVOCs only.

Field methods can impact the analysis of PFAS. PFAS samples will be collected using dedicated disposable HDPE tubing. Sampling containers for PFAS will be made of HDPE with caps that will not be lined with PTFE. PFAS sampling containers will be kept in separate coolers from all other sampling containers and only regular ice will be used to cool the samples. Field staff conducting the sampling will not wear clothing that contains PTFE material or that has been waterproofed with PFAS material during sampling and all clothing worn will be laundered multiple times. Any bug spray or sunscreen utilized by field staff conducting the sampling will be PFAS free. A sampling guide is included in Appendix B. A list of PFAS compounds to be analyzed and associated MDLs is included in Appendix C. Alpha Analytical, an ELAP-certified lab for 40 PFAS analytes by EPA Method 1633, will be performing all PFAS analyses of groundwater. The laboratory standard operating procedures for PFAS analysis is included in Appendix D.

3.8 Analytical Methods/Quality Assurance Summary Table

A summary of the analytical methods and quality assurance methods are included in Table 1, below.

Table 1
Analytical Methods/Quality Assurance Summary

Matrix	Proposed Samples (per quarter)	QA/QC Samples				Total # Samples	Analytical Parameter	Method	Preservative	Holding Time	Container
		TB	FB	DUP	MS/MSD						
Groundwater	10	1	1	1	1 / 1	15	CVOCs	8260C	Cool to 4°C, pH<2 with HCl	14 days to analysis	(3) 40 mL amber glass vials
	11	0	1	1	1 / 1	15	PFAS	1633	Cool to 4°C	14 days to extraction	(2) 250 mL HDPE bottles

TB – Trip Blank
FB – Field Blank
DUP – Duplicate
°C – degrees Celsius
mL – milliliter
L – liter

3.9 Decontamination

Where possible, samples will be collected using new, dedicated sampling equipment so that decontamination is not required. All non-dedicated drilling tools and equipment will be decontaminated between boring locations using potable tap water and a phosphate-free detergent (e.g., Alconox) and/or a steam cleaner. All non-dedicated sampling equipment will also have a final rinse with deionized water. Decontamination water will be collected and disposed as investigation-derived waste (IDW).

3.10 Data Review and Reporting

The NYSDEC ASP Category B data package will be validated by an independent data validation subconsultant and a DUSR summarizing the results of the data validation process will be prepared. All reported analytical results will be qualified as necessary by the data validation and will be reviewed and compared against background concentrations and/or applicable New York State criteria:

Groundwater – Ambient Water Quality Standards (AWQS) and Guidance Values and Groundwater Effluent Limitations for groundwater as listed in NYSDEC Technical and Operations Guidance Series (TOGS) 1.1.1 and February 2023 Addendum.

Reports documenting the quarterly groundwater monitoring analytical results will be prepared in accordance with a Site Management Plan, and will describe Site conditions and document applicable observations made during the sample collection. In addition, the reports will include a description of the sampling procedures, tabulated sample results and an assessment of the data and conclusions. The laboratory data packages, DUSR, and field notes will be included in the report as appendices. All data will also be submitted electronically to NYSDEC via the Environmental Information Management System (EIMS) in EqUIS format.

Appendix A

Resumes

Mohamed Ahmed, Ph.D., C.P.G.
Sr. Geologist/Principal

Experience Summary

Mohamed Ahmed is a certified professional geologist with nearly 23 years of experience in the New York City metropolitan area. He has designed and implemented subsurface investigations and is proficient in groundwater modeling, design of groundwater treatment systems and soil remediation. He has managed numerous projects focused on compliance with the New York State Brownfield Cleanup and Spills programs and the New York City "e" designation program. Dr. Ahmed also has extensive experience in conducting regulatory negotiations with the New York State Department of Environmental Conservation, the NYC Office of Housing Preservation and Development, and the Mayor's Office of Environmental Remediation.

Selected Project Experience

Willoughby Square, Downtown Brooklyn

As Project Manager, directs all regulatory interaction and investigation on this joint public-private sector redevelopment that will include a public park and four-level underground parking garage. Prepared the remedial investigation work plan and remedial action work plan, conducted investigation activities and waste characterization, and negotiated with the NYC Department of Environmental Protection and the Mayor's Office of Environmental Remediation to transition the site into the NYC Voluntary Cleanup Program.

School Facility, Borough Park, Brooklyn

Managed all regulatory agency coordination, work plan and report preparation and remedial oversight; worked with OER to determine measures to retroactively address the hazardous materials and air quality E-designations on a previously constructed school building and prepared supporting documentation to justify the use of electrical units rather than natural gas.

LGA Hotel Site, East Elmhurst, Queens

Project manager for all work conducted at this former gasoline service station which is being remediated under the NYS Brownfield Cleanup Program; technical oversight of work plans, reports, and design and implementation of field and soil disposal characterization.

436 10th Avenue, Manhattan

As project manager and technical lead, assisted client in developing remedial cost estimates used for property transaction, developed regulatory strategy to address NYS Spills and NYC E-designation requirements, and currently overseeing remedial activities which include removal and disposal of petroleum-contaminated bedrock and dewatering and disposal of impacted groundwater.

Brownfield Cleanup Program Site, Downtown Brooklyn

Managed investigation and remediation under the BCP program for a proposed mixed-use development; designed the remedial investigation and prepared the remedial action work plan which includes an SVE system monitored natural attenuation. Prepared remedial cost estimates for several scenarios. The project will include a 53-story mixed-use structure and parking garage.

Queens West Development, Long Island City
Directed project team and subcontractors for soil investigation/remediation studies on multiple properties; provided technical support for negotiations with NYSDEC during investigation and remediation.

Former Creosote Site, Long Island City
Designed and implemented a complex investigation to assess the nature and extent of historic creosote contamination at this former industrial site; conducted studies to optimize recovery of LNAPL and DNAPL and developed strategies using bioremediation and natural attenuation in conjunction with conventional remedial approaches. Performed pilot tests for soil vapor extraction system design and coordinated with NYSDEC and NYSDOH to implement sub-slab soil vapor sampling.

NYSDEC Spill Site – Far West Side, Manhattan
Developed a detailed remedial cost estimate for to support client negotiations with a major oil company. The estimate included costs pertaining to: chipping, removal and disposal of petroleum-impacted bedrock; removal/disposal of recycled concrete; costs for dewatering and disposal of impacted groundwater during construction; and design and installation of a vapor barrier below the redevelopment.

Active Industrial Facility, Newburgh, New York
Designed remedial investigation of soil and groundwater contaminated with trichloroethane; performed soil vapor pilot test and pump test to aid in design of soil and groundwater remediation alternatives; conducted sub-slab vapor sampling in accordance with NYSDOH guidance.

Former Dry Cleaning Facility, New York City
Conducted soil and groundwater investigations, designed and installed a soil vapor extraction system and performed extensive testing of indoor air. Negotiated the scope of the RI and IRM with NYSDEC.

Waterfront Redevelopment, Yonkers, NY
Designed and performed geophysics survey of six parcels to determine locations of subsurface features; supervised test pit excavation to confirm geophysics results and evaluate and classify soil conditions prior to development activities.

Prince's Point, Staten Island, New York
Performed soil, groundwater and sediment sampling to delineate the extent of contamination; used field-screening techniques to control analytical costs and supervised soil excavation and disposal.

Apartment Complex, New York City, New York
Coordinated with Con Edison, the owner of the adjacent property and NYSDEC to determine oil recovery protocol; assessed hydrogeological conditions and conducted pilot tests to design cost-effective recovery system; designed and supervised installation of recovery system.

Publications

“Impact of Toxic Waste Dumping on the Submarine Environment: A Case Study from the New York Bight”. Northeastern Geology and Environmental Sciences, V. 21, No. 12, p. 102-120. (With G. Friedman)

Metals Fluxes Across the Water/Sediment Interface and the Influence of pH. Northeastern Geology and Environmental Sciences, in press. (With G. Friedman)

“Water and Organic Waste Near Dumping Ground in the New York Bight”. International Journal of Coal Geology, volume 43. (With G. Friedman)

Education and Certifications

Ph.D., Earth and Environmental Sciences, Graduate Center of the City of New York (2001)
M.Ph., Earth and Environmental Sciences, City University of New York (1998)
M.A. Geology, Brooklyn College (1993)
B.S. Geology, Alexandria University, Egypt (1982)

American Institute of Professional Geologists, Certified Professional Geologist, 1997-2015

Matthew Carroll, P.E.
Environmental Engineer/Principal

Experience Summary

Matthew Carroll is an environmental engineer experienced in all aspects of site assessment and development and implementation of remedial strategies. He has managed projects from inception through investigation, remediation and closure. His expertise includes soil, soil gas, and groundwater remediation, preparation of cost estimates, remedial alternative selection and design, soil characterization for disposal, field safety oversight, and preparation of work plans and reports to satisfy New York and New Jersey state requirements, and New York City "e" designation and restrictive declarations. Mr. Carroll's project management experience includes past management of a New York City School Construction Authority hazardous materials contract. He is responsible for all engineering work performed by Tenen and is currently the project manager and remedial engineer for several New York State Brownfield Cleanup Program sites.

Selected Project Experience

470 Kent Avenue, Brooklyn
As project manager, supported the client in due diligence and transactional activities, including a Phase I ESA, preliminary site investigation, and remedial cost estimate; preparation of BCP application and remedial investigation work plan. The former manufactured gas plant, sugar refinery and lumberyard will be developed as a mixed-use project with market rate and affordable housing and public waterfront access. As remedial engineer, will be responsible for development of remedial alternatives and oversight and certification of all remedial activities.

500 Exterior Street, Bronx
Designed and implemented the investigation of this former lumberyard and auto repair shop that will be redeveloped as mixed use development with an affordable housing component; prepared BCP application and subsequent work plans and reports. Designed a remedial strategy incorporating both interim remedial measures (IRMs) and remediation during the development phase.

Gateway Elton I and II, Brooklyn
Conducted soil disposal characterization, prepared Remedial Action Work Plans and designed methane mitigation systems for two phases of a nine-building residential development and commercial space; prepared and oversaw implementation of a Stormwater Pollution Prevention Plan during construction and prepared and certified the remedial closure reports for the project.

Affordable Housing Development, Rye, NY
Consultant to the City of Rye on environmental issues pertaining to a county-owned development site slated for an afford senior housing; reviewed environmental documentation for the project and prepared summary memorandum for City Council review; recommended engineering controls to address potential exposure to petroleum constituents, presented report findings at public meetings and currently providing ongoing environmental support during project implementation.

Queens West Development BCP Site, Long Island City, New York
Assistant Project Manager for two developers involved in the site.

- Responsible for oversight of remediation under the New York State Brownfield Cleanup Program
- Technical review of work plans and reports and coordination of the Applicant's investigation and oversight efforts
- Provided input for mass calculations and well placement for an in-situ oxidation remedy implemented on a proposed development parcel and within a City street
- Conducted technical review of work pertaining to a former refinery. Documents reviewed included work plans for characterization and contaminant delineation; pilot test (chemical oxidation); remediation (excavation and groundwater treatment). Managed field personnel conducting full time oversight and prepared progress summaries for distribution to project team
- Following implementation of remedial action, implemented the Site Management Plan and installation/design of engineering controls (SSDS, vapor barrier/concrete slab, NAPL recovery). Also responsible for coordination with NYSDEC

Brownfield Cleanup Program Redevelopment Sites – West Side, New York City
Managed remediation of a development consisting of four parcels being addressed under one or more State and city regulatory programs (NYS Brownfield Cleanup Program, NYS Spills, and NYC "e" designation program). Remediation includes soil removal, screening and disposal; treatment of groundwater during construction dewatering and implementation of a worker health and safety plan and community air monitoring plan (HASP/CAMP)

Managed an additional BCP site, supported the Applicant in coordination with MTA to create station access for the planned No. 7 subway extension; also provided support the client in coordination with Amtrak to obtain access for remedial activities on the portion of the site that is within an Amtrak easement. The site will eventually be used for construction of a mixed-use high-rise building.

BCP Site, Downtown Brooklyn, New York
Performed investigation on off-site properties and designed an SSDS for an adjacent building, retrofitting the system within the constraints of the existing structure; coordinated the installation of the indoor HVAC controls and vapor barrier; provided input to the design of a SVE system to address soil vapor issues on the site.

West Chelsea Brownfield Cleanup Program Site
Designed an in-situ remediation program and sub-slab depressurization system to address contamination remaining under the High Line Viaduct; SSDS design included specification of sub-grade components, fan modeling and selection, identifying exhaust location within building constraints and performance modeling; prepared the Operations Maintenance and Monitoring Plan and Site Management Plan sections pertaining to the SSDS.

Historic Creosote Spill Remediation – Queens, New York – New York State Voluntary Cleanup Program
Modeled contamination volume and extent and prepared mass estimates of historic fill constituents and creosote-related contamination; designed a soil vapor extraction (SVE) and dewatering system to address historic creosote release both above and below static

water table; coordinated with the Metropolitan Transit Authority and prepared drawings to secure approval to drill in the area of MTA subway tunnels.

NYSDEC Spill Site– Far West Side, Manhattan
Provided support to client during negotiations with a major oil company regarding allocation of remedial costs. Worked with client's attorney to develop a regulatory strategy to address the client's obligations under the NYSDEC Spills Program and the New York City "e" designation requirements.

Affordable Housing Site, Brooklyn, New York
Modified prior work plans for soil, soil vapor and groundwater investigation to address requirements for site entry into the New York City Brownfield Cleanup Program. Prepared technical basis for use of prior data previously disallowed by OER. Currently conducting site investigation.

New York City School Construction Authority Hazardous Materials Contract
Provided work scopes and cost estimates, managed and implemented concurrent projects, including Phase I site assessments, Phase II soil, groundwater and soil gas investigations, review of contractor bid documents, preparation of SEQR documents, specifications and field oversight for above- and underground storage tank removal, and emergency response and spill control.

Former Manufacturing Facility, Hoboken, New Jersey
Evaluated site investigation data to support a revision of the current property use to unrestricted; modified the John & Ettinger vapor intrusion model to apply the model to a site-specific, mixed use commercial/residential development; implemented a Remedial Action Work Plan that included the characterization, removal and separation of 9,500 cubic yards of historic fill; designed and implemented a groundwater characterization/delineation program using a real-time Triad approach; designed and implemented an innovative chemical oxidation technology for the property.

F**ormer Varnish Manufacturer – Newark, New Jersey**
Prepared a Phase I environmental site assessment; implemented soil and groundwater sampling to assess presence of petroleum and chlorinated compounds; prepared alternate cost remediation scenarios for settlement purposes and implemented a groundwater investigation plan, including pump tests and piezometer installation to assess the effect of subsurface utilities and unique drainage pathways upon contaminant transport.

Education and Certifications

Professional Engineer, New York
Bachelor of Engineering, Environmental; Stevens Institute of Technology, 2002
Bachelor of Science, Chemistry, New York University, 2002
Technical and Regulatory Training in Underground Storage Tanks, Cook College, Rutgers University, 2006

Lori A. Beyer

SUMMARY: General Manager/Laboratory Director with a solid technical background combined with Management experience in environmental testing industry. Outstanding organizational, leadership, communication and technical skills. Customer focused, quality oriented professional with consistently high marks in customer/employee satisfaction.

EXPERIENCE:

1998-Present L.A.B. Validation Corporation, 14 West Point Drive, East Northport, NY
President

- Perform Data Validation activities relating to laboratory generated Organic and Inorganic Environmental Data.

1998-Present American Analytical Laboratories, LLC. 56 Toledo Street, Farmingdale, NY
Laboratory Director/Technical Director

- Plan, direct and control the operation, development and implementation of programs for the entire laboratory in order to meet AAL's financial and operational performance standards.
- Ensures that all operations are in compliance with AAL's QA manual and other appropriate regulatory requirements.
- Actively maintains a safe and healthy working environmental that is demanded by local laws/regulations.
- Monitors and manages group's performance with respect to data quality, on time delivery, safety, analyst development/goal achievement and any other key performance indices.
- Reviews work for accuracy and completeness prior to release of results to customers.

1996-1998 Nytest Environmental, Inc. (NEI) Port Washington, New York
General Manager

- Responsible for controlling the operation of an 18,000 square foot facility to meet NEI's financial and operational performance standards.
- Management of 65 FTEs including Sales and Operations
- Ensure that all operations are in compliance with NEI's QA procedures
- Ensures that productivity indicators, staffing levels and other cost factors are held within established guidelines
- Maintains a quantified model of laboratory's capacity and uses this model as the basis for controlling the flow of work into and through the lab so as to ensure that customer requirements and lab's revenue and contribution targets are achieved.

1994-1996 Nytest Environmental, Inc. (NEI) Port Washington, New York
Technical Project Manager

- Responsible for the coordination and implementation of environmental testing programs requirements between NEI and their customers
- Supervise Customer Service Department
- Assist in the development of major proposals
- Complete management of all Federal and State Contracts and assigned commercial contracts
- Provide technical assistance to the customer, including data validation and interpretation
- Review and implement Project specific QAPP's.

1995-1996 Nytest Environmental, Inc. (NEI) Port Washington, New York
Corporate QA/QC Officer

- Responsible for the implementation of QA practices as required in the NJDEP and EPA Contracts
- Primary contact for NJDEP QA/QC issues including SOP preparation, review and approval
- Responsible for review, verification and adherence to the Contract requirements and NEI QA Plan

1992-1994 Nytest Environmental, Inc. (NEI) Port Washington, New York
Data Review Manager

- Responsible for the accurate compilation, review and delivery of analytical data to the company's customers. Directly and effectively supervised a department of 22 personnel.
- Managed activities of the data processing software including method development, form creation, and production
- Implement new protocol requirements for report and data management formats
- Maintained control of data storage/archival areas as EPA/CLP document control officer

1987-1991 Nytest Environmental, Inc. (NEI) Port Washington, New York
Data Review Specialist

- Responsible for the review of GC, GC/MS, Metals and Wet Chemistry data in accordance with regulatory requirements
- Proficient with USEPA, NYSDEC, NJDEP and NEESA requirements
- Review data generated in accordance with SW846, NYSDEC ASP, EPA/CLP and 40 CFR Methodologies

1986-1987 Nytest Environmental, Inc (NEI) Port Washington, New York
GC/MS VOA Analyst

EDUCATION:

1982-1985 State University of New York at Stony Brook, New York; BS Biology/Biochemistry
1981-1982 University of Delaware; Biology/Chemistry
5/91 Rutgers University; Mass Spectral Data Interpretation Course, GC/MS Training
8/92 Westchester Community College; Organic Data Validation Course
9/93 Westchester Community College; Inorganic Data Validation Course

Westchester Community College
Professional Development Center

Awards this Certificate of Achievement To

LORI BEYER

for Successfully Completing

ORGANIC DATA VALIDATION COURSE (35 HOURS)

Dr. John Samuelian

Date AUGUST 1992

Assistant Dean
Professional Development Center

President

The Professional
Development Center

SUNY
WESTCHESTER COMMUNITY COLLEGE
Valhalla, New York 10595

Westchester Community College

Professional Development Center

Awards this Certificate of Achievement To

LORI BEYER

for Successfully Completing

INORGANIC DATA VALIDATION

Instructor: Dale Boshart

Date MARCH 1993

Assistant Dean
Professional Development Center

President

The Professional
Development Center

SUNY
WESTCHESTER COMMUNITY COLLEGE
Valhalla, New York 10595

New York State Department of Environmental Conservation
50 Wolf Road, Albany, New York 12233

Thomas C. Jorling
Commissioner

July 8, 1992

Ms. Elaine Sall
Program Coordinator
Westchester Community College
Valhalla, NY 10595-1698

Dear Elaine,

Thank you for your letter of June 29, 1992. I have reviewed the course outline for organic data validation, qualifications for teachers and qualifications for students. The course that you propose to offer would be deemed equivalent to that which is offered by EPA. The individuals who successfully complete the course and pass the final written exam would be acceptable to perform the task of organic data validation for the Department of Environmental Conservation, Division of Hazardous Waste Remediation.

As we have discussed in our conversation of July 7, 1992, you will forward to me prior to the August course deadline, the differences between the EPA SOW/90 and the NYSDEC ASP 12/91. You stated these differences will be compiled by Mr. John Samulian.

I strongly encourage you to offer an inorganic data validation course. I anticipate the same list of candidates would be interested in an inorganic validation course as well, since most of the data to be validated consists of both organic and inorganic data.

Thank you for you efforts and please contact me if I can be of any further assistance.

Sincerely,

Maureen P. Serafini

Maureen P. Serafini
Environmental Chemist II
Division of Hazardous Waste
Remediation

The Professional Development Center
AT
WESTCHESTER COMMUNITY COLLEGE

914 285-6619

October 2, 1992

Ms. Lori Beyer
3 sparkill Drive
East Northport, NY 11731

Dear Ms. Beyer:

Congratulations upon successful completion of the Organic Data Validation course held August 17 - 21, 1992, through Westchester Community College, Professional Development Center. This course has been deemed by New York State Department of Environmental Conservation as equivalent to EPA's Organic Data Validation Course.

Enclosed is your Certificate. Holders of this Certificate are deemed competent to perform organic data validation for the New York State DEC Division of Hazardous Waste Remediation.

The Professional Development Center at Westchester Community College plans to continue to offer courses and seminars which will be valuable to environmental engineers, chemists and related personnel. Current plans include a TCLP seminar on November 17th and a conference on Environmental Monitoring Regulations on November 18th.

We look forward to seeing you again soon at another environmental program or event. Again, congratulations.

Very truly yours,

Passing Grade is 70%
Your Grade is 99%

Elaine Sall
Program Coordinator

ES/bf

The Professional Development Center
AT
WESTCHESTER COMMUNITY COLLEGE

914 285-6619

June 21, 1993

Dear Ms. Beyer:

Enclosed is your graded final examination in the Inorganic Data Validation course you completed this past March. A score of 70% was required in order to receive a certificate of satisfactory completion. Persons holding this certificate are deemed acceptable to perform Inorganic Data Validation for the New York State Department of Environmental Conservation, Division of Hazardous Waste Remediation.

I am also enclosing a course evaluation for you to complete if you have not already done so. The information you provide will greatly aid us in structuring further courses. We wish to make these course offerings as relevant, targeted and comprehensive as possible. Your evaluation is vital to that end.

Congratulations on your achievement. I look forward to seeing you again at another professional conference or course. We will be co-sponsoring an environmental monitoring conference on October 21, 1993 with the New York Water Pollution Control Association, Lower Hudson Chapter, at IBM's Yorktown Heights, NY site. Information regarding this event will be going out in August.

Very truly yours,

Elaine Sall

Elaine Sall
Program Coordinator

ES/bf

Enclosures

SUNY
WESTCHESTER COMMUNITY COLLEGE
Valhalla, New York 10595

Appendix B

PFAS Field Sampling Guidelines

EPA 537 (PFAS) Field Sampling Guidelines

PLEASE READ INSTRUCTIONS ENTIRELY PRIOR TO SAMPLING EVENT

Sampling for PFAS via EPA 537 can be challenging due to the prevalence of these compounds in consumer products. The following guidelines are strongly recommended when conducting sampling.

Reference-NHDES https://www.des.nh.gov/organization/divisions/waste/hwrb/documents/pfc-stakeholder-notification-20161122.pdf

FIELD CLOTHING and PPE

- No clothing or boots containing Gore-Tex®
- All safety boots made from polyurethane and PVC
- No materials containing Tyvek®
- Do not use fabric softener on clothing to be worn in field
- Do not used cosmetics, moisturizers, hand cream, or other related products the morning of sampling
- Do not use unauthorized sunscreen or insect repellant (see reference above for acceptable products)

SAMPLE CONTAINERS

- All sample containers made of HDPE or polypropylene
- Caps are unlined and made of HDPE or polypropylene (no Teflon® -lined caps)

WET WEATHER (AS APPLICABLE)

Wet weather gear made of polyurethane and PVC only

EQUIPMENT DECONTAMINATION

- "PFAS-free" water on-site for decontamination of sample equipment. No other water sources to be used
- Only Alconox and Liquinox can be used as decontamination materials

FOOD CONSIDERATIONS

No food or drink on-site with exception of bottled water and/or hydration drinks (i.e., Gatorade and Powerade) that is available for consumption only in the staging area

OTHER RECOMMENDATIONS

Sample for PFAS first! Other containers for other methods may have PFAS present on their sampling containers

FIELD EQUIPMENT

- Must not contain Teflon® (aka PTFE) or LDPE materials
- All sampling materials must be made from stainless steel, HDPE, acetate, silicon, or polypropylene
- No waterproof field books can be used
- No plastic clipboards, binders, or spiral hard cover notebooks can be used
- No adhesives (i.e. Post-It® Notes) can be used
- Sharpies and permanent markers not allowed; regular ball point pens are acceptable
- Aluminum foil must not be used
- Keep PFC samples in separate cooler, away from sampling containers that may contain PFAS
- Coolers filled with regular ice only - Do not use chemical (blue) ice packs

EPA 537 (PFAS) Field Sampling Guidelines

PLEASE READ INSTRUCTIONS ENTIRELY PRIOR TO SAMPLING EVENT

Sampler must wash hands before wearing nitrile gloves in order to limit contamination during sampling. Each sample set requires a set of containers to comply with the method as indicated below. **Sample set is composed of samples collected from the same sample site and at the same time.*

Container Count	Container Type	Preservative
3 Sampling Containers - Empty	250 mL container	Pre preserved with 1.25 g Trizma
1 Reagent Water for Field Blank use	250 mL container	Pre preserved with 1.25 g Trizma
P1 Field Blank (FRB) - Empty	250 mL container	Unpreserved

Sampling container must be filled to the neck. For instructional purposes a black line has been drawn to illustrate the required fill level for each of the 3 Sample containers

Field blanks are recommended and the containers have been provided, please follow the instructions below.

Field Blank Instructions:

1. Locate the Reagent Water container from the bottle order. The Reagent Water container will be pre-filled with PFAS-free water and is preserved with Trizma.
2. Locate the empty container labeled "Field Blank".
3. Open both containers and proceed to transfer contents of the "Reagent Water" container into the "Field Blank" container.
4. If field blanks are to be analyzed, they need to be noted on COC, and will be billed accordingly as a sample.

Both the empty Reagent Water container and the filled Field Blank container must be returned to the lab along with the samples taken.

Sampling Instructions:

1. Each sampling event requires 3 containers to be filled to the neck of the provided containers for each sampling location.
2. Before sampling, remove faucet aerator, run water for 5 min, slow water to flow of pencil to avoid splashing and fill sample containers to neck of container (as previously illustrated) and invert 5 times.
3. Do not overfill or rinse the container.
4. Close containers securely. Place containers in sealed ZipLoc® bags, and in a separate cooler (no other container types).
5. Ensure Chain-of-Custody and all labels on containers contain required information. Place sample, Field Blank and empty Reagent Blank containers in ice filled cooler (do not use blue ice) and return to the laboratory. Samples should be kept at 4°C ±2. Samples must not exceed 10°C during first 48 hours after collection. Hold time is 14 days.

Please contact your Alpha Analytical project manager with additional questions or concerns.

Appendix C

PFAS Compounds to be Analyzed and Associated MDLs

Appendix C
PFAS Compounds to be Analyzed and Associated MDLs

Analyte	Soil MDL (ng/g)	Groundwater MDL (ng/l)
Perfluorobutanoic Acid (PFBA)	0.0504	0.512
Perfluoropentanoic Acid (PFPeA)	0.056	0.428
Perfluorobutanesulfonic Acid (PFBS)	0.0432	0.268
1H,1H,2H,2H-Perfluorohexanesulfonic Acid (4:2FTS)	0.0808	0.836
Perfluorohexanoic Acid (PFHxA)	0.0464	0.236
Perfluoropentanesulfonic Acid (PFPeS)	0.0232	0.14
Perfluoroheptanoic Acid (PFHpA)	0.0232	0.16
Perfluorohexanesulfonic Acid (PFHxS)	0.0592	0.192
Perfluorooctanoic Acid (PFOA)	0.052	0.348
1H,1H,2H,2H-Perfluorooctanesulfonic Acid (6:2FTS)	0.28	1.08
Perfluoroheptanesulfonic Acid (PFHpS)	0.0368	0.216
Perfluorononanoic Acid (PFNA)	0.0784	0.252
Perfluorooctanesulfonic Acid (PFOS)	0.0792	0.364
Perfluorodecanoic Acid (PFDA)	0.0752	0.324
1H,1H,2H,2H-Perfluorodecanesulfonic Acid (8:2FTS)	0.3872	1.244
Perfluorononanesulfonic Acid (PFNS)	0.0424	0.248
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	0.1	0.436
Perfluoroundecanoic Acid (PFUnA)	0.0512	0.348
Perfluorodecanesulfonic Acid (PFDS)	0.032	0.184
Perfluorooctanesulfonamide (FOSA)	0.0432	0.216
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	0.0824	0.432
Perfluorododecanoic Acid (PFDoA)	0.0408	0.368
Perfluorotridecanoic Acid (PFTrDA)	0.0528	0.3
Perfluorotetradecanoic Acid (PFTA)	0.1064	0.212
2,3,3,3-Tetrafluoro-2-[1,1,2,2,3,3,3-Heptafluoropropoxy]-Propanoic Acid (HFPO-DA)	0.0984	0.448
4,8-Dioxa-3h-Perfluorononanoic Acid (ADONA)	0.1464	0.504
Perfluorododecane Sulfonic Acid (PFDoDS)	0.0384	0.304
9-Chlorohexadecafluoro-3-Oxanone-1-Sulfonic Acid (9Cl-PF3ONS)	0.196	0.66
11-Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid (11Cl-PF3OUdS)	0.1672	0.66
N-Methyl Perfluorooctane Sulfonamide (NMeFOSA)	0.1	0.348
N-Ethyl Perfluorooctane Sulfonamide (NEtFOSA)	0.112	0.368
N-Methyl Perfluorooctanesulfonamido Ethanol (NMeFOSE)	0.2504	1.88
N-Ethyl Perfluorooctanesulfonamido Ethanol (NEtFOSE)	0.5104	0.98
Perfluoro-3-Methoxypropanoic Acid (PFMPA)	0.0408	0.228
Perfluoro-4-Methoxybutanoic Acid (PFMBA)	0.0312	0.212
Perfluoro(2-Ethoxyethane)Sulfonic Acid (PFEESA)	0.0832	0.176
Nonafluoro-3,6-Dioxaheptanoic Acid (NFDHA)	0.0952	0.944
3-Perfluoropropyl Propanoic Acid (3:3FTCA)	0.144	1.32
2H,2H,3H,3H-Perfluorooctanoic Acid (5:3FTCA)	0.5048	4.68
3-Perfluoroheptyl Propanoic Acid (7:3FTCA)	1.76	3.156

Appendix D

Laboratory Standard Operating Procedures for PFAS Analysis

Method 1633 Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids and Tissue Samples by LC-MS/MS

References: Method 1633 - Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids, and Tissue Samples by LC-MS/MS (2nd Draft - June 2022)

DOD QSM (US Department of Defense Quality Systems Manual for Environmental Laboratories, version 5.4, 20221)

1. Scope and Application

Matrices: Drinking water, Non-potable Water, Tissues, Biosolids and Soil Matrices

Definitions: Refer to Alpha Analytical Quality Manual.

1.1 Method 1633 is for use in the Clean Water Act (CWA) for the determination of the per- and polyfluoroalkyl substances (PFAS) in Table 1 in aqueous, solid (soil, biosolids, sediment) and tissue samples by liquid chromatography/mass spectrometry (LC-MS/MS).

1.2 The method calibrates and quantifies PFAS analytes using isotopically labeled standards. Where linear and branched isomers are present in the sample and either qualitative or quantitative standards containing branched and linear isomers are commercially available, the PFAS analyte is reported as a single analyte consisting of the sum of the linear and branched isomer concentrations

1.3 This is a liquid chromatography/tandem mass spectrometry (LC/MS/MS) method for the determination of selected perfluorinated alkyl substances (PFAS) in Non-Drinking Water, tissue soil and biosolid Matrices. Accuracy and precision data have been generated for the compounds listed in Table 1.

1.4 The data report packages present the documentation of any method modification related to the samples tested. Depending upon the nature of the modification and the extent of intended use, the laboratory may be required to demonstrate that the modifications will produce equivalent results for the matrix. Approval of all method modifications is by one or more of the following laboratory personnel before performing the modification: Area Supervisor, Department Supervisor, Laboratory Director, or Quality Assurance Officer.

1.5 This method is restricted to use by or under the supervision of analysts experienced in the operation of the LC/MS/MS and in the interpretation of LC/MS/MS data. Each analyst must demonstrate the ability to generate acceptable results with this method by performing an initial demonstration of capability.

2. Summary of Method

2.1 Environmental samples are prepared and extracted using method-specific procedures. Sample extracts are subjected to cleanup procedures designed to remove interferences. Analyses of the sample extracts are conducted by LC-MS/MS in the multiple reaction monitoring (MRM) mode. Sample concentrations are determined by isotope dilution or extracted internal standard quantification using isotopically labeled compounds added to the samples before extraction.

2.2 Aqueous samples are spiked with isotopically labeled standards, extracted using solid-phase extraction (SPE) cartridges and undergo cleanup using carbon before analysis.

2.3 Solid samples are spiked with isotopically labeled standards, extracted into basic methanol, and cleaned up by carbon and SPE cartridges before analysis

2.4 Tissue samples are spiked with isotopically labeled standards, extracted in potassium hydroxide and acetonitrile followed by basic methanol, and cleaned up by carbon and SPE cartridges before analysis.

2.5 A sample extract is injected into an LC equipped with a C18 column that is interfaced to an MS/MS). The analytes are separated and identified by comparing the acquired mass spectra and retention times to reference spectra and retention times for calibration standards acquired under identical LC/MS/MS conditions. The concentration of each analyte is determined by using the isotope dilution technique. Extracted Internal Standards (EIS) analytes are used to monitor the extraction efficiency of the method analytes.

2.6 Method Modifications from Reference

N/A

3. Reporting Limits

The reporting limit for PFAS's are listed in Table 8.

4. Interferences

4.1 PFAS standards, extracts and samples should not come in contact with any glass containers or pipettes as these analytes can potentially adsorb to glass surfaces. PFAS analyte and EIS standards commercially purchased in glass ampoules are acceptable; however, all subsequent transfers or dilutions performed by the analyst must be prepared and stored in polypropylene containers.

4.2 Method interferences may be caused by contaminants in solvents, reagents (including reagent water), sample bottles and caps, and other sample processing hardware that lead to discrete artifacts and/or elevated baselines in the chromatograms. The method analytes in this method can also be found in many common laboratory supplies and equipment, such as PTFE (polytetrafluoroethylene) products, LC solvent lines, methanol, aluminum foil, SPE sample transfer lines, etc. All items such as these must be routinely demonstrated to be free from interferences (less than 1/2 the RL for each method analyte) under the conditions of the analysis by analyzing laboratory reagent blanks as described in Section 9.1. Subtracting blank values from sample results is not permitted.

4.3 Matrix interferences may be caused by contaminants that are co-extracted from the sample. The extent of matrix interferences will vary considerably from source to source, depending upon the nature of the water. Humic and/or fulvic material can be co-extracted during SPE and high levels can cause enhancement and/or suppression in the electrospray ionization source or low recoveries on the SPE sorbent. Total organic carbon (TOC) is a good indicator of humic content of the sample.

4.4 SPE cartridges can be a source of interferences. The analysis of field and laboratory reagent blanks can provide important information regarding the presence or absence of such interferences. Brands and lots of SPE devices should be tested to ensure that contamination does not preclude analyte identification and quantitation.

5. Health and Safety

5.1 The toxicity or carcinogenicity of each reagent and standard used in this method is not fully established; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. A reference file of material safety data sheets is available to all personnel involved in the chemical analysis. Additional references to laboratory safety are available in the Chemical Hygiene Plan.

5.2 All personnel handling environmental samples known to contain or to have been in contact with municipal waste must follow safety practices for handling known disease causative agents.

5.3 PFOA has been described as “likely to be carcinogenic to humans.” Pure standard materials and stock standard solutions of these method analytes should be handled with suitable protection to skin and eyes, and care should be taken not to breathe the vapors or ingest the materials.

6. Sample Collection, Preservation, Shipping and Handling

6.1 Sample Collection for Aqueous Samples

6.1.1 Samples must be collected in two (2) 500-mL or 250-mL high density polyethylene (HDPE) container with an unlined plastic screw cap. All sample containers must have linerless HDPE or polypropylene caps.

6.1.2 The sample handler must wash their hands before sampling and wear nitrile gloves while filling and sealing the sample bottles. PFAS contamination during sampling can occur from a number of common sources, such as food packaging and certain foods and beverages. Proper hand washing and wearing nitrile gloves will aid in minimizing this type of accidental contamination of the samples.

6.1.3 Open the tap and allow the system to flush until the water temperature has stabilized (approximately 3 to 5 min). Collect samples from the flowing system.

6.1.4 Fill sample bottles. Samples do not need to be collected headspace free.

6.1.5 After collecting the sample and cap the bottle. Keep the sample sealed from time of collection until extraction.

6.1.6 Maintain all aqueous samples protected from light at 0 - 6 ºC from the time of collection until shipped to the laboratory. Samples must be shipped as soon as practical with sufficient ice to maintain the sample temperature below 6 ºC during transport and be received by the laboratory within 48 hours of collection. The laboratory must confirm that the sample temperature is 0 - 6 ºC upon receipt. Once received by the laboratory, the samples must be stored at ≤ -20 ºC until sample preparation.

6.2 Sample Collection for Soil and Sediment samples.

6.2.1 Grab samples are collected in polypropylene containers. Sample containers and contact surfaces containing PTFE shall be avoided. Samples should fill no more than ¾ full.

6.2.2 Maintain solid samples protected from light (in HDPE containers) at 0 - 6 ºC from the time of collection until receipt at the laboratory. The laboratory must confirm that the sample temperature is 0 - 6 ºC upon receipt. Once received by the laboratory, the samples must be stored at ≤ -20 ºC until sample preparation.

6.3 Sample Collection for fish and other tissue samples

6.3.1 Once received by the laboratory, the samples must be maintained protected from light at ≤ -20 ºC until prepared. Store unused samples in HDPE containers or wrapped in aluminum foil at ≤ -20 ºC.

6.3.2 The nature of the tissues of interest may vary by project. Field sampling plans and protocols should explicitly state the samples to be collected and if any processing will be conducted in the field (e.g., filleting of whole fish or removal of organs). All field procedures must involve materials and equipment that have been shown to be free of PFAS.

6.4 Sample Preservation

Not applicable.

6.5 Sample Shipping

Samples must be chilled during shipment and must not exceed 0 – 6 °C during the first 48 hours after collection. Sample temperature must be confirmed to be at or below 0 – 6 °C when the samples are received at the laboratory. Samples stored in the lab must be held at or below 6 °C until extraction but should not be frozen.

NOTE: Samples that are significantly above 0 – 6 ° C, at the time of collection, may need to be iced or refrigerated for a period of time, in order to chill them prior to shipping. This will allow them to be shipped with sufficient ice to meet the above requirements.

6.6 Sample Handling

6.6.1 Aqueous samples (including leachates) should be analyzed as soon as possible; however, samples may be held in the laboratory for up to 90 days from collection, when stored at ≤ -20 ºC and protected from the light. When stored at 0 - 6 ºC and protected from the light, aqueous samples may be held for up to 28 days, with the caveat that issues were observed with certain perfluorooctane sulfonamide ethanols and perfluorooctane sulfonamidoacetic acids after 7 days. These issues are more likely to elevate the observed concentrations of other PFAS compounds via the transformation of these precursors if they are present in the sample.

6.6.2 Solid samples (soils and sediments) and tissue samples may be held for up to 90 days, if stored by the laboratory in the dark at either 0 - 6 ºC or ≤ -20 ºC, with the caveat that samples may need to be extracted as soon as possible if NFDHA is an important analyte.

6.6.3 Biosolids samples may be held for up to 90 days, if stored by the laboratory in the dark at 0 - 6 ºC or at -20 ºC. Because microbiological activity in biosolids samples at 0 - 6 ºC may lead to production of gases which may cause the sample to be expelled from the container when it is opened, as well as producing noxious odors, EPA recommends that samples be frozen if they need to be stored for more than a few days before extraction. Store sample extracts in the dark at less than 0 - 4 ºC until analyzed. If stored in the dark at less than 0 - 4 ºC, sample extracts may be stored for up to 90 days, with the caveat that issues were observed for some ether sulfonates after 28 days. These issues may elevate the observed concentrations of the ether sulfonates in the extract over time. Samples may need to be extracted as soon as possible if NFDHA is an important analyte.

7. Equipment and Supplies

7.1 SAMPLE CONTAINERS – 500-mL or 250-mL high density polyethylene (HDPE) bottles fitted with unlined screw caps. Sample bottles must be discarded after use.

7.2 SAMPLE JARS – 8-ounce wide mouth high density polyethylene (HDPE) bottles fitted with unlined screw caps. Sample bottles must be discarded after use.

7.3 POLYPROPYLENE BOTTLES – 4-mL narrow-mouth polypropylene bottles.

7.4 CENTRIFUGE TUBES – 50-mL conical polypropylene tubes with polypropylene screw caps for storing standard solutions and for collection of the extracts.

7.5 AUTOSAMPLER VIALS – Polypropylene 0.7-mL autosampler vials with polypropylene caps.

7.5.1 NOTE: Polypropylene vials and caps are necessary to prevent contamination of the sample from PTFE coated septa. However, polypropylene caps do not reseal, so evaporation occurs after injection. Thus, multiple injections from the same vial are not possible.

7.6 POLYPROPYLENE GRADUATED CYLINDERS – Suggested sizes include 25, 50, 100 and 1000-mL cylinders.

7.7 Auto Pipets – Suggested sizes include 5, 10, 25, 50, 100, 250, 500, 1000, 5000 and 10,000-µls.

7.8 PLASTIC PIPETS – Polypropylene or polyethylene disposable pipets.

7.9 Silanized glass wool (Sigma-Aldrich, Cat # 20411 or equivalent) – store in a clean glass jar and rinsed with methanol (2 times) prior to use.

7.10 Disposable syringe filter, 25-mm, 0.2-µm Nylon membrane, PALL/Acrodisc or equivalent

7.11 Variable volume pipettes with disposable HDPE or polypropylene tips (10 µL to 5 mL) used for preparation of calibration standards and spiked samples.

7.12 ANALYTICAL BALANCE – Capable of weighing to the nearest 0.0001 g.

7.13 ANALYTICAL BALANCE – Capable of weighing to the nearest 0.1 g.

7.14 SOLID PHASE EXTRACTION (SPE) APPARATUS FOR USING CARTRIDGES

7.14.1 SPE CARTRIDGES – (Waters Oasis WAX 150 mg, Cat # 186002493 or equivalent). The SPE sorbent must have a pKa above 8 so that it remains positively charged during the extraction.

7.14.1.1 Note: SPE cartridges with different bed volume (e.g., 500 mg) may be used; however, the laboratory must demonstrate that the bed volume does not negatively affect analyte absorption and elution, by performing the initial demonstration of capability analyses described in Section.

7.14.2 VACUUM EXTRACTION MANIFOLD – A manual vacuum manifold with large volume sampler for cartridge extractions, or an automatic/robotic sample preparation system designed for use with SPE cartridges, may be used if all QC requirements discussed in Section 9 are met. Extraction and/or elution steps may not be changed or omitted to accommodate the use of an automated system. Care must be taken with automated SPE systems to ensure the PTFE commonly used in these systems does not contribute to unacceptable analyte concentrations in the MB.

7.14.3 SAMPLE DELIVERY SYSTEM – Use of a polypropylene transfer tube system, which transfers the sample directly from the sample container to the SPE cartridge, is recommended, but not mandatory. Standard extraction manifolds come equipped with PTFE transfer tube systems. These can be replaced with 1/8” O.D. x 1/16” I.D. polypropylene or polyethylene tubing cut to an appropriate length to ensure no sample contamination from the sample transfer lines. Other types of non-PTFE tubing may be used provided it meets the MB and LCS QC requirements.

7.15 EXTRACT CONCENTRATION SYSTEM – Extracts are concentrated by evaporation with nitrogen using a water bath set no higher than 55 °C.

7.16 LABORATORY OR ASPIRATOR VACUUM SYSTEM – Sufficient capacity to maintain a vacuum of approximately 10 to 15 inches of mercury for extraction cartridges.

7.17 LIQUID CHROMATOGRAPHY (LC)/TANDEM MASS SPECTROMETER (MS/MS) WITH DATA SYSTEM

7.17.1 LC SYSTEM – Instrument capable of reproducibly injecting up to 10-µL aliquots and performing binary linear gradients at a constant flow rate near the flow rate used for development of this method (0.4 mL/min). The LC must be capable of pumping the water/methanol mobile phase without the use of a degasser which pulls vacuum on the mobile phase bottle (other types of degassers are acceptable). Degassers which pull vacuum on the mobile phase bottle will volatilize the ammonium acetate mobile phase causing the analyte peaks to shift to earlier retention times over the course of the analysis batch. The usage of a column heater is optional.

7.17.2 LC/TANDEM MASS SPECTROMETER – The LC/MS/MS must be capable of negative ion electrospray ionization (ESI) near the suggested LC flow rate of 0.4 mL/min. The system must be capable of performing MS/MS to produce unique product ions for the method analytes within specified retention time segments. A minimum of 10 scans across the chromatographic peak is required to ensure adequate precision.

7.17.3 DATA SYSTEM – An interfaced data system is required to acquire, store, reduce, and output mass spectral data. The computer software should have the capability of processing stored LC/MS/MS data by recognizing an LC peak within any given retention time window. The software must allow integration of the ion abundance of any specific ion within specified time or scan number limits. The software must be able to calculate relative response factors, construct linear regressions or quadratic calibration curves, and calculate analyte concentrations.

7.17.4 INSTRUMENT COLUMNS

7.17.4.1 ANALYTICAL: C18 column, 1.7 µm, 50 x 2.1 mm (Waters Acquity UPLC® BEH or equivalent)

7.17.4.2 OPTIONAL GUARD COLUMN: (Phenomenex Kinetex® Evo C18 or equivalent)

8. Reagents and Standards

8.1 GASES, REAGENTS, AND SOLVENTS – Reagent grade or better chemicals must be used.

8.1.1 REAGENT WATER – Purified water which does not contain any measurable quantities of any method analytes or interfering compounds greater than 1/2 the RL for each method analyte of interest. Prior to daily use, at least 3 L of reagent water should be flushed from the purification system to rinse out any build-up of analytes in the system's tubing.

8.1.2 METHANOL (CH_3OH, CAS#: 67-56-1) – High purity, demonstrated to be free of analytes and interferences.

8.1.3 AMMONIUM ACETATE ($NH_4C_2H_3O_2$, CAS#: 631-61-8) – High purity, demonstrated to be free of analytes and interferences.

8.1.4 ACETIC ACID (H_3CCOOH, CAS#: 64-19-7) - High purity, demonstrated to be free of analytes and interferences.

8.1.5 1M AMMONIUM ACETATE/REAGENT WATER – High purity, demonstrated to be free of analytes and interferences.

8.1.6 2mM AMMONIUM ACETATE/METHANOL:WATER (5:95) – To prepare, mix 2 ml of 1M AMMONIUM ACETATE,1 ml ACETIC ACID and 50 ml METHANOL into I Liter of REAGENT WATER.

8.1.7 ACETONITRILE – UPLC grade or equivalent, store at room temperature

8.1.8 TOLUENE – HPLC grade or equivalent.

8.1.9 ACETONE – pesticide grade or equivalent

8.1.10 AMMONIUM ACETATE – (Caledon Ultra LC/MS grade or equivalent

8.1.11 AMMONIUM HYDROXIDE (NH_3, CAS#: 1336-21-6) – High purity, demonstrated to be free of analytes and interferences.

8.1.12 METHANOLIC AMMONIUM HYDROXIDE (0.3%) - add ammonium hydroxide (1 mL, 30%) to methanol (99 mL), store at room temperature, replace after 1 month

8.1.13 METHANOLIC AMMONIUM HYDROXIDE (1%) - add ammonium hydroxide (3.3 mL, 30%) to methanol (97 mL), store at room temperature, replace after 1 month

8.1.14 METHANOLIC AMMONIUM HYDROXIDE (2%) - add ammonium hydroxide (6.6 mL, 30%) to methanol (93.4 mL), store at room temperature, replace after 1 month

8.1.15 METHANOLIC POTASSIUM HYDROXIDE (0.05 M) – add 3.3 g of potassium hydroxide to 1 L of methanol, store at room temperature, replace after 3 months

8.1.16 METHANOL WITH 4% WATER, 1% AMMONIUM HYDROXIDE AND 0.625% ACETIC ACID - add ammonium hydroxide (3.3 mL, 30%), reagent water (1.7 mL) and acetic acid (0.625 mL) to methanol (92 mL), store at room temperature, replace after 1 month. This solution is used to prepare the instrument blank and calibration standards (Section 8.3.2).

8.1.17 FORMIC ACID – (greater than 96% purity or equivalent).

8.1.18 FORMIC ACID (aqueous, 0.1 M) - dissolve formic acid (4.6 g) in reagent water (1 L), store at room temperature, replace after 2 years

8.1.19 FORMIC ACID (aqueous, 0.3 M) - dissolve formic acid (13.8 g) in reagent water (1 L), store at room temperature, replace after 2 years

8.1.20 FORMIC ACID (aqueous, 5% v/v) - mix 5 mL formic acid with 95 mL reagent water, store at room temperature, replace after 2 years

8.1.21 FORMIC ACID (methanolic 1:1, 0.1 M formic acid/methanol) - mix equal volumes of methanol and 0.1 M formic acid, store at room temperature, replace after 2 years

8.1.22 FORMIC ACID (aqueous, 50% v/v) - mix 50 mL formic acid with 50 mL reagent water, store at room temperature, replace after 2 years

8.1.23 POTASSIUM HYDROXIDE – certified ACS or equivalent

8.1.24 CARBON - – EnviCarb® 1-M-USP or equivalent, verified by lot number before use, store at room temperature. Loose carbon allows for better adsorption of interferent organics. Note: The single-laboratory validation laboratory achieved better performance with loose carbon than carbon cartridges. Loose carbon will be used for the multi-laboratory validation to set statistically based method criteria.

8.1.25 NITROGEN – Used for the following purposes: Nitrogen aids in aerosol generation of the ESI liquid spray and is used as collision gas in some MS/MS instruments. The nitrogen used should meet or exceed instrument manufacturer's specifications. In addition, Nitrogen is used to concentrate sample extracts (Ultra High Purity or equivalent).

8.1.26 ARGON – Used as collision gas in some MS/MS instruments. Argon should meet or exceed instrument manufacturer's specifications. Nitrogen gas may be used as the collision gas provided sufficient sensitivity (product ion formation) is achieved.

8.2 REFERENCE MATRICES - Matrices in which PFAS and interfering compounds are not detected by this method. These matrices are to be used to prepare the batch QC samples.

8.2.1 Reagent water - purified water, Type I

8.2.2 Solid reference matrix Ottawa Sand or equivalent

8.2.3 Tissue Reference matrix – Cod loin or other animal tissue demonstrated to be PFAS free

8.3 STANDARD SOLUTIONS – When a compound purity is assayed to be 96% or greater, the weight can be used without correction to calculate the concentration of the stock standard. PFAS analyte and IS standards commercially purchased in glass ampoules are acceptable; however, all subsequent transfers or dilutions performed by the analyst must be prepared and stored in polypropylene containers and are stored at ≤4 °C. Standards for sample fortification generally should be prepared in the smallest volume that can be accurately measured to minimize the addition of excess organic solvent to aqueous samples.

8.3.1 Stock standards and diluted stock standards are stored at ≤4 °C. Prepare a spiking solution, containing the method analytes listed in Table 1, in methanol from prime stocks. The solution is used to prepare the calibration standards and to spike the known reference QC samples that are analyzed with every batch. Quantitative standards containing a mixture of branched and linear isomers must be used for method analytes if they are commercially available. Currently, these include PFOS, PFHxS, NEtFOSAA, and NMeFOSAA.

8.3.2 Calibration standard solutions – A series of calibration solutions containing the target analytes and the Labeled extracted internal standards (EIS) and non-extracted internal standards (NIS) is used to establish the initial calibration of the analytical instrument. Table 4 represents the concentrations of the native, EIS and NIS analytes of the calibration curve. Calibration standard solutions are made using the solution described in section 8.1.16.

8.3.3 ISOTOPE DILUTION EXTRACTED INTERNAL STANDARD (EIS) – Isotopically labelled analogs of the target analytes to be used for the quantification of target analytes. EIS stock standard solutions are purchased in glass ampoules and are stored in accordance with the manufacturer's recommendations. The EIS stock solution to be used for the fortification of samples and QC in accordance with the isotope dilution procedure. Table 2 represents the EIS concentrations and nominal sample amounts added to each field sample and QC element.

8.3.4 ISOTOPE DILUTION NON-EXTRACTED INTERNAL STANDARDS (NIS) – Isotopically labelled analogs to be added post extraction for the measurement of EIS extraction efficiency and is added to the final volume of all extractions. Table 3 represents the EIS concentrations and nominal sample amounts added to each field sample and QC element.

9. Quality Control

9.1 Method Blank

9.1.1 A Method Blank (MB) is required with each extraction batch to confirm that potential background contaminants are not interfering with the identification or quantitation of method analytes. An aliquot of reagent water that is treated exactly as a sample including exposure to all glassware, equipment, solvents, reagents and standards. Prep and analyze a MB for every 20 samples. If the MB produces a peak within the retention time window of any analyte that would prevent the determination of that analyte, determine the source of contamination, and eliminate the interference before processing samples. Background contamination must be reduced to an acceptable level before proceeding. Background from method analytes or other contaminants that interfere with the measurement of method analytes must be below the RL. If the method analytes are detected in the MB at concentrations equal to or greater than this level, then all data for the problem analyte(s) must be considered invalid for all samples in the extraction batch.

9.2 Laboratory Control Sample (LCS)

9.2.1 Low Level LCS or OPR (Ongoing Precision Recovery) sample is required with each extraction batch. A LLCS or OPR samples is a method blank spiked with known quantities of analytes. The fortified concentration of the LCS is spiked at 2X the LOQ. Default limits of 70-130% of the true value may be used for analytes until sufficient replicates have been analyzed to generate proper control limits. Calculate the percent recovery (%*R*) for each analyte using the equation:

9.2.2 An LCS or OPR (Ongoing Precision Recovery) sample is required with each extraction batch. A LCS or OPR samples is a method blank spiked with known quantities of analytes. The fortified concentration of the LCS is spiked at the midpoint of the calibration curve. Default limits of 70-130% of the true value may be used for analytes until sufficient replicates have been analyzed to generate proper control limits. Calculate the percent recovery (%*R*) for each analyte using the equation:

$$\%R = \frac{A \times 100}{B}$$

Where:

A = measured concentration in the fortified sample
B =fortification concentration.

9.1.1 Where applicable, in the absence of additional sample volume required to perform matrix specific QC, LCSD’s are to be extracted and analyzed. The concentration and analyte recovery criteria for the LCSD must be the same as the batch LCS The RSD’s must fall within ≤30% of the true value for medium and high-level replicates, and ≤50% for low level replicates. Calculate the relative percent difference (RPD) for duplicate MSs (MS and MSD) using the equation:

$$RPD = \frac{|LCS - LCSD|}{(LCS + LCSD) / 2} \times 100$$

9.1.2 If the LCS and or LCSD results do not meet these criteria for method analytes, then all data for the problem analyte(s) must be considered invalid for all samples in the extraction batch.

9.3 Non-extracted Internal Standard Area (NIS)

Each time an initial calibration is performed, use the data from all the initial calibration standards used to meet the linearity test in Section 10.3.3.3 to calculate the mean area response for each of the NIS compounds, using the equation below.

$$\text{Mean Area}_{\text{NISi}} = \sum \text{AREA}_{\text{NISi}} / \text{n}$$

where:

AreaNISi = Area counts for the ith NIS, where i ranges from 1 to 7, for the seven NIS compounds listed in Table 1
n = The number of ICAL standards (the default value is n = 6). If a different number of standards is used for the ICAL, for example, to increase the calibration range or by dropping a point at either end of the range to meet the linearity criterion, change 6 to match the actual number of standards used)
Record the mean areas for each NIS for use in evaluating results for sample analyses. There is no acceptance criterion associated with the mean NIS area data.

9.4 Extracted Internal Standards (EIS)

9.4.1 The EIS standard is fortified into all samples, CCVs, MBs, LCSs, MSs, MSDs, FD, and FRB prior to extraction. It is also added to the CAL standards. The EIS is a means of assessing method performance from extraction to final chromatographic measurement. Calculate the recovery (%R) for the EIS using the following equation:

$$\%R = (A / B) \times 100$$

Where:
A = calculated EIS concentration for the QC or Field Sample
B = fortified concentration of the EIS.

9.4.2 Default limits of 50-150% may be used for analytes until sufficient replicates have been analyzed to generate proper control limits. A low or high percent recovery for a sample, blank, or CCV does not require discarding the analytical data but it may indicate a potential problem with future analytical data. When EIS recovery from a sample, blank, or CCV are outside control limits, check 1) calculations to locate possible errors, 2) standard solutions for degradation, 3) contamination, and 4) instrument performance. For CCVs and QC elements spiked with all target analytes, if the recovery of the corresponding target analytes meet the acceptance criteria for the EIS in question, the data can be used but all potential biases in the recovery of the EIS must be documented in the sample report. If the associated target analytes do not meet the acceptance criteria, the data must be reanalyzed.

9.5 Matrix Spike (MS/MSD)

9.5.1 Analysis of an MS is prepared one per preparation batch (if required).

9.5.2 Aliquots of field samples that have been fortified with a known concentration of target compounds, prior to sample preparation and extraction, and analyzed to measure the effect of matrix interferences. The use of MS/MSD samples is generally not required in isotope dilution methods because the labeled compounds added to every sample provide more performance data than spiking a single sample in each preparation batch. Aliquots of field samples

9.5.3 Analyte recoveries may exhibit matrix bias. For samples fortified at or above their native concentration, recoveries should range between 50-150%. If the accuracy of any analyte falls outside the designated range, and the laboratory performance for that analyte is shown to be in control in the LCS, the recovery is judged to be matrix biased. The result for that analyte in the unfortified sample is labeled suspect/matrix to inform the data user that the results are suspect due to matrix effects.

9.6 Laboratory Duplicate

9.6.1 FIELD DUPLICATE OR LABORATORY FORTIFIED SAMPLE MATRIX DUPLICATE (FD or MSD) – Within each extraction batch (not to exceed 20 Field Samples), a minimum of one FD or MSD must be analyzed. Duplicates check the precision associated with sample collection, preservation, storage, and laboratory procedures. If method analytes are not routinely observed in Field Samples, an MSD should be analyzed rather than an FD.

9.6.2 Calculate the relative percent difference (*RPD*) for duplicate measurements (*FD1* and *FD2*) using the equation:

$$\text{RPD} = \frac{|\text{FD1} - \text{FD2}|}{(\text{FD1} + \text{FD2}) / 2} \times 100$$

9.6.3 RPDs for FDs should be ≤30%. Greater variability may be observed when FDs have analyte concentrations that are within a factor of 2 of the RL. At these concentrations, FDs should have RPDs that are ≤50%. If the RPD of any analyte falls outside the designated range, and the laboratory performance for that analyte is shown to be in control in the CCV, the recovery is judged to be matrix biased. The result for that analyte in the unfortified sample is labeled suspect/matrix to inform the data user that the results are suspect due to matrix effects.

9.6.4 If an MSD is analyzed instead of a FD, calculate the relative percent difference (RPD) for duplicate MSs (MS and MSD) using the equation:

$$\text{RPD} = \frac{|\text{MS} - \text{MSD}|}{(\text{MS} + \text{MSD}) / 2} \times 100$$

9.6.5 RPDs for duplicate MSs should be ≤30% for samples fortified at or above their native concentration. Greater variability may be observed when MSs are fortified at analyte concentrations that are within a factor of 2 of the RL. MSs fortified at these concentrations should have RPDs that are ≤50% for samples fortified at or above their native concentration. If the RPD of any analyte falls outside the designated range, and the laboratory performance for that analyte is shown to be in control in the LCSD where applicable, the result is judged to be matrix biased. If no LCSD is present, the associated MS and MSD are to be re-analyzed to determine if any analytical has occurred. If the resulting RPDs are still outside control limits, the result for that analyte in the unfortified sample is labeled suspect/matrix to inform the data user that the results are suspect due to matrix effects.

9.7 Bile Salt Interference Check

9.7.1 The laboratory must analyze a TDCA standard after the initial calibration, prior to the analysis of tissue samples, to check for interferences caused by bile salts. If an interference is present, the chromatographic conditions must be modified to eliminate the interference from TDCA (e.g., changing the retention time of TDCA such that it falls outside the

9.8 Initial Calibration Verification (ICV)

9.8.1 After each ICAL, analyze a QCS sample from a source different from the source of the CAL standards. If a second vendor is not available, then a different lot of the standard should be used. The QCS should be prepared and analyzed just like a CCV. Acceptance criteria for the QCS are identical to the CCVs; the calculated amount for each analyte must be ± 30% of the expected value. If measured analyte concentrations are not of acceptable accuracy, check the entire analytical procedure to locate and correct the problem.

9.9 Instrument Sensitivity Check (ISC)

9.9.1 At the start of each 12-hour shift, analyze a standard at the LOQ. The signal-to-noise ratio of the ISC standard must be greater than or equal to 3:1. If the requirements cannot be met, the problem must be corrected before analyses can proceed

9.10 Continuing Calibration Verification (CCV)

9.10.1 CCV Standards must be analyzed at the beginning of each analysis batch, after every 10 Field Samples, and at the end of the analysis batch.

9.10.2 The recovery of native and isotopically labeled compounds for the CVs must be within 70 - 130%

9.10.3

9.11 Method-specific Quality Control Samples

9.11.1 Instrument Blank – During the analysis of a batch of samples, a solvent blank is analyzed after samples containing high level of target compounds (e.g., calibration, CV) to monitor carryover from the previous injection. The injection blank consists of the solution in

Section 8.1.16 fortified with the EIS and NIS for quantitation purposes.

9.12 Example Method Sequence

- INSTRUMENT BLANK
- INSTRUMENT SENSITIVITY CHECK
- CALIBRATION VERIFICATION STANDARD
- QUALITATIVE IDENTIFICATION STANDARDS
- TDCA STANDARD (only if analyzing tissues)
- INSTRUMENT BLANK
- METHOD BLANK
- LOW-LEVEL LCS/OPR
- OPR/LCS
- SAMPLE (10 or fewer)
- CALIBRATION VERIFICATION STANDARD
- INSTRUMENT BLANK
- SAMPLE (10 or fewer)
- CALIBRATION VERIFICATION STANDARD
- INSTRUMENT BLANK

10. Procedure

10.1 Equipment Set-up

10.1.1 This procedure may be performed manually or in an automated mode using a robotic or automatic sample preparation device. If an automated system is used to prepare samples, follow the manufacturer's operating instructions, but all extraction and elution steps must be the same as in the manual procedure. Extraction and/or elution steps may not be changed or omitted to accommodate the use of an automated system. If an automated system is used, the MBs should be rotated among the ports to ensure that all the valves and tubing meet the MB requirements.

10.1.2 Some of the PFAS’s adsorb to surfaces, including polypropylene. Therefore, the aqueous sample bottles must be rinsed with the elution solvent whether extractions are performed manually or by automation. The bottle rinse is passed through the cartridge to elute the method analytes and is then collected.

10.1.3 The SPE cartridges and sample bottles described in this section are designed as single use items and should be discarded after use. They may not be refurbished for reuse in subsequent analyses.

10.1.4 All SPE apparatus, including manifolds, tubing and sample ports must be thoroughly rinsed following each use with 1% methanolic ammonium hydroxide, followed by Methanol and then DI water. Additionally, sample manifold ports and transfer tubing should be inspected regularly for signs of wear and/or discoloration. When such observations are made, the associated components should be replaced.

10.1.5 Prior to the start of any extraction, sample site information must be evaluated for any potentially high level PFAS concentrations or sample matrix irregularities that may impact the extraction process. If such samples are identified, aqueous samples may be pre-screened via direct aqueous injection prior to analysis to estimate the potential PFAS concentrations present.

10.1.6 To perform a direct aqueous injection (DAI) screen, the sample should be inverted several times to try and evenly disperse any organic matter present. A 1 ml aliquot (or less depending on the matrix) is to be taken from the parent sample, volume adjusted to 1 ml with reagent water if less than 1ml, fortified with EIS and NIS spiking solutions to match the concentrations of an extracted sample (typically 5 µl per 1 ml DAI), and then analyzed under the same analytical conditions as field samples.

10.2 Sample Preparation of Aqueous Samples

10.2.1 Samples are preserved, collected, and stored as presented in Section 6.

10.2.2 Determine sample volume. Weigh all samples to the nearest 1g. If visible sediment is present, centrifuge and decant into a new HDPE bottle and record the weight of the new container.

NOTE: Some of the PFAS's adsorb to surfaces, thus the sample volume may not be transferred to a graduated cylinder for volume measurement.

10.2.3 The MB, LCS and FRB may be prepared by measuring reagent water with a polypropylene graduated cylinder or filling an HDPE sample bottle to near the top.

10.2.4 Check that the pH is 6.5 ± 0.5. If necessary, adjust pH with 50% formic acid or ammonium hydroxide and 3% aqueous ammonium hydroxide. The extract is now ready for solid-phase extraction (SPE) and cleanup.

10.2.5 Add 20 µL of the EIS to each sample and QC, cap and invert to mix.

10.2.6 If the sample is an LCS, LCSD, MS, or MSD, add the necessary amount of analyte PDS. Cap and invert each sample to mix.

10.3 Sample Prep and Extraction Protocol for Soils, Solids and Sediments.

10.3.1 Homogenize and weigh 5 grams of sample (measured to the nearest hundredth of a gram) into a 50 ml polypropylene centrifuge tube. For laboratory control blanks and spikes, 5 grams of clean sand is used.

10.3.1.1 For Biosolids and other complex matrices, a small aliquot may be required due to co-extracted matrix interferences.

10.3.1.2 For batch QC samples using 5 g of reference solid, add 2.5 g of reagent water. The addition of reagent water to the sand provides a matrix closer in composition to real-world samples.

10.3.2 Add 20 µL of the EIS to each sample and QC.

10.3.3 If the sample is an LCS, LCSD, MS, or MSD, add the necessary amount of analyte PDS. Cap and invert each sample to mix.

10.3.4 Vortex the samples to evenly disperse the spiking solutions and allow to equilibrate for 30 minutes.

10.3.5 To all samples, add 10 ml of 0.3% methanolic ammonium hydroxide, cap, vortex for 25 seconds.

10.3.6 Following mixing, shake each sample for 30 minutes on a shaker table.

10.3.7 Centrifuge each sample at 2800RPM for 10 minutes.

10.3.8 Remove the supernatant and transfer to a clean 50 ml polypropylene centrifuge tube.

10.3.9 Repeat steps 10.3.4 to 10.3.7, with 15 ml of 0.3% methanolic ammonium hydroxide, combining the supernatants.

10.3.10 Add 5ml of 0.3% methanolic ammonium hydroxide to the sample, vortex for 25 seconds and centrifuge each sample at 2800RPM for 10 minutes.

10.3.11 Remove the supernatant and transfer to the same 50 ml polypropylene centrifuge tube containing eluates from the previous cycles.

10.3.12 Add 10 mg of carbon to the combined extract, mix by occasional hand shaking for no more than five minutes and then centrifuge at 2800 rpm for 10 minutes. Immediately decant the extract into a 50 ml polypropylene centrifuge tube.

10.3.13 Dilute to approximately 35 mL with reagent water. Samples containing more than 50% water may yield extracts that are greater than 35 mL in volume; therefore, do not add water to these. Determine the water content in the sample as follows (percent moisture is determined from the % solids):

Water Content in Sample = (Sample Weight * Percent moisture) / 100

10.3.14 Concentrate each extract at approximately 55 ºC with a gentle N2 flow to a final volume that is based on the water content of the sample (see table below). Allow extracts to concentrate for 10 minutes, then mix (by vortex if the volume is < 20. Continue concentrating and mixing every 5 minutes until the extract has been reduced to the required volume as specified in the table below. If the extract volume appears to stop dropping, the concentration must be stopped and the volume at which it was stopped recorded.

Water Content in Sample	Concentrated Final Volume
< 5 grams	15 ml
5-8 grams	15-20 ml
8-9 grams	20-22.5 ml
9-10 grams	22.5-25 ml

10.3.15 Add 40 - 50 mL of reagent water to the extract and vortex. Check that the pH is 6.5 ±0.5 and adjust as necessary with 50% formic acid or 30% ammonium hydroxide, or with 5% formic acid and 3% aqueous ammonium hydroxide. The extracts are ready for SPE and cleanup.

10.4 Sample Prep and Extraction Protocol for Tissues.

10.4.1 Homogenize and weigh 2 grams of sample (measured to the nearest hundredth of a gram) into a 50 ml polypropylene centrifuge tube. For laboratory control blanks and spikes, 2 grams of clean tissue is used.

10.4.2 Add 20 µL of the EIS PDS to each sample and QC.

10.4.3 If the sample is an LCS, LCSD, MS, or MSD, add the necessary amount of analyte PDS. Cap and invert each sample to mix.

10.4.4 Add 10 mL of 0.05M KOH in methanol to each sample. Vortex to disperse the tissue then place tubes on a mixing table to extract for at 16 hours. Centrifuge at 2800 rpm for 10 minutes and collect the supernatant in a 50-mL polypropylene centrifuge tube.

10.4.5 Add 10 mL of acetonitrile to remaining tissue in the 50-mL centrifuge tube, vortex to mix and disperse the tissue. Sonicate for 30 minutes. Centrifuge at 2800 rpm for 10 minutes and collect the supernatant, adding it to the 50-mL centrifuge tube containing the initial extract.

10.4.6 Add 5 mL of 0.05M KOH in methanol to the remaining sample in each centrifuge tube. Vortex to disperse the tissue and hand mix briefly. Centrifuge at 2800 rpm for 10 minutes and collect the supernatant, adding it to the 50-mL centrifuge tube containing the first two extracts.

10.4.7 Add 10 mg of carbon to the combined extract, mix by occasional hand shaking over a period of no more than five minutes and then centrifuge at 2800 rpm for 10 minutes. Immediately decant the extract into a 50-mL centrifuge tube.

10.4.8 Add 1 mL of reagent water to each tube and concentrate each extract at approximately 55 ºC with a gentle N2 flow to a final volume of 2.5 ml.

10.4.9 Add reagent water to each evaporation/concentrator tube to dilute the extracts to 50 mL. Check that the pH = 6.5 ± 0.5 and adjust as needed with 50% formic acid, or ammonium hydroxide or with 5% formic acid and 3% aqueous ammonium hydroxide. The extracts are ready for SPE and cleanup.

10.5 SPE Extract: All matrices

10.5.1 Pack clean silanized glass wool to half the height of the WAX SPE cartridge barrel.

10.5.2 Pre-condition the cartridges by washing them with 3 X 5 mL of 1% methanolic ammonium hydroxide, discarding the wash volumes.

10.5.3 Rinse the cartridge with 5 mL of 0.3M formic acid, allowing the cartridge to drain using gravity only, discarding the rinse volume. Do not allow the cartridge to go dry

10.5.4 Adjust the vacuum so that the approximate flow rate is ~5 mL/min and load the sample across the cartridge. Do not allow the cartridge to go dry before all the sample has passed through.

10.5.5 Once all the sample has passed across the cartridge, rinse the walls of the reservoir with 2 X 5 mL reagent water, loading the rinse across the cartridge.

10.5.6 Rinse the walls of the reservoir with 5 mL of 1:1 0.1M formic acid/methanol and pass the rinse through the cartridge using vacuum. Dry the cartridge by pulling air through for 15 seconds.

10.5.7 Rinse the inside of the sample bottle with 5 mL of 1% methanolic ammonium hydroxide. Use vacuum to pull the elution solvent through the cartridge and into the collection tubes. When the cartridge bed and glass wool are submerged, stop the cartridge flow by closing the valve, keeping the sorbent bed and wool submerged.

10.5.8 Let the wetted sorbent bed and wool soak for 1 minute.

10.5.9 Open the cartridge valve and collect the eluate into a 15 ml polypropylene collection tube.

10.5.10 Add 25 µL of concentrated acetic acid to each sample eluted in the collection tubes and vortex to mix.

10.5.11 Add 10 mg of carbon to each sample and batch QC extract, using a 10-mg scoop. Handshake occasionally for no more than 5 minutes. It is important to minimize the time the sample extract is in contact with the carbon. Immediately vortex (30 seconds) and centrifuge at 2800 rpm for 10 minutes.

10.5.12 Add NIS solution to a clean collection tube. Place a syringe filter (25-mm filter, 0.2-µm nylon membrane) on a 5-mL polypropylene syringe. Take the plunger out and carefully decant the sample supernatant into the syringe barrel. Replace the plunger and filter the entire extract into the new collection tube containing the NIS.

10.5.13 Vortex to mix and transfer a portion of the extract into a .7-mL polypropylene LC vial for LC-MS/MS analysis. Cap the collection tube containing the remaining extract and store at 4 °C

10.6 Sample Volume Determination

10.6.1 If using weight to determine volume, weigh the empty bottle to the nearest 1 g and determine the sample weight by subtraction of the empty bottle weight from the original sample weight. Assume a sample density of 1.0 g/mL. In either case, the sample volume will be used in the final calculations of the analyte concentration.

10.7 Initial Calibration - Demonstration and documentation of acceptable initial calibration is required before any samples are analyzed. After the initial calibration is successful, a CCV is required at the beginning and end of each period in which analyses are performed, and after every tenth Field Sample.

10.7.1 ESI-MS/MS TUNE

10.7.1.1 Calibrate the mass scale of the MS with the calibration compounds and procedures prescribed by the manufacturer.

10.7.1.2 Optimize the [M-H]- or [M-CO_2]- for each method analyte by infusing approximately 0.5-1.0 µg/mL of each analyte (prepared in the initial mobile phase conditions) directly into the MS at the chosen LC mobile phase flow rate (0.4 mL/min). This tune can be done on a mix of the method analytes. The MS parameters (voltages, temperatures, gas flows, etc.) are varied until optimal analyte responses are determined.

The method analytes may have different optima requiring some compromise between the optima.

The Mass spec conditions found in Table 7 show the Sciex Triple Quad 5500+ operation conditions used in this method.

10.7.1.3 Optimize the product ion for each analyte by infusing approximately 0.5-1.0 µg/mL of each analyte (prepared in the initial mobile phase conditions) directly into the MS at the chosen LC mobile phase flow rate (approximately 0.4 mL/min). This tune can be done on a mix of the method analytes. The MS/MS parameters (collision gas pressure, collision energy, etc.) are varied until optimal analyte responses are determined. Typically, the carboxylic acids have very similar MS/MS conditions, and the sulfonic acids have similar MS/MS conditions.

The conditions found on table 5 are representative of expected tune optimizations for each analyte. If conditions other the ones close to the values provided in table 5 are achieved, the process should be re-performed and/or instrument maintenance performed to resolve the problem.

10.7.2 Establish LC operating parameters that optimize resolution and peak shape. Modifying the standard or extract composition to more aqueous content to prevent poor shape is not permitted.

Table 6 represents the operation conditions of a Sciex Exion LC system when running this method.

10.7.3 Inject 2µl of a mid-level CAL standard under LC/MS conditions to obtain the retention times of each method analyte. Divide the chromatogram into retention time windows each of which contains one or more chromatographic peaks. During MS/MS analysis, fragment a small number of selected precursor ions ([M-H]-) for the analytes in each window and choose the most abundant product ion. For maximum sensitivity, small mass windows of ±0.5 daltons around the product ion mass were used for quantitation.

10.7.4 Inject a mid-level CAL standard under optimized LC/MS/MS conditions to ensure that each method analyte is observed in its MS/MS window and that there are at least 10 scans across the peak for optimum precision.

NOTE: PFHxS, PFOS, NMeFOSAA, and NEtFOSAA have multiple chromatographic peaks using the LC conditions in Table 7 due to chromatographic resolution of the linear and branched isomers of these compounds. Most PFAS's are produced by two different processes. One process gives rise to linear PFAS's only while the other process produces both linear and branched isomers. Thus, both branched and linear PFAS's can potentially be found in the environment. For the aforementioned compounds that give rise to more than one peak, all the chromatographic peaks observed in the standard must be integrated and the areas totaled. Chromatographic peaks in a sample must be integrated in the same way as the CAL standard.

10.7.5 Prepare a set of CAL standards as outlined in table 5. The lowest concentration CAL standard must be at or below the LOQ.

10.7.6 The LC/MS/MS system is calibrated using the isotope dilution technique. Target analytes are quantitated against their isotopically labeled analog (Extracted Internal Standard) where commercially available. If a labeled analog is not commercially available, the extracted internal standard with the closest retention time and /or closest chemical similarity is to be used. Use the LC/MS/MS data system software to generate a linear regression or quadratic calibration curve for each of the analytes. This curve must always be forced through zero and may be concentration weighted, if necessary. Forcing zero allows for a better estimate of the background levels of method analytes. A minimum of 5 levels are required for a linear calibration model and a minimum of 6 levels are required for a quadratic calibration model.

10.7.7 **CALIBRATION ACCEPTANCE CRITERIA** – A linear fit is acceptable if the calculated RSD or RSE for each target analyte is ≤20%. If linear or Quadratic regressions are used, coefficient of determination (r^2) values must be greater than 0.99. When quantitated using the initial calibration curve, each calibration point at or above the LOQ for each analyte must calculate to be within 70-130% of its true value. The calculate value of each EIS analyte must be within 50-150% of its true value. If these criteria cannot be met, corrective action is taken to reanalyze the CAL standards, restrict the range of calibration.

10.7.8 **Bile salts interference check -** The laboratory must analyze a TDCA standard after the initial calibration, prior to the analysis of tissue samples, to check for interferences caused by bile salts. If an interference is present, the chromatographic conditions must be modified to eliminate the interference from TDCA (e.g., changing the retention time of TDCA such that it falls outside the retention window for PFOS by at least one minute), and the initial calibration repeated.

10.8 CONTINUING CALIBRATION CHECK (CCV)

– Minimum daily calibration verification is as follows. Verify the initial calibration at the beginning and end of each group of analyses, and after every tenth sample during analyses. In this context, a “sample” is considered to be a Field Sample. MBs, CCVs, LCSs, MSs, FDs FRBs and MSDs are not counted as samples. The beginning CCV of each analysis batch must be at or below the RL in order to verify instrument sensitivity prior to any analyses. If standards have been prepared such that all low CAL points are not in the same CAL solution, it may be necessary to analyze two CAL standards to meet this requirement. Alternatively, the analyte concentrations in the analyte PDS may be customized to meet these criteria. Subsequent CCVs should alternate between a medium and Low concentration CAL standard.

10.8.1 Inject an aliquot of the appropriate concentration CAL standard and analyze with the same conditions used during the initial calibration.

10.8.2 Calculate the concentration of each analyte and EIS in the CCV. The calculated amount for each native and EIS analyte for medium level CCVs must be within ± 30% of the true. If these conditions do not exist, then all data for the problem analyte must be considered invalid, and remedial action should be taken which may require recalibration. Any Field or QC Samples that have been analyzed since the last acceptable calibration verification should be reanalyzed after adequate calibration has been restored, with the following exception. If the CCV fails because the calculated concentration is greater than 130% for a particular method analyte, and Field Sample extracts show no detection for that method analyte, non-detects may be reported without re-analysis.

10.8.3 REMEDIAL ACTION – Failure to meet CCV QC performance criteria may require remedial action. Major maintenance, such as cleaning the electrospray probe, atmospheric pressure ionization source, cleaning the mass analyzer, replacing the LC column, etc., requires recalibration and verification of sensitivity by analyzing a CCV at or below the LOQ.

10.9 EXTRACT ANALYSIS

10.9.1 The same operating conditions used for the initial calibration and summarized in Tables 6 and 7 are to be used.

10.9.2 Prior to analysis of sample extracts, the Instrument mass calibration verification must be performed using standards whose mass range brackets the masses of interest and performed in the negative ion mode. The mass calibration is verified if the calculated mass is within ± .2 daltons of the specified mass.

10.9.3 Establish an appropriate retention time window for each analyte. This should be based on measurements of actual retention time variation for each method analyte in CAL standard solutions analyzed on the LC over the course of time. A value of plus or minus three times the standard deviation of the retention time obtained for each method analyte while establishing the initial calibration can be used to calculate a suggested window size. However, the experience of the analyst should weigh heavily on the determination of the appropriate retention window size.

10.9.4 Calibrate the system by either the analysis of a calibration curve or by confirming the initial calibration is still valid by analyzing a CCV.

10.9.5 Begin analyzing Field Samples, including QC samples, at their appropriate frequency by injecting the same size aliquots under the same conditions used to analyze the CAL standards.

10.9.6 For concentrations at or above the method LOQ, the total (branched and linear isomer) quantification ion response to the total (branched and linear isomer) confirmation ion response ratio must fall within ± 50% of the ratio observed in the midpoint initial calibration standard.

10.9.7 At the conclusion of data acquisition, use the same software that was used in the calibration procedure to identify peaks of interest in predetermined retention time windows. Use the data system software to examine the ion abundances of the peaks in the chromatogram. Identify an analyte by comparison of its retention time with that of the corresponding method analyte peak in a reference standard.

10.9.8 The analyst must not extrapolate beyond the established calibration range. If an analyte peak area exceeds the range of the initial calibration curve, the sample should be re-extracted with a reduced sample volume in order to bring the out of range target analytes into the calibration range. If a smaller sample size would not be representative of the entire sample, the following options are recommended. Re-extract an additional aliquot of sufficient size to ensure that it is representative of the entire sample. Spike it with a higher concentration of internal standard. Prior to LC/MS analysis, dilute the sample so that it has a concentration of internal standard equivalent to that present in the calibration standard. Then, analyze the diluted extract.3

10.9.9 In instances where re-extraction is not an option, dilute a subsample of the sample extract with 0.1% acetic acid by a factor no greater than 10x adjust the amount of the NIS in the diluted extract, and analyze the diluted extract. If the responses for each EIS in the diluted extract meet the S/N and retention time, and the EIS recoveries from the analysis of the diluted extract are greater than 5%, then the compounds associated with those EISs may be quantified using isotope dilution. Use the EIS recoveries from the original analysis to select the dilution factor, with the objective of keeping the EIS recoveries in the dilution above that 5% lower limit. If the adjusted EIS recoveries are below 5%, the dilution is assumed invalid. If the adjusted EIS recoveries are greater than 5%, adjust the compound concentrations, detection limits, and minimum levels to account for the dilution.

11. Data Evaluation, Calculations and Reporting

11.1 Complete chromatographic resolution is not necessary for accurate and precise measurements of analyte concentrations using MS/MS. In validating this method, concentrations were calculated by measuring the product ions listed in Table 9.

11.2 Calculate analyte concentrations using the multipoint calibration established in Section 10.9. Do not use daily calibration verification data to quantitate analytes in samples. Adjust final analyte concentrations to reflect the actual sample volume determined in Section 10.8

C_{ex} = (Area of target analyte * Concentration of Labeled analog) / (area of labeled analog * CF)

C_s = (C_{ex} / sample volume in ml) * 1000

C_{ex} = The concentration of the analyte in the extract
CF = calibration factor from calibration.

11.3 Prior to reporting the data, the chromatogram should be reviewed for any incorrect peak identification or poor integration.

11.4 PFHxS, PFOS, PFOA, NMeFOSAA, and NEtFOSAA have multiple chromatographic peaks using the LC conditions in Table 7 due to the linear and branch isomers of these compounds (Sect. 10.10.4.). The areas of all the linear and branched isomer peaks observed in the CAL standards for each of these analytes must be summed and the concentrations reported as a total for each of these analytes.

11.5 Calculations must utilize all available digits of precision, but final reported concentrations should be rounded to an appropriate number of significant figures (one digit of uncertainty), typically two, and not more than three significant figures.

12. Contingencies for Handling Out-of-Control Data or Unacceptable Data

12.1 Section 9.0 outlines sample batch QC acceptance criteria. If non-compliant organic compound results are to be reported, the Organic Section Head and/or the Laboratory Director, and the Operations Manager must approve the reporting of these results. The laboratory Project Manager shall be notified and may choose to relay the non-compliance to the client, for approval, or other corrective action, such as re-sampling and re-analysis. The analyst, Data Reviewer, or Department Supervisor performing the secondary review initiates the project narrative, and the narrative must clearly document the non-compliance and provide a reason for acceptance of these results.

12.2 All results for the organic compounds of interest are reportable without qualification if extraction and analytical holding times are met, preservation requirements (including cooler temperatures) are met, all QC criteria are met, and matrix interference is not suspected during extraction or analysis of the samples. If any of the below QC parameters are not met, all associated samples must be evaluated for re-extraction and/or re-analysis.

13. Method Performance

13.1 Detection Limit Study (DL) / Limit of Detection Study (LOD) / Limit of Quantitation (LOQ)

13.1.1 The laboratory follows the procedure to determine the DL, LOD, and/or LOQ as outlined in Alpha SOP ID 1732. These studies performed by the laboratory are maintained on file for review.

13.2 Demonstration of Capability Studies

13.2.1 Refer to Alpha SOP ID 1739 for further information regarding IDC/DOC Generation.

13.2.2 The analyst must make a continuing, annual, demonstration of the ability to generate acceptable accuracy and precision with this method.

14. Pollution Prevention and Waste Management

14.1 Refer to Alpha's Chemical Hygiene Plan and Hazardous Waste Management and Disposal SOP for further pollution prevention and waste management information.

14.2 This method utilizes SPE to extract analytes from water. It requires the use of very small volumes of organic solvent and very small quantities of pure analytes, thereby minimizing the potential hazards to both the analyst and the environment as compared to the use of large volumes of organic solvents in conventional liquid-liquid extractions.

14.3 The analytical procedures described in this method generate relatively small amounts of waste since only small amounts of reagents and solvents are used. The matrices of concern are finished drinking water or source water. However, laboratory waste management practices must be conducted consistent with all applicable rules and regulations, and that laboratories protect the air, water, and land by minimizing and controlling all releases from fume hoods and bench operations. Also, compliance is required with any sewage discharge permits and regulations, particularly the hazardous waste identification rules and land disposal restrictions.

15. Referenced Documents

Chemical Hygiene Plan – ID 2124

SOP ID 1732 Detection Limit (DL), Limit of Detection (LOD) & Limit of Quantitation (LOQ) SOP

SOP ID 1739 Demonstration of Capability (DOC) Generation SOP

SOP ID 1728 Hazardous Waste Management and Disposal SOP

16. Attachments

Table 1: Names, Abbreviations, and CAS Registry Numbers for Target PFAS, Extracted Internal Standards and Non-extracted Internal Standards

Parameter	Acronym	CAS
PER- and POLYFLUOROALKYLETHER CARBOXYLIC ACIDS (PFECAs)		
Tetrafluoro-2-(heptafluoropropoxy)propanoic acid	HFPO-DA	13252-13-6
4,8-dioxa-3H-perfluorononanoic acid	ADONA	919005-14-4
Perfluoro-3-methoxypropanoic acid	PFMPA	377-73-1
Perfluoro-4-methoxybutanoic acid	PFMBA	863090-89-5
Nonafluoro-3,6-dioxaheptanoic acid	NFDHA	151772-58-6
PERFLUOROALKYLCARBOXILIC ACIDS (PFCAs)		

Perfluorobutanoic acid	PFBA	375-22-4
Perfluoropentanoic acid	PFPeA	2706-90-3
Perfluorohexanoic acid	PFHxA	307-24-4
Perfluoroheptanoic acid	PFHpA	375-85-9
Perfluorooctanoic acid	PFOA	335-67-1
Perfluorononanoic acid	PFNA	375-95-1
Perfluorodecanoic acid	PFDA	335-76-2
Perfluoroundecanoic acid	PFUnA	2058-94-8
Perfluorododecanoic acid	PFDoA	307-55-1
Perfluorotridecanoic acid	PFTrDA	72629-94-8
Perfluoorotetradecanoic acid	PFTeDA	376-06-7
PERFLUOROALKYL SULFONIC ACIDS (PFASs)		
Perfluorobutanesulfonic acid	PFBS	375-73-5
Perfluoropentanesulfonic acid	PFPeS	2706-91-4
Perfluorohexanesulfonic acid	PFHxS	355-46-4
Perfluoroheptanesulfonic acid	PFHpS	375-92-8
Perfluorooctanesulfonic acid	PFOS	1763-23-1
Perfluorononanesulfonic acid	PFNS	68259-12-1

Perfluorodecanesulfonic acid	PFDS	335-77-3
Perfluorododecanesulfonic acid	PFDoS	79780-39-5
CHLORO-PERFLUOROALKYLSULFONATE		
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11Cl-PF3OUdS	763051-92-9
Perfluoro(2-ethoxyethane)sulfonic acid	PFEESA	113507-82-7
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	9Cl-PF3ONS	756426-58-1
FLUOROTELOMER CARBOXYLIC ACIDS		
3-Perfluoropropyl propanoic acid	3:3FTCA	356-02-5
2H,2H,3H,3H-Perfluorooctanoic acid	5:3FTCA	914637-49-3
Perfluoroheptyl propanoic acid	7:3FTCA	812-70-4
PERFLUOROOCTANESULFONAMIDES		
Perfluorooctanesulfonamide	PFOSA	754-91-6
N-methylperfluoro-1-octanesulfonamide	NMeFOSA	31506-32-8
N-ethylperfluoro-1-octanesulfonamide	NEtFOSA	4151-50-2
PERFLUOROCTANE SULFONAMIDE ETHANOLS		
N-Methyl perfluorooctanesulfonamidoethanol	NMeFOSE	24448-09-7
N-ethyl perfluorooctanesulfonamidoethanol	NEtFOSE	1691-99-2
TELOMER SULFONIC ACIDS		

1H,1H,2H,2H-perfluorohexanesulfonic acid (4:2)	4:2FTS	757124-72-4
1H,1H,2H,2H-perfluorooctanesulfonic acid (6:2)	6:2FTS	27619-97-2
1H,1H,2H,2H-perfluorodecanesulfonic acid (8:2)	8:2FTS	39108-34-4
PERFLUOROOCTANESULFONAMIDOACETIC ACIDS		
N-methyl perfluorooctanesulfonamidoacetic acid	NMeFOSAA	2355-31-9
N-ethyl perfluorooctanesulfonamidoacetic acid	NEtFOSAA	2991-50-6
PERFLUOROETHER AND POLYETHER CARBOXYLIC ACIDS		
Perfluoro-3-methoxypropanoic acid	PFMPA	377-73-1
Perfluoro-4-methoxybutanoic acid	PFMBA	863090-89-5
Perfluoro(2-ethoxyethane)sulfonic acid	PFEESA	113507-82-7
Nonafluoro-3,6-dioxaheptanoic acid	NFDHA	151772-58-6

Table 2: Stock and Nominal Extracted Internal Standard Concentrations

Isotope Labeled Standard	Conc. of EIS Stock (ng/mL)	Nominal amount of EIS added to extracts (ng)
M4PFBA	2000	40
M5PFPeA	1000	20
M5PFHxA	500	10
M4PFHpA	500	10
M8PFOA	500	10
M9PFNA	250	5
M6PFDA	250	5
M7PFUdA	250	5
MPFDoA	250	5
M2PFTeDA	250	5
M3PFBS	466	9.32
M3PFHxS	474	9.48
M8PFOS	479	9.58
M2-4:2FTS	938	18.8

Isotope Labeled Standard	Conc. of EIS Stock (ng/mL)	Nominal amount of EIS added to extracts (ng)
M2-6:2FTS	951	19
M2-8:2FTS	960	19.2
M8FOSA	500	10
d3-N-MeFOSA	500	10
d5-N-EtFOSA	500	10
d3-N-MeFOSAA	1000	20
d5-N-EtFOSAA	1000	20
d7-N-MeFOSE	5000	100
d9-N-EtFOSE	5000	100
M3HFPO-DA	2000	40

Table 3: Stock and Nominal Non-Extracted Internal Standard Concentrations

Isotope Labeled Standard	Conc. of EIS Stock (ng/mL)	Nominal amount of EIS added to extracts (ng)
M3PFBA	1000	40
M2PFHxA	500	10
M4PFOA	500	10
M5PFNA	250	5
M2PFDA	250	5
18O2PFHxS	474	9.48
M4PFOS	479	9.58

Table 4: Initial Calibration levels and Concentrations

Analyte	Cal A	Cal B (LOQ)	CAL C	Cal D	Cal E (CCV)	Cal F	Cal G	Cal H	Cal I
PFBA	.4	.8	2	5	10	20	50	250	500
PFPeA	.2	.4	1	2.5	5	10	25	125	250
PFHxA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
PFHpA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
PFOA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
PFNA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
PFDA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
PFUnA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
PFDoA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
PFTrDA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
PFTA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
PFBS	0.089	0.177	0.444	1.11	2.22	4.44	11.1	55.4	111
PFPeS	0.094	0.188	0.471	1.18	2.35	4.71	11.8	58.8	118

PFHxS	0.091	0.183	0.457	1.14	2.29	4.57	11.4	57.1	114
PFHpS	0.095	0.191	0.477	1.19	2.38	4.77	11.9	59.6	119
PFOS	0.093	0.186	0.464	1.16	2.32	4.64	11.6	58	116
PFNS	0.096	0.192	0.481	1.20	2.41	4.81	12	60.1	120
PFDS	0.097	0.193	0.483	1.21	2.41	4.83	12.1	60.3	121
PFDOS	0.097	0.194	0.485	1.21	2.43	4.85	12.1	60.6	121.
4:2FTS	0.375	0.75	1.88	4.69	9.38	18.8	46.9	234	469
6:2FTS	0.38	0.76	1.9	4.75	9.5	19	47.5	238	475
8:2FTS	0.384	0.768	1.92	4.8	9.6	19.2	48	240	480
PFOSA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
NMeFOSA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
NEtFOSA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
NMeFOSAA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
NEtFOSAA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
NMeFOSE	1	2	5	12.5	25	50	125	625	1250
NEtFOSE	1	2	5	12.5	25	50	125	625	1250
HFPO-DA	.4	.8	2	5	10	20	50	250	500
ADONA	0.378	0.756	1.89	4.73	9.45	18.9	47.3	236	473
9Cl-PFONS	0.374	0.748	1.87	4.68	9.35	18.7	46.8	234	468
11Cl-PFOUdS	0.378	0.756	1.89	4.73	9.45	18.9	47.3	236	473
PFMPA	.2	.4	1	2.5	5	10	25	125	250
PFMBA	.2	.4	1	2.5	5	10	25	125	250
PFEESA	0.178	0.356	0.89	2.23	4.45	8.9	22.3	111	223
NFDHA	.2	.4	1	2.5	5	10	25	125	250
3:3FTCA	.5	1	2.5	6.25	12.5	25	62.5	312	624
5:3FTCA	2.5	5	12.5	31.3	62.5	125	312	1560	3120
7:3FTCA	2.5	5	12.5	31.3	62.5	125	312	1560	3125
M4PFBA	10	10	10	10	10	10	10	10	10
M5PFPeA	5	5	5	5	5	5	5	5	5
M5PFHxA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
M4PFHpA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
M8PFOA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
M9PFNA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
M6PFDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
M7PFUdA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
MPFDoA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25

M2PFTeDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
M3PFBS	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33
M3PFHxS	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37
M8PFOS	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
M2-4:2FTS	4.69	4.69	4.69	4.69	4.69	4.69	4.69	4.69	4.69
M2-6:2FTS	4.76	4.76	4.76	4.76	4.76	4.76	4.76	4.76	4.76
M2-8:2FTS	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
M8FOSA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
d3-N-MeFOSA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
d5-N-EtFOSA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
d3-N-MeFOSAA	5	5	5	5	5	5	5	5	5
d5-N-EtFOSAA	5	5	5	5	5	5	5	5	5
d7-N-MeFOSE	25	25	25	25	25	25	25	25	25
d9-N-EtFOSE	25	25	25	25	25	25	25	25	25
M3HFPO-DA	10	10	10	10	10	10	10	10	10
M3PFBA	5	5	5	5	5	5	5	5	5
M2PFHxA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
M4PFOA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
M5PFNA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
M2PFDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
18O2PFHxS	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37
M4PFOS	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4

Table 5: Expected Mass Transitions and instrument conditions.

Q1	Q2	Analyte	DP Volts	CE Volts
213.032	169.022	PFBA	-50	-14
263.039	219.03	PFPeA	-55	-12
263.039	68.9	PFPeA_2	-55	-55
313.047	269.037	PFHxA	-45	-12
313.047	119	PFHxA_2	-45	-28
363.055	319.045	PFHpA	-60	-12
363.055	169.022	PFHpA_2	-60	-24
413.063	369.053	PFOA	-65	-14
413.063	169.022	PFOA_2	-65	-23
463.071	419.061	PFNA	-70	-14
463.071	219.03	PFNA_2	-70	-24

513.078	469.069	PFDA	-80	-16
513.078	219.03	PFDA_2	-80	-30
563.086	519.076	PFUnA	-85	-18
563.086	269.037	PFUnA_2	-85	-25
613.094	569.084	PFDoA	-85	-18
613.094	319.045	PFDoA_2	-85	-28
663.102	619.092	PFTrDA	-85	-20
663.102	169.022	PFTrDA_2	-85	-36
713.11	669.1	PFTA	-70	-22
713.11	169.022	PFTA_2	-70	-38
299.092	80.062	PFBS	-100	-65
299.092	99.061	PFBS_2	-100	-40
349.1	80.062	PFPeS	-100	-75
349.1	99.061	PFPeS_2	-100	-60
399.107	80.062	PFHxS	-120	-75
399.107	99.061	PFHxS_2	-120	-80
449.115	80.062	PFHpS	-140	-95
449.115	99.061	PFHpS_2	-140	-80
499.113	80.062	PFOS	-145	-108
499.113	99.061	PFOS_2	-145	-85
549.131	80.062	PFNS	-180	-100
549.131	99.061	PFNS_2	-180	-100
599.139	80.062	PFDS	-170	-110
599.138	99.061	PFDS_2	-170	-100
699.154	80.062	PFDoS	-160	-150
699.154	99.061	PFDoS_2	-160	-130
327.146	307.139	4:2FTS	-100	-28
327.146	81.07	4:2FTS_2	-100	-50
427.161	407.155	6:2FTS	-120	-33
427.161	81.07	6:2FTS_2	-120	-65
527.177	507.17	8:2FTS	-140	-39
527.177	81.07	8:2FTS_2	-140	-85
498.146	78.07	FOSA	-150	-90
498.146	478	FOSA_2	-150	-35
512.163	219.03	NMeFOSA	-130	-35
512.163	169.022	NMeFOSA_2	-130	-40
526.192	219.03	NEtFOSA	-140	-35
526.192	169.022	NEtFOSA_2	-140	-35
570.202	419.061	NMeFOSAA	-100	-28

570.202	483	NMeFOSAA_2	-100	-22
584.229	419.061	NEtFOSAA	-100	-28
584.229	526.192	NEtFOSAA_2	-100	-38
616.1	58.9	NMeFOSE	-90	-70
630	58.9	NEtFOSE	-80	-75
285.035	169.022	HFPO-DA	-60	-12
285.035	184.9	HFPO-DA_2	-60	-18
377.06	251.028	ADONA	-65	-18
377.06	84.8	ADONA_2	-65	-48
530.8	351.05	9Cl-PFONS	-130	-38
532.8	353	9Cl-PFONS_2	-130	-38
630.9	451.031	11Cl-PFOUdS	-145	-41
632.9	452.9	11Cl-PFOUdS_2	-145	-41
241.085	177.069	3:3FTCA	-60	-12
241.085	117	3:3FTCA_2	-60	-50
341.101	237.072	5:3FTCA	-70	-20
341.101	217	5:3FTCA_2	-70	-35
441.117	316.9	7:3FTCA	-85	-30
441.117	337.088	7:3FTCA_2	-85	-20
315.093	135.013	PFEESA	-100	-35
315.093	82.9	PFEESA_2	-100	-25
229.032	85.006	PFMPA	-40	-25
279.042	85.006	PFMBA	-45	-25
295.032	201	NFDHA	-30	-15
295.032	84.9	NFDHA_2	-30	-40
217.001	171.999	MPFBA	-50	-14
268.001	222.999	M5PFPeA	-55	-12
318.009	273.007	M5PFHxA	-45	-12
367.024	322.022	M4PFHpA	-60	-12
421.002	376	M8PFOA	-65	-14
472.002	427	M9PFNA	-70	-14
519.033	474.03	M6PFDA	-80	-16
570.033	525.031	M7-PFUdA	-85	-18
615.079	570.033	MPFDoA	-85	-18
715.094	670.092	M2PFTeDA	-70	-22
302.069	80.062	M3PFBS	-100	-65
402.084	80.062	M3PFHxS	-120	-74
507.062	80.062	M8PFOS	-145	-85
329.13	81.07	M2-4:2FTS	-100	-50

429.162	81.07	M2-6:2FTS	-120	-65
529.162	81.07	M2-8:2FTS	-140	-85
506.077	78.07	M8FOSA	-150	-90
515.183	219.03	d3-NMeFOSA	-130	-35
531.222	219.03	d5-NEtFOSA	-140	-35
573.22	419.061	d3-NMeFOSAA	-75	-28
589.259	419.061	d5-NEtFOSAA	-90	-28
623.2	58.9	d7-NMeFOSE	-100	-28
639.2	58.9	d9-NEtFOSE	-100	-28
287.02	169.022	M3HFPO-DA	-60	-12
216.009	171.999	M3PFBA	-50	-14
315.032	270.03	M2PFHxA	-45	-12
417.032	372.03	M4PFOA	-65	-14
468.032	423.03	M5PFNA	-70	-14
515.063	470.061	M2PFDA	-80	-16
403.107	84.062	18O2-PFHxS	-120	-74
503.093	80.062	M4PFOS	-145	-85

Table 6: LC Method Conditions

Time (min)	2 mM Ammonium Acetate (5:95 CH/H_2O)	100% Acetonitrile	Gradient Curve
Initial	100.0	0.0	0
.2	100.0	0.0	2
4	70	30	7
7	45	55	8
9	25	80	8
10	5	95	6
10.4	98	2	10
11.8	100	0	7
12	100	0	1
Waters Aquity UPLC ® BEHC$_{18}$ 2.1 x 50 mm packed with 1.7 µm BEH C$_{18}$ stationary phase Flow rate of 0.4 mL/min 2 µL injection			

Table 7: ESI-MS Method Conditions

ESI Conditions	
Polarity	Negative ion
Curtain Gas	30
Collision gas	9
Ion Spray Voltage	-4500
Desolvation gas temp.	500 ºC
Ion Source Gas 1	30
Ion Source Gas 2	50
Entrance Poitential	-10
Exic Cell Potential	-11

Table 8. Reporting limits by Matrix

Compound	Aqueous (ng/L)	Solid (ng/g)	Tissue (ng/g)
PFBA	6.4	0.8	2
PFPeA	3.2	0.4	1
PFHxA	1.6	0.2	0.5
PFHpA	1.6	0.2	0.5
PFOA	1.6	0.2	0.5
PFNA	1.6	0.2	0.5
PFDA	1.6	0.2	0.5
PFUnA	1.6	0.2	0.5
PFDoA	1.6	0.2	0.5
PFTrDA	1.6	0.2	0.5
PFTA	1.6	0.2	0.5
PFBS	1.6	0.2	0.5
PFPeS	1.6	0.2	0.5
PFHxS	1.6	0.2	0.5
PFHpS	1.6	0.2	0.5
PFOS	1.6	0.2	0.5
PFNS	1.6	0.2	0.5
PFDS	1.6	0.2	0.5
PFDoS	1.6	0.2	0.5
4:2FTS	6.4	0.8	2
6:2FTS	6.4	0.8	2
8:2FTS	6.4	0.8	2
FOSA	1.6	0.2	2
NMeFOSA	1.6	0.2	0.5

NEtFOSA	1.6	0.2	0.5
NMeFOSAA	1.6	0.2	0.5
NEtFOSAA	1.6	0.2	0.5
NMeFOSE	16	2	5
NEtFOSE	16	2	5
HFPO-DA	6.4	0.8	2
ADONA	6.4	0.8	2
9Cl-PFONS	6.4	0.8	2
11Cl-PFOUdS	6.4	0.8	2
3:3FTCA	8	1	2.5
5:3FTCA	40	5	12.5
7:3FTCA	40	5	12.5
PFEESA	3.2	0.4	1
PFMPA	3.2	0.4	1
PFMBA	3.2	0.4	1
NFDHA	3.2	0.4	1

Appendix D

Citizen Participation Plan

NEW YORK
STATE OF
OPPORTUNITY.

Department of
Environmental
Conservation

Brownfield Cleanup Program

Citizen Participation Plan
for
965 Mamaroneck Avenue

August 2019

BCP Site No. C360189
965 Mamaroneck Avenue
Village of Mamaroneck
Westchester County, New York

www.dec.ny.gov

Contents

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Note: The information presented in this Citizen Participation Plan was current as of the date of its approval by the New York State Department of Environmental Conservation. Portions of this Citizen Participation Plan may be revised during the site's investigation and cleanup process.

Applicant: **1946 Holding Corp. (“Applicant”)**
Site Name: **965 Mamaroneck Avenue (“Site”)**
Site Address: **965 Mamaroneck Avenue, Village of Mamaroneck, NY 10543**
Site County: **Westchester County**
Site Number: **C360189**

1. What is New York’s Brownfield Cleanup Program?

New York’s Brownfield Cleanup Program (BCP) works with private developers to encourage the voluntary cleanup of contaminated properties known as “brownfields” so that they can be reused and developed. These uses include recreation, housing, and business.

A *brownfield* is any real property that is difficult to reuse or redevelop because of the presence or potential presence of contamination. A brownfield typically is a former industrial or commercial property where operations may have resulted in environmental contamination. A brownfield can pose environmental, legal, and financial burdens on a community. If a brownfield is not addressed, it can reduce property values in the area and affect economic development of nearby properties.

The BCP is administered by the New York State Department of Environmental Conservation (NYSDEC) which oversees Applicants who conduct brownfield site investigation and cleanup activities. An Applicant is a person who has requested to participate in the BCP and has been accepted by NYSDEC. The BCP contains investigation and cleanup requirements, ensuring that cleanups protect public health and the environment. When NYSDEC certifies that these requirements have been met, the property can be reused or redeveloped for the intended use.

For more information about the BCP, go online at:
http://www.dec.ny.gov/chemical/8450.html .

2. Citizen Participation Activities

Why NYSDEC Involves the Public and Why It Is Important

NYSDEC involves the public to improve the process of investigating and cleaning up contaminated sites, and to enable citizens to participate more fully in decisions that affect their health, environment, and social well-being. NYSDEC provides opportunities for citizen involvement and encourages early two-way communication with citizens before decision makers form or adopt final positions.

Involving citizens affected and interested in site investigation and cleanup programs is important for many reasons. These include:

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- Promoting the development of timely, effective site investigation and cleanup programs that protect public health and the environment

- Improving public access to, and understanding of, issues and information related to a particular site and that site's investigation and cleanup process

- Providing citizens with early and continuing opportunities to participate in NYSDEC's site investigation and cleanup process

- Ensuring that NYSDEC makes site investigation and cleanup decisions that benefit from input that reflects the interests and perspectives found within the affected community

- Encouraging dialogue to promote the exchange of information among the affected/interested public, State agencies, and other interested parties that strengthens trust among the parties, increases understanding of site and community issues and concerns, and improves decision making.

This Citizen Participation (CP) Plan provides information about how NYSDEC will inform and involve the public during the investigation and cleanup of the site identified above. The public information and involvement program will be carried out with assistance, as appropriate, from the Applicant.

Project Contacts

Appendix A identifies NYSDEC project contact(s) to whom the public should address questions or request information about the site's investigation and cleanup program. The public's suggestions about this CP Plan and the CP program for the site are always welcome. Interested people are encouraged to share their ideas and suggestions with the project contacts at any time.

Locations of Reports and Information

The locations of the reports and information related to the site's investigation and cleanup program also are identified in Appendix A. These locations provide convenient access to important project documents for public review and comment. Some documents may be placed on the NYSDEC web site. If this occurs, NYSDEC will inform the public in fact sheets distributed about the site and by other means, as appropriate.

Site Contact List

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Appendix B contains the site contact list. This list has been developed to keep the community informed about, and involved in, the site's investigation and cleanup process. The site contact list will be used periodically to distribute fact sheets that provide updates about the status of the project. These will include notifications of upcoming activities at the site (such as fieldwork), as well as availability of project documents and announcements about public comment periods.
The site contact list includes, at a minimum:

- chief executive officer and planning board chairperson of each county, city, town and village in which the site is located;
- residents, owners, and occupants of the site and properties adjacent to the site;
- the public water supplier which services the area in which the site is located;
- any person who has requested to be placed on the site contact list;
- the administrator of any school or day care facility located on or near the site for purposes of posting and/or dissemination of information at the facility;
- location(s) of reports and information.

The site contact list will be reviewed periodically and updated as appropriate. Individuals and organizations will be added to the site contact list upon request. Such requests should be submitted to the NYSDEC project contact(s) identified in Appendix A. Other additions to the site contact list may be made at the discretion of the NYSDEC project manager, in consultation with other NYSDEC staff as appropriate.

Note: The first site fact sheet (usually related to the draft Remedial Investigation Work Plan) is distributed both by paper mailing through the postal service and through DEC Delivers, its email listserv service. The fact sheet includes instructions for signing up with the appropriate county listserv to receive future notifications about the site. See http://www.dec.ny.gov/chemical/61092.html .

Subsequent fact sheets about the site will be distributed exclusively through the listserv, except for households without internet access that have indicated the need to continue to receive site information in paper form. Please advise the NYSDEC site project manager identified in Appendix A if that is the case. Paper mailings may continue during the investigation and cleanup process for some sites, based on public interest and need.

CP Activities

The table at the end of this section identifies the CP activities, at a minimum, that have been and will be conducted during the site's investigation and cleanup program. The flowchart in Appendix D shows how these CP activities integrate with the site investigation and cleanup process. The public is informed about these CP activities through fact sheets and notices distributed at significant points during the program. Elements of the investigation and cleanup process that match up with the CP activities are explained briefly in Section 5.

- **Notices and fact sheets** help the interested and affected public to understand contamination issues related to a site, and the nature and progress of efforts to investigate and clean up a site.

- **Public forums, comment periods and contact with project managers** provide opportunities for the public to contribute information, opinions and perspectives that have potential to influence decisions about a site's investigation and cleanup.

The public is encouraged to contact project staff at any time during the site's investigation and cleanup process with questions, comments, or requests for information.

This CP Plan may be revised due to changes in major issues of public concern identified in Section 3 or in the nature and scope of investigation and cleanup activities. Modifications may include additions to the site contact list and changes in planned citizen participation activities.

Technical Assistance Grant

NYSDEC must determine if the site poses a significant threat to public health or the environment. This determination generally is made using information developed during the investigation of the site, as described in Section 5.

If the site is determined to be a significant threat, a qualifying community group may apply for a Technical Assistance Grant (TAG). The purpose of a TAG is to provide funds to the qualifying group to obtain independent technical assistance. This assistance helps the TAG recipient to interpret and understand existing environmental information about the nature and extent of contamination related to the site and the development/implementation of a remedy.

An eligible community group must certify that its membership represents the interests of the community affected by the site, and that its members' health, economic well-being or enjoyment of the environment may be affected by a release or threatened release of contamination at the site.

As of the date the declaration (page 2) was signed by the NYSDEC project manager, the significant threat determination for the site had not yet been made.

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To verify the significant threat status of the site, the interested public may contact the NYSDEC project manager identified in Appendix A.

For more information about TAGs, go online at
http://www.dec.ny.gov/regulations/2590.html

Note: The table identifying the citizen participation activities related to the site's investigation and cleanup program follows on the next page:

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Citizen Participation Activities	Timing of CP Activity(ies)
Application Process:	
• Prepare site contact list • Establish document repository(ies)	At time of preparation of application to participate in the BCP.
• Publish notice in Environmental Notice Bulletin (ENB) announcing receipt of application and 30-day public comment period • Publish above ENB content in local newspaper • Mail above ENB content to site contact list • Conduct 30-day public comment period	When NYSDEC determines that BCP application is complete. The 30-day public comment period begins on date of publication of notice in ENB. End date of public comment period is as stated in ENB notice. Therefore, ENB notice, newspaper notice, and notice to the site contact list should be provided to the public at the same time.
After Execution of Brownfield Site Cleanup Agreement (BCA):	
• Prepare Citizen Participation (CP) Plan	Before start of Remedial Investigation **Note:** Applicant must submit CP Plan to NYSDEC for review and approval within 20 days of the effective date of the BCA.
Before NYSDEC Approves Remedial Investigation (RI) Work Plan:	
• Distribute fact sheet to site contact list about proposed RI activities and announcing 30-day public comment period about draft RI Work Plan • Conduct 30-day public comment period	Before NYSDEC approves RI Work Plan. If RI Work Plan is submitted with application, public comment periods will be combined and public notice will include fact sheet. Thirty-day public comment period begins/ends as per dates identified in fact sheet.
After Applicant Completes Remedial Investigation:	
• Distribute fact sheet to site contact list that describes RI results	Before NYSDEC approves RI Report
Before NYSDEC Approves Remedial Work Plan (RWP):	
• Distribute fact sheet to site contact list about draft RWP and announcing 45-day public comment period • Public meeting by NYSDEC about proposed RWP (if requested by affected community or at discretion of NYSDEC project manager) • Conduct 45-day public comment period	Before NYSDEC approves RWP. Forty-five day public comment period begins/ends as per dates identified in fact sheet. Public meeting would be held within the 45-day public comment period.
Before Applicant Starts Cleanup Action:	
• Distribute fact sheet to site contact list that describes upcoming cleanup action	Before the start of cleanup action.
After Applicant Completes Cleanup Action:	
• Distribute fact sheet to site contact list that announces that cleanup action has been completed and that NYSDEC is reviewing the Final Engineering Report • Distribute fact sheet to site contact list announcing NYSDEC approval of Final Engineering Report and issuance of Certificate of Completion (COC)	At the time the cleanup action has been completed. **Note:** The two fact sheets are combined when possible if there is not a delay in issuing the COC.

3. Major Issues of Public Concern

This section of the CP Plan identifies major issues of public concern that relate to the site. Additional major issues of public concern may be identified during the course of the site's investigation and cleanup process.

No shallow groundwater use exists in the area or vicinity of the Site. This eliminates potential wellhead issues, but does not take into account the vapor intrusion issues to which on-Site and adjacent buildings may become susceptible since groundwater contamination included Volatile Organic Compounds (VOCs). Potable water is provided to residents by the Westchester Joint Water Works from the Catskill and Delaware watersheds of the New York City water system. There may also be impacts with regards to noise, odor, and truck traffic.

The Site is located within a Potential Environmental Justice Area. Environmental justice is defined as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Based on neighborhood 2010 census data, there is a sizable Hispanic-American community near the Site. Therefore, all future fact sheets will be translated into Spanish.

Environmental justice efforts focus on improving the environment in communities, specifically minority and low-income communities, and addressing the disproportionate adverse environmental impacts that may exist in those communities.

Upon conclusion of the BCP Application 30 day public comment period, if issues of public concern are identified, this CP Plan will be amended to address any additional CP activities that may need to be implemented.

4. Site Information

Appendix C contains a map identifying the location of the site.

Site Description

The Site is an irregularly-shaped parcel located on the east side of Mamaroneck Avenue, between Hillside Avenue and North Barry Avenue Extended. The Site is identified by Westchester County TaxID No. 8-20-244. The Site is bounded by North Barry Avenue Extended to the north, commercial buildings to the south, Mamaroneck Avenue to the west, and residential buildings to the east. Currently, the Site is vacant, but was recently occupied by a commercial dry cleaner.

History of Site Use, Investigation, and Cleanup

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The Site was initially developed sometime prior to 1950 with the existing single-story building. The Site operated as a dry cleaning facility for its entire history until its recent closing. The Site is currently vacant.

Environmental investigations completed at the Site have included analysis of soil, groundwater, and soil vapor. The investigations were completed in 2019 as part of the applicant's due diligence.

Previous Environmental Studies

Phase I Environmental Site Assessment (February 2019)

A Phase I Environmental Site Assessment (ESA) was prepared in early 2019 and identified the following recognized environmental conditions (RECs) in connection with the Site as having the potential for negative environmental impacts:

- Historical use of the subject property as a dry cleaner;
- The possibility of VOCs impacting the subject property from known spill incidences at the north, east, and west adjoining properties; and
- The possibility of volatile vapor intrusion affecting the occupants of the subject property.

Phase II Environmental Site Assessment (March 2019)

Soil and groundwater sampling was completed to further investigate the Phase I ESA findings. Nine soil samples were collected from three soil borings and nine groundwater samples were collected from six temporary well points (six from the groundwater interface and three from deep groundwater). Three of the nine soil samples were and all nine of the groundwater samples were analyzed for VOCs.

The results of sample analysis showed low concentrations of chlorinated solvents, specifically tetrachloroethene (PCE) in all three soil samples analyzed. Elevated concentrations of chlorinated solvents, specifically PCE, were detected in eight of nine groundwater samples. In addition, elevated levels of trichloroethene (TCE), a breakdown product of PCE, were detected in two deep groundwater samples. In general, the highest concentrations of PCE and TCE were detected in the three deep groundwater samples.

Soil Vapor Investigation (June 2019)

Soil vapor sampling was completed to investigate the potential for chlorinated solvent contamination associated with the chlorinated solvent impacts identified in groundwater at the Site during the Phase II ESA. The soil vapor investigation included the installation of three soil vapor points and the collection of three soil vapor samples.

The results of sample analysis showed elevated concentrations of chlorinated solvents, specifically PCE, in all three soil vapor samples, with the highest concentration occurring in the northeastern corner of the Site. A variety of other chlorinated VOCs (cVOCs) and petroleum-related VOCs were also detected at low concentrations in one or more soil vapor samples.

5. Investigation and Cleanup Process

Application

The Applicant has applied for and been accepted into New York's Brownfield Cleanup Program as a **Participant.** This means **that the Applicant was the owner of the site at the time of the disposal or discharge of contaminants or was otherwise liable for the disposal or discharge of the contaminants. The Participant must fully characterize the nature and extent of contamination onsite, as well as the nature and extent of contamination that has migrated from the site. The Participant also must conduct a "qualitative exposure assessment," a process that characterizes the actual or potential exposures of people, fish and wildlife to contaminants on the site and to contamination that has migrated from the site.**

The Applicant in its Application proposes that the site will be used for **restricted-commercial** purposes.

To achieve this goal, the Applicant will conduct **investigation** activities at the site with oversight provided by NYSDEC. The Brownfield Cleanup Agreement executed by NYSDEC and the Applicant sets forth the responsibilities of each party in conducting these activities at the site.

Investigation

The Applicant will conduct an investigation of the site officially called a "remedial investigation" (RI). This investigation will be performed with NYSDEC oversight. The Applicant must develop a remedial investigation workplan, which is subject to public comment.

The site investigation has several goals:
1) define the nature and extent of contamination in soil, surface water, groundwater and any other parts of the environment that may be affected;
2) identify the source(s) of the contamination;

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3) assess the impact of the contamination on public health and the environment; and
4) provide information to support the development of a proposed remedy to address the contamination or the determination that cleanup is not necessary.

The Applicant submits a draft “Remedial Investigation Work Plan” to NYSDEC for review and approval. NYSDEC makes the draft plan available to the public review during a 30-day public comment period.

When the investigation is complete, the Applicant will prepare and submit a report that summarizes the results. This report also will recommend whether cleanup action is needed to address site-related contamination. The investigation report is subject to review and approval by NYSDEC.

NYSDEC will use the information in the investigation report to determine if the site poses a significant threat to public health or the environment. If the site is a “significant threat,” it must be cleaned up using a remedy selected by NYSDEC from an analysis of alternatives prepared by the Applicant and approved by NYSDEC. If the site does not pose a significant threat, the Applicant may select the remedy from the approved analysis of alternatives.

Interim Remedial Measures

An Interim Remedial Measure (IRM) is an action that can be undertaken at a site when a source of contamination or exposure pathway can be effectively addressed before the site investigation and analysis of alternatives are completed. If an IRM is likely to represent all or a significant part of the final remedy, NYSDEC will require a 30-day public comment period.

Remedy Selection

When the investigation of the site has been determined to be complete, the project likely would proceed in one of two directions:

1. The Applicant may recommend in its investigation report that no action is necessary at the site. In this case, NYSDEC would make the investigation report available for public comment for 45 days. NYSDEC then would complete its review, make any necessary revisions, and, if appropriate, approve the investigation report. NYSDEC would then issue a “Certificate of Completion” (described below) to the Applicant.

or

2. The Applicant may recommend in its investigation report that action needs to be

taken to address site contamination. After NYSDEC approves the investigation report, the Applicant may then develop a cleanup plan, officially called a “Remedial Work Plan”. The Remedial Work Plan describes the Applicant’s proposed remedy for addressing contamination related to the site.

When the Applicant submits a draft Remedial Work Plan for approval, NYSDEC would announce the availability of the draft plan for public review during a 45-day public comment period.

Cleanup Action

NYSDEC will consider public comments, and revise the draft cleanup plan if necessary, before approving the proposed remedy. The New York State Department of Health (NYSDOH) must concur with the proposed remedy. After approval, the proposed remedy becomes the selected remedy. The selected remedy is formalized in the site Decision Document.

The Applicant may then design and perform the cleanup action to address the site contamination. NYSDEC and NYSDOH oversee the activities. When the Applicant completes cleanup activities, it will prepare a final engineering report that certifies that cleanup requirements have been achieved or will be achieved within a specific time frame. NYSDEC will review the report to be certain that the cleanup is protective of public health and the environment for the intended use of the site.

Certificate of Completion

When NYSDEC is satisfied that cleanup requirements have been achieved or will be achieved for the site, it will approve the final engineering report. NYSDEC then will issue a Certificate of Completion (COC) to the Applicant. The COC states that cleanup goals have been achieved, and relieves the Applicant from future liability for site-related contamination, subject to certain conditions. The Applicant would be eligible to redevelop the site after it receives a COC.

Site Management

The purpose of site management is to ensure the safe reuse of the property if contamination will remain in place. Site management is the last phase of the site cleanup program. This phase begins when the COC is issued. Site management incorporates any institutional and engineering controls required to ensure that the remedy implemented for the site remains protective of public health and the environment. All significant activities are detailed in a Site Management Plan.

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An *institutional control* is a non-physical restriction on use of the site, such as a deed restriction that would prevent or restrict certain uses of the property. An institutional control may be used when the cleanup action leaves some contamination that makes the site suitable for some, but not all uses.

An *engineering control* is a physical barrier or method to manage contamination. Examples include: caps, covers, barriers, fences, and treatment of water supplies.

Site management also may include the operation and maintenance of a component of the remedy, such as a system that pumps and treats groundwater. Site management continues until NYSDEC determines that it is no longer needed.

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Appendix A -
Project Contacts and Locations of Reports and Information

Project Contacts

For information about the site's investigation and cleanup program, the public may contact any of the following project staff:

New York State Department of Environmental Conservation (NYSDEC):

Kimberly Junkins
Project Manager
NYSDEC Region 3
Division of Environmental Remediation
21 South Putt Corners Road
New Paltz, NY 12561
Phone: (845) 633-5457
Email: Kimberly.junkins@dec.ny.gov

Stephanie Mossey
Citizen Participation Specialist
NYSDEC Region 3
21 South Putt Corners Road
New Paltz, NY 12561
Phone: (845) 256-3154
Email: stephanie.mossey@dec.ny.gov

New York State Department of Health (NYSDOH):

Johnathan Robinson
Project Manager
NYSDOH
145 Huguenot Street, 6th Floor
New Rochelle, NY 10801-5291
Phone: (518) 402-7860
Email:
Johnathan.robinson@health.ny.gov

Locations of Reports and Information

The facilities identified below are being used to provide the public with convenient access to important project documents:

Mamaroneck Public Library
136 Prospect Avenue
Mamaroneck, NY 10543
Attn: Susan Riley
Phone: (914) 698-1250

Hours: Monday & Wednesday (10 AM to 8 PM); Tuesday & Thursday (10 AM to 6 PM); Friday & Saturday (10 AM to 5 PM)

NYSDEC Region 3
21 South Putt Corners Road
New Paltz, NY 12561

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Attn: Kimberly Junkins
Phone: (845) 633-5463

Hours: (call for appointment)

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Appendix B – Site Contact List

B1. The Chief Executive Officer And Planning Board Chairperson Of Each County, City, Town And Village In Which The Property Is Located.

Mayor Tom Murphy
123 Mamaroneck Avenue
Mamaroneck, NY 10543

Gregory Cutler, Village Planner
Planning Department
169 Mt. Pleasant Avenue,
Mamaroneck, NY 10543

Planning Department
Westchester County
148 Martine Avenue
White Plains, NY 10601

George Latimer, County Executive
Westchester County
148 Martine Avenue
White Plains, NY 10601

Steven Otis
Assembly Member, District 91
222 Grace Church Street
Port Chester, NY 10573

Shelley Mayer
State Senator, District 37
222 Grace Church Street, Suite 300
Port Chester, NY 10573

B2. Residents, Owners And Occupants Of The Property And Properties Adjacent To The Property.

<u>Site Owner</u>
1946 Holding Corp.
43 Robins Road
New Rochelle, NY 10801

<u>955 Mamaroneck Avenue</u>
Commercial building owned by: L P Heeler
Owner Address: 955 Mamaroneck Avenue, Mamaroneck, NY 10543
Occupied by: Harvest Field Market
Occupant Address: 955 Mamaroneck Avenue, Mamaroneck, NY 10543
Occupied by: Sweet Charlie’s
Occupant Address: 955 Mamaroneck Avenue, Mamaroneck, NY 10543

1001 Mamaroneck Avenue
Commercial building owned by: Expny, LLC
Owner Address: 1001 Mamaroneck Avenue, Mamaroneck, NY 10543
Occupied by: Valvoline Instant Oil Change
Occupant Address: 1001 Mamaroneck Avenue, Mamaroneck, NY 10543

1008-44 Mamaroneck Avenue
Commercial buildings owned by: La-Vine Realty Co
Owner Address:1008-44 Mamaroneck Avenue, Mamaroneck, NY 10543
Occupied by: F.W. Wedd Company
Occupant Address: 1020 Mamaroneck Avenue, Mamaroneck, NY 10543
Occupied by: Calico
Occupant Address: 1040 Mamaroneck Avenue, Mamaroneck, NY 10543

976 Mamaroneck Avenue
Commercial building owned by: NY Dealer Stations, LLC
Owner Address: 976 Mamaroneck Avenue, Mamaroneck, NY 10543
Occupied by: Shell
Occupant Address: 974 Mamaroneck Avenue, Mamaroneck, NY 10543
Occupied by: J & G Auto Services
Occupant Address: 974 Mamaroneck Avenue, Mamaroneck, NY 10543

960 Mamaroneck Avenue
Commercial building owned by: Thomas LaGuidice
Owner Address: 960 Mamaroneck Avenue, Mamaroneck, NY 10543
Occupied by: Tomart USA, Inc.
Occupant Address: 960 Mamaroneck Avenue, Mamaroneck, NY 10543

950 Mamaroneck Avenue
Commercial building owned by: 950 Realty Co LLC
Owner Address: 950 Mamaroneck Avenue, Mamaroneck, NY 10543
Occupied by: Domino's Pizza
Occupant Address: 950 Mamaroneck Avenue, Mamaroneck, NY 10543

926 Lester Avenue
Residential building owned/occupied by: Nilesh Mandhare and Taruna Garg or Occupant

932 Lester Avenue
Residential building owned/occupied by: Elaine Snider or Occupant

934 Lester Avenue
Residential building owned/occupied by: Carlo Balsamo or Occupant

B3. Local News Media From Which The Community Typically Obtains Information.

The Journal News
1133 Westchester Avenue, Suite N110
White Plains, NY 10604

The Mamaroneck Review

170 Hamilton Avenue, Suite 203
White Plains, NY 10601

New York Daily News
4 New York Plaza
New York, NY 10004

New York Post
1211 Avenue of the Americas
New York, NY 10036

B4. The Public Water Supplier Which Services The Area In Which The Property Is Located

Westchester Joint Water Works
1625 Mamaroneck Avenue
Mamaroneck, NY 10543

The Village of Mamaroneck receives its water supply from the Catskill and Delaware watersheds of the New York City water system. There are connections at the Delaware Aqueduct in Yonkers and at Rye Lake where the water is pulled from the New York City system.

B5. Any Person Who Has Requested To Be Placed On The Contact List.

We are unaware of any requests for inclusion on the contact list.

B6. The Administrator Of Any School Or Day Care Facility Located On Or Near The Property.

Two day care facilities are within 1,000 feet of the site:

Little Sweethearts Day Care
926 Lester Avenue
Mamaroneck, NY 10543
Santos E. Morales, Owner
(914) 630-1486

Happy Feet Child Care
615 1st Street
Mamaroneck, NY 10543
Witt Kinuyo Gochaku, Owner
(914) 217-9611

One school is within 1,000 feet of the site:

Mamaroneck Avenue School
850 Mamaroneck Avenue
Mamaroneck, NY 10543
Neill Alleva, Principal
(914) 220-3600

B7. Locations of the Document Repositories

Mamaroneck Public Library
Attn: Susan Riley
136 Prospect Avenue
Mamaroneck, NY 10543

B8. In Cities With A Population of One Million or More, The Local Community Board, if The Proposed Site is Located Within Such Community Board's Boundaries

The Village of Mamaroneck has a population of less than one million.

Appendix C - Site Location Map

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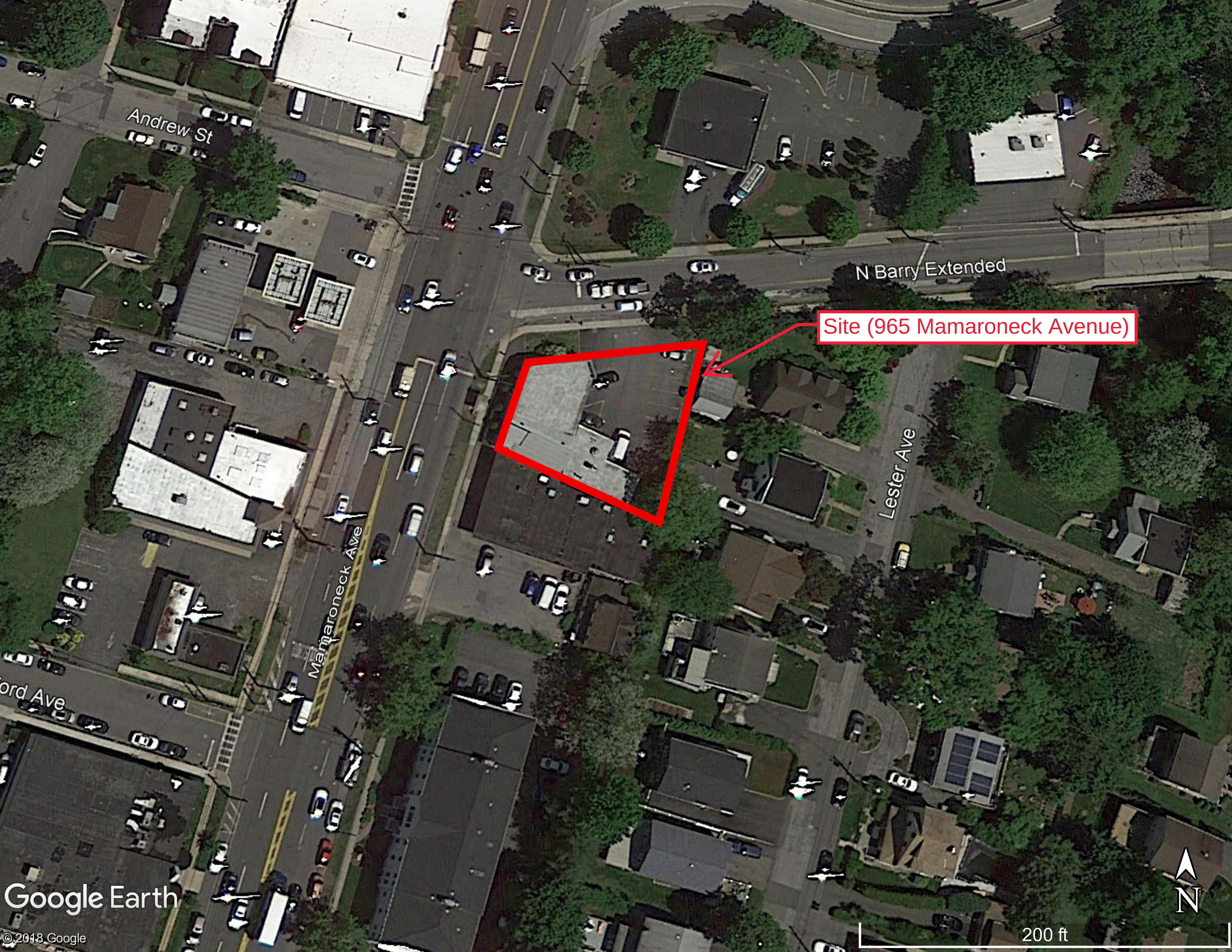
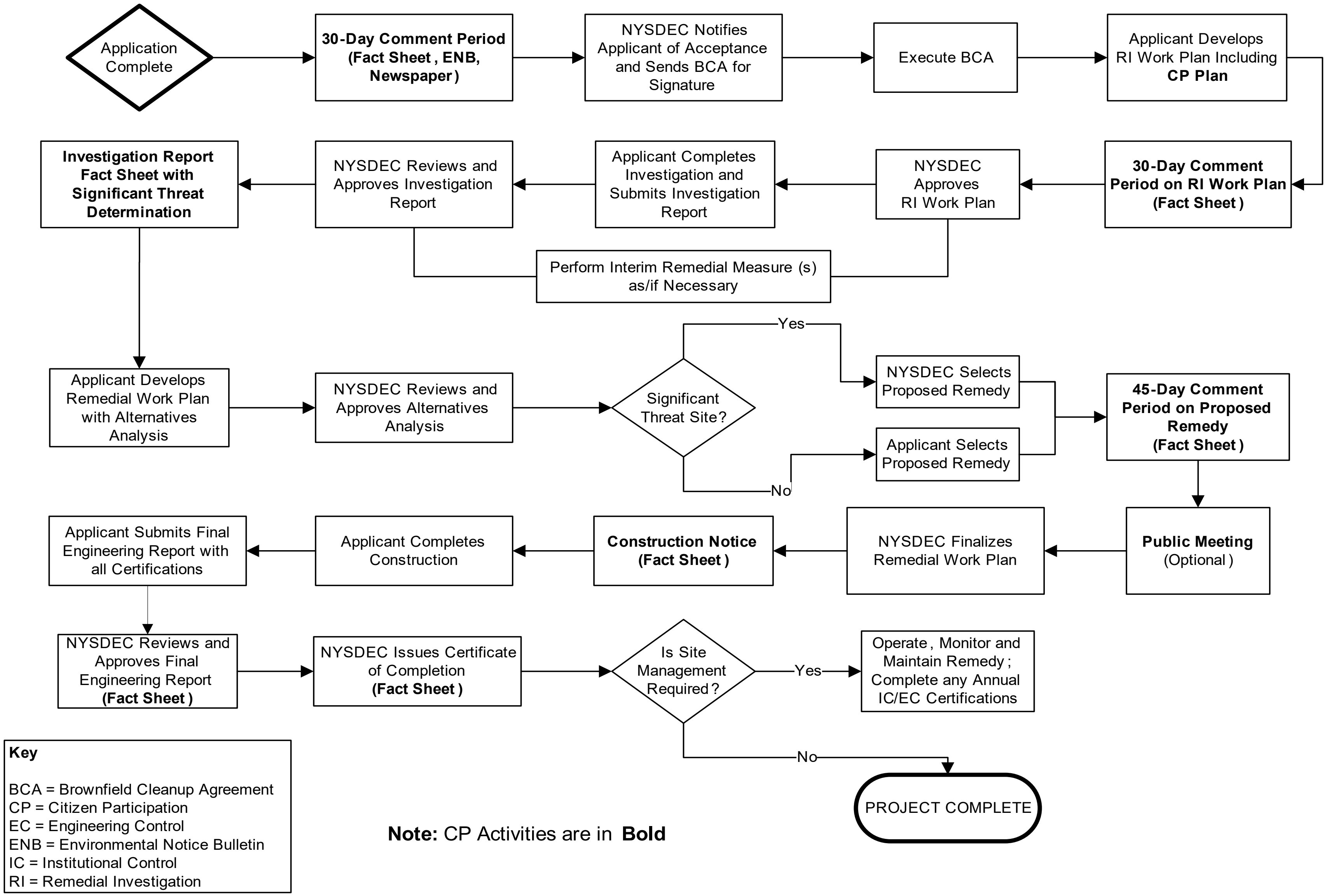

Andrew St
N Barry Extended
Site (965 Mamaroneck Avenue)
Lester Ave
Mamaroneck Ave
ford Ave
Google Earth
© 2018 Google
N
200 ft

Appendix D– Brownfield Cleanup Program Process



Note: CP Activities are in **Bold**

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New York State of Opportunity. | Department of Environmental Conservation

Division of Environmental Remediation

Remedial Programs
Scoping Sheet for Major Issues of Public Concern

Site Name: 965 Mamaroneck Avenue

Site Number: C360189

Site Address and County: 965 Mamaroneck Avenue, Village of Mamaroneck, Westchester County, NY

Remedial Party(ies): 1946 Holding Corp.

Note: For Parts 1. – 3. the individuals, groups, organizations, businesses and units of government identified should be added to the site contact list as appropriate.

Part 1. List major issues of public concern and information the community wants. Identify individuals, groups, organizations, businesses and/or units of government related to the issue(s) and information needs. **Use this information as an aid to prepare or update the Major Issues of Public Concern section of the site Citizen Participation Plan.**

Groundwater contamination includes volatile organic compounds (VOCs) which could pose soil vapor intrusion issues in on-Site and adjacent buildings. The Site is located within a Potential Environmental Justice Area. Environmental justice is defined as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Based on neighborhood 2010 census data, there is a sizable Hispanic-American community near the Site. Therefore, all future fact sheets will be translated into Spanish. There may also be impacts with regards to noise, odor, and truck traffic.

How were these issues and/or information needs identified?
A Phase II Investigation for soil and groundwater was performed at the Site in March 2019 and a soil vapor investigation was performed at the Site in June 2019.

Part 2. List important information needed **from** the community, if applicable. Identify individuals, groups, organizations, businesses and/or units of government related to the information needed.
N/A

How were these information needs identified?
N/A

Part 3. List major issues and information that need to be communicated **to** the community. Identify individuals, groups, organizations, businesses and/or units of government related to the issue(s) and/or information.
Possibly commercial and residential tenants of the surrounding community.

How were these issues and/or information needs identified?
A Phase II Investigation for soil and groundwater was performed at the Site in March 2019 and a soil vapor investigation was performed at the Site in June 2019.

Part 4. Identify the following characteristics of the affected/interested community. This knowledge will help to identify and understand issues and information important to the community, and ways to effectively develop and implement the site citizen participation plan (mark all that apply):

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a. Land use/zoning at and around site:
☒ **Residential** ☐ **Agricultural** ☐ **Recreational** ☒ **Commercial** ☐ **Industrial**

b. Residential type around site:
☐ **Urban** ☒ **Suburban** ☐ **Rural**

c. Population density around site:
☐ **High** ☒ **Medium** ☐ **Low**

d. Water supply of nearby residences:
☒ **Public** ☐ **Private Wells** ☐ **Mixed**

e. Is part or all of the water supply of the affected/interested community currently impacted by the site?
☐ **Yes** ☒ **No**

Provide details if appropriate:
N/A

f. Other environmental issues significantly impacted/impacting the affected community?
☐ **Yes** ☒ **No**

Provide details if appropriate:

g. Is the site and/or the affected/interested community wholly or partly in an Environmental Justice Area?
☒ **Yes** ☐ **No**

h. Special considerations:
☒ **Language** ☐ **Age** ☐ **Transportation** ☐ **Other**

Explain any marked categories in **h:**
All future fact sheets will be translated in Spanish.

Part 5. The site contact list must include, at a minimum, the individuals, groups, and organizations identified in Part 2. of the Citizen Participation Plan under 'Site Contact List'. Are *other* individuals, groups, organizations, and units of government affected by, or interested in, the site, or its remedial program? (Mark and identify all that apply, then adjust the site contact list as appropriate.)

☒ **Non-Adjacent Residents/Property Owners:** See Site Contact List

☒ **Local Officials:** See Site Contact List

☒ **Media:** See Site Contact List

☒ **Business/Commercial Interests:** See Site Contact List

☐ **Labor Group(s)/Employees:** N/A

☐ **Indian Nation:** N/A

☐ **Citizens/Community Group(s):** N/A

☐ **Environmental Justice Group(s):** N/A

☐ **Environmental Group(s):** N/A

☐ **Civic Group(s):** N/A

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☐ **Recreational Group(s):** N/A

☐ **Other(s):** N/A

Prepared/Updated By: Alana Carroll, PG	**Date:** 08/19/2019
Reviewed/Approved By: Click here to enter text.	**Date:** Click here to enter text.

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Appendix E

Reagent Manufacturer Specifications

PlumeStop® Liquid Activated Carbon™ Technical Description

PlumeStop Liquid Activated Carbon is an innovative groundwater remediation technology designed to rapidly remove and permanently degrade groundwater contaminants. PlumeStop is composed of very fine particles of activated carbon (1-2µm) suspended in water through the use of unique organic polymer dispersion chemistry. Once in the subsurface, the material behaves as a colloidal biomatrix, binding to the aquifer matrix, rapidly removing contaminants from groundwater, and expediting permanent contaminant biodegradation.

This unique remediation technology accomplishes treatment with the use of highly dispersible, fast-acting, sorption-based technology, capturing and concentrating dissolved-phase contaminants within its matrix-like structure. Once contaminants are sorbed onto the regenerative matrix, biodegradation processes achieve complete remediation at an accelerated rate.

Distribution of PlumeStop in water

To see a list of treatable contaminants with the use of PlumeStop, view the Range of Treatable Contaminants Guide.

Chemical Composition

- Water - CAS# 7732-18-5
- Colloidal Activated Carbon ≤2.5 - CAS# µm 7440-44-0
- Proprietary Additives

Properties

- Physical state: Liquid
- Form: Aqueous suspension
- Color: Black
- Odor: Odorless
- pH: 8 - 10

Storage and Handling Guidelines

Storage
Store in original tightly closed container
Store away from incompatible materials
Protect from freezing

Handling
Avoid contact with skin and eyes
Avoid prolonged exposure
Observe good industrial hygiene practices
Wash thoroughly after handling
Wear appropriate personal protective equipment

PLUME STOP®
Liquid Activated Carbon

PlumeStop® Liquid Activated Carbon™ Technical Description

Applications

PlumeStop is easily applied into the subsurface through gravity-feed or low-pressure injection.

Health and Safety

Wash hands after handling. Dispose of waste and residues in accordance with local authority requirements. Please review the Material Safety Data Sheet for additional storage, usage, and handling requirements here: PlumeStop SDS.

Potassium and Sodium Permanganate

Hepure Technologies provides sodium and potassium permanganate for environmental remediation projects. Permanganate is a powerful oxidant which chemically reduces chlorinated ethene compounds quickly and effectively without forming daughter products such as dichloroethene and vinyl chloride. Permanganate is pH neutral and does not release gas or create heat during reaction, an excellent option for sites with underground utilities and equipment and is easy to detect in soil and monitoring wells due to the dark purple color it maintains while unreacted.

Permanganate effectively treats a fairly broad variety of contaminants, such as chlorinated ethenes (e.g., PCE, TCE, dichloroethene [DCE], and vinyl chloride [VC]), certain polycyclic aromatic hydrocarbons (e.g., napthalene, phenathrene, and pyrene), and energetic compounds such as trinitrotoluene (TNT). Permanganate does not effectively treat chlorinated ethanes/methanes (e.g., trichloroethane [TCA], carbon tetrachloride [CT], and chloroform), benzene, toluene, ethylbenzene, and xylene (BTEX) compounds, methyl tert-butyl ether (MTBE), or polychlorinated biphenyls (PCBs).

When permanganate reacts with organic contaminants, the contaminant is oxidized to carbon dioxide and the permanganate is reduced to a manganese dioxide salt and a potassium salt. The equations below depict the reaction of permanganate in the subsurface.

Sodium and Potassium permanganate dissociates in aqueous solution:

$KMnO_4 \rightarrow K^+ + MnO_4^-$

$NaMnO_4 \rightarrow Na^+ + MnO_4^-$

Permanganate ions oxidize the organic contaminant PCE and TCE:

PCE: $C_2Cl_4 + 2MnO_4^- \rightarrow 2CO_2 + 2MnO_2\,(s) + Cl_2 + 2Cl^-$

TCE: $C_2Cl_3H + 2MnO_4^- \rightarrow 2CO_2 + 2MnO_2\,(s) + 3Cl^- + H^+$

From these equations, it can be seen that it takes two moles of the permanganate to oxidize one mole of the contaminants PCE and TCE. The reaction of permanganate is described by second order reaction kinetics. The rate of reaction is dependent upon the concentrations of both the permanganate and the COC as well as the concentrations of other competing species such as, reduced metals and natural organic matter. Hence, increasing the concentration of permanganate will increase the rate of reaction with the COCs and other competing species.

Laboratory Analysis

Permanganate is a natural mineral and may contain unwanted metals. Hepure's Permangate is produced exclusively for environmental remediation and consistently tested to insure the highest quality with the lowest mineral content possible.

Type	**Sodium**	**Potassium**
Metal	Test Results (mg/kg) June 24, 2016	Test Results (mg/kg) February 6, 2016
Silver (Ag)	<0.19	<0.4
Arsenic (As)	<0.098	1.13
Berylium (Be)	<0.47	<0.6
Cadmium (Cd)	<0.1	<0.12
Chromium (Cr)	<1.0	4.43
Copper (Cu)	<1.0	<1.0
Mercury (Hg)	<0.029	<0.03
Nickel (Ni)	<1.0	<1.0
Lead (Pb)	<0.1	0.172
Antimony (Sb)	<0.19	<1.0
Selinium (Se)	<0.94	<1.2
Thalium (Ti)	<1.0	<1.0
Zinc (Zn)	<1.0	<1.0

Application Methods

Permanganate is easily applied to most sites. The application method is determine by the geological characteristics of the site, type and concentration of contaminates, and potential physical limitations of the working space. A brief synopsis on application methods is discussed below. Permanganate is only effective with dissolved phase contaminates in the saturated zone. Successful applications are dependent on achieving contact of the oxidant with the contaminated in the time period where the oxidant is active. Permanganate is typically active for a few hours to a few weeks depending on site conditions.

Ambient Pressure Injection: Many times referred to as a gravity flow or drip application. Shallow or deep injection points are installed and a low flow of a permanganate solution is applied. Typical applications utilize sodium permanganate to prevent potential clogging of the injection points with crystalline permanganate. Sodium also allows for a greater concentration to be applied at a lower flow rate. A gallery of injection points can be constructed of driven or drilled points which need not be fully constructed as a well. The radius of influence is very limited, distribution of permanganate is dependent on aquifer flow. This method has the advantage in non-homogenous soils and fractured bedrock which allows the permanganate to penetrate the formation in a similar manner as the contaminate.

Pressure Injection: The application is through a driven rod under adequate pressure to distribute the permanganate into the formation. High volumes of low permanganate concentration are typically applied to increase the radius of influence. Potassium Permanganate has the advantage of being able to be placed as a slurry, allowing release over a longer period of time. The method is limited by geological features which may limit the depth of the driven rod and limit the radius of influence. Applications may also be non-uniform with more permanganate being distributed to more permeable zones. Pressure injection allows for more permanganate to be applied over a shorter time period with a greater radius of influence than Ambient Pressure Injection.

Pneumatic and Hydraulic Fracturing: Fracturing involves the placement of high volumes at very high pressures under controlled conditions. Very large radius of influences may be achieved in heavy clays and fractured bedrock. Potassium permanganate can be applied as a slurry allowing the release of permanganate over a longer period of time.

Soil Mixing: Permanganate may be directly mixed into the soil of contaminated zones by placement and mixing in the bottom with an excavation, auger, or rotating mixing head. All applications require the treatment area to be in the saturated zone. High rates of removal are typically achieved due to the contact of the permanganate with the contaminate.

Logistics: Hepure has relationships with product distributors positioned throughout the United States, allowing us to provide competitive shipping rates. In addition to the standard packaging, our relationships with chemical blenders provide our clients with the opportunity to receive chemicals made to order and ready to inject at the desired concentration. Typical packaging and concentration by product are provided below.

Typical Packaging and Concentration of Remediation Grade Permanganates

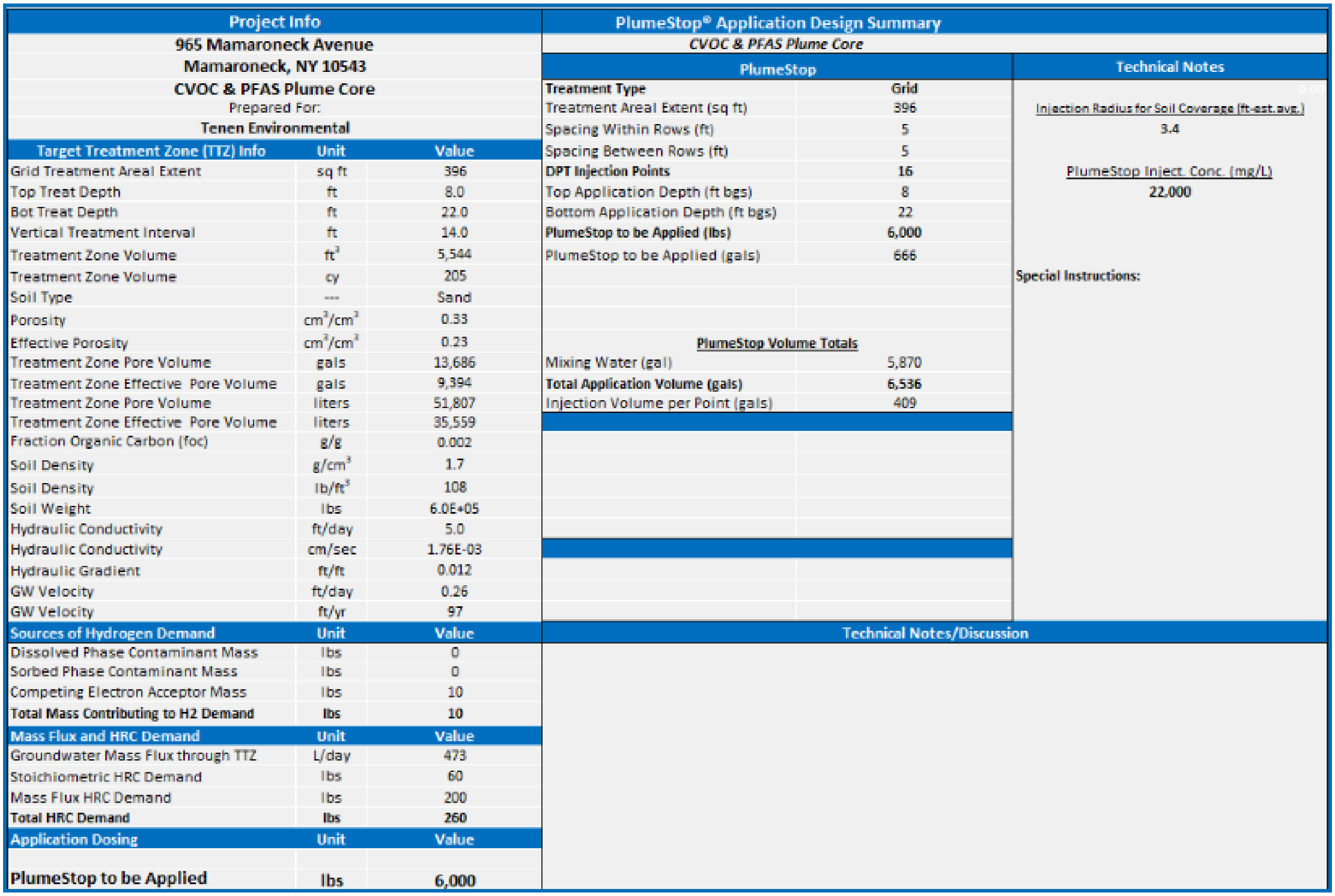
	NaMnO4	**KMnO4**
Standard Packaging at 40%	55-gallon Drums and 275-gallon Totes	55-lb Pails or 330-lb Drums, dry crystals
<3,000 gallons at 5% or less	275-gallon Totes and 55-gallon Drums	275-gallon Totes and 55-gallon Drums
>3,000 gallons at 5% or less	Tankers and/or 275-gallon Totes	Tankers and/or 275 gallon Totes
<3,000 gallons at 10% or greater	275-gallon Totes and 55-gallon Drums	Not Available
>3,000 gallons at 10% or greater	Tankers and/or 275-gallon Totes	Not Available

In addition to the variable packaging and delivery options, Hepure can assist with preparation and maintenance of CSAT paperwork for potassium permanganate projects. Our clients not only enjoy the benefits of product reliability and cost effectiveness, but also the support to complete their projects successfully in a timely manner.

Appendix F

PlumeStop® Design Summary Sheet

Detailed Design Table



Project Info		
965 Mamaroneck Avenue		
Mamaroneck, NY 10543		
CVOC & PFAS Plume Core		
Prepared For:		
Tenen Environmental		
Target Treatment Zone (TTZ) Info	**Unit**	**Value**
Grid Treatment Areal Extent	sq ft	396
Top Treat Depth	ft	8.0
Bot Treat Depth	ft	22.0
Vertical Treatment Interval	ft	14.0
Treatment Zone Volume	ft^3	5,544
Treatment Zone Volume	cy	205
Soil Type	---	Sand
Porosity	cm^3/cm^3	0.33
Effective Porosity	cm^3/cm^3	0.23
Treatment Zone Pore Volume	gals	13,686
Treatment Zone Effective Pore Volume	gals	9,394
Treatment Zone Pore Volume	liters	51,807
Treatment Zone Effective Pore Volume	liters	35,559
Fraction Organic Carbon (foc)	g/g	0.002
Soil Density	g/cm^3	1.7
Soil Density	lb/ft^3	108
Soil Weight	lbs	6.0E+05
Hydraulic Conductivity	ft/day	5.0
Hydraulic Conductivity	cm/sec	1.76E-03
Hydraulic Gradient	ft/ft	0.012
GW Velocity	ft/day	0.26
GW Velocity	ft/yr	97
Sources of Hydrogen Demand	**Unit**	**Value**
Dissolved Phase Contaminant Mass	lbs	0
Sorbed Phase Contaminant Mass	lbs	0
Competing Electron Acceptor Mass	lbs	10
Total Mass Contributing to H2 Demand	**lbs**	**10**
Mass Flux and HRC Demand	**Unit**	**Value**
Groundwater Mass Flux through TTZ	L/day	473
Stoichiometric HRC Demand	lbs	60
Mass Flux HRC Demand	lbs	200
Total HRC Demand	**lbs**	**260**
Application Dosing	**Unit**	**Value**
PlumeStop to be Applied	**lbs**	**6,000**

PlumeStop® Application Design Summary

CVOC & PFAS Plume Core

PlumeStop	
Treatment Type	**Grid**
Treatment Areal Extent (sq ft)	396
Spacing Within Rows (ft)	5
Spacing Between Rows (ft)	5
DPT Injection Points	**16**
Top Application Depth (ft bgs)	8
Bottom Application Depth (ft bgs)	22
PlumeStop to be Applied (lbs)	**6,000**
PlumeStop to be Applied (gals)	666
PlumeStop Volume Totals	
Mixing Water (gal)	5,870
Total Application Volume (gals)	**6,536**
Injection Volume per Point (gals)	409

Technical Notes

0.00

Injection Radius for Soil Coverage (ft-est.avg.)

3.4

PlumeStop Inject. Conc. (mg/L)

22,000

Special Instructions:

Technical Notes/Discussion