South Brooklyn Marine Terminal Remedial Investigation Work Plan

Portions of Lots 1, 130, 136, 137, and 155, Block 662
2nd Avenue
Brooklyn, New York 11232

Tetra Tech Project #194-1247-0003
Revision 0
March 17, 2022

PRESENTED TO

SBMT Asset LLC
80 State Street
Albany, NY 12207

PRESENTED BY

Tetra Tech, Inc.
6 Century Drive, 3rd Floor
Parsippany, NJ07054

P +1-973-639-8000
tetratech.com

"I, Robert C. Cantagallo, certify that I am a Qualified Environmental Professional as defined in 6 NYCRR Part 375, and that this Work Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the Division of Environmental Remediation Technical Guidance for Site Investigation and Remediation (DER-10)."

Robert C. Cantagallo 0**3/17/22**

Robert C. Cantagallo, CHMM. **Date**

TABLE OF CONTENTS

TABLE OF CONTENTS

(Continued)

FIGURES

TABLES

APPENDICES

1.0 INTRODUCTION

Tetra Tech, Inc. (Tetra Tech), on behalf of SBMT Asset LLC (SBMT Asset), has prepared this Remedial Investigation Work Plan (RIWP) for portions of the South Brooklyn Marine Terminal (SBMT) Site located in Brooklyn, New York (the “Site”; Figure 1). The Site will be used for two separate projects: the Empire Wind 1 offshore wind project (EW1 Project), as the location for the submarine export cable landfall and onshore substation, and the SBMT Port Infrastructure Improvement Project, which will allow SBMT to serve as a staging and operations-and-maintenance base for the offshore wind industry.

The purpose of this RIWP is to define the remedial investigation (RI) work scope that will be used to complete the site characterization in conjunction with the data collected by Tetra Tech in during the December 2021 Phase II Environmental Site Assessment (ESA). The RI data will be used to further characterize the subsurface conditions on-site and evaluate the need for future remedial measures. The RIWP includes the methodologies and approach for soil borings and monitoring well installation, groundwater, and soil sampling, and preparation of the Remedial Investigation Report.

1.1 Scope of Work

The Scope of Work for the RIWP includes the collection and analysis additional on-site soil and groundwater samples throughout the SBMT site to further characterize the extent of subsurface contamination in areas of previously observed impacts, and in areas where subsurface work will be conducted during facility construction. These activities include:

- Completing a geophysical survey at the proposed boring locations to evaluate the presence or absence of subsurface utilities. Boring locations will also be hand-cleared to 5 feet below ground survey (BGS) using appropriate tools;
- Advancing 27 soil borings to approximately 10 feet BGS at the locations specified on (Figure 2, Proposed Sample Location Plan);
- Screening soil samples for evidence of contamination such as staining, odors, or vapors with a photoionization detector (PID);
- Collecting 58 soil samples (including 3 duplicates and one MS/MSD) for off-site laboratory analysis;
- Installing of 9 permanent groundwater monitoring wells;
- Collection of one round of groundwater samples from the monitoring wells;
- Surveying all sampling locations;
- Performing data validation/data usability;
- Reviewing analytical results against the soil cleanup objectives (SCOs) described in New York Codes, Rules and Regulations (NYCRR) Part 375 and the groundwater criteria in NYSDEC Ambient Water Quality Standards and Guidance Values; and
- Preparing the Remedial Investigation Report (RIR).

The investigation activities presented herein will be performance in accordance with the Health and Safety Plan (HASP) and the Quality Assurance Project Plan (QAPP). The HASP and QAPP are included in this work plan as Appendices A and B, respectively. The proposed RI sample locations are depicted on Figure 2.

1.2 Project Schedule

Implementation of the field activities will begin immediately following approval of the RIWP, pending any short delays due to inclement weather. The results of the RI will be incorporated into a Remedial Investigation Report. It is anticipated that completion of the soil borings and well installation for the RI will be completed in approximately three weeks, with groundwater sample collection following two weeks later.

2.0 SITE DESCRIPTION AND BACKGROUND

2.1 General Site Conditions

The Site is irregular in shape, and is bounded by 2nd Avenue to the southeast, 39th Street to the southwest, a recycling facility and 29th Street to the northeast and the Gowanus Bay to the northwest (Figure 1). The total Site area includes an approximately 73.68-acre tract of land within portions of Lots 1, 130, 136, 137, and 155 of Block 662. The Site is largely vacant and primarily consists of asphalt and concrete pavement, existing above-grade structures, railway spurs, and bulkheads. There are seven existing structures located on the property, including the J1 Shed, J2 Shed, N Shed, Graffiti Building, two temporary structures near 650 2nd Avenue, and the Tower Building located at 632 2nd Avenue. The Site is surrounded by an approximately eight-foot-tall chain-link fence, and access is restricted to the entrance near the northwest terminus of 39th Street with a security guard present. The topography at the Site is relatively flat and ground elevations vary between 2 feet to 10 feet above mean sea level (ASML).

As early as 1888, the Site was undeveloped and consisted of open waters. Between 1888 and 1922, the Site elevation was progressively raised with fill to construct a series of piers formerly known as the City of New York Piers. Based on aerial imagery, the site has been in its current condition since at least 2011. Additional historical information for the site is included in the Phase 1 Environmental Site Assessment prepared by AECOM in May 2018.

2.2 Site Geology and Hydrology

2.2.1 Regional Geology

The Site is situated within the glaciated Coastal Plain physiographic province of New York State. Limited public data is available regarding to the depth to bedrock within the project area. According to the Geology and Engineering Geology of the New York Metropolitan Area, Field Trip Guidebook T361 (Baskerville 1989) and the Geologic Map of New York City, SBMT is underlain by the Cambro-Ordovician age Hartland Formation. The Hartland Formation is generally comprised of gneiss and belongs to the Pelham Bay Member. Surficial deposits in this region of New York are also mapped as glacial till. Based on a review of historic aerial imagery, low-lying portions of the site have been raised using fill materials as early as 1888 (AECOM 2018).

According to a review of the Natural Resources Conservation Service (NRCS) Web Soil Survey, the majority of the Site is mapped within the Urban land, reclaimed substratum, 0-3 percent slopes map unit. The typical soil profile for this map unit includes 0 to 15 inches of cemented material, and up to 15 to 79 inches of gravelly sandy loam. A small portion of the Site is mapped within the Urban land, till substratum, 0 to 3 percent slopes map unit. The typical soil profile for this map unit also includes cemented material and gravelly sandy loam.

2.2.2 Site Geology

A subsurface exploration program was completed by AECOM at SBMT between December 2017 and February 2018 to characterize the geotechnical conditions. The 2021 Phase II ESA conducted by Tetra Tech supported the AECOM observations. The site is generally underlain by fill consisting of fine to coarse sands with varying amounts of gravel and silt, as well as brick, wood, gravel etc. within the upper 6-8 feet. Shallow layers of fine to coarse gravel with sand and silt, approximately eight to eleven feet thick, were observed in three borings. Deeper strata containing clay, sand, and silt, approximately 15 to 20 feet thick, were observed at depths between 40 and 102 feet BGS.

2.2.3 Site Hydrology

During the Phase II ESA performed by Tetra Tech in December 2021, groundwater depths varied across the Site, but were generally observed to be approximately eight to ten feet BGS. The groundwater flow direction has not been investigated but is assumed to follow the general topography of the Site and flow northwest towards Gowanus Bay.

2.3 Previous Investigations

Based on a review of prior reports for the Site, environmental investigations have been completed for the SBMT since at least October 1997. In March 1998, two 550-gallon gasoline underground storage tanks (USTs), four 4,000-gallon gasoline USTs, one 4,000-gallon diesel UST, one 550-gallon waste oil UST, one 1,000-gallon above-ground storage tank (AST) of unknown contents, and one 550-gallon fuel AST were removed from the property. Since impacted soils were detected through post-excavation sampling around the tanks and associated pumps, four spill cases (No. 97-14187, 97-14188, 97-14189, and 97-14190) were opened by NYSDEC on March 23, 1998. No additional USTs were located during a 1998 geophysical investigation performed at eight portions of the Site following removal of the tanks (TRC 2004). Impacted soils surrounding the former UST area were excavated and transported off-Site for disposal. 13 groundwater monitoring wells were installed around the former tank area and quarterly groundwater sampling was completed by URS Corporation (URS) for various wells between August 2003 and March 2005. Once groundwater contaminant concentrations were measured below the NYSDEC Groundwater Quality Criteria, a request for spill closure was submitted and approved for both cases in May 2005.

An April 2004 investigation by TRC included the advancement of 12 soil borings throughout the Site that revealed the presence of petroleum-related volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs), and metals in subsurface soils between 0 and 10.5 feet BGS. It was suspected that four former 160,000-gallon ASTs existed in in the location of the “N Shed” along the 39th Street Pier. Based on a review of historic aerial photographs, it was estimated that these tanks were active between 1940 and 1953. However, information regarding the decommissioning of the tanks and any impacted soil removal was not available (AECOM 2018). Petroleum-related impacts were observed in four shallow and two subsurface soil samples collected from four borings in the vicinity of the former ASTs (TRC 2004).

A Phase I Environmental Site Assessment was performed by AECOM for the Site in May 2018. AECOM documented that due to the potential for orphan USTs and presence historic urban fill, subsurface contamination may exist at the SBMT. A brass cap within a concrete pad was observed behind the two temporary structures associated with the auto maintenance facility near 37th Street and Second Avenue. The Phase I report also recognized the history of reported spills and removal of the former USTs in 1999.

AECOM also completed a Phase II Limited Site Investigation at SBMT in October 2018 that included the advancement of 15 soil borings to a maximum depth of 20 feet, collection of groundwater grab samples from eight borings, and an inspection of an underground vault located near the New York Department of Transportation (DOT) building in the northeast portion of the Site. Elevated SVOCs concentrations were detected above unrestricted, residential, and commercial SCOs in eight borings at the Site, but primarily in the location of the former ASTs within the "N Shed". PCBs were also detected above the commercial SCOs in the vicinity of the DOT building. No VOCs were detected in any soil samples above the unrestricted SCO. SVOCs above the New York Technical and Operational Guidance Series (TOGS) 1.1.1 standards were detected in only one groundwater sample from a boring near the 39th Street parking lot.

A subsurface investigation was completed by TRC in July 2019 throughout the Site that included a geophysical survey, advancement of 20 soil borings, installation of eight temporary wells, and installation of eight soil vapor sample locations. The geophysical survey identified an additional UST in the southwestern portion of the Site near 39th Street. Information regarding the four former 160,000-gallon ASTs was not provided in this investigation report. According to the TRC Phase II Investigation Report, the following contaminants were identified for on-Site soils:

- Select VOCs were detected over the Unrestricted Use SCO and Commissioner's Policy Table 2 and/or Table 3 SCLs, but below the Restricted Residential Use, Restricted Commercial Use, and Restricted Industrial Use SCOs;
- Select SVOCs and metals were detected above the Unrestricted Use, Restricted Residential, Restricted Commercial, and Restricted Industrial SCOs;
- Total PCBs were detected in one sample at a concentration above the Unrestricted Use SCO, but below the Restricted Residential Use, Restricted Commercial Use, and Restricted Industrial Use SCOs; and,
- Select pesticides were detected over the Unrestricted Use SCOs but below the Restricted Residential Use, Restricted Commercial Use, and Restricted Industrial Use SCOs.
- Impacts to adjacent subsurface materials were not observed downgradient of the UST.

A supplemental Phase II ESA was completed by Tetra Tech in December 2021 that included a geophysical survey, advancement of 40 soil borings to a depth of approximately 10 feet BGS, installation of 11 temporary monitoring wells to depths between 6 and 10 feet BGS and collection of groundwater samples, installation of 13 temporary soil vapor points and collection of 13 soil vapor samples below ground cover, collection of one ambient air sample from the Site and laboratory analyses for parameters of environmental concern by laboratory certified under the New York Environmental Laboratory Approval Program (ELAP).

The analytical results for soil samples were compared to the NYSDEC Industrial Use SCO and produced the following exceedances:

- Benzo(a)pyrene was detected in 33 of 42 samples, ranging from 22.9 to 9,330 ug/kg, and exceeded the NYSDEC Industrial Use SCO in eight (8) samples.
- Dibenzo(a,h)anthracene was detected in 24 of 42 samples, ranging from 19.2 to 1,530 ug/kg, and exceeded the NYSDEC Industrial Use SCO in one (1) sample.

The analytical results for groundwater samples were compared to the NYSDEC Ambient Water Quality Stands and Guidance Values for groundwater (GA) and revealed the following exceedances:

- Benzo(a)anthracene was detected in 2 of 12 samples, ranging from 0.47 to 0.76 ug/L, and exceeded its NYSDEC Ambient Water Quality Standards and Guidance Values in both samples.
- Benzo(b)fluoranthene was detected in 2 of 12 samples, ranging from 0.61 to 0.9 ug/L, and exceeded its NYSDEC Ambient Water Quality Standards and Guidance Values in both samples.
- Benzo(k)fluoranthene was detected in 2 of 12 samples, ranging from 0.21 to 0.38 ug/L, and exceeded its NYSDEC Ambient Water Quality Standards and Guidance Values in both samples.
- Chrysene was detected in 2 of 12 samples, ranging from 0.37 to 0.64 ug/L, and exceeded its NYSDEC Ambient Water Quality Standards and Guidance Values in both samples.
- Indeno(1,2,3-cd)Pyrene was detected in 3 of 12 samples, ranging from 0.57 to 1.1 ug/L, and exceeded its NYSDEC Ambient Water Quality Standards and Guidance Values in all three (3) samples.
- Antimony was detected in one sample, at a concentration of 6.2 ug/L, exceeding its NYSDEC Ambient Water Quality Standards and Guidance Values.
- Arsenic was detected in 9 of 11 samples, ranging from 3.1 to 66.6 ug/L, exceeding its NYSDEC Ambient Water Quality Standards and Guidance Values at one location.
- Beryllium was detected in 5 of 11 samples, ranging from 1.1 to 7.1 ug/L, exceeding its NYSDEC Ambient Water Quality Standards and Guidance Values at one location.
- Chromium was detected in 4 of 11 samples, ranging from 11.7 to 140 ug/L, exceeding its NYSDEC Ambient Water Quality Standards and Guidance Values at one location.
- Manganese was detected in all 11 samples, ranging from 20.5 to 10,700 ug/L, exceeding its NYSDEC Ambient Water Quality Standards and Guidance Values at six (6) locations.

- Nickel was detected in 5 of 11 samples, ranging from 11.2 to 206 ug/L, exceeding its NYSDEC Ambient Water Quality Standards and Guidance Values at one location.

A total of 68 VOCs were analyzed for TO-15 suite parameters. Of the 68 VOCs analyzed, 46 were detected at 13 of the soil vapor locations. Below is a summary of the VOCs that were detected above ambient air concentrations:

- Benzene was detected at concentrations ranging from 0.7 to 45.4 ug/m3,
- Cyclohexane was detected at concentrations ranging from 0.27 to 372 ug/m3,
- Ethylbenzene was detected at concentrations ranging from 0.42 to 2.9 ug/m3,
- Heptane was detected at concentrations ranging from 0.49 to 422 ug/m3,
- Hexane was detected at concentrations ranging from 0.49 to 206 ug/m3,
- Methyl ethyl ketone was detected at concentrations ranging from 0.41 to 121 ug/m3,
- Toluene was detected at concentrations ranging from 1.5 to 51.6 ug/m3, and
- Xylenes (total) was detected at concentrations ranging from 0.91 to 136 ug/m3.

One ambient air sample was collected as part of the sampling event. There were 17 VOCs that were detected in the ambient air sample.

3.0 FIELD SAMPLING PROGRAM

This section describes the tasks to be performed as part of the Remedial Investigation. Sampling of soil and groundwater will be consistent with the guidance provided in NYSDEC Division of Environmental Remediation Technical Guidance for Site Investigation and Remediation (DER-10) Sections 3.5.1 and 3.5.3.

The proposed sampling locations and frequency are intended to further characterize the extent of subsurface contamination in areas of previously observed impacts, and in areas where subsurface work will be conducted during facility construction. The sampling locations may be field adjusted as needed if previously unknown utilities are identified or if shallow refusal is encountered due to bricks, large rocks, or other unknown obstructions.

3.1 Sample Locations

The field sampling program will consist of collecting soil samples from 27 locations and collection of groundwater samples from 8 monitoring wells to be installed as part of the field effort. The proposed sampling locations are depicted on Figure 2.

3.2 Utility Clearance

Prior to commencing ground-intrusive activities on-Site, a public utility mark out will be requested through notification to the New York 811 System (800-272-4480). The mark out request must be placed at least 48 hours, but no more than 10 days, prior to drilling. A private utility location company will also be subcontracted to clear the proposed sample locations prior to drilling. If any utilities are identified, then the proposed sampling locations may be modified to avoid overhead, or subsurface obstructions as needed. Borings will also be hand-cleared to approximately five feet BGS.

3.3 Installation of Soil Borings

Soil borings will be advanced at 27 locations within SBMT. The soil sampling will be performed by a field engineer, scientist, or technician under the supervision of a New York-licensed geologist or engineer. Soil samples will be continuously collected using direct-push drilling methods with macro-core samplers and acetate liners from ground surface to the target boring depths. If required due to the soil conditions (i.e., fill/lag layer), a hollow stem auger (HSA) may be used to facilitate the collection of soil samples at depth.

Two soil samples will be collected from each boring for off-Site laboratory analysis. One sample will be collected from the two-foot interval exhibiting the greater evidence of impact (e.g., elevated PID readings, odors, or staining). Samples may be also collected at target depths to delineate impacts observed at adjacent soil borings with SCO industrial exceedances If no evidence of impacts is observed during soil boring advancement, a soil sample will be collected from the interval immediately above the groundwater table. A second sample will be collected from the final two-foot interval of the boring (e.g., 8 to 10 feet BGS). The target boring depth is approximately 10 feet BGS, which coincides with the previously observed groundwater table elevation, but may be modified in the field pending subsurface conditions.

Quality assurance / quality control (QAQC) samples will be collected at a rate of 1:20. Therefore, it is anticipated that three duplicate soil samples will be collected.

Soil samples will be logged according to the Universal Soil Classification System to evaluate whether the soils are classified as Fill Material or Native Soil.

The soil cores will be screened with a photoionization detector (PID) for volatiles, and detections will be noted on the boring log. Any unusual soil conditions identified through visual and olfactory observations will also be recorded.

Samples selected for off-site laboratory analysis will be transferred to certified-clean containers provided by the laboratory by personnel wearing clean, disposable latex or nitrile gloves. The soil fraction for TCL VOCs will be collected using an En Core® sampler before removing the soil from the core tube. Collected soils will then be placed into a clean, disposable aluminum tin using a disposable plastic trowel, and mixed together to ensure a homogeneous sample that is representative of the sampling interval. The remaining analytical fractions will then be transferred into the appropriate glass jars, labeled, recorded on a chain-of-custody, and placed into an ice-chilled cooler pending transport to the analytical laboratory (additional details are provided below).

Soil samples will be analyzed for the Target Compound List (TCL) Volatile Organic Compounds (VOCs), TCL Semi-volatile Organic Compounds (SVOCs), Target Analyte List (TAL) Metals, Total Organic Carbon (TOC), and cyanide (CN). Soil samples collected from near the Tower building in the southeastern portion of the site, where AECOM's investigation revealed PCB impacted soil, will also be analyzed for PCBs.

Each soil sample location will be surveyed by a Professional Land Surveyor licensed in New York State.

Table 1: Soil Sampling and Analysis Plan

Parameter	Interval(s)	No. of Soil Borings	No. of Samples	QA/QC
TCL VOCs	based on field observations, previous sampling, and/or termination of boring (at GW table)	27	58	3 duplicates, 1 MS/MSD
TCL SVOCs	based on field observations, previous sampling, and/or termination of boring (at GW table)	27	58	3 duplicates, 1 MS/MSD
TAL Metals	based on field observations, previous sampling, and/or termination of boring (at GW table)	27	58	3 duplicates, 1 MS/MSD
TOC	based on field observations, previous sampling, and/or termination of boring (at GW table)	27	58	3 duplicates, 1 MS/MSD

Parameter	Interval(s)	No. of Soil Borings	No. of Samples	QA/QC
PCBs	based on field observations, previous sampling, and/or termination of boring (at GW table)	5	10	1 duplicates, 1 MS/MSD

3.4 Groundwater Investigation and Sampling Methods

Nine new permanent groundwater monitoring wells will be installed on-Site to further characterize groundwater contamination at SBMT. One well will be constructed in the northwestern portion of the 33rd Street Pier, three wells will be installed along the southeastern boundary of the Site near 2nd Avenue, one well will be installed adjacent to the DOT building, two wells will be installed in the central portion of the site. The typical well construction will consist of no longer than a five (5) ft long two-inch diameter Schedule 40 PVC 0.2 slot screen and the PVC riser will consist of flush joint connections. The annular space will be filled with appropriately sized sand pack up to one (1) ft above the top of the slotted screen followed by at least one (1) ft of a bentonite pellet layer on top which will be hydrated. The remaining annular space will be filled with additional bentonite pellets subsequently hydrated or a cement-bentonite grout. It is anticipated that the well screen will be installed between 5 feet and 15 feet BGS, based on depth to the groundwater table, with 1 ft of screen above the water table. The finished well will be completed with a flush-mount road box and a concrete collar at the surface. The well will also have a locking well cap.

Table 2: Monitoring Well Installation Detail and Rationale

Well ID	Location	Type	Rationale
MW-1	On site	Flushmount	Upgradient location southern corner of the site
MW-2	On site	Flushmount	Upgradient location southeast portion of the site
MW-3	On site	Flushmount	Upgradient location southeast portion of the site
MW-4	On site	Flushmount	Southern corner of the site to characterize area of anticipated subsurface construction and impacts around TT-SB-17
MW-5	On site	Flushmount	North corner of tower building to characterize potential PCB impacts
MW-6	On site	Flushmount	Near cable landing area to characterize area of anticipated subsurface construction and impacts around SBMT-TW-7
MW-7	On site	Flushmount	Southwest portion of the site to characterize impacts around TT-SB-13
MW-8	On site	Flushmount	Northwest central portion of the site to characterize downgradient groundwater conditions
MW-9	On site	Flushmount	Northeast corner of the site to characterize groundwater conditions in this area and potentially characterize any off-site influences to the north

After approximately 24 hours, the monitoring wells will be developed. Development consists of surging the well using a surge block to for approximately 5 minutes, followed by pumping with a submersible pump to remove fines from the well.

No less than two weeks after well development, a full round of synoptic groundwater level measure measurements will be collected from the monitoring wells prior to sampling. Each monitoring well will be screened with a PID immediately upon opening the casing. If NAPL is observed in any of the monitoring wells it will be noted in the field notebook. Groundwater samples will be collected from the monitoring wells by low-flow purge and sample methods using a peristaltic pump and the following parameters will be recorded via field instrumentation until stabilization requirements are met (~10%): temperature, redox potential, dissolved oxygen, pH and turbidity. A duplicate and trip blank will also be collected for QA/QC purposes. Purge water will be collected in 5-gallon buckets and transferred to 55-gallon steel drums for disposal. Purged water will be placed into 55-gallon drums and temporarily stored awaiting off-Site disposal. Purging rates will be set below the maximum sustainable flow rate in order to minimize drawdown.

Groundwater samples for PFAS will be collected in accordance with the June 2021 NYSDEC guidance, *Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs,* and will be outlined in the project specific SOPs developed for the QAPP.

QAQC samples will be collected at a rate of 1:20. Therefore, it is anticipated that one duplicate groundwater sample will be collected.

Table 3: GW Sampling and Analysis Plan

ID	GW Level	Sampling Method	Sampling Analysis
MW-1	X	Low-Flow	TCL VOCs, TCL SVOCs, TAL Metals, PCBS, PFAS
MW-2	X	Low-Flow	TCL VOCs, TCL SVOCs, TAL Metals, PCBs, PFAS
MW-3	X	Low-Flow	TCL VOCs, TCL SVOCs, TAL Metals, PCBs, PFAS
MW-4	X	Low-Flow	TCL VOCs, TCL SVOCs, TAL Metals, PFAS
MW-5	X	Low-Flow	TCL VOCs, TCL SVOCs, TAL Metals, PCBs, PFAS
MW-6	X	Low-Flow	TCL VOCs, TCL SVOCs, TAL Metals, PFAS
MW-7	X	Low-Flow	TCL VOCs, TCL SVOCs, TAL Metals, PFAS
MW-8	X	Low-Flow	TCL VOCs, TCL SVOCs, TAL Metals, PFAS

3.5 Surveying

A New York State licensed land surveyor will survey the vertical and horizontal locations of the new monitoring wells and soil boring locations. The elevation of the reference point of each monitoring well (the top of the well casing) will be surveyed for aid in determining groundwater elevations and corresponding flow direction.

3.6 Off-Site Laboratory Sample Analytical Methods

The representative soil samples will be analyzed by New York ELAP-certified laboratory with a standard 10-day turn-around-time. The analytical methods proposed for the remedial investigation are summarized below:

- Target Compound List (TCL) VOCs using USEPA Method 8260;
- TCL semi-volatile organic compounds SVOCs using USEPA Method 8270;
- Target Analyte List (TAL) metals using USEPA Methods 6010 and 7471;
- Total organic carbon by USEPA Method SW-846;
- Polychlorinated biphenyls (PCBs) using USEPA Method 8082;

The ground water sample will be submitted to a New York State Department of Health (NYSDOH) approved laboratory for the following analyses:

- VOCs by USEPA Method 8260;
- SVOCs by USEPA Method 8270;
- Total Metals (total and dissolved metals);
- PCBs by USEPA Method 8082;
- Per- and poly-fluoroalkyl (PFAS) compounds by Method 537.1 (21 Compound List);

The laboratory will provide a Category B data deliverable (PDF) and a NYSDEC EQuIS-formatted electronic data deliverable (EDD).

3.7 Boring Abandonment and Waste Disposal

Due to the relatively shallow nature of the sampling, the sampling locations will be restored to grade using a cement/bentonite slurry. Investigation-derived waste that is generated during this sampling effort will be placed in 55-gallon drums, labeled appropriately, and stored on-Site in an owner-designated area for proper off-Site disposal of the investigation-derived waste using a licensed waste hauler and disposal facility.

3.8 Field Log

Field sampling personnel will keep a daily record of the field activities, including work completed that day, samples collected, visitors to the Site, and any other pertinent observations. Photographs taken during field activities will be noted in the daily field log with the date and time of the photo, location, direction of the photo and description of the subject of the photograph.

4.0 HEALTH AND SAFETY PLAN with COVID-19 Precautions

A site-specific Health and Safety Plan (HASP) will be used during field activities described in this Work Plan. This HASP will provide the following content:

1. Describe the expected hazardous substances that could be encountered during field work;
2. Specify appropriate personal protective equipment levels for the work;
3. Specify the monitoring equipment and monitoring procedures for on-site activities;
4. Identify safe work practices around drilling equipment and during sampling activities;
5. Describe measures to be implemented in the event of an emergency; and
6. Describe the COVID-19 precautions that will be used.

On-site personnel will be required to review the HASP prior to the start of field activities; and will be required to conduct field activities in accordance with procedures specified in the HASP.

5.0 REPORTING

Upon completion of the remedial investigation activities discussed above, a Remedial Investigation Report (RIR) will be prepared for submission to the NYSDEC. The RIR will describe the nature and extent, as well as the fate and transport of contaminants associated with SBMT, and will identify specific contaminant concentrations throughout each media (e.g., soil, groundwater, etc). The RIR will also include the following documentation:

- Descriptions of soil sampling activities and encountered surface soils;
- Results of the subsurface geophysical survey;
- Soil sampling logs;
- Groundwater sampling logs;
- Monitoring well completion logs;
- Site photographs;
- Analytical results in the electronic data deliverables EQuIS format; and
- Recommendations for further investigation and/or remediation based on the sampling results.

A qualitative human health exposure assessment (QHHEA) and a fish and wildlife impact analysis (FWIA) will be included in the RIR. The QHHEA will be completed to identify any potential exposure pathways and/or risks to human receptors from those site contaminants of concern identified during the Remedial Investigation, and will include:

- Characterization of the exposure setting (including the physical environment and potentially exposed human populations);
- Identification of exposure pathways;
- Evaluation of contaminant fate and transport, and;
- Determination of potential exposure of human receptors relative to site related contaminants of concern.

The FWRIA will be completed to identify any potential impacts to fish and wildlife resources from those site contaminants of ecological concern identified during the Remedial Investigation. The FWRIA will consist of:

- Identification of fish and wildlife resources;
- Identification of contaminant migration pathways and fish and wildlife exposure pathways;
- Description of the resources on and within one-half mile of the Site;
- Identification of contaminants of ecological concern, and;
- Provide conclusions regarding the actual or potential adverse impacts to fish and wildlife resources.

6.0 REFERENCES

AECOM, 2018 Phase I Environmental Site Assessment, South Brooklyn Marine Terminal, Second Avenue between 33rd and 39th Streets, Brooklyn, New York

AECOM, 2018, Phase II Limited Site Investigation Results Report, South Brooklyn Marine Terminal.

AECOM, 2018, Subsurface Exploration Report, 269 37th Street, Brooklyn, New York.

KC Engineering and Land Surveying, P.C., 2021, Survey of South Brooklyn Marine Terminal Lease Parcels for Equinor Wind.

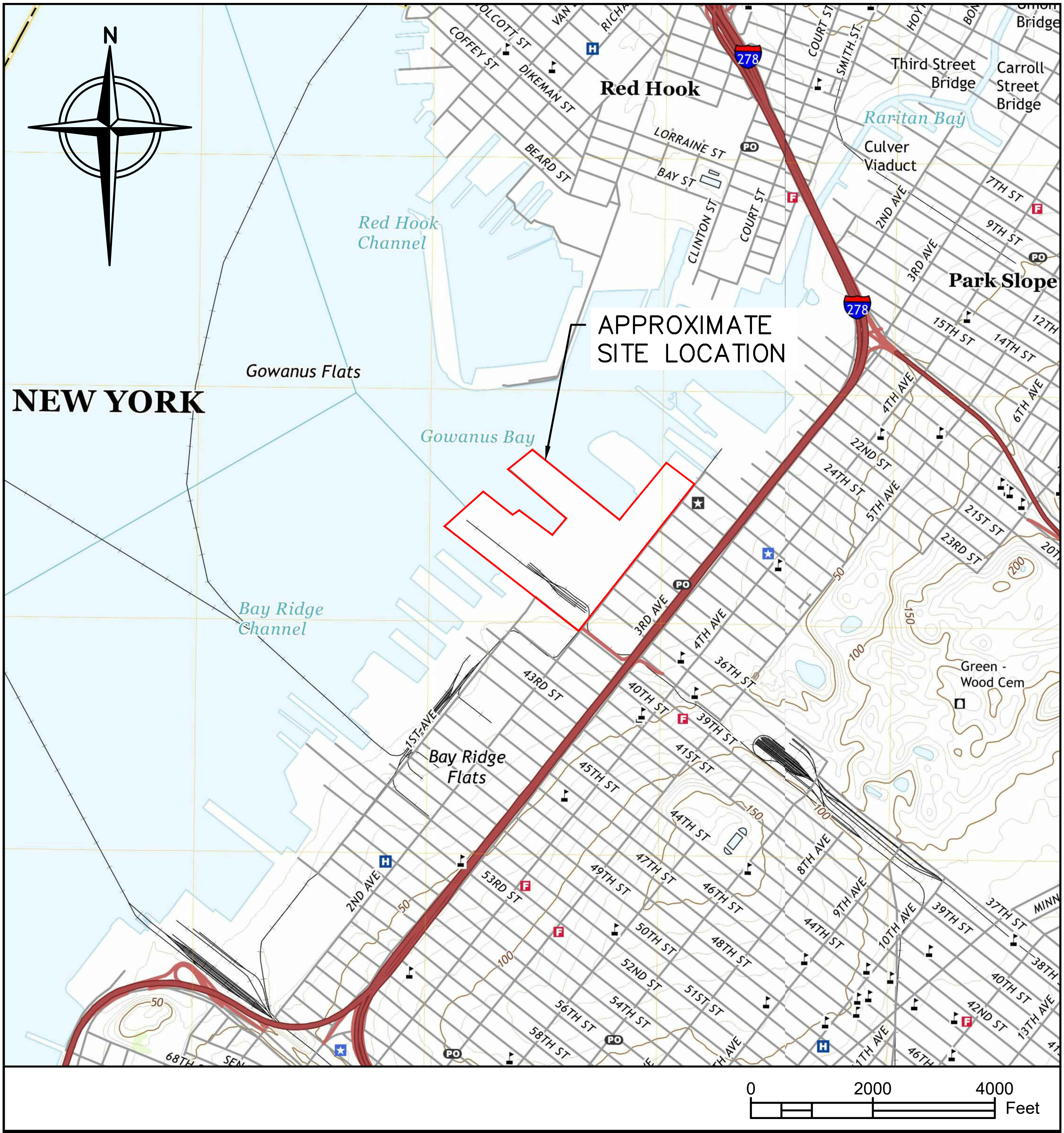
New York State Department of Environmental Conservation (NYSDEC), 2010; DER-10 - Technical Guidance for Site Investigation and Remediation.

Tetra Tech, 2021, Empire Wind 1 Phase 2 Sediment Sampling Plan, Empire Offshore Wind Lease Area OCS-A 0512, Empire Wind 1 Project

TRC Companies, 2019, Phase II Environmental Site Investigation (ESI) Summary Report, NYCEDC – South Brooklyn Marine Terminal

TRC Companies, 2004, Supplemental Site Investigation Report, South Brooklyn Marine Terminal, Brooklyn, New York

FIGURES



TETRA TECH

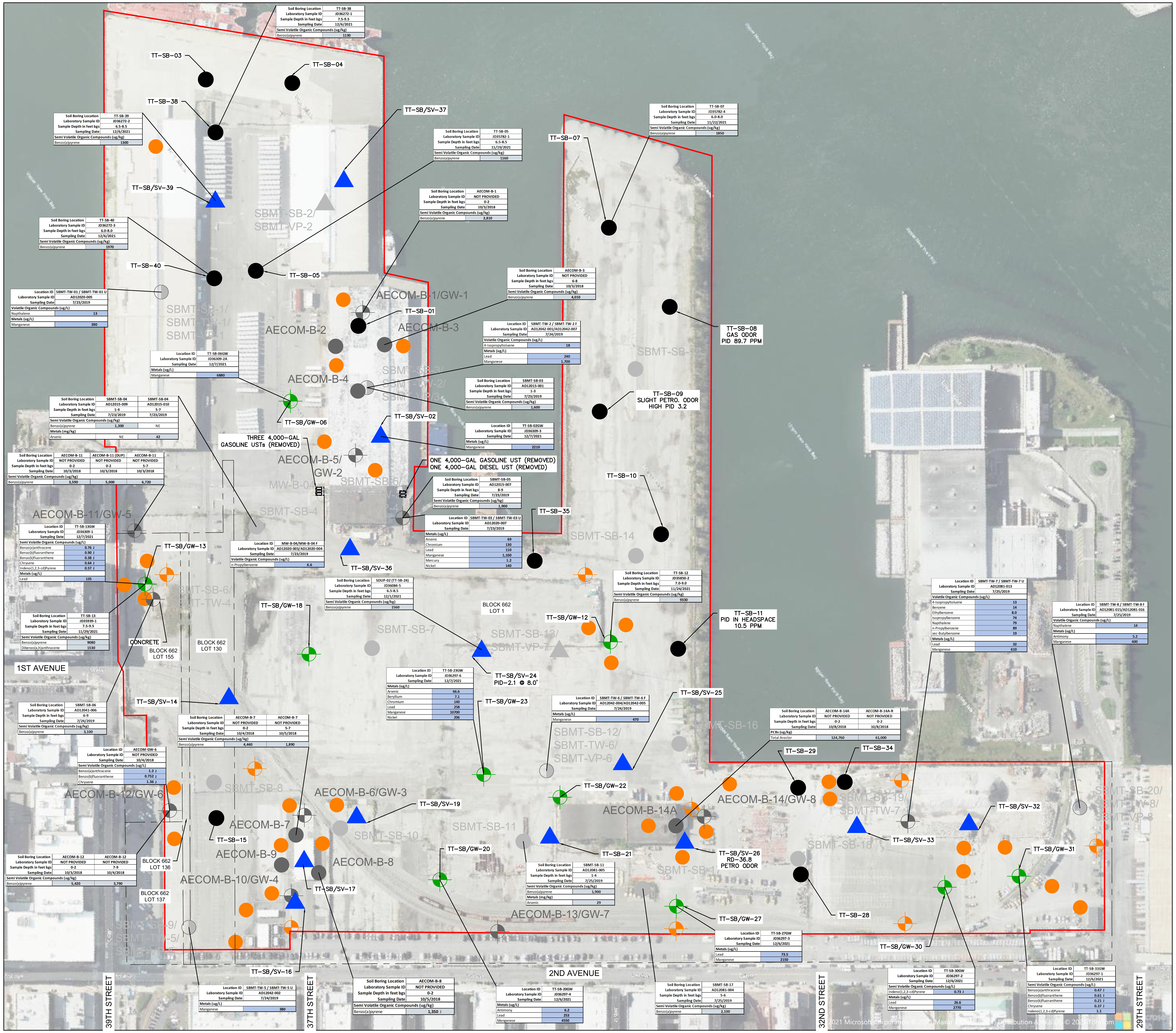
TETRA TECH, INC.
6 CENTURY DRIVE, SUITE 3
PARSIPPANY, NJ 07054
(973) 630-8000

FIGURE 1 - SITE LOCATION MAP

SOUTH BROOKLYN MARINE
TERMINAL
2ND AVENUE
BROOKLYN, NY 11232

SBMT Asset LLC

80 State Street
Albany, NY 12207



LEGEND

●	SOIL BORING AND SOIL SAMPLES
⊕	SOIL BORING AND GROUNDWATER GRAB SAMPLE
▲	COLLOCATED SOIL BORING AND SOIL VAPOR SAMPLE
●	PROPOSED RI SOIL BORINGS
⊕	PROPOSED MONITORING WELL LOCATIONS
▲	TRC SOIL BORING AND SOIL VAPOR SAMPLE
●	TRC SOIL BORING LOCATION
⊕	TRC SOIL BORING AND GROUNDWATER GRAB SAMPLE
◐	TRC SOIL BORING, GROUNDWATER GRAB SAMPLE, AND SOIL VAPOR SAMPLE
⊕	TRC GROUNDWATER GRAB SAMPLE
●	AECOM SOIL BORING LOCATION
⊕	AECOM SOIL BORING AND GROUNDWATER GRAB SAMPLE
——	PROJECT AREA
— - —	PARCEL BOUNDARIES

0 120 240
Feet

SBMT Asset LLC
80 State Street
Albany, NY 12207

TETRA TECH

STAMP:

DRAFT
NOT FOR CONSTRUCTION

SOUTH BROOKLYN MARINE TERMINAL

SBMT Asset LLC
2nd Avenue
BROOKLYN, NY 11232

PROJECT NUMBERS:
194-1247-0003

SHEET TITLE:
PROPOSED REMEDIAL INVESTIGATION SAMPLE LOCATION PLAN

SHEET SIZE:
ARCH "D"
24" X 36" (610 x 914)
0 ½" 1"

THIS DOCUMENT IS THE PROPERTY OF TETRA TECH WHO HAS UNLIMITED RIGHTS. THIS DOCUMENT IS PROVIDED UPON CONDITION THAT IT WILL NEITHER BE REPRODUCED, COPIED, OR ISSUED TO A THIRD PARTY AND WILL BE USED SOLELY FOR THE ORIGINAL INTENDED PURPOSE.

NO.	REVISION	DATE	INIT.

DATE: 2/25/2022
DRAWN BY:
ENGINEER:
APPROVED BY:

PROJECT PHASE:
N/A

SCALE:
1" = 120'

SHEET NO.:
FIGURE 2

\\tt.local\gfs\USVolume3\Legacy\ttsi19ris2\CES\Projects\Equinor\Brownfields\SBMT\RI Work Plan\Drawings\SBMT Proposed RI Sample Location Plan 02092022.dwg

Printed: 3/15/2022 3:06 PM

Appendix A – Health and Safety Plan

(to be developed)

Appendix B – Quality Assurance Project Plan

South Brooklyn Marine Terminal Quality Assurance Project Plan

Portions of Lots 1, 130, 136, 137, and 155, Block 662
2nd Avenue
Brooklyn, New York 11232

Tetra Tech Project #194-1247-0003
Revision 0
March 17, 2022

PREPARED FOR	PREPARED BY	
SBMT Asset LLC 80 State Street Albany, NY 12207	**Tetra Tech, Inc.** 6 Century Drive, Suite 300 Parsippany, NJ07054	**P** +1-973-639-8000 tetratech.com

TABLE OF CONTENTS
QUALITY ASSURANCE PROJECT PLAN

Section
No. Title Page
No.

TABLE OF CONTENTS (CONT'D)

Section No. Title Page No.

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

1.0 GENERAL

Tetra Tech, Inc. (Tetra Tech), on behalf of SBMT Asset LLC (SBMT Asset), has prepared this Quality Assurance Project Plan (QAPP) for portions of the South Brooklyn Marine Terminal (SBMT) Site located in Brooklyn, New York (the “Site”; Figure 1). The Site will be used for two separate projects: the Empire Wind 1 offshore wind project (EW1 Project), as the location for the submarine export cable landfall and onshore substation, and the SBMT Port Infrastructure Improvement Project, which will allow SBMT to serve as a staging and operations-and-maintenance base for the offshore wind industry.

The RI data will be used to further characterize the subsurface conditions on-site and evaluate the need for future remedial measures. The project includes soil borings and monitoring well installation, groundwater, and soil sampling, and preparation of the Remedial Investigation Report.

This QAPP for the SBMT site has been prepared to specify procedures that will provide data of known, documented quality, and which will be legally defensible, should the need exist. To the extent discrepancies exist between this QAPP and the Remedial Investigation Work Plan, the Work Plan will take precedence.

Implementation of the field activities will begin immediately following approval of the QAPP by the project stakeholders, pending any short delays due to inclement weather.

2.0 PROJECT AND SITE DESCRIPTION

The Site is irregular in shape, and is bounded by 2nd Avenue to the southeast, 39th Street to the southwest, a recycling facility and 29th Street to the northeast and the Gowanus Bay to the northwest (Figure 1). The total Site area includes an approximately 73.68-acre tract of land within portions of Lots 1, 130, 136, 137, and 155 of Block 662. The Site is largely vacant and primarily consists of asphalt and concrete pavement, existing above-grade structures, railway spurs, and bulkheads. There are seven existing structures located on the property, including the J1 Shed, J2 Shed, N Shed, Graffiti Building, two temporary structures near 650 2nd Avenue, and the Tower Building located at 632 2nd Avenue. The Site is surrounded by an approximately eight-foot-tall chain-link fence, and access is restricted to the entrance near the northwest terminus of 39th Street with a security guard present. The topography at the Site is relatively flat and ground elevations vary between 2 feet to 10 feet above mean sea level (ASML).

As early as 1888, the Site was undeveloped and consisted of open waters. Between 1888 and 1922, the Site elevation was progressively raised with fill to construct a series of piers formerly known as the City of New York Piers. Based on aerial imagery, the site has been in its current condition since at least 2011. Additional historical information for the site is included in the Phase 1 Environmental Site Assessment prepared by AECOM in May 2018.

2.1 Site Geology and Hydrology

The Site is situated within the glaciated Coastal Plain physiographic province of New York State. Limited public data is available regarding to the depth to bedrock within the project area. According to the Geology and Engineering Geology of the New York Metropolitan Area, Field Trip Guidebook T361 (Baskerville 1989) and the Geologic Map of New York City, SBMT is underlain by the Cambro-Ordovician age Hartland Formation. The Hartland Formation is generally comprised of gneiss and belongs to the Pelham Bay Member. Surficial deposits in this region of New York are also mapped as glacial till. Based on a review of historic aerial imagery, low-lying portions of the site have been raised using fill materials as early as 1888 (AECOM 2018).

According to a review of the Natural Resources Conservation Service (NRCS) Web Soil Survey, the majority of the Site is mapped within the Urban land, reclaimed substratum, 0-3 percent slopes map unit. The typical soil profile for this map unit includes 0 to 15 inches of cemented material, and up to 15 to 79 inches of gravelly sandy loam. A small portion of the Site is mapped within the Urban land, till substratum, 0 to 3 percent slopes map unit. The typical soil profile for this map unit also includes cemented material and gravelly sandy loam.

A subsurface exploration program was completed by AECOM at SBMT between December 2017 and February 2018 to characterize the geotechnical conditions. The 2021 Phase II ESA conducted by Tetra Tech supported the AECOM observations. The site is generally underlain by fill consisting of fine to coarse sands with varying amounts of gravel and silt, as well as brick, wood, gravel etc. within the upper 6-8 feet. Shallow layers of fine to coarse gravel with sand and silt, approximately eight to eleven feet thick, were observed in three borings. Deeper strata containing clay, sand, and silt, approximately 15 to 20 feet thick, were observed at depths between 40 and 102 feet BGS.

During the Phase II ESA performed by Tetra Tech in December 2021, groundwater depths varied across the Site, but were generally observed to be approximately eight to ten feet BGS. The groundwater flow direction has not been investigated but is assumed to follow the general topography of the Site and flow northwest towards Gowanus Bay.

2.2 Previous Investigations

Based on a review of prior reports for the Site, environmental investigations have been completed for the SBMT since at least October 1997. In March 1998, two 550-gallon gasoline underground storage tanks (USTs), four 4,000-gallon gasoline USTs, one 4,000-gallon diesel UST, one 550-gallon waste oil UST, one 1,000-gallon above-ground storage tank (AST) of unknown contents, and one 550-gallon fuel AST were removed from the property. Since impacted soils were detected through post-excavation sampling around the tanks and associated pumps, two spill cases (No. 97-14188 and 97-14190) were opened by NYSDEC on March 23, 1998. No additional USTs were located during a 1998 geophysical investigation performed at eight portions of the Site following removal of the tanks (TRC 2004). Impacted soils surrounding the former UST area were excavated and transported off-Site for disposal. 13 groundwater monitoring wells were installed around the former tank area and quarterly groundwater sampling was completed by URS Corporation (URS) for various wells between August 2003 and March 2005. Once groundwater contaminant concentrations were measured below the NYSDEC Groundwater Quality Criteria, a request for spill closure was submitted and approved for both cases in May 2005.

An April 2004 investigation by TRC included the advancement of 12 soil borings throughout the Site that revealed the presence of petroleum-related volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOC)s, and metals in subsurface soils between 0 and 10.5 feet BGS. It was suspected that four former 160,000-gallon ASTs existed in in the location of the “N Shed” along the 39th Street Pier. Based on a review of historic aerial photographs, it was estimated that these tanks were active between 1940 and 1953. However, information regarding the decommissioning of the tanks and any impacted soil removal was not available (AECOM 2018). Petroleum-related impacts were observed in four shallow and two subsurface soil samples collected from four borings in the vicinity of the former ASTs (TRC 2004).

A Phase I Environmental Site Assessment was performed by AECOM for the Site in May 2018. AECOM documented that due to the potential for orphan USTs and presence historic urban fill, subsurface contamination may exist at the SBMT. A brass cap within a concrete pad was observed behind the two temporary structures associated with the auto maintenance facility near 37th Street and Second Avenue. The Phase I report also recognized the history of reported spills and removal of the former USTs in 1999.

AECOM also completed a Phase II Limited Site Investigation at SBMT in October 2018 that included the advancement of 15 soil borings to a maximum depth of 20 feet, collection of groundwater grab samples from eight borings, and an inspection of an underground vault located near the New York Department of Transportation (DOT) building in the northeast portion of the Site. Elevated SVOCs concentrations were detected above unrestricted, residential, and commercial SCOs in eight borings at the Site, but primarily in the location of the former ASTs within the "N Shed". PCBs were also detected above the commercial SCOs in the vicinity of the DOT building. No VOCs were detected in any soil samples above the unrestricted SCO. SVOCs above the New York Technical and Operational Guidance Series (TOGS) 1.1.1 standards were detected in only one groundwater sample from a boring near the 39th Street parking lot.

A subsurface investigation was completed by TRC in July 2019 throughout the Site that included a geophysical survey, advancement of 20 soil borings, installation of eight temporary wells, and installation of eight soil vapor sample locations. The geophysical survey identified an additional UST in the southwestern portion of the Site near 39th Street. Information regarding the four former 160,000-gallon ASTs was not provided in this investigation report. According to the TRC Phase II Investigation Report, the following contaminants were identified for on-Site soils:

- Select VOCs were detected over the Unrestricted Use SCO and Commissioner's Policy Table 2 and/or Table 3 SCLs, but below the Restricted Residential Use, Restricted Commercial Use, and Restricted Industrial Use SCOs;
- Select SVOCs and metals were detected above the Unrestricted Use, Restricted Residential, Restricted Commercial, and Restricted Industrial SCOs;
- Total PCBs were detected in one sample at a concentration above the Unrestricted Use SCO, but below the Restricted Residential Use, Restricted Commercial Use, and Restricted Industrial Use SCOs; and,
- Select pesticides were detected over the Unrestricted Use SCOs but below the Restricted Residential Use, Restricted Commercial Use, and Restricted Industrial Use SCOs.
- Impacts to adjacent subsurface materials were not observed downgradient of the UST.

A supplemental Phase II ESA was completed by Tetra Tech in December 2021 that included a geophysical survey, advancement of 40 soil borings to a depth of approximately 10 feet BGS, installation of 11 temporary monitoring wells to depths between 6 and 10 feet BGS and collection of groundwater samples, installation of 13 temporary soil vapor points and collection of 13 soil vapor samples below ground cover, collection of one ambient air sample from the Site and laboratory analyses for parameters of environmental concern by laboratory certified under the New York Environmental Laboratory Approval Program (ELAP).

The analytical results for soil samples were compared to the NYSDEC Industrial Use SCO and produced the following exceedances:

- Benzo(a)pyrene was detected in 33 of 42 samples, ranging from 22.9 to 9,330 ug/kg, and exceeded the NYSDEC Industrial Use SCO in eight (8) samples.
- Dibenzo(a,h)anthracene was detected in 24 of 42 samples, ranging from 19.2 to 1,530 ug/kg, and exceeded the NYSDEC Industrial Use SCO in one (1) sample.

The analytical results for groundwater samples were compared to the NYSDEC Ambient Water Quality Stands and Guidance Values for groundwater (GA) and revealed the following exceedances:

- Benzo(a)anthracene was detected in 2 of 12 samples, ranging from 0.47 to 0.76 ug/L, and exceeded its NYSDEC Ambient Water Quality Standards and Guidance Values in both samples.
- Benzo(b)fluoranthene was detected in 2 of 12 samples, ranging from 0.61 to 0.9 ug/L, and exceeded its NYSDEC Ambient Water Quality Standards and Guidance Values in both samples.
- Benzo(k)fluoranthene was detected in 2 of 12 samples, ranging from 0.21 to 0.38 ug/L, and exceeded its NYSDEC Ambient Water Quality Standards and Guidance Values in both samples.
- Chrysene was detected in 2 of 12 samples, ranging from 0.37 to 0.64 ug/L, and exceeded its NYSDEC Ambient Water Quality Standards and Guidance Values in both samples.
- Indeno(1,2,3-cd)Pyrene was detected in 3 of 12 samples, ranging from 0.57 to 1.1 ug/L, and exceeded its NYSDEC Ambient Water Quality Standards and Guidance Values in all three (3) samples.
- Antimony was detected in one sample, at a concentration of 6.2 ug/L, exceeding its NYSDEC Ambient Water Quality Standards and Guidance Values.
- Arsenic was detected in 9 of 11 samples, ranging from 3.1 to 66.6 ug/L, exceeding its NYSDEC Ambient Water Quality Standards and Guidance Values at one location.
- Beryllium was detected in 5 of 11 samples, ranging from 1.1 to 7.1 ug/L, exceeding its NYSDEC Ambient Water Quality Standards and Guidance Values at one location.
- Chromium was detected in 4 of 11 samples, ranging from 11.7 to 140 ug/L, exceeding its NYSDEC Ambient Water Quality Standards and Guidance Values at one location.
- Manganese was detected in all 11 samples, ranging from 20.5 to 10,700 ug/L, exceeding its NYSDEC Ambient Water Quality Standards and Guidance Values at six (6) locations.

- Nickel was detected in 5 of 11 samples, ranging from 11.2 to 206 ug/L, exceeding its NYSDEC Ambient Water Quality Standards and Guidance Values at one location.

A total of 68 VOCs were analyzed for TO-15 suite parameters. Of the 68 VOCs analyzed, 46 were detected at 13 of the soil vapor locations. Below is a summary of the VOCs that were detected above ambient air concentrations:

- Benzene was detected at concentrations ranging from 0.7 to 45.4 ug/m3,
- Cyclohexane was detected at concentrations ranging from 0.27 to 372 ug/m3,
- Ethylbenzene was detected at concentrations ranging from 0.42 to 2.9 ug/m3,
- Heptane was detected at concentrations ranging from 0.49 to 422 ug/m3,
- Hexane was detected at concentrations ranging from 0.49 to 206 ug/m3,
- Methyl ethyl ketone was detected at concentrations ranging from 0.41 to 121 ug/m3,
- Toluene was detected at concentrations ranging from 1.5 to 51.6 ug/m3, and
- Xylenes (total) was detected at concentrations ranging from 0.91 to 136 ug/m3.

One ambient air sample was collected as part of the sampling event. There were 17 VOCs that were detected in the ambient air sample.

3.0 PROJECT ORGANIZATION AND PERSONNEL RESPONSIBILITIES

An organization structure has been developed to identify the roles and responsibilities of the various personnel involved with the SBMT site. The team will consist of the following personnel, with a description of their responsibilities:

For the purpose of quality control (QC), Tetra Tech's Project Manager (PM) will be responsible for review of data upon receipt from the analytical laboratory. The PM will assure that data usability screening is performed by trained and experienced data reviewers using the applicable criteria specified in the NYSDEC 2005 Analytical Services Protocol (ASP). For the purposes of this document, all references to ASP indicate the 2005 NYSDEC Analytical Services Protocol. The specific requirements for data usability screening are given in Section 9.3. The PM will be responsible for ensuring that all analytical data are in conformance with requirements of this QAPP.

The Project Quality Assurance Manager (PQAM) is accountable for all QA activities, including oversight of subcontracted laboratories, verification of corrective actions, and supervision of data quality evaluation activities, including the validation and reporting of the analytical data.

The Field Operations Lead (FOL) will be responsible for the management and supervision of the field investigation program, providing consultation and decision-making on day-to-day issues relating to the sampling activities. The FOL oversees the sampling to determine that operations are consistent with plans and procedures, and that the data acquired meets the analytical and data quality needs. When necessary, the FOL documents any deviations from the plans and procedures for approval by the PM prior to implementation.

All project personnel have the responsibility, as part of the normal work duties, to promptly identify, solicit approved correction, and report conditions adverse to quality.

4.0 QA/QC OBJECTIVES FOR MEASUREMENT OF DATA

The overall quality assurance (QA) objective for the project is to develop and implement procedures which will provide data of known, documented quality. Field and laboratory quality assurance/quality control (QA/QC) requirements defined in the NYSDEC ASP and other applicable guidelines ensure acceptable levels of data quality will be maintained throughout the sampling and analysis program.

The QA/QC objectives for all measurement data include precision, accuracy, representativeness, completeness, and comparability. The samples to be collected (type and frequency of collection) are specified in the Remedial Investigation Work Plan.

4.1 Precision

Precision is an expression of the reproducibility of measurements of the same parameter under a given set of conditions. Specifically, it is a quantitative measurement of the variability of a group of measurements compared to their average value (USEPA, 1987). Precision is usually stated in terms of standard deviation, but other estimates such as the coefficient of variation (relative standard deviation), range (maximum value minus minimum value), and relative range are also common. For this project, precision will be evaluated by recording duplicate measurements of the same parameter on similar sample aliquots (i.e., field duplicate samples) under the same conditions, and calculating the relative percent difference (RPD) between the values. The formula for calculating RPD is presented in Section 13.2.

Measurement data for this project will include field data as well as laboratory analytical data. Laboratory precision will be performed according to the requirements described in the associated analytical methods (eg., laboratory duplicate samples). The field measurement data may include pH, temperature, conductivity, organic vapor readings, water level measurements, and turbidity. The objective for precision of field data collection methods is to take duplicate (minimum of 2 for every 20 samples) measurements for field parameters to determine the reproducibility of the measurements. Field duplicates will be collected as discussed in Section 5.3 and RPDs will be calculated to determine the precision of field sampling methods.

For the pH meter, precision will be tested by multiple readings in the medium of concern. Consecutive readings should agree within 0.1 pH units after the instrument has been field calibrated with standard buffers before each day’s use. The thermometer will be visually inspected prior to each use to ensure its condition is satisfactory. Consecutive measurements of a given sample should agree to within 1°Celsius. After calibration, the conductivity meter will be tested for precision at ± 1% of full-scale, depending on the meter/scale. The organic vapors will be measured using a Photovac Microtip (or equivalent) photoionization detector (PID). Daily background and upwind readings of drilling and sampling activities will be measured prior to commencing work and at periodic intervals throughout each day's activities. The natural variation/fluctuation in measurements at background or upwind locations will be used for baseline background values, and the variability will be noted. Water level indicator readings will be precise to within 0.01 feet for duplicate measurements, or additional water level measurements will be collected to determine whether the difference is due to operator or instrument error. Turbidity measurements will be calibrated to a precision of ± 2% nephelometric turbidity units (NTUs).

4.2 Accuracy

Accuracy is a measure of the difference between a measured value and the "true" or accepted reference value. The accuracy of an analytical procedure is best determined by the analysis of a sample containing a known quantity of material and is expressed as the percent of the known quantity, which is recovered, or measured. The recovery of a given analyte is dependent upon the sample matrix, method of analysis, and the specific compound or element being determined. The concentration of the analyte relative to the detection limit of the analytical method is also a major factor in determining the accuracy of the measurement. Concentrations of analytes that are close to the detection limits are less accurate because they may be affected by such factors as instrument "noise." Higher concentrations will not be as affected by the instrument or other variables and thus will be more accurate.

The accuracy of laboratory-measured data will be evaluated by determining the percent recovery of both matrix and blank spike samples as described in Section 13.1. For the measurement of organics by gas chromatography (GC) or GC/mass spectroscopy (MS), the recovery of a surrogate spiked into each sample, blank, and standard will also be used to assess accuracy.

The objective for accuracy of the field measurements is to achieve and maintain factory equipment specifications for the equipment. Field measurements cannot be assessed for accuracy by spiking the medium with the analytical parameter and measuring the increase in response; therefore, these instruments can only be assessed for accuracy by the response to a known sample (such as a calibration standard) used to standardize them. The pH meter, conductivity meter, and turbidity meter are calibrated with solutions traceable to the National Institute of Standards and Technology (NIST, formerly the National Bureau of Standards).

All volatile organic detectors (such as the PID) will be calibrated to an appropriate standard daily prior to use.

4.3 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter that is most concerned with the proper design of the sampling program. Samples must be representative of the environmental media being sampled. Selection of sample locations and sampling procedures will incorporate consideration of obtaining the most representative sample possible.

Field and laboratory procedures will be performed in such a manner as to ensure, to the degree that is technically possible, that the data derived represents the in-place quality of the material sampled. Every effort will be made to ensure chemical compounds will not be introduced into the sample via sample containers, handling, or analysis. Decontamination of sampling devices and digging equipment will be performed between samples. Laboratory sample containers will be thoroughly cleaned in accordance with procedures outlined in Section 5.2. Analysis of field blanks, trip blanks and method blanks will also be performed to monitor for potential sample contamination from field and laboratory procedures.

The assessment of representativeness also must consider the degree of heterogeneity in the material from which the samples are collected. Sampling heterogeneity will be evaluated through the analysis of field duplicate samples, coded to ensure the samples are treated and analyzed as separate samples. Field personnel will homogenize the soil samples in the field. The analytical laboratory will make every reasonable effort to assure the samples are adequately homogenized prior to taking aliquots for analysis, so the reported results are representative of the sample received. Many means of homogenization expose the sample to significant risk of contamination or loss through volatilization, and these will be avoided if possible.

Chain-of-custody procedures will be followed to document that contamination of samples has not occurred during container preparation, shipment, and sampling. Details of blank/duplicate and chain-of-custody procedures are presented in Sections 5.3 and 6.1, respectively.

4.4 Completeness

Completeness is defined as the percentage of measurements made which are judged to be valid. The QC objective for completeness is generation of valid data for 100 percent of the analysis requested. Any data deficiencies and their impact on project goals will be evaluated during data validation and discussed in the Data Usability Summary Report (DUSR) (see Section 9.3).

4.5 Comparability

Comparability expresses the degree of confidence with which one data set can be compared to another. The comparability of all data collected for this project will be ensured by:

- Using identified standard methods for both sampling and analysis phases of this project;
- Ensuring traceability of all analytical standards and/or source materials to United States Environmental Protection Agency (USEPA) or NIST;
- Verifying all calibrations with an independently prepared standard from a source other than that used for calibration;
- Using standard reporting units and reporting formats, including the reporting of QC data;
- A usability review of all analytical results, including the use of data qualifiers in all cases where appropriate; and
- The requirement that all qualifier flags be used any time an analytical result is used for any purpose whatsoever.

These steps will ensure all future users of either the data or the conclusions drawn from them will be able to judge the comparability of these data and conclusions.

5.0 SAMPLING PROCEDURES

5.1 Sampling Program

The objective of the sampling program is to provide current data concerning the presence, nature and extent of contamination of groundwater and soils. Sampling and analysis may include, as identified in the Remedial Investigation Work Plan:

- Groundwater samples
- Subsurface soil samples

Proposed Sampling Locations are found in Figure 2. Detailed sampling procedures are found in the attached sampling SOP Attachment 1.

5.2 Sampling Procedures and Handling

Sample Container Preparation

Sample containers will be properly washed and decontaminated by the factory or laboratory prior to use. All preservatives will be added to containers prior to shipment by the laboratory. The types of containers and preservation techniques are shown in Table 1. Records of the sources of bottles and preservatives will be kept by the analytical laboratory. Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination will be verified inadvance to be PFAS-free through laboratory analysis or certification.

Methods of Sampling

At a minimum, sampling procedures will be in accordance with the most recent NYSDEC or USEPA guidelines and/or regulations, as appropriate. Alternate techniques will be utilized when such guidelines and/or regulations are inappropriate or non-existent. Alternate techniques will be implemented only after consultation with NYSDEC, whenever possible. Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice.

Referenced sampling procedures are listed below. All procedures will be the latest in effect as of the date of this QAPP.

- USEPA - 600-4-79-020, "Methods for Chemical Analysis of Water and Wastes"
- USEPA - 540/S-95/504, “Low-Flow (Minimal Drawdown) Ground Water Sampling Procedures”
- NYSDEC – “Technical Guidance for Site Investigation and Remediation, DER-10” May 3, 2010
- NYSDEC – “CP-51 Soil Cleanup Guidance” October 21, 2010
- NYSDEC – “Sampling, Analysis and Assessment of Per-and Polyfluoroalkyl Substances (PFAS), June 2021. Under NYSDEC’s Part 375 Remedial Programs Issued January 17, 2020

Standard Operating Procedures (SOPs) to be used in the field are provided in Attachment 2.

5.3 Quality Assurance Samples

Field Quality Control Samples

To assess field sampling, shipment and storage performance, a trip blank will be collected and submitted to the laboratory for analyses involving:

> **Trip Blank** - A trip blank will be prepared by the laboratory, and will consist of 40-ml volatile organic analysis (VOA) vials containing distilled, deionized water which accompanies the other sample bottles into the field and back to the laboratory. A trip blank will be included with each shipment of water samples for which analysis for Target Compound List (TCL) volatile organic compounds (VOCs) is planned. The trip blank will be analyzed for TCL VOCs to assess any contamination introduced as a result of sampling and transport, handling and storage.

The precision of field sampling procedures will be assessed by collecting coded field duplicates and additional volume for matrix spike (MS)/matrix spike duplicates (MSD)/matrix duplicates (MD).

> **Field Duplicate** - To determine the reproducibility and homogeneity of samples, coded field duplicates will be collected. The samples are termed "coded" because they will be labeled in such a manner that the laboratory will not be able to determine that they are a duplicate sample. This will eliminate any possible bias that could arise. The frequency of collection of these samples is one per approximately 20 field samples for each matrix (i.e., soil, groundwater), as specified in the Remedial Investigation Work Plan. The criteria for assessing coded field duplicates are given in Section 13.0.
>
> **Matrix Spike/Matrix Spike Duplicate/Matrix Duplicate (MS/MSD/MD)** – Additional volume will be collected for MS/MSD/MD samples (MSD for organics; MD for inorganics) at a frequency of one per up to 20 field samples sample delivery group (SDG). The reproducibility and homogeneity of the samples can be assessed by determining the RPD for both spike and non-spike compounds as described in Section 13.0. The MS, MSD, and MD samples should be site-specific, unless otherwise authorized by the Tetra Tech Project Manager and/or PQAM after consultation with EQUINOR and NYSDEC personnel whenever possible.
>
> **Equipment Blank** - One equipment blank per day per site and minimum 1 equipment blank per 20 samples will be collected. The equipment blank will test the new and decontaminated sampling equipment utilized to obtain a sample forresidual PFAS contamination. This field blank is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers

6.0 SAMPLE TRACKING AND CUSTODY

Sample chain-of-custody (COC) will be initiated by the laboratory with selection and preparation of the sample containers. To reduce the chance for error, the number of personnel handling the samples will be minimized. Personnel involved in the COC and transfer of samples will be trained on the purpose and procedures prior to implementation.

6.1 Sample Designation

The method of identification of a sample depends on the type of measurement or analysis performed. When field screening measurements (e.g., PID/FID) are made, data are recorded directly in logbooks or on field investigation forms. Identifying information such as project name, station number, station location, date and time, name of sampler, field observations, remarks, etc. will be recorded.

Each sample collected for off-site laboratory analysis during the field investigation will be specifically designated by Tetra Tech personnel with a unique identification. Each sample will be designated by an alpha-numeric code which will identify the Site, matrix sampled, and sampling event or depth.

Sample locations will be designated first by a Site identifier code (“SBMT” for South Brooklyn Marine Terminal). A letter code (see below) will follow, along with the name and/or number that depicts the specific location. Soil samples will be numbered by the depth in feet at the top and bottom of the sample interval (e.g., the sample collected from 4 to 6 feet bgs would be identified as “0406”). Sampling events will be numbered in sequence beginning with “01.” Field, trip and deionized water blanks will include the letter code corresponding to the appropriate type of equipment and/or portion of the field investigation for which the blank sample was collected and the date of sampling.

Location letter code segments for the field investigation are as follows:

• SB	Soil Boring Soil Sample
• MW -	Monitoring Well
• GW	Groundwater Sample
• FB	Field Blank Sample
• TB	Trip Blank Sample

For example, the 2 to 4-foot bgs subsurface soil sample obtained at the third direct push boring location will be identified as SBMT-SB03-0204. A groundwater sample collected from monitoring well MW-01 during the first event will be denoted as SBMT-MW01-GW01. A field blank sample collected for the soil sampling portion of the project on August 2, 2022 would be SBMT-SBFB-080222.

All location and identification information for the samples will be recorded in the field sampling logbook and on the appropriate chain of custody (COC) record form for shipment.

6.2 Field Sample Custody

Evidence of sample traceability and integrity will be provided by COC procedures. These procedures document the sample traceability from the selection and preparation of the sample containers by the laboratory, to sample collection, to sample shipment, to laboratory receipt and analysis. A sample will be considered to be in a person's custody if the sample is:

- In a person's possession;
- Maintained in view after possession is accepted and documented;
- Locked and tagged with custody seals so that no one can tamper with it after having been in physical custody; or
- In a secured area which is restricted to authorized personnel.

In situ or on-site monitoring data will be controlled and entered in logbooks designated for this project. These logbooks will be maintained in the Site files by the FOL and PM.

A COC record will accompany the sample from time of collection to receipt by the analytical laboratory. If samples are split and sent to different laboratories, COC records will be sent with each sample. The "remarks" column will be used to record specific considerations associated with sample acquisition such as: sample type, container type, sample preservation methods, and analyses to be performed. Two copies of this record will be prepared in the field. One copy will accompany the samples to the laboratory, and will be maintained as a file copy by the laboratory. The second version will be retained by Tetra Tech.

Individual sample containers, provided by the laboratory, will be used for shipping/couriering samples. The shipping containers will be insulated (e.g., coolers), and ice will be used to maintain samples at approximately four degrees Celsius until samples are in the custody of the laboratory. All sample bottles within each shipping container will be individually labeled and controlled.

The field sampler will indicate each individual sample designation/location number in the space provided on the appropriate COC form for each sample collected. The shipping container will then be appropriately packed and closed, and a seal provided by the laboratory affixed to the latch. This seal must be broken to open the container. Tampering may be indicated if the seal is broken before receipt at the laboratory. The laboratory will contact the FOL or Tetra Tech’s PM, and the associated samples will not be analyzed, if tampering is apparent.

The FOL will notify the laboratory of upcoming field sampling activities and the subsequent transfer of samples to the laboratory. This notification will include information concerning the number and type of samples to be shipped, as well as the anticipated date of arrival.

6.3 Laboratory Sample Custody

The laboratory sample program will meet the following criteria:

- The laboratory will designate a sample custodian who is responsible for maintaining custody of the samples and for maintaining all associated records documenting that custody.

- Upon receipt of samples, the custodian will check the original COC documents and compare them with the labeled contents of each sample container for correctness and traceability. The sample custodian will sign the COC record and record the date and time received.
- Care will be exercised to annotate any labeling or descriptive errors. In the event of any discrepancy in documentation, the laboratory will immediately contact the Tetra Tech PM and/or PQAM as part of the corrective action process. A qualitative assessment of each sample container will be performed to note any anomalies, such as broken or leaking bottles. That assessment will be recorded as part of the incoming COC procedure.
- The samples will be stored in a secured area at a temperature of approximately four degrees Celsius until analyses are to commence.
- A laboratory tracking record will accompany the sample or sample fraction through final analysis for control.
- A copy of the tracking form will accompany the laboratory report and will become a permanent part of the project records.

6.4 Sample Tracking System

A sample tracking system will be implemented to monitor the status of sampling events and laboratory analysis of samples. Sample numbers, types, analytical parameters, sampling dates, and required due dates for receipt of analytical results will be entered into the system. Tetra Tech's PM will use the tracking system to monitor the project sampling schedules and the status of analytical reports.

A description of the sample tracking system follows:

1. For each day that samples are collected, the FOL or designee will complete a COC form listing all appropriate samples.
2. The FOL or designee will retain the client copy of the COC, and forward the laboratory copy of the COC with the sample shipment.
3. The FOL or designee will fax copies of the completed COC form to the Tetra Tech PM. Tetra Tech's PM or a designated employee will confirm sample shipment with the laboratory and resolve any sample transfer issues.
4. The status of analytical results will be tracked by the Tetra Tech PM or designee using the information provided on the completed COC form. The information will be summarized in a computerized database, as warranted.

Upon receipt of the analytical results from the laboratory, the Tetra Tech PM or designee will review the data package for completeness and contract compliance. The Tetra Tech PM will then forward the result package to the QA/QC data reviewer for the data usability analysis.

The QA/QC data reviewer will be required to submit a complete set of reviewed data to Tetra Tech's

PM within 30 days of receipt of the data package report.

Tetra Tech’s PM or a designated representative will maintain day-to-day contact with the laboratory concerning specific samples and analyses directly.

7.0 CALIBRATION PROCEDURES AND FREQUENCY

7.1 Field Instrumentation Calibration

The FOL will be responsible for ensuring that instrumentation are of the proper range, type and accuracy for the test being performed, and that all of the equipment are calibrated at their required frequencies, according to their specific calibration protocols/procedures.

All field measurement instruments must be calibrated according to the manufacturer's instructions prior to the commencement of the day's activities. Exceptions to this requirement will be permitted only for instruments that have fixed calibrations pre-set by the equipment manufacturer. Calibration information will be documented on instrument calibration and maintenance log sheets or in a designated field logbook. The calibration information (log sheet or logbook) will be maintained at the Site during the on-site investigation and, once the field work is completed, will be placed in Tetra Tech's project files. Information to be recorded includes the date, the operator, and the calibration standards (concentration, manufacturer, lot number, expiration date, etc.). All project personnel using measuring equipment or instruments in the field will be trained in the calibration and usage of the equipment, and are personally responsible for ensuring the equipment has been properly calibrated prior to its use.

In addition, all field instruments will undergo response verification checks at the end of the day's activities and at any other time that the user suspects or detects anomalies in the data being generated. Verification checks may also be performed at the request of EQUINOR or NYSDEC representatives. The checks consist of exposing the instrument to a known source of analyte (e.g., the calibration solution), and verifying a response. If an unacceptable instrument response is obtained during the check (i.e., not within specifications), the data will be labeled suspect, the problem documented in the Site logbook, and appropriate corrective action taken.

Any equipment found to be out of calibration will be re-calibrated. When instrumentation is found to be out of calibration or damaged, an evaluation will be made to ascertain the validity of previous test results since the last calibration check. If it is necessary to ensure the acceptability of suspect items, the originally required tests will be repeated (if possible), using properly calibrated equipment, to acquire replacement data for the measurement in question.

Any instrument consistently found to be out of calibration will be repaired or replaced within 24 hours or field work will be terminated until the malfunctioning equipment is repaired/replaced.

7.2 Laboratory Instrumentation Calibration

Personnel at the laboratory will be responsible for ensuring that analytical instrumentation are of the proper range, type and accuracy for the test being performed, and that all of the equipment are calibrated at their required frequencies, according to specific protocols/procedures.

According to the applicable methodologies and the laboratory SOPs, off-site laboratory equipment will be calibrated using certified/nationally recognized standards. In addition, these methods/procedures specify the appropriate operations to follow during calibration or when any instrument is found to be out of calibration. Off-site laboratory equipment will be calibrated using certified/nationally recognized standards.

8.0 ANALYTICAL PROCEDURES

All off-site laboratory samples will be analyzed according to the methods provided in Table 2 and Exhibit D of the NYSDEC ASP. QA/QC procedures given in Exhibits E and I of the ASP will be followed. Regardless of the method used, all analytical and extraction holding times must meet the NYSDEC ASP requirements for that analytical group (e.g., volatile analyses have a holding time of seven days, if unpreserved). Holding times will be calculated from verified time of sample receipt at the laboratory. For NYSDEC ASP, samples must be received at the laboratory within 48 hours of sample collection. The analytical laboratory chosen for the project will be certified, and must maintain certification, under the New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP) for analyses of solid and hazardous waste. The breakdown of investigative samples is detailed in the Remedial Investigation Work Plan. Laboratory analytical methods and quantitation limits are presented in Table 3 of this QAPP. The method detection limits (MDLs) for the analytes will be specified by the laboratory selected for the project based on its most recent MDL studies, and subject to approval by the NYSDEC.

9.0 DATA REDUCTION, REVIEW, AND REPORTING

The criteria used to identify and quantify the analytes will be those specified for the applicable methods in the ASP.

The laboratory will provide a Category B data deliverable (PDF) and a NYSDEC EQuIS-formatted electronic data deliverable (EDD). The EDD and EQuIS EDD for the project will be prepared for electronic submittal of field sampling and laboratory analytical results, geologic data, and well and locational data, in accordance with NYSDEC policies, guidelines, and formats.

9.1 Chain-of-Custody Records

Completed copies of the COC records accompanying each sample from time of initial bottle preparation to completion of analysis will be attached to the report of analytical testing.

9.2 Data Handling

One electronic version (PDF or other appropriate format) of the complete analytical data report will be provided by the laboratory. The Tetra Tech PM will immediately arrange for electronic filing of the complete package, after the QA/QC data reviewer checks the package to ensure all deliverables have been provided. In addition, an electronic version of the analytical results will be provided by the laboratory in a mutually-agreed upon database format (i.e., an Electronic Database Deliverable, or EDD). The EDD will be used to generate summary tables. These tables will form the foundation of a working database for assessment of the Site contamination condition.

The Tetra Tech PM will maintain close contact with the QA/QC data reviewer to ensure all non-conformance issues are acted upon prior to data manipulation and assessment routines. Once the review has been completed, Tetra Tech's PM will direct the QA/QC data reviewer or designee to finalize the analytical data assessment and update the data summary tables.

The reviewed laboratory data will be reduced into a computerized tabulation which will be suitable for inclusion in site reports and will be designed to facilitate comparison and evaluation of the data. The data tabulations will be sorted by classes of constituents and by sample matrix. Each individual table will present the following information:

- Sample matrix, designations, and locations;
- Sample dates;
- Constituents for which positive results were obtained;
- Reported constituent concentrations in the field and/or trip blanks associated with the samples;
- Constituent concentration units;
- Name and location of laboratory which performed the analyses;
- Data qualifiers provided by the laboratory; and
- Data qualifiers and comments provided by the QA/QC data reviewer, if any.

9.3 Data Usability Review

Data review is a basic step in the control and processing of the project data generated by the laboratory. The data review process will consist of a systematic assessment of the analytical results and QC documentation, and will be performed in accordance with NYSDEC guidelines. The parameters to be evaluated in reference to compliance with the analytical method protocols include all sample COC forms, holding times, raw data (instrument print out data and chromatograms), calibrations, blanks, spikes, controls, surrogate recoveries, duplicates and sample data. If available, the field sampling notes should also be reviewed and any QC problems should be evaluated as to their effect on the usability of the sample data. All off-site laboratory data will undergo data review, unless otherwise stated in the Remedial Investigation Work Plan. On the basis of this review, the QA/QC data reviewer will make judgments and express concerns and comments on the quality and limitations of specific data, as well as on the validity of the overall data package. The QA/QC data reviewer will prepare documentation of his or her review and conclusions in a DUSR.

The DUSR will describe the samples and analysis parameters reviewed. Data deficiencies, analytical method protocol deviations and QC problems will be described and their effect on the data will be discussed in the DUSR. In addition, the DUSR will identify data gaps caused by non-compliant or rejected data, and will indicate what steps have been or will be taken to fill these gaps. Resampling/reanalysis recommendations, if applicable, will be made. Data qualifications are documented for each sample analyte following the NYSDEC ASP guidelines. The results of the data assessment screening (e.g., missed holding times or data rejected due to blank contamination) will be incorporated into the data summary tables used in Remedial Investigation reports (see Section 9.2).

The QA/QC data reviewer will inform the Tetra Tech PM of data quality and limitations, and assist the PM in interacting with the laboratory to correct data omissions and deficiencies. The laboratory may be required to rerun or resubmit data depending on the extent of the deficiencies, and their importance in meeting the data quality objectives within the overall context of the project.

This work will be performed by trained and experienced QA/QC data reviewers who meet the NYSDEC approval criteria. The Environmental Scientist preparing the DUSR must submit (or have previously submitted) a resume to the NYSDEC Quality Assurance Unit documenting relevant experience in environmental sampling, analysis and data review methods, and documentation of a Bachelors Degree in Natural Science or Engineering.

10.0 INTERNAL QUALITY CONTROL CHECKS AND FREQUENCY

10.1 Quality Assurance Batching

Each set of samples will be analyzed concurrently with calibration standards, method blanks, MS, MSD or MD, and QC check samples (if required by the protocol). The MS/MSD/MD samples will be designated by the field personnel. If no MS/MSD/MD samples have been designated, the laboratory must contact Tetra Tech's PQAM or PM for corrective action.

10.2 Organic Standards and Surrogates

All standard and surrogate compounds are checked by the methods of MS for correct identification and GC for degree of purity and concentration. When the compounds pass the identity and purity tests, they are certified for use in standard and surrogate solutions. Concentrations of the solutions are checked for accuracy before release for laboratory use. Standard solutions are replaced monthly or earlier based upon data indicating deterioration.

10.3 Laboratory Quality Control Samples

QC samples may include the following, depending on analytical method:

Method Blanks/Preparation Blanks - Analyses for organic compounds (method blank) and inorganics (preparation blank) include a blank analysis of the laboratory reagent water. The blank is analyzed with each set of samples or more often as required to verify that contamination has not occurred during the analytical process. The concentration of target compounds in the blanks must be less than or equal to the quantitation limits specified in Table 3 for the selected method of analysis.

Matrix Spike/Matrix Spike Duplicate Analysis - This analysis is used to determine the effects of matrix interference on analytical results. Spikes of analytes are added to aliquots of sample matrix in the manner specified in the ASP. Selected samples are spiked to determine accuracy as a percent recovery of the analyte from the sample matrix and precision as RPD between the MS and MSD samples. The MSD is prepared in the same manner as the MS sample.

Analytical Replicate/Matrix Replicate Samples - Replicate samples are aliquots of a single sample that are split on arrival at the laboratory, or upon analysis (i.e., laboratory duplicates). Significant differences between two replicates, split in a controlled laboratory environment, will result in flagging the affected analytical results.

Surrogate Spike Analyses - Surrogate spike analyses are used to determine the efficiency of recovery of organic analytes in the sample preparations and analyses. Calculated percentage recovery of the spike is used as a measure of the accuracy of the total analytical method.

Laboratory Control Sample/Spike Blank - For each method which requires a laboratory control sample (LCS) or spike blank, a LCS/spike blank will be prepared with each quality control batch and analyzed according to criteria specified in the ASP. These samples support an assessment of the ability of the analytical procedure to generate a correct result without matrix effects or interference affecting the analysis.

11.0 QUALITY ASSURANCE PERFORMANCE AUDITS AND SYSTEM AUDITS

QA audits may be performed by the PQAM or personnel designated by the PQAM. The PQAM and his or her designees function as an independent body and report directly to Tetra Tech's quality assurance management. The PQAM may plan, schedule, and approve system and performance audits based upon Tetra Tech procedures customized to the project requirements. These audits may be implemented to evaluate the capability and performance of project and subcontractor personnel, items, activities, and documentation of the measurement system(s). At times, the PQAM may request additional personnel with specific expertise from the company and/or project groups to assist in conducting performance audits.

Formal audits encompass documented activities performed by qualified lead auditors following a written procedure or checklists, to objectively verify that QA requirements have been developed, documented, and instituted in accordance with contractual and project criteria. Formal audits may be performed on project and subcontractor work at various locations.

Audit reports will be written by lead auditors after gathering and evaluating all resultant data. Items, activities, and documents determined by lead auditors to be in noncompliance will be identified at exit interviews conducted with the involved management. Noncompliances will be logged, documented, and controlled through audit findings which are attached to and are a part of the integral audit report. These audit finding forms will then be directed to management to satisfactorily resolve the noncompliance in a specified and timely manner. All audit checklists, audit reports, audit findings, and acceptable resolutions must be approved by the PQAM prior to issue. QA verification of acceptable resolutions will be determined by re-audit or documented surveillance of the item or activity. Upon verification acceptance, the PQAM will close out the audit report and findings.

It is the Tetra Tech PM's overall responsibility to verify that all corrective actions necessary to resolve audit findings are acted upon promptly and satisfactorily. Audit reports must be submitted to Tetra Tech's PM within 15 days of completion of the audit. Serious deficiencies must be reported to the Tetra Tech PM within 24 hours.

Serious deficiencies identified during an audit will be reported to National Grid and NYSDEC as part of the DUSR or investigation reports.

11.1 System Audits

System audits, performed by the PQAM or designated auditors, may encompass evaluation of measurement system components to ascertain their appropriate selection and application. In addition, field and laboratory QC procedures and associated documentation may be audited. These audits may be performed once during the performance of the project. However, if conditions adverse to quality are detected or if the Tetra Tech PM requests the PQAM to perform unscheduled audits, these activities will be instituted.

11.2 Performance Audits

In accordance with the requirements for NYSDOH ELAP CLP certification, the laboratory will participate in all performance evaluation testing.

Also, one field audit may be performed by the PQAM or designated auditor during collection of the field samples to verify that field personnel are following established sampling procedures. Performance of a field audit will be based on the type of investigation activities being performed, the length of the field project, and any available information concerning prior inspections of the project or sampling team.

12.0 PREVENTIVE MAINTENANCE PROCEDURES AND SCHEDULES

12.1 Preventive Maintenance Procedures

Equipment, instruments, tools, gauges, and other items requiring preventive maintenance will be serviced in accordance with the manufacturer's specified recommendations and written procedure developed by the operators. A repair/maintenance logbook will be kept for each piece of equipment/instrument, as applicable, and this log will be available on-site during field activities and, at the completion of the investigation, be placed in the project files. Entries include the date of service, type of problem encountered, corrective action taken, and initials and affiliation of the person providing the service.

Laboratory analytical instruments will be serviced at intervals recommended by the manufacturer. Instrument use logbooks will be monitored by the analysts to detect any degradation of instrument performance. Changes in response factors or sensitivity are used as indications of potential problems. These are brought to the attention of the laboratory supervisor and preventive maintenance or service is scheduled to minimize down time. Back-up instrumentation and an inventory of critical spare parts are maintained to minimize delays in completion of analyses.

Use of equipment in need of repair will not be allowed in the field or laboratory, and work will be terminated until the malfunction is repaired or the instrument replaced.

12.2 Schedules

Written procedures, where applicable, will identify the schedule for servicing critical items in order to minimize the downtime of the measurement system. It will be the responsibility of the operator to adhere to this maintenance schedule and to arrange any necessary and prompt service as required. Service to the equipment, instruments, tools, gauges, etc. will be performed only by qualified personnel.

12.3 Records

Logs will be established to record and control maintenance and service procedures and schedules. All maintenance records will be documented and traceable to the specific equipment, instruments, tools, and gauges. Records produced will be reviewed, maintained, and filed by the operators at the laboratories and by the data and sample control personnel when and if equipment, instruments, tools, and gauges are used at the sites. Tetra Tech’s PM or the PQAM may audit these records to verify complete adherence to these procedures.

12.4 Spare Parts

Where appropriate, a list of critical spare parts will be identified by the operator in consultation with the equipment manufacturer. These spare parts will be stored for availability and use in order to reduce the downtime. In lieu of maintaining an inventory of spare parts, a service contract for rapid instrument repair or backup instruments will be available.

13.0 ASSESSMENT PROCEDURES FOR DATA ACCEPTABILITY

Procedures used to assess data precision and accuracy will be in accordance with the appropriate laboratory method, and as periodically updated.

13.1 Accuracy

The percent recovery is calculated as below:

$$\% = \frac{Ss - So}{S} \times 100$$

So = The original value, i.e.; the value obtained by analyzing the sample

S = Concentration of the spike added to the sample

Ss = Value obtained by analyzing the sample with the spike added

% = Percent Recovery

13.2 Precision

The relative percent difference (RPD) is calculated as below:

$$RPD = \frac{|V1 - V2|}{0.5\,(V1 + V2)} \times 100$$

V1, V2 = The two values obtained by analyzing the duplicate samples

RPDs can only be calculated when the two samples (the original and the duplicate) both contain detectable concentrations of the analyte. If an analyte is considered not detected at the quantitation limit, then a RPD cannot be calculated.

13.3 Completeness

Completeness is the measure of the amount of valid data obtained from a measurement system compared to the total amount expected to be obtained under ideal conditions. A target of 100 percent completeness, calculated for each analysis method, has been established as the overall project objective.

$$PC = \frac{NA}{NI} \times 100$$

where:

PC = Percent completeness
NA = Actual number of valid analytical results obtained
NI = Theoretical number of results obtainable under ideal conditions

14.0 CORRECTIVE ACTION

The following procedures have been established to assure that conditions adverse to quality, such as malfunctions, deficiencies, deviations, and errors, are promptly investigated, documented, evaluated, and corrected.

When a significant condition adverse to quality is noted on-site, at the laboratory, or at a subcontractor location, the cause of the condition will be determined and corrective action taken to preclude repetition. Condition identification, cause, reference documents, and corrective action planned to be taken will be documented and reported to the FOL, Tetra Tech PM, and involved subcontractor management, at a minimum. Implementation of corrective action is verified by documented follow-up action. All project personnel have the responsibility, as part of the normal work duties, to promptly identify, solicit approved correction, and report conditions adverse to quality.

At a minimum, corrective actions may be initiated:

- When predetermined acceptance standards are not attained
- When procedures or data are determined deficient
- When equipment or instrumentation is found faulty
- When samples and test results are questionably traceable
- When QA requirements have been violated
- When designated approvals have been circumvented
- As a result of system and performance audits
- As a result of a management assessment
- As a result of laboratory/inter-field comparison studies
- As required by National Grid
- As required by NYSDEC ASP, 2005

Project management and staff, such as field investigation teams, remedial response planning personnel, and laboratory groups, monitor on-going work performance in the normal course of daily responsibilities.

During the field investigation, any changes to the program outlined in the Remedial Investigation Work Plan and this QAPP must be documented on a Field Change Request (FCR) form (Attachment 1). FCRs will be numbered serially, starting with the number “01.” A copy of the FCR must be maintained at the Site during the investigation and in the project management files. All project personnel may identify a noncompliance; however, the FOL is responsible for documenting, numbering, logging, and verifying the closeout action. It is the Tetra Tech PM’s responsibility to verify all recommended corrective actions are produced, accepted, and received in a timely manner.

Work may be audited at Tetra Tech's office, site, laboratory, and subcontractor locations by the PQAM and/or designated auditor. Items, activities, or documents ascertained to be in noncompliance with QA requirements will be documented and corrective actions mandated through audit finding sheets attached to the audit report. Audit findings are logged, maintained, and controlled by the PQAM (Section 11.0).

15.0 QUALITY ASSURANCE REPORTS

QA reports to management may consist of the reports on audits, FCRs, a final QA report on field sampling activities, and the DUSRs.

At the end of the project, the PQAM may submit a lesson learned report to the Tetra Tech PM which will discuss the QA activities. That report may include discussions of any conditions adverse or potentially adverse to quality, such as responses to the findings of any field or laboratory audits; any field, laboratory, or sample conditions which necessitated a departure from the methods or procedures specified in this QAPP; field sampling errors; and any missed holding times or problems with laboratory QC acceptance criteria, and the associated corrective actions undertaken. This report will not preclude immediate notification to project management of such problems when timely notice can reduce the loss or potential loss of quality, time, effort, or expense.

These reports, if prepared, will be reviewed by the Tetra Tech PM for completeness and the appropriateness of any corrective actions, and they will be retained in the project files.

In the final investigative report, laboratory and field QC data will be presented, including a summary of QA activities and any problems and/or comments associated with the analytical and sampling effort. Any corrective actions taken in the field, results of any audits, and any modifications to laboratory protocols will be discussed.

16.0 REFERENCES

New York State Department of Environmental Conservation – “Technical Guidance for Site Investigation and Remediation, DER-10”. May 3, 2010

New York State Department of Environmental Conservation – “CP-51 Soil Cleanup Guidance” October 21, 2010

New York State Department of Environmental Conservation. Sampling, Analysis, and Assessment of Per-and Polyfluoroalkyl substances (PFAS) Under NYSDEC’s Part 375 Remedial Programs Issued January 2020.

United States Environmental Protection Agency. Methods for Chemical Analysis of Water and Wastes. EPA 600-4-79-020. March 1983.

United States Environmental Protection Agency. Data Quality Objectives for Remedial Response Activities. EPA 540/G-87/003. March 1987.

TABLE 1
SAMPLE CONTAINERIZATION

Analysis	Bottle Type	Preservation[1]	Holding Time[2]
Aqueous Samples			
Volatile Organics	40 ml glass vial with Teflon-lined septa	HCl to pH < 2	10 days
Semi-Volatile Organics	1000 ml amber glass	Cool to 4ºC	5 days for extraction; 40 days for analysis
PCBs	1000 ml amber glass	Cool to 4ºC	5 days for extraction; 40 days for analysis
Total Metals	1000 ml polyethene	HNO_3 to pH < 2	Metals - 6 months Mercury - 26 days
PFAS	1000 high density polyethylene (HDPE)	Cool to 4ºC	14 days for extraction; 28 days for analysis
Soil Samples			
Volatile Organics	Small coring device or wide-mouth glass w/ teflon-lined septa [3]	Cool to 4ºC	7 days
Semi-Volatile Organics	Wide-mouth glass w/ teflon cap [3]	Cool to 4ºC	5 days for extraction; 40 days for analysis
PCBs	Wide mouth glass w/ teflon cap [3]	Cool to 4ºC	5 days for extraction; 40 days for analysis
Metals	Wide mouth glass w/ teflon cap [3]	Cool to 4ºC	Metals - 6 months Mercury - 26 days
Total Organic Carbon	Wide mouth glass w/ teflon cap [3]	Cool to 4ºC	12 days

NOTES

1. All samples to be preserved in ice at 4ºC during collection and transport.
2. Days from verified time of sample receipt (VTSR) by the laboratory.
3. Sized appropriately for the analytical method.
4. If the information provided in this table differs from the most recent version of the RIWP (2022), the RIWP requirements will take precedence. In addition, if site-specific requirements dictate a change in containerization requirements, the Remedial Investigation Work Plan (which will include this information) will take precedence.

TABLE 2
LABORATORY ANALYSIS PROGRAM

Matrix	Parameter [1]	Analytical Method [2]
Water	VOCs	Method 8260
	SVOCs	Method 8270
	PCBs	Method 8082
	Total Metals	Method 6010/7470
	PFAS	Method 537.1 (21 Compound List)
Soil	VOCs	Method 8260
	SVOCs	Method 8270
	Metals	Method 6010/7471
	Total Organic Carbon	Lloyd Kahn method
	PCBs	Method 8082

NOTES

1. Abbreviations: VOCs = Volatile organic compounds; SVOCs = Semi-volatile organic compounds; PCBs = Polychlorinated Biphenyls; CLP = Contract Laboratory Program; PFAS = Per- and polyfluoroalkyl substances
2. NYSDEC Analytical Services Protocol, 2005, Category B deliverables.
   Analyses must meet NYSDEC ASP holding time specified for Methods in Exhibit I Part II.
3. If the information provided in this table differs from the most recent version of the ASP (2005), the ASP requirements will take precedence. In addition, if site-specific requirements dictate a change in analytical requirements, the Remedial Investigation Work Plan (which will include this information) will take precedence

TABLE 3
TARGET ANALYTES AND PRACTICAL QUANTITATION LIMITS[1]

	Practical Quantitation Limit Water Samples (ug/L)	**Practical Quantitation Limit Soil Samples (ug/kg)**
NYSDEC ASP TCL Volatile Organic Compounds		
Acetone	5	10
Benzene	0.5	10
Bromodichloromethane	0.5	10
Bromoform	0.5	10
Bromomethane	0.5	10
2-Butanone	5	10
Carbon disulfide	0.5	10
Carbon tetrachloride	0.5	10
Chlorobenzene	0.5	10
Chloroethane	0.5	10
Chloroform	0.5	10
Chloromethane	0.5	10
Dibromochloromethane	0.5	10
1,1-Dichloroethane	0.5	10
1,2-Dichloroethane	0.5	10
1,1-Dichloroethene	0.5	10
1,2-Dichloroethene (cis and trans)	0.5	10
1,2-Dichloropropane	0.5	10
cis-1,3-Dichloropropene	0.5	10
trans-1,3-Dichloropropene	0.5	10
Ethylbenzene	0.5	10
2-Hexanone	5	10
4-Methyl-2-pentanone	5	10
Methylene chloride	0.5	10
Styrene	0.5	10
1,1,2,2-Tetrachloroethane	0.5	10
Tetrachloroethene	0.5	10
Toluene	0.5	10
1,1,1-Trichloroethane	0.5	10
1,1,2-Trichloroethane	0.5	10
Trichloroethene	0.5	10
Vinyl chloride	0.5	10
Total Xylenes	0.5	10
NYSDEC ASP TCL – Semi-Volatile Organic Compounds		
Acenaphthene	10	330
Acenaphthylene	10	330
Anthracene	10	330
Benzo(a)anthracene	10	330
Benzo(b)fluoranthene	10	330
Benzo(k)fluoranthene	10	330

TABLE 3
TARGET ANALYTES AND PRACTICAL QUANTITATION LIMITS[1]

	Practical Quantitation Limit Water Samples (ug/L)	**Practical Quantitation Limit Soil Samples (ug/kg)**
Benzo(g,h,i)perylene	10	330
Benzo(a)pyrene	10	330
bis(2-Chloroethoxy)methane	10	330
bis(2-Chloroethyl)ether	10	330
bis(2-ethylhexyl)phthalate	10	330
4-Bromophenyl phenyl ether	10	330
Butyl benzyl phthalate	10	330
Carbazole	10	330
4-Chloroaniline	10	330
2-Chloronaphthalene	10	330
4-Chlorophenyl phenyl ether	10	330
Chrysene	10	330
Dibenz(a,h)anthracene	10	330
Dibenzofuran	10	330
Di-n-butylphthalate	10	330
1,2-Dichlorobenzene	10	330
1,3-Dichlorobenzene	10	330
1,4-Dichlorobenzene	10	330
3,3'-Dichlorobenzidine	10	330
Diethyl phthalate	10	330
Dimethyl phthalate	10	330
2,4-Dinitrotoluene	10	330
2,6-Dinitrotoluene	10	330
Di-n-octylphthalate	10	330
Fluoranthene	10	330
Fluorene	10	330
Hexachlorobenzene	10	330
Hexachlorobutadiene	10	330
Hexachlorocyclopentadiene	10	330
Hexachloroethane	10	330
Indeno(1,2,3-cd)pyrene	10	330
Isophorone	10	330
2-methyl Naphthalene	10	330
Naphthalene	10	330
2-Nitroaniline	25	800
3-Nitroaniline	25	800
4-Nitroaniline	25	800
Nitrobenzene	10	330
N-Nitroso-diphenylamine	10	330
N-Nitroso-dipropylamine	10	330
2,2' Oxybis(1-chloropropane)	10	330

TABLE 3
TARGET ANALYTES AND PRACTICAL QUANTITATION LIMITS[1]

	Practical Quantitation Limit Water Samples (ug/L)	Practical Quantitation Limit Soil Samples (ug/kg)
Phenanthrene	10	330
Pyrene	10	330
1,2,4-Trichlorobenzene	10	330
4-Chloro-3-methylphenol	10	330
2-Chlorophenol	10	330
2,4-Dichlorophenol	10	330
2,4-Dimethylphenol	10	330
4,6-Dinitro-2-methylphenol	25	800
2,4-Dinitrophenol	25	800
2-Methylphenol	10	330
4-Methylphenol	10	330
2-Nitrophenol	10	330
4-Nitrophenol	25	800
Pentachlorophenol	25	800
Phenol	10	330
2,4,5-Trichlorophenol	25	800
2,4,6-Trichlorophenol	10	330

NYSDEC ASP TCL PCBs		
Aroclor-1016	1.0	33.0
Aroclor-1221	2.0	67.0
Aroclor-1232	1.0	33.0
Aroclor-1242	1.0	33.0
Aroclor-1248	1.0	33.0
Aroclor-1254	1.0	33.0
Aroclor-1260	1.0	33.0
NYSDEC ASP TAL Metals		
Aluminum	200	20
Antimony	60	6
Arsenic	10	1
Barium	200	20
Beryllium	5	0.5
Cadmium	5	0.5
Calcium	5000	500
Chromium	10	1
Cobalt	50	5
Copper	25	2.5
Iron	100	10
Lead	10	1
Magnesium	5000	500
Manganese	15	1.5

TABLE 3
TARGET ANALYTES AND PRACTICAL QUANTITATION LIMITS[1]

	Practical Quantitation Limit Water Samples (ug/L)	Practical Quantitation Limit Soil Samples (ug/kg)
Mercury	0.2	0.1
Nickel	40	4
Potassium	5000	500
Selenium	35	3.5
Silver	10	1
Sodium	5000	500
Thallium	25	2.5
Vanadium	50	5
Zinc	60	6
Total Cyanide	10	60
PFAS	2 ng/L	0.5

NOTES:

1. Specific detection limits are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable. Quantitation limits listed for soil are based on wet weight.
2. If the information provided in this table differs from the most recent version of the ASP, the ASP requirements will take precedence. In addition, if site-specific requirements dictate a change in quantitation limits, the site-specific Work Plan will take precedence.
3. These practical quantitation limits are the instrument detection limits obtained in pure water that must be met using the procedure in Exhibit E. The quantitation limits for samples may be considerably higher depending on the sample matrix.

TETRA TECH

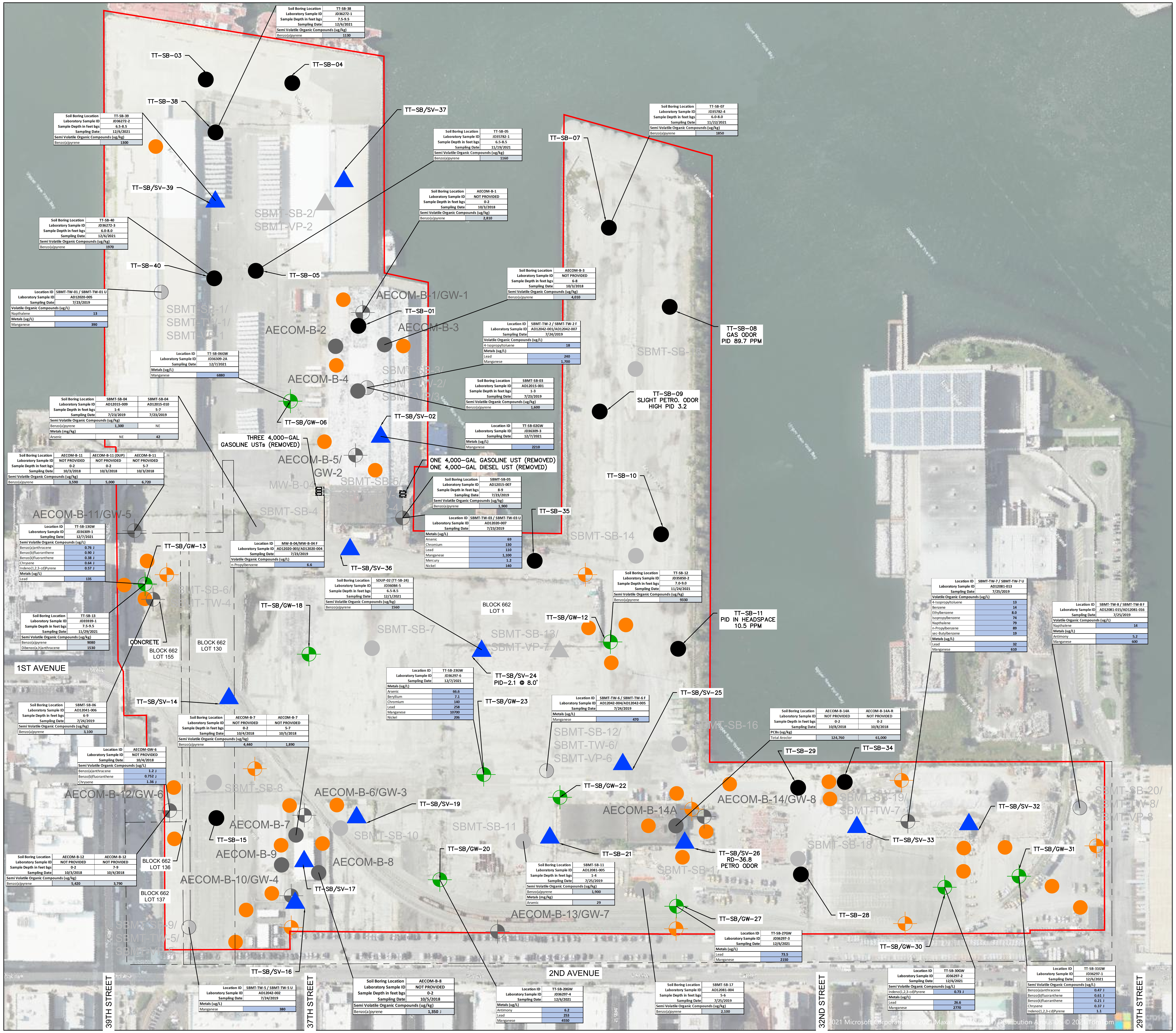
TETRA TECH, INC.
6 CENTURY DRIVE, SUITE 3
PARSIPPANY, NJ 07054
(973) 630-8000

FIGURE 1 - SITE LOCATION MAP

SOUTH BROOKLYN MARINE
TERMINAL
2ND AVENUE
BROOKLYN, NY 11232

SBMT Asset LLC

80 State Street
Albany, NY 12207



Soil Boring Location	TT-SB-38
Laboratory Sample ID	JD36272-1
Sample Depth in feet bgs	7.5-9.5
Sampling Date	12/6/2021
Semi Volatile Organic Compounds (ug/kg)	
Benzo(a)pyrene	1130

Soil Boring Location	TT-SB-39
Laboratory Sample ID	JD36272-2
Sample Depth in feet bgs	6.5-8.5
Sampling Date	12/6/2021
Semi Volatile Organic Compounds (ug/kg)	
Benzo(a)pyrene	1300

Soil Boring Location	TT-SB-07
Laboratory Sample ID	JD35782-4
Sample Depth in feet bgs	6.0-8.0
Sampling Date	11/22/2021
Semi Volatile Organic Compounds (ug/kg)	
Benzo(a)pyrene	1850

Soil Boring Location	TT-SB-05
Laboratory Sample ID	JD35782-1
Sample Depth in feet bgs	6.5-8.5
Sampling Date	11/19/2021
Semi Volatile Organic Compounds (ug/kg)	
Benzo(a)pyrene	1160

Soil Boring Location	AECOM-B-1
Laboratory Sample ID	NOT PROVIDED
Sample Depth in feet bgs	0-2
Sampling Date	10/3/2018
Semi Volatile Organic Compounds (ug/kg)	
Benzo(a)pyrene	2,810

Soil Boring Location	TT-SB-40
Laboratory Sample ID	JD36272-3
Sample Depth in feet bgs	6.0-8.0
Sampling Date	12/6/2021
Semi Volatile Organic Compounds (ug/kg)	
Benzo(a)pyrene	1970

Soil Boring Location	AECOM-B-3
Laboratory Sample ID	NOT PROVIDED
Sample Depth in feet bgs	6-8
Sampling Date	10/3/2018
Semi Volatile Organic Compounds (ug/kg)	
Benzo(a)pyrene	4,010

Location ID	SBMT-TW-01 / SBMT-TW-01 U
Laboratory Sample ID	AD12020-005
Sampling Date	7/23/2019
Volatile Organic Compounds (ug/L)	
Napthalene	13
Metals (ug/L)	
Manganese	390

Location ID	SBMT-TW-2 / SBMT-TW-2 F
Laboratory Sample ID	AD12042-001/AD12042-007
Sampling Date	7/24/2019
Volatile Organic Compounds (ug/L)	
4-Isopropyltoluene	18
Metals (ug/L)	
Lead	240
Manganese	1,700

Location ID	TT-SB-06GW
Laboratory Sample ID	JD36309-2A
Sampling Date	12/7/2021
Metals (ug/L)	
Manganese	6880

Soil Boring Location	SBMT-SB-03
Laboratory Sample ID	AD12015-001
Sample Depth in feet bgs	1-3
Sampling Date	7/23/2019
Semi Volatile Organic Compounds (ug/kg)	
Benzo(a)pyrene	1,600

Soil Boring Location	SBMT-SB-04	SBMT-SB-04
Laboratory Sample ID	AD12015-009	AD12015-010
Sample Depth in feet bgs	1-4	5-7
Sampling Date	7/23/2019	7/23/2019
Semi Volatile Organic Compounds (ug/kg)		
Benzo(a)pyrene	1,300	NE
Metals (mg/kg)		
Arsenic	NE	42

Location ID	TT-SB-02GW
Laboratory Sample ID	JD36309-3
Sampling Date	12/7/2021
Metals (ug/L)	
Manganese	2210

Soil Boring Location	AECOM-B-11	AECOM-B-11 (DUP)	AECOM-B-11
Laboratory Sample ID	NOT PROVIDED	NOT PROVIDED	NOT PROVIDED
Sample Depth in feet bgs	0-2	0-2	5-7
Sampling Date	10/3/2018	10/3/2018	10/3/2018
Semi Volatile Organic Compounds (ug/kg)			
Benzo(a)pyrene	3,590	5,000	6,720

Soil Boring Location	SBMT-SB-05
Laboratory Sample ID	AD12015-007
Sample Depth in feet bgs	8-9
Sampling Date	7/23/2019
Semi Volatile Organic Compounds (ug/kg)	
Benzo(a)pyrene	1,900

Location ID	SBMT-TW-03 / SBMT-TW-03 U
Laboratory Sample ID	AD12020-007
Sampling Date	7/23/2019
Metals (ug/L)	
Arsenic	69
Chromium	130
Lead	110
Manganese	1,100
Mercury	1.2
Nickel	140

Location ID	TT-SB-13GW
Laboratory Sample ID	JD36309-1
Sampling Date	12/7/2021
Semi Volatile Organic Compounds (ug/L)	
Benzo(a)anthracene	0.76 J
Benzo(b)fluoranthene	0.90 J
Benzo(k)fluoranthene	0.38 J
Chrysene	0.64 J
Indeno(1,2,3-cd)Pyrene	0.57 J
Metals (ug/L)	
Lead	135

Location ID	MW-B-04/MW-B-04 F
Laboratory Sample ID	AD12020-003/AD12020-004
Sampling Date	7/23/2019
Volatile Organic Compounds (ug/L)	
n-Propylbenzene	6.6

Soil Boring Location	TT-SB-12
Laboratory Sample ID	JD35850-2
Sample Depth in feet bgs	7.0-9.0
Sampling Date	11/24/2021
Semi Volatile Organic Compounds (ug/kg)	
Benzo(a)pyrene	9330

Soil Boring Location	SDUP-02 (TT-SB-24)
Laboratory Sample ID	JD36084-5
Sample Depth in feet bgs	6.5-8.5
Sampling Date	12/1/2021
Semi Volatile Organic Compounds (ug/kg)	
Benzo(a)pyrene	1560

Location ID	SBMT-TW-7 / SBMT-TW-7 U
Laboratory Sample ID	AD12081-013
Sampling Date	7/25/2019
Volatile Organic Compounds (ug/L)	
4-Isopropyltoluene	13
Benzene	14
Ethylbenzene	8.0
Isopropylbenzene	74
Napthalene	79
n-Propylbenzene	89
sec-Butylbenzene	19
Metals (ug/L)	
Lead	32
Manganese	610

Location ID	SBMT-TW-8 / SBMT-TW-8 F
Laboratory Sample ID	AD12081-015/AD12081-016
Sampling Date	7/25/2019
Volatile Organic Compounds (ug/L)	
Napthalene	14
Metals (ug/L)	
Antimony	5.2
Manganese	600

Soil Boring Location	TT-SB-13
Laboratory Sample ID	JD35939-1
Sample Depth in feet bgs	7.5-9.5
Sampling Date	11/29/2021
Semi Volatile Organic Compounds (ug/kg)	
Benzo(a)pyrene	9080
Dibenzo(a,h)anthracene	1530

Location ID	TT-SB-23GW
Laboratory Sample ID	JD36297-6
Sampling Date	12/7/2021
Metals (ug/L)	
Arsenic	66.6
Beryllium	7.1
Chromium	140
Lead	258
Manganese	10700
Nickel	206

Location ID	SBMT-TW-6 / SBMT-TW-6 F
Laboratory Sample ID	AD12042-004/AD12042-005
Sampling Date	7/24/2019
Metals (ug/L)	
Manganese	470

Soil Boring Location	SBMT-SB-06
Laboratory Sample ID	AD12041-006
Sample Depth in feet bgs	6-9
Sampling Date	7/24/2019
Semi Volatile Organic Compounds (ug/kg)	
Benzo(a)pyrene	3,100

Soil Boring Location	AECOM-B-7	AECOM-B-7
Laboratory Sample ID	NOT PROVIDED	NOT PROVIDED
Sample Depth in feet bgs	0-2	5-7
Sampling Date	10/4/2018	10/5/2018
Semi Volatile Organic Compounds (ug/kg)		
Benzo(a)pyrene	4,440	1,890

Soil Boring Location	AECOM-B-14A	AECOM-B-14A-R
Laboratory Sample ID	NOT PROVIDED	NOT PROVIDED
Sample Depth in feet bgs	0-2	0-2
Sampling Date	10/8/2018	10/8/2018
PCBs (ug/kg)		
Total Aroclor	124,760	61,000

Location ID	AECOM-GW-6
Laboratory Sample ID	NOT PROVIDED
Sampling Date	10/4/2018
Semi Volatile Organic Compounds (ug/L)	
Benzo(a)anthracene	1.2 J
Benzo(b)fluoranthene	0.752 J
Chrysene	1.36 J

Soil Boring Location	AECOM-B-12	AECOM-B-12
Laboratory Sample ID	NOT PROVIDED	NOT PROVIDED
Sample Depth in feet bgs	0-2	7-9
Sampling Date	10/3/2018	10/4/2018
Semi Volatile Organic Compounds (ug/kg)		
Benzo(a)pyrene	5,420	3,790

Soil Boring Location	SBMT-SB-11
Laboratory Sample ID	AD12081-005
Sample Depth in feet bgs	1-4
Sampling Date	7/25/2019
Semi Volatile Organic Compounds (ug/kg)	
Benzo(a)pyrene	1,900
Metals (mg/kg)	
Arsenic	29

Location ID	TT-SB-27GW
Laboratory Sample ID	JD36297-3
Sampling Date	12/6/2021
Metals (ug/L)	
Lead	73.5
Manganese	2150

Location ID	SBMT-TW-5 / SBMT-TW-5 U
Laboratory Sample ID	AD12042-002
Sampling Date	7/24/2019
Metals (ug/L)	
Manganese	380

Soil Boring Location	AECOM-B-8
Laboratory Sample ID	NOT PROVIDED
Sample Depth in feet bgs	0-2
Sampling Date	10/5/2018
Semi Volatile Organic Compounds (ug/kg)	
Benzo(a)pyrene	1,350 J

Location ID	TT-SB-20GW
Laboratory Sample ID	JD36297-4
Sampling Date	12/6/2021
Metals (ug/L)	
Antimony	6.2
Lead	253
Manganese	4550

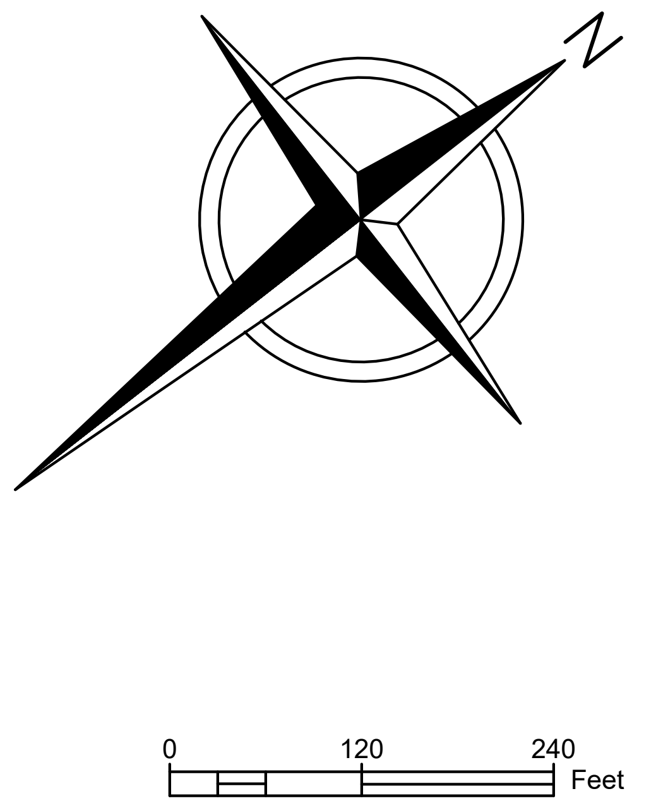
Soil Boring Location	SBMT-SB-17
Laboratory Sample ID	AD12081-004
Sample Depth in feet bgs	5-6
Sampling Date	7/25/2019
Semi Volatile Organic Compounds (ug/kg)	
Benzo(a)pyrene	2,100

Location ID	TT-SB-30GW
Laboratory Sample ID	JD36297-2
Sampling Date	12/6/2021
Semi Volatile Organic Compounds (ug/L)	
Indeno(1,2,3-cd)Pyrene	0.73 J
Metals (ug/L)	
Lead	26.6
Manganese	2770

Location ID	TT-SB-31GW
Laboratory Sample ID	JD36297-1
Sampling Date	12/6/2021
Semi Volatile Organic Compounds (ug/L)	
Benzo(a)anthracene	0.47 J
Benzo(b)fluoranthene	0.61 J
Benzo(k)fluoranthene	0.21 J
Chrysene	0.37 J
Indeno(1,2,3-cd)Pyrene	1.1

LEGEND

●	SOIL BORING AND SOIL SAMPLES
⊕	SOIL BORING AND GROUNDWATER GRAB SAMPLE
▲	COLLOCATED SOIL BORING AND SOIL VAPOR SAMPLE
●	PROPOSED RI SOIL BORINGS
⊕	PROPOSED MONITORING WELL LOCATIONS
▲	TRC SOIL BORING AND SOIL VAPOR SAMPLE
●	TRC SOIL BORING LOCATION
⊕	TRC SOIL BORING AND GROUNDWATER GRAB SAMPLE
◐	TRC SOIL BORING, GROUNDWATER GRAB SAMPLE, AND SOIL VAPOR SAMPLE
⊕	TRC GROUNDWATER GRAB SAMPLE
●	AECOM SOIL BORING LOCATION
⊕	AECOM SOIL BORING AND GROUNDWATER GRAB SAMPLE
──	PROJECT AREA
— – —	PARCEL BOUNDARIES



SBMT Asset LLC
80 State Street
ALBANY, NY 12207

TETRA TECH

STAMP:

DRAFT
NOT FOR CONSTRUCTION

SOUTH BROOKLYN
MARINE TERMINAL

SBMT Asset LLC
2ND AVENUE
BROOKLYN, NY 11232

PROJECT NUMBERS:
194-1247-0003

SHEET TITLE:
PROPOSED REMEDIAL INVESTIGATION SAMPLE LOCATION PLAN

SHEET SIZE:
ARCH "D"
24" X 36" (610 x 914)
0 ½" 1"

NO.	REVISION	DATE	INIT.

DATE: 2/25/2022
DRAWN BY:
ENGINEER:
APPROVED BY:

PROJECT PHASE:
N/A

SCALE:
1" = 120'

SHEET NO.:
FIGURE 2

\\tt.local\gfs\USVolume3\Legacy\tts119fs2\CES\Projects\Equinor\Brownfields\SBMT\RI Work Plan\Drawings\SBMT Proposed RI Sample Location Plan 02092022.dwg

Printed: 3/15/2022 3:06 PM

ATTACHMENT 1
FIELD CHANGE REQUEST FORM

FCR Number: ______________

Field Change Request Title: ____

To: ______________________________________ **Location:** ____________________________

Date: ____________________________________

Description:

____

____

Reason for Change:

____

____

Recommended Disposition:

____

____

Field Operations Lead (or designee) [print name]	Signature	Date

I have reviewed the above change request, and

[ ] approve the modification.

[ ] do not approve the modification.

The above change request has been discussed with National Grid personnel:

[ ] Yes (see below).

[ ] No. The change is minor and does not need EPA concurrence.

Project Manager [print name]	Signature	Date

I have reviewed the above change request, and

[ ] concur with the modification.

[ ] do not concur with the modification.

Equinor Project Manager [print name]	Signature	Date

Distribution:

Equinor Project Manager
Project Manager
PQAM
Field Operations Lead
Project File
Other:

ATTACHMENT 2 – SITE OPERATING PROCEDURES

Site Location and Elevation Survey (SOP #1)

All surveying will be performed by a qualified licensed surveyor. Vertical control will be established to conform with the National Geodetic Vertical Datum (NGVD) of 1988. Establishment of vertical control benchmarks shall be performed to third-order accuracy with a precision of 0.01 foot by utilizing existing benchmarks. Horizontal control will be established based upon New York State Plane Coordinate System (North American Datum (NAD) of 1983). Establishment of horizontal control benchmarks will be performed to third-order accuracy with a precision of 0.1 foot by utilizing existing benchmarks.

During the field investigation, the horizontal location of all sample locations will be surveyed to the nearest 0.1 foot. In addition, the vertical elevation of the ground surface adjacent to each of the sampling locations will be surveyed to the nearest 0.1 foot. The vertical elevation of the outer casing and inner well casing will be surveyed to the nearest 0.01 foot for the monitoring wells. The surveyor will make a black mark or notch on the highest point of the inner casing. Elevations will be recorded at this mark, and all water level measurements will be determined from this point. In addition, general boundaries and other pertinent site features/information essential for completion of the RIR will be surveyed.

Direct Push Subsurface Soil Boring (SOP #2)

1. Using the direct push drill rig, advance a carbon steel core sampler containing a 2 to 4-foot clear acetate sample tube to the desired depth into the soil. Upon removal of the sampler from the borehole, the acetate sample tube will be removed and the ends will be capped to prevent volatilization from the sample. Sample tubes will be marked with the depth interval and the sample orientation.

2. Place acetate sample tubes on clean polyethylene sheeting for inspection/sampling. Each sample tube will be inspected for the presence of groundwater. The tube will be cut lengthwise using a decontaminated utility knife, and the soil will be screened using a PID.

3. Thoroughly describe soils, including approximate recovery (length), USCS and Burmeister classifications, composition, color, moisture, and any impacts noted.

4. Collect samples for laboratory analysis in the following order (as applicable): VOCs, SVOCs, PCBs, metals, and Total Organic Carbon (TOC). Collect the VOC sample immediately upon opening the sample tube, bias to the most impacted area (if no impacts, collect from the middle of the soil interval), using a decontaminated stainless steel spoon, spatula or trowel, and place into a wide-mouth glass jar with a Teflon-lined septa. Homogenize the remaining parameter samples in a stainless steel bowl with a dedicated clean stainless steel spatula prior to sample collection.

   - Collect the TCL VOC sample from the soil using three EnCore® Samplers. An additional aliquot of soil for percent moisture analysis will also be required.

   - Prior to collecting the TCL VOC sample, hold coring body of EnCore® Sampler, and push plunger rod down until small o-ring rests against tabs. This will assure that the plunger moves freely.

   - Depress locking level on EnCore® T-handle. Place coring body - plunger end first - into open end of T-handle, aligning the two (2) slots on the coring body with the two (2) locking pins in the T-handle. Twist coring body <u>clockwise</u> to lock pins in slots. Double check that Sampler is locked in place prior to use.

   - To collect the TCL VOC soil sample, turn T-handle such that "T" is up and coring body is down. This positions plunger bottom flush with the bottom of the coring body; double check that plunger bottom is in position.

- Using T-handle, push EnCore® Sampler into soil until coring body is completely full. When full, the small o-ring will be centered in the T-handle viewing hole.

- Remove Sampler from soil. Wipe any excess soil from the exterior of the coring body.

- Cap coring body while it is still on T-handle. Push cap over flat area of ridge. Push and twist cap to lock in place - cap must be seated over coring body ridges to seal sampler.

- Remove capped EnCore® Sampler by depressing the locking lever on the T-handle while twisting and pulling Sampler from T-handle.

- Lock plunger by rotating extended plunger rod fully counter-clockwise until wings rest firmly against tabs.

- Attach a completed label (provided with the EnCore® Sampler in the bag) to the cap on the coring body container. Place Sampler in zipper bag provided, and seal bag.

- Place initialed custody seal(s) over the top of the closed EnCore® bag, in such a manner that the bag cannot be opened (even partially); two or more custody seals may be needed. **Do not place custody seals directly on the EnCore® Sampler!**

- Attach a completed sample tag to the bag, using tape or other method, provided that the sample tag is securely fastened to the bag and will not become dislodged in transit.

- Repeat for the remaining two EnCore® samplers

5. Complete sample labels for the parameters, and attach them to the outside of the sampling containers.

6. Fill out chain of custody forms. Record sample information in the field notebook.

7. Place the analytical samples in coolers for shipment and cool to 4^{o}C.

Monitoring Well Installation [Cased Overburden Well] (SOP #3)

Drilling protocols to be followed during the program will meet New York State drilling procedural requirements, and were summarized from the NYSDEC DER-10 and other technical guidelines. Rationale for the selection of these locations and depths are presented in the Work Plan. However, the actual location and/or depth of any well is dependent on information obtained during the soil boring installation and during well drilling.

The direct push drilling method will be the preferred method for drilling within overburden to an approximate depth of 12 feet or direct push refusal. If any visual impacts or PID readings above background are encountered during installation, a soil sample will be collected and submitted for analysis in accordance with SOP #2. The monitoring wells will be logged by a geologist during installation.

1. Advance the borehole using direct push drilling techniques (SOP #2), to the desired screening depth (approximately 10 feet bgs).
2. Construct the wells as 2-inch PVC wells with 5-foot slotted screened intervals (0.2 slot screen and a PVC riser) straddling the water table and flush-mount casing.
3. Backfill the annular space to approximately 2 feet above the well screen with Morie No. 1 sand or a filter pack appropriate for the formation. The remaining annular space will be filled to the surface with a bentonite/cement slurry. The ratio of cement to bentonite for grouting will be approximately 94 pounds of cement to every 5 pounds of bentonite.
4. Complete the well following SOP #5.

Monitoring Well Development (SOP #4)

1. All monitoring wells will be developed no sooner than 24 hours and no longer than 2 weeks after completion.

2. Develop the well by using a surge block and a submersible pump (i.e., whale pump, or similar). The surge block will be comprised of a length of narrow diameter PVC with a foam disc or material at one end. The surge block will be raised and lowered across the length of the screen to remove fine particles and deposits which may be clogging the screen for period of at least 5 minutes. The well will then be purged with the submersible pump to remove suspended particles and induce flow into the well to prevent clogging of the sand pack.

3. Continue development until turbidity is less than 50 NTUs. Development will be continued for a minimum of one hour, but for no longer than eight hours without NYSDEC permission. Development water will be properly containerized for disposal.

Monitoring Well Completion (SOP #5)

Each monitoring well installed as part of the field investigation will be completed in accordance with the following procedure:

For flushmount wells,

1. Concrete will be used to fill the space above the bentonite-cement slurry (at approximately 3 feet below grade) to grade. Construct a concrete pad (approximately 2-foot by 2-foot by 8-inch) around the roadway box in such a way as to direct surface runoff from the casing.

2. Place a two-inch plug on the PVC riser and use a lock to secure it in place. The locked cap will be locked to ensure that well access will only be provided during well development, sampling or water level measurement events. All locks will be keyed alike.

Field Parameter Measurement (SOP #6)

Field parameters will be monitored during purging of the monitoring wells utilizing a Horiba® U-52 water quality meter or equivalent. Measurements will be conducted in accordance with the manufacturer's instructions and the following procedure:

1. Calibrate the water quality meter as per manufacturer's instructions.

2. For low flow purging of the monitoring wells:

   X Attach a flow-through cell to the polyethylene tubing. Position the water quality meter probe in the flow-through cell. Begin purging the monitoring well, following SOP #8.

   X After the cell has been "flushed" at least twice, begin monitoring the field parameters, and continue approximately every 3 to 5 minutes during purging. All water quality measurements will be recorded in the appropriate field logbook or on a well purge data sheet.

   X When the indicator parameters have stabilized for three consecutive readings (see Step 12 of SOP #8), the well is considered stabilized and ready for sample collection. Remove the flow-through cell from the tubing.

3. Decontaminate the probe of the water quality meter between wells (SOP #10).

4. Record water quality measurements in the appropriate field logbook, noting well identification, sample date and time, and observations.

Groundwater Level Measurements (SOP #7)

1. Prior to the commencement of measurements, check the electronics of the water level indicator with a jar of water.

2. Slowly lower the probe portion of the water level indicator into the monitoring well. The electronic water level indicator must have ruler markings on the cable in increments of 0.01 foot or less.

3. Suspend lowering the probe when the light and/or buzzer signals contact with the top of water.

4. Carefully measure the groundwater level at the established reference point, normally identified by a mark or notch at one point on the upper edge of the inner well casing.

5. Record the measurement in the field logbook, along with the well identification, date and time, and weather conditions.

6. Decontaminate the water level indicator cable, tape and probe between wells (SOP #10).

Groundwater Sampling [Low Flow Purge Procedure] (SOP #8)

1. Check and record the condition of the well for any damage or evidence of tampering.

2. Remove the well cap.

3. Measure well headspace with a PID and record the reading in the field logbook.

4. Measure the depth to water as stated in SOP #7**,** and record the measurement in the field logbook. Do not measure the depth to the bottom of the well at this time (to avoid disturbing any sediment that may have accumulated); see Step 16.

5. Lay out plastic sheeting and place the monitoring, purging and sampling equipment on the sheeting. To avoid cross-contamination, do not let any downhole equipment touch the ground.

6. Re-check and record the depth to water after approximately 5 minutes at the well location. If the measurement has changed more than 0.01 foot, check and record the measurement again, then begin well purging.

7. Lower the polyethylene tubing to approximately the middle of the screen and/or the best depth based on the stratigraphy of the well. Be careful not to place the tubing less than approximately 2 feet above the bottom of the well as this may cause mobilization of any sediment present in the bottom of the well.

8. Attach and secure the polyethylene tubing to the peristaltic pump with silicone tubing passing through the gear well.

9. Start pumping the well at 0.2 to 0.5 liters per minute.

10. Monitor the water level in the well periodically during pumping - ideally the pump rate should equal the well recharge rate with little or no water level drawdown in the well (drawdown shall be 0.3 foot or less). There should be at least 1 foot of water over the pump intake so there is no risk of the pump suction being broken, or entrapment of air in the sample.

11. Record the pumping rate adjustments and depth(s) to water in the logbook. Pumping rates should, if needed, be reduced to the minimum capabilities of the pump (0.1 to 0.2 liters per minute) to avoid purging the well dry. However, if the recharge rate of the well is very low and the well is purged dry, then wait until the well has recharged to a sufficient level and then collect the appropriate volume of sample.

12. Purge the well at a low flow rate (from 0.2 to 0.5 liters per minute). During purging, monitor the field parameters (temperature, pH, turbidity, specific

conductivity, and DO) approximately every 3 to 5 minutes. A flow-through cell will be used to monitor the field parameters (SOP #6). Begin measuring field parameters after the flow-through cell has been "flushed" with groundwater twice.

13. The well is considered stabilized and ready for sample collection when the indicator parameters have stabilized for three consecutive readings, as follows:

    - for pH
    - 3 percent for specific conductance
    - 10 percent for dissolved oxygen
    - 10 percent for turbidity
    - 10 mV for Eh

    Dissolved oxygen and turbidity usually require the longest time to achieve stabilization.

5. 14. Once the field parameters have stabilized, carefully remove the tubing from the well, fill the appropriate glassware from the end of the tubing. Volatiles and analyses that degrade by aeration must be collected first. Collect samples for laboratory analysis in the following order (as applicable): VOCs, SVOCs, PCBs, metals, and Total Organic Carbon (TOC).

6. Samples for PFAS analysis will be collected as set forth in SOP #SA-1.8

15. The polyethylene tubing can be disposed of after sampling..

16. After sampling is complete, measure the total depth of the well.

17. Close and lock the well.

Decontamination [Drilling Equipment] (SOP #9)

All drilling equipment involved in field sampling activities will be decontaminated prior to and subsequent to sampling. Equipment leaving the site will also be decontaminated.

The drilling equipment will be steam cleaned prior to use, to remove any cutting oils and staged on clean plastic sheeting prior to installation. Pressurized steam will be used to remove all visible excess material from rods, drill bits, the back of the drilling rig, and other parts of the rig which contact rods, drill bits, etc.

Steam cleaning will be conducted on a decontamination pad, which will be constructed on-site for the field investigation.

Decontamination [Field Instrumentation - Probes, Water Quality Meters, etc.] (SOP #10)

Field instrumentation (such as interface probes, water quality meters, etc.) will be decontaminated between sample locations by rinsing with deionized water. If visible contamination still exists on the equipment after the rinse, an Alconox detergent scrub will be added, and the probe thoroughly rinsed again.

Decontamination [Non-disposable Chemical Sampling Equipment] (SOP #11)

Decontamination of non-disposable sampling equipment used to collect samples for chemical analyses (i.e., spoons/trowels, bowls, etc.) will be conducted as described below:

1. Alconox detergent and potable water scrub.
2. Potable water rinse.
3. Air dry.
4. Wrap or cover exposed ends of equipment with aluminum foil for transport and handling.

TETRA TECH	**STANDARD OPERATING PROCEDURE**	Number SA-1.8	Page 1 of 12
		Effective Date 01/25/2018	Revision 3
		Applicability Tetra Tech, Inc., NUS Operating Unit	
		Prepared Earth Sciences Department	
Subject SAMPLE ACQUISITION FOR PERFLUOROALKYL AND POLYFLUOROALKYL SUBSTANCES (PFAS) ANALYSIS		Approved T. Johnston	tom. johnston @tetratech.com Digitally signed by: tom. johnston@tetratech.com DN: CN = tom. johnston@tetratech.com Date: 2018.01.25 14:21:16 -05'00'

TABLE OF CONTENTS

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the methods and protocols to be used for collecting and handling samples to be analyzed for polyfluoroalkyl and perfluoroalkyl substances (PFAS). PFAS are present in many consumer products including some typical sampling equipment and are widely present in the environment.

Low regulatory criteria and high contamination potential require special precautions to be implemented to avoid compromising sample integrity. Instructions are provided herein for collection of environmental samples without contaminating them. This SOP is designed to supplement but not replace existing sampling SOPs SA-1.1, SA-1.2, SA-1.3, SA-1.7, and SA-5.1. In addition, some clients and/or projects may have specific PFAS-related sampling requirements that extend beyond the procedures described in this SOP. Such additional requirements typically are documented in work plans or similar documents.

2.0 SCOPE AND APPLICABILITY

This document provides information on selection of proper sampling equipment and techniques for groundwater, surface water, sediment, soil, and water supply sampling for PFAS analysis. Sampling of air or biota is not addressed in this SOP, but the same principles would apply for those media.

3.0 BACKGROUND

PFAS have been used since the 1940s as manufacturer-applied oil and water repellants on products such as clothing, upholstery, paper, and carpets and in making fluoropolymers for non-stick cookware. They are found in textiles and leather products, mist suppressants for metal plating, materials used in the photography industry, photolithography, semi-conductors, paper and packaging, coatings, cleaning products, pesticides, and cosmetics. They have been used in well-known consumer products including Teflon, StainMaster, Scotchgard, and GoreTex. In the 1960s, aqueous film-forming foam (AFFF) containing PFASs was developed for fighting flammable liquid fires, particularly petroleum-fueled (Class B) fires (ATSDR, 2009). The two most researched and most prevalent PFAS in the environment are perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) (ATSDR, 2009).

Military uses of PFAS have been primarily related to fire fighting and electroplating. AFFF meeting MIL-F-24385 specifications was developed by various manufacturers for use in extinguishing fires at military bases, airports, commercial facilities, and fire-fighting training facilities throughout the United States. Beginning in the late 1960s the United States Department of Defense (DoD) used large quantities of AFFF for shipboard and shore facility fire-suppression systems, on fire-fighting vehicles, and at fire-training facilities. AFFF concentrate that contains PFAS may still be in use at DoD facilities, and large quantities of AFFF may have been released to the environment at some facilities.

PFAS are persistent in the environment, tend to bioaccumulate, and demonstrate toxicity in laboratory animals, enough to raise concerns about their presence in the environment. Some areas where PFAS may have been released to the environment include the following:

- Fire-fighting training areas
- Areas where fire-fighting products/materials are stored
- Aircraft crash sites
- Metal coating and plating facilities
- Water treatment systems and receiving water bodies
- Airport hangars and other facilities storing fire-fighting foams
- Fluorochemical manufacturing, use, and disposal facilities

PFAS are ubiquitous in consumer products and are present in or on some materials used in environmental sampling (e.g., Teflon tubing, waterproof logbooks, and GoreTex field clothing). Laboratory detection limits are low for PFAS, and contact of sample material or sampling equipment with any one of the multitude of PFAS sources could result in detectable contamination. In addition, PFAS tend to adsorb to glass and some plastics, so certain glass or plastic sample collection containers are inappropriate for use in PFAS sample collection. Adsorption to sample containers may result in a low bias for measured PFAS concentrations.

Collection and analysis of quality control blanks is an important aspect of verifying that samples have not been contaminated during sample collection and handling. Use of additional blanks or blanks of a different type than usual may be required in some circumstances, and the governing project planning documents should be consulted. Consult Section 7.7 of this SOP for instructions regarding collection of field reagent blanks (FRBs).

4.0 DEFINITIONS AND ABBREVIATIONS

AFFF – Aqueous film-forming foam.

Emerging Contaminant – An emerging contaminant is a chemical or material that is characterized by a perceived, potential, or real threat to human health or the environment or by a lack of published health standards (U.S. EPA, 2014). A contaminant may also be “emerging” because a new source or a new pathway for human exposure has been discovered or a new detection method or treatment technology has been developed (DoD, 2011).

FRB – Field Reagent Blank. A blank sample prepared in the field by transferring laboratory-supplied, chemically preserved, deionized water to an empty, laboratory-supplied, collection bottle. FRBs are typically analyzed only for PFAS and are treated as site samples in all respects, including shipment to the sampling site, exposure to sampling site conditions, storage, preservation, and all PFAS analytical procedures. The purpose of FRBs is to indicate whether PFAS measured in corresponding site samples may have been introduced during sample collection and handling.

PFAS – Per- and Polyfluoroalkyl Substances. A reference term currently in use, replacing “PFCs” in recent scientific and other technical literature. The term is inclusive of both perfluorinated chemicals like PFOA and PFOS and polyfluoroalkyl substances like fluorinated telomers.

PFCs – Perfluorinated Compounds or Chemicals. PFCs are a family of man-made chemicals that have been used for commercial, industrial, and military applications because they resist thermal degradation and repel oil, stains, grease, and water.

PFOA – Perfluorooctanoic Acid. PFOA is used as an aqueous dispersion agent and in the manufacture of fluoropolymers (including Teflon) used in industrial components such as electrical wire casings, fire- and chemical-resistant tubing, and plumbing seal tape. PFOA is used in surface treatment products to impart oil, stain, grease, and water resistance. PFOA can also be produced by the breakdown of some fluorinated telomers.

PFOS – Perfluorooctane Sulfonate. PFOS was a key ingredient in Scotchgard and used in the manufacture of Class B AFFF used per DoD military specifications. Phase out of AFFF by 3M occurred in 2002.

5.0 SAFETY PRECAUTIONS

Sample acquisition activities shall be conducted in accordance health and safety requirements identified in the project-specific Health and Safety Plan (HASP), Accident Prevention Plan (APP), and corporate health and safety policies. Alteration may be necessary to allow sample collection without cross contamination as dictated by site-specific conditions.

Caution

The use of personal protective equipment (PPE) containing PFAS (e.g., some insect repellants, sunscreens, traffic safety vests, etc.) should be avoided if possible or, if deemed necessary to control hazards, should be carefully considered as they can pose a potential cross-contamination risk for samples. Extra care (e.g., changing outer gloves) must be exercised to ensure that PFAS is not transferred directly or indirectly from PPE to samples or sample containers.

The Tetra Tech Project Manager (PM), in coordination with the Tetra Tech NUS Operating Unit Health and Safety Group, shall ensure that the development of project-specific plans balances the need to control exposure to safety hazards as well as address PFAS contamination risks.

6.0 PERSONNEL RESPONSIBILITIES, QUALIFICATIONS, AND TRAINING

Project Manager (PM) – The PM along with the management team are responsible for determining sampling objectives, initial sampling locations, and field procedures used in the collection of samples of environmental media. Additionally, in consultation with other project personnel (geologist, hydrogeologist, etc.), the PM is responsible for selecting and detailing the specific sampling techniques and equipment to be used and for providing detailed input in this regard to the project planning documents. The PM has the overall responsibility for ensuring that sampling activities are properly conducted by appropriately trained staff.

Site Safety and Health Officer (SSHO) – The SSHO (or a qualified designee) is responsible for providing the technical support necessary to implement the project HASP, APP, or equivalent. The SSHO or SSHO designee may also be required to advise the Field Operations Leader (FOL) on safety-related matters regarding sampling, such as measures to mitigate potential hazards, hazardous objects, or conditions.

Project Geologist/Sampler – The project geologist/sampler is responsible for proper acquisition of samples in accordance with this SOP or other project-specific documents. In addition, this individual is responsible for the completion of all required paperwork (e.g., sample log sheets, field notebook, boring logs, container labels, custody seals, and chain-of-custody forms) associated with the collection of those samples.

Field Operations Leader (FOL) – This individual is primarily responsible for the execution of the field sampling program in accordance with the project planning documents. This is accomplished through management of a field sampling team for the proper acquisition of samples.

Personnel implementing this SOP must read and understand this SOP prior to collection of samples designated for PFAS analysis.

7.0 PROCEDURES

The following sampling procedure establishes requirements for collection of samples designated for PFAS analysis while minimizing potential cross contamination of the samples and other materials.

7.1 Selection of Equipment

It is important to research available equipment and materials at the project planning stage to avoid last-minute problems in the field, for example, ensuring compatibility of high-density polyethylene (HDPE) tubing with fittings for use in a peristaltic or other pump, or ensuring that equipment (e.g., a bladder pump) does not contain Teflon.

Sampling Equipment:

Note: PFAS cross-contamination of samples can be minimized through decontamination or conditioning of equipment left in a well. Use of dedicated equipment also is helpful so that handling during decontamination is unnecessary.

- Decontamination – All reusable equipment used in sample acquisition should be adequately decontaminated prior to use.

- Unless project requirements indicate otherwise, use sampling equipment made of stainless steel, acetate, silicone, or HDPE. This applies to tubing, pumps and pump components, tape for plumbing fittings, trowels, mixing bowls, or other equipment that could contact the sample media. Gasket and O-ring components of sampling equipment may also contain fluoropolymers.

Note: PFAS on purchased or rented items is likely to occur predominantly in newly manufactured or rented items treated with chemicals containing PFAS. Therefore, all rental equipment that will make direct contact with the material being sampled must be thoroughly decontaminated prior to use, especially if the equipment items are new.

- Use sampling equipment that does not include or containing polytetrafluoroethylene (PTFE) or Teflon (DuPont brand name) or fluorinated ethylene propylene (FEP) during sample handling or mobilization/demobilization.

- Use products that are not made of low-density polyethylene products (LDPE) if contamination from those products can be transferred to environmental samples or QC samples.

- For collecting drinking water samples to be analyzed using United States Environmental Protection Agency (U.S. EPA) Method 537, use polypropylene sample bottles with a polypropylene screw cap; for all other samples, use HDPE containers with unlined plastic screw caps.

Non-Sampling Field Equipment:

- Non-waterproof loose-leaf paper or notebooks are acceptable. Avoid using waterproof field books or paper during sampling activities, although “Rite in the Rain” books have been found empirically to be acceptable. Do not use plastic clipboards, binders, or spiral hard-cover notebooks that may be coated; use Masonite or aluminum clipboards instead.

- Avoid using Post-it notes or similar removable notes during sample handling or mobilization/demobilization activities.

- Use ballpoint pens or pencils for note taking and sample bottle labeling. Avoid using Sharpies or similar indelible markers.

- Avoid the use of aluminum foil.

Field Personnel Clothing and Protective Gear:

- Wear clothing that has been washed at least six times without fabric softener to remove possible stain-resistant coatings. Clothing made of natural fibers such as cotton is preferred to other fabrics. Protective clothing must be washed in accordance with manufacturer recommendations to ensure that the protective properties necessary to control safety hazards (e.g., fire-retardant clothing) are not compromised.

- Avoid unnecessary contact with upholstery in vehicles because many such fabrics may be treated with stain-resistant materials that could contain PFAS. Typically, rental vehicles are newer and more likely to pose a contamination risk to samples. Well-washed towels or rags may be placed on the seats to prevent contact with car seats and other materials that could transfer PFAS to clothing worn by samplers. If practical, cover clothing and skin that has been in contact with such upholstery with non-fluorinated clothing.

- During wet weather, use rain gear made from polyurethane or wax-coated materials.

- Avoid wearing water-resistant (e.g., Gore-Tex or similar material) clothing or footwear (e.g., boots) immediately prior to or during sample collection and management.

- Avoid wearing coated Tyvek or similar coated PPE suits.

- Wear un-powdered nitrile gloves at all times while collecting and handling samples, and change gloves often. Anecdotal evidence indicates that changing gloves is one of the most effective methods of reducing or eliminating sample contamination potential; therefore, change to a new pair of gloves prior to collecting each sample.

- Avoid wearing cosmetics, shampoos, moisturizers, hand cream, or other similar personal care products on the day of sampling.

- When expected to be effective, use sunscreens and insect repellants that are made with 100-percent natural ingredients and that the Air Force Civil Engineer Center has identified as acceptable for use. ***These products must be used in accordance with manufacturer recommendations and in combination with controls in the project-specific HASP, APP, and corporate health and safety policies. Multiple applications of these products per work shift may be required to ensure their effectiveness.***

    - Sunscreens: Alba Organics Natural Sunscreen, Yes To Cucumbers, Aubrey Organics, Jason Natural Sun Block, Kiss My Face, baby sunscreens that are “free” or “natural.”

    - Sunscreen and insect repellant: Avon Skin So Soft Bug Guard Plus – SPF 30 Lotion

    - Insect Repellent: Jason Natural Quit Bugging Me, Repel Lemon Eucalyptus Insect Repellant, Herbal Armor, California Baby Natural Bug Spray, BabyGanics.

Note: The suitability of these items has not been independently verified. Products containing N-diethyl-meta-toluamide (DEET), picaridin, and IR3535 and some oil of lemon eucalyptus (OLE) and para-menthane-diol products are known to provide longer-lasting protection than others. One of the products recommended by the Air Force Civil Engineer Center and listed above, Repel Lemon Eucalyptus Insect Repellant, contains OLE and is most likely to be effective.

Sample Containers and Shipping Materials:

- Avoid the use of glass sample containers, which are believed to result in loss of PFAS through adsorption to the container inner walls.

- Collect samples in clean, laboratory-supplied, plastic bottles only, typically polypropylene for drinking water or HDPE for other matrices.

- Confirm that Teflon-lined caps are not used in sample containers; unlined polypropylene screw caps must be used. It is best to segregate sample containers with Teflon components (e.g., Teflon-lined septa) from PFAS sample containers.

- Avoid using Blue Ice or similar items to cool samples and avoid placing such items in sample coolers for shipping. Use commercially available (e.g., from convenience stores or supermarkets) double-bagged ice instead.

Caution: Samples designated for PFAS analysis must be cooled to achieve a storage temperature of less than 6 °C. Cooling to this temperature may take several hours, and sample temperatures may not achieve 6 °C by the time they arrive at the laboratory. If sample temperatures upon arrival at the laboratory are not less than 10 °C, the laboratory may conclude that sample preservation was compromised and may reject the samples. Therefore, place samples on ice as soon after collection as possible. On warm days, or when a representative from a nearby laboratory picks up the samples, take extra care (e.g., use more ice or delay shipment, if necessary) to ensure that sample temperatures will not exceed 10 °C when the samples arrive at the laboratory.

- Use of commercially available plastic bags (e.g., 3-mil-thick trash can liners) for lining coolers to prevent leakage and to separate potential melt water from chain-of-custody forms is allowed.

7.2 Other Precautions for Sample Handling

- Wash hands thoroughly before sampling and after handling fast food, carryout food, snacks, or other items that may contain PFAS. Do not carry pre-packaged food items such as candy bars or microwave popcorn into sampling areas.

- Assume that shipping tape used for securing coolers could contain PFAS; therefore, take care not to transfer PFAS from tape to samples.

- Minimize exposure of samples to light. This can be done by placing the collected samples into a cooler (with ice) and closing the cooler lid.

- If in doubt about a particular product or item that comes into contact with environmental media to be sampled or is in close proximity to sampling operations, consider collecting and analyzing a rinsate blank using laboratory-supplied PFAS-free water to test the item for contamination potential. Consult the Tetra Tech PM in these cases to verify whether collection of additional blanks is warranted.

- Support personnel that are within 2 to 3 meters of the sample processing area are considered subject to the same restrictions related to precautionary measures for clothing and food as applied to sampling personnel.

These precautions must be observed during sampling activities, especially during water sample collection (groundwater, water supply, and surface water), given the high solubilities of PFAS in water. Examples of how these precautions may be applied to sampling of specific media are provided in the following sections.

7.3 Groundwater Sample Acquisition

The precautions and requirements identified in Sections 7.1 and 7.2 must be observed for groundwater sampling. Do not proceed any further without reviewing each of those precautions and requirements.

- Collect groundwater samples for PFAS analyses in accordance with this SOP, SOP SA-1.1, and/or project- or client-specific requirements.

- If non-dedicated non-disposable equipment is used between sampling locations, it should be decontaminated with Alconox or Liquinox, unless 1,4-dioxane (a potential component of Liquinox) is also a contaminant of concern. In that case, Liquinox should not be used. Products such as Decon 90, which contains fluorosurfactants, should not be used. Alconox or Liquinox rinses should be followed by a potable water rinse then deionized water rinse.

- If Teflon or LDPE materials are required for the non-PFAS analytes, use multiple sets of containers. Collect samples for PFAS analysis last to ensure adequate purging and conditioning of sampling equipment. If practical to do so, suitable PPE (especially gloves) may also be changed out for PFAS sampling. For example, purge and sample a monitoring well for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and metals using a peristaltic pump with HDPE and silicone tubing, then collect the material for PFAS analysis or switch to a stainless steel bailer to collect the PFAS samples. If either the proper sampling sequence or proper equipment is unclear, consult the FOL or Tetra Tech PM and record the actual sequence in the field notes.

- If sampling wells that have or had dedicated Teflon or FEP tubing that potentially contained PFAS, remove the dedicated tubing and, using silicone or HDPE tubing, remove at least one well volume from the target sampling interval prior to sampling. Accomplish this removal in a manner that is rigorous enough to remove the entire water column from the well and not just a limited vertical interval of the water column. This will minimize the potential for collecting a sample that was in contact with the Teflon/FEP tubing.

- The use of detergents must be avoided during decontamination of drilling equipment. All equipment must be scrubbed with a plastic brush or steam cleaned and rinsed thoroughly in potable water to clean away any debris or material on exposed surfaces and then triple-rinsed in distilled (American Society for Testing and Materials Grade 3 or better) or deionized water (or Millipore water).

- Sample(s) representing any water collected at the point of use (e.g., water truck or tank on site) used by the driller for drilling purposes must be analyzed for PFAS. See Section 7.8 for guidance on waste management.

- Collect drinking water samples to be analyzed using U.S. EPA Method 537 in clean polypropylene sample bottles with a polypropylene screw cap; for all other samples, use clean, laboratory-supplied, HDPE bottles with unlined plastic screw caps.

7.4 Soil Sample Acquisition

The precautions and requirements identified in Sections 7.1 and 7.2 must be observed for soil sampling. Do not proceed any further without reviewing each of those precautions and requirements.

- Collect soil samples for PFAS analyses in accordance with this SOP, SOP SA-1.3, and/or project- or client-specific requirements. Review client–specific (e.g., DoD component) guidance or previously approved Sampling and Analysis Plans (SAPs).

- Soil sampling equipment should not be constructed of or contain Teflon or other materials likely to contain or be coated with PFAS. Acceptable materials for sampling include stainless steel, acetate, and HDPE.

- If non-dedicated non-disposable equipment is used between sampling locations, it should be decontaminated with Alconox or Liquinox, unless 1,4-dioxane (a potential component of Liquinox) is also a contaminant of concern. In that case, Liquinox should not be used. Products such as Decon 90, which contains fluorosurfactants, should not be used. Alconox or Liquinox rinses should be followed by a potable water rinse then deionized water rinse.

- Collect samples in laboratory-provided HDPE containers specifically designated for PFAS analysis. Do not use glass jars typically used for soil sample collection because some PFAS may irreversibly adsorb to the glass and could create a negative bias in the measured PFAS concentrations. Also consult Section 7.6 if sampling a water supply.

7.5 Surface Water and Sediment Sample Acquisition

The precautions and requirements identified in Sections 7.1 and 7.2 must be observed for surface water and sediment sampling. Do not proceed any further without reviewing each of those precautions and requirements.

- Collect surface water and sediment samples for PFAS analysis in accordance with this SOP, SOP SA-1.2, and/or project- or client-specific requirements.

- Surface water and sediment sampling equipment should not be constructed of or contain Teflon or LDPE materials. Acceptable materials for sampling include HDPE, small amounts of silicone, stainless steel, and acetate. Do not use glass. The bottleware should be supplied clean by the laboratory and specifically designated for PFAS analysis. If transfer bottles are required for collection of surface water samples, the transfer bottles used should be of the same material as the containers designated for submission to the laboratory.

- For surface water sample collection, invert the capped sample bottle, with the opening pointing downward, at least 10 cm below the water surface, 10 cm above the bottom of the water body, and as close to the center of the channel or water body as practical. To collect the sample, uncap the bottle underneath the water surface and point the bottle upward so that gloved hands, sample container, and sampler are downstream of where the sample is being collected.

- For aquatic samples collected from the shoreline or via wading, ensure that waders are constructed of fabric that has not been treated with waterproofing coatings.

- If non-dedicated non-disposable sampling equipment is used between sampling locations, it should be decontaminated with Alconox or Liquinox, unless 1,4-dioxane (a potential component of Liquinox) is also a contaminant of concern. In that case, Liquinox should not be used. Products such as Decon 90, which contains fluorosurfactants, also should not be used. Alconox or Liquinox rinses should be followed by a potable water rinse then deionized water rinse.

7.6 Water Supply Sampling

This section applies to sampling from taps, spigots, faucets, or similar devices for PFAS analysis. The precautions and requirements identified in Sections 7.1 and 7.2 must be observed for water supply sampling. Do not proceed any further without reviewing each of those precautions and requirements.

- Collect water supply samples for PFAS analysis in accordance with applicable portions of SOP SA-1.7 and/or project- or client-specific requirements.

- Water supply sampling equipment (if needed) should not be constructed of or contain Teflon or LDPE materials. Acceptable materials for sampling include HDPE, polypropylene (drinking water sampling only), small amounts of silicone (e.g., short runs of silicone tubing used in peristaltic pumps), stainless steel, and acetate. Non-drinking water supply samples should be collected in clean, laboratory-supplied, HDPE bottleware specifically designated for PFAS analysis (not glass). Collect drinking water samples in clean polypropylene bottles supplied by the laboratory.

- Ensure that sample bottles used to collect chlorinated water samples contain the proper Trizma preservative (5 g/L to preserve and remove chlorine). Non-chlorinated water does not require chemical preservatives designed to remove chlorine.

- If non-dedicated non-disposable equipment is used between sample locations, it should be decontaminated with Alconox or Liquinox.

- Locate the sampling point. If a specific sampling point has already been designated (e.g., a kitchen tap), plan to collect the sample from that point. Otherwise, identify a location in the water supply line that is as close as possible to the water's point of origination (e.g., a well or other water source) and upstream of any local water treatment unit(s) that could affect PFAS levels (e.g., water softeners, activated carbon, or reverse osmosis treatment units). If a treatment unit is in use, a post-treatment sample may also be required in some cases, per project requirements.

  Note: If treatment that could affect PFAS levels (e.g., carbon filtration or reverse osmosis) is part of the water distribution system, often a spigot will be present in the plumbing line between the water source and the treatment unit, and this spigot should be used for sample collection.

- Remove any aerator/diffuser from the faucet, if possible. If removal is not possible, record this observation in the field notes.

- Allow the water to run freely from the tap until water quality parameter stabilization per project-specific requirements is achieved, or as otherwise required by project-specific requirements. This will often require purging for 3 to 5 minutes.

- Reduce the water flow rate to minimize aeration of the sample. The water stream should be no wider than the diameter of a pencil.

- Fill the sample bottle (typically 250 mL) directly from the tap to the bottom of the neck of the bottle, and cap the bottle immediately.

- After collecting the sample, cap the bottle and, if preservative is included, agitate by hand until the preservative is dissolved.

- Do not use filters when collecting samples because the filters may introduce PFAS contamination or absorb PFAS and thus reduce PFAS concentrations in the samples.

7.7 Field Reagent Blank Collection

Note: If PFAS are detected in site samples, FRBs may be analyzed to assess whether PFAS in site samples could be non-site-related contamination and whether resampling is necessary. U.S. EPA Method 537 and modifications thereof for PFAS analysis require an FRB to be handled along with each sample set. A sample set is described as samples collected from the same sample site and at the same time, but "sample site" and "same time" are not precisely defined. Therefore, it is important to verify that the correct number of FRBs will be collected. The intent is to be able to verify whether samples have been contaminated and to help identify the source of contamination. In general, collecting one FRB at each sampling point is recommended when sampling drinking water; fewer FRBs are recommended when sampling non-drinking water matrices. The actual number will depend on project needs. *Collection of an FRB at every sampling point may be required.*

- Verify the number of FRBs to be collected for the project and where those samples must be collected. This should be described in the project planning documents such as work plans or SAPs. If it is not, consult the PM.

- At the sampling site, when ready to collect an FRB, open the bottle of chemically preserved FRB reagent water provided by the laboratory and a corresponding clean empty bottle, also provided by the laboratory.

- Pour the preserved FRB reagent water into the empty sample bottle, close the cap, and label this filled bottle as the FRB.

- Pack and ship the FRB along with site samples and required documentation (e.g., chain-of-custody form) to the laboratory.

Note: Although chain-of-custody forms will indicate that FRBs must be analyzed for PFAS, analysis of an FRB will be required only if site samples contain PFAS greater than a certain concentration. If an FRB is analyzed and any PFAS concentration in the FRB exceeds one-third of the laboratory minimum reporting limit (or equivalent), all samples collected with that FRB may be considered invalid and may require recollection and reanalysis. Consult the project planning documents governing sample collection for specifics as to whether resampling is necessary. Care in collection and handling of site samples and FRBs in a way that avoids contamination cannot be overemphasized.

Note: It will be necessary to associate individual FRBs with corresponding site samples; otherwise, decisions about which samples to recollect (if recollection is indicated) could be compromised. Associations between FRBs and corresponding site samples may be accomplished by marking chain-of-custody forms with the associations, but other methods also may be useful. Consult the governing planning document or the PM for guidance, if necessary.

7.8 Disposal of Investigation-Derived Waste Potentially Containing PFAS

PFAS are not hazardous wastes as defined in the Resource Conservation and Recovery Act and Comprehensive Environmental Response, Compensation, and Liability Act. It may be possible to dispose of PFAS-containing solid waste as non-hazardous, but sampling solid waste material for PFAS analysis is not advised. Consult the client PM or on-site point of contact to verify their current disposal acceptance criteria, and indicate on waste manifests that the waste potentially contains PFAS. Waste water potentially containing PFAS should be analyzed for PFAS to determine the appropriate disposal option. If the sum of PFOS and PFOA concentrations is less than 70 µg/L the water may be disposed of without special handling if no other enforceable regulations apply; otherwise, the water should be treated to reduce the PFOA + PFOS concentration to an acceptable level or should be directed to an appropriate treatment facility for disposal. On-site treatment (e.g., granular activated carbon filtration) may be appropriate. Consult the client PM or on-site point of contact for direction regarding disposal.

Note: If aqueous investigation-derived waste (IDW) is expected to contain much greater than 70 ng/L (e.g., captured residual from an accidental release in a hangar), special actions may be necessary and the client PM should be consulted. For wastes that are dewatered and potentially contain PFAS, containerize the waste water and analyze it for PFAS prior to disposal.

8.0 REFERENCES

ATSDR, (Agency for Toxic Substances and Disease Registry), Division of Toxicology and Environmental Medicine, 2009. Toxicological profile for perfluoroalkyls. U.S. Government Printing Office. http://www.atsdr.cdc.gov/toxprofiles/tp.asp?id=1117&tid=237.

ASTSWMO (Association of State and Territorial Solid Waste Management Officials, Remediation and Reuse Focus Group), Federal Facilities Research Center, 2015. Perfluorinated Chemicals (PFCs): Perfluorooctanoic Acid (PFOA) and Perflurooctane Sulfonate (PFOS), Information Paper. August

DoD (Department of Defense), 2011. Chemical & Material Emerging Risk Alert Aqueous Film Forming Foam (AFFF). Risk Alert # 03-11. Materials of Evolving Regulatory Interest Team.

Department of the Navy, 2014. Perfluorinated Compounds (PFCs) Interim Guidance/Frequently Asked Questions (FAQs). December.

Chemical & Material Emerging Risk Alert Aqueous Film Forming Foam (AFFF). Risk Alert # 03-11. Materials of Evolving Regulatory Interest Team.

NAVFAC, 2017. Interim Per-and Polyfluoroalkyl Substances (PFAS) Site Guidance for NAVFAC Remedial Project Managers (RPMs)/September 2017 Update.

New Hampshire Department of Health and Human Services, 2014. Fact Sheet, Perfluorinated Chemicals (PFCs). May.

U.S. EPA (United States Environmental Protection Agency), 2009. Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS), Version 1.1, EPA/600/R-08/092. September.

U.S. EPA (United States Environmental Protection Agency), 2014. Emerging Contaminants – Perflurooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA). Emerging Contaminants Fact Sheet – PFOS and PFOA. EPA-50-F-14-001. March.

U.S. EPA, 2015. Perfluorooctanoic Acid (PFOA) and Fluorinated Telomers – Frequent Questions. http://www.epa.gov/oppt/pfoa/pubs/faq.html. Accessed April 27.

Appendix C – Community Air Monitoring Plan

APPENDIX C

COMMUNITY AIR MONITORING PLAN

Real-time air monitoring for volatile compounds and particulates at the perimeter of the exclusion zones will be conducted. Exclusion zones will be established at each area of subsurface investigation (e.g., borings and wells near TT-SB-13, borings and wells around the Tower building, etc.). Monitoring will be conducted at one upwind and one downwind station. The locations of these stations will be determined on a daily basis by use of wind sock to determine predominant wind directions, and will be adjusted throughout the day as necessary.

If particulates become a concern at the Site as a result of drilling activities, this community plan will be modified accordingly. The following procedures will be implemented during field activities as appropriate:

Volatile organic compounds will be monitored at the downwind perimeter of the exclusion zone on a continuous basis at monitoring stations using a PID with data logging capabilities, as well as visible and audible alarms.

- 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 will 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.

- 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 will 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.

    - All readings will be recorded in the field logbook and be available for State (NYSDEC & NYSDOH) personnel to review.

Particulate concentrations will be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring will 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 will be capable of logging data, and will be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration will be visually assessed during all work activities.

- 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 will 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.

- If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m3 above the upwind level, work will 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.
- All readings will be recorded in the field logbook and be available for State (NYSDEC & NYSDOH) personnel to review. These action levels can be modified with the agreement of NYSDEC & NYSDOH if particulates are better characterized and identified.

Vapor Emission Response Plan

If the organic vapor level is above 50 ppm over background at the perimeter of the exclusion zone, work activities will halt and odor control contingencies will be implemented. When work shutdown occurs, downwind air monitoring as directed by the ESS will be implemented to ensure that vapor emissions do not impact the nearest residential or commercial structure.

If organic vapor levels greater than 25 ppm over background are identified 200 feet downwind from the investigation site, or half the distance to the nearest residential or commercial property line, whichever is less, all work must cease. If, following cessation of work activities and implementation of odor control contingencies, organic vapor levels persist above 25 ppm above background 200 feet downwind or half the distance to the nearest residential or commercial property from the exclusion zone, then air quality must be monitored within 20 feet of the perimeter of the nearest residential/commercial structure (the “20 foot zone”).

If organic vapor levels approach 25 ppm above background within the “20 foot zone” for a period of more than 30 minutes, or organic vapor levels greater than 50 ppm above background for any time period occur within the “20 foot zone”, then the following steps will be taken:

- The local police/authorities will immediately be contacted by the ESS and advised of the situation.
- Frequent air monitoring will be conducted at 30-minute intervals within the 20 foot zone. If two successive readings below action levels are measured, air monitoring may be halted or modified by the EL.
- All emergency contacts will go into effect as appropriate.
- If readings fail to drop below 25 ppm after 30 minutes the borehole will be sealed.