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July 14, 2023

Daniel Evans
Director, Bureau of Hazardous Waste and Radiation Management
Division of Materials Management
New York State Department of Environmental Conservation
625 Broadway
Albany, NY 12233-7256

Re: Re-submission of RIWP for Lafarge / Former Spectra Construction Storage Area at Indian Point Energy Center for review

Dear Mr. Evans:

This letter is intended to provide you with the submittal of the Remedial Investigation Work Plan (RIWP) for the Lafarge/Spectra Area at Indian Point Energy Center (IPEC) for review and approval. The enclosed work plan incorporates the comments received in a letter from the Department dated June 20, 2023.

As a requirement of the Order on Consent and Administrative Settlement, a Remedial Investigation Scoping Work Plan (RISWP) was prepared, which identified specific Areas of Concern (AOC) at IPEC that require additional performance of a Remedial Investigation (RI). The RISWP dated June 2022 was approved in a letter from NYSDEC dated August 11, 2022. This AOC was included since it is located outside of the Protected Area and Radiologically Controlled Areas and was not subject to continuous security and oversight by IPEC personnel.

As always, if you have any questions or require anything further, please contact Ben Reynolds, Director of Environmental Affairs at b.reynolds@holtec.com, (610) 742.2848 or Kristin Maddalo, IPEC Site Characterization Project Manager at k.maddalo@holtec.com, (914) 254.7248.

Sincerely,

Jean A. Fleming
Digitally signed by Jean A. Fleming
Date: 2023.07.14 08:09:50 -04'00'

Jean Fleming
Vice President of Licensing, Regulatory Affairs, and PSA
Holtec International

Enclosure – Draft Remedial Investigation Work Plan for AOC 118 – Certified on July 12, 2023

cc: Richard Burroni
Frank Spagnuolo
Benjamin Reynolds
Matthew Johnson
Kristin Maddalo
Carlos A. Garcia
Jenna Raup (TRC)
Emily Ebert (TRC)
Kirsten Myers (TRC)

REMEDIAL INVESTIGATION WORK PLAN

for the

INDIAN POINT ENERGY CENTER
AREA OF CONCERN 118
LAFARGE EASEMENT / FORMER SPECTRA CONSTRUCTION STORAGE AREA
450 BROADWAY
BUCHANAN, NEW YORK 10511

ORDER ON CONSENT AND ADMINISTRATIVE SETTLEMENT
SITE NO. 360042

TRC PROJECT NO. 504007.0000.0000

JULY 2023

Submitted to:
New York State Department of Environmental Conservation
625 Broadway, Albany, New York 12233-7015
Attn: Mr. Daniel Evans

Prepared by:

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Prepared for:

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CERTIFICATIONS

I, Kirsten Myers, certify that I am currently a NYS registered professional engineer and that this Remedial Investigation Work Plan (RIWP) was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the Division of Environmental Technical Guidance for Site Investigation and Remediation (DER-10).

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

7/12/2023

Kirsten Myers, P.E. — Date
NYS Professional Engineer No. 089236-1

It is a violation of Article 130 of New York State Education Law for any person to alter this document in any way without the express written verification of adoption by the New York State licensed engineer identified above in accordance with Section 7209(2), Article 130, New York State Education Law.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Jean Fleming	7/12/2023	Jean A. Fleming Digitally signed by Jean A. Fleming Date: 2023.07.12 15:50:58 -04'00'
Vice President of Licensing, Regulatory & PSA Holtec International, LLC	Date	Signature

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ABBREVIATIONS AND ACRONYMS

AOC	Area of concern
ASP	Analytical Services Protocol
bgs	Below Ground Surface
CAMP	Community Air Monitoring Plan
CP-51	Commissioner Policy 51
DER	Department of Environmental Remediation
DER-10	DER Technical Guidance for Site Investigation and Remediation
DO	Dissolved Oxygen
DQO	Data Quality Objectives
DUSR	Data Usability Summary Report
ELAP	Environmental Laboratory Approval Program
HASP	Health and Safety Plan
HDI	Holtec Decommissioning International, LLC
JP	Joint proposal
IDW	Investigation Derived Waste
LNAPL	Light Non-Aqueous Phase Liquid
NAD83	North American Datum 1983
NTU	Nephelometric Turbidity Unit
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
ORP	Oxidation Reduction Potential
OCAS	Order on Consent and Administrative Settlement
PCB	Polychlorinated biphenyl
PFAS	Per- and polyfluoroalkyl substances
PID	Photoionization detector
PVC	Polyvinyl chloride
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RI	Remedial Investigation
SVOC	Semi volatile organic compound
TAL	Target Analyte List
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
USEPA	United States Environmental Protection Agency
VOC	Volatile organic compound

1.0 INTRODUCTION

Indian Point Energy Center (IPEC) was acquired by Holtec Indian Point 2, LLC (Holtec IP2) and Holtec Indian Point 3, LLC (Holtec IP3), wholly owned subsidiaries of Holtec International, LLC (Holtec) in May 2021. In support of the transaction, Holtec and New York State (NYS) agreed to a Joint Proposal (JP) establishing agreed upon terms for the transfer of IPEC to Holtec. An Order on Consent and Administrative Settlement (OCAS) between Holtec Decommissioning International, LLC (HDI) and the New York State Department of Environmental Conservation (NYSDEC or the "Department") was included as part of the JP, and defines the overall scope and regulatory approach for environmental Site restoration activities to be conducted during decommissioning of IPEC under the jurisdiction and oversight of NYSDEC.

As a requirement of the OCAS, a Remedial Investigation Scoping Work Plan (RISWP) was prepared, which identified specific Areas of Concern (AOC) at IPEC that require additional performance of a Remedial Investigation (RI). The RISWP dated June 2022 was approved in a letter from NYSDEC dated August 11, 2022. AOC No. 118: Lafarge Easement / Former Spectra Construction Storage Area was included as an AOC since it is located outside of the Protected Area and Radiologically Controlled Areas and was not subject to continuous security and oversight by IPEC personnel.

The purpose of this Remedial Investigation Work Plan (RI Work Plan) is to present to NYSDEC, for review and approval, the proposed plan for investigation of Area of Concern No. 118: Lafarge Easement / Former Spectra Construction Storage Area, IPEC, Buchanan, New York 10511 (herein referred to as the "Site").

This RI Work Plan will be implemented in general accordance with the protocols in NYSDEC Division of Environmental Remediation (DER) Technical Guidance for Site Investigation and Remediation (DER-10). Following completion of the RI, HDI will submit an RI Report documenting the findings and conclusions of the investigation.

2.0 SITE DESCRIPTION AND HISTORY

2.1 Site Location and Setting

Area of Concern No. 118 (AOC118): Lafarge Easement / Former Spectra Construction Storage Area is located at Indian Point Energy Center in Buchanan, New York. Based on review of Town of Cortlandt and Westchester County records, AOC118 is located within the Town of Cortlandt but assessed by the Village of Buchanan. The Site is an approximately 10-acre portion of the 280-acre IPEC facility. The Site is located on the southernmost portion of the IPEC-area subject to the OCAS. At the time of this report, the Site is undeveloped. The Site location is shown on *Figure 1*.

The Site is bordered to the north by an unnamed access road used under an Easement by the LaFarge Gypsum plant (to the west), followed by Indian Point Energy Center; to the east by Broadway, followed by St Patrick's Cemetery; to the south by single family residential buildings; and, to the west by a vacant, wooded lot, followed by a wetland. In addition, an underground natural gas pipeline, which runs south to north, traverses the westernmost portion of the Site. A Site plan showing the surrounding properties is presented as *Figure 2*.

2.2 Current Site Use

AOC118 is currently vacant and overgrown. Access to the area is restricted by a chain-link fence.

2.3 Historic Site Use

Prior to its construction, the IPEC electric generation facility property was occupied by an amusement park. IPEC facility construction began in 1958 with one nuclear reactor (Unit 1). Unit 1 began operation in 1962 and was taken out of service in October 1974. Units 2 and 3 were constructed and placed into service in 1974 and 1976, respectively. Unit 2 was permanently shut down in April 2020 and Unit 3 was permanently shut down in April 2021. Between 1958 and 2021, IPEC was operated by various entities including, Consolidated Edison (Con Edison), the Power Authority of the State of New York (NYPA), and Entergy (Entergy Nuclear Indian Point 3, LLC and Entergy Nuclear Indian Point 2, LLC).

AOC118 was undeveloped as early as 1940 until circa 2016, when the Site was used by a third-party for staging of construction equipment and supplies associated with the Spectra pipeline installation. TRC understands that a Stormwater Pollution Prevention Plan (SWPPP) and Spill Prevention, Control, and Countermeasure (SPCC) plan were prepared and implemented during this former Site use. Daily inspections were performed and there are no records of releases. Although there were no spills reported during this former Site use, the area was not subject to continuous security and oversight by IPEC personnel. By 2018, the use of this area for staging of pipeline-related construction materials and equipment was complete, materials were removed, and the area was reseeded.

2.4 Future Use of the Site

The proposed future use of the Site is unknown; however, the Town of Cortland has expressed interest in purchasing the property for redevelopment.

2.5 Site Geology and Hydrogeology

The subsurface geology of Westchester County (Buchanan) is characterized by metamorphic rocks (schist, gneiss, and marble) of Middle Proterozoic age. Topography is strongly controlled by underlying bedrock, which is composed of the Manhattan formation (consisting of pelitic schists, amphibolites, and plagioclase-quartz gneiss) unconformably overlain by the Balmville Limestone Formation (consisting of marble). Much of the bedrock is covered by Pleistocene glacial till deposits and more recent coastal plain deposits of unconsolidated sand, gravel, and silt. The depth to bedrock in the area is estimated to be approximately 5 to 40 feet below ground surface (bgs).

Ground surface elevations for the Site ranges between 80 feet above mean sea level (MSL) in the western portion of the Site to 115 feet above MSL in the eastern portion of the Site. The Site is situated on the eastern bank of the Hudson River, which has a mean surface elevation of 1 foot above MSL. The Hudson River is the regional sink in the area, and as such, it is assumed that groundwater flow in the vicinity of the Site is westerly towards the Hudson River. The local direction and amplitude of bedrock groundwater flow may be influenced by the frequency and occurrence of fractures and joints in the bedrock. The depth to groundwater is assumed to be less than 25 feet bgs.

2.6 Radiological Characterization

As described in Section 1.0, the OCAS defines the overall scope and regulatory approach for environmental site restoration activities to be conducted during decommissioning of IPEC under the jurisdiction and oversight of NYSDEC. Radiological decommissioning activities required by Nuclear Regulatory Commission (NRC) laws, regulations, and guidance will be completed under NRC oversight, under separate cover, and are not specifically addressed in the OCAS. However, the OCAS does stipulate an objective to coordinate corrective actions with radiological characterization under the jurisdiction of the NRC and will culminate following NRC issuance of a Partial Site Release (PSR). PSR occurs when the NRC provides approval to release portions of a site for unrestricted use in accordance with 10 CFR 50.83(b) prior to approval of the License Termination Plan (LTP). PSR is required to meet a total effective dose equivalent (TEDE) to a member of the critical group not to exceed 25 millirem per year (mrem/year), but the OCAS requires remediation beyond this value to 10 mrem/year.

This AOC is located on what is referred to as "Parcel D" of the IPEC property and is within "Site Boundary" per NRC definitions. Parcel D is radiologically "non-impacted" per the 10 CFR 50.2 definition and the guidance provided in NUREG-1575, "Multi Agency Radiation Survey and Site Investigation Manual (MARSSIM)". Areas identified as non-impacted have no reasonable potential for residual radioactivity more than natural background or fallout levels.

A 10 CFR 50.83(b) submittal to the NRC is being planned in parallel with this RIWP and is required to provide specific information including a justification for why the area is "non-impacted" and include a historical site assessment. Although not a requirement under MARSSIM, MARSSIM-like submittal packages containing characterization sampling results and surveys are planned to aid NRC's review of the radiological classification for non-impacted areas and PSR. Specific details of the proposed surveys and sampling plan in AOC 118 are not yet developed, but are expected to include Gamma walkover surveys and laboratory analysis of soil and groundwater samples. Following the NRC's acceptance of the submittal, a public meeting would be scheduled, and it is anticipated that approval from the NRC would be provided 12 months after the submittal of the request. The actual timeframe may be longer if NRC requests additional information.

Should radiological characterization surveys be performed in tandem with RIWP implementation, the Department will be made aware of the schedule prior to commencement of fieldwork. Documentation prepared and submitted to NRC will be provided to NYSDEC at the same time for informational purposes. All final documentation accepted by the NRC will be provided to the NYSDEC and, for this AOC, will incorporate compliance in accordance with the 10 millirem per year guidance in DER-38, "Cleanup Guidelines for Soils Contaminated with Radioactive Materials". Radiological submittals will be wholly separate from the RI.

3.0 REMEDIAL INVESTIGATION OBJECTIVES AND METHODS

This section of the Work Plan presents the objectives and methods for the proposed additional investigation for the Site, and follows the guidance for an investigative work plan in NYSDEC DER-10, Technical Guidance for Site Investigation and Remediation. The Work Plan has been prepared in consideration of the Site history (refer to Section 2.0).

3.1 Objectives

The principal objectives of the RI are to characterize the soil and groundwater at the Site; further define the surface and subsurface characteristics of the Site (topography, geology, and hydrogeology); identify sources of contamination, migration pathways, and receptors (e.g., through air, soil, bedrock, sediment, groundwater, etc.); and, generate adequate data to perform an evaluation of threats to public health and the environment and develop effective remedial alternatives.

3.2 Scope of Investigation

The scope of the planned field investigation activities has been organized into the following tasks:

- Task 1 – Geophysical Survey/Utility Clearance
- Task 2 – Soil Sampling
- Task 3 – Monitoring Well Installation and Development and Groundwater Sampling
- Task 4 – Sample Location Survey
- Task 5 – Management of Investigation Derived Waste

Additionally, quality control and quality assurance procedures are summarized in the following task:

- Task 6 – Quality Assurance/Quality Control (QA/QC) Data Evaluation

The site-specific sampling techniques and analytical methods to be used in implementing the RI are presented in the Quality Assurance Project Plan (QAPP) in *Appendix A*.

Refer to *Figure 3* for proposed boring and sampling locations.

3.3 Health and Safety Protocols and Community Air Monitoring

The investigation activities will be performed in accordance with site-specific Health and Safety Plan (HASP) and Community Air Monitoring Plan (CAMP) in *Appendices B and C*, respectively.

3.4 Citizen Participation Activities

Citizen participation activities will be conducted in accordance with the DEC-approved Citizen Participation Plan (*Appendix D*).

3.5 Task 1 - Geophysical Survey/Utility Clearance

Required UDig NY notifications will be made by TRC's drilling subcontractor at least three days prior to intrusive work, and the locations of underground utility lines in public roads and rights-of-way will be marked out. TRC and its subcontractors will additionally coordinate with HDI to identify subsurface utilities that may interfere with proposed sampling locations.

Prior to intrusive work activities, a geophysical survey will be performed to locate subsurface anomalies and confirm the proposed sampling locations are clear of underground utilities using a complement of surface geophysical methods that may include a magnetometer, electromagnetic conductivity meter, utility locating instruments, and/or ground-penetrating radar. The geophysical survey will include accessible areas in the vicinity of AOC118 to identify potential underground utilities and structures (e.g., underground storage tanks, buried foundations, etc.). The geophysical survey subcontractor, under the supervision by TRC, will survey a 20-foot by 20-foot maximum area around each proposed boring/soil sampling location for the purpose of identifying subsurface utilities prior to drilling. Note that there are limitations with the performance of a geophysical survey, including potential interference due to the presence of subsurface structures. Additionally, as noted above, the geophysical survey will only be performed within accessible areas of the Site and areas flooded or covered with snow or ponded water cannot be scanned. The maximum traceable depth is 8 to 10 feet below ground surface, depending on subsurface soil conditions.

A narrative description of the methods and results of the geophysical survey and the utility locating process will be included in the RI Report. In addition, the RI Report will include a geophysical survey report, which provides a detailed summary of the geophysical activities as well as a site map noting the results of the electromagnetic conductivity survey and the ground penetrating radar intersects.

3.6 Task 2 – Soil Sampling

TRC will advance five soil borings (TRC-SB-01 through TRC-SB-05). In addition, surface soil sampling will be performed at five additional locations (TRC-SS-01 through TRC-SS-05). Please refer to *Figure 3* for the proposed soil sampling locations. The soil sampling program will include the following:

- Hand tools will be used to collect surface soil samples from TRC-SS-01 through TRC-SS-05. The ground surface covering and root layer will be removed from the proposed sampling location, and the hand auger will remove soil in 0.5-foot lifts to a depth of 1-foot bgs. One soil sample from each surface soil sampling location will be submitted to the laboratory for the analyses listed below.
- A truck- or track-mounted direct push Geoprobe rig (or similar) will be used to advance borings and collect subsurface soil samples from TRC-SB-01 through TRC-SB-05. The direct push Geoprobe rig will be used to advance 5-foot long 2-inch diameter macrocore samplers lined with acetate sleeves to 20 feet bgs or drive-rod refusal (i.e., bedrock), whichever is encountered first.
- Surface and subsurface soil samples from each boring will be screened throughout the boring with a photoionization detector (PID) and inspected for indications of contamination (e.g., staining, odors, etc.). Geologic descriptions of the soil and field screening results for each soil layer will be recorded in field logs using the Unified Soil Classification System (USCS).
- Soil samples from TRC-SS-01 through TRC-SS-05 will be selected for laboratory analysis based on the following rationale:
    - One soil sample will be selected from 0 to 2 inches bgs.
- Up to three soil samples from TRC-SB-01 through TRC-SB-05 will be selected for laboratory analysis based on the following rationale:
    - One shallow soil sample from 0 to 2 feet bgs will be selected for laboratory analysis.
    - If indications of contamination are not observed, one subsurface soil sample from the 2-foot interval directly above bedrock, the terminal boring depth, or groundwater, whichever is shallowest, will be selected for laboratory analysis.

    - If impacted soils are identified (elevated PID readings or other visual indications, including evidence of fill material, or olfactory indications of contamination), one soil sample will be selected from the most impacted zone (based on field screening) and one soil sample will be selected from the first underlying apparent clean interval. If no apparent underlying clean interval is observed before reaching the terminal boring depth, one subsurface soil sample from the 2-foot interval directly above bedrock, the terminal boring depth, or groundwater will be selected for laboratory analysis.

- Selected discrete soil samples (including surface soil samples) will be analyzed for the following parameters:
    - NYSDEC Commissioner Policy 51 (CP-51) and United States Environmental Protection Agency (USEPA) Target Compound List (TCL)-listed volatile organic compounds (VOCs) by USEPA Method 8260D;
    - CP-51/TCL-listed semivolatile organic compounds (SVOCs) (including 1-4-dioxane) by USEPA Method 8270E;
    - TCL pesticides/polychlorinated biphenyls (PCBs) by USEPA Methods 8081B and 8082A;
    - Herbicides by USEPA Method 8151A;
    - Target Analyte List (TAL) metals by USEPA Methods 6020B and 7470A; and,
    - Per- and polyfluoroalkyl substances (PFAS) (NYSDEC Analyte List of 40 PFAS Compounds) by USEPA Method 1633.

- Duplicate samples will be collected at a frequency of 1 per 20 soil samples and analyzed for the parameters listed above.

- Soil samples will be containerized in laboratory prepared jars, labeled, sealed, and placed in a chilled cooler for shipment to a New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP)-certified laboratory for analysis, and results will be requested from the laboratory on a 10-day turnaround time (TAT). NYSDEC Analytical Services Protocol (ASP) Category B deliverable packages will be provided. In addition, as required by NYSDEC for sites in remedial programs, data will be provided by the laboratory in NYSDEC EQuIS electronic data deliverables (EDDs) for upload to NYSDEC's database.

- Upon completion of probing/drilling, at boring locations not proposed for well installation, drill cuttings free of evidence of contamination will be returned to the borehole, followed by clean sand and/or a cement/bentonite grout mixture. The ground surface will be restored by replacing the landscaped ground surface covering.

3.7 Task 3 – Monitoring Well Installation and Development and Groundwater Sampling

The work under this task includes the installation, development, and sampling of three (3) permanent monitoring wells to assess groundwater conditions at the Site and establish a groundwater flow direction. The wells will be installed based on the results of the soil sampling investigation (i.e., biased toward areas of observed contamination, if present), and located to provide upgradient (TRC-MW-01 and TRC-MW-03) and downgradient (TRC-MW-02) hydraulic coverage. Refer to *Figure 3* for proposed bedrock monitoring well locations.

Monitoring well installation and sampling will include the following:

- Three (3) soil borings (TRC-SB-01, TRC-SB-02, and TRC-SB-03) will be converted to permanent monitoring wells TRC-MW-01, TRC-MW-02, and TRC-MW-03 as described further below.
- The borehole for each groundwater monitoring well will be advanced using air rotary drilling methods to a maximum depth of approximately 10 feet below the observed water table. The borehole for each groundwater monitoring well will be 6-inches.
- Regional data (including groundwater elevation data for the northern portions of IPEC) suggest that groundwater is present at approximately 25 feet bgs. Site-specific bedrock data was not available for review; therefore, it is assumed that bedrock will be encountered approximately 35 feet bgs. It is expected that monitoring wells will be installed to a maximum depth of 40 feet bgs. If appropriate, monitoring well installation will be performed by sealing the overburden with permanent isolation casing and grouting prior to advancing an open bedrock hole to the terminal depth of the boring. The permanent isolation casing will be advancing 5 feet into the bedrock interval.
- After drilling is complete, monitoring well construction will proceed as follows:
    - Casing and screen will be inserted. Each well will be screened from approximately 5 feet above the observed water table to approximately 10 feet below the observed

water table. Each well will be constructed using 2-inch diameter Schedule 40 polyvinyl chloride (PVC) casing and 10-slot (0.010-inch) PVC screen.

- The annular space between each well screen and the borehole wall will be filled with clean silica sand (Morie No. 1 or similar material) to at least 2 feet above the top of the screen.
- A 2-foot-thick layer of bentonite pellets or chips will be installed above the sand pack and hydrated with potable water.
- The remainder for each borehole annulus will be filled with cement or cement-bentonite grout to within 2 feet of grade.
- After the grout has been allowed to settle, each well will be completed with a secure locking plug and stand-pipe outer protective casing.

- Well construction diagrams will be prepared for each well.
- Following installation, the groundwater monitoring wells will be developed using mechanical surging methods until three to five well volumes are removed and the water is reasonably free of turbidity and field parameter readings (temperature, conductivity, oxidation reduction potential [ORP], pH, and dissolved oxygen [DO]) sufficiently stabilize. During well development, TRC will actively monitor and track the volume of water purged and the field parameter readings. Field measurements will be recorded in a field logbook. Fifty nephelometric turbidity units (NTUs) or less will be the turbidity goal, but not an absolute value. The groundwater monitoring wells will be allowed to equilibrate for at least two weeks prior to sampling.
- On the day of groundwater sampling and prior to initiation of sampling activities, a synoptic round of water level measurements will be collected and the three (3) on-Site wells (TRC-MW-01, TRC-MW-02, and TRC-MW-03) will be gauged for non-aqueous phase liquid. The water table elevations will be used to determine Site-specific groundwater flow. Additionally, a headspace reading will be collected, using a PID, from each monitoring well location.
- Although not anticipated, if light non-aqueous phase liquid (LNAPL) or dense non-aqueous phase liquid (DNAPL) is encountered, the thickness of the LNAPL will be measured and recorded, and groundwater from that well will not be analyzed. Rather, a sample of the LNAPL will be collected for fingerprint analysis.

- Prior to sampling, groundwater from each well (TRC-MW-01, TRC-MW-02, and TRC-MW-03) will be purged using a submersible pump until field parameters have stabilized in accordance with USEPA Low-Stress (Low-Flow) sampling procedures. A turbidity level of 50 NTUs or less is the well purging goal. Other field parameters including temperature, conductivity, ORP, pH, and DO will also be monitored and, prior to sampling, field parameters should stabilize (i.e., conductivity should be within ±3%, ORP ±10 mV, pH ±0.1 and ±10% for turbidity and DO) for three consecutive readings, three to five minutes apart. Ideally, pumping rates will be maintained between 100 and 500 milliliters per minute (ml/min) so that minimal drawdown of the groundwater level occurs (i.e., pumping rate is less than recharge rate). During purging, TRC will actively monitor and track the volume of water purged and the field parameter readings. Field measurements will be recorded in a field logbook. Once groundwater conditions have stabilized and groundwater levels have recovered, the samples will be collected. For wells with low yield, alternative sample collection means per USEPA Low-Stress (Low-Flow) sampling procedures will be employed.
- Groundwater samples will be analyzed for the following:
  - TCL/CP-51 listed VOCs by USEPA Method 8260;
  - TCL/CP-51 listed SVOCs by USEPA Method 8270;
  - 1,4-Dioxane by Modified USEPA Method 8270 Select Ion Monitoring (SIM) with isotope dilution;
  - Pesticides/PCBs by USEPA Method 8081/8082;
  - Herbicides by USEPA Method 8151;
  - Field filtered and unfiltered TAL metals by USEPA Method 6010 and 7471; and,
  - PFAS (NYSDEC Analyte List of 40 Compounds) by USEPA Method 1633.
- Groundwater samples will be containerized in laboratory supplied jars, labeled, sealed, and placed in a chilled cooler for shipment to the laboratory. Groundwater samples will be analyzed by an ELAP-certified laboratory approved by the NYSDOH and NYSDEC ASP Category B deliverable packages will be provided.
- One duplicate and one equipment blank will be collected per 20 samples. Additionally, each cooler containing groundwater samples for VOC analysis will also be accompanied by a trip blank sample for TCL/CP-51 VOCs analysis only.

- Drill cuttings generated by well installation activities and purged groundwater will be containerized in New York State Department of Transportation (NYSDOT)-approved 55-gallon drums for off-Site disposal.

3.8 Task 4 – Sample Location Survey

Boring and sample locations will be documented in the field utilizing a handheld GPS unit in the North American Datum 1983 (NAD83)/New York State Plane Coordinate System, East Zone US Foot (NY83-EF) coordinate system. The GPS accuracy will be field verified against measurements to known fixed points.

Following sampling, pin flags and spray-paint will be used to field mark sampling locations. The location and elevation of soil sampling locations and the top of the PVC casing (cap off) and ground surface adjacent of each monitoring well will be surveyed by a New York State-licensed Land Surveyor. Horizontal coordinates will be measured in NAD83 coordinate system and elevations will be measured relative to the North American Vertical Datum 1988 to an accuracy of 0.01 feet vertically and 0.1 feet horizontally.

3.9 Task 5 – Management of Investigation Derived Waste

In accordance with NYSDEC DER guidance document (DER-10 Section 3.3[e][1]), investigation-derived wastes (IDW) will be minimized by returning excess soil from soil borings to its original location except where prohibited (e.g., soil is grossly contaminated, free product is present, boring has penetrated an aquitard, etc.). Additionally, disposable personal protective equipment (PPE) and sampling equipment (scoops, gloves, etc.) will be placed in heavy-duty plastic bags and disposed of properly.

As noted in Section 3.5, drill cuttings generated by well installation activities and purged groundwater will be containerized in NYSDOT-approved 55-gallon drums for off-site disposal. In addition, purged groundwater generated during well development and sampling will be containerized in NYSDOT-approved 55-gallon drums for off-site disposal.

In support of disposal of IDW, one composite sample of each soil and liquid IDW will be submitted to the laboratory for analysis for typical waste characterization parameters (i.e., VOCs, SVOCs, pesticides, PCBs, metals [including hexavalent chromium], cyanide, Resource Conservation and Recovery Act [RCRA] characteristics [reactivity, corrosivity, ignitability], total petroleum hydrocarbons, and paint filter). In addition, if the results of analysis of soil for any single analyte is greater than 20 times the USEPA toxicity level, that sample will also be analyzed by the lab for that analyte by the toxicity characteristic leaching procedure (TCLP).

Waste characterization analytical results will be provided to the waste disposal subcontractor for facility approval in advance of removal of drums. Upon receipt of approval of a facility and in coordination with HDI, drums will be removed from the site in a single mobilization and brought to the permitted facility for disposal.

3.10 Task 6 – Quality Assurance /Quality Control (QA/QC)

A QA/QC program for the RI will be instituted to verify that the project analytical data objectives were met. The QA/QC program will be implemented consistent with the QAPP, which specifies the data quality objectives (DQOs) for each analytical parameter for the entire investigation. During the program, the collection of QC samples will be monitored to verify that the field QC samples are collected at the proper frequency. Finally, the QA/QC program will include data validation for analytical data generated during this RI, as specified in the QAPP (refer to *Appendix A).* The results of the data validation will be summarized in Data Usability Summary Reports (DUSRs) prepared in accordance with DER-10 Appendix 2B: Guidance for Data Deliverables and the Development of Data Usability Summary Reports.

4.0 PROJECT PERSONNEL

Key project personnel and contact information are identified in the table below. Resumes of key TRC project personnel are in *Appendix E.*

Key Personnel and Contact Information

Name	Role	Phone Number
Richard Wetherbee, PG, PMP	TRC National Director of RE POWER®	
Jenna Raup, TRC	TRC Project Manager	cellular: (929) 502-6469
Kirsten Myers, PE, TRC	TRC Remedial Engineer	(212) 221 - 7822
Emily Ebert, CHMM, TRC	TRC Office Safety Coordinator TRC Project Manager	(347) 618 - 6526 cellular: (908) 451-0203
Elizabeth Denly, ASQ CMQ/OE, TRC	TRC Quality Assurance Officer	(978) 970-5600
Kristin Maddalo	HDI Project Manager	(914) 254-7248
Carlos Garcia	HDI Chemistry/Environmental Supervisor	(914) 254-8336 cellular: (646) 355-8972
Aquifer Drilling and Testing, a Cascade Company	Drilling Services	(516) 616-6026
Eurofins TestAmerica	Laboratory Services	732-549-3900
Susan M. Anacker, Professional Land Surveyor, PLLC	Land Surveying Services	(718) 474-7700
Advanced Geological Services	Geophysical Survey	(888) 454-5923
AARCO Environmental	Waste Disposal	(631) 586-5900
Environmental Data Services	Data Validation	(561) 475-2000

5.0 REPORTING

A comprehensive RI Report will be prepared after receipt of surveying and laboratory data. The RI Report will conform to the guidelines set forth in NYSDEC DER-10 Sections 3.14 (Remedial Investigation Report) to the extent consistent with the scope of the investigation described above and to the extent necessary and applicable. The RI Report will include the following:

- Summaries of historic data and the results of prior investigations;
- A description of the scope of the Remedial Investigation;
- Descriptions of investigation methods;
- Scaled Site plan showing sampling locations;
- Field sample screening data and documentation (logs, chain-of-custody forms, etc.);
- Results of analyses of samples, including laboratory data packages, and a discussion of the findings;
- Data Usability Summary Reports;
- Map summarizing the results of the sampling, showing locations of and highlighting exceedances of relevant regulatory standards, criteria, and guidance;
- Groundwater surface elevation contour map showing apparent gradients and inferred predominant local groundwater flow directions;
- Geologic cross sections;
- A Fish and Wildlife Analysis;
- Qualitative Human Health Exposure Assessment and Conceptual Site Model; and,
- An analysis and discussion with a supporting drawing showing the estimated overall extent of contamination, if appropriate.

6.0 SCHEDULE

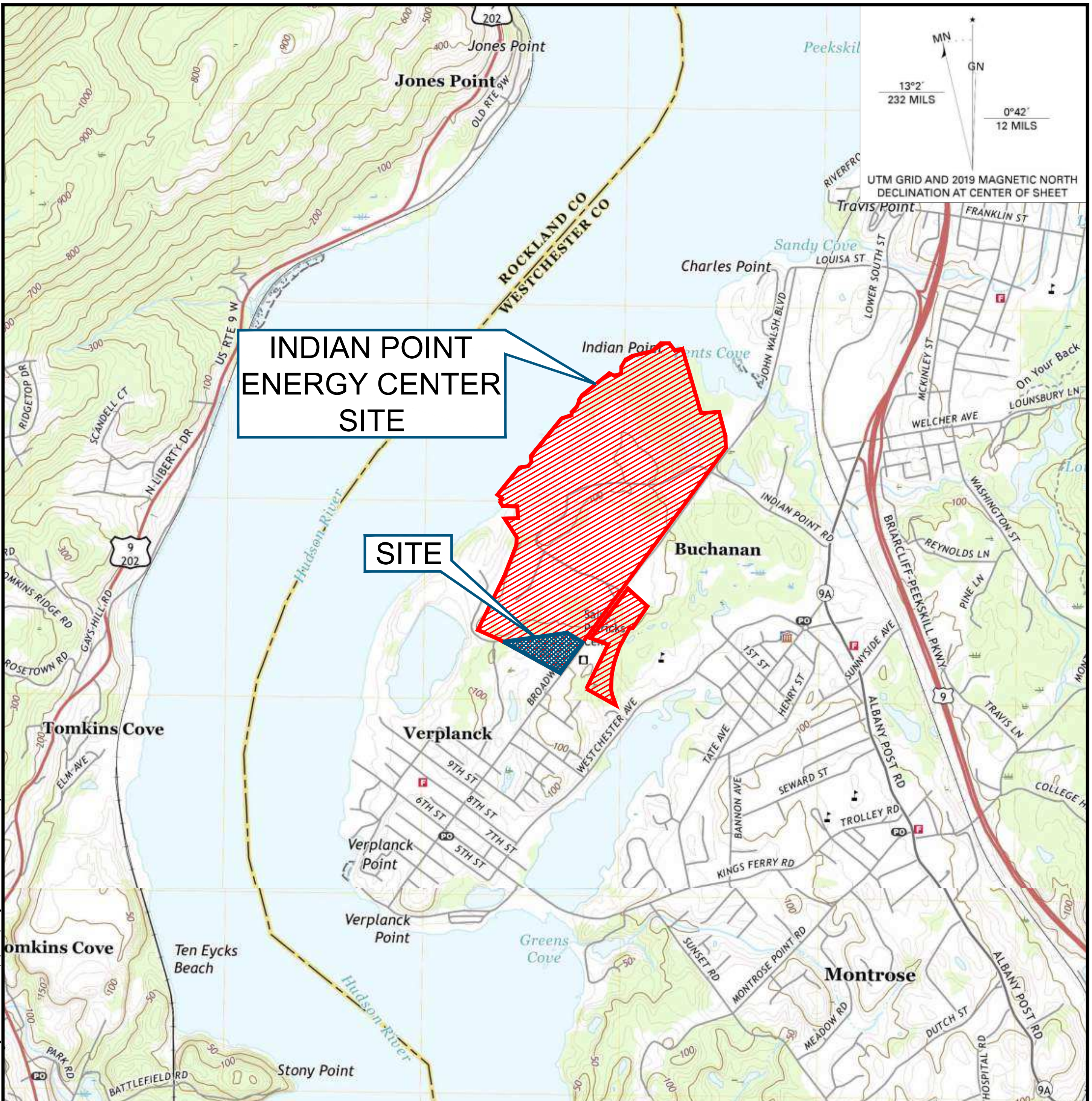
It is anticipated that the RI Work Plan will be implemented following receipt of NYSDEC approval of the RI Work Plan. Presented below are estimated completion dates for key milestones associated with implementation of the Remedial Investigation.

KEY MILESTONE	ESTIMATED TIME TO COMPLETION IN CALENDAR DAYS FROM RECEIPT OF NYSDEC APPROVAL OF RIWP
NYSDEC Approval of RI Work Plan	0
Begin Remedial Investigation Field Activities	14
Complete Remedial Investigation (including laboratory analyses)	45
Submit Draft Remedial Investigation Report to NYSDEC	105

7.0 REFERENCES

1. 6 NYCRR 375: New York State Department of Environmental Conservation Rules and Regulations, Remedial Program Requirements.
2. 6 NYCRR 703, Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations.
3. Buxton, Soren, Posner, and Shernoff, 1981, “Geologic Map of New York State.”
4. Indian Point Energy Center Remedial Investigation Scoping Work Plan, TRC Engineers, June, 2022.
5. New York State Department of Environmental Conservation (NYSDEC) Division of Environmental Remediation (DER)-10, Technical Guidance for Site Investigation and Remediation, May 2010.

FIGURES



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KILOMETERS 1 0.5 0 1 2

METERS 1000 500 0 1000 2000

MILES 1 0.5 0 1

FEET 1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000

NEW YORK

QUADRANGLE LOCATION

MAP INCLUDES INFORMATION FROM THE FOLLOWING MAP SHEET(S): TP, PEEKSKILL, NY, 7.5 MINUTE DATED 2019, S, HAVERSTRAW, NY, 7.5 MINUTE DATED 2019.

MAP OBTAINED THROUGH USE OF TOPOVIEW WITH THE INTERFACE CREATED BY THE NATIONAL GEOLOGIC MAP DATABASE PROJECT (NGMDB), IN SUPPORT OF THE TOPOGRAPHIC MAPPING PROGRAM, MANAGED BY THE USGS NATIONAL GEOSPATIAL PROGRAM (NGP).

TRC
1430 Broadway, 10th Floor
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PROJECT: HOLTEC DECOMMISSIONING INTERNATIONAL, LLC
INDIAN POINT ENERGY CENTER
AREA OF CONCERN 118: LAFARGE EASEMENT / FORMER SPECTRA CONSTRUCTION STORAGE AREA
BUCHANAN, NEW YORK

TITLE:

SITE LOCATION MAP

DRAWN BY:	H. DELGADO
CHECKED BY:	K. MEAZELL
APPROVED BY:	J. RAUP
DATE:	JANUARY 2023
PROJ. NO.:	504007
FILE:	Fig 1 - Site Loc. Map (IPEC).dwg

FIGURE 1

8.5x11 — ATTACHED XREFS: — ATTACHED IMAGES: NY_Haverstraw_20190927_TM; NY_Peekskill_20190926_TM; DRAWING NAME: \\nyc-fp1\Shared\Projects\504007 - IPEC Lafarge RI\Figures\TRC WD\ Fig 1 - Site Loc. Map (IPEC).dwg — PLOT DATE: January 10, 2023 - 5:09PM — LAYOUT: 8.5x11P

LEGEND (SYMBOLS NOT TO SCALE):

- SITE BOUNDARY
- INDIAN POINT ENERGY CENTER BOUNDARY
- PARCEL BOUNDARY
- MUNICIPAL TOWN LINE
- BUCHANAN — MUNICIPALITY
- APPROXIMATE LOCATION OF GAS LINE

N

NOTES:

1. LOCATIONS AND DIMENSIONS OF PHYSICAL FEATURES AND BOUNDARIES ARE APPROXIMATE.
2. BASEMAP IMAGERY SOURCED FROM GOOGLE EARTH PRO DATED OCTOBER 13, 2020.

0 800' 1,600'

SCALE: 1" = 800'
SHEET SIZE: 11" X 17"

ASSUMED GROUNDWATER FLOW DIRECTION

PROJECT: HOLTEC DECOMMISSIONING INTERNATIONAL, LLC
INDIAN POINT ENERGY CENTER
AREA OF CONCERN 118: LAFARGE EASEMENT / FORMER SPECTRA CONSTRUCTION STORAGE AREA
BUCHANAN, NEW YORK

TITLE:

SITE PLAN

DRAWN BY:	H. DELGADO	PROJ NO.:	504007
CHECKED BY:	K. MEAZELL	FIGURE 2	
APPROVED BY:	J. RAUP		
DATE:	JANUARY 2023		

TRC

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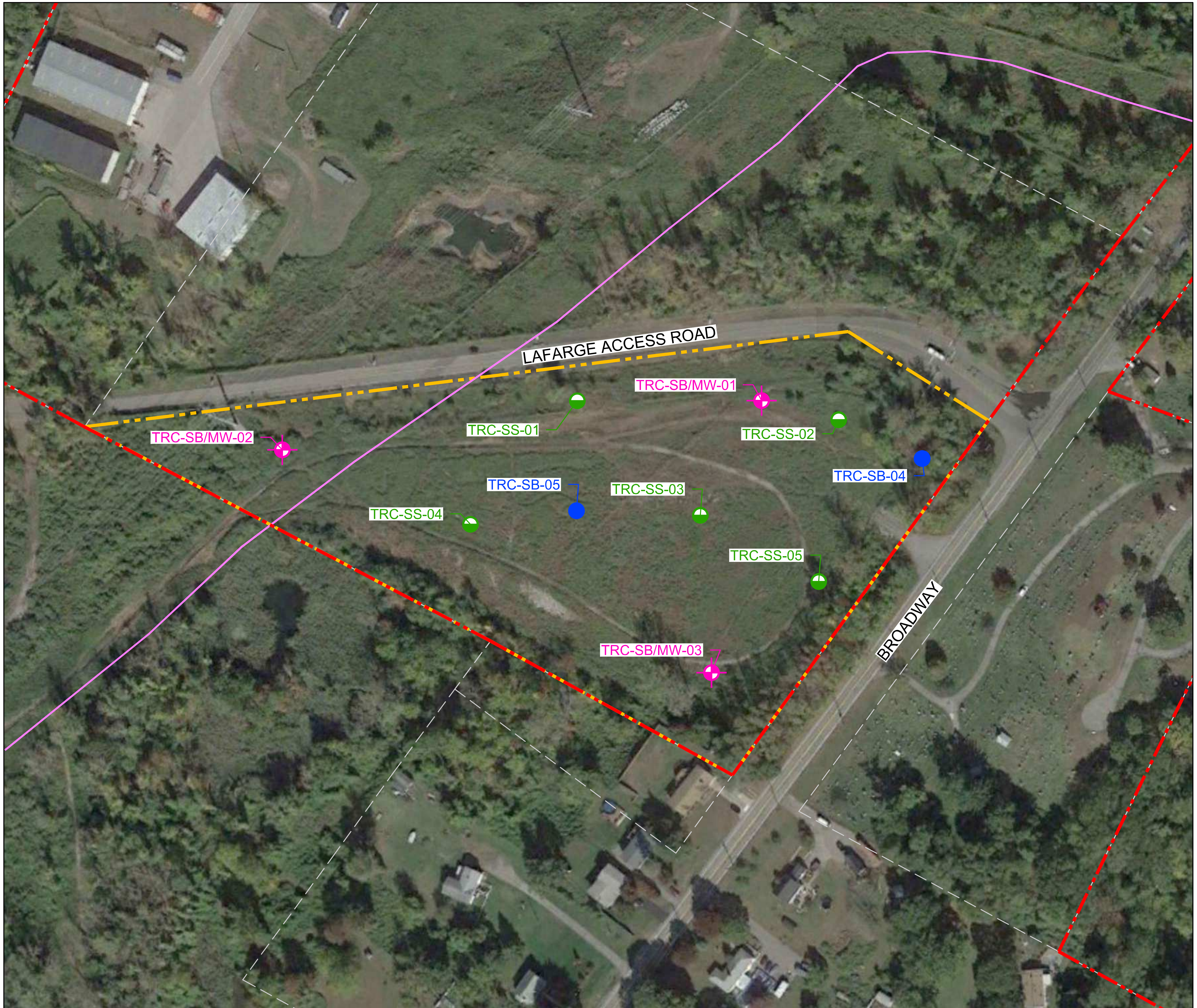
FILE NO.: Fig 2 - Site Plan (IPEC).dwg

11x17 -- ATTACHED XREFS: -- ATTACHED IMAGES: GEPro Aerial 04.29.2022-2005ft (IPEC); GEPro Aerial 04.29.2022-2695ft (IPEC); GEPro Aerial 04.29.2022-610ft (IPEC); IndianPoint; Site Plan Markup;
DRAWING NAME: \\nyc-fp1\Shared\Projects\504007 - IPEC Lafarge RI\Figures\TRC WD\ Fig 2 - Site Plan (IPEC).dwg --- PLOT DATE: January 10, 2023 - 5:03PM --- LAYOUT: 11X17L



LEGEND (SYMBOLS NOT TO SCALE):

- SITE BOUNDARY
- INDIAN POINT ENERGY CENTER BOUNDARY
- PARCEL BOUNDARY
- APPROXIMATE LOCATION OF GAS LINE
- TRC-SB/MW-## — PROPOSED SOIL BORING AND PERMANENT MONITORING WELL AND IDENTIFICATION NUMBER
- TRC-SB-## — PROPOSED SOIL BORING AND IDENTIFICATION NUMBER
- TRC-SS-## — PROPOSED SURFACE SOIL SAMPLING AND IDENTIFICATION NUMBER

N

NOTES:

1. LOCATIONS AND DIMENSIONS OF PHYSICAL FEATURES AND BOUNDARIES ARE APPROXIMATE.
2. BASEMAP IMAGERY SOURCED FROM GOOGLE EARTH PRO DATED OCTOBER 13, 2020.
3. PROPOSED LOCATIONS OF MONITORING WELLS ARE SUBJECT TO CHANGE BASED ON RESULTS OF THE SOIL SAMPLING.

0 150' 300'

SCALE: 1" = 150'
SHEET SIZE: 11" X 17"

ASSUMED GROUNDWATER FLOW DIRECTION

PROJECT: HOLTEC DECOMMISSIONING INTERNATIONAL, LLC
INDIAN POINT ENERGY CENTER
AREA OF CONCERN 118: LAFARGE EASEMENT / FORMER SPECTRA CONSTRUCTION STORAGE AREA
BUCHANAN, NEW YORK

TITLE:

SAMPLE LOCATION PLAN

DRAWN BY:	H. DELGADO	PROJ NO.:	504007
CHECKED BY:	K. MEAZELL	FIGURE 3	
APPROVED BY:	J. RAUP		
DATE:	JANUARY 2023		

TRC

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Phone: 212.221.7822
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FILE NO.: Fig 3 - Sample Loc. Plan (IPEC).dwg

DRAWING NAME: \\nyc-fp1\Shared\Projects\504007 - IPEC Lafarge RI\Figures\TRC WD\ Fig 3 - Sample Loc. Plan (IPEC).dwg — PLOT DATE: January 10, 2023 - 5:19PM — LAYOUT: 11X17L

TABLES

TABLE 1
REMEDIAL INVESTIGATIONWORK PLAN
INDIAN POINT ENERGY CENTER
AREA OF CONCERN 118
LAFARGE EASEMENT FORMER SPECTRA CONSTRUCTION STORAGE AREA
PROPOSED SAMPLING PLAN

Sample Location Name	Proposed Soil Sample Depth Interval(s) (bgs)	Number of Soil Samples	Number of Groundwater Samples
TRC-SS-01	0 - 2 inches	1	
TRC-SS-02	0 - 2 inches	1	
TRC-SS-03	0 - 2 inches	1	
TRC-SS-04	0 - 2 inches	1	
TRC-SS-05	0 - 2 inches	1	
TRC-SB/MW-01	0-2.0 feet, 18.0-20.0 feet[a]	2[b]	1
TRC-SB/MW-02	0-2.0 feet, 18.0-20.0 feet[a]	2[b]	1
TRC-SB/MW-03	0-2.0 feet, 18.0-20.0 feet[a]	2[b]	1
TRC-SB-04	0-2.0 feet, 18.0-20.0 feet[a]	2[b]	
TRC-SB-05	0-2.0 feet, 18.0-20.0 feet[a]	2[b]	

Notes:
bgs - Below ground surface
[a] - Sample will be collected from the 2-foot interval directly above the observed groundwater table or the terminal boring depth.
[b] - This sampling plan presents proposed sampling depths based on no observed evidence of contamination. Additional, third sample will be collected from impacted soil layer, if identified.

APPENDIX A

Quality Assurance Project Plan

QUALITY ASSURANCE PROJECT PLAN

This Quality Assurance Project Plan (QAPP) presents the organization, objectives, planned activities, and specific quality assurance/quality control (QA/QC) procedures associated with the field activities described in the scope of work. The QAPP also describes specific protocols for field sampling, sample handling and storage, and laboratory analysis. The data generated from the analysis of samples will be used to characterize soil and groundwater at the Site; confirm groundwater flow direction at the Site; and, develop remedial action decisions.

Project Organization and Responsibility

A qualified person will coordinate and manage the sampling and analysis program, data reduction, QA/QC, data validation, analysis, and reporting. TRC will direct the sampling activities and coordinate laboratory and remedial investigation activities. Data validation will be performed by Environmental Data Services, Inc. (EDS) of Palm Beach Gardens, FL. Specifically, the third-party data validator will be Nancy Weaver of EDS. The TRC Project Quality Assurance (QA) Officer will be Elizabeth Denly, ASQ CMQ/OE, and will report directly to the Project Manager, Jenna Raup.

A qualified person will ensure that the QAPP is implemented and will oversee data validation. A qualified person will provide oversight and technical support for the sampling and analytical procedures followed in this project. This individual has the broad authority to approve or disapprove project plans, specific analyses, and final reports. The Project QA Officer is independent from the data generation activities. In general, the QA officer will be responsible for reviewing and advising on all QA/QC aspects of this program.

Laboratories used will be New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP)-certified laboratories. The laboratories will communicate directly with the Project Manager regarding the analytical results and reporting and will be responsible for providing all labels, sample containers, trip blanks, temperature blanks, shipping coolers, and laboratory documentation.

QA Objectives for Data Management

New York State Analytical Services Protocol (ASP) Category B laboratory packages will be provided by the laboratory.

All analytical measurements will be made so that the results are representative of the media sampled and the conditions measured. Data will be reported in consistent dry weight units for solid samples (i.e., µg/kg and/or mg/kg). Tables 1A-1B present the proposed samples, sampling and analytical parameters, analytical methods, sample preservation requirements, containers, and QA/QC samples.

Quantitation Limits (QLs) are laboratory-specific and reflect those values achievable by the laboratory performing the analyses.

Data Quality Levels (DQLs) are those reporting limits required to meet the objectives of the program (i.e., program action levels, cleanup standards, etc.).

Data Quality Objectives (DQOs) define the quality of data and documentation required to support decisions made in the various phases of the data collection activities. The DQOs are dependent on the end uses of the data to be collected and are also expressed in terms of objectives for precision, accuracy, representativeness, completeness, and comparability.

The analytical methods to be used at this site provide the highest level of data quality and can be used for purposes of risk assessment, evaluation of remedial alternatives and verification that cleanup standards have been met. However, in order to ensure that the analytical methodologies are capable of achieving the DQOs, measurement performance criteria have been set for the analytical measurements in terms of accuracy and precision.

The overall QA objective is to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis, and reporting which will provide results that are scientifically valid, and the levels of which are sufficient to meet DQOs.

For quantitation limits for parameters associated with soil samples, the laboratory will be required to attempt to meet or surpass the parameter-specific limits listed in 6 NYCRR Part 375 Unrestricted Use Criteria and Commissioner Policy 51 Tables 2 and 3 (CP-51).

For quantitation limits for parameters associated with groundwater samples, the laboratory will be required to attempt to meet or surpass the parameter-specific limits for groundwater from the NYSDEC Division of Water Technical and Operational Guidance Series (1.1.1) Ambient Water Quality Standards and Guidance Values.

For quantitation limits for parameters associated with PFAS, including PFOS and PFOA, the laboratory will be required to attempt to meet or surpass the parameter-specific limits listed in Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs, dated November 2022.

The QA objectives are defined as follows:

- ***Accuracy*** is the closeness of agreement between an observed value and an accepted reference value. The difference between the observed value and the reference value includes components of both systematic error (bias) and random error.

  Accuracy in the field is assessed through the adherence to all field instrument calibration procedures, sample handling, preservation, and holding time requirements, and through the collection of equipment blanks prior to the collection of samples for each type of equipment being.

  The laboratory will assess the overall accuracy of their instruments and analytical methods (independent of sample or matrix effects) through the measurement of "standards," materials of accepted reference value. Accuracy will vary from analysis to analysis because of individual sample and matrix effects. In an individual analysis, accuracy will be measured in terms of blank results, the percent recovery (%R) of surrogate compounds in organic analyses and/or laboratory control samples (LCSs). This gives an indication of expected recovery for analytes tending to behave chemically like the spiked or surrogate compounds. Tables 2A, 2B, and 2B-I summarize the laboratory accuracy requirements.

- ***Precision*** is the agreement among a set of replicate measurements without consideration of the "true" or accurate value: i.e., variability between measurements of the same material for the same analyte. Precision is measured in a variety of ways including statistically, such as calculating variance or standard deviation.

Precision in the field is assessed through the collection and measurement of field duplicates (one extra sample in addition to the original field sample). Field duplicates will be collected at a frequency of one per twenty investigative samples per matrix per analytical parameter. Precision will be measured through the calculation of relative percent differences (RPDs). The resulting information will be used to assess sampling and analytical variability. These criteria apply only if the sample and/or duplicate results are >5x the quantitation limit; if both results are < 5x the quantitation limit, the criterion will be doubled.

Precision in the laboratory is assessed through the calculation of RPD for duplicate samples. For organic soil and groundwater analyses, laboratory precision will be assessed through the analysis of field duplicates.

- ***Completeness*** is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. "Normal conditions" are defined as the conditions expected if the sampling plan was implemented as planned.

  Field completeness is a measure of the amount of (1) valid measurements obtained from all the measurements taken in the project and (2) valid samples collected. The field completeness objective is greater than 90 percent.

  Laboratory completeness is a measure of the quantity of valid measurements obtained from all valid samples submitted to the laboratory. The laboratory completeness objective is greater than 95 percent.

- ***Representativeness*** is a qualitative parameter that expresses the degree to which data accurately and precisely represents either a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition within a defined spatial and/or temporal boundary. To ensure representativeness, the sampling locations have been selected to provide coverage over a wide area and to highlight potential trends in the data. In addition, field duplicate samples will provide an additional measure of representativeness at a given location.

  Representativeness is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the RI Work Plan (Work Plan) is followed and that proper sampling, sample handling, and sample preservation techniques are used.

  Representativeness in the laboratory is ensured by using the proper analytical procedures, appropriate methods, and meeting sample holding times.

- ***Comparability*** expresses the confidence with which one data set can be compared to another. Comparability is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the Work Plan is followed and that proper sampling techniques are used.

  Comparability is dependent on the use of recognized United Stated Environmental Protection Agency (USEPA) or equivalent analytical methods and the reporting of data in standardized units.

Table 1A
Analytical Parameters, Methods, Preservation, Holding Time, and Container Requirements for Soil Samples

Sample Matrix	Analytical Parameter	Sample Type[1]	No. of Samples[2]	No. of QA/QC Samples	EPA Analytical Method	Sample Preservation	Holding Time[3]	Sample Container
Soil	TCL and CP-51 VOCs	Grab	20	Duplicate: 1/20 Equipment Blank: 1 per day	8260D	Sealed in TerraCore; Cool to 4º C	Terracores: Frozen within 48 hours of collection	1 vial MeOH/2 Vial water
Soil	TCL and CP-51 SVOCs (includes 1,4-dioxane[4])	Grab	20	Duplicate: 1/20 Equipment Blank: 1 per day	8270E	Cool to 4º C	14 days	Glass 4 oz unpreserved
Soil	TAL Metals	Grab	20	Duplicate: 1/20 Equipment Blank: 1 per day	6020B	Cool to 4º C	Other metals: 180 days	Glass 4 oz unpreserved
Soil	Mercury	Grab	20	Duplicate: 1/20 Equipment Blank: 1 per day	7471B	Cool to 4º C	Mercury: 28 days to analysis	Glass 4 oz unpreserved
Soil	TCL Pesticides	Grab	20	Duplicate: 1/20 Equipment Blank: 1 per day	8081B	Cool to 4º C	14 days	Glass 4 oz unpreserved
Soil	TCL Herbicides	Grab	20	Duplicate: 1/20 Equipment Blank: 1 per day	8151A	Cool to 4º C	14 days	Glass 4 oz unpreserved

Table 1A
Analytical Parameters, Methods, Preservation, Holding Time, and Container Requirements for Soil Samples

Sample Matrix	Analytical Parameter	Sample Type[1]	No. of Samples[2]	No. of QA/QC Samples	EPA Analytical Method	Sample Preservation	Holding Time[3]	Sample Container
Soil	PCBs	Grab	20	Duplicate: 1/20 Equipment Blank: 1 per day	8082A	Cool to 4° C	365 days	Glass 4 oz unpreserved
Soil	PFAS[5]	Grab	20	Duplicate: 1/20 Equipment Blank: 1 per day	1633 Draft	Cool to 4° C	90 days	HDPE Plastic 4 oz unpreserved

TCL – Target Compound List
CP-51 – Soil Cleanup Guidance Policy
VOCs – Volatile organic compounds
SVOCs – Semi volatile organic compounds
TAL – Target Analyte List
PCBs – Polychlorinated biphenyls
PFAS – Per and polyfluoroalkyl substances
HDPE – High density polyethylene

[1] A six-inch sampling interval is the targeted sample size; however, sample volume recovery, analytical method requirements, and field conditions can affect the actual sample interval size. For these reasons, the actual sampling interval may be increased to obtain adequate volume.
[2] Actual number of samples may vary depending on field conditions, sample material availability, and field observations.
[3] From date and time of sample collection
[4] The reporting limit for 1,4-dioxane is 0.1 mg/kg.
[5] Select list of 40 PFAS for analysis includes Perfluoroheptanoic acid (PFHpA), Perfluorooctanoic acid (PFOA), Perfluorononanoic acid (PFNA), Perfluorobutanesulfonic acid (PFBS), Perfluorohexanesulfonic acid (PFHxS), Perfluorooctanesulfonic acid (PFOS), perfluoroheptanesulfonic acid (PFHpS), perfluorodecanesulfonic acid (PFDS), Perfluorobutanoic acid (PFBA), Perfluoropentanoic acid (PFPeA), Perfluorohexanoic acid (PFHxA), Perfluorodecanoic acid (PFDA), Perfluoroundecanoic acid (PFUA/PFUdA), Perfluorododecanoic acid (PFDoA), Perfluorotridecanoic acid (PFTriA/PFTrDa), Perfluorotetradecanoic acid (PFTA/PFTeDA), 6:2 Fluorotelomer sulfonate (6:2 FTS), 8:2 Fluorotelomer sulfonate (8:2 FTS), Perfluroroctanesulfonamide (FOSA), N-methyl perfluorooctanesulfonamidoacetic acid (N-MeFOSAA), N-ethyl perfluorooctanesulfonamidoacetic acid (N-EtFOSAA), Perfluoropentanesulfonic acid (PFPeS), Perfluorononanesulfonic acid (PFNS), Perfluorododecanesulfonic acid (PFDoS), 4:2 FTS, NEtFOSA, NMeFOSE, NEtFOSE, 9Cl-PF3ONS, HFPO-DA (GenX), 11Cl-PF3OUdS, ADONA, 3:3 FTCA, 5:3 FTCA, 7:3 FTCA, NFDHA, PFMBA, PFMPA, PFEESA

Table 1B
Analytical Parameters, Methods, Preservation, Holding Time, and Container Requirements for Groundwater Samples

Sample Matrix	Analytical Parameter	Sample Type	No. of Samples[1]	No. of QA/QC Samples	EPA Analytical Method	Sample Preservation	Holding Time[2]	Sample Container
Groundwater	TCL and CP-51 VOCs	Grab	3	Trip Blank[3]: as necessary (one per day, per cooler containing VOC groundwater samples) Duplicate: 1/20 Equipment Blank: 1 per day	8260D	pH<2 with HCl; cool to 4°C; no headspace	14 days to analysis	3 40-mL glass vials
Groundwater	TCL and CP-51 SVOCs	Grab	3	Duplicate: 1/20 Equipment Blank: 1 per day	8270E	Cool, 4°C	7 days	2 250-ml amber glass jar
Groundwater	TAL Metals (unfiltered)	Grab	3	Duplicate: 1/20 Equipment Blank: 1 per day	6020B	pH < 2 w/ HNO_3; Cool, 4°C	Other Metals: 180 days to analysis	250 mL polyethylene bottle
Groundwater	TAL Metals (field filtered)	Grab	3	Duplicate: 1/20 Equipment Blank: 1 per day	6020B	pH < 2 w/ HNO_3; Cool, 4°C	Other Metals: 180 days to analysis	250 mL polyethylene bottle
Groundwater	Mercury (unfiltered)	Grab	3	Duplicate: 1/20 Equipment Blank: 1 per day	7470A	pH < 2 w/ HNO_3; Cool, 4°C	Mercury: 28 days to analysis	250 mL polyethylene bottle
Groundwater	Mercury (field filtered)	Grab	3	Duplicate: 1/20 Equipment Blank: 1 per day	7470A	pH < 2 w/ HNO_3; Cool, 4°C	Mercury: 28 days to analysis	250 mL polyethylene bottle
Groundwater	TCL Pesticides	Grab	3	Duplicate: 1/20 Equipment Blank: 1 per day	8081B	Cool to 4° C	7 days	2 x 250-ml amber glass jar
Groundwater	TCL Herbicides	Grab	3	Duplicate: 1/20 Equipment Blank: 1 per day	8151A	Cool to 4° C	7 days	2 x 250-ml amber glass jar

Table 1B
Analytical Parameters, Methods, Preservation, Holding Time, and Container Requirements for Groundwater Samples

Sample Matrix	Analytical Parameter	Sample Type	No. of Samples[1]	No. of QA/QC Samples	EPA Analytical Method	Sample Preservation	Holding Time[2]	Sample Container
Groundwater	PCBs	Grab	3	Duplicate: 1/20 Equipment Blank: 1 per day	8082A	Cool to 4° C	365 days	2 x 250-ml amber glass jar
Groundwater	1,4-Dioxane[4]	Grab	3	Duplicate: 1/20 Equipment Blank: 1 per day	8270E SIM	Cool to 4ºC	7 days	2 x 250-ml amber glass jar
Groundwater	PFAS[5]	Grab	3	Duplicate: 1/20 Equipment Blank: 1 per day	1633 Draft	Cool to 4 ± 2 ºC	28 days	2 x 500 mL HDPE Bottles 1 x 250 mL HDPE (for TSS determination)

TCL – Target Compound List
CP-51 – Soil Cleanup Guidance Policy
VOCs – Volatile organic compounds
SVOCs – Semi volatile organic compounds
TAL – Target Analyte List
TSS – Total suspended solids
PCBs – Polychlorinated biphenyls
PFAS – Per and polyfluoroalkyl substances
HDPE – High density polyethylene

[1] Actual number of samples may vary depending on field conditions, sample material availability, and field observations.
[2] From date and time of sample collection
[3] Trip blank bottleware – 3 40-mL HCl-preserved glass vials
[4] The method detection limit for 1,4-dioxane is 0.0720 ug/L and the reporting limit is 0.20 ug/L.
[5] Select list of 40 PFAS for analysis includes Perfluoroheptanoic acid (PFHpA), Perfluorooctanoic acid (PFOA), Perfluorononanoic acid (PFNA), Perfluorobutanesulfonic acid (PFBS), Perfluorohexanesulfonic acid (PFHxS), Perfluorooctanesulfonic acid (PFOS), perfluoroheptanesulfonic acid (PFHpS), perfluorodecanesulfonic acid (PFDS), Perfluorobutanoic acid (PFBA), Perfluoropentanoic acid (PFPeA), Perfluorohexanoic acid (PFHxA), Perfluorodecanoic acid (PFDA), Perfluoroundecanoic acid (PFUA/PFUdA), Perfluorododecanoic acid (PFDoA), Perfluorotridecanoic acid (PFTriA/PFTrDa), Perfluorotetradecanoic acid (PFTA/PFTeDA), 6:2 Fluorotelomer sulfonate (6:2 FTS), 8:2 Fluorotelomer sulfonate (8:2 FTS), Perfluroroctanesulfonamide (FOSA), N-methyl perfluorooctanesulfonamidoacetic acid (N-MeFOSAA), N-ethyl perfluorooctanesulfonamidoacetic acid (N-EtFOSAA), Perfluoropentanesulfonic acid (PFPeS), Perfluorononanesulfonic acid (PFNS), Perfluorododecanesulfonic acid (PFDoS), 4:2 FTS, NEtFOSA, NMeFOSE, NEtFOSE, 9Cl-PF3ONS, HFPO-DA (GenX), 11Cl-PF3OUdS, ADONA, 3:3 FTCA, 5:3 FTCA, 7:3 FTCA, NFDHA, PFMBA, PFMPA, PFEESA

Table 2A
Laboratory Data Quality Objectives: Precision and Accuracy: Soil Samples

Parameter	Method	Matrix	Accuracy Control Limits	Accuracy Frequency Requirements	Precision (RPD) Control Limits	Precision Frequency Requirements
TCL and CP-51 VOCs	8260D	Soil	Surrogates — % Rec. 1,2-Dichloroethane-d4 72-145 4-Bromofluorobenzene 75-139 Toluene-d8 68-150 Dibromfluoromethane 80-120	Surrogates: All samples, standards, QC samples	Field Duplicates RPD ≤30	Field Duplicates: One per 20 soil samples
TCL and CP-51 SVOCs	8270E	Soil	Surrogates — % Rec. 2-Fluorophenol 18-123 Phenol-d6 23-120 2,4,6-Tribromophenol 10-123 Nitrobenzene-d5 16-125 2-Fluorobiphenyl 22-122 Terphenyl-d14 25-126	Surrogates: All samples, standards, QC samples	Field Duplicates RPD ≤50	Field Duplicates: One per 20 soil samples
TAL Metals	6020B	Soil	Matrix Spikes: 75-125% recovery Laboratory Control Samples: 80-120% recovery	Matrix Spikes: One per 20 soil samples per laboratory analytical batch Laboratory Control Samples: One per 20 samples per laboratory analytical batch	Field Duplicates RPD ≤20	Field Duplicates: One per 20 soil samples
Mercury	7471B	Soil	Matrix Spikes: 80-120% recovery Laboratory Control Samples: 80-120% recovery	Matrix Spikes: One per 20 soil samples per laboratory analytical batch Laboratory Control Samples: One per 20 samples per laboratory analytical batch	Field Duplicates RPD ≤20	Field Duplicates: One per 20 soil samples

Table 2A
Laboratory Data Quality Objectives: Precision and Accuracy: Soil Samples

Parameter	Method	Matrix	Accuracy Control Limits	Accuracy Frequency Requirements	Precision (RPD) Control Limits	Precision Frequency Requirements
TCL Pesticides	8081B	Soil	Matrix Spikes: 48-150% recovery Laboratory Control Samples: 48-150% recovery	Matrix Spikes: One per 20 soil samples per laboratory analytical batch Laboratory Control Samples: One per 20 samples per laboratory analytical batch	Field Duplicates RPD ≤20	Field Duplicates: One per 20 soil samples
TCL Herbicides	8151A	Soil	Matrix Spikes: 30-150% recovery Laboratory Control Samples: 10-150% recovery	Matrix Spikes: One per 20 soil samples per laboratory analytical batch Laboratory Control Samples: One per 20 samples per laboratory analytical batch	Field Duplicates RPD ≤20	Field Duplicates: One per 20 soil samples
PCBs	8082A	Soil	Matrix Spikes: 65-150% recovery Laboratory Control Samples: 65-150% recovery	Matrix Spikes: One per 20 soil samples per laboratory analytical batch Laboratory Control Samples: One per 20 samples per laboratory analytical batch	Field Duplicates RPD ≤20	Field Duplicates: One per 20 soil samples
PFAS	1633	Soil	Matrix Spikes: 40-150% recovery Laboratory Control Samples: 40-150% recovery	Matrix Spikes: One per 20 soil samples per laboratory analytical batch Laboratory Control Samples: One per 20 samples per laboratory analytical batch	Field Duplicates RPD ≤20	Field Duplicates: One per 20 soil samples

Table 2B
Laboratory Data Quality Objectives: Precision and Accuracy: Groundwater Samples

Parameter	Method	Matrix	Accuracy Control Limits	Accuracy Frequency Requirements	Precision (RPD) Control Limits	Precision Frequency Requirements
TCL and CP-51 VOCs[1]	8260D	Groundwater	Surrogates — % Rec. 1,2-Dichloroethane-d4 70-128 4-Bromofluorobenzene 76-120 Toluene-d8 80-120 Dibromofluoromethane 77-124	Surrogates: All samples, standards, QC samples	Field Duplicates RPD ≤20	Field Duplicates: One per 20 groundwater samples
TCL and CP-51 SVOCs[2]	8270E	Groundwater	Surrogates — % Rec 2-Fluorophenol 19-80 Phenol-d5 10-56 2,4,6-Tribromophenol 37-150 Nitrobenzene-d5 52-137 2-Fluorobiphenyl 46-139 Terphenyl-d14 22-150	Matrix Spikes: One per 20 samples per laboratory analytical batch	Field Duplicates RPD ≤40	Method Blank/LCS/MS/MSD: 1 per preparation batch of 20 or fewer field samples.
TAL Metals (unfiltered)	6020B	Groundwater	Matrix Spikes 75-125% recovery	Matrix Spikes: One per 20 samples per laboratory analytical batch	Field Duplicates: RPD ≤20	Field Duplicates: One per 20 groundwater samples
TAL Metals (filtered)	6020B	Groundwater	Matrix Spikes 75-125% recovery	Matrix Spikes: One per 20 samples per laboratory analytical batch	Field Duplicates: RPD ≤20	Field Duplicates: One per 20 groundwater samples
Mercury (unfiltered)	7470A	Groundwater	Matrix Spikes: 75-125% recovery	Matrix Spikes: One per 20 samples per laboratory analytical batch	Field Duplicates: RPD ≤20	Field Duplicates: One per 20 groundwater samples

[1] Results of analyses for VOCs will include all TCL VOCs and CP-51-listed VOCs. Included on the TCL and CP-51 list are the 6 NYCRR Part 375-listed VOCs.
[2] Results of analyses for SVOCs will include all TCL SVOCs and CP-51-listed SVOCs. Included on the TCL and CP-51 list are the 6 NYCRR Part 375-listed SVOCs.

Table 2B
Laboratory Data Quality Objectives: Precision and Accuracy: Groundwater Samples

Parameter	Method	Matrix	Accuracy Control Limits	Accuracy Frequency Requirements	Precision (RPD) Control Limits	Precision Frequency Requirements
Mercury (unfiltered)	7470A	Groundwater	Matrix Spikes: 75-125% recovery	Matrix Spikes: One per 20 samples per laboratory analytical batch	Field Duplicates: RPD ≤20	Field Duplicates: One per 20 groundwater samples
TCL Pesticides	8081B	Groundwater	Surrogates — % Rec. Tetrchloro-m-xylene 17-120 DCB Decachlorobiphenyl 15-121	Matrix Spikes: One per 20 samples per laboratory analytical batch	Field Duplicates: RPD ≤20	Field Duplicates: One per 20 groundwater samples
TCL Herbicides	8151A	Groundwater	Surrogates — % Rec. DCAA 10-150	Matrix Spikes: One per 20 samples per laboratory analytical batch	Field Duplicates: RPD ≤20	Field Duplicates: One per 20 groundwater samples
PCBs	8082A	Groundwater	Surrogates — % Rec. Tetrachloro-m-xylene 11-131 DCB Decachlorobiphenyl 12-150	Matrix Spikes: One per 20 samples per laboratory analytical batch	Field Duplicates: RPD ≤20	Field Duplicates: One per 20 groundwater samples
1,4-Dioxane	8270E-SIM	Groundwater	Surrogate — % Rec. 1,4-Dioxane-d8 10-150	Matrix Spikes: One per 20 samples per laboratory analytical batch	Field Duplicates: RPD ≤20	Field Duplicates: One per 20 groundwater samples
PFAS	1633	Groundwater	Extracted Internal Standard (IDA): 40-150 Refer to Table 2B-I below for LCS & MS/MSD.	Extracted Internal Standard (IDA): Every field and QC sample. LCS/MS/MSD: one per extraction batch of no more than 20 samples. LCSD if not enough sample for MS/MSD.	LCS/LCSD or MS/MSD: RPD ≤30	LCS/LCSD or MS/MSD for each batch of no more than 20 field samples.

Table 2B-I
LCS & MS/MSD Accuracy Control Limits for PFAS

Analyte	LCS/MS/MSD % R	Analyte	LCS/MS/MSD % R
Perfluorobutanoic acid (PFBA)	40-150	Perfluorononanoic acid (PFNA)	40-150
Perfluoropentanoic acid (PFPeA)	40-150	Perfluorodecanoic acid (PFDA)	40-150
Perfluorohexanoic acid (PFHxA)	40-150	Perfluoroundecanoic acid (PFUnA)	40-150
Perfluoroheptanoic acid (PFHpA)	40-150	Perfluorododecanoic acid (PFDoA)	40-150
Perfluorooctanoic acid (PFOA)	40-150	Perfluorotridecanoic acid (PFTriA)	40-150
Perfluorotetradecanoic acid (PFTeA)	40-150	Perfluorodecanesulfonic acid (PFDS)	40-150
Perfluorobutanesulfonic acid (PFBS)	40-150	Perfluorooctane sulfonamide (FOSA)	40-150
Perfluorohexanesulfonic acid (PFHxS)	40-150	N-ethylperfluoro-1-octanesulfonamidoacetic acid (EtFOSAA)	40-150
Perfluoroheptanesulfonic acid (PFHpS)	40-150	N-methylperfluoro-1-octanesulfonamidoacetic acid (MeFOSAA)	40-150
Perfluorooctanesulfonic acid (PFOS)	40-150	1H,1H,2H,2H-perfluorooctane sulfonate (6:2 FTS)	40-150
1H,1H,2H,2H-perfluorodecane sulfonate (8:2 FTS)	40-150	HFPO-DA	40-150
Perfluoropentanesulfonic acid (PFPeS)	40-150	11Cl-PF3OUdS	40-150
Perfluorononanesulfonic acid (PFNS)	40-150	ADONA	40-150
Perfluorododecanesulfonic acid (PFDoS)	40-150	3:3 FTCA	40-150
4:2 FTS	40-150	5:3 FTCA	40-150
NEtFOSA	40-150	7:3 FTCA	40-150
NMeFOSA	40-150	NFDHA	40-150
NMeFOSE	440-150	PFMBA	40-150
NEtFOSE	40-150	PFMPA	40-150
9Cl-PF3ONS	40-150	PFEESA	40-150

Table 2B-II
Method Detection Limits (MDLs) and Reporting Limits (RLs) for PFAS

Matrix	Soil	Groundwater
Analyte	**MDL (ug/kg)**	**MDL (ng/L)**
Perfluorobutanoic acid (PFBA)	0.100	2.00

Table 2B-II
Method Detection Limits (MDLs) and Reporting Limits (RLs) for PFAS

Matrix	**Soil**	**Groundwater**
Analyte	**MDL (ug/kg)**	**MDL (ng/L)**
Perfluoropentanoic acid (PFPeA)	0.100	1.00
Perfluorohexanoic acid (PFHxA)	0.0590	0.500
Perfluoroheptanoic acid (PFHpA)	0.0500	0.520
Perfluorooctanoic acid (PFOA)	0.0510	0.640
Perfluorononanoic acid (PFNA)	0.0500	0.500
Perfluorodecanoic acid (PFDA)	0.0500	0.500
Perfluoroundecanoic acid (PFUnA)	0.0500	0.500
Perfluorododecanoic acid (PFDoA)	0.0500	0.500
Perfluorotridecanoic acid (PFTrDA)	0.0500	0.500
Perfluorotetradecanoic acid (PFTA)	0.0500	0.500
Perfluorobutanesulfonic acid (PFBS)	0.0500	0.300
Perfluorohexanesulfonic acid (PFHxS)	0.0500	0.570
Perfluoroheptanesulfonic acid (PFHpS)	0.0500	0.400
Perfluorooctanesulfonic acid (PFOS)	0.0510	0.500
Perfluorodecanesulfonic acid (PFDS)	0.0500	0.500
Perfluorooctanesulfonamide (FOSA)	0.0500	0.500
N-methylperfluorooctanesulfonamidoacetic acid (NMeFOSAA)	0.0500	1.20
N-ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)	0.0500	0.700
1H,1H,2H,2H-Perfluorooctanesulfonic acid (6:2 FTS)	0.350	2.50
1H,1H,2H,2H-Perfluorodecanesulfonic acid (8:2 FTS)	0.350	2.60
Perfluoropentanesulfonic acid (PFPeS)	0.0500	0.500
Perfluorononanesulfonic acid (PFNS)	0.0500	0.400
Perfluorododecanesulfonic acid (PFDoDS)	0.0500	0.900
1H,1H,2H,2H-Perfluorohexanesulfonic acid (4:2 FTS)	0.200	1.70
NEtFOSAA	0.0500	0.700
NMeFOSA	0.0500	0.500
NMeFOSE	0.500	5.00
NEtFOSE	0.500	5.00
9Cl-PF3ONS	0.200	1.00
HFPO-DA	0.0510	2.00
11Cl-PF3OUdS	0.200	2.00

Table 2B-II
Method Detection Limits (MDLs) and Reporting Limits (RLs) for PFAS

Matrix	Soil	Groundwater
Analyte	**MDL (ug/kg)**	**MDL (ng/L)**
ADONA	0.200	1.50
3:3 FTCA	0.250	1.50
5:3 FTCA	1.00	10.0
7:3 FTCA	1.00	10.0
NFDHA (PFECA B)	0.104	1.00
PFMBA (PFECA F)	0.100	0.500
PFMPA (PFECA A)	0.100	1.00
PFEESA	0.100	0.500

Project Goals

The principal objectives of the Remedial Investigation (RI) are to complete the characterization of soil and groundwater at the Site and confirm groundwater flow direction. The data obtained during the implementation of the RI will be utilized to develop remedial action decisions, as necessary.

Project Scope

In order to assess soil and groundwater at the Site, the scope of work includes the advancement of soil borings; installation of permanent groundwater monitoring wells; and the collection and laboratory analysis of soil and groundwater samples.

Select soil and groundwater samples will be analyzed for TCL and NYSDEC CP-51-listed VOCs; TCL and NYSDEC CP-51-listed SVOCs; TAL metals, TCL pesticides, TCL herbicides, PCBs and PFAS. Groundwater samples will also be analyzed for 1,4-dioxane (included as SVOC).

Sampling Plan

Environmental sampling will include soil and groundwater. Soil samples will be collected using disposable sampling equipment. Groundwater samples will be collected from permanent monitoring wells using peristaltic or submersible pumps and new dedicated high-density polyethylene (HDPE) tubing.

Soil Sampling

Soil samples will be collected in 5-foot long 2-inch diameter macrocore samplers lined with acetate sleeves for all locations. With the exception of soil collected for VOC analysis, the samples will be collected with a disposable scoop and placed in the sample bottles. TerraCore samplers will be used to collect soil samples for VOC analysis. Samplers will wear phthalate-free gloves such as nitrile (no latex will be used). Only clean instruments will be allowed to touch the sample.

When sampling for PFAS in soil, specific modifications, in accordance with TRC's Standard Operating (SOP) for Soil Sampling dated February 2022, will be implemented. TRC's SOP for Soil Sampling is provided in Attachment A.

Groundwater Sampling

Groundwater samples will be collected from two-inch diameter permanent wells installed on the Site. Groundwater from each well will be purged via a submersible pump equipped with HDPE tubing until parameters have stabilized in accordance with USEPA Low-Stress (Low-Flow) sampling procedures. A turbidity level of 50 Nephelometric Turbidity Units (NTUs) or less is the well purging goal, but not an absolute value before sampling. Other field parameters including temperature, conductivity, ORP, pH, and DO will also be monitored and, prior to sampling, field parameters should stabilize (i.e., conductivity should be within ±3%, ORP ±10 mV, pH ±0.1 and ±10% for turbidity and DO) for three consecutive readings, three to five minutes apart. As practical, all field measurements will be taken from the flow-through cell and will be recorded during and after purging, and before sampling.

Ideally, pumping rates will be maintained between 100 and 500 milliliters per minute (ml/min) so that no drawdown of the groundwater level occurs (i.e., pumping rate is less than recharge rate). During purging, the sampler will actively monitor and track the volume of water purged and the field parameter readings.

Data will be recorded in the field logbook. For example, the sampler will record the running total volume purged from each well and note the readings for the corresponding field parameters.

Once groundwater conditions have stabilized and groundwater levels have recovered, samples will be collected. Sampling will be performed with the pump intake at the same location used for purging. Pumping rates for withdrawing the samples will be similar to those followed for well purging. For wells with low yield, alternative sample collection means per USEPA Low-Stress (Low-Flow) sampling procedures will be employed.

The samples will be collected in sample bottles (pre-preserved, if appropriate), placed in chilled coolers and removed from light immediately after collection. All bottles will be filled to avoid cascading and aeration of the samples, the goal being to minimize any precipitation of colloidal matter.

Due to the pervasive nature of PFAS in various substances routinely used during sampling and the need to mitigate potential cross contamination or sampling bias to ensure representative data are collected, special care should be taken when sampling for PFAS. When sampling for PFAS in groundwater, specific modifications, in accordance with TRC's Standard Operating (SOP) for Groundwater Sampling dated August 2020, will be implemented. TRC's SOP for Groundwater Sampling is provided in Attachment A.

QC Sample Collection

QC samples will include trip blanks and equipment blanks for groundwater and field duplicates for soil and groundwater samples. Refer to Tables 1A-1B for a summary of QC sample preservation and container requirements.

Trip blanks will consist of distilled water (supplied by the laboratory) and will be used to assess the potential for volatile organic compound contamination of groundwater samples due to contaminant migration during sample shipment and storage. Trip blanks will be transported to the Site unopened, stored with the investigative samples, and kept closed until analyzed by the laboratory. Trip blanks will be submitted to the laboratory at a frequency of one per cooler that contains groundwater samples for analysis for VOCs.

Field duplicates are an additional aliquot of the same sample submitted for the same parameters as the original sample. Field duplicates will be used to assess the sampling and analytical reproducibility. Field duplicates will be collected by alternately filling sample bottles from the source being sampled. Field duplicates will be submitted at a frequency of one per 20 samples for all matrices and all parameters. Refer to Tables 1A-1B for a summary of QC sample preservation and container requirements.

Equipment blanks will consist of distilled water and will be used to check for potential contamination of the equipment, which may cause sample contamination. Equipment blanks will be collected by routing the distilled water through the sampling equipment prior to sample collection. Equipment blanks will be submitted to the laboratory at a frequency of one per day of groundwater sample delivery. Refer to Tables 1A-1B for a summary of QC sample preservation and container requirements.

Sample Preservation and Containerization

The analytical laboratory will supply the containers for analytical samples. These containers will be cleaned by the manufacturer to meet or exceed all analyte specifications established in the latest USEPA's Specifications and Guidance for Contaminant-Free Sample Containers. Certificates of analysis are provided with each bottle lot and maintained on file to document conformance to USEPA specifications. Soil and groundwater samples will be placed in chilled coolers immediately after collection.

Equipment Decontamination

Re-usable sampling equipment shall be cleaned between each use in the following manner:

- Wash and scrub with Alconox and water mixture
- Tap water rinse
- Wash and scrub with biodegradable degreaser ("ZEP") if there is oily residue on equipment surface.
- Tap water rinse
- Distilled/deionized water rinse
- Air dry

As noted above, special care should be taken when sampling for PFAS. TRC will implement TRC's SOP ECR-010 Equipment Decontamination for PFAS-specific decontamination protocols. TRC's Equipment Decontamination SOP is provided in Attachment A.

Field Custody Procedures

Sample chain-of-custody and packaging procedures are summarized below. These procedures are intended to ensure that the samples will arrive at the laboratory with the chain-of-custody intact. TRC's SOP for Chain of Custody Practices is provided in Attachment A.

- The field sampler is personally responsible for the care and custody of the samples until they are transferred or dispatched properly. Field procedures have been designed such that as few people as possible will handle the samples.

- All bottles will be identified by the use of sample labels with sample numbers, sampling locations, date/time of sample collection, and type of analysis.

- Sample labels will be completed for each sample using waterproof ink unless prohibited by weather conditions. For example, a logbook notation would explain that a pencil was used to fill out the sample label because the pen would not function in wet weather.

- Samples will be accompanied by a properly completed chain-of-custody form. The sample numbers and locations will be listed on the chain-of-custody form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents the transfer of custody of samples from the sampler to another person, to a mobile laboratory, to the permanent laboratory, or to/from a secure storage location. A Chain of Custody Form is provided in Attachment B.

- All shipments will be accompanied by the chain-of-custody record identifying the contents. The original record will accompany the shipment, and copies will be retained by the sampler and placed in the project files.

- Samples will be properly packaged for shipment and dispatched to the appropriate laboratory for analysis, with a separate signed custody record enclosed in and secured to the inside top of each sample box or cooler. Shipping containers will be secured with strapping tape and custody seals for shipment to the laboratory. The custody seals will be attached to the front right and back left of the cooler and covered with clear plastic tape after being signed by field personnel. The cooler will be strapped shut with strapping tape in at least two locations.

- If the samples are sent by common carrier, the air bill will be used. Air bills will be retained as part of the permanent documentation. Commercial carriers are not required to sign off on the custody forms since the custody forms will be sealed inside the sample cooler and the custody seals will remain intact.

- Samples remain in the custody of the sampler until transfer of custody is completed. This consists of delivery of samples to the laboratory sample custodian, and signature of the laboratory sample custodian on chain-of-custody document as receiving the samples and signature of sampler as relinquishing samples.

Data Management and Reporting

ASP Category B Laboratory Packages will undergo data validation. A NYSDEC Data Usability Summary Report (DUSR) will be prepared for each laboratory package. Note that waste characterization samples, if collected for laboratory analysis, will not undergo data validation.

ATTACHMENT A

Standard Operating Procedures – TRC

Title: **Chain-of-Custody Procedures**		Procedure Number: **ECR 002**
		Revision Number: **2**
		Effective Date: **February 2021**
Authorization Signatures		
Technical Review Date Amanda Smith 2/24/21	Environmental Sector Quality Director Date Elizabeth Denly 2/24/21	

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ATTACHMENTS

1.0 INTRODUCTION

1.1 Scope & Applicability

This Standard Operating Procedure (SOP) guides TRC personnel in proper Chain-of-Custody (COC) practices.

This SOP was prepared to direct TRC personnel in the sample custody procedure requirements associated with field sample collection. Other state or federal requirements may be above and beyond the scope of this SOP and will be followed, if applicable. Sample custody procedures are an important part of the field investigation program in order to maintain data quality and to be able to document proof of proper handling. Sample custody begins at the time of sample collection and continues until the samples have been analyzed. Sample custody is addressed in three parts: field sample collection, laboratory analysis, and final evidence files.

Custody is one of several factors that are necessary for the admissibility of environmental data as evidence in a court of law or other evidentiary venue. Custody procedures help to satisfy the two major requirements for admissibility: relevance and authenticity. An overriding consideration essential for the validation of environmental measurement data is the necessity to demonstrate that samples have been obtained from the locations stated and that they have reached the laboratory without alteration (i.e., representative of the identified sample media).

1.2 Summary of Method

Evidence of the sample tracking from collection to shipment, laboratory receipt, and laboratory custody must be properly documented.

A sample or evidence file is considered to be in a person's custody if the item is:

- In a person's possession;
- Within sight of the person after they have taken possession;
- Secured and preserved so that no one can tamper with it after having been in a person’s possession; and/or
- In a secured area where access is restricted to authorized personnel.

The Field Team Leader or designee is responsible for overseeing and supervising the implementation of proper sample custody procedures in the field and ensuring sample custody until samples have been transferred to a courier or directly to the laboratory. Once received by the laboratory, the samples proceed through an orderly processing sequence specifically designed to ensure continuous integrity of both the sample and its documentation.

1.3 Equipment

The following list is an example of items that may be utilized when implementing sample custody procedures in the field. Project-specific conditions or requirements may warrant the use of additional items or deletion of items from this list. Many of these items may be provided by the selected analytical laboratory for a given project.

- Chain-of-Custody forms
- Sample labels
- Sample tags
- Custody seals
- Computer, tablet or smart device
- Indelible/waterproof ink
- Printer
- Ziploc® bags, or equivalent

2.0 PROCEDURES

Sample custody and transfer procedures are summarized below. These procedures are intended to ensure that the samples will arrive at the laboratory with the COC intact. The COC procedures are initiated in the field immediately following sample collection. The procedures consist of four main components: (1) preparing and attaching a unique sample label to each sample collected, (2) completing the COC form, (3) reviewing the COC form for accuracy, and (4) preparing the samples for shipment and custody transfer. For projects using TRC's Environmental Data Management System (EDMS) the project team's Data Manager can assist in planning sampling events to prepopulate bottle labels and COC forms and log all COC forms generated for the project.

2.1 Specific Chain-of-Custody Procedures

2.1.1 Sample Labels

Field personnel are responsible for uniquely identifying and labeling all samples collected during a field investigation program. All labeling must be completed in indelible/waterproof ink and securely affixed to the sample container. Individual sample containers may be pre-labeled or labeled in the field at the time of collection. Sufficient sample information should be cross-referenced in the field documentation for tracking purposes. A unique sample location may contain multiple sample containers with the same sample identification for the purposes of separate analyses or additional sample volume as required by the laboratory.

Sample labels may contain the following information:

- **Unique sample identification per ECR's Best Practices Document: Environmental Sample Identification and Naming or per a project-specific document (e.g., Quality Assurance Project Plan, Sampling & Analysis Plan)
- Sample location and/or depth/description number, if different from above
- Sample matrix

- Sample container volume
- **Type of analysis to be performed
- **Type of chemical preservation used
- Grab or composite designation
- **Filtered or unfiltered (if submitting both)
- **Sampling date and time using military format (unless blank)
- Sampler's affiliation and initials
- **Site and/or client name

**required

An example of a sample label is provided in Figure 1. TRC's EDMS can produce pre-printed sample labels for regularly scheduled sampling events.

2.1.2 Custody Seals

Custody seals should be secured across the shipping container to ensure content integrity and should be affixed such that the cooler cannot be opened without breaking the seals. The seals contain both the date and the signature of the person affixing them and must be completed in black or blue/black indelible/waterproof ink. Custody seals are attached to the cover seal of the cooler (front and back if cooler opens on both sides) and can be covered with clear plastic tape after being signed and dated by field personnel. An example of a custody seal is shown in Figure 1. The use of custody seals will be determined on a project-specific basis by the Project Manager.

2.1.3 Chain-of-Custody Form

For all analyses, COC forms must be completed and included with each sample set submitted. COC forms are initiated by the samplers in the field. If multiple laboratories are being used, a separate set of COC forms must be completed for each laboratory receiving samples to ensure proper transfer of custody from the time of sample collection to analysis. These forms serve as a record of sample collection, transfer, shipment, and receipt by the laboratory. These forms may contain the following pertinent information:

- Project/site name and/or project number
- Courier or shipping company name, if applicable
- Air bill tracking numbers(s), if known and applicable
- Laboratory name and address
- Sample identifications
- Sample matrices (e.g., soil, water, air, etc.)
- Type of sample (e.g., grab or composite)
- Date/time (military format) sample collected, unless sample is being submitted as a blind duplicate
- Size, type, and number of containers for each sample set
- Preservative(s) used (if any)
- Required analysis or method for each sample set
- Filtered or unfiltered
- Requested turnaround time for sample results
- Names of individuals responsible for sample custody
- Type of deliverables required
- Date shipped or otherwise transferred
- Number of coolers being submitted

Figure 2 provides an example COC form. It should be noted that this is an example format only. Laboratories typically provide their own laboratory-specific COC form. Other COC formats may be used as long as all of the applicable information is included. COC forms will be initiated in the field. TRC's EDMS can produce pre-printed COC forms for regularly scheduled sampling events.

All entries on the COC form must be legible and must be made in blue or black permanent ink. No erasures or obliterations can be made. If an incorrect entry is made, the information must be crossed out with a single strike mark which is signed or initialed and dated by the person recording the information. The correction must be written adjacent to the error. The original entry should still be legible even though crossed out.

2.1.4 Transfer of Custody

Samples will be accompanied by a properly completed COC form during each step of custody transfer and shipment. When physical possession of samples is transferred, both the individual relinquishing the samples and the individual receiving them will sign, date, and record the time of transfer on the COC form.

If at the completion of sampling the samples are not shipped directly from the field or point of collection to the analytical laboratory, the samples will be temporarily stored in an iced cooler at a secure location (e.g., locked vehicle, residence, office). Access to the secure location and transfer of the sample containers for laboratory delivery shall only be provided by a TRC employee and such sample transfer shall be recorded on the COC form.

All samples will be shipped directly to the laboratories by a TRC employee, an overnight commercial courier, or a laboratory-supplied courier service. Occasionally, samples may be relinquished directly to a client for subsequent transfer to the laboratory with proper COC procedures being followed.

In the case of sample shipment by an overnight commercial courier, a package tracking number will serve as an extension of the COC form while the samples are in transit. The COC forms will be sealed inside the sample cooler within a clear plastic bag taped to the inner top of the cooler and the custody seals, if used, will be completed on the outside of the cooler prior to shipment. Commercial couriers are not required to sign off on the custody forms since the forms are sealed inside the cooler prior to shipment; this allows the custody seal to remain intact.

The original COC form will accompany the samples at all times. A copy of all COC forms submitted to the laboratory will be retained by the sampler along with field records/logbooks documenting sample collection and will be placed in the project files. In the case of multiple sample coolers associated with one COC, a copy of the COC should be placed in each cooler and the total number of coolers should be recorded on the COC.

3.0 QUALITY ASSURANCE/QUALITY CONTROL

Following sample collection, all samples will be brought to a location for batching and paperwork checks. At this location, labels and logbook information are cross-checked to ensure there is no error in sample identification or sample collection time and that all samples are accounted for.

The sample information is transferred to the COC form. The samples are packaged to prevent breakage and/or leakage, and the shipping containers are labeled for transport.

The Field Team Leader has the responsibility of maintaining the COC and air bill documentation (if applicable). Individual responsibilities may be delegated to other field staff, as appropriate. Quality control procedures will place emphasis on ensuring that appropriate samples were collected and submitted to the laboratory for the correct analyses. The COC forms will also be reviewed by the Field Team Leader or designee to ensure that all required information is clearly presented.

Many laboratories will provide a sample receipt confirmation via electronic mail upon request. COC forms should be cross-checked with laboratory sample receipt confirmations, if applicable, to ensure that all samples were received and logged in correctly by the laboratory.

4.0 INVESTIGATION-DERIVED WASTE DISPOSAL

Not applicable.

5.0 DATA MANAGEMENT AND RECORDS MANAGEMENT

The Project Manager or Field Team Leader will maintain an inventory of all COC forms completed during the program and will be responsible for ensuring that they are archived in the project files following the completion of the field work.

It is good practice to scan all completed COC forms at the conclusion of field activities and store the resulting electronic PDF files in the project directory.

For projects using TRC's EDMS, the project team's Data Manager can assist in planning sampling events to prepopulate bottle labels and chain of custody forms and log all COC forms generated for the project. The TRC EDMS system has a completeness report that can track the samples collected and the analyses performed as data are received from the laboratory.

6.0 REFERENCES

A Compendium of Superfund Field Operations Methods EPA/540/P-87/001. December 1987.

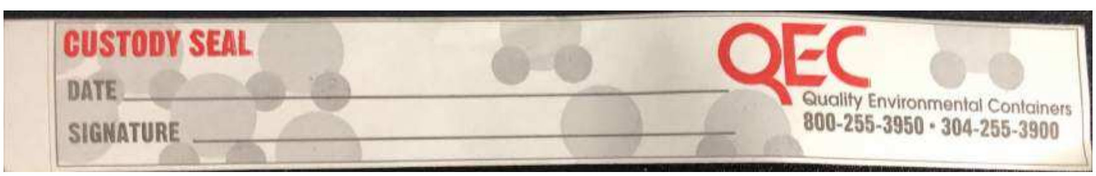
U.S. Environmental Protection Agency (EPA) Office of Enforcement and Compliance Monitoring – National Enforcement Investigations Center (NEIC) requirements (NEIC, 1986)

7.0 SOP REVISION HISTORY

REVISION NUMBER	REVISION DATE	REASON FOR REVISION
0	MARCH 2013	NOT APPLICABLE
1	JANUARY 2020	TRC RE-BRANDING AND SOP RE-NUMBERING
2	FEBRUARY 2021	GENERAL UPDATES; MOBILE DATA APPLICATIONS ADDED

Figure 1 Example Sample Label and Custody Seal

Example Sample Label



Example Custody Seal

Figure 2 Example Chain-of-Custody Form

PROJECT/CLIENT INFO		LABORATORY		OTHER INFO	
Site Name	Missouri City Oil Well Response	Lab Name	ALS Houston	Email Invoice To	A/P
Project Number	123987.0001.0000	Lab Contact	Corey Grandits	Invoice Reports	
TRC Office	TRC Houston	Email	Corey.Grandits@alsglobal.com	Email Report To	Bbillings@trccompanies.com
Address	16350 Park Ten Place	Address	10450 Stancliff Rd	Email Reports	
	Suite 101		#210	Shipping Company	
City	Houston; State TX	City	Houston; State TX	Tracking Number	
Postal Code	77084; Country Harris	Postal Code	77099; Country Harris	Cooler Count	
Phone Number	(713) 224 -1000	Phone Number	(555) 555-5656	Cooler Description	
Project Manager	Clayton Andrew	Quote Number		Sampler 2	
Email Address	Aclayton@trccompanies.com	PO Number	C123987	Sampler 3	

SAMPLE DETAILS — **ANALYSIS REQUESTED** — Filtered - F: Field, L: Lab, FL: Field & Lab, N: None

Sample ID	Start Depth	End Depth	Depth Unit	Field Matrix	Date	Time (24hr)	G=Grab C=Comp	Total # Of Cont.		BTEX (5035/8260)	TPH (TX1005)	Chloride (EPA 300)
									Filt.	N	N	N
									PRESERV.	Methanol	NA	NA
									ANALYSIS			
SS-1	0	1	ft bgs	SS	2/2/21	1120	G	1		X	X	X
SS-2	0	1	ft bgs	SS	2/2/21	1140	G	1		X	X	X
SS-3	0	1	ft bgs	SS	2/2/21	1210	G	1		X	X	X
DUP-1	0	1	ft bgs	SS	2/2/21	1200	G	1		X	X	X
SED-1	0	0.5	ft bgs	SS	2/2/21	1250	G	1				X
SED-2	0	0.5	ft bgs	SS	2/2/21	1235	G	1				X
SED-3	0	0.5	ft bgs	SS	2/2/21	1215	G	1				X
DUP-2	0	0.5	ft bgs	SS	2/2/21	1300	G	1				X
Trip Blank - SS Cooler	--	--	--	W	2/2/21	--	G	2		X		

ADDITIONAL COMMENTS/SPECIAL INSTRUCTIONS	RELINQUISHED BY/AFFILIATION	DATE/TIME	ACCEPTED BY/AFFILIATION	DATE/TIME
Perform MS/MSD analyses on sample SS-1 for BTEX, TPH, and chloride.	Braedon Billings, TRC	2/2/21 / 17:00		

NO OF BOTTLES RETURNED/DESCRIPTION				
	Sampler's Name	Braedon Billings	Mobile #	(555) 555-1758
	Sampler's Signature			

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Attachment A: SOP Fact Sheet

PURPOSE AND OBJECTIVE

Chain-of-Custody procedures have been developed to direct TRC personnel in the sample custody procedure requirements associated with field sample collection. Other state or federal requirements may be above and beyond the scope of this SOP and should be followed, if applicable. Sample custody procedures are an important part of the field investigation program to maintain data quality and to be able to document proof of proper handling. Sample custody begins at the collection of the samples and continues until the samples have been analyzed. Sample custody is addressed in three parts: field sample collection, laboratory analysis, and final evidence files.

WHAT TO BRING

- Chain-of-Custody (COC) forms
- Sample Labels
- Custody Seals (if required)
- Indelible/waterproof ink

ON-SITE

- Complete all sample labels with indelible/waterproof ink.
- At a minimum, sample labels should include: site name; unique sample identification; analysis to be performed; preservation method; indication of filtering, if performed; sample date and time.
- COC forms must be completed for each sample set and must be initiated in the field by the sampler.
- COC forms must be completed in blue or black permanent ink.
- At a minimum, the COC forms should include: site name; sample identification; sample matrix; type of preservative; type of analysis; sampling date; and sampler's name.
- Once sampling activity is completed and the COC form is filled out, place samples in sample coolers.
- Package samples to prevent breakage and/or leakage.
- The COC forms will be reviewed by the Field Team Leader or designee prior to relinquishing the samples.
- The original COC form must accompany samples to the laboratory.
- When samples are transferred from one person to another, both the relinquisher and the person receiving the samples should sign, date and record the date of transfer on the COC form.
- If samples are not sent directly to laboratory, samples need to remain on ice and be stored in a secure location.

Title: **Soil Sampling**	Procedure Number: **ECR 003**
	Revision Number: **04**
	Effective Date: **February 2022**

Authorization Signatures

Technical Reviewer — Date	SOP Work Group Co-Lead — Date
Chelsea Wenhardt — 2/21/2022	Ryan Jorrey — 2/21/2022

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LIST OF ATTACHMENTS

1.0 INTRODUCTION

1.2 Scope and Applicability

This Standard Operating Procedure (SOP) was prepared to direct TRC personnel in the logistics, collection techniques, and documentation requirements for collecting representative soil samples for chemical analysis. These are standard (i.e., typically applicable) operating procedures that may be changed, as required, depending on site conditions, equipment limitations, or limitations imposed by the procedure. In addition, other state or federal requirements may be above and beyond the scope of this SOP and will be followed, if applicable. In all instances, the actual procedures used should be documented and described in the field notes (see ECR SOP-001). Portions of this SOP may be applicable to soil sample collection for geotechnical analysis. However, specific instructions for collection of geotechnical samples are not provided; these samples should be collected in accordance with ASTM methods or other applicable standards.

1.3 Summary of Method

The objective of soil sampling is to obtain a representative sample of soil for laboratory analysis of constituents of interest at a given site. This objective requires that the sample be of sufficient quantity and quality for analysis by the selected analytical method. For specialized sampling programs involving per- and polyfluorinated alkyl substances (PFAS), refer to Attachment D for further details. Soil samples may be collected using a variety of methods and equipment depending on the depth of the desired sample, the type of sample required (disturbed vs. undisturbed), and the soil type. Near-surface soils may be sampled using a spade, trowel, and/or scoop. Sampling at greater depths typically is performed using a hand auger, continuous flight auger, a split-spoon, direct-push methods (i.e., Geoprobe®), sonic drilling, a backhoe, or an excavator. The following reference may be used as a guide to aid in selecting an appropriate method or sampling device for the collection of subsurface soil samples with a drill rig: ASTM D6169–98 *Standard Guide for Selection of Soil and Rock Sampling Devices Used with Drill Rigs for Environmental Investigation*.

1.4 Equipment

The following equipment may be utilized when collecting soil samples. Project-specific conditions or laboratory requirements may warrant the addition or deletion of items from this list.

- Appropriate level of personal protective equipment (PPE), as specified in the site-specific Health and Safety Plan (HASP).
- Sample containers: The proper containers should be determined in conjunction with the analytical laboratory in the planning stages of the project, and will depend on the analytical program, laboratory SOPs, and regulatory requirements.

  For non-volatile organic compound (VOC) parameters, glass containers with Teflon®-lined caps are typically utilized. Typical containers used for VOC parameters are provided in Attachment A. Brass liners, steel liners, or soil core acetate liners with Teflon® tape and plastic end caps may also be used.
- Stainless steel mixing bowl or new aluminum pie pan.

- Stainless steel spoon or spatula or sterile individually wrapped single use scoop.
- Plastic bowl or plastic resealable bag for inorganics.
- Hand auger, mud auger, sand auger, bucket auger, and/or T-handle.
- Post hole auger.
- Extension rods.
- Stainless steel trowel.
- Shovel.
- Applicable field screening equipment with calibration solution/gas [i.e., pH meter, photoionization detector (PID), flame ionization detector (FID), etc.].
- Tape measure or folding ruler.
- Wooden stakes and spray paint, plastic flagging (highly visible), or steel pin flags.
- Field book/field notes and/or boring log.
- Sample container labels.
- Chain-of-custody (COC) forms (TRC or laboratory, as appropriate).
    - Custody seals for sample coolers.
    - Tape to secure sample coolers and sample container labels (if necessary).
- Camera.
- Maps/site plan.
- Survey equipment, global positioning system (GPS), or other means of measuring sample locations.
- Indelible marking pens or markers.
- Organic absorbent material (e.g., Slickwick, ground corn cob, sawdust).
- Sample coolers.
- Bubble wrap.
- Ice (for sample storage/preservation).
- Zip-loc® plastic bags (for ice and COCs).
- Equipment decontamination supplies (see ECR SOP-010).

1.5 Definitions

Composite sample	Composed of two or more grab samples collected over a period of time or space during a single sampling event and mixed together.
En-Core® sampler	A disposable volumetric sampling device with an airtight sealing cap.
Grab sample	Individual discrete sample collected at a particular time.

High-level VOC analysis	VOC soil analysis that yields high reporting limits (approximately 50-200 µg/kg, depending on the laboratory). Samples are typically preserved in methanol and cooled to 4°C. High-level VOC analyses are used for samples that are expected to contain elevated concentrations of VOCs (>200 µg/kg).
Low-level VOC analysis	VOC soil analysis that yields low reporting limits (approximately 5 µg/kg, depending on the laboratory). Samples are typically preserved in water, cooled to 4°C, and can be frozen within 48 hours of collection. Low-level VOC analyses are used for samples that are expected to contain lower concentrations of VOCs (≤200 µg/kg).
Terra Core™ sampler	A disposable volumetric sampling device used to transfer soil samples to the appropriate sample containers.

1.6 Health & Safety Considerations

TRC personnel will be on site when implementing this SOP. Therefore, TRC personnel shall follow the site-specific HASP. TRC personnel will use the appropriate level of PPE, as defined in the HASP.

Soil samples containing chemical contaminants may be handled during implementation of this SOP. Additionally, sample preservatives including caustics and/or acids may be considered hazardous materials and TRC employees will appropriately handle and store them at all times. The HASP will address chemicals that pose specific toxicity or safety concerns and TRC employees will follow relevant requirements, as appropriate. Hazardous substances may be incompatible or may cause dangerous chemical reactions, including the production of heat, violent reactivity, or production of toxic vapors or other byproducts. Hazardous substances may be incompatible with clothing or equipment; some substances can permeate or degrade protective clothing or equipment. Also, hazardous substances may pose a direct health hazard to workers through inhalation or skin contact or if exposed to heat/flame resulting in combustion. Safety data sheets (SDS) for chemicals handled by TRC should be maintained in the field.

1.7 Cautions and Potential Problems

- Cross contamination: Cross contamination problems can be eliminated or minimized through the use of dedicated sampling equipment. If this is not possible or practical, then decontamination of sampling equipment is necessary.

- Improper sample collection: Improper sample collection can involve using contaminated equipment, disturbance of the matrix resulting in compaction of the sample, or inadequate homogenization of the samples where required, resulting in variable, non-representative results.

- Special considerations for the different soil sampling techniques are provided below in the applicable sections. Cautions and potential problems associated with soil sampling for VOCs are provided in Attachment A.

- Special care should be taken when sampling for PFAS. Please refer to Attachment D for details.

1.8 Personnel Qualifications

Since this SOP will be implemented at sites or in work areas that entail potential exposure to toxic chemicals or hazardous environments, TRC personnel must be adequately trained. Project and client-specific training requirements for samplers and other personnel on site should be developed in project planning documents, such as the sampling plan or project work plan. These requirements may include:

- OSHA 40-hour Health and Safety Training for Hazardous Waste Operations and Emergency Response (HAZWOPER) workers
- 8-hour annual HAZWOPER refresher training

2.0 PROCEDURES

Always review the site-specific work plan and/or scope of work for any site-specific sampling procedures.

2.2 Pre-Sampling Activities

Pre-sampling activities that the sampling team should consider include the following:

- reviewing the work plan approved by the client and/or regulatory agency;
- developing a strategy to implement the work plan
- selecting a laboratory; and
- determining laboratory-specific procedures related to bottle orders, holding times, work orders, methods of analysis, COC procedures, data deliverables, schedule, and cost.

Additional activities include determining shipping logistics, utility clearance, and handling of investigation-derived waste (IDW) disposal. Pre-labeling bottles can help to reduce sampling and labeling errors.

The following steps should also be employed:

1. Determine the extent of the sampling effort, the sampling methods to be employed, and the types and amounts of equipment and supplies required.

2. Obtain necessary sampling and monitoring equipment.

3. Decontaminate or clean equipment and ensure that it is in working order.

4. Prepare schedules and coordinate with staff, client, and regulatory agencies, if appropriate.

5. Perform a general site survey prior to site entry in accordance with the site-specific HASP.

6. Use stakes, flagging, or paint, to identify and mark all sampling locations. Specific site factors, including extent and nature of contaminants, should be considered when selecting sample locations. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions.

   NOTE: If spray paint is used to mark stakes, the spray paint should be carefully isolated from the space used to hold sample bottles, sampling equipment, etc.

7. Prior to any subsurface soil sampling, especially that completed with a drill rig or backhoe, it is important to ensure that all sampling locations are clear of overhead and buried utilities by conducting a utility survey/markout. Locations on private properties should also be reviewed with the owner prior to sampling. Client or project-specific utility clearances may also be required, such as air-knifing or ground-penetrating radar (GPR) and should be specified in the site-specific work plan.

2.3 General Soil Sampling Procedures

These are general soil sampling procedures. However, regulatory requirements may dictate a different procedure.

1. Refer to other TRC SOPs for the proper procedures for classifying soil samples (ECR SOP 005) and for screening of samples for VOCs (ECR SOP 014). Special care is required when sampling for PFAS - Please refer to Attachment D for details.

2. **For sampling in the State of California only:** When the sampling interval is predetermined and soil samples are collected by direct-push methods into an acetate liner, the section of the liner corresponding to the predetermined depth interval may be cut off and submitted to the laboratory for analysis with the exception of samples for VOC, volatile petroleum hydrocarbon (VPH), or gasoline-range organics (GRO) analysis. If VOC, VPH, or GRO analysis is required, then these samples can be collected from either open end of the acetate liner section according to the procedures outlined in Attachment A prior to packaging and submitting it to the laboratory. The laboratory should be consulted for the required length of liner tube (i.e., sample volume) depending on the analytical suite and to ensure that the use of acetate liners is appropriate for the analytical method(s). After collecting material for the VOC, VPH, or GRO analysis samples (if required), seal each end of the acetate liner section with Teflon tape and plastic end caps. Label the acetate liner with the sample identification (ID) and date and time of collection. Ensure that the laboratory will perform homogenization of the soil sample within the acetate liner and proceed to Step #9.

3. Prior to the collection of soil samples from a particular location or depth, the soil is typically screened for organic vapors with a portable meter equipped with a FID and/or PID depending upon the suspected contaminants of concern, site-specific work plan requirements, and/or regulatory requirements. Such organic vapor screening may be used to determine appropriate soil sample locations or depths for laboratory VOC analysis depending upon established site-specific work plan requirements. Soil should be screened *in situ* or immediately upon retrieval of the soil sample from the subsurface. It is good practice to photograph surface soil, stockpiles, etc. prior to sample collection with measurements and orientation identified for reference.

4. Samples for VOC, VPH, or GRO analysis are then collected as soon as possible after the soil has been exposed to the atmosphere and prior to sample collection for other analyses. Refer to Attachment A.

5. After collecting the sample(s) for VOC analysis, the sample portion for the remaining analyses should be well homogenized in a decontaminated stainless-steel bowl, disposable new aluminum pie pan, plastic bowl (for inorganics), or re-sealable plastic bag (for inorganics). These soil samples must be thoroughly mixed to ensure that the sample is uniform and as representative as possible of the sample media. Samples for VOC analysis are not homogenized. The most common method of mixing is referred to as quartering. The quartering procedure should be performed as follows:
    - The material in the sample pan should be divided into quarters and each quarter should be mixed individually.
    - Two quarters should then be mixed to form halves.
    - The two halves should be mixed to form a homogenous matrix.

   This procedure should be repeated several times until the sample is adequately mixed. If round bowls are used for sample mixing, adequate mixing is achieved by stirring the material in a circular fashion, reversing direction, and occasionally turning the material over. Soil can be homogenized and transferred to sample containers using soil sampling devices that have been decontaminated (e.g., stainless steel spoon) prior to use or individually wrapped or new devices (e.g., plastic scoopula). Such devices are generally for one-time use. Stainless steel devices may be decontaminated and individually foil wrapped, plastic bagged, or field decontaminated and foil wrapped between uses. Decontamination of sampling equipment shall be conducted in accordance with TRC's SOP on equipment decontamination.

6. Stones, gravel, or vegetation should be removed from the soil sample as much as practical prior to placement in sample containers, since these materials will not be analyzed. Visible asphalt, concrete, ash, slag, and coal debris should also be removed from the sample as much as possible to ensure sufficient soil quantity for laboratory analyses, unless these matrices are part of the overall characterization program. The soil sample must be representative of what the end user is trying to characterize. In addition, if such debris is to be tested, further sample preparation (e.g., pulverizing) will likely be necessary in the field or laboratory. In any case, the presence of any such materials in the soil at the sample location must be documented in the fieldnotes.

7. Filling of the sample bottles should be completed immediately after sample collection to minimize losses due to volatilization and biodegradation. Soil classification can be completed following VOC sample collection.

8. Place the sample into an appropriate, labeled container(s) by using the alternate shoveling method and secure the cap(s) tightly. The alternate shoveling method involves placing a spoonful of soil in each container in sequence and repeating until the containers are full or the sample volume has been exhausted. Threads on the container and lid should be cleaned to ensure a tight seal when closed.

9. Restore the sampling location to grade in accordance with applicable state or federal guidelines and/or the site-specific work plan. Options include backfilling the sample location

with the remaining removed soil, bentonite pellets, or cement/bentonite grout depending on site conditions/hole depth and patching the surface to match the surrounding area (e.g., topsoil with grass seed, asphalt, or concrete patch), as necessary. The site-specific work plan may prohibit the backfilling of sample locations with removed soil if there is evidence of contamination, site-specific restoration requirements, etc. Boreholes must be abandoned or backfilled after the completion of sampling. In general, shallow boreholes (e.g., less than 10 feet deep) that remain open and do not approach the water table may be abandoned by pouring a cement/bentonite grout mixture from the surface or pouring bentonite pellets from the surface and hydrating the pellets in lifts. The grout mixture should be based on site-specific conditions (e.g., boring depth, groundwater depth, and formation permeability), site-specific work plan procedures, and local regulatory requirements. Boreholes where bridging of the bentonite may be an issue, such as boreholes that intercept groundwater or are greater than approximately 10 feet in depth, should be backfilled by pressure grouting with a cement/bentonite grout mixture, either through a re-entry tool string or through a tremie pipe introduced to within several feet of the borehole bottom.

10. Record locations of soil borings/samples in the field notes by sketching a map and/or providing a description of the location. Always measure and record distances to fixed landmarks, such as buildings, fences, curbs, existing surveyed wells, etc. Additionally, photographs or a GPS unit with real-time sub-meter accuracy (not applicable for interior samples or other site conditions such as heavy tree/brush cover and thick cloud cover that limit unit connection with satellites) could be used to document sample locations. Note observations about elevation changes between sample locations.

3.0 SURFACE SOIL SAMPLING METHODS

The depth of surface soil samples will be determined on a site-specific basis and may be influenced by site-specific conditions and/or applicable local, state, or federal regulatory programs and potential exposure pathways. Surface soils are generally classified as soils between the ground surface and 6 to 12 inches below ground surface (bgs). The most common interval is 0 to 6 inches; however, the data quality objectives of the investigation or regulatory requirements may dictate another interval, such as 0 to 3 inches for risk assessment purposes.

The following procedure should be used for surface soil sampling:

1. If a thick, matted root zone, leaf layer, gravel, surface debris, concrete, etc. is present at or near the surface, it should be carefully removed using clean, decontaminated tools or clean nitrile gloves before the soil sample is collected. The presence and thickness of any such material should be recorded in the field notes for each location. The depth measurement for the soil sample begins at the top of the soil horizon, immediately following any such removed materials.

2. A decontaminated stainless-steel spoon, scoop, or trowel is typically used for surface soil sampling depths from 0 to 12 inches bgs where conditions are generally soft and there is no problematic vegetative layer to penetrate. A hand auger or shovel may also be used to dig down to the desired depth, and then after careful removal of the dug soils from the hole, a decontaminated stainless-steel spoon, scoop, or trowel is used to collect the soil sample from the bottom of the hole for laboratory chemical analysis. Plated trowels typically available

from garden supply centers should not be used due to potential heavy metal impacts from the trowel plating.

3. When using stainless steel spoons or trowels, consideration must be given to the procedure used to collect a soil sample for VOC analysis. Samples for VOC, VPH, or GRO analysis must be collected first and never homogenized or composited. These samples are collected using an open-barrel disposable syringe, a Terra Core™ sampler, an En-Core® sampler, or equivalent. If the soil being sampled is cohesive and holds its *in-situ* texture in the spoon or trowel, the En-Core® sampler or disposable syringe used to collect the sub-sample should be plugged directly from the spoon or trowel. However, if the soil is not cohesive and crumbles when removed from the ground surface for sampling, the sub-sample should be plugged directly from the surface of the appropriate sample depth. Additionally, note that En-Core® samplers are not recommended for non-cohesive soils (see Attachment A). Generally, the sample portion for VOC analysis is collected from several inches below grade to minimize volatilization from the *in-situ* soil.

4. Continue by following the General Soil Sampling Procedures in Section 2.3.

4.0 SUBSURFACE SOIL SAMPLING METHODS

The general soil sampling procedures described above should be followed for subsurface sampling. There are numerous options available for subsurface soil retrieval for sampling, including the following:

- Hand auger methods
- Direct-push drilling (standard or dual tube)
- Hollow-stem auger drilling with split spoon or continuous core sampling
- Shelby tube/thin walled sampling
- Roto-sonic drilling
- Excavator sampling (remedial excavations/trenching and test pits)

Other drilling methods not covered are available and may be appropriate for specific project purposes. Project specific procedures should be defined in project documentation. Be sure that the drilling method selected is appropriate for required sample volumes. For information regarding the applicability and details of commonly used subsurface sampling technologies please refer to Attachment E.

4.2 Hand Auger Sampling Methods

The following procedure is used for collecting soil samples with a hand auger:

1. Attach the auger head to a rod extension and attach the T-handle to the rod.

2. Clear the area to be sampled of any surface debris (e.g., twigs, rocks, litter). It may be advisable to remove the first several inches of surface soil and any root layer for an area approximately 6 inches in radius around the borehole location.

3. Begin augering, periodically removing and depositing accumulated soils onto a plastic sheet spread near the borehole or other appropriate container. This prevents accidental brushing of loose material back down the borehole when removing the auger or adding rod extensions. It also facilitates refilling the borehole and avoids possible contamination of the surrounding area.

4. When the sample depth is reached, remove the bucket used to advance the borehole and attach a decontaminated or clean bucket. Place the clean auger bucket in the borehole, advance the clean auger bucket to fill it with the soil sample, and then carefully remove the clean auger bucket.

5. If VOC analysis is to be performed, collect a sample directly at the bottom of the boring, if within reach, and not from the auger bucket. If not within reach, collect the sample directly from the auger bucket or from minimally disturbed material immediately after the auger bucket is emptied. Use an En-Core® sampler or other coring device (i.e., syringe, Terra Core™) to collect the sub-sample as described in Attachment A. Note: some regulatory agencies do not allow for subsurface VOC sample collection directly with a hand auger; refer to the site-specific work plan and regulatory requirements to ensure the collection of VOC samples with a hand auger is appropriate.

6. Continue by following the General Soil Sampling Procedures in Section 2.3. Note that if another sample is to be collected in the same borehole, but at a greater depth, reattach the auger bucket to the rod assembly, and follow steps 1 through 5 above, making sure to decontaminate the sampling device between samples.

Special Considerations for Hand Auger Sampling

- *Slough* - Because of the tendency for the auger bucket to scrape material from the sides of the auger hole while being extracted, the top several inches of soil in the auger bucket should be discarded prior to placing the bucket contents in the homogenization container for processing.
- *VOC Sample Collection* - Observe precautions for VOC sample collection found in Attachment A and/or the site-specific work plan.
- *Decontamination* - If sampling equipment is to be reused at a new sampling location or at a deeper depth in the same location, proper decontamination of sampling equipment is required.

4.3 Direct-Push Sampling Methods

Direct-push sampling methods include but may not be limited to the following techniques:

- Macro-Core® Sampler (Direct-push)
- Dual-tube Soil Sampling System (Direct-push*)* -
- Discrete Sampling

The following procedure is used for collecting soil samples from direct-push soil cores:

1. The driller will advance and extract the soil sample liner which will then be given to the field sampler - confirm with the driller which end is top and which end is bottom. Record the time

of core collection (military time), the soil boring ID and the depth interval in feet bgs in the field notes, field log sheet, or electronic data collection form.

2. Measurement of vertical depth should start from the top of the ground surface. The presence and thickness of surface asphalt, surficial concrete slabs, or gravel sub-base should be noted on the boring log and in the field notes.

3. Measure the length of recovered soil in inches and record in the field notes.

4. Continue by following the General Soil Sampling Procedures in Section 2.3.

   If a specific depth interval is targeted for sampling, be sure to give consideration to the percent recovery of soil and use professional judgement when selecting the sample interval. For example, if the targeted sample interval was from 2.0 to 2.5-ft, and the core barrel was advanced from 0 to 4 ft bgs, and 30 inches (2.5 ft) of soil was recovered, the sample should be collected immediately below the mid-point of the recovered soil, or 15 inches below the top of the recovered soil (not including slough). If the sample interval is comprised of multiple soil types, there may be one or more materials that are underrepresented in the sample tube (e.g., when a more dense/stiff material overlies a softer material). The sampler should use their best professional judgement to select the sample interval. The sample designation will indicate that the depth was 2.0 to 2.5 ft bgs.

Special Considerations for Direct-push Sampling

- *Liner Use and Material Selection* - Direct-push soil samples are collected within a dedicated new or decontaminated liner to facilitate removal of sample material from the sample barrel. The liners may only be available in a limited number of materials for a given sample tool, although overall, liners are available in brass, stainless steel, cellulose acetate butyrate (CAB), polyethylene terephthalate glycol (PETG), polyvinyl chloride (PVC) and Teflon®. For most investigations, the standard disposable new polymer liner material for a sampling tool will be acceptable. When the study objectives require very low reporting levels or unusual contaminants of concern, the use of more inert liner materials such as Teflon® or stainless steel may be necessary. However, such costly liner materials typically are not disposable and therefore require decontamination between each use.
- *Sample Orientation* - When the liners and associated sample are removed from the sample tubes, it is important to confirm and maintain the proper orientation of the sample. This is particularly important when multiple sample depths are collected from the same push. It is also important to maintain proper orientation to define precisely the depth at which a sample was collected. Maintaining proper orientation is typically accomplished using vinyl end caps. Convention is to place red caps on the top of the liner and black caps on the bottom to maintain proper sample orientation. Orientation can also be indicated by marking on the exterior of the liner with a permanent marker.
- *Core Catchers* - Occasionally the material being sampled lacks cohesiveness and is subject to crumbling and falling out of the sample liner. In such cases, the use of core catchers on the leading end of the sampler may help retain the soil until it is retrieved to the surface. Core catchers may only be available in specific materials and should be evaluated for suitability. However, given the limited sample contact that core catchers have with the sample material, most standard core catchers available for a tool system will be acceptable.

- *VOC Sample Collection* - Observe precautions for VOC sample collection found in Attachment A and/or the site-specific work plan.
- *Decontamination* - The cutting shoe and piston rod point are to be decontaminated between each sample interval. Within a borehole, the sample barrel, rods, and drive head may be subjected to an abbreviated cleaning to remove obvious and loose material, but must be cleaned between boreholes, such as with high-pressure water, steam, or soap solution with 5-gallon buckets and water rinse.
- *Health and Safety* – Liners should be cut open with the proper tools and in accordance with TRC's health and safety policies.

4.4 Split-spoon Sampling Methods

The following procedure is used for collecting soil samples from split-spoon soil cores:

1. Record the blow count per 6-inch interval when advancing split-spoon samplers with the hollow stem auger rig. Record the hammer weight (e.g., 140 pounds [lb] is standard, but 300 lb may also be used to advance the spoon). Blow counts are an indication of soil density and are a measure of the number of blows it takes for a 140 lb slide hammer falling over a distance of 30 inches to penetrate 6 inches of soil. The drillers will keep the count and will repeat them to the field sampler (e.g., 11, 13, 16 – means the number of blows the hammer advanced the spoon every 6 inches over a total depth interval of the split-spoon sampler, in this case over 18 inches). If refusal is encountered, the count is recorded in the field notes as "# of hammer blows / depth in inches the spoon is driven" (e.g., 50/3 – means 50 blows of the hammer advanced the spoon 3 inches).

2. The driller will advance, extract, and open the split spoon, which will then be given to the field sampler - confirm with the driller which end is top and which end is bottom, if a soil sample liner is used and removed from the spoon. Record the time of core collection (military time), the soil boring ID, and the depth interval in feet bgs in the field notes.

3. Measurement of vertical depth should start from the top of the ground surface.; The presence and thickness of surface asphalt, surficial concrete slabs, or gravel sub-base should be noted on the boring log and in the field notes.

4. Measure the length of recovered soil in inches and record in the field notes.

5. Continue by following the General Soil Sampling Procedures in Section 2.3.

Special Considerations for Split-spoon Sampling

- Split-spoon soil sampling for geotechnical purposes should be conducted in accordance with ASTM Method D1586 *Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soil*.
- *Slough* - Generally discard the top several inches of material in the spoon before removing any portion for sampling. This material normally consists of borehole wall material that has sloughed off of the borehole wall after removal of the drill string prior to and during insertion of the split spoon.

- *VOC Sample Collection* - Observe precautions for VOC sample collection found in Attachment A and/or the site-specific work plan.
- *Decontamination* - Within a borehole, the split spoon sample barrels must be cleaned between each sample - the driller typically has multiple barrels and can alternate between clean and dirty barrels so drilling progress is not affected by decontamination of the barrels. The augers should be decontaminated between boreholes (such as with high-pressure steam).

4.5 Shelby Tube/Thin-walled Sampling Methods

Shelby tube or thin-walled soil sampling should be conducted in accordance with ASTM Method D1587 *Practice for Thin-walled Tube Sampling of Soils for Geotechnical Purposes*.

After retrieval to the surface, the tube containing the sample is then removed from the sampler head. If samples for chemical analyses are needed, the soil contained inside the tube is then removed for sample acquisition by following the direct-push sampling procedures in Section 4.3. If the sample is collected for geotechnical parameters, the tube is typically sealed, to maintain the sample in its relatively undisturbed state, capped, labeled appropriately (including sample ID, top end of sample, inches of recovery, etc.), and shipped to the appropriate geotechnical laboratory. The tube is typically stored in an upright position to maintain the integrity of the undisturbed sample. For geotechnical use, check with the laboratory prior to sampling to understand sample volume recoveries needed to perform the actual tests.

4.6 Sonic Drilling Sampling Methods

The soil core is extruded from the core barrel or casing into a flexible plastic sleeve. The sleeve is then placed on an appropriate surface or prepared sample area to contain spoils. The sleeve is opened to screen with a PID, log lithology and collect samples. The procedures for collecting soil samples from sonic cores are the same as the procedures presented for collecting soil samples from direct-push sampling methods in Section 4.3.

Special Considerations for Sonic Drilling Sampling

- *Utility Clearance* - Due to the ability of sonic drilling to advance through material that may normally cause refusal of standard DPT, extra care should be taken with clearances and borehole location selection.
- Sonic-generated soils are not undisturbed. The resonation of the core barrel during advancement energizes the skin of the sample immediately adjacent to the barrel, approximately ⅛ to ¼ inch around the OD of the sample. Heating of the soils is possible. VOC samples particularly may require permission, approval, or data quality review to be considered representative and/or applicable to the project requirements.
- Depending on site conditions, the outer casing may require adding some water to the borehole if heaving or flowing sand(s) and gravel are present. An adequate water supply should be considered in these site-specific conditions.
- Sonic drilling sleeves in general will produce more IDW to be disposed of than DPT. The sleeves themselves can be awkward and heavy to move to a sample processing area.

4.7 Excavator Sampling Methods

The following procedures are used for collecting soil samples excavated with a backhoe or excavator:

- Refer to the site-specific work plan for the number of floor and/or sidewall samples, which is typically driven by the surface area and can vary depending on the governing regulatory agency.
- For a shallow excavation where the soil samples can be collected directly from the excavation, samples can be collected using a trowel, spoon, or coring device at the desired intervals in the excavation. A clean shovel may be used to remove a 1 to 2- inch layer of soil from the vertical face of the pit that contacted the backhoe bucket and where soil sampling is planned. Scrape the vertical face at the point of sampling to remove any soil that may have fallen from above and to expose fresh soil for sampling.
- For deeper excavations where sample locations are inaccessible, soil samples can be collected directly from the excavator bucket. Do not enter an excavation to collect a sample.
- Soil samples should be collected from the top of the soil in the excavator bucket with special care taken that residual soil on the excavator bucket is not scrapped off and placed in the excavation sample. Collect enough sample volume into a clean, stainless-steel bowl so that the sample containers can be filled at a safe distance from the excavation equipment. Confirm with the equipment operator when the sampling is complete, and excavation can continue.
- Continue by following the General Soil Sampling Procedures in Section 2.3.

<u>Special Considerations for Excavator Sampling</u>

- Effective communication with the excavation equipment operator is critical to collecting the samples safely. Establish a set of hand signals that will be used with the equipment operator to conduct the sampling safely. Confirm with the operator which direction the excavator arm will swing and establish a safe zone where the field staff should stand by to collect the sample. Field staff should always stand at least 3 feet away from the edge of an open excavation. Samples should be collected from the excavator bucket only after the bucket is safely on the ground and confirmation from the equipment operator is received that the equipment is stationary.
- *VOC Sample Collection* - Observe precautions for VOC sample collection found in Attachment A and/or the site-specific work plan.
- Do not physically enter backhoe excavations to collect a sample if the excavations are unstable or not sloped and protected with shoring. A trench with non-cohesive soils (i.e., sand, saturated/wet muds, or flowing water at the base) is particularly susceptible to collapsing suddenly. Never enter a trench without a confined space entry permit, as required by OSHA regulations.
- Smearing is a potential issue when sampling with a backhoe or excavator. Any time a vertical or near vertical surface is sampled, such as achieved when shovels or similar devices are used for subsurface sampling, the surface should be dressed (scraped) to remove smeared soil. This is necessary to minimize the effects of contaminant migration interferences due to smearing of material from other levels.

- The backhoe/excavator bucket should be decontaminated and loose paint, grease, and rust should be removed to the extent practical prior to use for sample collection if the bucket will come in direct contact with the material to be sampled. Care should be taken to collect the soil sample from the center of the excavated material within the bucket (i.e., material that has not touched the bucket walls).

4.8 Stockpile Soil Sampling Methods

Stockpiled soils are typically sampled to characterize the soils for reuse or disposal. The stockpile sampling strategy used must consider the source of the soil, available data, field observations, shape/dimensions and volume of the pile, and sampling frequency requirements established by oversight regulatory agencies or potential soil disposal facilities.

If the stockpile is known to be a representative mixture of soil with no known or suspected significant variability of contamination with depth in the pile, the stockpile sampling may be conducted according to the surface soil sampling method described in Section 3. However, if the soil characteristics are not known or are known or suspected to vary with depth in the pile, both surface soil and deeper subsurface soil samples will be required to properly characterize the soil pile.

A backhoe or excavator equipped with a bucket can be used to collect subsurface soil samples from stockpiles. This method is often preferred for collecting subsurface soil samples from a stockpile since it allows the sampler greater opportunity to inspect the physical characteristics of the pile for potential signs of variability for determining appropriate sample depths and locations.

Typically, based on the minimum required number of samples for the estimated stockpile volume, the stockpile is divided into the appropriate number of estimated volumes equal to that sample number. For example, if the specified sample frequency is 1 sample per 1,000 cubic yards (cy) and the estimated stockpile size is 4,000 cy, the stockpile would be broken down into approximately four equal volumes or quadrants. Grab VOC samples and composite non-VOC samples, as required, would then be collected from each of the areas for characterization of the stockpile.

5.0 POST-SAMPLING ACTIVITIES

1. After the samples have been collected, the sampling locations must be appropriately documented. The type of documentation will depend on the project specific data quality objectives (DQOs). Sampling locations may be marked with wooden stakes colored with highly visible spray paint and/or flagging in order to identify the sample location for surveying purposes, recorded immediately using a GPS receiver with sub-meter accuracy, recorded using GPS on a mobile device, measured from building corners or other fixed reference points, or a combination of the above. If stakes/markers are used to identify the locations for photos or to physically locate the point at a future date, sample and/or location identification should be written on each stake in indelible ink or marking pen. A sketch or photograph of the sampling locations should also be included in the field notes.

2. Package the samples with bubble wrap and/or organic absorbent, as necessary.

3. Place the samples into a shipping container and cool to 4ºC. If wet ice is used to cool the samples, place the ice in double-bags to prevent water from the melting ice from damaging the samples during shipment.

4. Complete the COC form.

5. Decontaminate non-disposable sampling equipment.

6.0 INVESTIGATION-DERIVED WASTE DISPOSAL

Field personnel should discuss specific documentation and containerization requirements for investigation-derived waste disposal with the Project Manager.

Each project must consider investigation-derived waste disposal methods and have a plan in place prior to performing the field work. Provisions must be in place as to what will be done with investigation-derived waste. If investigation-derived waste cannot be returned to the site, consider material containment, such as a composite drum, proper labeling, on-site storage by the client, testing for disposal approval of the materials, and ultimately the pickup and disposal of the materials by appropriately licensed vendors.

7.0 QUALITY ASSURANCE/QUALITY CONTROL

The collection of specific field quality control (QC) samples will be specified in the project-specific planning documents and/or specified by the regulatory agency. and may include one or more of the following: field blank, equipment blank, trip blank, field duplicate, and/or matrix spike/matrix spike duplicates.

7.2 Duplicate Soil Sample Collection

The following procedures should be used for collecting duplicate soil samples:

1. For QC purposes, each duplicate sample will be submitted to the laboratory as a "blind" duplicate sample, in that a unique sample identification not tied to the primary sample identification will be assigned to the duplicate (e.g., DUP-01). Standard labeling procedures used for soil sampling will be employed. However, a sample collection time will not be included on the sample label or the COC form. The actual source of the duplicate sample will be recorded in the field notes.

2. Each duplicate sample will be collected simultaneously with the actual sample in accordance with the same collection procedures. At the same step in the sampling procedures that the VOC, VPH, and/or GRO containers are filled and sealed, the duplicate sample VOC, VPH, and/or GRO containers will also be filled and sealed. Duplicates for all parameters other than VOCs, VPH, and GRO should be filled from the homogenized sample to ensure consistency between the sample and the duplicate. Following the order of collection specified for each set of containers (i.e., VOCs, VPH, GRO, semivolatile organic compounds [SVOCs], other organics and then inorganic compounds), the duplicate sample containers will be filled simultaneously with each parameter.

3. Collection and preservation procedures outlined for soil sampling will be followed for each duplicate sample.

8.0 DATA MANAGEMENT AND RECORDS MANAGEMENT

Record the general sample collection information such as location, identification, and date/time in the field notes or on a field data sheet. Typical field documentation recorded in field notes includes the following information:

- Sample identification number
- Sample location (description or sketch of the sample point)
- Sample depth interval
- GPS coordinates and coordinate system
- Time and date sample was collected
- Personnel performing the task
- Visual or sensory description of the sample (e.g., odors, staining)
- Brief soil descriptions (e.g., color, texture, appearance)
- Presence of any fill materials (e.g., concrete, asphalt, ash)
- Readings from field screening equipment (e.g., PID)
- Weather conditions during sampling (e.g., temperature, wind)
- Other pertinent observations including whether photographs were taken
- Sample collection equipment used
- Decontamination procedure
- Analytical parameters

Affix a properly completed label to each sample container.

All sample numbers must be documented on the COC form that accompanies the samples during shipment. Any deviations from the record management procedures specified in the site-specific work plan must be approved by the Project Manager and documented in the field notes.

For projects using TRC's Environmental Data Management System (EDMS), the project team's Data Manager can assist in planning sampling events to prepopulate bottle labels and chain of custody forms and keep track of COC forms and laboratory EDDs generated for the project. The TRC EDMS system has a completeness report that can track the samples collected and the analyses performed as data are received from the laboratory.

TRC's EDMS includes an approved electronic mobile field data collection system (e.g., EQuIS Collect, Fulcrum, or esri Collector). A TRC Data Manager must be assigned for coordination and setup of the respective application to be used by the project team. The details and specifications of the sampling event should be discussed with the TRC Data Manager during the project kickoff meeting. The TRC Data Manager will work with the TRC project team and field personnel on configuring the system for efficient use in the field with pre-populated, project-specific menus following TRC's best practices for sample ID naming conventions compatible with TRC's EDMS.

For projects that do not use electronic mobile field data collection systems field notes containing sample IDs, sample date, sample matrix, sample start depth, sample end depth, sample method, sample event task code, and sample purpose, along with GPS coordinates for each sample location ID should be transcribed into TRC's standard Location and Field Sample EDDs for import into TRC's EDMS as soon as the soil sampling event is completed, preferably the same day in order to get data into the EDMS in as near real time as possible.

9.0 SUSTAINABLE RECOMMENDATIONS

Sustainable practices should be incorporated wherever practical. Items to consider for soil sampling are as follows:

- Utilize reusable equipment as appropriate;
- Utilize recycled material as appropriate (i.e., Recycle plastic bags or use green bags);
- Utilize laboratories with smaller sample containers;
- Utilize electronic data collection methods rather than paper for field notes and boring logs

10.0 REFERENCES

ASTM Methods D1586 *Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soil,* D1587 *Practice for Thin-walled Tube Sampling of Soils for Geotechnical Purposes*, ASTM D6169 *Standard Guide for Selection of Soil and Rock Sampling Devices Used With Drill Rigs for Environmental Investigation,* ASTM International, Most Current Version.

California EPA, *Guidance Document for the Implementation of United States Environmental Protection Agency Method 5035: Methodologies for Collection, Preservation, Storage, and Preparation of Soils to be Analyzed for Volatile Organic Compounds,* November 2004

MassDEP, *Method for the Determination of Volatile Petroleum Hydrocarbons (VPH)*, May 2004.

U.S, EPA, SW-846 Method 5035A, *Closed System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples*, Draft Revision 1, July 2002.

U.S. EPA Environmental Response Team, Soil Sampling SOP #2012, February 18, 2000.

U.S. EPA Science and Ecosystem Support Division, Soil Sampling Operating Procedure (SESDPROC-300-R2), December 20, 2011.

11.0 SOP REVISION HISTORY

REVISION NUMBER	REVISION DATE	REASON FOR REVISION
0	SEPTEMBER 2013	NOT APPLICABLE
1	NOVEMBER 2016	ADDED ATTACHMENT D TO ACCOMMODATE SOP MODIFICATIONS REQUIRED WHEN SAMPLING FOR PFAS; CHANGED NAMING CONVENTION FOR SOP FROM RMD TO ECR.
2	JANUARY 2020	TRC RE-BRANDING
3	AUGUST 2020	ADDITIONAL MODIFICATIONS FOR PFAS SAMPLING
4	JANUARY 2022	SOP UPDATE

Attachment A:

Procedure for Collection of Samples for VOCs, VPH, or GRO (SW-846 Method 5035A)

1.0 SAMPLING FOR VOLATILE ORGANIC COMPOUNDS IN SOIL BY EPA METHOD 5035/5035A

The following sampling protocol is recommended for site investigations assessing the extent of VOCs (including VPH and GRO) in soils. Because of the large number of options available, careful coordination between field and laboratory personnel is needed. The specific sampling containers and sampling tools required will depend upon the required detection levels and intended data use. Once this information has been established, selection of the appropriate sampling procedure and preservation method best applicable to the investigation can be made.

SW-846 Method 5035 provides instructions and options on the preservation of soil samples for low-level and high-level VOC analyses:

- Low-level (≤ 200 µg/kg) and
- High-level (> 200 µg/kg).

The choice of low-level or high-level analysis is determined by the requirements of the project. However, since the low-level method is only valid for a certain concentration range, a sample for analysis by the high-level method must also be collected to ensure quantification of all target analytes is possible, if needed.

The low-level method uses one or more of the following options for the sampling/preservation of soils:

- Soil sampled into a vial with a sodium bisulfate ($NaHSO_4$) solution.
- Soil collected in an En-Core® sampler and immediately shipped to the laboratory for further preservation (within 48 hours).
- Soil collected in a vial with organic-free water, sealed in the field, and shipped to the laboratory immediately in order to meet the method preservation requirement to freeze within 48 hours of collection.

Based on project-specific requirements, trip blanks may be recommended. Refer to the site-specific work plan for quality assurance (QA)/QC requirements.

1.1 Low-level Method (VOCs)

Option A - Direct sampling into En-Core® samplers

- Three 5-gram size En-Core® samplers for each sample.
- One non-preserved container for moisture determination.

Option B - Direct sampling into vial with chemical preservative

- Two 5-gram size cores are added to volatile organic analysis (VOA) vials (one soil core is added to each of two VOA vials with sodium bisulfate solution) for each sample using a Terra Core™ or other coring sampler (e.g., disposable syringe). Once the vials are sealed in the field, these are not opened again.
- One non-preserved container for moisture determination.

Option C - Direct sampling into vial with water (to be frozen at the laboratory)

- Two 5-gram size cores are added to VOA vials (one soil core is added to each of two VOA vials with water) for each sample using a Terra Core™ or other coring sampler (e.g., disposable syringe). Once the vials are sealed in the field, these are not opened again.
- One non-preserved container for moisture determination.

1.2 High-level Method (VOC, VPH, GRO)

Option A - Direct sampling into En-Core® samplers

- One 5-gram size En-Core® sampler for each sample.
- One non-preserved container for moisture determination.

Option B - Direct sampling into a methanol-preserved vial

- For VOCs: 5 or 10 grams of soil is added to a VOA vial (with 5 or 10 grams of methanol, respectively) for each sample using a Terra Core™ or other coring sampler (e.g., disposable syringe). This may also depend upon the regulatory agency (e.g., New Jersey Department of Environmental Protection requires 8 to 12 grams in 25 mL methanol or 5 grams in 10 mL methanol).
- For VPH or GRO: The coring device will be filled with 25 grams of undisturbed soil if 60-ml vials with 25 ml of methanol are used, or 15 grams of undisturbed soil if 40-ml vials with 15 ml of methanol are used. The goal is to have a 1:1 ratio of soil- to- methanol.
- One non-preserved container for moisture determination.

1.3 Cautions and Potential Problems

1. Potential leaking sample containers for VOC, VPH, and GRO analyses:

   Options for evaluating containers for leaking preservatives:

   a. When ordering pre-preserved sample containers, laboratories should be encouraged to mark the meniscus of the preservative on all sample containers. The preservative level should be checked before sampling as a quick check that there has not been any loss of liquid.
   b. Compare preservative level in multiple bottles and select one for comparison purposes to subsequent sample bottles.
   c. Weigh methanol-preserved sample containers prior to sampling. Sample containers found to have lost greater than 0.2 grams of methanol compared to their initial weight should not be used. In order to perform this option, initial container weights must be provided by the laboratory.

2. Potential methanol absorption:

   Soil may be encountered that absorbs all of the methanol preservative (e.g., organic-rich soil, fine-grain soil). These soils can absorb the methanol leaving no methanol extract for the laboratory to analyze. In these instances, the use of additional methanol is required. The laboratory must be contacted for sample containers with an increased volume of methanol. Using a 1:2 ratio of soil to methanol will help to ensure that there will be adequate volume of methanol remaining for analysis. **NOTE: Additional methanol should not be added to the sample container by the sampler in the field. Containers with additional methanol must be obtained from the laboratory.**

3. Collection of samples with high moisture content:

   Soil samples with high (>50%) moisture content (e.g., sediments, soil samples below the water table) may prevent the attainment of the ideal 1:1 soil-to-preservative ratio. In these instances, depending on the data quality objectives, it may be necessary to evaluate the soil to determine what level in the disposable syringe corresponds to the required weight (typically 5 grams for VOCs and 15 or 25 grams for VPH). This can be performed by collecting several trial samples with disposable syringes. Weigh each trial sample and note the length of the soil in the syringe. These measurements would be used to determine how much soil in the syringe corresponds to 5 $\pm$ 0.5 grams (or the desired weight $\pm$ 0.5). All trial samples should be discarded and not used for analysis.

4. En-Core® sampler cautions:

   a. En-Core® samplers, or equivalent, should only be used on fine-grain or cohesive soils (soils that stay together in the En-Core® sampler and do not fall apart). En-Core® samplers should not be used to collect soil samples that consist of dry sand, gravel, or a mixture of gravel and fines, or samples with high moisture (e.g., sediments and soil samples below the water table). In the case of soil samples that consist of dry sand, gravel, or a mixture of gravel and fines, or samples with high moisture (e.g., sediments and soil samples below the water table), a stainless-steel spatula or scoop should be used with field preservation techniques.
   b. The En-Core® sampler is a single-use device and cannot be decontaminated and reused.

c. The volume of material collected in an En-Core® sampler should not cause excessive stress on the coring tool.
d. The volume of material collected should not be so large that the sample easily falls apart during extrusion.
e. The En-Core® sampler should not be used if any of the components are damaged as the seals may be compromised. Under no circumstances should any components be removed or disturbed.
f. It is important to make sure air is not trapped behind the sample, as this could cause air to pass through the sample, resulting in a loss of VOCs, or it could cause the sample to be pushed prematurely from the coring tool.

5. Potential effervescence with use of sodium bisulfate as a preservative for low-level VOC analysis of soils:

This method of preservation is not preferred and, therefore, is not outlined below. If it is used, the following cautions exist:

a. Carbonaceous or strongly alkaline soils may cause potential effervescence when reacting with the sodium bisulfate and may result in a loss of VOCs and a shattered vial. If effervescence occurs, sodium bisulfate should not be used. The laboratory must be contacted and low-level preservation techniques, using water only, should be followed.
b. Loamy materials or materials containing decayed material may result in false positive results for acetone due to the interaction with the sodium bisulfate.
c. Some VOCs may be lost due to the resulting acidification when sodium bisulfate is used (e.g., styrene, 2-chloroethyl vinyl ether, acrylonitrile).
d. Some VOCs may be lost if the laboratory is using a heated purge in combination with the sodium bisulfate preservative (e.g., methyl tert butyl ether [MTBE] and other fuel oxygenates).

1.4 Sample Containers and VOC Sampling Equipment

- Method 5035A-compatible containers or kits (for VOCs, VPH, and GRO): Preservatives may be required for some samples with certain variations of SW-846 method 5035A – consult the governing regulatory agency or principal analytical chemist to determine which preservatives are necessary.

  Low-level VOCs: two 40-mL VOA vials pre-preserved with 5 mL organic-free water and also containing a magnetic stir bar.
  High-level (or medium-level) VOCs: one 40-mL VOA vial pre-preserved with 5 or 10 mL of purge-and-trap-grade methanol. Volume will be dependent upon laboratory's preference or regulatory agency requirements (e.g., New Jersey Department of Environmental Protection prefers vials with 10 or 25 mL of purge-and-trap-grade methanol).
  VPH and GRO: One 60-mL vial pre-preserved with 25 mL of purge-and-trap-grade methanol **or** One 40-mL VOA vial pre-preserved with 15 mL of purge-and-trap-grade methanol
  and
  One glass container (or other appropriate container) with no preservative to allow the laboratory to perform the percent solids measurement. NOTE: The laboratory typically requires a minimum of 20 grams to perform this test. Therefore, submitting a sample size less than 4 ounces may be acceptable. This additional container will not be required if the sample is also being submitted for other non-VOC parameters.

- En-Core® samplers, or equivalent, for VOC, VPH and/or GRO analysis:

  High-level VOC or GRO analysis: one 5-gram En-Core® sampler.
  Low-level VOC analysis: two 5-gram En-Core® samplers.
  VPH, GRO or toxicity characteristic leaching procedure (TCLP) VOC analysis: one 25-gram En-Core® sampler.

- Disposable plastic syringes or Terra Core™ samplers.

- Foam VOC vial holders.

- Portable digital scale (accurate to ± 0.01 grams) with calibration weights.

2.0 COLLECTION OF SAMPLES USING EN-CORE® SAMPLERS, OR EQUIVALENT

- The sample will be collected using an En-Core® sampler, or equivalent, as soon as possible after the soil has been exposed to the atmosphere.
- Check that the En-Core® sampler, or equivalent, is full using both of the following procedures:
  a. Be sure that the back o-ring on the plunger can be seen when looking through the viewing hole on the handle. This will mean that the soil has pushed the plunger fully to the back.
  b. The plunger can only be rotated when it is fully pushed to the back of the body. Therefore, it is important to twist the plunger to guarantee that the soil has filled the sampler and the back o-rings have sealed.
- Immediately seal the En-Core® sampler, or equivalent. Be sure to twist the cap as it is pushed on. The cap is properly sealed when the two locking arms are completely and symmetrically over the body ridge.
- The samples must be shipped to a laboratory within 24 hours of sampling to ensure the 48-hour hold time for preservation will be met.
- In the event that a field screening technique (instrument reading or visual staining of the soil) indicates the possible presence of VOCs or hydrocarbons, note the observations or instrument readings in the field notes. If the field screening technique does not indicate the presence of VOCs, this should also be noted.
- If samples are collected for only VOC and VPH analyses, a separate aliquot must be collected in an unpreserved container in order for the laboratory to perform a dry weight determination.

3.0 COLLECTION OF SAMPLES USING FIELD PRESERVATION

- Samples for VOCs will be collected as soon as possible after the soil has been exposed to the atmosphere.
- Samples for VOCs will be collected first (prior to collection of samples for other parameters) using an open-barrel disposable syringe, Terra Core™ sampler, or equivalent. In the case of soil samples that consist of dry sand, gravel, or a mixture of gravel and fines, or samples with high moisture (e.g., sediments and soil samples below the water table), an open-barrel disposable syringe may not be practical; a stainless steel spatula or scoop can be used with field preservation techniques.
- Soil samples for VOC analyses should **never** be homogenized.
- Each pre-preserved sample container will be weighed prior to sample collection, and the container/preservative weight will be recorded. This procedure will generally be performed by the laboratory prior to shipping the containers to the field.
- Depending upon project requirements, samples for VOC analysis will be collected as low-level, high-level, or both.

A. Low-level VOCs

1. The syringe will be filled with undisturbed soil of the following volume: 5 grams of soil.

   As an option to the syringes, 5-gram Terra Core™ samplers, or equivalent, can be used. The goal is to have a 1:1 ratio of soil- to- preservative.
2. The soil will be extruded into a pre-preserved VOA vial containing a magnetic stir bar and 5 mL organic-free water. This will be done in replicate.
3. Any sand grains present on the container rim or cap must be removed to ensure an air-tight seal of the vial. The VOA vial will be capped quickly and labeled with the sample ID, date, and time of collection. Labels should not be written on the cap of the vial.
4. Gently swirl sample to break up the soil aggregate, if necessary, until the soil is covered with preservative. It is imperative that the soil sample be completely immersed in the preservative solution.

5. In the event that a field screening technique (instrument reading or visual staining of the soil) indicates the possible presence of VOCs or hydrocarbons, note the observations or instrument readings in the field notes. If the field screening technique does not indicate the presence of VOCs, this should also be noted.
6. If samples are collected for only VOC analysis, a separate aliquot must be collected in an unpreserved container in order for the laboratory to perform a dry weight determination.

B. High-level VOCs, VPH, or GRO

1. High-level VOCs: The syringe will be filled with undisturbed soil of the following volume: 5 or 10 grams of soil for high-level analysis (added to the 5 or 10 ml of methanol, respectively). This may also depend upon the regulatory agency (e.g., New Jersey Department of Environmental Protection requires 8 to 12 grams in 25 mL methanol or 5 grams in 10 mL methanol).

   VPH or GRO: The syringe will be filled with 25 grams of undisturbed soil if 60-ml vials with 25 ml of methanol are used, or 15 grams of undisturbed soil if 40-ml vials with 15 ml of methanol are used. The goal is to have a 1:1 ratio of soil- to- methanol.

   As an option to the syringes, 5-gram Terra Core™ samplers, or equivalent, can be used. Typically, the goal is to have a 1:1 ratio of soil- to- preservative.
2. The sample will be extruded into a VOA vial containing purge-and-trap grade methanol
3. Any sand grains present on the container rim or cap must be removed to ensure an air-tight seal of the vial. The VOA vial will be capped quickly and labeled with the sample ID, date, and time of collection. Labels should not be written on the cap of the vial.
4. Gently swirl sample to break up the soil aggregate, if necessary, until the soil is covered with preservative. It is imperative that the soil sample be completely immersed in the preservative solution.
5. In the event that a field screening technique (instrument reading or visual staining of the soil) indicates the possible presence of VOCs or hydrocarbons, note the observations or instrument readings in the field notes. If the field screening technique does not indicate the presence of VOCs, this should also be noted.
6. Methanol is considered to be a hazardous material by the US Department of Transportation (DOT) and the International Air Transportation Association (IATA). Shipments containing methanol between the field and the laboratory must conform to the rules established in Title 49 of the Code of Federal Regulations (49 CFR parts 171 to 179) and the most current edition of the IATA Dangerous Goods Regulations. The volumes of methanol recommended in the VOC method fall under the small quantity exemption of 49 CFR section 173.4. Refer to Attachment B for further details.
7. If samples are collected for only VOC analysis, a separate aliquot must be collected in an unpreserved container in order for the laboratory to perform a dry weight determination.

Attachment B:

Shipping Methanol-preserved Samples

Shipping of Hazardous Materials

Methanol is considered a hazardous material by the US Department of Transportation (DOT) and the International Air Transport Association (IATA). Shipments of methanol between the field and the laboratory must conform to the rules established in Title 49 of the Code of Federal Regulations (49 CFR parts 171 to 179) and the most current edition of the IATA Dangerous Goods Regulations. Consult these documents or your shipping company for complete details.

Small Quantity Exemption

The volumes of methanol recommended in the high-level VOC, VPH, and GRO methods fall under the small quantity exemption of 49 CFR section 173.4. To qualify for this exemption, all of the following conditions must be met:

- ◊ the maximum volume of methanol in each sample container must not exceed 30 mL
- ◊ the sample container must not be full of methanol
- ◊ the sample container must be securely packed and cushioned in an upright position and be surrounded by a sorbent material capable of absorbing spills from leaks or breakage of sample containers
- ◊ the package weight must not exceed 64 pounds
- ◊ the volume of methanol per shipping container must not exceed 500 mL
- ◊ the packaging and shipping container must be strong enough to hold up to the intended use
- ◊ the package must not be opened or altered while in transit
- ◊ the shipper must mark the shipping container as follows:

"This package conforms to 49 CFR 173.4"

When shipping domestically by Federal Express via ground or air, the following rules apply:

- ◊ follow the inner packaging requirements of 49 CFR 173.4
- ◊ no labels, placards, up arrows, or dangerous goods shipping papers are required
- ◊ if the Federal Express airbill has a shipper's declaration for hazardous goods on it, check the Yes box under *Shipper's Declaration not Required*

When shipping internationally by Federal Express, the following rules apply:

- ◊ follow the inner packaging requirements of 49 CFR 173.4
- ◊ use dangerous goods shipping papers
- ◊ apply orientation arrows on opposite vertical sides on the exterior of the package

Shipping Papers for International Shipments

International shipments must be accompanied by dangerous goods shipping papers that include the following:

Proper Shipping Name:	Methyl Alcohol
Hazardous Class:	Flammable Liquid
Identification Number:	UN1230
Total Quantity:	*(mL methanol/container x the number of containers)*
Emergency Response Info:	Methanol SDS attached
Emergency Response Phone:	1-800-424-9300

Attachment C:

SOP Fact Sheet

SOIL SAMPLING PROCEDURES – SOP 003 FACT SHEET

PURPOSE AND OBJECTIVE

Soil sampling is conducted in order to obtain a representative sample for laboratory analysis of constituents of interest at a given site. Soil samples may be collected using a variety of methods and equipment depending on the depth of the desired sample, the type of sample required (disturbed vs. undisturbed), and the soil type.

WHAT TO BRING

- Appropriate level of personal protective equipment (PPE), as specified in the site-specific Health and Safety Plan (HASP).
- Sample containers: The proper containers should be determined in conjunction with the analytical laboratory in the planning stages of the project, and will depend on the analytical program, laboratory SOPs, and regulatory requirements.
- For non-volatile organic compound (VOC) parameters, glass containers with Teflon®-lined caps are typically utilized. Typical containers used for VOC parameters are provided in Attachment A. Brass liners, steel liners, or soil core acetate liners with Teflon® tape and plastic end caps may also be used.
- Stainless steel mixing bowl or new aluminum pie pan.
- Plastic bowl or plastic resealable bag for inorganics.
- Stainless steel spoon or spatula or sterile individually wrapped single use scoop.
- Hand auger, mud auger, sand auger, bucket auger, and/or T-handle.
- Post hole auger.
- Extension rods.
- Stainless steel trowel.
- Shovel.
- Applicable field screening equipment with calibration solution/gas (i.e., pH meter, photoionization detector, flame ionization detector, etc.)
- Tape measure or folding ruler.
- Wooden stakes and spray paint, plastic flagging (highly visible), or steel pin flags.
- Field book and/or boring log.
- Sample container labels.
- Chain-of-custody (COC) forms (TRC or laboratory, as appropriate).
- Custody seals for sample coolers.
- Tape to secure sample coolers and sample container labels (if necessary).
- Camera.
- Maps/site plan.
- Survey equipment, global positioning system (GPS), or other means of measuring sample locations.
- Indelible marking pens or markers.
- Organic absorbent material (e.g., Slickwick, ground corn cob, sawdust).
- Sample coolers.
- Bubble wrap.
- Ice (for sample storage/preservation).
- Zip-loc® plastic bags (for ice and COCs).
- Equipment decontamination supplies (see ECR SOP-010).
-

OFFICE

- Prepare/update the HASP; make sure the field team is familiar with the latest version.
- Review workplan, discuss the objective for the soil sampling program with the Project Manager and/or the field lead. Develop strategy including sample order, collection method, designation, analytical parameters, turn-around times, laboratory, etc.
    - Are the soil cuttings to be containerized in drums or returned to borehole?
    - Volume of soil required for each sample?
    - QA/QC sample collection?
    - Field decontamination required?
- Confirm that all necessary equipment is available in-house or has been ordered. Rental equipment is typically delivered the day before fieldwork is scheduled. Prior to departure, test equipment and make sure it is in proper working order.
- Verify that a utility survey/mark-out has been performed to ensure that sample locations are clear of overhead and buried utilities. Obtain a copy of the mark out ticket or confirmation number. Additionally, a private geophysical sub-surface survey may be necessary.
- Review sample bottle order for accuracy and completeness.
- Confirm soil boring locations (or specific sampling areas) are clearly identified on figure and that soil boring and sample designations are understood.

SOIL SAMPLING PROCEDURES

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ON-SITE

- Verify that underground utilities have been marked out and that the mark outs are clear. Stay at least two feet away from any marked utility. Identify if any overhead obstructions or limited access areas exist near proposed borings and contact the Project Manager if any proposed locations need to be moved. Sketch/photograph mark-out locations. Client or project-specific utility clearances such as air-knifing or GPR may also be required.
- Review the HASP with all field personnel, conduct Health & Safety tailgate meeting.
- Ensure appropriate PPE is worn by all personnel and work area is safe (i.e., utilize traffic cones, minimize interference with on-site activities and pedestrian traffic, etc.)
- Calibrate equipment (if applicable) and record all equipment serial numbers in the field book.
-

GENERAL SOIL SAMPLING PROCEDURES

- Refer to other TRC SOPs for the proper procedures for classifying soil samples (ECR SOP 005) and for screening of samples for VOCs (ECR SOP 014).
- Refer to Attachment D of this SOP for specialized sampling requirements for PFAS.
- Refer to the appropriate guidance documents for state-specific sampling requirements.
- Perform any required field screening in-situ or immediately upon retrieval of the soil sample from the subsurface.
- Samples for VOC, VPH, or GRO analysis are collected as soon as possible after the soil has been exposed to the atmosphere and prior to sample collection for other analyses. Refer to Attachment A of this SOP for additional details.
- After collecting the sample(s) for VOC analysis, the sample portion for the remaining analyses should be well homogenized in a decontaminated stainless-steel bowl, disposable new aluminum pie pan, plastic bowl (for inorganics), or re-sealable plastic bag (for inorganics) to ensure the sample is uniform and as representative as possible of the sample media.
- Stones, gravel, vegetation, or debris (such as concrete, asphalt, ash or slag) should be removed from the soil sample as much as practical prior to placement in sample containers, unless these matrices are part of the overall characterization program.
- Transfer to sample containers using new, clean, or decontaminated spoons/scoops.
- Filling of the sample bottles should be completed immediately after sample collection to minimize losses due to volatilization and biodegradation. Soil classification can be completed following sample collection.
- Place the sample into an appropriate, labeled container(s) by using the alternate shoveling method and secure the cap(s) tightly. The alternate shoveling method involves placing a spoonful of soil in each container in sequence and repeating until the containers are full or the sample volume has been exhausted. Threads on the container and lid should be cleaned to ensure a tight seal when closed.
- Make sure ALL sample containers are clearly labeled with the site name, sample date, sample collection time and sample designation including depth in indelible ink. Make sure to clearly identify requested samples and analyses on the COC.
- Labeled samples should be immediately put into a cooler with ice; sample coolers should always be kept within eyesight or stored within the cab of the vehicle or other secured place such as a locked office.
- Be aware of sample holding times and arrange for samples to be in the laboratory's possession accordingly.
- Restore the sampling location to grade in accordance with applicable state or federal regulations and/or the site-specific work plan. Options include backfilling the sample location with the remaining removed soil, bentonite pellets, or cement/bentonite grout depending on site conditions/hole depth and patching the surface to match the surrounding area (e.g., topsoil with grass seed, asphalt, or concrete patch), as necessary.
- Record locations of soil borings/samples in the field book by sketching a map and/or providing a description of the location. When measuring locations of soil borings/samples, always use fixed landmarks such as buildings, fences, curbs, etc.
- Decontaminate sampling equipment in accordance with TRC's SOP (ECR SOP 010) on equipment decontamination.
- Ensure any IDW is appropriately managed. If IDW cannot be returned to the site, consider material containment, such as a composite drum, proper labeling, on-site storage by the client, testing for disposal, approval of the materials, and ultimately the pickup and disposal of the materials by appropriately licensed vendors.

SOIL SAMPLING PROCEDURES

Surface Soil Sampling Procedures

The depth of surface soil samples are typically from 0-6 in. or 0-12 in. and will be determined on a site-specific basis and may be influenced by site-specific conditions. The following procedure should be used for surface soil sampling:

- If a thick, matted root zone, leaf layer, gravel, surface debris, concrete, etc. is present at or near the surface, it should be carefully removed using clean, decontaminated tools before the soil sample is collected. The presence and thickness of any such material should be recorded in the field book for each location. The depth measurement for the soil sample begins at the top of the soil horizon, immediately following any such removed materials.
- A decontaminated stainless-steel spoon, scoop, or trowel is typically used for surface soil sampling depths from 0 to 12 inches bgs. A hand auger or shovel may also be used to dig down to the desired depth and then after careful removal of the dug soils from the hole, a decontaminated stainless-steel spoon, scoop, or trowel is used to collect the soil sample from the bottom of the hole for laboratory chemical analysis.
- Continue by following the General Soil Sampling Procedures.

Hand Auger Sampling Procedures

Hand augers may be used to advance boreholes and collect soil samples in shallow subsurface intervals. The auger is advanced by simultaneously pushing and turning using an attached T-handle with extensions (if needed). Auger holes are advanced one bucket at a time until the appropriate sample depth is achieved. The following procedure should be used for hand auger sampling:

- Clear the area to be sampled of any surface debris (e.g., twigs, rocks, litter).
- Begin augering, periodically removing and depositing accumulated soils onto a plastic sheet spread near the borehole.
- When the sample depth is reached, remove the bucket used to advance the borehole and attach a decontaminated or clean bucket. Place the clean auger bucket in the borehole, advance the clean auger bucket to fill it with the soil sample and then carefully remove the clean auger bucket.
- If VOC analysis is to be performed, collect a sample directly at the bottom of the boring, if within reach, and not from the auger bucket. If not within reach, collect the sample directly from the auger bucket or from minimally disturbed material immediately after the auger bucket is emptied.
- Continue by following the General Soil Sampling Procedures.
- Refer to the SOP for special considerations for hand auger sampling.

Direct Push/Split Spoon/Sonic Drilling Sampling Procedures

For some soil investigations, soil logs provide justification for sample locations and intervals, so be descriptive and precise.

- The driller will advance the soil sampler (macrocore, split spoon, sonic casing, etc.) which will then be given to the sampler - confirm with driller which end is top and which end is bottom. Record the time of core collection in the field book (military time). Begin the soil record by indicating the soil boring location and ID, followed by the depth interval in feet bgs [e.g., B-1/0-4].
- Record the blow count per six-inch interval when collecting split-spoon samplers with hollow stem auger rig. The drillers will keep the count and repeat them to you. If refusal is encountered, the count is recorded in the book as "# of hammer blows / depth in inches the spoon is driven" (e.g., 50/3 – means 50 blows of the hammer advanced the spoon 3 inches).
- Measurement of vertical depth should start from the top of the ground surface. The presence and thickness of surface asphalt, surficial concrete slabs or gravel sub-base should be noted in the field book and/or boring log.
- Measure the length of recovered soil in inches and record in the field book.
- Continue by following the General Soil Sampling Procedures. If a specific depth interval is targeted for sampling, be sure to account for percent recovery when selecting the sample interval.
- Refer to the SOP for special considerations for Direct Push, Split Spoon, and Sonic Drilling sampling.

Shelby Tube/Thin-Walled Sampling Procedures

Shelby tube or thin-walled soil sampling should be conducted in accordance with ASTM Method D1587 Practice for Thin-walled Tube Sampling of Soils for Geotechnical Purposes.

To collect a sample, the tube is attached to a string of drill rod and is lowered into the borehole, where the sampler is then pressed into the undisturbed material by hydraulic force from the drill rig. After retrieval to the surface, the tube containing the sample is then removed from the sampler head.

- If samples for chemical analyses are needed, the soil contained inside the tube is then removed for sample acquisition by following the direct-push sampling procedures.
- If the sample is collected for geotechnical parameters, the tube is typically sealed to maintain the sample in its relatively undisturbed state, capped, labeled appropriately (including sample ID, top end of sample, inches of recovery, etc.), and shipped to the appropriate geotechnical laboratory. The tube is typically stored in an upright position to maintain the integrity of the undisturbed sample.

- For geotechnical use, check with the laboratory prior to sampling to understand sample volume recoveries needed to perform the actual tests.
  - Refer to the SOP for special considerations for Shelby Tube or Thin-Walled sampling.

EXCAVATOR SAMPLING PROCEDURES

A backhoe or excavator can be used to assist with soil sampling such as during remedial excavation activities (to collect floor and sidewall samples within the excavation), test pit installation, or trenching operations. The following procedures are used for collecting soil samples excavated with a backhoe or excavator:

- For test pits or trench excavation, excavate in accordance with the site-specific work plan. The work plan may also require that excavated soils be placed on plastic sheets or another impervious surface and protected from rain.
- Refer to the site-specific work plan for the number of floor and/or sidewall samples, which is typically driven by the surface area and can vary depending on the governing regulatory agency.
- Samples can be collected using a trowel, spoon, or coring device at the desired intervals. A clean shovel may be used to remove a 1 to 2- inch layer of soil from the vertical face of the pit that contacted the backhoe bucket and where soil sampling is planned. Scrape the vertical face at the point of sampling to remove any soil that may have fallen from above and to expose fresh soil for sampling.
- In many instances, soil sample locations within the excavation area are inaccessible (do not physically enter backhoe excavations to collect a sample). In these cases, soil samples can be collected directly from the backhoe bucket – use caution not to collect a soil sample from edges that may have come into contact with the backhoe bucket.
- Continue by following the General Soil Sampling Procedures.
- Abandon the pit or excavation according to applicable state regulations and the site-specific work plan. Generally, shallow excavations can simply be backfilled with the removed soil material.
  - Refer to the SOP for special considerations for Excavator sampling.

STOCKPILE SOIL SAMPLING PROCEDURES

Stockpiled soils are typically sampled to characterize the soils for reuse or disposal. The stockpile sampling strategy used must consider the source of the soil and all available data, field observations, shape/dimensions and volume of the pile, and sampling frequency requirements established by oversight regulatory agencies or potential soil disposal facilities.

If the stockpile is known to be a representative mixture of soil with no known or suspected significant variability of contamination with depth in the pile, the stockpile sampling may be conducted according to the surface soil sampling method described above. However, if the soil characteristics are not known or are known or suspected to vary with depth in the pile, both surface soil and deeper subsurface soil samples will be required to properly characterize the soil pile. Based on the minimum required number of samples for the estimated stockpile volume, the stockpile is divided into the appropriate number of estimated volumes equal to that sample number.

Refer to the SOP for special considerations for Stockpile Soil sampling.

POST SAMPLING ACTIVITIES

- After the samples have been collected, the sampling location should be surveyed in the field with a GPS unit if not surveyed later by some other means. A sketch or photograph of the sampling locations should also be included in the field book.
- Package the samples with bubble wrap and/or organic absorbent as necessary.
- Place the samples into a shipping container and cool to 4ºC. If wet ice is used to cool the samples, place the ice in double-bags to prevent water from the melting ice from damaging the samples during shipment.
- Complete and cross check the COC form.
- Refer to Attachment B in the SOP for specific guidance on shipping methanol-preserved samples.
- Decontaminate non-disposable sampling equipment.

DOS AND DO NOTS OF SOIL SAMPLING

DOs:

- No matter the work plan or the site, DO have the following items when going into the field:
  - Site-Specific HASP
  - Appropriate PPE
  - Field book and a pen with indelible ink
  -
  - Business cards
- DO review soil boring logs or cross sections from previous sampling events, if available.
- DO call the Project Manager or field team leader if unexpected conditions are encountered and at least twice during the workday to update them. Even if everything is fine and there are no questions, call or text with an update. It is also recommended to call when sampling is winding down for the day to make sure that the work plan has been fully implemented and there are no additional tasks to complete.
- DO have the numbers for laboratory, vehicle rental, and equipment rental providers readily available while in the field.
- DO decontaminate any heavy equipment used for the advancement of sampling devices by steam cleaning or high pressure/hot water wash prior to and between sample locations. This would include, but is not limited to auger flights, drill rods, backhoe buckets and other respective accessories.
- DO review and count the sample bottles and compare to the COC prior to leaving the site.
- DO record sampler type (e.g., macrocore, split spoon, etc.) and boring method (e.g., direct push, hammer, etc.) in the field book.
- DO record the hammer weight, the distance of the hammer drop and the method for hammer lift (i.e., cathead and rope, hydraulic, etc.) in the field book at least once per day when collecting split-spoon samples with a drill rig.

DO NOTs:

- DO NOT sign anything other than the COC in the field. This includes disposal documentation, statements, etc; call the Project Manager if there is an issue.
- DO NOT use non-indelible ink to label samples or record field notes – if the field book gets wet, notes become illegible.
- DO NOT include any upper soils which may "fall" as a result of the open borehole caving in (slough) when recording recovery.
- DO NOT use general terms such as "Fill" or "Till" as a sole description for layers – always give detailed description of soil components

Attachment D:

SOP Modifications for PFAS

Due to the pervasive nature of PFAS in various substances routinely used during sampling and the need to mitigate potential cross-contamination or sampling bias to ensure representative data are collected, special care should be taken when sampling for PFAS. The following table highlights the required modifications to this SOP when sampling for PFAS.

PFAS Sampling Protocols	
SOP Section Number	**Modifications to SOP**
1.3	• Do not use equipment utilizing Teflon® during sample handling or mobilization/demobilization. This includes waterproof/resistant paper products, certain personal protective equipment (PPE) (see below), and Teflon® tape. • Blue Ice® (chemical ice packs) must not be used to cool samples or be used in sample coolers. Regular ice in Ziploc® bags can be used. • Do not use low density polyethylene (LDPE)[1] or glass sample containers or containers with Teflon-lined lids. HDPE or polypropylene containers are acceptable for sample storage. HDPE or polypropylene caps are acceptable. • Do not use aluminum foil. • Waterproof field notes, plastic clipboards and spiral bound notebooks should not be used. Field notes should be recorded on loose paper field forms maintained in aluminum or Masonite clipboards. Field notes should be attached to the project-specific field notes or folder upon returning to the office. • Avoid using waterproof labels for sample bottles. The use of paper labels covered with clear tape or placed in Ziploc® bags to avoid moisture on the sample label is acceptable. • Do not use Post-It Notes during sample handling or mobilization/ demobilization. • Refer to TRC's SOP ECR-010 Equipment Decontamination for PFAS-specific decontamination protocols. Ensure that PFAS-free water is used during the decontamination procedure.
1.5	Always consult the Site Specific Health and Safety Plan (HASP) prior to conducting field work. The following considerations should be made with regards to field preparation during PFAS sampling: • Tyvek® suits should not be worn during PFAS sampling events. Cotton coveralls may be worn. • Boots and other field clothing containing Gore-Tex™ or other waterproof/resistant material should not be worn. This includes rain gear. Boots made with polyurethane and polyvinyl chloride (PVC) are acceptable. • Stain resistant clothing should not be worn. • Food and drink should not be allowed within the exclusion area. Pre-wrapped food or snacks should not be in the possession of sampling personnel during sampling. Bottled water and hydration drinks (e.g., Gatorade®) may be consumed in the staging area only. • Personnel involved with sample collection and handling should wear nitrile gloves at all times while collecting and handling

PFAS Sampling Protocols	
SOP Section Number	**Modifications to SOP**
	samples or sampling equipment. Avoid handling unnecessary items with nitrile gloves. A new pair of gloves must be donned prior to collecting each sample. • Wash hands with Alconox or Liquinox and deionized water after leaving vehicle before setting up at a soil sampling location.
1.6	• Avoid wearing clothing laundered with fabric softeners. • Avoid wearing new clothing (recommended 6 washings since purchase). Clothing made of cotton is preferred. • Avoid using cosmetics, moisturizers, hand creams, or other related products as part of cleaning/showering on the day of sampling. • Avoid using sunscreens or insect repellants that are not natural or chemical free. • If installing borings for PFAS sampling, assume the surface soil is contaminated with PFAS and remove the top six inches and transfer to drums prior to installing the borings. Clear an area of at least 1.5 feet by 1.5 feet. Keep all site surface soil in one drum, if possible. It is important to minimize PFAS in the surface soil from getting into the boring during soil sampling or well construction. • If sampling for PFAS under a roadway, move the dense aggregate subgrade out of the way prior to sampling. • Efficient and consistent homogenization procedures must be performed on soil samples; this is critical due to the small mass used by the laboratory. Do not homogenize soil in aluminum pie pans; use a decontaminated stainless steel bowl.
2.2	• LDPE and/or glass containers should not be used for sampling. Teflon®-lined caps should also not be used during sample collection. Instead, HDPE or polypropylene containers are acceptable for sample storage. HDPE or polypropylene caps are acceptable. Do not homogenize soil in aluminum pie pans. Use a decontaminated stainless steel bowl. • Stainless steel tools should not be wrapped in aluminum foil after decontaminating prior to and in between uses. • Homogenize the soil sample in a decontaminated, stainless steel bowl and place in an appropriate laboratory-provided sample container (as listed above) following the collection of VOC, VPH or GRO samples.
2.2.3	• Do not use Teflon® liners for direct push sampling methods. Cellulose acetate butyrate (CAB) liners are acceptable.
2.2.7	• Homogenize the soil sample in a decontaminated, stainless steel bowl and place in an appropriate laboratory-provided sample container (as listed above) following the collection of VOC, VPH or GRO samples.
2.3	• Samples for PFAS analysis must be shipped at <10°C. Standard coolers are acceptable. Keep high-concentration PFAS samples in separate coolers from low-concentration PFAS samples.

[1]PFAS have been used as an additive in the manufacturing of LDPE to smooth rough surfaces.

Attachment E:

Explanation of Common Subsurface Sampling Technologies

Hand Augering

Hand augers may be used to advance boreholes and collect soil samples in shallow subsurface intervals. Often, 4-inch diameter stainless steel auger buckets with cutting heads are used. The auger is advanced by simultaneously pushing and turning using an attached T-handle with extensions (if needed).

The practical depth of investigation using a hand auger largely depends upon the soil properties and depth of investigation. In sand, augering is typically easy to perform, but the depth of collection is limited to the depth at which the sand begins to flow or collapse. The use of hand augers may be of limited use in soils containing large amounts of unnatural fill (e.g., brick, slag, concrete), coarse gravel and cobbles (or larger grain size), and in tight clays or cemented sands. In these soil types, it becomes more difficult to recover a sample due to increased friction and torque of the hand auger extensions as the depth increases. At some point, these problems become so severe that alternate methods (i.e., power equipment) must be used.

Auger holes are advanced one bucket at a time until the appropriate sample depth is achieved. When the sample depth is reached, the bucket used to advance the hole is removed and decontaminated or a clean bucket is attached. The clean auger bucket is then placed in the hole and filled with soil to make up the sample and then carefully removed.

Direct Push

Direct-push sampling methods are used primarily to collect shallow and deep subsurface soil samples. Soil sampling probes may range from simple hand tools to truck-mounted or track-mounted hydraulically operated rigs. The sampling tool is hydraulically driven into the soil, filling the tube, and withdrawn. All of the sampling tools involve the collection and retrieval of the soil sample within a thin-walled liner. The following sections describe two specific sampling methods using direct-push techniques, along with details specific to each method.

- *Macro-Core® Sampler (Direct-push)* - The Macro-Core® (MC®) sampler is a solid barrel, direct-push sampler equipped with a piston-rod point assembly used primarily for collection of either continuous or depth-discrete subsurface soil samples. Other lengths are available, the standard MC® sampler comes in lengths of 48 or 60 inches (1219 or 1524 mm) with an outside diameter (OD) of 2.25 inches (57 mm). The MC® sampler is capable of recovering a discrete sample the length of the sample core used with a diameter of 1.5 inches (38 mm) contained inside a removable liner. The resultant sample volume is an approximate maximum of 1400 mL (for a 48-inch sampler). The MC® sampler may be used in either an open-tube or closed-point configuration.

- *Dual-tube Soil Sampling System (Direct-push)* - The Dual-tube soil sampling system is a direct-push system for collecting continuous core samples of unconsolidated materials from within a sealed outer casing of 2.25-inch (57 mm) to 6-inch (152 mm) OD probe rod. For the 2.25-inch OD probe rods, the samples are collected and retrieved within a liner that is threaded onto the leading end of a string of 1.25-inch (32 mm) OD diameter probe rods inserted into the bottom of the outer casing. Collected samples have a volume of up to 800 mL in the form of a 1.125-inch x 48-inch (29 mm x 1219 mm) core. In addition to the 48-inch length, nominal liner lengths include 36 inches, 1 meter, and 60 inches. Use of this method allows for collection of a continuous core inside a cased hole, minimizing or preventing cross contamination between different intervals during sample collection. The outer casing is advanced, one core length at a time, with only the inner probe rod and core being removed and replaced between samples. If the sampling zone of interest begins at some depth below ground surface, a solid drive tip must be used to drive the dual-tube assembly and core to its initial sample depth.

Split Spoon

All split-spoon samplers, regardless of size, are basically split cylindrical barrels that are threaded on each end. The leading end is held together with a beveled threaded collar that functions as a cutting shoe. The other end is held together with a threaded collar that serves as the stub used to attach the spoon to a string of drill rod.

- *Standard Split Spoon* - A drill rig auger is used to advance a borehole to the target depth. The drill auger string is then removed and a standard split spoon is attached to a string of drill rod. Split spoons used for soil sampling must be constructed of hardened carbon steel and are typically 2.0 inches OD (1.5 inches inside diameter) and 18 inches to 24 inches in length. Other diameters and lengths are common and may be used if constructed of the proper material. After the spoon is attached to the string of drill rod, it is lowered into the borehole. The safety hammer is then used to drive the split spoon into the soil at the bottom of the borehole. After the split spoon has been driven into the soil, filling the spoon, it is retrieved to the surface, where it is removed from the drill rod string and opened for sample acquisition.

Shelby Tubes

Shelby tubes, also referred to generically as thin-walled push tubes or Acker thin-walled samplers, are used to collect subsurface soil samples in cohesive soils and clays during drilling activities. In addition to samples for chemical analyses, Shelby tubes are also used to collect relatively undisturbed soil samples for geotechnical analyses of physical properties such as shear strength, grain size distribution, density, hydraulic conductivity and permeability, to support engineering design, construction, and hydrogeologic characterizations at hazardous waste and other sites.

A typical Shelby tube is 30 inches in length, has a 3.0-inch OD (2.875-inch inside diameter) and may be constructed of steel, stainless steel, galvanized steel, or brass. They are typically attached to push heads constructed with a ball check to aid in holding the sample in the tube during retrieval. If used for collecting samples for chemical analyses, it must be constructed of stainless steel. If used for collecting samples for standard geotechnical parameters, any material is acceptable. To collect a sample, the tube is attached to a string of drill rod and is lowered into the borehole, where the sampler is then pressed into the undisturbed material by hydraulic force from the drill rig.

Sonic Drilling

Sonic drilling/rotary vibratory drilling employs the use of high-frequency, resonant energy to advance a core barrel or casing into subsurface formations. Although sonic drilling is not technically a direct-push method of soil sampling, it is similar because soil sample collection from cores of recovered unconsolidated soil would follow the same procedures as described for direct-push methodologies.

Sonic drilling is different than conventional drilling, as sonic drilling minimizes the friction between the borehole wall and the drilling tool by maintaining the resonance of the drill string with a sonic drill head. It also allows for drilling in areas where standard DPT would be refused, potentially requiring multiple step-outs and/or not sampling the desired area. It is also generally faster to advance than HSA or DPT. Typically, the drilling method utilizes dual casings that independently resonate into the subsurface with an inner core barrel that is overrun by an outer casing, similar to dual tube DPT sampling.

Excavator

A backhoe or excavator can be used to assist with soil sampling. This method is typically used during remedial excavation activities (to collect floor and sidewall samples within the excavation), test pit installation, or trenching operations. Test pit excavations are commonly completed to allow for greater observation of physical soil characteristics (e.g., stockpiles) and/or to further investigate buried suspect areas of concern (e.g., petroleum tanks, drums, waste, fill).

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Authorization Signatures

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Technical Reviewer	Date	Environmental Sector Quality Director	Date
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ATTACHMENTS

1.0 INTRODUCTION

1.1 Scope & Applicability

This Standard Operating Procedure (SOP) was prepared to provide TRC personnel with general guidance in performing groundwater sampling activities. This SOP details equipment and sampling procedures for low-flow sampling, multi-volume purge sampling and passive diffusion bag sampling from monitoring wells. Various regulatory agencies and project-specific work plans may have specific requirements (e.g., equipment/instrument, flow rate, etc.) that may be applicable and take precedence, depending on the program.

The objective of groundwater sampling is to obtain a representative sample of water from a saturated zone or groundwater-bearing unit (i.e., aquifer) with minimal disturbance of groundwater chemistry. This requires that the sample being collected is representative of groundwater within the formation surrounding the well bore as opposed to stagnant water within the well casing or within the filter pack immediately surrounding the well casing.

1.2 Summary of Method

There are three general approaches to groundwater purging/sampling that can be used to obtain a representative groundwater sample for analysis: 1) the low-flow or micropurge method where the mixing of the stagnant water is minimized using low-flow pumping rates during the collection of the groundwater sample; 2) the multiple well volume removal approach in which the stagnant water is removed from the well and the filter pack prior to sample collection; and 3) the passive sampler procedure where water quality equilibration with the surroundings is achieved through deployment of the passive sampler for a sufficient amount of time prior to sampling.

For low-flow and multiple well volume removal, there are various types of equipment available to perform groundwater sampling. The most common of these are the submersible pump, peristaltic pump, and bailer. However, the equipment selected and the purge method used, if any, will depend on project goals, data quality objectives (DQOs), hydrogeologic conditions, and regulatory requirements. Care should be taken when choosing the sampling procedures and device(s), as some procedures have the potential to affect the representativeness of the sample more than others. For repeated monitoring events, the sampling methodology and operating equipment employed should be consistent to minimize potential variability due to sampling procedures. The type of sampling method utilized is dependent upon site-specific conditions and it is not within the scope of this document to recommend a specific methodology. For specialized sampling programs involving per- and polyfluorinated alkyl substances (PFAS), refer to Attachment D for further details. Information on applicability of sampling methods can be found on Interstate Technology & Regulatory Council (ITRC) and United States Environmental Protection Agency (EPA) websites.

1.3 Equipment

The following equipment is commonly used to collect groundwater samples from a monitoring well. Site-specific conditions may warrant the use of additional equipment or deletion of items from this list.

- Appropriate level of personal protective equipment (PPE) as specified in the site-specific Health and Safety Plan (HASP)
- Electronic water level indicator capable of measuring to 0.01 foot accuracy
- Oil/water interface probe
- Extra batteries for water level/interface probe
- Submersible pump with low-flow capabilities (less than 1 liter/min) constructed of inert materials (e.g., stainless steel and Teflon®), such as a bladder pump (with sufficient quantity of bladders, o-rings, grab plates, etc.)
- Peristaltic pump
- Source of power for use with submersible or peristaltic pump (e.g., 12-volt battery, compressor, generator, compressed gas tanks, etc.)
- Flow controller for use with submersible pump (varies depending on type of pump used)
- Bottom-filling bailer constructed of inert materials (i.e., polyethylene, polyvinyl chloride [PVC], stainless steel or Teflon®)
- Bailer cord or wire (recommended Teflon®-coated, stainless steel cable; bailer wire; or contaminant-free rope with a Teflon®-coated stainless steel leader to connect bailer and rope)
- Tubing (Teflon®, Teflon®–lined polyethylene, or high density polyethylene [HDPE], type dependent upon project objectives)
- Silicone tubing (only used for peristaltic pump head and/or flow-through cell connections)
- Water quality meter(s) capable of measuring parameters, such as pH, temperature, specific conductivity, oxidation-reduction potential (ORP), and dissolved oxygen (DO)
- Flow-through cell
- T-connector
- Turbidity meter
- Passive sampling device (and any device-specific accessories)
  - Passive diffusion bags (PDBs)
  - Tether (stainless steel cable or marine-grade polyethylene rope), well cap, and weights, unless already installed
  - Funnel (Fill kit)
  - PVC cable ties
  - Tool to cut cable ties
  - PVC discharge tubes
  - Tether reel
- Well lock keys
- Bolt cutters

- Appropriate tools for equipment and to open well box (e.g., socket wrench, pry bar, etc.)
- Containers with lids for purge water (i.e., 5-gallon buckets, drums, etc.)
- Stopwatch or timer
- Graduated measuring container appropriately sized to measure flow rate
- Sample bottle labels
- Laboratory-grade water (can request from lab – for equipment blanks)
- Chain-of-custody (COC) forms
- Sample cooler(s)
- Photoionization detector (PID) or flame ionization detector (FID) for well head monitoring
- Sample containers (may be supplied by the laboratory depending upon the regulatory program): The proper containers should be determined in conjunction with the analytical laboratory in the planning stages of the project. If not included in sample containers provided by laboratory, sample preservatives will need to be kept with sample containers, and added to sample containers prior to sample collection.
- Field book and/or Groundwater Field Data Record (multiple copies)
- Filtration equipment
- In-line filter (0.45 micron [µm]) or as otherwise required by the project-specific work plan.
- Bubble wrap/Bubble wrap bags
- Lint-free, non-abrasive, disposable towels (e.g., Kimwipes®)
- Indelible marking pens
- Plastic bags (e.g., Ziploc®)
- Ice
- Teflon® tape
- Plastic sheeting or large trash bags which can be cut open
- Umbrella, tent, or equivalent for shading equipment (particularly the flow-through cell) from sunlight or blocking rain
- Equipment decontamination supplies
- Container for bailing water out of water-logged road boxes or well vaults
- Map of well locations and well construction data
- Copy of field notes from previous sampling event for reference
- Project-specific work plan

1.4 Definitions

Bailer A cylindrical device suspended from a rope or cable, which is used to remove water, non-aqueous phase liquid (NAPL), sediment or other materials from a well or open borehole. Usually equipped with some type of check valve at the base to allow water, NAPL, and/or sediment to enter the bailer and be retained as it is lifted to the surface. A bailer may be made in varying diameters; however a bailer that fits in a two-inch well is the most common. In some instances a < 1-inch diameter bailer (a.k.a. pencil bailer) is used for small diameter wells.

Borehole A hole drilled into the soil or bedrock using a drill rig or similar equipment.

Dense Non-aqueous Phase Liquid (DNAPL) Separate-phase product that is denser than water and, therefore, sinks to the bottom of the water column.

Depth To Water (DTW) The distance to the groundwater surface from an established measuring point.

Drawdown The response to purging/pumping a well resulting in the lowering of groundwater within the water column in the well or in a water-bearing zone.

FID An instrument that uses a flame to break down volatile organic compounds (VOCs) into ions that can be measured.

Flow-Through Cell The container used to immerse the multi-parameter probes in well purge water during pre-sampling well purging. The flow-through cell is usually made of transparent acrylic and is connected to the end of the discharge tubing creating an in-line, sealed container in which purge water circulates around the measurement probes. The discharge from the pump prior to the flow-through cell may be fitted with a check valve or T-connector for collection of water for turbidity measurement.

Flush Mount The type of well completion where the riser terminates at or below grade. Flush-mounted wells are typically completed with a "curb box" which is an "at-grade" enclosure designed to protect the well riser.

Light Non-aqueous Phase Liquid (LNAPL) Separate-phase product that is less dense than water and therefore floats on the surface of the water.

Monitoring Well	A well made from a PVC pipe, or other appropriate material, with slotted screen installed across or within a saturated zone. A monitoring well is typically constructed with a PVC or stainless steel pipe in unconsolidated deposits and with steel casing in bedrock.
PID	An instrument that uses an ultraviolet light source to break down VOCs into ions that can be measured.
Piezometer	A well made from PVC or metal with a slotted screen installed across or within a saturated zone. Piezometers are primarily installed to monitor changes in the potentiometric surface elevation.
Potentiometric Surface	A surface representing the hydraulic head of groundwater.
Protective Casing	The pipe installed around the well riser that sticks up from the ground (above-grade completions) or is flush with the ground (at-grade completions, e.g., curb box) in order to protect the well integrity. Protective casings are typically constructed of steel or aluminum and usually closeable with a locking cover/hasp to maintain well integrity between sampling events.
Recharge Rate	The rate at which groundwater returns to the water column in the well.
Separate-Phase Product	A liquid that does not easily dissolve in water. Separate-phase product can be more dense (i.e., DNAPL) or less dense (i.e., LNAPL) than water and, therefore, can be found at different depths in the water column.
Static Water Level	Level at which water resides in a well when the water level is at equilibrium with atmospheric pressure.
Well Cover	The cap or lid constructed at the end of the protective casing (above-grade completions) or flush-mounted curb box (ground surface completions) to secure access to the well. Well covers for stick-up wells are often equipped with a hasp to accommodate a padlock. Well covers for flush-mounted road boxes or vaults are opened and closed using a threaded bolt.
Well Filter Pack	A material composed of clean silica sand or sand and gravel of selected grain size and gradation that is placed in the annulus between the screened interval and the borehole wall in a well for the purpose of retaining and stabilizing the formation material.

Well Plug/Expansion Plug	The plug fashioned into a cap placed into the top of the well riser (e.g., J-Plug). Well plugs are usually designed with an expandable gasket that is activated by turning a locking wing nut or removable key latch, closing a snap cap or engaging a magnetic clutch cap to seal the well riser.
Well Riser	Sections of blank (non-slotted) pipe that extend from the well screen to or above the ground surface.
Well Screen	Pipe (typically PVC or stainless steel) used to retain the formation or filter pack materials outside of the well. The pipe has openings/slots of a uniform width, orientation, and spacing. The openings/slots can vary based on formation and filter pack material specifications.

1.5 Health & Safety Considerations

TRC personnel will be on site when implementing this SOP. Therefore, TRC personnel shall follow the site-specific HASP. TRC personnel will use the appropriate level of PPE as defined in the HASP.

The well head should be pre-screened using a PID/FID to avoid inhalation of contaminants venting from the well. If monitoring results indicate sustained elevated concentrations of organic contaminants, the level of PPE may need to be increased in accordance with the HASP or work could be conducted upwind of the well.

When present, special care should be taken to avoid contact with LNAPL or DNAPL. The use of an air monitoring program, as well as the proper PPE designated by the site-specific HASP, can identify and/or mitigate potential health hazards.

Implementing this SOP may require the use of reagents and/or compressed gases for the calibration and operation of field equipment. These substances may be hazardous and TRC personnel must appropriately handle, store, and dispose of them at all times. Skin contact with liquid from preserved sample bottles must be avoided as they may contain strong acids or bases. When filling bottles pre-preserved with acid (e.g., hydrochloric acid, nitric acid, sulfuric acid), vapors may be released and should not be inhaled. Do not allow bottles with acid to be exposed to elevated atmospheric temperatures or sunlight as this will facilitate fumes from the acids.

1.6 Cautions and Potential Problems

The following sections highlight issues that may be encountered and should be discussed with the Project Manager prior to mobilization into the field. Special care should be taken when sampling for PFAS. Please refer to Attachment D for details.

1.6.1 Pre-Sampling Issues

(a) Selection of equipment for groundwater sampling should consider multiple factors, including: DTW, well specifications (e.g., depth and length of well screen intervals), desired flow rate, possible weather conditions, type and concentration of contaminant(s), and remoteness/accessibility to the site. The benefits and limits of each type of groundwater sampling equipment should be fully reviewed during project planning or prior to mobilization if the project-specific work plan does not identify the required equipment. For example, peristaltic pumps are incapable of withdrawing water in wells in which the depth to water is greater than approximately 20-25 feet below ground surface (bgs).

(b) If the screen or open borehole is greater than 10 feet in length, consult the project-specific work plans for the target sampling interval. Generally, pumps are either placed in the middle of the saturated zone if the water level is below the top of the screen or in the middle of the screen interval if the water level is above the top of the screen.

(c) The need for redevelopment of the monitoring wells should be evaluated periodically in accordance with the project-specific requirements. This is assessed by comparing the measured total depth of the well with the constructed depth. If the measured depth is less than the constructed depth, this may indicate siltation of the well and/or the presence of an obstruction in the well. If it is determined that redevelopment is necessary, it should be performed in accordance with ECR SOP 006, *Well Development.* The time necessary for a well to restabilize after redevelopment will be determined on a project-specific basis and may depend on regulatory requirements.

(d) During the total well depth measurement, there is the potential for sediment, if present at the bottom of the well, to be disturbed, thereby increasing the turbidity of the groundwater. Therefore, the total well depth measurement should be collected the day prior to collecting groundwater samples, if possible.

(e) Use caution if using compressed gas cylinders (e.g., nitrogen, carbon dioxide) for purging/sampling of groundwater. Check for leaks around regulator connections by spraying soapy water on the connections. If a leak is discovered, the connection to the regulator should be disassembled, wrapped with Teflon® tape, and reconnected to the cylinder. If the leak continues, the regulator should be replaced. It should be noted that Department of Transportation (DOT) regulations apply to the transportation and handling of compressed gas cylinders (see 49 Code of Federal Regulations [CFR] 171). Never transport cylinders with the regulator attached. Replace the cylinder valve cover on the compressed gas cylinder before transport.

(f) All field personnel must be made aware of the water level measurement reference point being used for each well at a site (i.e., must be clearly marked) in order to ensure collection of comparable data between events.

(g) Bolt cutters may be necessary to remove rusted locks. Dipping rusted locks in a soapy solution may help with opening difficult locks. Oils and other products containing VOCs (e.g., WD-40) should not be used on locks as these compounds may cause contamination of water samples collected at the well. Replace cut locks and note in the field book.

(h) Prior to accessing the well, physical conditions around the well head should be assessed for situations that might result in cross-contamination or the introduction of foreign material/debris into the well. For example, flush-mounted wells may have water or road sand/salt/debris inside the curb box. Rodents and insects (e.g., bees, wasps) have been known to construct nests within the protective casing of a well. If bees, wasps, or other insects are encountered, insecticides should be used with caution as the chemicals may cause contamination of water samples collected at the well. If water or foreign material is introduced into the well, the Project Manager should be immediately notified.

1.6.2 General Purging and Sampling Issues

(a) Prior to installation of a submersible pump into a well, ensure that the tubing is properly sealed to the pump to avoid losing the pump down the well and to prevent escape of air or water from the pump, which could result in poor pump performance and the aeration of the well water. Do not do this by tugging on tubing. Never lower pumps into the well using only tubing; instead a security line attached to the pump is required to prevent potentially losing the pump down the well.

(b) A submersible pump should not be lowered to the bottom of the well to avoid stirring up any sediment at the bottom of the well and prevent getting the pump stuck (fine sediment accumulation in the bottom of the well can create a strong suction with a flat bottom pump such as a bladder pump, which may require jetting to retrieve the pump).

(c) Start with the lowest pumping rate possible and increase until a sustainable rate is reached. Avoid high pumping rates (> 1 liter/min), as this could lead to damage of the well filter pack, if present. Where practical and/or possible, refer to previous sampling events to establish consistent flow rates.

(d) Some regulatory agencies may have concern about the use of peristaltic pumps when sampling for VOCs due to the potential for loss of VOCs during sampling and alteration of other water quality parameters such as pH and alkalinity. Samplers should review the requirements in the project-specific work plan and/or regulatory guidelines prior to performing the work. Explicit approval to use a peristaltic pump for the collection of VOCs may be required by the governing regulatory agency. An option may be to use the "soda straw" method to collect the VOC sample which does not allow the water to go through the pump head:
   (1) After purging the well with the peristaltic pump, collect all fractions <u>except VOCs</u> from the outlet side of the pump (i.e., VOCs will be collected last instead of first).
   (2) Turn the pump off.
   (3) Change into clean gloves.
   (4) Disconnect the tubing coming out of the well from the inlet side of the pump and <u>immediately</u> put a finger over the end of this tubing to prevent water from draining out of the tubing.
   (5) Retrieve tubing from the well, coiling it in one hand as it is being retrieved (maintain finger over end of tubing).
   (6) Open VOC vials. Briefly remove finger from end of tubing to allow water to flow into vial. Replace finger on end of tubing to stop flow. Do this for remaining VOC vials.

(e) In the event that a well cannot be purged and sampled with a pump, the alternative to pumping may be the use of a bottom-filling bailer. The applicable regulatory agency requirements and the Project Manager should be consulted if in doubt about the appropriateness of using a bailer at a site or during a particular sampling event.

(f) During purging and sampling, the tubing should remain filled with water to minimize possible changes in water chemistry due to contact with the atmosphere. All flow-through cells should be shaded from direct sunlight to minimize the potential for off-gassing and temperature fluctuations.

(g) Ensure monitoring instruments (i.e., multi-parameter water quality instrument, turbidity meter, water level measuring device) are maintained in good condition and properly calibrated to ensure accurate readings. Be sure to have appropriate-sized extra batteries on hand.

(h) Adverse weather conditions may present challenges that need to be dealt with on a case-by-case basis. For example, air temperatures below 32°F may cause ice formation in the tubing, flow-through cell, and on the sampling equipment, or heavy rain could cause standing water issues with flush-mounted wells. Heavy rain can also impact electronic sampling equipment; preventative measures should be taken to keep electronic equipment dry.

(i) Observe and avoid any uncontrolled ambient/surrounding air conditions that could affect analytical results (e.g., truck/vehicle exhaust nearby, industrial building vents). Always ensure that vehicles are turned off during sampling to avoid introducing vehicle exhaust into the sample. If uncontrolled ambient/surrounding air conditions cannot be avoided, contact the Project Manager for further instruction; collection of a field blank sample may be warranted in this situation.

(j) Procedures should be established to minimize potential cross-contamination. For example:

- Wrap monitoring and sampling equipment with protective material (e.g., aluminum foil, polyethylene sheeting, Ziploc® bags) after decontamination and between sampling locations to minimize the potential for cross-contamination between well purging events at different locations.
- Use dedicated or disposable sampling equipment or new tubing at each sampling point when appropriate to minimize the need for decontamination.
- Protect sampling equipment and/or the open well head from blowing soil and dust by covering with plastic sheeting as needed.
- If a bailer and rope are used to purge and/or sample the well, then there is the possibility of contamination from the rope used to lower the bailer. New or dedicated rope should be used when appropriate. Alternatively, a decontaminated, Teflon®-coated stainless steel leader can be attached between the rope and the bailer. The leader acts as an extension to the rope and allows for the top of the bailer to enter the water column without immediately placing the rope into the water. It is important to keep the rope clean and not allow contact with the ground surface during bailing.

(k) Disposal of the groundwater collected during purging must be performed in accordance with all applicable regulations and the project-specific work plan.

(l) Clear tape should not be used to cover labels on containers used for certain analyses (e.g., 40-mL vials for VOC analysis) due to potential interference with analytical equipment.

(m) In cases where it is difficult to obtain sufficient sample volume for multiple analytical fractions as well as required quality control (QC) analyses (*e.g.*, field duplicates, matrix spike/matrix spike duplicate [MS/MSD] analyses), discuss this situation with the Project Manager and laboratory prior to sample collection. Laboratories can often "make do" with less volume, especially for inorganic parameters, or increase the reporting limit proportional to the sample volume obtained.

1.7 Personnel Qualifications

Since this SOP will be implemented at sites or in work areas that entail potential exposure to toxic chemicals or hazardous environments, all TRC personnel must be adequately trained. Project- and client-specific training requirements for samplers and other personnel on site should be developed in project planning documents, such as the sampling plan or project-specific work plan. These requirements may include:

- OSHA 40-hour Health and Safety Training for Hazardous Waste Operations and Emergency Response (HAZWOPER) workers
- 8-hour annual HAZWOPER refresher training.

2.0 PROCEDURES

Procedures for collecting groundwater samples from monitoring wells are described below. The project-specific work plan should also be consulted for specific details regarding sampling.

When possible, sampling should always begin at the monitoring well with the least contaminated groundwater and systematically proceed to the well with the most contaminated groundwater, including sites which may have nested wells.

2.1 Pre-sampling Activities

(a) It should be determined if there is the requirement to determine static water level measurements on <u>all</u> wells at the site prior to sampling, regardless if the well is being sampled.

(b) Prior to field activities, review historical groundwater sampling logs (if available) to maintain consistency for the current sampling event (e.g., equipment type, pump intake depth setting, flow rate, etc.)

(c) Organize monitoring, purging, and sampling equipment taking care not to allow cross-contamination. This can be accomplished by laying new polyethylene sheeting near the well or using new buckets, etc.

(d) Calibrate (or perform a calibration check on) all field monitoring equipment on the same day before collecting groundwater samples. Refer to TRC SOPs and manufacturer's equipment calibration instructions. A calibration check may also be required during or at the end of each sampling day. Consult the project-specific work plan.

(e) Unlock the well cover on the well.

(f) Record the sample location, time, and date in the field book and/or on the Groundwater Field Data Record.

(g) On the Groundwater Field Data Record, note the physical condition of the well, including damage, deterioration, and signs of tampering, if any. Collect photographic documentation of serious damage to present to the Project Manager.

(h) Open the well cap and expansion plug, and stay upwind of and not directly over the well. Note any unusual odors, sounds, or difficulties in opening the well and, if required, measure the organic vapor reading at the rim of the well with a suitable organic vapor screening device (e.g., PID or FID), and record the reading in the field book and/or on the Groundwater Field Data Record. If pressure or vacuum is noted or suspected in the well, allow sufficient time for the water level elevation in the well to equilibrate.

(i) Gently lower a clean, decontaminated water level measuring device into the well to determine the static water level. If appropriate for site conditions, check for the presence of LNAPL or DNAPL using an oil/water interface probe (refer to ECR SOP 004, *Water Level and Product Measurements*). If LNAPL or DNAPL is detected, contact the Project Manager before proceeding with purging and sampling activities. Record the information on depth to groundwater to the nearest 0.01 feet, depth to LNAPL or DNAPL, and/or thickness of NAPL in the field book and/or the Groundwater Field Data Record. Refer to ECR SOP 004, *Water Level and Product Measurements*, for proper procedures in performing these measurements.

(j) If required in the project-specific work plan, measure the depth to the bottom of the well to assist in calculating the well volume of the well. If possible, avoid making total well depth measurements on the same day as sampling due to the tendency to disturb sediment during this measurement. If NAPL is suspected, use a decontaminated oil/water interface probe. If the measured depth is less than the constructed depth, this may indicate that the well needs to be redeveloped (see ECR SOP 006, *Well Development*). Consult the project-specific work plan or Project Manager for further instructions.

2.2 Groundwater Purging Activities

Purging is conducted to ensure that representative groundwater is obtained from the water-bearing unit for analysis. The multiple-volume or low-flow purging approach may be used to remove water from the well and monitor the water in order to determine when a well has been adequately purged (i.e., stabilized); at a minimum, the pH, specific conductance and temperature of the groundwater removed during purging should be monitored and recorded in the field notes. Other parameters may be required in some regulatory jurisdictions (e.g., turbidity). Additionally, the purge volume should be monitored and recorded. In some instances, such as when monitoring at solid waste disposal facilities, simply removing an adequate volume of water (e.g., three well volumes) may be suitable for adequate purging, and sampling can commence. Check with the project-specific work plan and appropriate regulatory guidance to determine any specific purging requirements.

If the well has been previously sampled consistent with this SOP, then the prior purging strategy (e.g., method, pump intake depth and the flow rates) should be followed during subsequent sampling events to maintain consistency and minimize potential variability due to the sampling procedure.

2.2.1 Multiple-Volume Purging Approach

The multiple-volume purging approach is typically performed using bailers or submersible or peristaltic pumps. In the multiple-volume purging approach, there are two measurements used to determine adequate purge volume removal prior to sample collection: 1) purge volume and 2) field parameter stabilization. The field parameters should be recorded at regular volumetric intervals. There are no set criteria for establishing how many total sets of measurements are adequate to document stability of parameters. If the calculated purge volume is small, the measurements should be taken frequently enough (e.g., every 3 to 5 minutes) to provide a sufficient number of measurements to evaluate stability. If the purge volume is large, measurements taken every 15 minutes may be sufficient.

<u>Purge Volume</u>
Prior to purging a well, the amount of water inside the well riser and well screen (i.e., water column) should be determined, if possible. To do this, the diameter of the well should be determined and the water level and total depth of the well should be measured and recorded. The specific methodology for obtaining these measurements is included in ECR SOP 004 *Water Level and Product Measurements*.

Once this information is known, the well volume can be calculated using Equation 1:

Well Volume (V) = πr^2 h (cf) **Equation 1**
where:
π = pi (3.14)
r = radius of well in feet (ft)
h = height of the water column in ft. [This may be determined by subtracting the depth to water from the total depth of the well as measured from the same reference point.]
cf = conversion factor in gallons per cubic foot (gal/ft^3) = 7.48 gal/ft^3.

The volume in gallons/linear foot (gal/ft) and liters/linear foot (L/ft) for common-size wells are as follows:

Well Inside Diameter (inches)	Volume (gal/ft)	Volume (L/ft)
1	0.0408	0.1529
2	0.1631	0.6174
3	0.3670	1.3892
4	0.6524	2.4696
6	1.4680	5.5570

If the volumes for the common-size wells above are utilized, Equation 1 is modified as follows:

Well volume = (h)(f) **Equation 2**
where:
h = height of water column (feet)

f = the volume in gal/ft or L/ft

For volumetric purging, an adequate purge is typically achieved when 3 to 5 well volumes have been removed. The field notes should reflect the single-well volume calculations or determinations according to one of the above methods and a reference to the appropriate multiplication of that volume, (i.e., a minimum of 3 well volumes) clearly identified as a purge volume goal.

For volumetric purging, it is suggested that field readings are collected every ½ well/well screen volume after an initial 1 to ½ well volumes are purged. The volume removed between readings can be adjusted as well-specific information is developed.

If removing a specified volume of water (e.g., 3 well volumes) has been determined to be suitable for purging, sampling can commence immediately upon achieving the required purge volume. In other cases, where specified in the project-specific work plan, stabilization of field parameters must be documented prior to sample collection. If, after 3 well volumes have been removed, the field parameters have not stabilized (see discussion in Section 2.2.3), additional well volumes (up to a total of 5 well volumes), should be removed. If the parameters have not stabilized within five well volumes, it is at the discretion of the Project Manager whether or not to collect a sample or to continue purging. If, after 5 well volumes, pH and conductivity have stabilized and the turbidity is still decreasing and approaching an acceptable level, additional purging should be considered to obtain the best sample possible with respect to turbidity. The conditions of sampling should be noted in the field book.

2.2.2 Low-flow Purging Approach

The low-flow purging approach is typically performed using peristaltic pumps or submersible pumps. Low-flow purging (also referred to as low-stress purging, low-volume purging, or Micropurging®) is a method of well purging/sampling that minimizes the volume of water withdrawn from a well in obtaining a representative sample. The term low-flow refers to the low velocity with which water enters the pump intake during purging and sampling. The objective is to draw representative saturated zone water through the well screen to the pump intake while avoiding disturbance of the stagnant water above the well screen through minimizing drawdown of the water column in the well. To achieve this, the flow rate should be adjusted to less than 1 L/min (usually, this will be a rate less than 500 ml/min and may be as low as 100 ml/min). Once drawdown stabilizes, the sampled water is isolated from the stagnant water in the well casing, thus eliminating the need for its removal. This sampling method is based on the principle that water within the screened zone passes through continuously and does not mix with water above the screen. Water entering the pump can be considered representative of water in the formation after drawdown and indicator parameters have stabilized.

When performing low-flow purging and sampling, it is recommended that the pump intake be set in the center of the well screen interval (or center of the water column within the well screen if the water level is below the top of the well screen) to help prevent disturbance of any sediment at the bottom of the well. If known, the pump can be placed adjacent to the areas with the highest hydraulic conductivity or highest level of contaminants. Dedicated pumps can be utilized to minimize disturbance of the water column. Subsequent sampling events should duplicate as closely as possible the pump intake depth and the stabilized flow rate from the previous events.

To begin purging, the pump should be started at the lowest pressure/power flow rate setting (e.g., 100 mL/min) and then slowly increased until water begins discharging. Monitor the water level and slowly adjust the pump speed until there is little or no drawdown or drawdown has stabilized. The pump pressure/power may need to be increased for discharge to occur.

The stabilization of drawdown should be documented. Measure and record the flow rate and water level every 3 to 5 minutes during purging. The flow rate should be reduced if drawdown is greater than 0.3 feet over three consecutive 3 to 5 minute interval readings. Note any flow rate adjustments on the Groundwater Field Data Record. Once an appropriate purge rate has been achieved, record this information, continue purging until water quality indicator parameters have stabilized (see Section 2.2.3), and then sample the well.

Attempts should be made to avoid pumping a well dry. If drawdown cannot be maintained at less than 0.3 feet and the falling water level is approaching the top of the screened interval (or the top of the pump for sampling that began with the water level below the top of the screen), perform the following steps:

1. Reduce the flow rate, or turn the pump off and allow for recovery. (The pump must have a check valve to prevent backflow if it is shut off).
2. Begin pumping again at a lower flow rate.
3. If water draws down to the top of the screened interval again (or the top of the pump for sampling that began with the water level below the top of the screen), turn the pump off and allow for recovery.
4. If two tubing volumes (including volume of water in the pump and flow-through cell) have been removed during purging, sampling can proceed the next time the pump is turned on without waiting for indicator field parameters to stabilize. The project-specific work plan or Project Manager should be consulted for guidance.
5. If this procedure is used, this should be recorded in the field book and/or on the Groundwater Field Data Record.

2.2.3 Field Parameter Stabilization During Purging

Stabilization criteria may depend on project objectives or regulatory-specific requirements. Refer to Appendix A for some of the regulatory-specific requirements for field parameter stabilization. Generally, an adequate purge with respect to the ground water chemistry is achieved when, stability for at least three consecutive measurements is as follows:

- pH ± 0.1 standard unit (SU)
- specific conductance within 3%
- turbidity within 10% for values greater than 5 nephelometric turbidity units (NTUs). If three turbidity readings are less than 5 NTUs, the values are considered as stabilized

Other parameters, such as DO, may also be used as a stabilization parameter. Typical stabilization goals for DO are within 0.2 mg/L or 10% saturation, whichever is greater. DO measurements should be conducted using either a flow-through cell or an over-topping cell to minimize or reduce potential oxygenation of the sample.

Because groundwater temperature is generally not very sensitive in distinguishing between stagnant casing water and formation water and is subject to rapid changes during purging, its usefulness is subject to question for the purpose of determining parameter stability. Even if temperature is not used to determine stability during well purging, it is still advisable to record the sample temperature, along with the other groundwater chemistry parameters, during well purging, as it may be needed to interpret other parameter results.

ORP is not always used as a stabilization parameter since it may also be subject to rapid changes during the purging process; however, it may be measured and recorded during well purging.

2.2.4 Special Considerations During Purging

Wells Purged Dry/Purge Adequacy

For wells with slow groundwater recovery, attempts should be made to avoid purging the well dry. This may be accomplished by slowing the purge rate. As water enters a well that has been purged dry, the water may cascade down the sand pack and/or the well screen, potentially stripping VOCs that may be present and/or potentially mobilizing soil fines into the re-accumulating water column.

However, even with slower purge rates, in some situations, a well may be pumped or bailed dry (evacuated) during the purging process. In these situations, evacuation generally constitutes an adequate purge and the well may be sampled following sufficient recovery (enough volume to allow filling of all sample containers). **It is not necessary that the well be evacuated three times before it is sampled.** Purging parameters should be measured and recorded during sample collection to serve as the measurements of record for the sampling event.

It is particularly important that wells be sampled as soon as possible after purging to maintain sample representativeness. If adequate volume is available upon completion of purging, the well should be sampled immediately. If not, sampling should occur as soon as adequate volume has recovered. If possible, sampling of wells that have a slow recovery should be scheduled so that they can be purged and sampled in the same day after adequate volume has recovered. Wells of this type should, unless it is unavoidable, not be purged at the end of one day and sampled the following day.

Temporary Monitoring Wells

Procedures used to purge temporary groundwater monitoring wells may differ from permanent wells, because temporary wells are installed with different DQOs for immediate sample acquisition. Wells of this type may include standard well screens and risers placed in boreholes created by hand augering, power augering, or by drilling. Alternatively, they may consist of a rigid rod and screen that is pushed, driven, or hammered into place to the desired sampling interval, such as a direct push Wellpoint®, a Geoprobe® Screen Point 15/16 sampler, or a Hydropunch® sampler.

Purging to address stagnant water may not necessarily apply to temporary wells, because stagnant water is not typically present. It is important to note, however, that the longer a temporary well is in place and not sampled, the more stagnant the water column may become, and the more appropriate it may be to apply, to the extent possible, standard permanent monitoring well purging criteria.

In cases where the temporary well is to be sampled immediately after installation, purging is conducted primarily to mitigate the impacts of installation. In most cases, temporary well installation procedures disturb the existing saturated conditions, resulting primarily in increased turbidity. Therefore, the goal of purging, if conducted, may be to reduce the turbidity and remove the volume of water in the area directly impacted by the installation procedure. Low turbidity conditions in these types of wells that are completed within the limit of suction are typically and routinely achieved by the use of low-flow/low-stress purging techniques using variable-speed peristaltic pumps.

2.2.5 Equipment Considerations for Purging

Monitoring well purging is accomplished by using in-place plumbing and dedicated pumps or by using portable pumps/equipment when dedicated systems are not present. The pump of choice is usually a function of the purging approach (e.g., multiple-volume vs. low-flow), well diameter, the DTW, the total depth of the well, the amount of water that is to be removed during purging, the specific analytical testing program for the well, and the equipment previously used during purging and sampling of the well. A peristaltic pump is appropriate for purging whenever the head difference between the sampling location and the water level is less than the limit of suction (approximately 25’ to 30’) and the volume to be removed is reasonably small. For wells where the water level is below the limit of suction, and/or where there is a large volume of water to be purged, the variable-speed electric submersible pump or adjustable-rate bladder pumps would be appropriate. Bailers may also be used for purging in appropriate situations (e.g., shallow wells with small purge volumes); bailers are not suitable for low-flow purging.

The following subsections describe well evacuation devices that are most commonly used. Other devices are available but are not discussed in this SOP due to their limited use. Site-specific operating procedures should be developed in the case that an uncommon purge device is used.

2.2.5.1 Purging with a Suction Pump

There are many different types of suction pumps. They commonly include: centrifugal, peristaltic and diaphragm. Diaphragm pumps can be used for well evacuation at a fast pumping rate and sampling at a low pumping rate. The peristaltic pump is a low-volume pump that incorporates a roller to squeeze flexible tubing, thereby creating suction. This tubing can be dedicated to a well for re-use or discarded. It is recommended that 1/4 inch or 3/8 inch (inner diameter) tubing be used to help ensure that the sample tubing remains filled with water and to prevent water from being aerated as it flows through the tubing. Purging procedures are as follows.

(a) Determine the volume of water to be purged as described in Section 2.2.1 or follow the low-flow approach described in Section 2.2.2 (applicable to peristaltic pumps only).
(b) Take necessary precautions (e.g., laying plastic sheeting around the well) to prevent contamination of pumps, tubing or other purging/sampling equipment with foreign materials.
(c) Assemble the pump, tubing and power source, if necessary, in accordance with manufacturer’s specifications.
(d) Ensure that the pump tubing is set at the pre-determined pump intake depth.
(e) Connect the discharge line from the pump to the flow-through cell for parameter measurements. Use a T-connection or valve prior to the flow-through cell to allow for

collection of water for turbidity measurements. Direct the discharge line from the flow-through cell to a 5-gallon bucket (or equivalent) to contain the purge water for proper disposal. Verify the end of the tubing is not submerged in the purge bucket. Manage purge water as specified in the project-specific work plan.

(f) Do not allow the pump to run dry. If the pumping rate exceeds the well recharge rate, adjust the rate accordingly or, if consistent with the purging and sampling objectives, lower the tubing further into the well and continue pumping.

(g) Using the water quality meter, take an initial reading of the required indicator parameters. All measurements, except turbidity, must be obtained using a transparent flow-through cell unless an unforeseen situation makes this impractical or inadvisable. Initially, turbidity may be elevated. Once turbidity has decreased to a measurable range, begin monitoring indicator parameters at approximately every 3-5 minutes, or as appropriate. Please note that flow-through cell size should be taken into account in conjunction with the flow rate to determine the length of time between water quality parameter readings. At least one flow-through cell volume should be turned over between readings. For example, if the flow through cell size is 500 mL and the flow rate is 100 mL/min, then it would be appropriate to measure water quality parameters every 5 minutes.

(h) Record the readings on the Groundwater Field Data Record. The monitoring probes must be submerged in water at all times. Record the indicator parameters, along with the water level, as described in Step (g) above. If removing a specified volume of water (e.g., 3-5 well volumes) has been determined to be suitable for purging, sampling can commence immediately upon achieving the required purge volume. In other cases, where specified in the project-specific work plan, stabilization of field parameters must be documented prior to sample collection. Stabilization criteria are discussed in Section 2.2.3.

Particulate build-up in the flow-through cell may impact indicator parameters. If the cell must be cleaned during pumping operations, continue pumping and disconnect the cell for cleaning, then reconnect and continue monitoring. Record the start and stop times, and describe the cleaning steps in the field book.

If indicator parameter stabilization is required and parameters have not stabilized after 2-hours of purging (or other pre-determined length of time), one of three options may be taken after consultation with the Project Manager:

1) continue purging until stabilization is achieved;
2) discontinue purging, do not collect any samples, and record in the field book and/or on the Groundwater Field Data Record the stabilization conditions and steps taken to attempt to achieve stabilization; or,
3) discontinue purging, collect samples and document attempts to achieve stabilization.

NOTE: If parameters do not stabilize, or turbidity remains greater than 5 NTU within the project-determined time range (EPA recommends up to 2 hours), contact the Project Manager to develop a modified sampling approach.

(i) Record the volume of water purged on the Groundwater Field Data Record. Record the disposal method used for purge water in the field book.

(j) Once the required volume of water is removed (typically 3 to 5 well volumes) from the well and/or parameters are stabilized to the satisfaction of the project-specific work plan, proceed to Section 2.3, Post-purging Groundwater Sample Collection.

2.2.5.2 Purging with a Submersible Pump

Submersible pumps generally use one of two types of power supplies, either electric or compressed gas. Electric pumps can be powered by a 12-volt DC rechargeable battery, or a 110- or 220-volt AC power supply. Those units powered by compressed gas (e.g., bladder pump) normally use a small electric controller that also needs a 12-volt DC battery or 110-volt AC power. They may also utilize compressed gas from bottles. Pumps differ according to the depth and diameter of the monitoring wells and the height of the potentiometric surface/water table (e.g., pressure head). It is recommended that 1/4-inch or 3/8-inch (inner diameter) tubing be used to help ensure that the sample tubing remains filled with water and to prevent water from being aerated as it flows through the tubing. Purging procedures are as follows.

(a) Determine the volume of water to be purged as described in Section 2.2.1 or follow the low-flow approach described in Section 2.2.2.

(b) Take necessary precautions (e.g., laying plastic sheeting around the well) to prevent contamination of pumps, tubing or other purging/sampling equipment with foreign materials.

(c) Assemble the pump, tubing and power source, if necessary, in accordance with manufacturer's specifications. If the pump itself is being lowered into the well, ensure a safety line is attached.

(d) Non-dedicated purge/sampling vs. dedicated purge/sampling systems.

<u>Dedicated systems:</u> Pump has already been installed. Refer to historical monitoring well information, and record the depth of the pump intake in the field book and/or on the Groundwater Field Data Record.

<u>Non-dedicated systems:</u> Determine the target depth of the pump intake. Note that this may be a historical intake depth; see well construction data or the project-specific work plan. If there is not an established intake depth, the center of the screened interval should be targeted. If the measured water level is lower than the top of the well screen, position the pump intake at the midpoint of the water column. The intake should be generally 1 to 2 feet above the bottom of the well to minimize potential mobilization of any settled sediment, the risk of the pumping suction being broken, or the entrainment of air in the pump tubing and resulting sample. Slowly lower the pump, safety line, and tubing into the well to the pre-determined pump intake depth. The tubing should be cut to the desired length to assist in installing the pump. Measure the depth of the pump intake while lowering the tubing/pump into location. Record the pump intake depth in the field book and/or on the Groundwater Field Data Record. For deeper wells and large diameter wells, two staff members may be necessary to accomplish this task.

(e) Connect the discharge line from the pump to the flow-through cell for parameter measurements. Use a T-connection or valve prior to the flow-through cell to allow for collection of water for turbidity measurements. Direct the discharge line from the flow-through cell to a 5-gallon bucket (or equivalent) to contain the purge water for proper disposal. Verify the end of the tubing is not submerged in the purge bucket. Manage purge water as specified in the project-specific work plan.

(f) Measure the flow rate of the pump with a graduated container and stop watch. The pump pressure may need to be increased for discharge to occur. Record the volume of water collected for a period of 1 minute and calculate the flow rate as follows.

$$Flowrate\,(mL\,/\,min) = \frac{volume\ collected\ (mL)}{1\,minute}$$

(g) Measure the water level and record the flow rate and the water level. This should be performed every 3 to 5 minutes during purging. For low-flow purging, the flow rate should be adjusted to result in a rate between 100 to 500 mL/min; however, if drawdown of the well is observed, a slower flow rate may be necessary. If using a bladder pump, it is recommended that the pump be set to deliver long pulses of water so that one pulse will fill a 40 mL volatile organic analysis (VOA) vial, if possible.

(h) Prior to recording the water quality indicator parameters, a minimum of one tubing volume should be purged. Note that this includes the volume of the flow-through cell.

(i) Proceed to steps (g) through (j) in Section 2.2.5.1.

2.2.5.3 Purging with a Bailer

(a) Determine the volume of water to be purged as described in Section 2.2.1.

(b) Take necessary precautions (e.g., laying plastic sheeting around the well) to prevent contamination of tubing or other purging/sampling equipment with foreign materials.

(c) Use a well-dedicated bailer (i.e., used exclusively for that well only), a decontaminated bailer or an unused, disposable bailer.

(d) Attach an appropriate length of (a) bailing line, (b) Teflon®-coated bailing wire or (c) rope with Teflon®-coated stainless steel leader to reach the bottom of the well. Secure a knot or series of knots to the top of the bailer. Be sure to have additional length of line to facilitate handling of the bailer at the surface (typically 10 ft).

(e) Lower the bailer gently into the well until it reaches the water column and fills with water from the bottom. Note: It is recommended that the bailer be lowered into the water to a depth that prevents the water from entering the top of the bailer. This is done to prevent excess turbulence caused by filling from the bottom and the top simultaneously. Controlling the line attached to the bailer as it is lowered into the well is also important to prevent degassing of the water as the bailer impacts the water. In shallow wells, controlling the line is not too difficult; however, for wells of greater depths it is common to utilize a hand-over-hand (windmill) approach using both hands to control longer lengths of line and prevent the loops in the line from tangling with one another. This procedure is simple to learn and saves a good deal of time by preventing tangles. Do not allow the bailing line or rope to become contaminated by surface soil.

(f) Once the bailer is full of water, gently withdraw the bailer from the well until it comes out of the top of the well. Be sure to control excess line in your hands to prevent the rope and bailer from touching the ground, and then grasp the bailer as it appears at the top of the well.

(g) Immediately pour the water into a vessel for water quality measurements, and record the measurements in the field book or on the Groundwater Field Data Record (at the project-required frequency). Otherwise, pour water into a 5-gallon bucket or other vessel to track the volume purged. As a general rule, standard 2-inch bailers are able to hold about 1 liter of water when full. This process will have to be repeated several times to complete adequate purging of the well (e.g., three to five well volumes).

(h) Record the volume of water purged on the Groundwater Field Data Record. Record the disposal method used for purge water in the field book.

(i) Once the required volume of water is removed (typically 3 to 5 well volumes) from the well and/or parameters are stabilized to the satisfaction of the project-specific work plan, proceed to Section 2.3, Post-purging Groundwater Sample Collection.

2.3 Post-purging Groundwater Sample Collection

(a) New, disposable gloves should be donned immediately prior to sample collection and should be changed at any point that their cleanliness becomes compromised during sample collection.

(b) If using a submersible or peristaltic pump, maintain the same flow rate as used during purging. Disconnect the pump tubing from the flow-through cell or sample from the T-connector, if used. Samples must be collected directly from the discharge port of the pump tubing prior to passing through the flow-through cell. This is critically important to avoid cross-contamination between wells.

(c) If using bottom-filling bailers,

- Slowly lower the bailer into the well until it is submerged to the point where water does not enter the top (i.e., bottom-filling).
- Retrieve the bailer. The first bailer recovered after well purging must be used for sample collection.

2.3.1 Sample Collection Order

Fractions of the groundwater sample should be collected in the following order (i.e., decreasing volatility) unless otherwise specified in the project-specific work plan:

1. VOCs;
2. Semivolatile organic compounds (SVOCs);
3. Other organic parameters;
4. Unfiltered inorganic constituents (e.g., total metals);
5. Filtered inorganic constituents (e.g., dissolved metals); and
6. Other constituents.

During sample collection, allow the water to flow directly down the side of the sample container without allowing the tubing to touch the inside of the sample container or lid in order to minimize aeration and turbulence and maintain sample integrity. The tubing should remain filled with water.

2.3.2 VOC Sample Collection

<u>Collection of VOCs/Volatile Petroleum Hydrocarbons (VPH):</u> Samples for VOCs will be collected first unless they are being collected by the "straw" method described in Section 1.6.2 (d), and the sample vial must be filled so a meniscus forms over the mouth of the vial. This ensures no air bubbles or headspace will be formed after it has been capped. Ensure the lack of air bubbles and headspace by turning the vial upside down and tapping it lightly. If any bubbles are observed, the vial should be topped off using a minimal amount of sample to re-establish the

meniscus. Care should be taken to not flush any preservative out of the vial when topping off. If, after topping off and capping the vial, bubbles are still present, a new vial should be obtained and the sample re-collected. Note: Extra VOC vials should be obtained prior to the sampling event in case this situation occurs.

Note: When using a bladder pump, it is recommended that the pump be set to deliver long pulses of water so that one pulse will fill a 40 ml VOA vial, if possible.

When acid preservation is used for the collection of VOCs, the acid must be added to the vials before sample collection. However, in most cases 40-ml VOA vials come pre-preserved. If a pre-preserved vial effervesces upon the addition of sample, the acid preservative can be rinsed out of the vial with sample water and then used to collect the sample. The laboratory should be made aware that the affected sample will not be acid-preserved as this may affect the sample holding time. Note effervescence in the field book for future reference.

2.3.3 Non-VOC Sample Collection

Completely fill the remaining sample containers for all non-VOC analyses.

Preserve the non-VOC samples in accordance with method and project-specific requirements following sample collection if the sample containers are not pre-preserved. (**NOTE:** Pre-preserved vials may be supplied by the laboratory, depending on the program).

2.3.4 Field Filtering

Depending upon project requirements, field filtering may be performed for non-VOC analyses. An in-line filter should be fitted at the end of the discharge tubing and the sample should be collected after the filter. Pre-rinse the in-line filter by allowing a minimum of 0.5 to 1 liter of groundwater from the well to pass through the filter prior to sampling. Ensure the filter is free of air bubbles prior to collecting samples. Preserve the filtered water sample immediately or directly fill pre-preserved containers (if provided). Clearly note “filtered” or “dissolved” on sample label and COC document.

2.4 Groundwater Sample Collection Without Purging (Passive Sampling)

Passive sampling can be defined as the free flow of contaminants from the media being sampled to a receiving phase in a sampling device. Depending upon the sampler, the receiving phase can be a solvent (e.g., water), chemical reagent, or porous adsorbent (e.g., activated carbon). While there are many different types of passive samplers, most have a barrier between the medium being sampled and the receiving phase. The barrier determines the sampling rate that contaminants are collected at a given concentration and can be used to selectively permit or restrict various classes of chemicals from entering the receiving phase.

There are three generic forms of passive (no purge) samplers: thief (grab) samplers, diffusion (equilibrium) samplers, and integrating (kinetic) samplers. However, this SOP focuses on the more commonly used diffusion (equilibrium) samplers.

Passive samplers are deployed down a well to the desired depth within the screened interval or open borehole to obtain a discrete sample without using pumping or a purging technique. Most samplers are able to be stacked to obtain samples at multiple depths. Some samplers can also be used to measure contaminants in groundwater as it enters a surface water body.

Diffusion, or equilibrium, samplers are devices that rely on diffusion of the analytes to reach equilibrium between the sampler fluid and the well water. Samples are time-weighted toward conditions at the sampling point during the latter portion of the deployment period. The degree of weighting depends on analyte and device-specific diffusion rates. Typically, conditions during only the last few days of sampler deployment are represented. Depending upon the contaminant of concern, equilibration times range from a few days to several weeks. Diffusion samplers are less versatile than grab samplers as they are not generally effective for all chemical classes.

Both the diffusion and integrating samplers depend upon permeation or diffusion through barriers that hold the receiving phase. This diffusion process is chemical and barrier specific. Diffusion samplers are commonly known as PDBs or rigid porous polyethylene (RPP) samplers. PDBs may be used to sample for VOCs, and RPPs may be used to sample for various organic and inorganic constituents. PDBs must be allowed to remain in the well for a sufficient period of time to allow the deionized water in the sampler to come into equilibrium with the constituents in the ambient groundwater.

Some regulatory agencies allow groundwater samples to be collected without purging the well. This may be accomplished by suspending a passive sampler in the well for a period of time appropriate for the type of passive sampler being used. It is important to confirm that the chosen sampler is compatible with the contaminants of concern including all VOCs of interest at the site.

Diffusion passive samplers are used most commonly and the procedure for their use is as follows:

(a) Passive samplers are deployed at a predetermined depth across the well screen. Typically, the initial sampling event may deploy multiple passive samplers across 5-foot intervals of saturated well screen to observe any potential stratification. Long-term sampling depths typically target a zone of higher concentration, if present.

(b) New passive samplers are attached via PVC cable ties to a tether (a pre-made marine-grade polyethylene rope or stainless steel cable with a weight at the bottom) that is then suspended within the well. There should be sufficient well screen saturation within the well to completely cover the passive sampler. For VOCs, it is recommended that there should be several feet of groundwater above the top of the PDB.

(c) The passive sampler should be allowed to equilibrate with groundwater for an appropriate period of time (e.g., at least 2 weeks for PDB samplers). Longer equilibration times may be necessary in lower permeability formations. Once sufficient time for equilibration has passed, the PDB samplers can be retrieved when convenient.

(d) Raise the passive sampler to the surface using a tether reel. Examine the surface of the passive sampler for evidence of algae, iron, or other coatings, and for tears to the membrane. Note observations in the field book. If tears are present and water is leaking out, the sample is not considered viable. Contact the Project Manager.

(e) Detach the passive sampler from the tether.

(f) Remove excess beaded water from the passive sampler with a clean gloved hand, running top to bottom; this is to minimize the contact of beaded water with water in the passive sampler.

(g) Use a small diameter discharge tube (<0.15 inch diameter to reduce volatilization) and pierce near the bottom, allowing water to smoothly flow into the VOA vial. Tilting the passive sampler will control the flow rate. The VOA vials must be filled within the first several minutes of passive sampler retrieval. (Note that sample vials should be prepared and opened on a stable surface or holding device such as a foam pack. Decanting sample from passive samplers into containers requires techniques that may require some practice and patience.) Refer to Section 2.3.2 for special circumstances regarding the filling of VOA vials.

(h) A small amount of water may remain within the passive sampler after filling the VOA vials and can be used for field parameter measurements if required.

(i) Dispose of the passive sampler after use.

2.5 Post-sampling Activities

(a) Cease pumping and, if system is non-dedicated, disassemble and decontaminate the purging and sampling equipment. Verify the end of the tubing is not submerged in the purge bucket prior to turning off the pump.

(b) Dispose of the bailer (if disposable) and/or rope and/or other disposable equipment in accordance with the project-specific work plan, or store the bailer in a plastic bag for transport to the site decontamination area.

(c) Dispose of the empty passive sampler and/or rope and/or other disposable equipment in accordance with the project-specific work plan, or store the empty passive sampler in a plastic bag for transport to the site decontamination area

(d) Replace the well cap and well cover on the well and lock the outer casing (if present).

(e) Label each sample. If the labels are covered with clear tape, ensure this is not performed for VOA vials.

(f) Place all samples in a cooler with ice.

(g) Ensure samples are delivered to the laboratory well before the required holding time expires.

(h) Consult the project-specific work plan to determine if a calibration check is required at the end of the day for the water quality parameters.

3.0 INVESTIGATION-DERIVED WASTE DISPOSAL

Field personnel should discuss specific documentation and containerization requirements for investigation-derived waste disposal with the Project Manager.

Each project must consider investigation-derived waste disposal methods and have a plan in place prior to performing the field work. Provisions must be in place as to what will be done with investigation-derived waste. If investigation-derived waste cannot be returned to the site, consider material containment, such as a composite drum, proper labeling, on-site storage by the client, testing for disposal approval of the materials, and ultimately the pickup and disposal of the materials by appropriately licensed vendors.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

The collection of QC samples is dependent upon the DQOs. Project-specific work plans should be consulted to determine the required frequency of QC sample collection.

4.1 Field Duplicates

The following procedures should be used for collecting field duplicates of groundwater samples:

(a) For QC purposes, each duplicate sample will be typically submitted to the laboratory as a "blind" duplicate sample, in that a unique sample identification not tied to the primary sample identification will be assigned to the duplicate (e.g., DUP-01). Standard labeling procedures used for groundwater sampling will be employed. However, a sample collection time will not be included on the sample label or the COC form. The actual source of the duplicate sample will be recorded in the field book and/or on the Groundwater Field Data Record.

(b) Each duplicate sample will be collected simultaneously with the actual sample by alternately filling sample and duplicate bottles. Following the order of collection specified for each set of containers (VOCs, SVOCs, other organic parameters, unfiltered inorganic constituents, and filtered inorganic constituents), the duplicate sample containers will be alternately filled with groundwater for each parameter.

(c) All collection and preservation procedures outlined for groundwater sampling will be followed for each duplicate sample.

4.2 Equipment Blanks

Equipment blanks include reagent water that is run through the bailer (if not disposable), rope, leader line, decontaminated pump, a representative section of the pump's tubing, or any other piece of sampling equipment that may have come in contact with the sample. The equipment blanks are collected and preserved in the same sample containers as field samples. If dedicated or disposable systems are used, equipment blanks are not required, although an initial blank could be performed to demonstrate that the dedicated equipment is clean prior to use. If only dedicated tubing is used, the equipment blank will include only the pump in subsequent sampling events. A passive sampler is considered a dedicated device and no equipment blank is required.

Ideally, the reagent water should come from the laboratory and be certified clean. If not certified and/or if not from the laboratory performing the analyses, a separate water blank that has not run through the sampling equipment should be sent to the laboratory for analysis.

4.3 Trip Blanks

Trip blanks will be used to check for potential contamination of VOCs via migration during storage and shipping. Trip blanks typically consist of two to three 40 mL VOA vials filled with analyte-free water and preserved with hydrochloric acid (HCl) to pH <2 SU. Trip blank containers are usually supplied pre-filled by the laboratory. Trip blanks are typically submitted to the laboratory at a frequency of one per cooler for coolers that contain samples for VOC and/or VPH analysis. Trip blanks are analyzed by the laboratory for VOCs and/or VPH, depending on field sample analyses.

4.4 Field Blanks

Field blanks consists of analyte free water exposed to the atmosphere during field sample collection. The water is containerized in an appropriate bottle and preservative for the analytical suite and shipped to the laboratory with the other field samples. The results are used to assess whether or ambient/surrounding air conditions may have influenced analytical results.

4.5 MS/MSDs and MS/Duplicates

MSs are an additional analysis of a sample spiked by the laboratory with a subset or all of the target analytes and are used to demonstrate the accuracy of analytical methods for a given matrix. MSDs are an additional analysis of a sample spiked with a subset or all of the target analytes and are also used to demonstrate the accuracy of analytical methods for a given matrix. MS/MSDs also provide a measure of analytical precision for a given matrix. Duplicates are an additional analysis of a sample and are used to demonstrate the precision of analytical methods for a given matrix.

Triplicate volumes of a field sample must be collected in order for the laboratory to have enough volume to perform the MS/MSD analyses for organic parameters. Duplicate volumes of a field sample must be collected in order for the laboratory to have enough volume to perform MS/Duplicate analyses for inorganic parameters. The sample designated for MS/MSD or MS/Duplicate analyses should be noted in the Comments column of the COC document.

4.6 Temperature Blanks

Temperature blanks consist of a sample container filled with non-preserved water (potable or distilled) and typically are included in all coolers that contain samples that require temperature preservation. These may be added to the coolers by the field team if not provided by the laboratory. Temperature blanks must remain inside the coolers on ice during the sampling process.

5.0 DATA MANAGEMENT AND RECORDS MANAGEMENT

Record the sample location, sample identification, and date and time of collection in the field book and/or the Groundwater Field Data Record. The Groundwater Field Data Record (Attachment B) should be used to record the following information:

- Volume of each sample

- Sample identification number
- Sample location (sketch of the sample point)
- Time and date sample was collected
- Personnel performing the task
- Volume of water removed
- Purging time
- Flow rate during purging and sampling
- Weather conditions during sampling (e.g. temperature, wind)
- Field parameters such as water level, pH, temperature, conductivity, turbidity, ORP, and DO
- Sample collection equipment and method used
- Decontamination procedures
- Analytical parameters
- Preservation method and amount of preservative

All sample numbers must be documented on the COC form that accompanies the samples during shipment. Any deviations from the records management procedures specified in the project-specific work plan must be approved by the Project Manager and documented in the field book.

6.0 REFERENCES

Interstate Technology Regulatory Council (ITRC). March 2006. *Technology Overview of Passive Sampler Technologies.*

USEPA. November 1992. *RCRA Ground-Water Monitoring: Draft Technical Guidance*. EPA/530-R-93-001. USEPA Office of Solid Waste.

USEPA. April 1996. *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures*. EPA Ground Water Issue. EPA/540-S-95-504. USEPA Office of Solid Waste and Emergency Response.

USEPA. May 2002. *Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers*. EPA/542-S-02-001. USEPA Office of Solid Waste and Emergency Response.

USEPA. September 2004. Field Sampling Guidance Document #1220: Groundwater Well Sampling. USEPA Region 9 Laboratory Richmond, California.

USEPA, January 19, 2010. *Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells*. USEPA Region 1, Rev. 3.

USEPA. March 6, 2013. *Groundwater Sampling.* SESDPROC-301-R3. USEPA Region 4, Science and Ecosystem Support Division. Athens, Georgia.

USEPA. April 22, 2014. Passive (No Purge) Samples.
http://www.clu-in.org/characterization/technologies/default.focus/sec/Passive_%28no%20purge%29_Samplers/cat/Overview/

7.0 SOP REVISION HISTORY

REVISION NUMBER	REVISION DATE	REASON FOR REVISION
0	AUGUST 2014	NOT APPLICABLE
1	JULY 2016	ADDED ATTACHMENT D TO ACCOMMODATE SOP MODIFICATIONS REQUIRED WHEN SAMPLING FOR PFCS; CHANGED NAMING CONVENTION FOR SOP FROM RMD TO ECR.
2	NOVEMBER 2016	ADDED ADDITIONAL INFORMATION REGARDING PFAS.
3	JANUARY 2020	TRC RE-BRANDING; ADDED FIELD BLANKS TO SECTION 4
4	AUGUST 2020	ADDITIONAL PFAS-SPECIFIC INFORMATION INCLUDED

Attachment A:

Groundwater Field Parameter Stabilization Criteria for Selected Jurisdictions

Jurisdiction	Information Source	Applicable Stabilization Criteria
USEPA Region 1	Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells; U.S. Environmental Protection Agency Region 1, January 19, 2010. http://www.epa.gov/region1/lab/qa/pdfs/EQASOP-GW001.pdf (for low flow PDF) http://www.epa.gov/region1/lab/qa/qualsys.html (for EPA's Quality System Documents)	pH: ±0.1 unit Specific Conductance: ±3% Temperature: ±3% Turbidity: ±10% if >5 NTUs; if three Turbidity values are <5 NTU, consider the values as stabilized Dissolved Oxygen: ±10% if >0.5 mg/L, if three Dissolved Oxygen values are <0.5 mg/L, consider the values as stabilized Oxidation/Reduction Potential: ±10 millivolts
USEPA Region 2	Groundwater Sampling Procedure: Low Stress (Low Flow) Purging and Sampling, SOP # SST-7, Revision No. 1, November 2010.	Same as above
USEPA Region 4	USEPA Region 4 SOPs: http://www.epa.gov/region4/sesd/fbqstp/index.html See Chemical Parameter Stabilization Criteria (section 3.2.1.1.2 of Groundwater Sampling SOP, revision 3/6/2013: http://www.epa.gov/region4/sesd/fbqstp/Groundwater-Sampling.pdf	pH: ±0.1 unit Specific Conductance: ±5% Temperature: Not used Turbidity: "Stabilized" (no criteria specified) if >10 NTUs ; if three Turbidity values are <10 NTUs, consider the values as stabilized Dissolved Oxygen (optional parameter): ±0.2 mg/L or ±10% of saturation, whichever is greater Oxidation/Reduction Potential: Not used
USEPA Region 5	Ground Water Forum Issue Paper (May 2002, Yeskis and Zavala) http://www.epa.gov/superfund/remedytech/tsp/download/gw_sampling_guide.pdf A minimum set of parameters would include pH, conductivity, and turbidity or DO. Puls and Barcelona, 1996 (pH, specific conductance, ORP, turbidity) Wilde et al., 1998 (pH, turbidity, DO)	pH: ±0.1 unit Specific Conductance: ±3% Temperature: Not used Turbidity: ±10% if >10 NTUs Dissolved Oxygen: ±0.3 mg/L Oxidation/Reduction Potential: ±10 millivolts
USEPA Region 9	See USEPA Region 1 (above)	
USEPA Region 10	See USEPA Region 5 (above)	
Alabama	Alabama Environmental Investigation and Remediation Guidance (section C.3.1) http://www.adem.state.al.us/MoreInfo/pubs/AEIRGInvestigation.pdf	pH: ±0.1 unit Specific Conductance: ±10% Temperature: "Constant" (no criteria specified) Turbidity: Stabilized (no criteria specified), or <10 NTUs Dissolved Oxygen: No criteria specified Oxidation/Reduction Potential: No criteria specified

Jurisdiction	Information Source	Applicable Stabilization Criteria
Indiana	Indiana Department of Environmental Management The Micro-Purge Sampling Option http://www.in.gov/idem/files/remediation_tech_guidance_micro-purge.pdf The parameters normally measured for stability (listed in increasing order of sensitivity) are pH, temperature, specific conductivity, oxidation-reduction potential, DO and turbidity. At least one of the last three listed must be used.	pH: ±0.1 unit Specific Conductance: ±3% Temperature: ±3% Turbidity: ±10% Dissolved Oxygen: ±10% Oxidation/Reduction Potential: ±10 millivolts (document says microvolts, but that may be an error)
Michigan	MDEQ Part 201 Op Memo 2, Attachment 5 http://www.michigan.gov/documents/deq/deq-rrd-OpMemo_2_Attachment5_249853_7.pdf	No specific values to determine stabilization are listed, but the Op Memo lists several other groundwater sampling guidance documents. If a valid reference exists, then it can be used to justify a sampling approach and stabilization parameters.
New Jersey	New Jersey Department of Environmental Protection http://www.state.nj.us/dep/srp/guidance/fspm/	pH: ± 0.1 unit Specific Conductance: ± 3% Temperature: ± 3% Dissolved Oxygen: ± 10% Turbidity: ± 10% for values greater than 1 NTU ORP/Eh: ± 10 millivolts
Ohio	Ohio EPA SOPs: http://www.epa.state.oh.us/portals/30/rules/FSOPs.pdf See Purging Stabilization Criteria (SOP 2.2.4, dated January 2, 2007, review in progress)	pH: ±0.1 unit Specific Conductance: ±3% Temperature: No criteria specified Turbidity: Below 10 NTUs ideal; ±10% if greater than 10 NTUs Dissolved Oxygen: ±0.3 mg/L Oxidation/Reduction Potential: ±10 millivolts
This table was last updated in July 2014.		

Attachment B:

Example Groundwater Field Data Records

TRC

Groundwater Field Data Record

Project: Project No.: Date/Time: Sheet ___ of ___

TRC Personnel: Well ID:

WELL INTEGRITY

	YES	NO
Protect. Casing Secure	☐	☐
Concrete Collar Intact	☐	☐
PVC Stick-up Intact	☐	☐
Well Cap Present	☐	☐
Security Lock Present	☐	☐

Sampling Equipment:

Flow-thru Cell Volume:

PID SCREENING MEAS.

Background	
Well Mouth	

Protective Casing Stick-up _______ ft. (from ground)

Riser Stick-up (from ground) _________ ft.

WELL DIAMETER ☐ 2 inch ☐ 4 inch ☐ 6 inch

Other: ________

WELL MATERIAL

☐ PVC ☐ SS

Other: ______

Well Depth ______ ft. ☐ top of riser ☐ top of casing ☐ __________ ☐ measured ☐ historical

Water Depth _______ ft.

Well Volume______

LNAPL/DNAPL Depth = ____

NAPL Thickness = ______

Depth of pump intake:

Static water level after pump put into well:

Initial purge Rate/ Water Level (100-400 ml/min):

Adjusted purge Rates/time/WL(record changes)

Flow rate at time of sampling:

Total volume of water purged:

FIELD WATER QUALITY MEASUREMENTS (record at appropriate intervals)

Time									
Temp. (°C)									
Conduct. (μmhos/cm)									
DO (mg/L)									
pH (su)									
ORP (millivolts)									
Turbidity (NTU)									
Flow (ml/min)									
Depth To Water (ft)									
Cumulative Purge Vol. (gal or L)									

Time						
Temp. (°C)						
Conduct. (μmhos/cm)						
DO (mg/L)						
pH (Std. Units)						
Eh/ORP (millivolts)						
Turbidity (NTU)						
Flow (ml/min)						
Depth To Water (ft)						
Cumulative Purge Vol. (gal or L)						

Stabilization Criteria*
(3 consecutive readings)
- Temperature: ± 3 %
- Conduct. (μmhos/cm): ± 3 %
- DO (mg/L): ± 10 % (for values >0.5 mg/L)
- pH (Std. Units): ± 0.1 SU
- ORP (millivolts): ± 10 mV
- Turbidity (NTU): +/- 10 % (for values >5.0 NTUs)
- Drawdown: < 0.3 ft (can be greater as long as water level stabilizes above well screen)

	Purge	Sample
Peristaltic Pump	☐	☐
Submersible Pump	☐	☐
Bladder Pump	☐	☐
Bailer	☐	☐
Other: __________	☐	☐

Comments:

Analytical Parameter	Filtered (Y/N)	Preservation	# Bottles	Size/Type Bottles	Time Collected	QC	Sample #

- Consult the applicable regulatory guidance for the specific criteria.

Signed: ____________________

Rev: April 2014

PAGE ______ OF ______

TRC

WATER SAMPLE LOG

PROJECT NAME:	PREPARED		CHECKED	
PROJECT NUMBER:	BY:	DATE:	BY:	DATE:

SAMPLE ID: WELL DIAMETER: ☐ 2" ☐ 4" ☐ 6" ☐ OTHER ______

WELL MATERIAL: ☐ PVC ☐ SS ☐ IRON ☐ GALVANIZED STEEL ☐ OTHER ______

SAMPLE TYPE: ☑ GW ☐ WW ☐ SW ☐ DI ☐ LEACHATE ☐ OTHER ______

PURGING	TIME:	DATE:	SAMPLE	TIME:	DATE:

PURGING

PURGE METHOD: ☐ PUMP ______ ☐ BAILER ______

DEPTH TO WATER: ______ T/ PVC

DEPTH TO BOTTOM: ______ T/ PVC

PUMP INTAKE DEPTH: ______ T/ PVC

FLOW-THRU CELL VOLUME ______ LITERS

WELL VOLUME: ______ ☐ LITERS ☐ GALLONS

VOLUME REMOVED: ______ ☐ LITERS ☐ GALLONS

COLOR: ______ ODOR: ______

TURBIDITY

☐ NONE ☐ SLIGHT ☐ MODERATE ☐ VERY

DISPOSAL METHOD: ☐ GROUND ☐ DRUM ☐ OTHER

SAMPLE

PH: ______ SU CONDUCTIVITY: ______ umhos/cm

ORP: ______ mV DO: ______ mg/L

TURBIDITY: ______ NTU

☐ NONE ☐ SLIGHT ☐ MODERATE ☐ VERY

TEMPERATURE: ______ °C OTHER: ______

COLOR: ______ ODOR: ______

FILTRATE (0.45 um) ☐ YES ☐ NO

FILTRATE COLOR: ______ FILTRATE ODOR: ______

QC SAMPLE: ☐ MS/MSD ☐ DUP- ______

COMMENTS:

TIME	PURGE RATE (ML/MIN)	PH (SU)	CONDUCTIVITY (umhos/cm)	ORP (mV)	D.O. (mg/L)	TURBIDITY (NTU)	TEMPERATURE (°C)	WATER LEVEL (FEET)	CUMULATIVE PURGE VOLUME (GAL OR L)
									INITIAL

NOTE: STABILIZATION TEST IS COMPLETE WHEN 3 SUCCESSIVE READINGS ARE WITHIN THE FOLLOWING LIMITS:

pH: +/- **10 %** COND.: +/- **10 %** ORP: +/- **10 %** D.O.: +/- **10 %** TURB: +/- **10 %** or </= **5** TEMP.: +/- **0.5°C**

BOTTLES FILLED — PRESERVATIVE CODES A - NONE B - HNO3 C - H2SO4 D - NaOH E - HCL F - ______

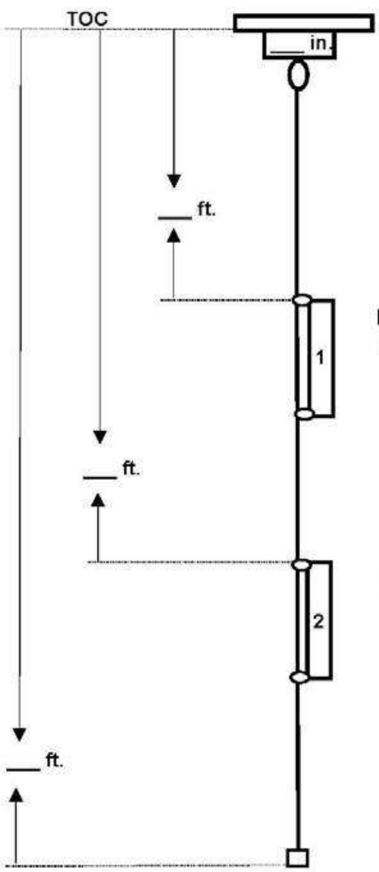
NUMBER	SIZE	TYPE	PRESERVATIVE	FILTERED	NUMBER	SIZE	TYPE	PRESERVATIVE	FILTERED
				☐ Y ☐ N					☐ Y ☐ N
				☐ Y ☐ N					☐ Y ☐ N
				☐ Y ☐ N					☐ Y ☐ N
				☐ Y ☐ N					☐ Y ☐ N

SHIPPING METHOD: ______	DATE SHIPPED: ______	AIRBILL NUMBER: ______
COC NUMBER: ______	SIGNATURE: ______	DATE SIGNED: ______

REVISED 06/2011

Groundwater Sampling Record for Organics (For Wells with Passive Diffusion Bags)	Project Name/No:	Well ID:

Installation of PDBs:	Sampling of PDBs:
TRC Personnel: ______	TRC Personnel: ______
Date: ______	Date: ______
Time: ______	DTW (ft): ______
DTW (ft): ______	



PDB #1
Length: ___ in.

Sample ID: ______
Sample Time: ______
Evidence of algae, iron or other coatings?: ______

PDB #2
Length: ___ in.

Sample ID: ______
Sample Time: ______
Evidence of algae, iron or other coatings?: ______

Measured well depth during tether installation: ___ ft.

Field Notes:

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Attachment C: SOP Fact Sheet

GROUNDWATER SAMPLING

PURPOSE AND OBJECTIVE

The objective of groundwater sampling is to obtain a representative sample of water from a saturated zone or groundwater-bearing unit (i.e., aquifer) with minimal disturbance of groundwater chemistry. This requires that the sample being collected is representative of groundwater within the formation surrounding the well bore as opposed to stagnant water within the well casing or within the filter pack immediately surrounding the well casing.

There are three general approaches to groundwater purging/sampling that can be used to obtain a representative groundwater sample for analysis: 1) the low-flow or micropurge method where the mixing of the stagnant water is minimized using low-flow pumping rates during the collection of the groundwater sample; 2) the multiple well volume removal approach in which the stagnant water is removed from the well and the filter pack prior to sample collection; and 3) the passive sampler procedure where water quality equilibration with the surroundings is achieved through deployment of the passive sampler for a sufficient amount of time prior to sampling. All three approaches are summarized in this document.

WHAT TO BRING

- Site-specific HASP and field book
- Project-specific work plan
- Figure or site map showing well locations and table showing well construction details
- Field data sheets from previous sampling event
- Well wrenches, ratchet set, and turkey baster to remove standing water from flushmount manholes
- Bolt cutters, padlocks and keys
- Water level meter of sufficient length
- Decontaminated pump, control box, power source (i.e., battery, generator, etc.)
- Tubing (Teflon®, Teflon®–lined polyethylene, or HDPE, type dependent upon project objectives)
- Multi-parameter instrument and flow-through cell (typically should include: pH, temperature, conductivity, ORP, and DO)
- Turbidity meter
- Equipment decontamination supplies (refer to ECR SOP 010, *Equipment Decontamination*)
- Appropriate PPE
- Field book
- Sample bottleware, labeled cooler, ice, temperature blank and blank COC forms; may also need field blank bottles and reagent-grade water
- Zip-loc® plastic bags
- Groundwater field data records
- Graduated cylinder and stop-watch
- Rope for tying off pump at desired intake
- Indelible marking pens
- Bubble wrap
- 5-gallon bucket(s)

As Needed:

- Calibrated PID or FID for well mouth readings
- Oil/water interface probe of sufficient length
- Drums for purge water, grease pen and adhesive drum labels; appropriate crescent or socket wrench
- Filtration equipment, if required (0.45 micron filters, or as otherwise required for the project)
- Other non-routine PPE such as Tyvek coveralls or respirators
- Traffic cones
- Field calibration sheets and calibration solutions

OFFICE

- Prepare/update the site-specific HASP; make sure the field team is familiar with the most recent version.
- Review the project-specific work plan with the Project Manager and/or the field team leader. Discuss the following:
  - Communication procedures;
  - Sampling order and designation;
  - Collection and sample method;
  - Analytical parameters, holding times and turn-around times;
  - Laboratory (contact/shipping info, COC, billing references);
  - Purge water management (Drums? Discharge to ground?);
  - QC sample collection; and
  - Decontamination procedures.
- Verify that monitoring wells will be accessible and/or coordinate to have a site contact available to assist.
- Make sure that monitoring well sample designations and QC sample designations/frequency are understood.
- Confirm that all necessary equipment is available in-house or has been ordered. Rental equipment is typically delivered the day before fieldwork is scheduled. Prior to departure or mobilization to site, test equipment and make sure it is in proper working order. Have rental equipment supplier contact information available for use in field.
- Review sample bottle order for accuracy and completeness and damaged bottles.
- Discuss specific documentation and containerization requirements for investigation-derived waste disposal with the Project Manager

ON-SITE

GROUNDWATER SAMPLING

- Review the HASP with all field personnel, sign acknowledgement form and conduct Health & Safety tailgate meeting. Check in security, site contact, or designated person per project-specific work plan or Project Manager.
- Make sure appropriate PPE is worn by all personnel and work area is safe (i.e., utilize traffic cones; minimize interference with on-site activities and pedestrian traffic, etc.)
- Calibrate equipment (if applicable) and record all rental equipment serial numbers in the field book.
- Open wells to allow equilibration and collect full round of water level gauging before sampling is started (unless otherwise noted in project-specific work plan). Record the following:
  - Well mouth PID/FID reading (if necessary);
  - Depth to product and water;
  - Total well depth (not required if free product is measured unless otherwise noted in project-specific work plan); and
  - Condition of wells (i.e., lid broken, pad cracked, rusted lock) and collect photographs if site allows camera use.

SAMPLING PROCEDURES: PRE-PURGE

- Decontaminate pump.
- Take water level measurements prior to pump installation.
- Connect sampling tubing to pump outlet and lower to sample depth; **ALWAYS USE ROPE TO SECURE PUMP TO SURFACE.**
- The pump intake depth(s) for each well should be specified in the project-specific work plan (either specific depth or mid-point of saturated well screen).
- For wells with screened or open borehole intervals greater than 10 feet in length, sampling of multiple intervals may be required.
- If samples are to be collected from multiple depths from an individual well, always collect a sample from the shallowest depth first and leave enough extra tubing coiled at the surface so the pump can be lowered to the next interval; always try to cover excess tubing present at the surface to prevent the air temperature from influencing the measurements and exposure to contaminants on the ground;
- Be careful not to let the pump hit the bottom of the well.
- If using Teflon®-lined tubing, be sure that the lining does not bunch up around the connection. This will restrict water flow and make the pump work harder than it has to.
- Calibrate (or perform a calibration check on) all field monitoring equipment on the same day before collecting groundwater samples. Refer to TRC SOPs and manufacturer's equipment calibration instructions. A calibration check may also be required during or at the end of each sampling day. Consult the project-specific work plan.

SAMPLING PROCEDURES: MULTIPLE-VOLUME PURGING

- The multiple-volume purging approach is typically performed using bailers or submersible or peristaltic pumps. In the multiple-volume purging approach, there are two measurements used to determine adequate purge volume removal prior to sample collection: 1) purge volume and 2) field parameter stabilization.
- The field parameters should be recorded at regular volumetric intervals. There are no set criteria for establishing how many total sets of measurements are adequate to document stability of parameters.
- Prior to purging a well, the amount of water inside the well riser and well screen (i.e., water column) should be determined, if possible. Once this information is known, the well volume can be calculated using the following equation:

  Well Volume (V) = $\pi r2$ h
- For volumetric purging, an adequate purge is typically achieved when 3 to 5 well volumes have been removed.
- For volumetric purging, it is suggested that field readings are collected every ½ well/well screen volume after an initial 1 to ½ well volumes are purged. The volume removed between readings can be adjusted as well-specific information is developed.
- If removing a specified volume of water (e.g., 3 well volumes) has been determined to be suitable for purging, sampling can commence immediately upon achieving the required purge volume.
- In other cases, where specified in the project-specific work plan, stabilization of field parameters must be documented prior to sample collection.
- If, after 3 well volumes have been removed, the field parameters have not stabilized, additional well volumes (up to a total of 5 well volumes), should be removed.
- If the parameters have not stabilized within five well volumes, it is at the discretion of the Project Manager whether or not to collect a sample or to continue purging.

SAMPLING PROCEDURES: LOW-FLOW PURGING

- The low-flow purging approach is typically performed using peristaltic pumps or submersible pumps. Low-flow purging (also referred to as low-stress purging, low-volume purging, or Micropurging®) is a method of well purging/sampling that minimizes the volume of water withdrawn from a well in obtaining a representative sample.
- When performing low-flow purging and sampling, it is recommended that the pump intake be set in the center of the well screen interval to help prevent disturbance of any sediment at the bottom of the well.

GROUNDWATER SAMPLING

- To begin purging, the pump should be started at the lowest pressure/power flow rate setting (e.g., 100 mL/min) and then slowly increased until water begins discharging. Monitor the water level and slowly adjust the pump speed until there is little or no drawdown or drawdown has stabilized. The pump pressure/power may need to be increased for discharge to occur.
- The stabilization of drawdown should be documented. Measure and record the flow rate and water level every 3 to 5 minutes during purging. The flow rate should be reduced if drawdown is greater than 0.3 feet over three consecutive 3 to 5 minute interval readings.
- Attempts should be made to avoid pumping a well dry.

Field Parameter Stabilization During Purging

- Generally, an adequate purge with respect to the groundwater chemistry is achieved when stability for at least three consecutive measurements is achieved. See stability requirements in Appendix A of this SOP.

POST-PURGE GROUNDWATER SAMPLE COLLECTION

- New, disposable gloves should be donned immediately prior to sample collection and should be changed at any point that their cleanliness becomes compromised during sample collection.
- If using a submersible or peristaltic pump, maintain the same flow rate as used during purging. Disconnect the pump tubing from the flow-through cell. Samples must be collected directly from the discharge port of the pump tubing prior to passing through the flow-through cell. This is critically important to avoid cross-contamination between wells.
- If using bottom-filling bailers, slowly lower the bailer into the well until it is submerged to the point where water does not enter the top (i.e., bottom-filling). Retrieve the bailer. The first bailer recovered after well purging must be used for sample collection.
- Collect groundwater samples in the following order:
  - VOCs;
  - SVOCs;
  - Other organic parameters;
  - Unfiltered inorganic constituents; and
  - Filtered inorganic constituents.
- Note that sample vials for VOCs must be filled so a meniscus forms over the mouth of the vial. This ensures no air bubbles or headspace will be formed after it has been capped. Ensure the lack of air bubbles and headspace by turning the vial upside down and tapping it lightly. If any bubbles are observed, see Section 2.3.2 of this SOP.
- Preserve the non-VOC samples in pre-preserved vials supplied by the laboratory or if the sample containers are not pre-preserved, preserve the non-VOC samples in accordance with method and project-specific requirements.
- Depending upon project requirements, filtering may be performed. See procedures listed in Section 2.3.4 of this SOP. Clearly note "filtered" on the sample label and the COC.
- Make sure all sample bottles are appropriately labeled.
- Package the samples with bubble wrap and/or organic absorbent, as necessary. Place into shipping container and cool to 4°C and complete the COC.
- Decontaminate non-disposable sampling equipment between uses.

PASSIVE SAMPLING

- There are three generic forms of passive (no purge) samplers: thief (grab) samplers, diffusion (equilibrium) samplers, and integrating (kinetic) samplers. However, this SOP focuses on the more commonly used diffusion (equilibrium) samplers. Be aware of sample holding times, and arrange for samples to be in the laboratory's possession accordingly.
- Passive samplers are deployed at a predetermined depth across the well screen. Typically, the initial sampling event may deploy multiple passive samplers across 5-foot intervals of saturated well screen to observe any potential stratification. Long-term sampling depths typically target a zone of higher concentration, if present.
- New passive samplers are attached via PVC cable ties to a tether (pre-made marine-grade polyethylene rope or stainless steel cable with a weight at the bottom) that is then suspended within the well.
- The passive sampler should be allowed to equilibrate with groundwater for an appropriate period of time (e.g., at least 2 weeks for PDB samplers).
- Raise the passive sampler to the surface using a tether reel. Examine the surface of the passive sampler for evidence of algae, iron, or other coatings, and for tears to the membrane. Note observations in the field book. If tears are present and water is leaking out, the sample is not considered viable. Contact the Project Manager.
- Detach the passive sampler from the tether.
- Remove excess beaded water from the passive sampler with a clean gloved hand, running top to bottom; this is to minimize the contact of beaded water with water in the passive sampler.

GROUNDWATER SAMPLING

- Use a small diameter discharge tube (<0.15 inch diameter to reduce volatilization) and pierce near the bottom, allowing water to smoothly flow into the VOA vial. The VOA vials must be filled within the first several minutes of passive sampler retrieval.
- A small amount of water may remain within the passive sampler after filling the VOA vials and can be used for field parameter measurements if required.
- Dispose of the passive sampler after use.
- Note that sample vials for VOCs must be filled so a meniscus forms over the mouth of the vial. This ensures no air bubbles or headspace will be formed after it has been capped. Ensure the lack of air bubbles and headspace by turning the vial upside down and tapping it lightly. If any bubbles are observed, see Section 2.3.2 of this SOP.
- Make sure all sample bottles are appropriately labeled.
- Package the samples with bubble wrap and/or organic absorbent, as necessary. Place into shipping container and cool to 4°C and complete the COC.

DOS AND DO NOTS OF GROUNDWATER PURGING AND SAMPLING

DOs:

- DO have the following items when going into the field: site-specific work plan; site-Specific HASP; appropriate PPE (steel-toed boots, safety glasses, etc.) as required by the Site-Specific HASP; field book and a water-proof ball-point pen; business cards; nitrile gloves; well keys; copies of well installation forms and field data forms from previous sampling event.
- DO make sure that the equipment is set up properly and the bottleware is nearby and ready to be filled. There is little time between taking parameters.
- DO look at the water quality parameters from the previous round of sampling. If there is a large deviation from the previous round's measurements, make sure the meters are properly calibrated and the parameter units are the same. Otherwise, consult the Project Manager or field team leader.
- DO fill sample bottles slowly to make sure that they are not overfilled and that preservative does not become diluted. If collecting filtered samples, fill all non-filtered first, then fill filtered samples - if water is very silty, more than one filter might be required to fill sample bottles.
- DO record the time that purging begins and ends. "Purge Stop" and sample start time are the same.
- DO call your Project Manager or field team leader if unexpected conditions are encountered or at least daily to update them. It is also recommended to call when sampling is winding down for the day to make sure that the project-specific work plan has been fully implemented and there are no additional tasks to complete. Provide shipping tracking numbers to the Project Manager and laboratory contact.
- DO have the numbers for laboratory, vehicle rental and equipment rental providers readily available while in the field.
- DO record sample locations and parameters in the field book and the Groundwater Field Data Records as you purge.
- DO check on the purging setup frequently to make sure proper equipment function is maintained.
- DO bring ice to the site in the morning so that samples are kept cool throughout the entire event. Storing samples in a warm cooler can invalidate sample results and may result in re-sampling on your own time.

DO NOTs:

- DO NOT sign anything in the field. This includes disposal documentation, statements, etc.; call the Project Manager if this is an issue.
- DO NOT allow the pump or sampling equipment to hit the bottom of the well - If the pump hits the bottom of the well, it can stir up mud. Remember, the goal of low-flow sampling is to collect non-turbid samples.
- DO NOT use non-indelible ink to label samples or record field notes – if the field book gets wet, notes become illegible.
- DO NOT leave air bubbles in VOA vials.
- DO NOT pour any extracted water back down into the well.
- DO NOT lean over wells with pens, keys, cell phones, tools, etc. in your pocket.
- DO NOT use clear tape to cover labels on certain analyses (e.g., 40-mL vials for VOC analysis) due to potential interference with analytical equipment.

Attachment D: SOP Modifications for PFAS

Due to the pervasive nature of PFAS in various substances routinely used during sampling and the need to mitigate potential cross-contamination or sampling bias to ensure representative data are collected, special care should be taken when sampling for PFAS. The following table highlights the required modifications to this SOP when sampling for PFAS.

PFAS Sampling Protocols	
SOP Section Number	**Modifications to SOP**
1.3	• Do not use equipment utilizing Teflon® or low density polyethylene (LDPE)[1] during sample handling or mobilization/demobilization. This includes bailers, tubing, bladders, bailer cord/wire, waterproof/resistant paper products, certain personal protective equipment (PPE) (see below), and Teflon® tape. High density polyethylene (HDPE) or silicone tubing should be used in lieu of Teflon® or Teflon®-lined tubing. • Passive diffusion bags (PDBs) should not be used due to the presence of LDPE material in PDBs. • Blue Ice® (chemical ice packs) must not be used to cool samples or be used in sample coolers. Regular ice in Ziploc® bags can be used. • Do not use LDPE or glass sample containers or containers with Teflon-lined lids. HDPE or polypropylene containers are acceptable for sample storage. HDPE or polypropylene caps are acceptable. • Do not use aluminum foil. • Field notes should be recorded on loose paper field forms maintained in aluminum or Masonite clipboards. Waterproof field books, plastic clipboards and spiral bound notebooks should not be used. • Do not use Post-It Notes during sample handling or mobilization/demobilization. • Refer to TRC's SOP ECR-010 Equipment Decontamination for PFAS-specific decontamination protocols. Ensure that PFAS-free water is used during the decontamination procedure.
1.5	Always consult the Site Specific Health and Safety Plan prior to conducting field work. The following considerations should be made with regards to field preparation during PFAS sampling: • Tyvek® suits should not be worn during PFAS sampling events. Cotton coveralls may be worn. • Boots and other field clothing containing Gore-Tex™ or other waterproof/resistant material should not be worn. This includes rain gear. Boots made with polyurethane and polyvinyl chloride (PVC) are acceptable. • Stain resistant clothing should not be worn. • Food and drink should not be allowed within the exclusion area. Pre-wrapped food or snacks should not be in the possession of sampling personnel during sampling. Bottled water and hydration drinks (e.g., Gatorade®) may be consumed in the staging area only.

PFAS Sampling Protocols	
SOP Section Number	**Modifications to SOP**
	• Personnel involved with sample collection and handling should wear nitrile gloves at all times while collecting and handling samples or sampling equipment. Avoid handling unnecessary items with nitrile gloves. A new pair of gloves must be donned prior to collecting each sample. • Wash hands with Alconox or Liquinox and deionized water after leaving vehicle before setting up to sample a well.
1.6.1	• Avoid wearing clothing laundered with fabric softeners. • Avoid wearing new clothing (recommended 6 washings since purchase). Clothing made of cotton is preferred. • Avoid using cosmetics, moisturizers, hand creams, or other related products as part of cleaning/showering on the day of sampling. • Avoid using sunscreens or insect repellants that are not natural or chemical free.
1.6.2	• Consider collecting samples for total suspended solids which will become important for fate and transport and treatment considerations. Floc accumulates high concentrations of PFAS and specifically some of the longer-chain PFAS; when this floc settles out, concentrations can decrease by an order of magnitude. • Low-flow sampling is preferred for PFAS sampling. Bailers should be avoided due to the potential for PFAS to accumulate at the air/water interface. If bailers need to be used, purging of at least one well volume should be performed to remove static surface conditions. • If sampling for parameters other than PFAS, perform PFAS sampling first. Schedule PFAS sampling at the beginning of the work day to avoid other sources of contamination.
2.0	• Monitoring wells should always be sampled from the lowest contamination to the highest contamination, when possible. In source areas, if deep wells are anticipated to be less contaminated, the deep wells should be sampled prior to sampling the shallow wells to avoid cross-contamination from sampling equipment.
2.2.5	Tubing used to purge and sample groundwater for PFAS must not be LDPE or Teflon®. HDPE and silicone are acceptable.
2.3 and 2.3.3	LDPE and/or glass containers should not be used for sampling. Teflon®-lined caps should also not be used during sample collection. Instead, HDPE or polypropylene containers are acceptable for sample storage. HDPE or polypropylene caps are acceptable.
2.4	Due to LDPE material in PDBs, PDBs cannot be used for PFAS sampling.
2.5 (e)	Avoid using waterproof labels for sample bottles. The use of paper labels covered with clear tape or placed in Ziploc® bags to avoid moisture on the sample label is acceptable.
2.5 (f)	Samples for PFAS analysis must be shipped at <10°C. Standard coolers are acceptable. Keep high-concentration PFAS samples in separate coolers from low-concentration PFAS samples.

Notes:

[1] – PFAS have been used as an additive in the manufacturing of LDPE to smooth rough surfaces and, in the case of LDPE tubing, to allow for less turbulent flow along the surface of the tubing.

Title: **Equipment Decontamination**	Procedure Number: **ECR 010**
	Revision Number: **3**
	Effective Date: **April 2021**

Authorization Signatures

Technical Reviewer Cory Yates — Date 4/29/21	Environmental Sector Quality Director Elizabeth Denly — Date 4/29/21

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ATTACHMENTS

1.0 INTRODUCTION

1.1 Scope & Applicability

This Standard Operating Procedure (SOP) was prepared to direct TRC personnel in the procedures needed for decontamination of equipment used in the field during environmental investigations (e.g., sediment, soil, groundwater investigations). Other state or federal requirements may be above and beyond the scope of this SOP and will be followed, if applicable. The actual procedures used should be documented and described in the field notes. Preventing or minimizing potential cross-contamination of samples is important for the collection of representative samples, avoiding the possible introduction of sampling error into sample results, and for protecting the health and safety of site personnel.

Removing or neutralizing potential contaminants that may have accumulated on equipment and vehicles ensures protection of personnel, reduces or eliminates potential transfer of contaminants to clean areas, and minimizes the likelihood of sample cross-contamination.

The use of dedicated or disposable sampling equipment (e.g., disposable liners, plastic spoons, plastic or aluminum bowls) should be considered as an alternative to equipment decontamination and the subsequent generation of decontamination fluids.

1.2 Summary of Method

Equipment decontamination is used to remove potential contaminants from a sampling device or piece of field equipment prior to and between the collection of samples. It is also used to limit personnel exposure to residual contamination that may be present on used field equipment.

Contaminants can be physically removed from equipment or deactivated by sterilization or disinfection. Gross contamination of equipment requires physical decontamination, including abrasive and nonabrasive methods. These may include the use of brushes, air and wet blasting, or high-pressure water, followed by a wash/rinse process using appropriate cleaning solutions. A solvent rinse may be required when organic contamination is present, and an acid rinse may be required when metals are parameters of interest. Equipment decontamination procedures can vary depending on the media being sampled and the type of sampling equipment being used. Disposal of decontamination fluids will be handled on a project-specific basis and will be conducted in accordance with the applicable regulations.

1.3 Equipment

The following equipment may be utilized when decontaminating equipment. Project-specific conditions or requirements may warrant the use of additional equipment or deletion of items from this list. For specialized sampling programs involving per- and polyfluoroalkyl substances (PFAS), refer to Attachment B for further details.

- Appropriate level of personal protective equipment (PPE) as specified in the site-specific Health and Safety Plan (HASP)

- Alconox®, Liquinox® or other non-phosphate, concentrated, laboratory-grade soap
- Simple Green® or other nontoxic biodegradable cleaner
- Deionized, distilled, organic-free, or potable water as appropriate as determined by the Project Manager. Water may be supplied by the laboratory or purchased from commercial vendors depending on project requirements.
- Pump sprayer
- Pressure sprayer
- Squeeze bottle filled with hexane (option for organic analyses)
- Squeeze bottle filled with methanol as appropriate (option for organic analyses)
- Squeeze bottle filled with isopropanol as appropriate (option for organic analyses)
- Squeeze bottle filled with 10 percent nitric acid (option for metals analyses and stainless-steel equipment)
- Squeeze bottle filled with 1 percent nitric acid (option for metals analyses)
- Container (squeeze bottle to 5-gallon bucket) filled with appropriate grade water and a non-phosphate, laboratory-grade soap (approximately 1 tablespoon of soap to 5 gallons of water)
- Extra quantities of above listed liquids
- Containers, such as buckets or wash basins (the type and number of containers is dependent on the procedure)
- Scrub brushes
- Small wire brush
- Aluminum foil
- Polyethylene sheeting
- A container for decontamination of pumps and associated tubing

1.4 Health & Safety Considerations

TRC personnel will be on site when implementing this SOP. Therefore, TRC personnel and/or subcontractors shall follow the site-specific HASP. TRC personnel and/or subcontractors will use the appropriate level of PPE as defined in the HASP.

Sampling equipment or materials that have come in contact with chemical contaminants may be handled during implementation of this SOP. Certain decontamination fluids, including solvents and/or acids, are considered hazardous materials, and TRC employees will always handle and store them appropriately. Hazardous substances may be incompatible or may cause dangerous chemical reactions, including the production of heat, violent reactivity, or produce toxic vapors or other byproducts. Some hazardous substances may be incompatible with clothing or equipment and can permeate or degrade protective clothing or equipment. Also, hazardous substances may pose a direct health hazard to workers through inhalation, skin contact, or if a combustible material is exposed to heat/flame. Safety data sheets (SDS) for chemicals handled by TRC personnel should be maintained in a designated location at the project site.

1.5 Cautions and Potential Problems

Special care should be taken when decontaminating equipment used for sampling for PFAS. Please refer to Attachment B for details.

- The use of deionized, distilled, or organic-free water commonly available from commercial vendors may be acceptable for decontamination of sampling equipment, provided that it has been certified by the vendor as analyte-free and/or meets the project-specific requirements.

- Alconox®, Liquinox®, or other non-phosphate, concentrated, laboratory-grade soap may contain trace quantities of perchlorate or 1,4-dioxane.

- Avoid using an excessive amount of soap during decontamination procedures, as this could result in difficulty rinsing the soap residue off of the equipment. Typically, the soap solution is prepared using 1 tablespoon of soap to 5 gallons of water.

- Use sufficient amounts of decontamination fluid (e.g., acid or solvent rinses) so that the fluid flows over the equipment and runs off. Spraying the equipment with a minimal amount of decontamination fluid that does not run off is ineffective.

- Spent decontamination solutions are considered investigation-derived waste (IDW) and must be managed as directed by the site-specific field program. Project and regulatory requirements, chemical compatibility, ambient conditions, and professional judgment should be used to determine the appropriate decontamination process with respect to combining and/or segregating decontamination fluids. Section 3 of this SOP provides more guidance on the disposal procedures.

- Several procedures can be established to minimize the potential for cross-contamination or analytical interference by decontamination fluids. For example:

  - The use of methanol in the decontamination procedure may not be appropriate if methanol is a contaminant of concern.

  - Isopropanol may be used as a substitute for methanol but may not be appropriate when collecting samples for volatile organic compound (VOC) analyses. Residual isopropanol on the equipment may cause substantial interferences in subsequent VOC analyses and may result in unnecessary dilutions and/or false positive results if isopropanol is not removed in subsequent decontamination steps. It should also be noted that the application of isopropanol to hot metal surfaces (e.g., a steam-cleaned split spoon) may cause oxidation of the isopropanol to acetone.

  - If hexane is used in the decontamination procedure, caution should be used to ensure that the hexane is completely volatilized and the equipment is subsequently rinsed when samples are to be analyzed for VOCs and volatile petroleum hydrocarbons (VPH).

Residual hexane on equipment could interfere with the VOC and VPH analyses and may result in unnecessary dilutions and/or false positive results.

- Cover monitoring and sampling equipment with protective material (i.e., aluminum foil, polyethylene sheeting, or Ziploc® bags) to minimize potential re-contamination after decontamination.

- Use dedicated or disposable sampling equipment when appropriate to minimize the need for decontamination. Although disposable sampling tools are encouraged in order to minimize the generation of decontamination fluids, it should be noted that plastic tools may not be appropriate for collection of samples to be analyzed for semi-volatile organic compounds (SVOCs), pesticides, and polychlorinated biphenyls (PCBs). Potential phthalate contamination may cause significant interferences in the subsequent analyses and may result in unnecessary dilutions and/or false positive results.

- After decontamination, equipment should be handled only by personnel wearing clean disposable, powder-free, nitrile gloves to prevent recontamination.
- Following decontamination, the equipment should be moved away (preferably upwind) from the decontamination area to prevent recontamination.
- Equipment that is not decontaminated properly may result in potentially high, biased results in field samples. **Note:** Equipment blank collection may be appropriate after decontamination of equipment used to collect highly contaminated samples.

1.6 Personnel Qualifications

Since this SOP will be implemented at sites or in work areas that entail potential exposure to toxic chemicals or hazardous environments, all TRC personnel must be adequately trained. Project and client-specific training requirements for samplers and other personnel on site should be developed in project planning documents, such as the sampling plan or project work plan. These requirements may include:

- Occupational Safety and Health Administration (OSHA) 40-hour Health and Safety Training for Hazardous Waste Operations and Emergency Response (HAZWOPER) workers; and
- 8-hour annual HAZWOPER refresher training.

2.0 PROCEDURES

Refer to the site-specific sampling plan and/or Quality Assurance Project Plan (QAPP), if applicable, for site-specific procedures. Other state or federal requirements may be above and beyond the scope of this SOP and will be followed if applicable. The actual procedures used should be documented and described in the field notes.

2.1 General

Personnel, sample containers, and equipment leaving the contaminated area of a site must be decontaminated. Various decontamination methods will either physically remove contaminants by abrasive and/or washing actions, inactivate contaminants by disinfection or sterilization, or both. Decontamination procedures should be documented in the field book.

2.2 Physical Decontamination Procedures

In many cases, gross contamination can be removed by physical means. The physical decontamination techniques appropriate for equipment decontamination can be grouped into two categories: abrasive methods and nonabrasive methods. In general, heavy equipment decontamination is conducted by drilling and construction subcontractors and not by TRC personnel. However, TRC personnel will typically need to document such decontamination efforts as part of project work. Special care should be taken during decontamination procedures following sampling for PFAS; please refer to Attachment B for details.

ABRASIVE CLEANING METHODS APPROPRIATE FOR DRILLING EQUIPMENT (DRILLING RIGS, ETC.)

Abrasive cleaning methods involve rubbing and wearing away the top layer of the surface containing the contaminant. The following abrasive methods are available but are not commonly used:

- *Mechanical:* Mechanical cleaning methods use metal or nylon brushes. The amount and type of contaminants removed will vary with the hardness of bristles, length of brushing time, and degree of brush contact.

- *Air Blasting:* Air blasting is used for cleaning large equipment, such as bulldozers, drilling rigs, or auger bits. The equipment used in air blasting employs compressed air to force abrasive material through a nozzle at high velocities. The distance between the nozzle and the surface cleaned, as well as the pressure of air, the time of application, and the angle at which the abrasive material strikes the surface, determines cleaning efficiency. Air blasting has several disadvantages, including its inability to control the amount of materials removed, it can aerate contaminants, and it generates large amounts of waste.

- *Wet Blasting:* Wet blasting, also used to clean large equipment, involves use of a suspended fine abrasive delivered by compressed air to the contaminated area. The amount of materials removed can be carefully controlled by using very fine abrasives. One disadvantage of this method is the generation of a large amount of waste.

NONABRASIVE CLEANING METHODS APPROPRIATE FOR FIELD EQUIPMENT (DRILLING AUGERS AND RIGS, ETC.)

Nonabrasive cleaning methods involve forcing the contaminant off a surface with pressure. In general, less of the equipment surface is removed using nonabrasive methods. The following nonabrasive methods are available:

High-pressure Potable Water: This method consists of a high-pressure pump, an operator-controlled directional nozzle, and a high-pressure hose. Flow rates typically range from 20 to 140 liters per minute (approximately 5 to 37 US gallons per minute). This procedure is used the majority of the time and is more appropriate for equipment with painted surfaces.

Ultrahigh-Pressure Potable Water: This system produces a pressurized water jet. The ultrahigh-pressure spray removes tightly adhered surface film. The water velocity ranges from 500 meters per second (m/sec) to 900 m/sec (approximately 1,640 to 2,953 feet per second). Additives can enhance the method. This method is not applicable for hand-held sampling equipment. This procedure is not commonly used but would be appropriate for carbon steel drilling rods and augers.

Steam Cleaning: This method consists of a high-pressure hot water cleaner capable of generating a pressure of at least 2,500 pounds per square inch (psi) and producing hot water and/or steam (at least 200 degrees Fahrenheit), and is typically equipped with a soap compartment. Due to the high temperatures associated with this method, steam cleaning should not be used for polyvinyl chloride (PVC) or plastic equipment.

2.3 Procedure for Sampling Equipment

Sampling equipment, such as split-spoon samplers, shovels, hand augers, trowels, spoons, spatulas, bailers, tethers, dippers, and pumps, will be cleaned using the following procedure. Special care should be taken during decontamination procedures following sampling for PFAS; please refer to Attachment B for details. **Note:** The overall number of containers needed for collection of decontamination fluids may vary depending on chemical compatibilities, project and regulatory requirements, and ultimate disposal methods for these fluids.

1. Lay out sufficient polyethylene sheeting on the ground or floor to allow placement of the necessary number of containers (e.g., plastic wash basins or buckets) and an air-drying area. The number of decontamination steps and designated containers should be determined prior to field sampling based on the site-specific sampling plan. At a minimum, one container should be designated for the detergent wash. A second container should be designated for water rinsing. A third container may be designated for non-water rinsing. If more than one, the non-water rinsate fluids may need to be separated. Non-water rinsate fluids should not be combined with the detergent wash during decontamination. Place the containers on the polyethylene sheeting. The decontamination line should progress from "dirty" to "clean".

   Note: In instances where acid or solvent rinses are required, additional containers may be needed to manage collection and subsequent disposal of the spent decontamination fluids.

2. Fill the first container with potable water. Add sufficient non-phosphate, concentrated, laboratory-grade soap to cause suds to form. Do not use an excessive amount of the soap (approximately 1 tablespoon of soap to 5 gallons of water) or rinsing the soap residue off the equipment will be difficult.

3. Disassemble the equipment, as appropriate.

4. Brush any visible dirt off sampling equipment into a designated area before getting equipment wet.

5. Using a clean, coarse scrub brush, submerge and wash the sampling equipment in the soap solution in the first container, removing all dirt and/or visible hydrocarbons. Allow excess soap to drain off the equipment into the container when finished.

6. If cleaning a pump that is not completely disassembled, run the submerged pump in the container long enough to allow sufficient contact time with the internal components of the pump.

7. Rinse the equipment with appropriate water over an appropriate container, using a coarse scrub brush or pressure sprayer to aid in the rinse if necessary. If an additional acid or solvent rinse is not required, proceed to Step 10.

8. **If sampling for metals and if required by the project, rinse the equipment with nitric acid over an appropriate container. Consider using a container dedicated to acidic solutions to minimize the volume of liquid that needs to be neutralized later. A 10 percent nitric acid solution is used on stainless steel equipment. A 1 percent nitric acid solution is used on all other equipment. If not required, this step may be omitted.

9. **If sampling for organic parameters and if required by the project, rinse the equipment over an appropriate container using methanol or isopropanol (see Cautions and Potential Problems). If oily, a hexane rinse should follow the methanol/isopropanol rinse, or as an alternative, Simple Green® can be used if approved by the Project Manager. Consider using an appropriate container dedicated to volatile solvents to minimize the volume of liquid that subsequently needs to be managed as IDW. If not required, this step may be omitted.

   Allow the equipment to completely air dry prior to proceeding to the next step.

   **** Steps 8 and 9 are optional and may be used on a site-specific basis. The site-specific sampling plan or QAPP, if available, should be consulted. In the absence of a sampling plan or QAPP, the Project Manager will decide upon the necessity of these steps.**

10. Rinse the equipment over an appropriate container using deionized, distilled or organic-free water after each step. If cleaning a pump that is not completely disassembled, run the submerged pump in the container long enough to allow sufficient contact time with the internal components of the pump.

11. Allow the equipment to completely air dry on a clean surface (e.g., polyethylene sheeting or a clean container) (See*NOTE).

    ***NOTE** that if temperature or humidity conditions preclude air drying equipment, sufficient spares, as applicable and if possible, should be available so that no item of sampling equipment need be used more than once. If an ample amount of spare equipment is not available and the equipment will not completely air dry, additional rinses with deionized, distilled or organic-free water should be used. The inability of equipment to air dry and the usage of additional rinses should be recorded in the field book or on the appropriate form.

12. Reassemble equipment, if necessary, and wrap completely in clean, unused, protective material. Reuse of equipment on the same day without wrapping in protective material is acceptable.

13. Spent decontamination fluids are considered IDW and must be managed as directed by the site-specific field program.

14. Record the decontamination procedure in the field book or on the appropriate form.

15. Decontamination solution and rinse water should be refreshed at regular intervals as appropriate to meet project quality objectives.

2.4 Procedure for Measuring Equipment

Measuring equipment, such as pressure transducers, water level indicators, oil/water interface probes, and soil moisture/pH meters will be cleaned using the following procedure, unless it conflicts with the manufacturer's recommendations. Special care should be taken during decontamination procedures following sampling for PFAS; please refer to Attachment B for details.

1. Fill two clean containers (e.g., plastic wash basins or buckets) with potable water.

2. Add sufficient nonphosphate, concentrated, laboratory-grade soap to one container to form a thin layer of soap suds. If oily residues are apparent, the use of Simple Green® may be required.

3. Brush any visible dirt off measuring equipment before getting the equipment wet.

4. Either spray rinse the device with the soap solution over the first container, or for heavily soiled equipment, immerse the device in the container containing soap and gently agitate. Scrub device if it is soiled. Do not submerse any electrical controls or take-up reels. Submerse only that portion of the device that came in contact with potential contaminants.

5. Immerse the device in the container containing the potable water and gently agitate. Do not submerse any electrical connectors or take-up reels. Submerse only that portion of the device that came in contact with potential contaminants.

6. Spray rinse equipment with deionized, distilled, or organic-free water over the last container used.

7. Allow the equipment to air dry if time allows.

8. Record the decontamination procedure in the field book or on the appropriate form.

3.0 INVESTIGATION-DERIVED WASTE DISPOSAL

Field personnel should discuss specific documentation and containerization requirements for IDW disposal with the Project Manager.

Each project must consider IDW disposal methods and have a plan in place prior to performing field work. Provisions must be in place regarding what will be done with IDW. If IDW must be removed from the site, consider material containment, such as a composite drum, proper labeling, on-site storage by the client, testing for disposal approval of the materials, and ultimately the pickup and disposal of the materials by appropriately licensed vendors.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

One type of quality control sample specific to the field decontamination process is the equipment blank. The equipment blank provides information about the effectiveness of the decontamination process employed in the field. An equipment blank can detect contamination that may arise from potentially contaminated equipment or equipment that has not been decontaminated effectively.

Equipment blanks consist of a sample of analyte-free (i.e., deionized, distilled, organic-free) water that is poured over and through a decontaminated sampling device and placed in a clean sample container. Ideally, the reagent water should come from the laboratory and be certified as clean. If the blank water is not certified as clean and/or not supplied by the laboratory performing the analyses, a separate water blank that has not run through the sampling equipment should also be sent to the laboratory for analysis.

Equipment blanks are typically collected for all parameters of interest at a minimum rate of 1 per day per matrix; however, the frequency of equipment blank collection will vary from project to project, depending upon the data quality objectives and/or regulatory requirements, and will be specified in either the site-specific sampling plan or QAPP. Equipment blanks are typically not required if dedicated sampling equipment is used.

5.0 DATA MANAGEMENT AND RECORDS MANAGEMENT

All reagents used must be documented in the field book or on the appropriate form. Any deviations from the decontamination procedures specified in the sampling plan or QAPP must be approved by the Quality Assurance Officer and Project Manager and documented in the field book. The lot number and vendor of each reagent used should be documented in the field book. Refer to ECR SOP 001 for field documentation procedures.

Planning for the collection of equipment blank samples can be tracked in the TRC Environmental Data Management System (EDMS). This can ensure the field teams are reminded by the mobile data collection app to collect equipment blank samples per the sampling plan or QAPP. Data quality checks for equipment blank samples can be automatically run by the TRC EDMS and highlight any non-conformities to the QAPP or concentrations detected in the equipment blank samples when data are loaded. Discuss with your EDMS data manager to have this automated report configured for your project site.

6.0 REFERENCES

USEPA. December 1987. *A Compendium of Superfund Field Operations Methods*. EPA/540/P-87/001.

USEPA. January 1991. *Compendium of ERT Groundwater Sampling Procedures*. OSWER Directive 9360.4-06. PB91-9211275.

USEPA. November 1992. *RCRA Ground-Water Monitoring: Draft Technical Guidance*. EPA/530-R-93-001. USEPA Office of Solid Waste.

USEPA. January 1999. *Compendium of ERT Groundwater Sampling Procedures*. EPA/540/P-91/007. OSWER Directive 9360.4-06. PB91-921275.

USEPA. June 22, 2020. *Field Equipment Cleaning and Decontamination*. LSASDPROC-205-R4. Region 4. Laboratory Services and Applied Science Division. Athens, Georgia.

7.0 SUSTAINABLE RECOMMENDATIONS

Sustainable practices should be incorporated wherever practical. Items to consider for equipment decontamination are as follows:

- Utilize Alconox® soap when appropriate due to its biodegradable nature;
- Utilize a reusable container such as a carboy for decontamination water;
- Utilize reusable decontamination equipment such as plastic spray bottles, plastic brushes, etc., when appropriate;
- Utilize recycled plastic sheeting to contain decontamination rinsate, if available; and,
- Send decontamination rinsate to a wastewater treatment facility for water reuse/recycling when practical.

8.0 SOP REVISION HISTORY

REVISION NUMBER	REVISION DATE	REASON FOR REVISION
1	DECEMBER 2016	ADDED ATTACHMENT B TO ACCOMMODATE SOP MODIFICATIONS REQUIRED WHEN SAMPLING FOR PFAS; CHANGED NAMING CONVENTION FOR SOP FROM RMD TO ECR.
2	JANUARY 2020	TRC RE-BRANDING
3	APRIL 2021	REVIEWED AND REVISED SOP

Attachment A: SOP Fact Sheet

EQUIPMENT DECONTAMINATION

PURPOSE AND OBJECTIVE

Removing or neutralizing potential contaminants that may have accumulated on equipment and vehicles ensures protection of personnel, reduces or eliminates potential transfer of contaminants to clean areas, and minimizes the likelihood of sample cross-contamination. Preventing or minimizing potential cross-contamination of samples is important for the collection of representative samples, avoiding the possible introduction of sampling error into sample results, and for protecting the health and safety of site personnel.

WHAT TO BRING

- Field book
- Appropriate PPE
- Site-specific HASP
- Alconox®, Liquinox® or other nonphosphate, concentrated, laboratory-grade soap
- Simple Green® or other nontoxic biodegradable cleaner
- Deionized, distilled, organic-free water, or potable water as appropriate as determined by the Project Manager
- Pump or pressure sprayer
- Squeeze bottles filled with appropriate decontamination chemicals (e.g., organic solvents, nitric acid)
- Containers, such as buckets or wash basins (type and number is dependent on the procedure)
- Scrub brushes and/or small wire brush
- Aluminum foil
- Polyethylene sheeting
- A container for decontamination of pumps and associated tubing

OFFICE

- Prepare/update the site-specific HASP; make sure the field team is familiar with the latest version.
- Review site-specific sampling plan/QAPP for decontamination procedures and procedures for management of investigation-derived waste (IDW) (e.g., used decontamination solutions).
- Confirm all required decontamination supplies are in stock or order as needed.

ON-SITE

- Verify project HASP including safety data sheets for decontamination chemicals used on site.
- Conduct daily Health & Safety tailgate meetings, as appropriate.
- Establish a designated equipment and personnel decontamination area.
- Provide for the proper collection and management of all IDW.
- Verify that appropriate PPE is worn by all site personnel (including subcontractors) and the work area is safe.

SAMPLING EQUIPMENT DECONTAMINATION - PROCEDURES

Sampling equipment, such as split-spoon samplers, shovels, hand augers, trowels, spoons, spatulas, bailers, tethers, dippers, and pumps, will be cleaned using the following procedure. **A more simplified procedure for decontamination of measuring equipment is presented in the SOP.** Note: The overall number of containers needed for collection of decontamination fluids may vary depending on chemical compatibilities, project and regulatory requirements, and ultimate disposal methods for these fluids.

1. Lay out sufficient polyethylene sheeting on the ground or floor to allow placement of the necessary number of containers (e.g., plastic wash basins or buckets) and an air-drying area. At a minimum, one container should be designated for the detergent wash. A second container should be designated for water rinsing. A third container may be designated for nonwater rinsing. Nonwater rinsate fluids should not be combined with the detergent wash during decontamination. The decontamination line should progress from "dirty" to "clean".
   Note: In instances where acid or solvent rinses are required, additional containers may be needed to manage collection and subsequent disposal of the spent decontamination fluids.
2. Fill the first container with potable water. Add sufficient nonphosphate concentrated laboratory-grade soap to cause suds to form. Do not use excessive amount of the soap (approximately 1 tablespoon of soap to 5 gallons of water) or rinsing the soap residue off the equipment will be difficult.
3. Brush any visible dirt off of the sampling equipment into a designated area before getting equipment wet.
4. Using a clean, coarse scrub brush, submerge and wash the sampling equipment in the soap solution in the first container, removing all dirt and/or visible hydrocarbons.

EQUIPMENT DECONTAMINATION

5. Rinse the equipment with appropriate water over an appropriate container, using a coarse scrub brush or pressure sprayer to aid in the rinse if necessary. If an additional acid or solvent rinse is not required, proceed to Step 8.
6. **If sampling for metals and if required by the project, rinse the equipment with nitric acid over an appropriate container. Consider using a container dedicated to acidic solutions to minimize the volume of liquid that needs to be neutralized later. A 10 percent nitric acid solution is used on stainless steel equipment. A 1 percent nitric acid solution is used on all other equipment. If not required, this step may be omitted.
7. **If sampling for organic parameters and if required by the project, rinse the equipment over an appropriate container using methanol or isopropanol (see Caution and Potential Problems). If oily, a hexane rinse should follow the methanol/isopropanol rinse, or as an alternative, Simple Green® can be used if approved by the Project Manager. Consider using an appropriate container dedicated to volatile solvents to minimize the volume of liquid that subsequently needs to be managed as IDW. If not required, this step may be omitted.
   Allow the equipment to completely air dry prior to proceeding to the next step.
   ** Steps 6 and 7 are optional and may be used on a site-specific basis. The site-specific sampling plan or QAPP, if available, should be consulted. In the absence of a sampling plan or QAPP, the Project Manager will decide upon the necessity of these steps.
8. Rinse the equipment over an appropriate container using deionized, distilled or organic-free water after each step.
9. Allow the equipment to completely air dry on a clean surface (e.g., polyethylene sheeting or a clean container).
   *NOTE that if temperature or humidity conditions preclude air drying equipment, sufficient spares, if possible, should be available so that no item of sampling equipment need be used more than once. If an ample amount of spare equipment is not available and the equipment will not completely air dry, additional rinses with deionized, distilled or organic-free water should be used. The inability of equipment to air dry and the usage of additional rinses should be recorded in the field logbook or on the appropriate form.
10. Reassemble equipment, if necessary, and wrap completely in clean, unused, protective material. Reuse of equipment on the same day without wrapping in protective material is acceptable.
11. Spent decontamination fluids are considered IDW and must be managed as directed by the site-specific field program.
12. Decontamination solution and rinse water should be refreshed at regular intervals as appropriate to meet project quality objectives.

INVESTIGATION DERIVED WASTE (IDW) DISPOSAL

Field personnel should review the project work plan and ensure project-specific IDW management documentation and containerization requirements are specified or discussed with the Project Manager before going to the project site.

DATA MANAGEMENT AND RECORDS MANAGEMENT

All reagents used must be documented in the field book or an appropriate field form. Any deviations from the decontamination procedures specified in the work plan, sampling plan or QAPP must be approved by the Quality Assurance Officer and Project Manager and documented in the field book. The lot number and vendor of each reagent used should be documented in the field logbook. Refer to ECR SOP 001 for field documentation procedures.

DOs AND DO NOTs OF EQUIPMENT DECONTAMINATION

DOs:

- DO call the Project Manager or field team leader if unexpected conditions are encountered or at least daily to update them on site work.
- DO manage and collect IDW in accordance with project requirements.
- DO use deionized, distilled or analyte free water that is provided by the laboratory, is certified analyte-free, and/or meets project requirements.
- DO use sufficient amount of decontamination fluids so that the fluid flows over the equipment and runs off.
- DO use new wrapped disposable dedicated sampling equipment when appropriate to minimize the need for decontamination.

DO NOTs:

- DO NOT use an excessive amount of soap during decontamination.
- DO NOT sign anything in the field unless authorized in writing by client. This includes waste disposal documentation, statements, etc.; call the Project Manager if this issue arises.

Attachment B: SOP Modifications for PFAS

Due to the pervasive nature of PFAS in various substances routinely used during sampling and the need to mitigate potential cross-contamination or sampling bias to ensure representative data are collected, special care should be taken when sampling for PFAS. The following table highlights the required modifications to this SOP when sampling for PFAS.

PFAS Equipment Decontamination Protocols	
SOP Section Number	**Modifications to SOP**
1.3	• Use only Alconox® or Liquinox® soap; do not use Decon 90. • Use new plastic buckets for wash and rinse water. • Ensure that PFAS-free water is used during the decontamination procedure. • Do not use aluminum foil.
1.5	Always consult the Site-specific Health and Safety Plan prior to conducting field work. The following considerations should be made with regards to decontamination procedures: • Tyvek® suits should not be worn. Cotton coveralls may be worn. • Boots and other field clothing containing Gore-Tex™ or other waterproof/resistant material should not be worn. This includes rain gear. Boots made with polyurethane and polyvinyl chloride (PVC) are acceptable. • Food and drink should not be allowed within the decontamination area. Bottled water and hydration drinks (e.g., Gatorade®) may be consumed in the staging area only. • Personnel involved with decontamination should wear a new pair of nitrile gloves after each decontamination procedure when handling equipment to avoid re-contamination. Avoid handling unnecessary items with nitrile gloves. • Do not store on or cover equipment with aluminum foil after decontamination. Use of polyethylene sheeting is acceptable. • Avoid wearing clothing laundered with fabric softeners. • Avoid wearing new clothing (recommended six washings since purchase). Clothing made of cotton is preferred. • Avoid using cosmetics, moisturizers, hand creams, or other related products as part of cleaning/showering the morning of sampling and decontamination field work.
2.2	• New nylon or metal bristle brushes should be used for mechanical cleaning methods. • If high-pressure water is used, it must be tested prior to use for the presence of PFAS.
2.3	• Ensure that PFAS-free water is used during the last step of the decontamination procedure.
2.4	• Ensure that PFAS-free water is used during the last step of the decontamination procedure.

ATTACHMENT B

Chain of Custody Form

>> Select a Laboratory or Service Center <<

#N/A
#N/A
#N/A
##

Chain of Custody Record

eurofins | Environment Testing America

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Eurofins Environment Testing America

Client Contact	Project Manager:			COC No:
Your Company Name here	Email:	Site Contact:	Date:	_____ of _____ COCs
Address	Tel/Fax:	Lab Contact:	Carrier:	TALS Project #:
City/State/Zip	Analysis Turnaround Time			Sampler:
(xxx) xxx-xxxx Phone	☐ CALENDAR DAYS ☐ WORKING DAYS			For Lab Use Only:
(xxx) xxx-xxxx FAX	TAT if different from Below ______			Walk-in Client:
Project Name:	☐ 2 weeks			Lab Sampling:
Site:	☐ 1 week			
P O #	☐ 2 days			Job / SDG No.:
	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)																	Sample Specific Notes:

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ____________

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for_________ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:		Cooler Temp. (°C): Obs'd:________ Corr'd:_________ Therm ID No.:__________		
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

APPENDIX B
Health and Safety Plan

SITE-SPECIFIC HEALTH AND SAFETY PLAN

INDIAN POINT ENERGY CENTER
AREA OF CONCERN 118
LAFARGE EASEMENT FORMER SPECTRA CONSTRUCTION AREA
BUCHANAN, NEW YORK 10511
ORDER ON CONSENT AND ADMINISTRATIVE SETTLEMENT SITE NO. 360042

Prepared for:
Holtec Decommissioning International, LLC
1 Holtec Boulevard
Camden, New Jersey 08104

Prepared by:
TRC Engineers, Inc.
1430 Broadway
New York, New York 10018

TRC Project No.: 504007.0000.0000 Phase 1
January 2023

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1. Site/Project Contact Information

Table 1 – Site/Project Contact Information			
Client Contact			
Name	**Organization**	**Title**	**Primary Phone No.**
Kristin Maddalo	Holtec Decommissioning International, LLC	Project Manager	(914) 254-7248
TRC Personnel and Project Role			
Name	**Role**	**Email**	**Primary Phone No.**
Michael Glenn	National Health and Safety Director	mglenn@trccompanies.com	(949) 697-7418 (cell)
Scott Buchanan	ECE Regional Safety Manager	sbuchanan@trccompanies.com	(978) 758-2808 (cell)
Robert Harrington, MS, CIH	Certified Industrial Hygienist	rharrington@trccompanies.com	(646) 988-7156 (cell)
Kirsten Myers, PE	Remedial Engineer	Kmyers@trccompanies.com	(212) 221-7822 (cell)
Jenna Raup	Project Manager	Jraup@trccompanies.com	(929) 502-6469 (cell)
Emily Ebert	Office Safety Coordinator (OSC)	eebert@trccompanies.com	(908) 451-0203 (cell)
Kevin Meazell	On-Site HSO	kmeazell@trccompanies.com	(646) 354-7868 (cell)
Subcontractor Information			
Company Name	**Service**	**Primary Contact**	**Primary Phone No.**
Aquifer Drilling and Testing, a Cascade Company	Driller	Shawn Miller	(516) 616-6026
Susan M. Anacker, Professional Land Surveyor, PLLC	Land Surveying Services	Susan M. Anacker	(718) 474-7700
Advanced Geological Services	Geophysical Survey	TBD	(610) 722-5500
AARCO Environmental	Waste Disposal	TBD	(631) 586-5900
Emergency Assistance			
Service	**Name**	**Emergency No.**	**Primary Phone No**
Ambulance	Cortland EMS	911	(914) 739-0881
Early Incident Intervention	WorkCare	1-888-449-7787	Not applicable
Fire	Buchanan Fire Department	911	(914) 737-0334
Hospital	New York Presbyterian	911	(914) 788-4635

Table 1 – Site/Project Contact Information

	Hudson Valley Hospital		
Police	Buchana Police Department	911	(914) 739-6776
Poison Control Center	NY Regional Poison Control Center	1-800-222-1222	Not applicable
Spill	CHEMTREC	Not applicable	1-800-424-9300 (TRC No. CCN 671126)
Spill (Federal)	National Response Center	1-800-424-8802	Not applicable
Spill (State)	New York State Spill Hotline	1-800-457-7362	Not applicable

2. Medical Facility Identification and Directions

<u>Nearest Hospital</u>: New York Presbyterian Hudson Valley Hospital

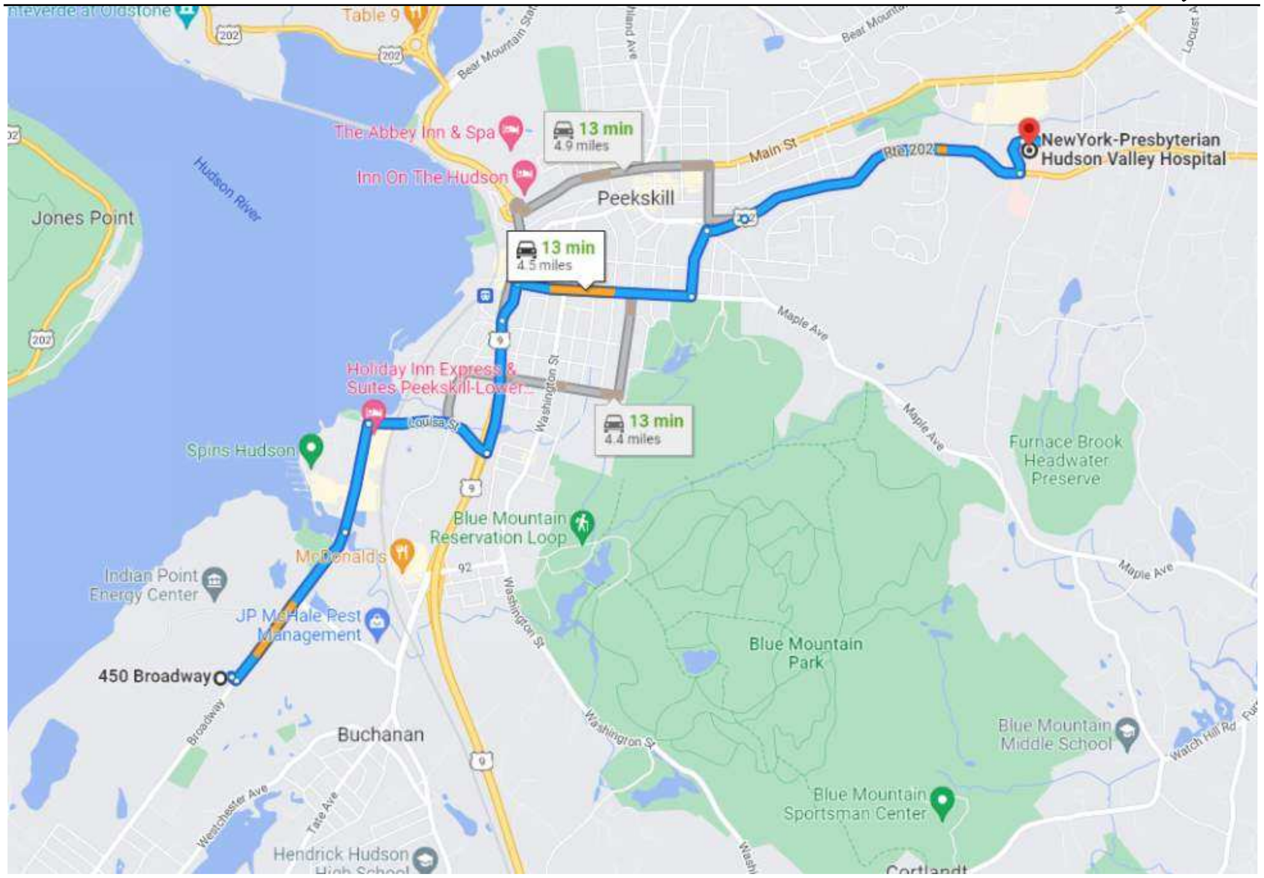
<u>Hospital Address</u>: 1980 Crompond Rd, Cortlandt, NY 10567

<u>Hospital Telephone Number</u>: (914) 788-4635

<u>Directions to Hospital (see attached Map)</u>:

Head north on Broadway for 0.7 miles. Take a right on Louisa Street for 0.5 miles. Turn left to merge onto US-9 N. Take the exit for South Street/Hudson Avenue. Take a right onto Hudson Avenue for 0.6 miles. Take a left onto Wells Street. Take a right onto South Division Street and continue onto Crompond Road for 1.1 miles. New York-Presbyterian Hudson Valley Hospital will be on the left.

<u>Map to Hospital</u>:



3. Utility Clearance

Dig Safely New York and non-member utilities will be notified at least 72 hours prior to commencing any ground intrusive work. Prior to the start of work, confirmation receipts will be reviewed, and utility mark-outs will be verified.

Prior to the operation of any heavy equipment, the site shall be inspected for potential overhead hazards (e.g., wires, tree branches, etc.). A minimum clearance of 10 feet must be maintained between equipment and overhead utility lines. If contact is possible (i.e., equipment, drill rig, excavator, etc.) one or more of the following will be done: 1) Power sources will be disconnected by the utility; 2) Power sources will be shielded by the utility; 3) Object will get no closer than 10 feet to prevent arcing, unless site specific conditions or weather conditions warrant greater separation per best professional judgment, or as directed by utility representatives; and, 3) Evaluate the need for shielding and coordinate with local utility representatives.

4. Scope of Work Summary

The work to be completed is:

- Geophysical survey – encompassing a 20'x 20' area around each boring location
- Soil Boring/Sampling
    - 10 surface soil samples collected via hand tools
    - 10-20 subsurface soil samples collected via direct push (i.e., Geoprobe)
- Installation of three, approximately 40-foot monitoring wells and collection of 3 groundwater samples
- Management of Investigation-Derived Waste

5. Hazard Assessment

This Health and Safety Plan (HASP) assumes that an ongoing hazard assessment process with the HSO (or his/her designee), Project Manager, OSC and field staff (including the On-Site HSO) will take place regularly (via meetings/teleconferences), supplemented by as needed communication on project safety needs, to ensure the project work is conducted at a high level of technical excellence both safely and efficiently. Where the on-going hazard assessment indicates the presence of hazards, tasks, or other activities that are not adequately covered by the HASP and supporting documentation and/or staff training levels, supplemental planning will be conducted and documented in a revised or higher-level HASP document and appropriately trained personnel assigned.

5.1 Chemical Hazards

There are no known and/or suspected contaminants expected to be present at the site. If any new condition is encountered during this activity, the HASP will be adjusted accordingly.

TRC anticipates the use of methyl alcohol (methanol) during decontamination procedures. Safety Data Sheets (SDS) for preservatives and decontamination products are provided in **Appendix A**. Sample bottles containing hazardous preservatives will be handled with care. Sample bottles will be checked for leaks and lids tightened. Cut resistant and chemical resistant gloves and safety glasses will be worn at all times when handling sample bottles (see Section 5.2 for information concerning edges and material handling).

Isobutylene may be used for brief periods each work day to calibrate a photoionization detector (PID). One hundred parts per million (ppm) isobutylene will be primarily contained in a Tedlar® bag. Any gas that is released to the air will quickly disperse and will not pose a threat to on-site workers. No further monitoring is required for isobutylene

5.2 Physical Hazards

Physical hazards that may be encountered at the site are outlined below. If hazards are identified by the ongoing hazard assessment process, which are not address by this HASP, work shall be stopped and the

HSO (or his/her designee), Project Manager, OSC or On-Site OSC, as appropriate, shall be contacted to determine if additional safety procedures and programs should be employed at the site.

Dust – When conducting any ground disturbing activities, be cognizant that the dust has potential to contain hazardous chemicals and should not be inhaled. Whenever possible dust reduction by wetting shall be used. If dust is billowing, wetting the area, letting the dust settle, working from an upwind direction, and/or respirator with P100 cartridges (with proper fit test, training and medical monitoring) is recommended to reduce exposure. With well repair, concrete materials will likely be disturbed potentially generating dust that could contain silica.

Edges/Material Handling – Cut resistant gloves are required to be worn at all times while performing tasks that have the potential for hand injuries. A glove selection guideline is presented in **Appendix B**.

Hand Tools – Use only the appropriate tool for the task at hand. Use the tool(s) as designed, described, and intended by the manufacturer. Hand tools will meet the manufacturer's safety standards. Hand tools will not be altered in any way. Makeshift tools will not be used. At a minimum, hand and eye protection will be used when working with hand tools (see glove selection guide provided herein). Wrenches, including adjustable, pipe, end and socket wrenches, will not be used when jaws are sprung to the point that slippage occurs. Impact tools such as drift pins, wedges and chisels, will be kept free of mushroom heads. Wooden handles will be free of splinters or cracks and secured tightly to the tool. At all times use appropriate hand protection when utilizing hand tools.

Heavy Equipment/Drill Rigs – Use caution around drill rigs, construction equipment, and open excavations. Ensure the equipment operator is aware of the location of on-site personnel at all times to avoid potential injuries (e.g., maintain eye contact with the equipment operator). A spotter should be used to direct the movement of heavy equipment. A swing zone should be established with cones behind any excavators to prevent injury during movement of equipment. Exercise caution and wear protective equipment as noted herein around the equipment to guard against crushing and pinching hazards. On-site personnel will maintain a distance (approximately 10 feet) from mechanical hazards associated with heavy equipment. All field team members working near or with equipment with emergency shut-off switches should be aware of the locations and situations when these switches should be used.

Hostile Individual(s) – Most personnel who are encountered during work will not be hostile, however if a hostile individual is encountered you should not confront them. You should back away and go to your vehicle or other safe location where you can isolate yourself from the hostile person(s). Once safe, if you are continuing to be harassed you should contact the local police for assistance. Contact the Project Manager or OSC once the situation is safe and under control.

Hunters/Firing Range, etc. – Be aware of surrounding activities that may involve hunting, firearms, etc.

that may not be in your immediate area, but could be create an unsafe work environment.

Lighting – There are areas/time within the work area(s) at the site which will potentially have little to no lighting. Lighting shall be utilized to make the work area and nearby hazards are illuminated. If gasoline powered equipment must be used to power portable lights, the generator shall be placed outside in a well-ventilated area.

Manual Lifting – Improper lifting can lead to a variety of injuries including back strains, muscle pulls and joint damage. It is important for all personnel to understand proper lifting techniques and to utilize safe lifting procedures when handling materials. Generally, no one person should lift more than 50 pounds without assistance. Mechanical means should be used whenever possible.

Noise – Hearing protection must be worn when noise levels exceed 85 dBA in the work area. If you need to raise your voice to be heard at the work site, then hearing protection should be worn. Hearing protection will be worn near drill rigs.

Power Tools – All power tools will be inspected regularly (at least on a daily basis) and used in accordance with the manufacturer's instructions and its capabilities. Electrical tools will not be used in flammable areas, unless they are approved for that purpose. Portable electric tools will be used only with a GFCI. Proper hand, eye and hearing protection will be used when working with power tools and all appropriate safety guards must be in place. Personnel will be trained in the proper use of the specific tool. Any defective power tools will be immediately tagged and removed from service. Tools will be stored properly after use.

Pressurized Fluids/Gases – All compressed gases are hazardous due to the high pressures inside the cylinders. Even at a relatively low pressure, gas can flow rapidly from an open or leaking cylinder. Damaged cylinders can become projectiles resulting in severe injury and property damage. An unsecured or uncapped cylinder can become a cause of a major accident. Cylinders shall be secured when not in use, in transport, and as much as possible when in use.

Slips, Trips and Falls – Be aware of uneven ground and buried debris (e.g., metal, plastic, etc.) to avoid potential slip/trip/fall hazards, and use caution near open excavations. Maintain good housekeeping practices to minimize physical hazards.

Traffic Hazards – Driving to and from the site each day is considered a physical hazard. Directions and travel time to the site should be determined in advance (a.k.a. Journey Management Planning) and adequate time should be allocated to drive safely. The use of cellular phones is prohibited, and distracted driving should be avoided. Seatbelts shall be worn at all times while the vehicle is moving. Use caution around traffic flow. Ensure proper traffic control (e.g., signs, traffic cones, barriers, etc.) are in place prior to and throughout the workday where work takes place in or near traffic. Work personnel must wear ANSI-rated class 3 reflective traffic vests at all times. A site-specific traffic management plan describing procedures to be employed, including barriers, signage, etc., will be used for each drilling location.

Utilities – Dig Safely New York and non-member utilities must be notified at least 72 hours prior to commencing any intrusive activities. Use extreme caution when operating heavy equipment near utilities. Excavation and drilling locations will be selected that are located at safe distances from utility hazards. Prior to the operation of any heavy equipment, the site shall be inspected for potential overhead hazards (e.g., wires, tree branches, etc.). A minimum clearance of 10 feet must be maintained between equipment and overhead utility lines. If contact is possible (i.e., equipment, drill rig, excavator, etc.) one or more of the following will be done: 1) Power sources will be disconnected by the utility; 2) Power sources will be shielded by the utility; 3) Object will get no closer than 10 feet to prevent arcing, unless site specific conditions or weather conditions warrant greater separation per best professional judgment, or as directed by utility representatives; and, 3) Evaluate the need for shielding and coordinate with local utility representatives.

Weather – Heat and cold stress are a potential concern for on-site workers. Take breaks as needed to cool down, replenish fluids and/or warm up. Please refer to **Appendix D** for the signs, symptoms and precautions for cold and heat stress. Work may occur during a time of year when thunderstorms are possible/likely. If thunder or lightning is noted by onsite personnel, work will cease until the storm passes (thunder and/or lightning ceases and is not observed over at least a 30-minute period). Personnel will seek shelter in buildings or vehicles.

5.3 Biological Hazards

Biological Waste – This includes feces, urine, needles/sharps and other materials which may contain biological matter from humans or animals. This material should be avoided and not handled in any way. If biological waste impedes the planned scope of work the Project Manager or OSC should be contacted to discuss appropriate actions.

Blood-Borne Pathogens – Injuries received in the field may require assistance from a field team member with appropriate first aid/first responder training to perform first aid. Contact with blood and certain body fluids can contain pathogens that may be transmitted by contact with an open wound by the caregiver. The following precautions should be used when giving first aid:

- Use nitrile gloves to avoid contact with blood/fluids. Spent bandages and gloves used to perform first aid should be placed in a plastic bag and properly disposed.
- Blood/fluid should be cleaned from surfaces that may be contacted by other individuals.
- Use an appropriate barrier if required to perform rescue breathing.

Ticks - Ticks generally favor areas of high grass and dense vegetation so to the extent possible, these areas should be avoided. It is advisable when entering these areas to tuck pants into socks and to wear a light-colored long sleeve shirt to help spot ticks before they bite. DEET-based insect repellents may be worn to repel ticks, but hands should be washed thoroughly after use and DEET should not be sprayed directly onto the skin surface. Self-checks should be made frequently and at least at the end of the field day for ticks when working in or near vegetated areas.

If discovered, the tick should be removed with a pair of tweezers and saved in a sealed plastic bag. Sometimes, tick bites occur but the tick may not stay attached, followed by a rash developing in the area within a few days of the bite**. If bitten by a tick or a bulls-eye like rash develops, it is advisable to consult WorkCare**.

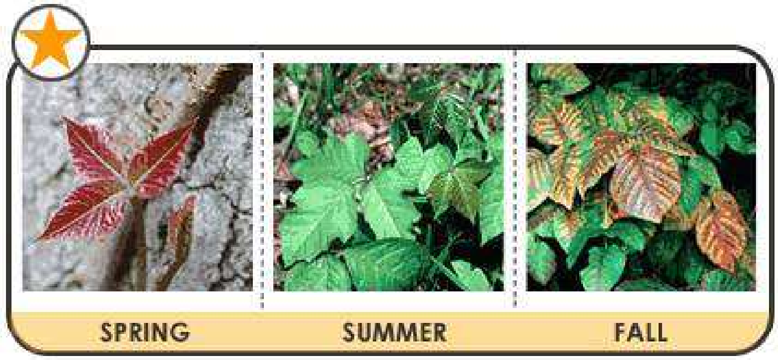
Spiders – Spiders typically seek cover in dark protected areas. Common areas where spiders may be encountered are heavy vegetation and trees. Spiders also are found in basements and enclosed spaces such as sheds, protective well covers, etc. Spider bites may cause swelling, pain and respiratory problems. Avoid dense vegetation and use caution when sampling in dark poorly illuminated locations. If bitten, wash the area and use ice on the bite area to reduce swelling. If respiratory stress, significant pain or swelling is noted, or discoloration around the bite area occurs, seek immediate medical attention.

Stinging Insects – Like spiders, wasps and yellow jackets often nest in dense vegetation and in the ground, or in protective casings on monitoring wells and shielded gate locks. A sting from these insects can cause pain, swelling, and respiratory problems that may be life-threatening to certain individuals. If stung, remove stinger (if present) using tweezers, or similar, and wash the area and use ice on the sting area to reduce swelling. If respiratory stress, significant pain or swelling is noted, or discoloration around the sting area occurs, seek immediate medical attention.

Dogs and Wild Animals – Dogs often are not leashed and may be unfriendly. Bites from dogs and wild animals can cause infections or transmit disease. In general, it is best to not approach dogs even if they appear to be friendly, and wild animals should never be approached. If bitten, the area should be washed with soap and water. If the bite resulted in puncturing or tearing of the skin, the wound should be covered with a sterile dressing and medical attention should be sought immediately. A description of the dog should be noted and if possible, the dog's owner.

Plants – There are many types of plants which can cause irritation or allergic type reactions. Examples of some encountered on TRC sites include the following:

Poison Ivy – the trademarks of this plant are its solid green, pointed leaves that hang from the stem in groups of three. It grows as both a vine and a shrub. The look of poison ivy can change with the seasons. It produces yellow-green flowers in the spring and its green leaves can change to yellow and red in autumn.



Wild Parsnip/Giant Hogweed – Both plants are part of the carrot family and can grow up to 15 feet tall. They look similar to giant Queen Anne's lace with bristly stalks. Contact with the sap from the plant can cause phytophotodermatits or irritation (sometimes severe) when skin is exposed to sunlight.

<u>*Pandemic Preparedness*</u> – A "pandemic" refers to an epidemic that has spread over several countries or continents, usually impacting a large number of people. A pandemic has the potential to significantly impact routine services. A pandemic disease presents a serious health risk and could prevent TRC from performing project-related tasks. The risk to employee health and the business will vary based on the geographic area of the pandemic and the potential severity of the disease. Pandemic risk assessments will be performed by the TRC Corporate Safety team who will provide direction to field personnel.

TRC will follow health and travel precautions issued by the respective authorities. Employees should stay at home when sick or otherwise experience symptoms that are consistent with the pandemic disease. When at a project site, infection control measures should be enacted, which are essential components of pandemic management and a component of public health measures. These essential measures include:

- Practice frequent hand washing. According to the CDC, washing hands with soap and water is the best way to get rid of germs in most situations. If soap and water are not readily available, you can use an alcohol-based hand sanitizer that contains at least 60 percent alcohol. You can tell if the sanitizer contains at least 60 percent alcohol by looking at the product label.
- Obtain immunizations recommended by healthcare providers to help avoid disease.
- Practice social distancing to increase the space between employee work areas and decreasing the possibility of contact by limiting large or close contact gatherings and avoid shaking hands.

- Frequently disinfect all areas that are likely to have frequent hand contact (like doorknobs, faucets, handrails, etc.).

5.4 Radiological Hazards

The Site is an approximately 10-acre portion of the 280-acre Indian Point Energy Center (IPEC), a former nuclear power generating station. The Site is not expected be impacted by radiological contamination; however, documentation of radiological investigations will be reviewed prior to mobilization. This SSHASP will be revised, as needed, following review of the radiological investigations.

6. Personal Protection Monitoring

Personal Protection Monitoring Equipment and Use Recommendations: The following table outlines monitoring equipment needs and rationale. Note that an upgrade to a higher level of respiratory protection (C or higher) will warrant revision or addendum to this HASP and consultation with the TRC Corporate Safety team before work recommences.

Table 2: Monitoring Equipment Use Recommendations

Instrument	Use Code	Action Levels	Notes/Rationale
PID	C	5 ppmv*	Recommended for VOC screening to monitor airborne VOC concentrations in breathing zone levels. If PID readings are sustained above 5 ppmv in the breathing zone for at least 5 minutes, move to an upwind location for 15 minutes. After 15 minutes, measure again. If PID readings are still above 5 ppmv in the breathing zone, contact the Project Manager or OSC to evaluate suitable response actions. Any upgrade in respiratory protection will be coordinated with the TRC Corporate Safety team. Withdraw from area if PID readings exceed 50 ppmv.
TSI Dustrak™ (or equivalent)	C	> 150 µg/m3; 15 minute average**	Used where contaminants could adhere to fugitive dust, and where fugitive dust migration could potentially serve as a significant exposure pathway. Half-faced APR for particulates to be used intermittently/temporarily where dust control measures cannot maintain dust levels below action level. Use is optional for dust levels below the action level. Use of a half-face APR for dust does not require CIH approval where dust action level excursions are limited in duration, and where dust control measures will be implemented until below the action level. However, personnel must be medically

Table 2: Monitoring Equipment Use Recommendations			
Instrument	**Use Code**	**Action Levels**	**Notes/Rationale**
			qualified, fit tested for half-face APR use, and trained in the use of the APR.
O^2/LEL	C	19.5%	Recommended for landfill, lagoon, excavation, sewer, and anaerobic degradation site work. Required for confined space work.
H_2S Meter	C	1 ppm	Recommended for landfill, lagoon, excavation, sewer, and anaerobic degradation site work. Required for confined space work.
CO	C	25 ppm	½ of the PEL (PEL = 50 ppm)
CGI	C	10% LEL	Recommended safe level to prevent explosive conditions.
MINIRAM (or equivalent)	O		Supplement operation of Dustrak™ stations for work near sensitive receptors.
Radiation meters	R		Radiological survey by handheld devices as required by HDI.

Notes:
* Site/project specific action levels for VOCs may be established in consultation with the OSC.
** Above background upwind levels
PID – Photoionization detector; LEL – Lower Explosive Limit; O_2 – Oxygen
H_2S – Hydrogen Sulfide; CO – Carbon Monoxide; ppm – Parts per Million
CGI – Combustible Gas Indicator; VOC – Volatile organic compound; ppmv – Parts per Million Volume
APR – Air Purifying Respirator; CIH – Certified Industrial Hygienist; PEL – Permissible Exposure Limit
µg/m3 – micrograms per cubic meter

Use Codes: R – Required, C – Condition specific, O – Optional, N/A – Not applicable

<u>Personal Protection Monitoring Procedures</u>: When necessary, the OHSO will measure organic vapor concentrations in the breathing zone using a PID. Fugitive dust emissions are not anticipated to be a concern. When required, air monitoring for dust will be performed using a combination of real-time dust monitoring upwind and downwind of the work area, and at a point near the closest receptor.

<u>Personal Protection Exposure Limits</u>: There are no chemicals of concern anticipated to be present at the Site. Provided below is a table of generic chemicals often found at environmental sites.

Table 3: Summary of Exposure Limits – Known or Suspected Site Impacts		
Chemical of Concern	**Detected Concentration**	**OSHA PEL/ACGIH TLV**
Volatile Organic Compounds (VOCs)	Unknown	200 ppm (OSHA PEL for PCE) 200 ppm (OSHA PEL for TCE) 200 ppm (OSHA PEL for DCE)
Semi-volatile Organic Compounds (SVOCs)	Unknown	0.2 mg/m^3 (OSHA PEL for PAHs)

Table 3: Summary of Exposure Limits – Known or Suspected Site Impacts

Chemical of Concern	Detected Concentration	OSHA PEL/ACGIH TLV
Polychlorinated Biphenyls (PCBs)	Unknown	1,000 µg/m^3 (OSHA PEL for PCBs containing 42% chlorine) 500 µg/m^3 (OSHA PEL for PCBs containing 54% chlorine)
Metals	Unknown	50 µg/m^3 (OSHA PEL for lead) 10 µg/m^3 (OSHA PEL for arsenic) 0.2 mg/m^3 (OSHA PEL for cadmium) 0.5 mg/m^3 (OSHA PEL for chromium) 0.2 mg/m^3 (OSHA PEL for selenium) 0.01 mg/m^3 (OSHA PEL for silver) 0.5 mg/m^3 (OSHA PEL for barium) 1.0 mg/10m^3 (OSHA PEL for mercury)

Notes: Exposure and hazard data obtained from the NIOSH Pocket Guide to Chemical Hazards unless otherwise noted.

ppm – parts per million
OSHA – Occupational Safety and Health Administration
PCE – Tetrachloroethene
DCE – Dichloroethene
µg/m3 – micrograms per cubic meter
TLV – Threshold Limit Value
PEL – Permissible Exposure Limit
TCE – Trichloroethelene
PAHs – Polycyclic aromatic hydrocarbons

Table 4: Preservatives and Decontamination Products

Chemical of Concern	On-Site Usage and Potential Exposures	Control Method
Hydrochloric Acid (HCl)	Less than 20 ml quantities used for sample preservation. Air phase exposure is expected to be minimal and incidental to sample containerization.	5 ppm (OSHA PEL)
Methyl Alcohol (methanol; MeOH)	Less than 20 ml quantities used for sample preservation. Air phase exposure is expected to be minimal and incidental to sample containerization.	200 ppm (OSHA PEL)
Nitric Acid (HNO_3)	Less than 20 ml quantities used for sample preservation. Air phase exposure is expected to be minimal and incidental to sample containerization.	5 mg/m^3 (OSHA PEL)

Table 4: Preservatives and Decontamination Products		
Chemical of Concern	**On-Site Usage and Potential Exposures**	**Control Method**
Isobutylene	100 ppm gas for use during calibration of PID instruments.	No specific exposure limits for isobutylene (simple asphyxiant). Maintain oxygen levels above 19.5%. Before attaching regulator to cylinder, verify that the regulator is off. Before opening regulator, make sure that tubing connecting regulator to monitoring device/ Tedlar® bag is secure. To use a Tedlar® bag, put bag control valve in an open position and close after filling. Before disconnecting gas from the instrument and/or Tedlar® bag, verify the regulator is closed. Empty bag of contents after calibration in a downwind position and/or to avoid inadvertent inhalation.
Notes: ppm – parts per million ml – milliliters PID – Photoionization Detector OSHA – Occupational Safety and Health Administration PEL – Permissible Exposure Limit		

7. Personal Protective Equipment

TRC personnel will use Level D PPE as noted/modified below:

Table 5: Level D Personal Protective Equipment

Item	Rationale/Notes
Hardhat	American National Standards Institute/International Safety Equipment Association (ANSI/ISEA) Z89.1-2009 rated hard hats will be worn by personnel at all times when overhead hazards are present, including electrical.
Hearing protection	Hearing protection will be worn by all personnel exposed to at least 85 dB of sound during the workday. A good rule of thumb to use in determining whether background noise is 85 dB or higher is if you must shout to be understood by somebody about one arm-length away, that background noise is hazardous.
Safety boots (steel or composite toe and shank)	Electrical Hazard (EH) rated safety-toe safety boots will be worn by all personnel during project work described in this HASP.
Eye protection (safety glasses)	ANSI rated eye protection (Z87 or Z87+) is required to be worn at all times when onsite or when personnel are exposed to flying debris, chemical vapors or particulates. Chemical splash goggles will be worn for protection against chemical gases, vapors or particulates. Safety glasses will be worn for protection against flying objects.
Safety vest	ANSI Class 2 safety vest is required at all times when onsite. Utilize in areas in or near vehicular traffic of any kind on or off property.
Chemical Protective Clothing (CPC) and Gloves	CPC and gloves will be inspected according to TRC's Personal Protective Equipment Program. CPC will be chosen with assistance from the OSC according to the chemical hazards present. Gloves are to be changed between samples to avoid cross-contamination.
Cut resistant work gloves	As indicated herein, use Cut and Abrasion Resistance Level 2 to Level 4 gloves when necessary for hand protection during field tasks. See **Appendix B** for a Glove Selection Guide. ***Leather work gloves are expressly prohibited.***
Electrical Safety	8 cal/cm^2 Flame Resistant (FR) clothing where required for the work environment.
Personal Floatation Device (PFD)	Type I, II, or III PFD is required to be worn at all times when working over/near water.

A basic first aid kit will be readily available on-site in the event of an emergency.

Fire extinguishers should be present within 50 feet of wherever more than 5 gallons of flammable or combustible liquids or 5 pounds of flammable gas are being used at the site, including operational equipment. All personnel working on or around the equipment should know the location of and how to operate the fire extinguisher. Ensure the fire extinguisher is in working order by checking the manufacture and/or most recent inspection dates.

8. Personnel and Equipment Decontamination Plan

At minimum, personnel and equipment decontamination will include the following:

Equipment Decontamination: There is a possibility that site media contacted during work activities contain compounds described in **Table 3**. All equipment that comes in contact with media needs to be decontaminated before it is removed from the job site. To properly decontaminate equipment that comes in contact with media, the following procedure should be followed:

- Brush accumulated material off equipment that has come in contact with impacted media. The material shall be returned to the location from which it came or disposed of properly;
- Wipe parts of the equipment that came in contact with the media down with cloth, rags or heavy-duty paper towel damp with non-phosphate concentrated laboratory-grade soap (i.e. Alconox© or Liquinox©); [Note: Ensure that materials used are PFAS free.]
- Follow up with a wipe from a separate cloth, rags or heavy-duty paper towel damp with potable water; and
- PPE and cloth, rags or heavy-duty paper towels can be disposed of in the regular waste stream.
- If equipment becomes grossly impacted with site media, equipment shall be steam cleaned over a decontamination pad.

Personnel Decontamination: In general, contamination of personnel shall be prevented through the use of PPE. At minimum, nitrile gloves shall be worn during contact with impacted material or chemical in addition to other Level D PPE.

9. Required Personnel Training

TRC field personnel will have the training outlined below before on-site work activities:

Table 6: Project Training Requirements

(* required for all sites; but minimum recommended)

Check “A” if training required for everyone, and check “T” if training required for specific task or per notations.

A	T	Subject	Reference	
			29 CFR 1910	29 CFR 1926 or Other
☒	☐	HAZWOPER 40 hour*	1910.120	1926.65
☒	☐	3-Day HAZWOPER Supervised On-site*	1910.120	1926.65

Table 6: Project Training Requirements				
(* required for all sites; but minimum recommended) Check "A" if training required for everyone, and check "T" if training required for specific task or per notations.				
A	**T**	**Subject**	**Reference**	
			29 CFR 1910	**29 CFR 1926 or Other**
☒	☐	8-Hour HAZWOPER Refresher*	1910.120	1926.65
☐	☒	8-Hour Supervisor HAZWOPER*	1910.120	1926.65
☐	☒	First Aid, CPR*,1	1910.151	1926.23,.50
☒	☐	Hazard Communication (HAZCOM)	1910.1200	1926.59
☐	☒	DOT/IATA Shipping Training	1910.1201	49 CFR 172.704
☒	☐	TRC Hand Protection Policy		
☒	☐	Defensive Driving		
☐	☐			
Client-specific training:_______________ ☐ Not Applicable ☐ Specify				
Client-specific training:_______________ ☐ Not Applicable ☐ Specify				
Client-specific training:_______________ ☐ Not Applicable ☐ Specify				
Note: 1 Per the TRC Health and Safety Policy and Procedure Manual, each TRC project will have at least one certified CPR/first aid trained person on site at all times. All Project Managers and anyone acting as the on-site Health and Safety Officer must be current in First Aid/CPR.				

Project training requirements beyond those provided in the above table will require a HASP revision/upgrade or concurrence of the TRC Safety Director or ECR Safety Manager.

10. Medical Monitoring

Medical monitoring will apply routinely to all employees who are or may be exposed to hazardous substances or health hazards at or above the established permissible exposure limit, above the published exposure levels for these substances, without regard to the use of respirators, for 30 days or more a year (40 CFR 1910.120[f][2][i]). Said TRC field personnel will have the medical surveillance outlined in the table below prior to commencing on-site work activities.

Table 7: Medical Surveillance Required			
*Baseline is minimum recommended.			
	29 CFR 1910	**29 CFR 1926 or Other**	**Notes**
☒ HAZWOPER Physical - Baseline*	1910.120	1926.65	
☒ HAZWOPER Physical – Annual	1910.120	1926.65	
☐ HAZWOPER Physical - Biennial*	1910.120	1926.65	
Client-specific drug testing[1]	☒ Not Applicable ☐ Specify		
Client-specific medical monitoring[1]	☒ Not Applicable ☐ Specify		
Site-specific medical monitoring:	☒ Not Applicable ☐ Specify		

Note:
[1] Client required drug testing or medical monitoring should be coordinated through the Project Manager.

TRC has a Drug and Alcohol-Free Workplace Policy (TRC Employee Handbook). TRC may require employees or subcontractors to be tested upon reasonable suspicion, following accidents or incidents during work activities, or during travel to or from a project site. Client policies may be stricter in regard to procedures following an accident. Project Managers must be aware of these and inform employees and subcontractors of any additional requirements.

11. General Safety Requirements

The general safety rules listed below apply to all TRC personnel present at the site.

- A tailgate health and safety meeting will be held and documented with all field team members each day prior to the start of work, the start of a new shift, upon changing of work conditions or job task duties, or when new field team members arrive onsite.
- Adhere to all requirements of this HASP.
- Wear protective clothing appropriate for the designated level of protection and decontaminate before entering clean areas when applicable.
- Use safety equipment in accordance with OSHA guidance and labeling instructions.
- Maintain safety equipment in good condition and proper working order and make sure that the equipment is calibrated prior to use.
- Immediately report unsafe acts or conditions to the Project Manager and OSC.
- Eating, drinking, and smoking are prohibited on site, except in designated areas.
- Maintaining a position upwind from intrusive activities is encouraged.
- The emergency shutoff switch should be demonstrated to be working prior to initiating drilling.
- An adequately stocked first-aid kit will be maintained at the work site.

12. Tailgate Safety Meetings

- A tailgate safety meeting will be conducted daily prior to commencement of the workday, the start of a new shift, upon changing of work conditions or job task duties, or when new field team members arrive onsite (see documentation checklist provided in **Appendix E**).
- Topics covered by the tailgate safety meeting will include, but not be limited to, scope of work and who will conduct each task, potential hazards, weather forecast, PPE, emergency procedures and the route to the medical facility, site conditions and features, and communication guidelines related to stakeholder engagement and visitors.
- Safety meetings must also be held to address modifications to this HASP and any addenda prepared to supplement the HASP.

- Subcontractors and personnel present at the tailgate safety meeting shall be required to sign an acknowledgement form after each meeting.

13. Emergency/Contingency Plan

Before commencing any on-site operations, the TRC OHSO will advise all personnel of potential emergencies. Personnel will be advised on their roles in the event of an emergency, and the steps to take for a timely and controlled response.

Communication networks/chain of command – All on-site personnel will communicate any accident, injury or near miss to the TRC OHSO who will provide instruction on how to proceed further.

First Aid / Safety Equipment – First aid equipment should be readily available in the event of an emergency. First aid equipment should include a well-stocked first aid kit, fire extinguisher and emergency eye wash.

Evacuation Plans and Refuge Area – All personnel should safely remove themselves from danger in the event of an emergency and safely access the refuge area. The refuge area should be in an upwind location a safe distance from the work zone. The refuge area will be determined during the daily safety briefing.

Notifications of Fire, Police and Emergency Facilities – In the event of an emergency that cannot be controlled by on-site personnel, the appropriate emergency contact shall be notified. All personnel shall remove themselves from the area of danger and wait for the arrival of help in the predetermined refuge area.

Non-Emergency Medical Assistance – If an injury does occur and it is not life threatening, then the employee or employee's supervisor/project manager should contact WorkCare as soon as possible, but within the first hour after an injury. WorkCare information is proved in **Appendix F**. This information will help assist the injured employee by connecting them with instant access to a medically qualified professional in order to provide guidance on appropriate first aid measures and medications.

14. Stop Work

TRC personnel are all empowered, responsible, authorized and obliged to stop work at any time we feel that our safety or the safety of others is, or could be, compromised. When a stop work occurs the Project Manager and/or OSC should be contacted to discuss the reason for the stop work and the corrective action(s) needed to resume work safely. Work on an activity shall not continue until the unsafe condition has been corrected.

15. Safe Catches

A "Safe Catch" is a potential hazard a that has not resulted in any personal injury. Unsafe working conditions, unsafe employee behaviors, improper use of equipment or use of malfunctioning equipment have the potential to cause work related injuries. It is everyone's responsibility to report and/or correct these potential incidents immediately. Please complete the form provided in **Appendix G** as a means to report these "Safe Catch" situations and submit to your local OSC Representative.

16. Observations

Note that the Project Manager and/or OSC may notify field staff that their site activities may be the subject of Safety Observation, an integral part of the continuous improvement safety culture promoted at TRC. If subject to an observation, please note the following:

- The Observation will tend to focus on the highest risk activity (as a general example, drilling in a public right-of-way).
- Follow-up observations may need to occur on previous observations, depending on prior data collected.
- The observer's preparation before visiting the site will be a review of the HASP, JSAs, client-specific requirements, etc., and a review of the work scope with the Project Manager to ensure the context of the work is well understood in advance.
- Review items may include PPE, body use and positioning, work environment, operating procedures, and tools and equipment.
- The observation should last between 30 and 60 minutes.

Both positive and negative observations are candidates for documentation and later discussion. The overarching goals are to identify and correct questionable practices and to identify and promote good, safe and efficient practices. It is a data gathering process that will allow TRC safety specialists to identify root causes for safety issues in both categories to better inform policy decisions.

17. Incident Reporting

In case of an incident, TRC personnel must report the incident immediately to their project manager/supervisor and/or OSC as well as the client's representative and follow the TRC Incident Response and Reporting Process (see **Appendix H -** In Case of Emergency and Incident Reporting). Required Incident Notification or Auto Incident Report forms must be completed within 24 hours following the incident. If neither is available, the incident shall be reported to the TRC Safety Director. Incident/injury/exposure information must be recorded per TRC policy and will be the basis of any incident investigations.

18. Job Safety Analysis

It is anticipated that the standard operating procedures (SOPs) detailed in Quality Assurance Project Plan will be utilized for all work practices. If site specific activities require additional or alternate procedures, TRC will assess the task hazards and controls using separate job safety analysis forms (JSAs). Prior to use in the field, JSAs will be reviewed and approved by the TRC Project Manager and OSC. JSA forms can be found in **Appendix I**.

19. Acknowledgement

All TRC personnel operating under this HASP must read the HASP and sign the acknowledgment page in **Appendix J**.

Figure 1
Site Layout


LAFARGE ACCESS ROAD
BROADWAY
TRC-SB-03
TRC-SB-04
TRC-SB-05
TRC-SS-06
TRC-SS-07
TRC-SS-08
TRC-SS-09
TRC-SS-10
TRC-SB/PMW-01
TRC-SB/PMW-02

Appendix A
Safety Data Sheets

SAFETY DATA SHEET

SECTION 1:	PRODUCT AND COMPANY IDENTIFICATION

Hydrochloric Acid, 31 – 36.7%

Product Name: Hydrochloric Acid, 31 – 36.7%

Identified Uses: acid etching, steel pickling, oil and gas, ore and mineral, food processing, pharmaceutical, organic chemical synthesis

Company Information:
ASHTA Chemicals Inc.
P.O. Box 858
Ashtabula Ohio 44005
Phone: (440) 997-5221
Fax: (440) 998-0286
24-hour Emergency Phone: CHEMTREC: (800) 424-9300

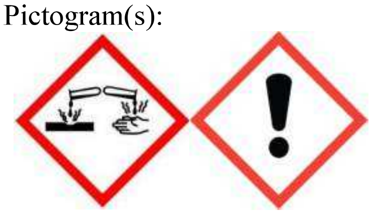
SECTION 2:	HAZARDS IDENTIFICATION

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)

GHS label elements, including precautionary statements:

Signal Word: **Danger**

Pictogram(s):



Hazard Statements	
H290	May be corrosive to metals.
H314	Causes severe skin burns and eye damage.
H318	Causes serious eye damage.
H335	May cause respiratory irritation.
Precautionary Statements	
P234	Keep only in original container.
P261	Avoid breathing dust/ fume/ mist/ vapors/ spray.
P264	Wash skin thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P301 + P330 + P331	IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
P303 + P361 + P353	IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water. Shower.

P304 + P340 + P310	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Immediately call a POISON CENTER or doctor/ physician.
P305 + P351 + P338 + P310	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER or doctor/ physician.
P363	Wash contaminated clothing before reuse.
P390	Absorb spillage to prevent material damage.
P403 + P233	Store in a well-ventilated place. Keep container with a resistant inner liner.
P405	Store locked up.
P406	Store in corrosive resistant stainless steel container with a resistant inner liner.
P501	Dispose of contents/ container to an approved waste disposal plant.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Synonyms:

CHEMICAL NAME:	Hydrochloric acid
TRADE NAME:	Hydrochloric acid, 31 – 36.7%
SYNONYMS:	Muriatic acid, Chlorohydric acid, Hydrogen Chloride
C.A.S:	7647-01-0
EC:	231-595-7
WHMIS:	D2A, E
CHEMICAL FORMULA:	HCl (in aqueous solution)
CHEMICAL FAMILY:	Inorganic Acid

SECTION 4 FIRST AID MEASURES

Description of first aid measures:
Consult a physician. Show this safety data sheet to the doctor in attendance.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. If breathing is difficult, give humidified air. Give oxygen, but only by a certified physician. Consult a physician.

In case of skin contact
Immediately flush with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician. Remove contact lenses if present and easy to do. Continue rinsing eyes during transport to medical facility.

If swallowed
Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth thoroughly with water. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs. Consult a physician.

SECTION 5	FIRE FIGHTING MEASURES

Flash Point (Method):	Non-combustible.
Extinguishing Media:	Use extinguishing agents compatible with acid and appropriate for the burning material. Use water spray to keep fire-exposed containers cool.
Auto Ignition Temp:	Non-combustible.
Special Fire Fighting Procedures:	Wear self-contained breathing apparatus and full protective clothing. In case of fire and/or explosion do not breathe fumes. Use standard firefighting procedures and consider the hazards of other involved materials.
Unusual Fire/Explosion Hazards:	Releases flammable hydrogen gas when reacting with metals.

SECTION 6	ACCIDENTAL RELEASE MEASURES

Environmental Precautions:
Use closed systems when possible. Provide local exhaust ventilation where vapor or mist may be generated. Avoid discharge into drains, water courses or onto the ground.

Containment and Cleaning:
Follow preplanned emergency procedures. Only properly equipped, trained, functional personnel should attempt to contain a leak. All other personnel should be evacuated from the danger area. Using full protective equipment, apply appropriate emergency device or other securement technology to stop the leak if possible.

Small Spill:	Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: neutralize the residue with a dilute solution of sodium carbonate.
Large Spill:	Corrosive liquid. Stop leak if without risk. Do not touch spilled material. Use water spray curtain to knock down vapor drift. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that vapor is not present at a concentration level above TLV.

SECTION 7:	HANDLING AND STORAGE

Precautions to be taken for handling and storage:
Wear appropriate personal protective equipment. Do not get in eyes, on skin, on clothing. Do not breathe mist or vapor. Observe good industrial hygiene practices. Do not empty into drains. Use caution when combining with water; DO NOT add water to acid, ALWAYS add acid to water while stirring to prevent release of heat, steam and fumes. Store in a well-ventilated place. Store away from incompatible materials. Store closed containers in a clean, cool, open or well ventilated area. Keep out of sun.

SECTION 8:	EXPOSURE CONTROL/PERSONAL PROTECTION

Principal Component: Hydrochloric Acid
Occupational Exposure Limits:
Regulatory Limits:

Component	OSHA Final PEL TWA	OSHA Final PEL STEL	OSHA Final PEL Ceiling
Hydrochloric Acid Mixture	---	---	5 ppm 7.59 mg/m^3

ACGIH TLV = 5 ppm (7.59 mg/m^3) TWA

NIOSH IDLH = 50 ppm (as HCl, 2010)

Exposure Controls:

Eye Protection: Tightly fitting safety goggles. Face shield (8-inch minimum). Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Respiratory Protection: Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multipurpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Other Protection: Complete suit protecting against chemicals. The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Ventilation Recommended: Exhaust ventilation is required to meet PEL limits.

Glove Type Recommended: Wear neoprene, nitrile, butyl rubber or PVC gloves to prevent exposure.

SECTION 9:	PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties:

Appearance	Colorless to light yellow liquid
Odor	Pungent (irritating/strong)
Odor Threshold	0.3ppm (can cause olfactory fatigue)
pH	<1 (in aqueous solution)
Melting point/freezing point	-30°C (-22°F)
Initial boiling point	>100°C (>212°F)
Flash point	Not applicable
Auto-ignition Temp	Not applicable
Evaporation rate	No data available

Decomposition temperature	No data available
Flammability (solid, gas)	Not combustible
Upper/lower flammability or explosive limits	Not combustible
Water solubility	100%
Molecular Weight	36.46
Relative Density (Specific Gravity)	1.16 (32% HCl solution) 1.19 (36.5% HCl solution)
Bulk Density	8.75 lbs/gal (32% HCl solution) 9.83 lbs/gal (36.5% HCl solution)
Vapor Density (air = 1)	1.267 at 20 °C
Vapor Pressure	84 mm Hg @ 20°C
Partition Coefficient: n-octanol/water	No data available

SECTION 10: STABILITY AND REACTIVITY

Stability: Hydrochloric acid is stable under normal conditions and pressures.

Conditions to avoid: Incompatible materials, metals, excess heat, bases.

Incompatibility: Bases, amines, metals, permanganates, (e.g. potassium permanganate), fluorine, metal acetylides, hexalithium disilicide.

Hazardous decomposition products: Hydrogen chloride, chlorine, hydrogen gas.

Polymerization: Hazardous polymerization WILL NOT occur.

SECTION 11: TOXICOGICAL INFORMATION

Information on likely routes of exposure:

Inhalation: Vapors and mist will irritate throat and respiratory system and cause coughing.

Skin contact: Causes skin burns.

Eye contact: Causes eye burns.

Ingestion: Harmful if swallowed. Causes digestive tract burns. Ingestion may produce burns to the lips, oral cavity, upper airway, esophagus and possibly the digestive tract.

Symptoms related to the physical, chemical and toxicological characteristics:
Contact with this material will cause burns to the skin, eyes and mucous membranes. Permanent eye damage including blindness could result.

Information on toxicological effects:

Acute toxicity: Harmful if swallowed.

Skin corrosion/irritation: Causes severe skin burns and eye damage.

Serious eye damage/eye Irritation: Causes serious eye damage.

Respiratory sensitization: Not available.

Skin sensitization:	No data available.
Germ cell mutagenicity:	No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.
Carcinogenicity:	This product is not considered to be a carcinogen by IARC, ACGIH, NTP or OSHA.
Reproductive toxicity:	This product is not expected to cause reproductive or developmental effects.
Specific target organ toxicity - single exposure:	May cause respiratory irritation.
Specific target organ toxicity - repeated exposure:	No data available.
Aspiration hazard:	Not available.
Chronic effects:	Prolonged inhalation may be harmful.

Components Species Test Results:
Hydrochloric acid (CAS# 7647-01-0)

Rat - Inhalation LC_{50}:	3124 ppm, (1 hour)
Rabbit - Dermal LD_{50}:	5010 mg/kg

SECTION 12: ECOLOGICAL INFORMATION

Ecotoxicity:	Because of the low pH of this product, it would be expected produce significant ecotoxicity upon exposure to aquatic organisms and aquatic systems.
Aquatic Toxicity:	This material is toxic to fish and aquatic organisms. Most aquatic species do not tolerate pH lower than 5.5 for any extended period.
Fish Toxicity:	Fish LC_{50} Mosquito fish: 282 mg/l, 96 hours Fish LC_{50} Bluegill: 3.6 mg/l, 48 hours
Persistence and degradability:	Not biodegradable. Hydrochloric acid will likely be neutralized to chloride by alkalinity present in natural environment..
Bioaccumulative Potential:	No data available.
Mobility in soil:	Hydrochloric acid will be neutralized by naturally occurring alkalinity. The acid will permeate soil, dissolving some soil material and will then neutralize.
Other adverse effects:	No other adverse environmental effects (e.g. ozone depletion, photochemical ozone creation

SECTION 13: DISPOSAL CONSIDERATIONS

Collect and reclaim or dispose in sealed containers at a properly licensed waste disposal site. This material , if not neutralized, must be disposed of as hazardous waste. Do not allow this material to drain into sewers/water supplies. Do not contaminate ponds, waterways or ditches with chemical or used container. Dispose of contents/container in accordance with local/regional/national or international regulations.

SECTION 14:	TRANSPORT INFORMATION

Shipping:

Usual Shipping Containers:	Tank cars, bulk tankers.
Usual Shelf Life:	Indefinite (life of containers).
Storage/Transport Temperatures:	Ambient.

Suitable Storage:

Materials/Coatings:	Teflon, Tygon, Rubber, PVC and polypropylene materials.

D.O.T. Information:

Labeling:	Corrosive
D.O.T. Identification Number	UN 1789
D.O.T. Shipping Name:	Hydrochloric Acid
Hazard Class:	8
Packing Group:	II
Hazard Guide:	157
Placard:	UN 1789

SECTION 15	REGULATORY INFORMATION

SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

Hydrochloric Acid CAS#: 7647-01-0

SARA 311/312 Hazards

Acute health hazard, reactive hazard.

Massachusetts Right To Know Components

Hydrochloric Acid CAS#: 7647-01-0

Pennsylvania Right To Know Components

Hydrochloric Acid CAS#: 7647-01-0

New Jersey Right To Know Components

Hydrochloric Acid CAS#: 7647-01-0

California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects or any other reproductive harm.

OSHA PSM TPQ:

CAS# 7647-01-0 is regulated under OSHA PSM ***only*** if anhydrous or >37% HCl.

Toxic Substances Control Act (TSCA):
Hydrochloric Acid CAS#: 7647-01-0

Comprehensive Environmental Response Compensation Liability Act: (CERCLA)
Hydrochloric Acid CAS#: 7647-01-0

SECTION 16	OTHER INFORMATION

NFPA Rating:
Health hazard: 3
Fire Hazard: 0
Reactivity Hazard: 1

This information is drawn from recognized sources believed to be reliable. ASHTA Chemicals, Inc. Makes no guarantees or assumes any liability in connection with this information. The user should be aware of changing technology, research, regulations, and analytical procedures that may require changes herein. The above data is supplied upon the condition that persons will evaluate this information and then determine its suitability for their use. Only U.S.A regulations apply to the above.

Version 1.0	For the new GHS SDS Standard	Revision Date: 12/31/2014
Version 1.1	Graphics updated	Revision Date: 3/9/2015
Version 1.2	Title updated	Revision Date: 6/2/2015
Version 1.3	Section 9 changes	Revision Date: 7/30/2015

SAFETY DATA SHEET

Nonflammable Gas Mixture: Isobutylene / Nitrogen / Oxygen

Section 1. Identification

GHS product identifier : Nonflammable Gas Mixture: Isobutylene / Nitrogen / Oxygen

Other means of identification : Not available.

Product use : Synthetic/Analytical chemistry.

SDS # : 002103

Supplier's details : Airgas USA, LLC and its affiliates
259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253

Emergency telephone number (with hours of operation) : 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture : GASES UNDER PRESSURE - Compressed gas

GHS label elements

Hazard pictograms :

Signal word : Warning

Hazard statements : Contains gas under pressure; may explode if heated.

Precautionary statements

General : Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use a back flow preventative device in the piping. Use only equipment of compatible materials of construction.

Prevention : Use and store only outdoors or in a well ventilated place.

Response : Not applicable.

Storage : Protect from sunlight. Protect from sunlight when ambient temperature exceeds 52°C/125°F. Store in a well-ventilated place.

Disposal : Not applicable.

Hazards not otherwise classified : None known.

Section 3. Composition/information on ingredients

Substance/mixture : Mixture

Other means of identification : Not available.

CAS number/other identifiers

CAS number : Not applicable.

Product code : 002103

Ingredient name	%	CAS number
Nitrogen	75 - 80.5	7727-37-9
oxygen	19.5 - 23.5	7782-44-7
2-methylpropene	0.0001 - 1.13	115-11-7

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention if irritation occurs.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention if adverse health effects persist or are severe. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband. In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Get medical attention if symptoms occur. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : As this product is a gas, refer to the inhalation section.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : Contact with rapidly expanding gas may cause burns or frostbite.

Inhalation : Exposure to decomposition products may cause a health hazard. Serious effects may be delayed following exposure.

Skin contact : Contact with rapidly expanding gas may cause burns or frostbite.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Ingestion : As this product is a gas, refer to the inhalation section.

Over-exposure signs/symptoms

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Section 4. First aid measures

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician	: In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.
Specific treatments	: No specific treatment.
Protection of first-aiders	: No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media	: Use an extinguishing agent suitable for the surrounding fire.
Unsuitable extinguishing media	: None known.

Specific hazards arising from the chemical	: Contains gas under pressure. In a fire or if heated, a pressure increase will occur and the container may burst or explode.
Hazardous thermal decomposition products	: Decomposition products may include the following materials: carbon dioxide carbon monoxide nitrogen oxides
Special protective actions for fire-fighters	: Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.
Special protective equipment for fire-fighters	: Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel	: No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Avoid breathing gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.
For emergency responders	: If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Environmental precautions	: Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill	: Immediately contact emergency personnel. Stop leak if without risk.
Large spill	: Immediately contact emergency personnel. Stop leak if without risk. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Avoid contact with eyes, skin and clothing. Avoid breathing gas. Empty containers retain product residue and can be hazardous. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Keep container tightly closed and sealed until ready for use. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F).

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

None.

Appropriate engineering controls : Good general ventilation should be sufficient to control worker exposure to airborne contaminants.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields.

Skin protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Section 8. Exposure controls/personal protection

Body protection	: Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
Other skin protection	: Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
Respiratory protection	: Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance	
Physical state	: Gas.
Color	: Not available.
Melting/freezing point	: -140.7°C (-221.3°F) This is based on data for the following ingredient: 2-methylpropene. Weighted average: -211.14°C (-348.1°F)
Critical temperature	: Lowest known value: -146.95°C (-232.5°F) (nitrogen).
Odor	: Not available.
Odor threshold	: Not available.
pH	: Not available.
Flash point	: Not available.
Burning time	: Not applicable.
Burning rate	: Not applicable.
Evaporation rate	: Not available.
Flammability (solid, gas)	: Not available.
Lower and upper explosive (flammable) limits	: Not available.
Vapor pressure	: Not available.
Vapor density	: Highest known value: 1.94 (Air = 1) (2-methylpropene). Weighted average: 1.01 (Air = 1)
Gas Density (lb/ft^3)	: Weighted average: 0.07
Relative density	: Not applicable.
Solubility	: Not available.
Solubility in water	: Not available.
Partition coefficient: n-octanol/water	: Not available.
Auto-ignition temperature	: Not available.
Decomposition temperature	: Not available.
SADT	: Not available.
Viscosity	: Not applicable.

Section 10. Stability and reactivity

Reactivity : No specific test data related to reactivity available for this product or its ingredients.

Chemical stability : The product is stable.

Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

Conditions to avoid : No specific data.

Incompatibility with various substances : Extremely reactive or incompatible with the following materials: reducing materials and combustible materials.

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Hazardous polymerization : Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Not available.

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Information on the likely routes of exposure : Not available.

Section 11. Toxicological information

Potential acute health effects

Eye contact	: Contact with rapidly expanding gas may cause burns or frostbite.
Inhalation	: Exposure to decomposition products may cause a health hazard. Serious effects may be delayed following exposure.
Skin contact	: Contact with rapidly expanding gas may cause burns or frostbite.
Ingestion	: As this product is a gas, refer to the inhalation section.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact	: No specific data.
Inhalation	: No specific data.
Skin contact	: No specific data.
Ingestion	: No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects	: Not available.
Potential delayed effects	: Not available.

Long term exposure

Potential immediate effects	: Not available.
Potential delayed effects	: Not available.

Potential chronic health effects

Not available.

General	: No known significant effects or critical hazards.
Carcinogenicity	: No known significant effects or critical hazards.
Mutagenicity	: No known significant effects or critical hazards.
Teratogenicity	: No known significant effects or critical hazards.
Developmental effects	: No known significant effects or critical hazards.
Fertility effects	: No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Toxicity

Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

Section 12. Ecological information

Not available.

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1956	UN1956	UN1956	UN1956	UN1956
UN proper shipping name	COMPRESSED GAS, N.O.S. (nitrogen, oxygen)	COMPRESSED GAS, N.O.S. (nitrogen, oxygen)	COMPRESSED GAS, N.O.S. (nitrogen, oxygen)	COMPRESSED GAS, N.O.S. (nitrogen, oxygen)	COMPRESSED GAS, N.O.S. (nitrogen, oxygen)
Transport hazard class(es)	2.2 	2.2 	2.2 	2.2 	2.2 
Packing group	-	-	-	-	-
Environment	No.	No.	No.	No.	No.
Additional information	-	**Explosive Limit and Limited Quantity Index** 0.125 **Passenger Carrying Road or Rail Index** 75	-	-	-

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations	:	**TSCA 8(a) CDR Exempt/Partial exemption**: Not determined **United States inventory (TSCA 8b)**: All components are listed or exempted. **Clean Air Act (CAA) 112 regulated flammable substances**: 2-methylpropene
Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs)	:	Not listed
Clean Air Act Section 602 Class I Substances	:	Not listed
Clean Air Act Section 602 Class II Substances	:	Not listed
DEA List I Chemicals (Precursor Chemicals)	:	Not listed
DEA List II Chemicals (Essential Chemicals)	:	Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ	:	Not applicable.

SARA 311/312

Classification	:	Sudden release of pressure

Composition/information on ingredients

No products were found.

State regulations

Massachusetts	:	The following components are listed: NITROGEN; OXYGEN (LIQUID); 2-METHYLPROPENE
New York	:	None of the components are listed.
New Jersey	:	The following components are listed: NITROGEN; OXYGEN; ISOBUTYLENE; 1-PROPENE, 2-METHYL-
Pennsylvania	:	The following components are listed: NITROGEN; OXYGEN; 1-PROPENE, 2-METHYL-
Canada inventory	:	All components are listed or exempted.

International regulations

International lists	:	**Australia inventory (AICS)**: All components are listed or exempted. **China inventory (IECSC)**: All components are listed or exempted. **Japan inventory**: Not determined. **Korea inventory**: All components are listed or exempted. **Malaysia Inventory (EHS Register)**: Not determined. **New Zealand Inventory of Chemicals (NZIoC)**: All components are listed or exempted. **Philippines inventory (PICCS)**: All components are listed or exempted. **Taiwan inventory (CSNN)**: Not determined.
Chemical Weapons Convention List Schedule I Chemicals	:	Not listed
Chemical Weapons Convention List Schedule II Chemicals	:	Not listed

Section 15. Regulatory information

Chemical Weapons Convention List Schedule III Chemicals : Not listed

Canada

WHMIS (Canada) : Class A: Compressed gas.

CEPA Toxic substances: None of the components are listed.
Canadian ARET: None of the components are listed.
Canadian NPRI: The following components are listed: Butene (all isomers)
Alberta Designated Substances: None of the components are listed.
Ontario Designated Substances: None of the components are listed.
Quebec Designated Substances: None of the components are listed.

Section 16. Other information

Canada Label requirements : Class A: Compressed gas.

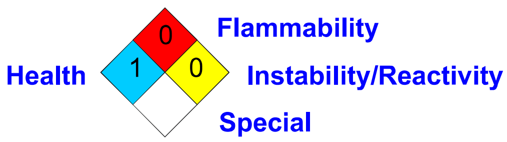
Hazardous Material Information System (U.S.A.)

Health	1
Flammability	0
Physical hazards	0

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks Although HMIS® ratings are not required on SDSs under 29 CFR 1910. 1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

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



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Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

History

Date of printing : 1/23/2015.

Date of issue/Date of revision : 1/23/2015.

Date of previous issue : No previous validation.

Version : 0.01

Section 16. Other information

Key to abbreviations : ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL 73/78 = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
UN = United NationsACGIH – American Conference of Governmental Industrial Hygienists
AIHA – American Industrial Hygiene Association
CAS – Chemical Abstract Services
CEPA – Canadian Environmental Protection Act
CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act (EPA)
CFR – United States Code of Federal Regulations
CPR – Controlled Products Regulations
DSL – Domestic Substances List
GWP – Global Warming Potential
IARC – International Agency for Research on Cancer
ICAO – International Civil Aviation Organisation
Inh – Inhalation
LC – Lethal concentration
LD – Lethal dosage
NDSL – Non-Domestic Substances List
NIOSH – National Institute for Occupational Safety and Health
TDG – Canadian Transportation of Dangerous Goods Act and Regulations
TLV – Threshold Limit Value
TSCA – Toxic Substances Control Act
WEEL – Workplace Environmental Exposure Level
WHMIS – Canadian Workplace Hazardous Material Information System

References : Not available.

Indicates information that has changed from previously issued version.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

MATERIAL SAFETY DATA SHEET

ALCONOX®

Prepared to U.S. OSHA, CMA, ANSI, Canadian WHMIS, Australian WorkSafe, Japanese Industrial Standard JIS Z 7250:2000, and European Union REACH Regulations

SECTION 1 - PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME:	**ALCONOX®**	
CHEMICAL FAMILY NAME:	Detergent.	
PRODUCT USE:	Critical-cleaning detergent for laboratory, healthcare and industrial applications	
U.N. NUMBER:	Not Applicable	
U.N. DANGEROUS GOODS CLASS:	Non-Regulated Material	
SUPPLIER/MANUFACTURER'S NAME:	Alconox, Inc.	
ADDRESS:	30 Glenn St., Suite 309, White Plains, NY 10603. USA	
EMERGENCY PHONE:	**TOLL-FREE in USA/Canada**	800-255-3924
	International calls	813-248-0585
BUSINESS PHONE:	914-948-4040	
DATE OF PREPARATION:	May 2011	
DATE OF LAST REVISION:	February 2008	

SECTION 2 - HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: This product is a white granular powder with little or no odor. Exposure can be irritating to eyes, respiratory system and skin. It is a non-flammable solid. The Environmental effects of this product have not been investigated.

US DOT SYMBOLS

Non-Regulated

CANADA (WHMIS) SYMBOLS

EUROPEAN and (GHS) Hazard Symbols

Signal Word: **Warning!**

EU LABELING AND CLASSIFICATION:

Classification of the substance or mixture according to Regulation (EC) No1272/2008 Annex 1
EC# 205-633-8 This substance is not classified in the Annex I of Directive 67/548/EEC
EC# 268-356-1 This substance is not classified in the Annex I of Directive 67/548/EEC
EC# 231-838-7 This substance is not classified in the Annex I of Directive 67/548/EEC
EC# 231-767-1 This substance is not classified in the Annex I of Directive 67/548/EEC
EC# 207-638-8 Index# 011-005-00-2
EC# 205-788-1 This substance is not classified in the Annex I of Directive 67/548/EEC

GHS Hazard Classification(s):
Eye Irritant Category 2A

Hazard Statement(s):
H319: Causes serious eye irritation

Precautionary Statement(s):
P260: Do not breath dust/fume/gas/mist/vapors/spray
P264: Wash hands thoroughly after handling
P271: Use only in well ventilated area.
P280: Wear protective gloves/protective clothing/eye protection/face protection/

Hazard Symbol(s):
[Xi] Irritant

Risk Phrases:
R20: Harmful by inhalation
R36/37/38: Irritating to eyes, respiratory system and skin

Safety Phrases:
S8: Keep container dry
S22: Do not breath dust
S24/25: Avoid contact with skin and eyes

HEALTH HAZARDS OR RISKS FROM EXPOSURE:

ACUTE: Exposure to this product may cause irritation of the eyes, respiratory system and skin. Ingestion may cause gastrointestinal irritation including pain, vomiting or diarrhea.

CHRONIC: This product contains an ingredient which may be corrosive.

TARGET ORGANS: ACUTE: Eye, respiratory System, Skin CHRONIC: None Known

SECTION 3 - COMPOSITION and INFORMATION ON INGREDIENTS

HAZARDOUS INGREDIENTS:	CAS #	EINECS #	ICSC #	WT %	HAZARD CLASSIFICATION; RISK PHRASES
Sodium Bicarbonate	144-55-8	205-633-8	1044	33 - 43%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium (C10 – C16) Alkylbenzene Sulfonate	68081-81-2	268-356-1	Not Listed	10 – 20%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium Tripolyphosphate	7758-29-4	231-838-7	1469	5 - 15%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Tetrasodium Pyrophosphate	7722-88-5	231-767-1	1140	5 - 15%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium Carbonate	497-19-8	207-638-8	1135	1 - 10%	HAZARD CLASSIFICATION: [Xi] Irritant RISK PHRASES: R36
Sodium Alcohol Sulfate	151-21-3	205-788-1	0502	1 – 5%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Balance of other ingredients are non-hazardous or less than 1% in concentration (or 0.1% for carcinogens, reproductive toxins, or respiratory sensitizers).					

NOTE: ALL WHMIS required information is included in appropriate sections based on the ANSI Z400.1-2004 format. This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR, EU Directives and the Japanese Industrial Standard *JIS Z 7250: 2000*.

SECTION 4 - FIRST-AID MEASURES

Contaminated individuals of chemical exposure must be taken for medical attention if any adverse effect occurs. Rescuers should be taken for medical attention, if necessary. Take copy of label and MSDS to health professional with contaminated individual.

EYE CONTACT: If product enters the eyes, open eyes while under gentle running water for at least 15 minutes. Seek medical attention if irritation persists.

SKIN CONTACT: Wash skin thoroughly after handling. Seek medical attention if irritation develops and persists. Remove contaminated clothing. Launder before re-use.

INHALATION: If breathing becomes difficult, remove victim to fresh air. If necessary, use artificial respiration to support vital functions. Seek medical attention if breathing dificulty continues.

INGESTION: If product is swallowed, call physician or poison control center for most current information. If professional advice is not available, do not induce vomiting. Never induce vomiting or give diluents (milk or water) to someone who is unconscious, having convulsions, or who cannot swallow. Seek medical advice. Take a copy of the label and/or MSDS with the victim to the health professional.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Pre-existing skin, or eye problems may be aggravated by prolonged contact.

RECOMMENDATIONS TO PHYSICIANS: Treat symptoms and reduce over-exposure.

SECTION 5 - FIRE-FIGHTING MEASURES

FLASH POINT: Not Flammable

AUTOIGNITION TEMPERATURE: Not Applicable

FLAMMABLE LIMITS (in air by volume, %): Lower (LEL): NA Upper (UEL): NA

FIRE EXTINGUISHING MATERIALS: As appropriate for surrounding fire. Carbon dioxide, foam, dry chemical, halon, or water spray.

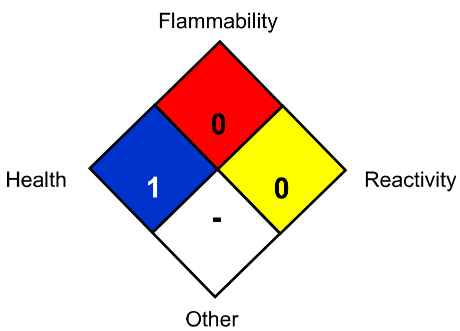
UNUSUAL FIRE AND EXPLOSION HAZARDS: This product is non-flammable and has no known explosion hazards.

Explosion Sensitivity to Mechanical Impact: Not Sensitive.

Explosion Sensitivity to Static Discharge: Not Sensitive

SPECIAL FIRE-FIGHTING PROCEDURES: Incipient fire responders should wear eye protection. Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment. Isolate materials not yet involved in the fire and protect personnel. Move containers from fire area if this can be done without risk; otherwise, cool with carefully applied water spray. If possible, prevent runoff water from entering storm drains, bodies of water, or other environmentally sensitive areas.

NFPA RATING SYSTEM



HMIS RATING SYSTEM

HAZARDOUS MATERIAL IDENTIFICATION SYSTEM

HEALTH HAZARD (BLUE)	**1**
FLAMMABILITY HAZARD (RED)	**0**
PHYSICAL HAZARD (YELLOW)	**0**

PROTECTIVE EQUIPMENT

EYES	RESPIRATORY	HANDS	BODY
	See Sect 8		See Sect 8

For Routine Industrial Use and Handling Applications

Hazard Scale: 0 = Minimal **1** = Slight **2** = Moderate **3** = Serious **4** = Severe * = Chronic hazard

SECTION 6 - ACCIDENTAL RELEASE MEASURES

SPILL AND LEAK RESPONSE: Personnel should be trained for spill response operations.

SPILLS: Contain spill if safe to do so. Prevent entry into drains, sewers, and other waterways. Sweep, shovel or vacuum spilled material and place in an appropriate container for re-use or disposal. Avoid dust generation if possible. Dispose of in accordance with applicable Federal, State, and local procedures (see Section 13, Disposal Considerations).

SECTION 7 - HANDLING and STORAGE

WORK PRACTICES AND HYGIENE PRACTICES: As with all chemicals, avoid getting this product ON YOU or IN YOU. Wash thoroughly after handling this product. Do not eat, drink, smoke, or apply cosmetics while handling this product. Avoid breathing dusts generated by this product. Use in a well-ventilated location. Remove contaminated clothing immediately.

STORAGE AND HANDLING PRACTICES: Containers of this product must be properly labeled. Store containers in a cool, dry location. Keep container tightly closed when not in use. Store away from strong acids or oxidizers.

SECTION 8 - EXPOSURE CONTROLS - PERSONAL PROTECTION

EXPOSURE LIMITS/GUIDELINES:

Chemical Name	CAS#	ACGIH TWA	OSHA TWA	SWA
Sodium Bicarbonate	144-55-8	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust
Sodium (C10 – C16) Alkylbenzene Sulfonate	68081-81-2	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust
Sodium Tripolyphosphate	7758-29-4	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust
Tetrasodium Pyrophosphate	7722-88-5	5 mg/m³	5 mg/m³	5 mg/m³
Sodium Carbonate	497-19-8	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust
Sodium Alcohol Sulfate	151-21-3	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust

Currently, International exposure limits are not established for the components of this product. Please check with competent authority in each country for the most recent limits in place.

VENTILATION AND ENGINEERING CONTROLS: Use with adequate ventilation to ensure exposure levels are maintained below the limits provided below. Use local exhaust ventilation to control airborne dust. Ensure eyewash/safety shower stations are available near areas where this product is used.

The following information on appropriate Personal Protective Equipment is provided to assist employers in complying with OSHA regulations found in 29 CFR Subpart I (beginning at 1910.132) or equivalent standard of Canada, or standards of EU member states (including EN 149 for respiratory PPE, and EN 166 for face/eye protection), and those of Japan. Please reference applicable regulations and standards for relevant details.

RESPIRATORY PROTECTION: Based on test data, exposure limits should not be exceeded under normal use conditions when using Alconox Detergent. Maintain airborne contaminant concentrations below guidelines listed above, if applicable. If necessary, use only respiratory protection authorized in the U.S. Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), equivalent U.S. State standards, Canadian CSA Standard Z94.4-93, the European Standard EN149, or EU member states.

EYE PROTECTION: Safety glasses. If necessary, refer to U.S. OSHA 29 CFR 1910.133 or appropriate Canadian Standards.

HAND PROTECTION: Use chemical resistant gloves to prevent skin contact.. If necessary, refer to U.S. OSHA 29 CFR 1910.138 or appropriate Standards of Canada.

BODY PROTECTION: Use body protection appropriate to prevent contact (e.g. lab coat, overalls). If necessary, refer to appropriate Standards of Canada, or appropriate Standards of the EU, Australian Standards, or relevant Japanese Standards.

SECTION 9 - PHYSICAL and CHEMICAL PROPERTIES

PHYSICAL STATE:	Solid
APPEARANCE & ODOR:	White granular powder with little or no odor.
ODOR THRESHOLD (PPM):	Not Available
VAPOR PRESSURE (mmHg):	Not Applicable
VAPOR DENSITY (AIR=1):	Not Applicable.
BY WEIGHT:	Not Available
EVAPORATION RATE (nBuAc = 1):	Not Applicable.
BOILING POINT (C°):	Not Applicable.
FREEZING POINT (C°):	Not Applicable.
pH:	9.5 (1% aqueous solution)
SPECIFIC GRAVITY 20°C: (WATER =1)	0.85 – 1.1
SOLUBILITY IN WATER (%)	>10% w/w
COEFFICIENT OF WATER/OIL DIST.:	Not Available
VOC:	None
CHEMICAL FAMILY:	Detergent

SECTION 10 - STABILITY and REACTIVITY

STABILITY: Product is stable
DECOMPOSITION PRODUCTS: When heated to decomposition this product produces Oxides of carbon (COx)
MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Strong acids and strong oxidizing agents.
HAZARDOUS POLYMERIZATION: Will not occur.
CONDITIONS TO AVOID: Contact with incompatible materials and dust generation.

SECTION 11 - TOXICOLOGICAL INFORMATION

TOXICITY DATA: Toxicity data is available for mixture:

CAS# 497-19-8 LD50 Oral (Rat)	4090 mg/kg
CAS# 497-19-8 LD50 Oral (Mouse)	6600 mg/kg
CAS# 497-19-8 LC50 Inhalation (Rat)	2300 mg/m³ 2H
CAS# 497-19-8 LC50 Inhalation (Mouse)	1200 mg/m³ 2H
CAS# 7758-29-4 LD50 Oral (Rat)	3120 mg/kg
CAS# 7758-29-4 LD50 Oral (Mouse)	3100 mg/kg
CAS# 7722-88-5 LD50 Oral (Rat)	4000 mg/kg

SUSPECTED CANCER AGENT: None of the ingredients are found on the following lists: FEDERAL OSHA Z LIST, NTP, CAL/OSHA, IARC and therefore is not considered to be, nor suspected to be a cancer-causing agent by these agencies.
IRRITANCY OF PRODUCT: Contact with this product can be irritating to exposed skin, eyes and respiratory system.
SENSITIZATION OF PRODUCT: This product is not considered a sensitizer.
REPRODUCTIVE TOXICITY INFORMATION: No information concerning the effects of this product and its components on the human reproductive system.

SECTION 12 - ECOLOGICAL INFORMATION

ALL WORK PRACTICES MUST BE AIMED AT ELIMINATING ENVIRONMENTAL CONTAMINATION.
ENVIRONMENTAL STABILITY: No Data available at this time.
EFFECT OF MATERIAL ON PLANTS or ANIMALS: No evidence is currently available on this product's effects on plants or animals.

EFFECT OF CHEMICAL ON AQUATIC LIFE: No evidence is currently available on this product's effects on aquatic life.

SECTION 13 - DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations, those of Canada, Australia, EU Member States and Japan.

SECTION 14 - TRANSPORTATION INFORMATION

US DOT; IATA; IMO; ADR:
THIS PRODUCT IS NOT HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.
PROPER SHIPPING NAME: Non-Regulated Material
HAZARD CLASS NUMBER and DESCRIPTION: Not Applicable
UN IDENTIFICATION NUMBER: Not Applicable
PACKING GROUP: Not Applicable.
DOT LABEL(S) REQUIRED: Not Applicable
NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2004): Not Applicable
MARINE POLLUTANT: None of the ingredients are classified by the DOT as a Marine Pollutant (as defined by 49 CFR 172.101, Appendix B)

U.S. DEPARTMENT OF TRANSPORTATION (DOT) SHIPPING REGULATIONS:
This product is not classified as dangerous goods, per U.S. DOT regulations, under 49 CFR 172.101.

TRANSPORT CANADA, TRANSPORTATION OF DANGEROUS GOODS REGULATIONS:
This product is not classified as Dangerous Goods, per regulations of Transport Canada.

INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA):
This product is not classified as Dangerous Goods, by rules of IATA:

INTERNATIONAL MARITIME ORGANIZATION (IMO) DESIGNATION:
This product is not classified as Dangerous Goods by the International Maritime Organization.

EUROPEAN AGREEMENT CONCERNING THE INTERNATIONAL CARRIAGE OF DANGEROUS GOODS BY ROAD (ADR):

SECTION 15 - REGULATORY INFORMATION

UNITED STATES REGULATIONS

SARA REPORTING REQUIREMENTS: This product is not subject to the reporting requirements of Sections 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act., as follows: None

TSCA: All components in this product are listed on the US Toxic Substances Control Act (TSCA) inventory of chemicals.

SARA 311/312:

Acute Health:	Yes	Chronic Health:	No	Fire:	No	Reactivity:	No

U.S. SARA THRESHOLD PLANNING QUANTITY: There are no specific Threshold Planning Quantities for this product. The default Federal MSDS submission and inventory requirement filing threshold of 10,000 lb (4,540 kg) may apply, per 40 CFR 370.20.

U.S. CERCLA REPORTABLE QUANTITY (RQ): None

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): None of the ingredients are on the California Proposition 65 lists.

CANADIAN REGULATIONS:

CANADIAN DSL/NDSL INVENTORY STATUS: All of the components of this product are on the DSL Inventory

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA) PRIORITIES SUBSTANCES LISTS: No component of this product is on the CEPA First Priorities Substance Lists.

CANADIAN WHMIS CLASSIFICATION and SYMBOLS: This product is categorized as a Controlled Product, Hazard Class D2B as per the Controlled Product Regulations

EUROPEAN ECONOMIC COMMUNITY INFORMATION:

EU LABELING AND CLASSIFICATION:

Classification of the mixture according to Regulation (EC) No1272/2008. See section 2 for details.

AUSTRALIAN INFORMATION FOR PRODUCT:

AUSTRALIAN INVENTORY OF CHEMICAL SUBSTANCES (AICS) STATUS: All components of this product are listed on the AICS.

STANDARD FOR THE UNIFORM SCHEDULING OF DRUGS AND POISONS: Not applicable.

JAPANESE INFORMATION FOR PRODUCT:

JAPANESE MINISTER OF INTERNATIONAL TRADE AND INDUSTRY (MITI) STATUS: The components of this product are not listed as Class I Specified Chemical Substances, Class II Specified Chemical Substances, or Designated Chemical Substances by the Japanese MITI.

INTERNATIONAL CHEMICAL INVENTORIES:

Listing of the components on individual country Chemical Inventories is as follows:

Asia-Pac:	Listed
Australian Inventory of Chemical Substances (AICS):	Listed
Korean Existing Chemicals List (ECL):	Listed
Japanese Existing National Inventory of Chemical Substances (ENCS):	Listed
Philippines Inventory if Chemicals and Chemical Substances (PICCS):	Listed
Swiss Giftliste List of Toxic Substances:	Listed
U.S. TSCA:	Listed

SECTION 16 - OTHER INFORMATION

PREPARED BY: Paul Eigbrett Global Safety Management, 10006 Cross Creek Blvd. Suite 440, Tampa, FL 33647

Disclaimer: To the best of Alconox, Inc. knowledge, the information contained herein is reliable and accurate as of this date; however, accuracy, suitability or completeness is not guaranteed and no warranties of any type either express or implied are provided. The information contained herein relates only to this specific product.

ANNEX:

IDENTIFIED USES OF ALCONOX® AND DIRECTIONS FOR USE

Used to clean: Healthcare instruments, laboratory ware, vacuum equipment, tissue culture ware, personal protective equipment, sampling apparatus, catheters, tubing, pipes, radioactive contaminated articles, optical parts, electronic components, pharmaceutical apparatus, cosmetics manufacturing equipment, metal castings, forgings and stampings, industrial parts, tanks and reactors. Authorized by USDA for use in federally inspected meat and poultry plants. Passes inhibitory residue test for water analysis. FDA certified.

Used to remove: Soil, grit, grime, buffing compound, slime, grease, oils, blood, tissue, salts, deposits, particulates, solvents, chemicals, radioisotopes, radioactive contaminations, silicon oils, mold release agents.

Surfaces cleaned: Corrosion inhibited formulation recommended for glass, metal, stainless steel, porcelain, ceramic, plastic, rubber and fiberglass. Can be used on soft metals such as copper, aluminum, zinc and magnesium if rinsed promptly. Corrosion testing may be advisable.

Cleaning method: Soak, brush, sponge, cloth, ultrasonic, flow through clean-inplace. Will foam—not for spray or machine use.

Directions: Make a fresh 1% solution (2 1/2 Tbsp. per gal., 1 1/4 oz. per gal. or 10 grams per liter) in cold, warm, or hot water. If available use warm water. Use cold water for blood stains. For difficult soils, raise water temperature and use more detergent. Clean by soak, circulate, wipe, or ultrasonic method. Not for spray machines, will foam. For nonabrasive scouring, make paste. Use 2% solution to soak frozen stopcocks. To remove silver tarnish, soak in 1% solution in aluminum container. RINSE THOROUGHLY—preferably with running water. For critical cleaning, do final or all rinsing in distilled, deionized, or purified water. For food contact surfaces, rinse with potable water. Used on a wide range of glass, ceramic, plastic, and metal surfaces. Corrosion testing may be advisable.

Appendix B
Glove Selection Guideline

APPENDIX B: GLOVE SELECTION GUIDELINE

HAZARD	EXAMPLE TASKS	ANSI CUT/ABRASION RATING*	REPRESENTATIVE GLOVE
Impact Hazards, Med/Heavy Duty Puncture Cut	Drilling/direct push activities. Construction. Heavy materials handling. Power tools. Air knifing. Excavation.	ANSI Cut and Abrasion Resistance **Level 5** **EN 388 4521**	Hexarmor®Chrome Hexarmor® GGT5 Hexarmor® L5 Hexarmor® SteelLeather III Ironclad® Kong Glove
Med/Heavy Duty Puncture Cut Oil/Solvent Resistant	Tasks where materials are treated with oil or solvents.	ANSI Cut and Abrasion Resistance **Level 3 - 4** **EN 388 4522**	Ansell Alpha-Tec ® Memphis® Ultra Tech Nitrile Cut & Splash Best® Neoprene 6780 Hexarmor™ TenX Threesixty
Medium Duty Cut/Puncture Gloves with Oily Surface Grip	Light materials handling, wet service	ANSI Cut and Abrasion Resistance **Level 3** **EN 388 44xx**	Best®Zorb-It Ultimate HV 4567 Ansell® Cut Protective Glove 97-505 Ansell HyFlex® 11-511 Ansell HyFlex® 11-624
Med/Heavy Duty Cut/Puncture	Light Materials Handling. System O&M. Use of Hand Tools. Hand Augering. Heavy Equipment Operator.	ANSI Cut and Abrasion Resistance **Level 2** **EN 388 33xx**	Perfect Fit® PF570 Hexarmor® Level Six 9010/9012 Ironclad® Cut Resistant Glove Ansell HyFlex® 11-511 Ansell HyFlex® 11-624 Ansell® Cut Protective Glove 97-505
Light Duty Cut/Puncture Abrasion Only	Handling soil and Groundwater Samples. Opening spoons. Well construction.	ANSI Cut and Abrasion Resistance **Level 2 - 4** **EN 388 21xx**	Memphis® Ninja Max N9676GL Memphis® UltraTech Dyneema 9676 Memphis® Ninja Ice (Cold Weather) Ansell HyFlex® 11-511 Ansell® Cut Protective Glove 97-505 Ansell® Powerflex 80-813 Ironclad™ Workforce
Light Duty Glove Cut/Abrasion (used under nitrile gloves)	Groundwater Sampling.	ANSI Cut and Abrasion Resistance **Level 2** **EN 388 21xx**	Ansell HyFlex® 11-500 Ansell HyFlex® 11-624 Ansell GoldKnit

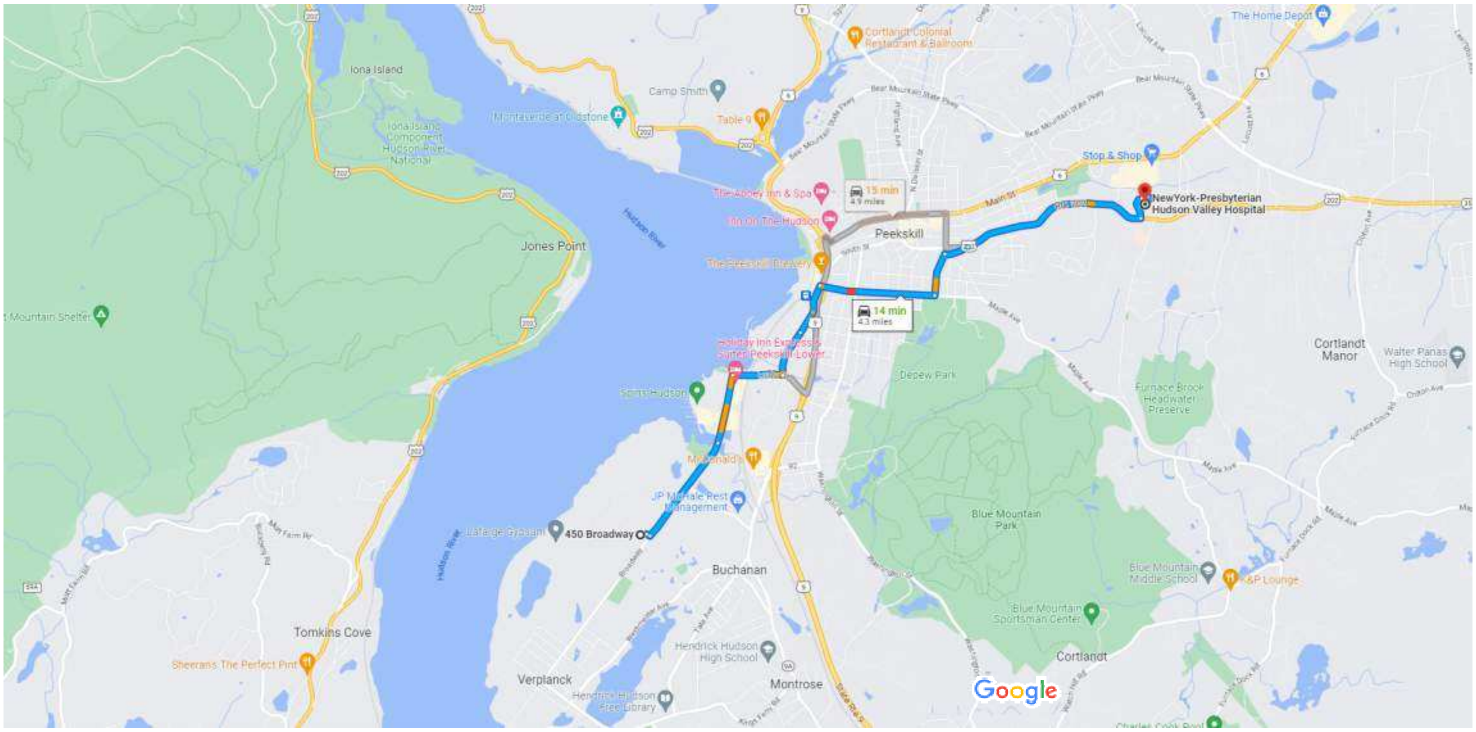
* Reference to ANSI and EN 388 glove testing standards. Listed gloves meet the standards in the table, but are not the only gloves that meet the standard.

This selection chart is not intended to address all chemical hazards. Gloves used for chemical protection shall provide cut/puncture resistance, or be used in tandem with cut/puncture protection. Nitrile gloves used for environmental sampling must be used in tandem with a cut/puncture resistant glove.

Gloves available in high visibility colors have shown to be effective and are preferred.

Appendix C
Hospital Route

Google Maps 450 Broadway, Buchanan, NY 10511 to NewYork-Presbyterian Hudson Valley Hospital, 1980 Crompond Rd, Cortlandt, NY 10567 Drive 4.3 miles, 14 min



Map data ©2023 Google 2000 ft

450 Broadway
Buchanan, NY 10511

1. Head southeast toward Broadway
⚠ Restricted usage road
8 sec (115 ft)

Continue on Broadway to Peekskill
3 min (1.4 mi)

2. Turn left onto Broadway
0.7 mi

3. Continue onto John Walsh Blvd
0.4 mi

4. Turn right onto Louisa St
0.3 mi

Take South St to Hudson Ave
2 min (0.6 mi)

5. Turn left onto Lower S St
0.3 mi

6. Continue onto South St
0.3 mi

7. Turn right onto Hudson Ave
3 min (0.7 mi)

Continue on Wells St to US-202 E/Crompond Rd
2 min (0.4 mi)

8. Turn left onto Wells St
0.2 mi

9. Slight right onto S Division St
0.1 mi

10. Slight right onto US-202 E/Crompond Rd
2 min (1.1 mi)

Drive to your destination
2 min (0.2 mi)

11. Turn left

0.1 mi

12. Turn right

243 ft

13. Turn right

Destination will be on the right

135 ft

NewYork-Presbyterian Hudson Valley Hospital
1980 Crompond Rd, Cortlandt, NY 10567

Appendix D
Heat and Cold Stress

COLD STRESS

Ambient air temperatures during site activities may create cold stress for on-site workers. Procedures for recognizing and avoiding cold stress must be followed. Cold stress can range from frostbite to hypothermia. The signs and symptoms of cold stress are listed below.

Frostbite is defined as the actual freezing of one or more layers of skin. In severe cases, organs and structures below the skin can become frozen. Usually, body areas exposed to the most cold, and least body warmth, are affected first. These areas include fingers, toes, ears, and the tip of your nose. Frostbite is characterized by pain and loss of dexterity in the affected limb. The tissue initially appears reddened, but may progress to white, blue, or black.

> **FIRST AID:** Bring the affected employee indoors and call the local emergency clinic. Rewarming of frostbitten parts is best left to a medical doctor in a controlled setting.

Hypothermia is the condition that occurs when the body's natural warming mechanisms (muscle activity and shivering) cannot counteract the loss of body heat to the environment. The onset of hypothermia is greatly hastened by being wet. Hypothermia is marked by severe, uncontrollable shivering. The patient will show signs of excessive fatigue, drowsiness, irritability, or euphoria. As hypothermia progresses, the patient will begin to lose consciousness, blood pressure will drop, shivering will cease, and the patient may slip into a coma and possibly die.

> **FIRST AID:** If these symptoms occur, remove the patient to a warm, dry place. If clothing is wet, remove and replace with dry clothing. Keep the patient warm, but not overheated. The patient should be gradually rewarmed to prevent shock. If the patient is conscious and alert, warm liquids should be provided. Coffee and other caffeinated liquids should be avoided because of diuretic and circulatory effects. Notify the emergency clinic if conditions worsen, the patient loses consciousness, or the patient has an altered mental status. Have the patient transported to an emergency facility.

General Precautions The reduction of adverse health effects from cold exposure can be achieved by adopting the following work practices.

- Provide adequate insulating clothing to maintain core temperature at 98.6° F if work is to be performed in air temperatures below 40° F. Wind chill cooling rates and the cooling power of air are critical factors. The higher the wind speed and the lower the air temperature in the work area, the greater the insulation value of the protective clothing should be.
- If the air temperature is 32° F or less, hands should be protected by mittens/gloves.
- If only light work is involved and if the clothing on the worker may become wet on the job site, the outer layer of clothing should be impermeable to water. With more severe work under such conditions, the outer layer should be water repellent, and the outer layer should be changed as it becomes wet. The outer garments should include provisions for easy ventilation in order to prevent wetting of the inner layer by sweat.
- If available clothing does not give adequate protection to prevent cold injury, work should be modified or suspended until adequate clothing is available, or until weather conditions improve.
- For prolonged work, heated shelters should be available. Workers should be encouraged to use these at regular intervals, with the frequency depending on the severity of the environmental exposure. When entering the shelter, the outer layer of clothing should be removed and the remainder of the clothing

loosened to permit heat evaporation, or a change of work clothing should be provided.

- Warm, sweet drinks, such as hot cocoa or soup, should be available at the work site to provide caloric intake and fluid volume. The intake of coffee should be limited because of diuretic and circulatory effects.
- The weight and bulk of cold-weather gear should be included in estimating the required work performance and weights to be lifted in the field.

Workers should be instructed in safety and health procedures regarding cold work environments as part of the pre-work safety meeting. The training program should include instruction in preventing, recognizing, and treating cold stress conditions.

Wind Chill Chart

Wind (mph) \ Temperature (°F)	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	29	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes, 10 minutes, 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

HEAT STRESS

There is a potential for heat stress from the use of protective clothing and climate conditions. One or more of the following procedures may be employed to alleviate potential heat stress problems in the event that site conditions warrant the use of personal protective equipment (PPE), or ambient temperatures exceed 85° F. Heat stress training must be emphasized during the daily safety meetings, and adequate supplies of potable water must be provided to workers each day.

General Precautions Provide plenty of liquids. To replace body fluids (water and electrolytes) lost because of sweating, use a 0.1 percent saltwater solution, more heavily salted foods, or commercial drink mixes. The commercial mixes may be preferable for those employees on a low sodium diet. Employees on low sodium diets, or other special diets, are advised to contact their personal physician for recommendations regarding appropriate electrolyte replacement fluids/beverages.

In extremely hot weather, conduct operations in early morning or evening and rotate shifts of workers wearing impervious clothing. Install mobile showers and/or hose-down facilities to reduce body temperature and cool protective clothing.

Ensure that adequate shelter is available for breaks to protect personnel against heat, which can decrease physical efficiency and increase the probability of accidents.

Acclimatization for workers not accustomed to working in elevated temperature environments will be considered and implemented as appropriate in accordance with American Conference of Governmental and Industrial Hygienists (ACGIH) Guidelines.

Heat Stress Monitoring

For monitoring the body's recuperative ability toward excess heat, one or more of the following techniques should be used as a screening mechanism. Monitoring of personnel wearing impervious clothing should commence when the ambient temperature is 70° F or above. Frequency of monitoring should increase as the ambient temperature increases or as slow recovery rates are indicated. When temperatures exceed 80° F, regardless of the use of Personal Protective Equipment (PPE), workers will be monitored for heat stress after every work period.

Good hygienic standards must be maintained by the employee to aid in the prevention of heat stress illnesses. At a minimum, frequent changes of clothing and daily showering should occur with clothing being allowed to dry during rest periods. Persons who notice skin problems should immediately inform their supervisor.

Heart rate (HR) should be measured by the radial pulse for 30 seconds as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 110 beats/minute. If the HR is higher, the next work period should be shortened by 25 percent. The HR is then measured again, once each minute for 2 minutes (a total of three measurements), after the initial rest period measurement. The HR should decrease by ten beats per minute between each measurement (a total reduction of 20 beats). If the HR does not decrease, the work period should be reduced by an additional 25 percent.

Body temperature can be measured orally with a clinical thermometer as early as possible in the resting period. Oral temperature (OT) at the beginning of the rest period should not exceed 99°F. If it is greater than 99°F, the next work period should be shortened by 25 percent. The OT should be measured again at the end of the rest period to make sure that it has dropped below 99° F.

Effects of Heat Street

If the body's physiological processes fail to maintain a normal body temperature because of excessive heat loading, a number of physical reactions can occur. The severity of these reactions ranges from mild (such as fatigue, irritability, anxiety, and decreased concentration, dexterity, or movement) to severe (fatal).

Heat-related illnesses include:

Heat rash (also known as prickly heat rash) is caused by continuous exposure to heat and humid air and aggravated by chafing clothes. Heat rash decreases the ability to tolerate heat as well as being a nuisance. Signs are not limited to, but may include, a red prickly rash.

FIRST AID: Employees exhibiting signs of heat rash will be directed to shower and change into clean, dry clothing.

Heat cramps are caused by profuse perspiration with inadequate fluid intake and electrolyte replacement (especially salts). Signs are muscle spasms and pain in the extremities and abdomen, and may occur several hours after work has stopped.

FIRST AID: Employees showing signs of heat cramps will be directed to lie in a cool, shady area, and drink cool fluids. If symptoms persist or worsen, the employee will be transported to an emergency facility.

Heat exhaustion is caused by increased stress on various organs to meet increased demands to cool the body. Signs are shallow breathing; pale, cool, moist skin; profuse sweating; dizziness and lassitude.

FIRST AID: Employees with signs of heat exhaustion will be brought to a cool, shady location and given fluids. After recovering, the employee will be dismissed for the day. If employee is unconscious, or conditions persist, the employee will be transported to a hospital.

Heat stroke is the most severe form of heat stress. The body must be cooled immediately to prevent severe injury and/or death. Signs and symptoms are red, hot, dry skin; no perspiration; nausea; dizziness and confusion; strong, rapid pulse; and/or coma.

FIRST AID: HEAT STROKE IS A MEDICAL EMERGENCY. Employees will be brought to a cool area, aggressively treated by removing constricting clothes and applying wet towels or ice packs, and transported without delay to an emergency facility.

Appendix E
Tailgate Meeting/Checklist

TRC

Daily Pre-Job Safety Briefing

Project Name: ______________________ Project Number: ____________

Work Location: ______________________ Date: ____________

Tasks Performed: ______________________ Time: ________ AM PM

Client Name: ______________ Submitted By: ______________

Weather: ______________________

Refuge Area: ______________________

First Aid/CPR Persons: ______________________

Potential Hazards: ______________________

For Emergencies Dial 911 For Non-Emergencies Dial WorkCare (888) 449-7787

Personal Protective Equipment Required

	Yes	*No*	*Specify*
Clothing	☐	☐	________
FR, reflective vest, chemical, other (specify)			
Eye/Face	☐	☐	________
Safety glasses, goggles, face shield, other (specify)			
Respirator	☐	☐	________
1/2 face, full face, other (specify)			
Foot Protection	☐	☐	________
Safety toe, EH rated, rubber boots, other (specify)			
Hand Protection	☐	☐	________
Kevlar, chemical, EH, other (specify)			
Head Protection	☐	☐	________
hard hat, electrical hazard, other (specify)			
Fall Protection	☐	☐	________
body harness, lifelines, barricades, other (specify)			
Hearing Protection	☐	☐	________
Other: ________			

Procedures/Programs Required

	Yes	*No*
Confined Space	☐	☐
Hot Work	☐	☐
Signs/Barricades	☐	☐
LOTO/Energy Control	☐	☐
Scaffolds/Aerial Lifts	☐	☐
________	☐	☐
________	☐	☐
________	☐	☐
________	☐	☐
Employee Certification/Training Required		
HAZWOPWER	☐	☐
Asbestos Awareness	☐	☐
Asbestos Inspector	☐	☐
XRF Trained	☐	☐
________	☐	☐
________	☐	☐
________	☐	☐

Additional Considerations

Work Procedures: ☐ Dig Safe
☐ Working clearances ☐ ________
☐ ________

People: ☐ Worker fatigue ☐ Other site activities
☐ Public safety ☐ Pedestrian control ☐ Experience
☐ Traffic control ☐ Other utilities
☐ ________

Tools/Equipment: ☐ Eye wash ☐ First Aid Kit
☐ Inspection of tools/equipment
☐ Specialized tools/equipment
☐ Correct tool/equipment for the job
☐ ________

Special Precautions: ☐ Environmental
☐ Condition of structures ☐ Weather conditions
☐ Lighting conditions ☐ Terrain ☐ Water bodies
☐ Adjacent structures
☐ ________

If Conditions CHANGE…Stop Work, Review and Revise the Plan!!

Daily Pre-Job Safety Briefing

Hazards Associated with the Job				
☐ Hazardous Chemicals	☐ Heavy Equipment	☐ Slip/Trip and Falls	☐ Work in Active Rail ROW	☐ Confined space
☐ Biological Waste	☐ Hostile Individual(s)	☐ Traffic Hazards	☐ Work in Active Substation	☐ Hot Work
☐ Asbestos	☐ Ladder	☐ Trenches Excavations	☐Animals/Insects	☐ Radioactive Materials
☐ Dust	☐ Lighting	☐ Utilities	☐Plants	☐ Boom/Scissor Lift
☐ Edges/Material Handling	☐ Manual Lifting	☐ Water/Boat Safety	☐ ____________	☐ ____________
☐ Electricity	☐ Pressurized Fluids/Gases	☐ Weather (hot/cold)	☐ ____________	☐ ____________

List all hazards associated with this task

Barriers to eliminate/control above hazards?

Supervisor Signature:

Signature of Crew Members Present	
Print Name	Sign Name

Post Task Safety Analysis

Did any injuries or incidents occur today? If yes, explain.

☐ Yes ☐ No

Was the injury or incident reported the safety department?

☐ Yes ☐ No ☐ N/A

What problems did you have with today's work assignment?

What can we do tomorrow to improve performance?

Appendix F
WorkCare Program Information

FACT SHEET

EARLY INCIDENT INTERVENTION®

Immediate Access to Medical Advice for Work Related Incidents

(888) 449-7787

INTRODUCTION

WorkCare, Inc. (WorkCare) and TRC have partnered together to promote Incident Intervention®, a resource designed to support company safety goals/targets—while reducing runaway-costs associated with workplace injuries and illnesses.

PURPOSE

Early Incident Intervention provides TRC employees with **IMMEDIATE** telephonic access to WorkCare clinicians at the time of a presumed, non-emergency workplace injury or illness. Clinicians provide expert guidance on the evaluation of symptoms, appropriate first aid, and the need for additional medical evaluation or treatment.

When utilizing this service within the first hour of an incident, known as the "Golden Hour," licensed medical staff can guide the case so that medical evaluation and treatment are rendered appropriately.

> *"…helps the worker traverse the unpredictable terrain of work-related injuries and illness."*

PRINCIPLES OF EARLY INCIDENT INTERVENTION

- Utilizes principles of the "Golden Hour."
- Provides workers immediate clinician support at the time of an incident.
- Focuses on providing the right care, at the right time in the proper setting.

BENEFITS FOR EMPLOYEES

- Instant access to a medically qualified professional for evaluation of symptoms and possible outcomes.
- Professional guidance on appropriate first aid measures and medications.
- Professional advice regarding the need for additional medical evaluation or treatment.

BENEFITS FOR TRC

- Point of contact for emergency and non-emergency medical clinicians.
- Triages the incident to determine risk and urgency, delivering interventions that are consistent with medical guidelines for the specified injury and illness.
- Maintains communication with clinicians to ensure accurate and timely reporting.

Appendix G
Safe Catch Form

"Safe Catch" Report

A "Safe Catch" is a potential hazard or incident that has not resulted in any personal injury. Unsafe working conditions, unsafe employee behaviors, improper use of equipment or use of malfunctioning equipment have the potential to cause work related injuries. It is everyone's responsibility to report and/or correct these potential incidents immediately. Please complete this form as a means to report these "Good Catch" situations and submit to your local OSC Representative and Mike Glenn, National Safety Director.

Employee Name:		Date:	
Incident Location:		Office:	
Project:		Practice:	

Conditions

Please check all appropriate conditions:

- ☐ Unsafe Act
- ☐ Unsafe Condition
- ☐ Unsafe Equipment
- ☐ Unsafe Use of Equipment

Description of Incident or Potential Hazard:

Task Performed at Time of Incident:

Causes (Primary and Contributing):

Corrective Action(s) Taken (remove the hazard, replace, repair, or retrain):

Employee Signature:		Date Completed:	

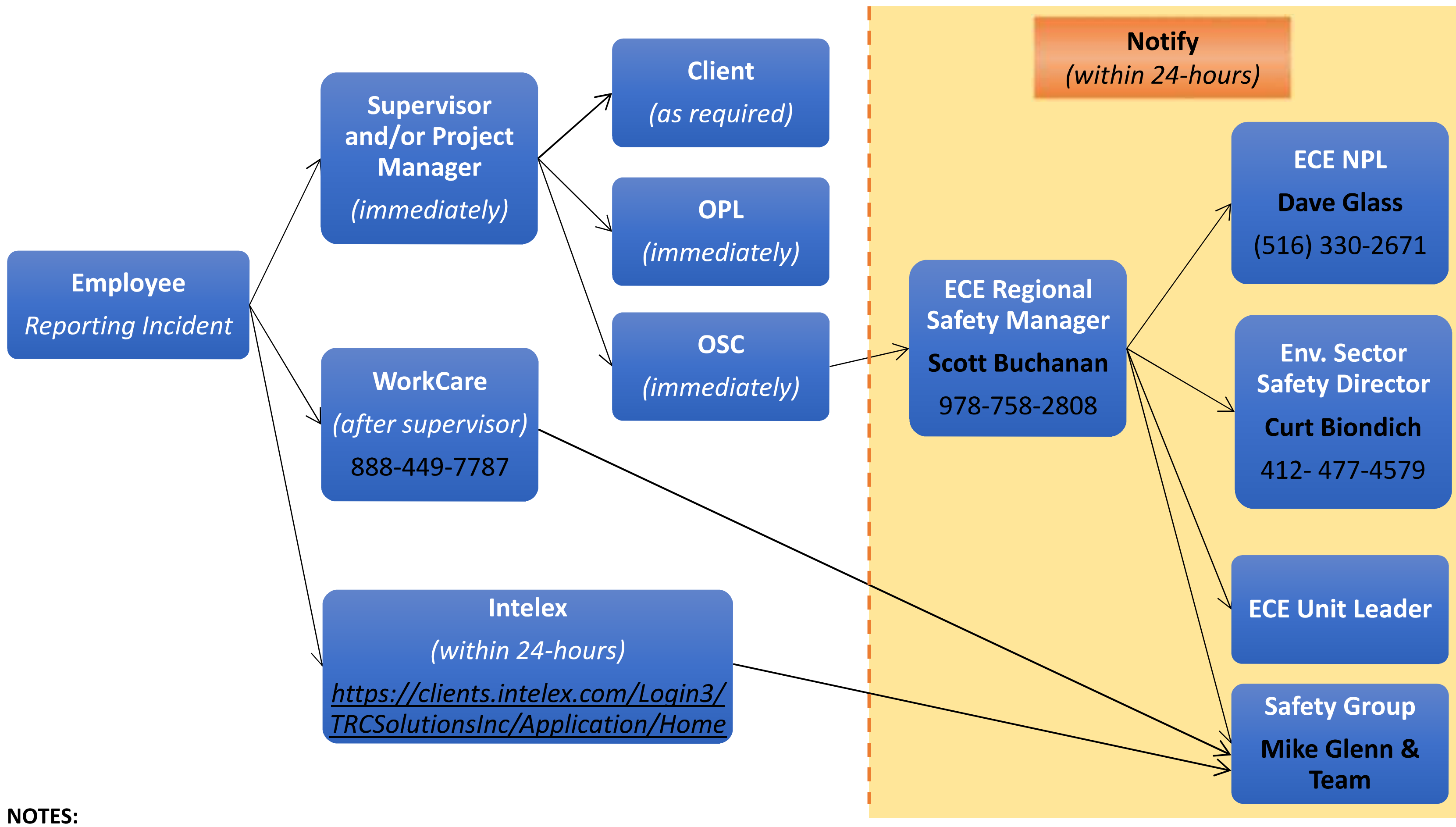
Our Mission: To reduce the frequency of incidents by applying local lessons learned globally.

If you have any questions about this report or would like additional information, please reference Compliance Program CP019—TRC Incident Response and Lessons Learned Program, located on TRCNET or contact Mike Glenn, National Safety Director at mglenn@trcsolutions.com.

Appendix H
In Case of Emergency and Incident Reporting

ECE Initial Incident Reporting Flow Chart

If emergency care is needed or if there is a motor vehicle incident call 9-1-1 first.



NOTES:

- This flow chart is for the initial reporting of all incidents. When incident investigations are required communications will occur across all or selected personnel on the chart.
- Phone numbers are provided for specific individuals but reporting via email is acceptable as well.
- In the event that personnel within the reporting chain cannot be reached in a timely manner please reach out to the next level to ensure communication occurs in a reasonable time.
- The Regional Safety Manager may compile low level incidents in a monthly update to the unit, sector and national managers.

AUTO INCIDENT REPORT

TRC DRIVER INFORMATION:

Driver's Name: ______________________ Driver's Phone: (   ) ______________

Company Name: ______________________ Company Location: ______________________

Supervisor's Name: ______________________ Supervisors Phone: (   ) ______________

Project Name: ______________________ Client Name: ______________________

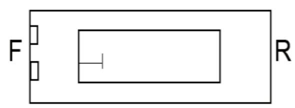
Driver's Date of Birth (MM/DD/YY): ________ Driver's License #: ______________ State: ________

TRC VEHICLE INFORMATION (V-1):

Year/Make/Model of Vehicle: ______________________

License Plate #: ______________________ Vehicle ID # (VIN): ______________________

Circle Point of Contact:



Was Vehicle Drivable? ☐ Yes ☐ No
Personal: ☐ Yes Rental: ☐ Yes Fleet: ☐ Yes
Rental Company

INCIDENT INFORMATION:

Date of Incident: ________ Time of Incident: ______ A.M. ______ P.M. Photos Taken: ☐ Yes ☐ No

Location of Incident: ______________________ City: ______________

Were The Authorities Contacted? Police: ☐ Yes ☐ No Ambulance: ☐ Yes ☐ No Fire: ☐ Yes ☐ No

Name of Police Dept: ______________ Case #: ______________ Officer Name: ______________

Were Citations Issued? ☐ Yes ☐ No If Yes, To Whom? ______________________

Citation Number: ______________________

Were There Any Witnesses? ☐ Yes ☐ No If Yes, Please Provide Name, Address and Phone Below:

Witness Name: ______________________ Witness Phone: (   ) ______________

Witness Address: ____

Traffic Conditions (i.e., heavy, light): ______________ Weather Conditions (i.e., dry, wet, ice, fog): ________

Was the TRC Driver Injured? ☐ Yes ☐ No Was Medical Treatment Received? ☐ Yes ☐ No

Describe Injuries:

Describe Damage to Property Other Than Motor Vehicles (i.e., guardrails, mailboxes, etc.):

AUTO INCIDENT REPORT

OTHER DRIVER & VEHICLE INFORMATION (V-2):

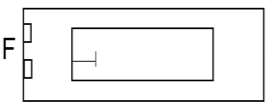
Driver's Name: ______________________ Driver's Phone: (   ) ______________

Driver's Address: ____

Owner's Name (If different than driver): ______________ Owner's Phone: (   ) ______________

Owner's Address: ____

Year/Make/Model of Vehicle: ______________ License Plate #: __________ State: ______

Circle Point of Contact: F  R

Was Vehicle Drivable? ☐ Yes ☐ No

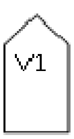
Insurance Company Name: ______________________ Policy Number: ______________________

Insurance Company Phone: (   ) ______________ Number of Passengers in Vehicle: ________

List Persons Injured: ____

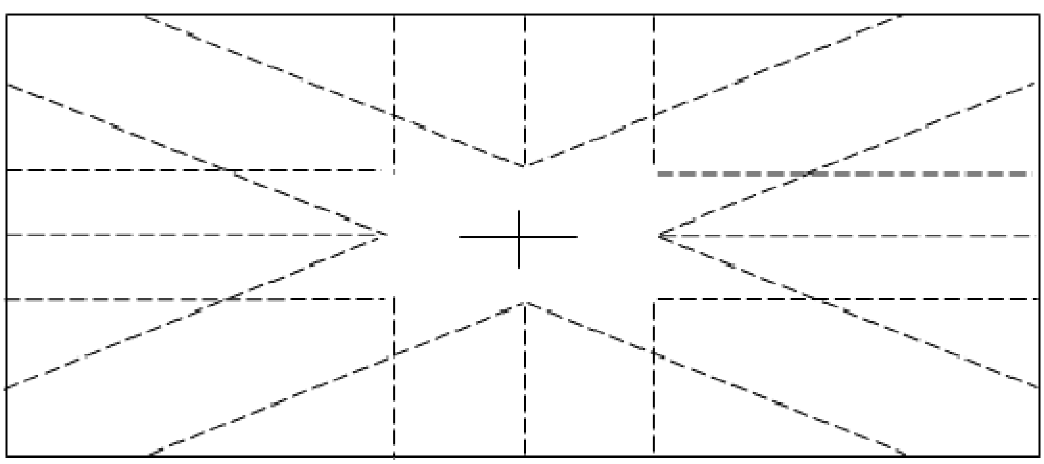
Were Any Other Vehicles Involved in Incident? ☐ Yes ☐ No If yes, provide details below:

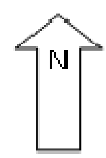
PLEASE DESCRIBE THE INCIDENT AND COMPLETE THE DIAGRAM BELOW. Be sure to indicate as many details as possible (i.e., How many lanes in each direction; Were there any turn lanes; What kind of traffic controls were there – light, stop sign, yield sign, Positions of vehicles on impact).



V-1 TRC Vehicle

V-2 Other Vehicle





Completed By: ______________________ Signature: ______________________

TRC Incident Report Form

(To be completed immediately after an Injury, Illness, Incident, Accident or Significant Near Miss by Employee's Supervisor and Employee involved)

Incident Category		
☐ Employee Injury/Illness ☐ Near Miss/Loss ☐ Property Damage ☐ Vehicle Accident ☐ Fire ☐ Other: Specify		
1	Incident Location:	
2	Site Identification/Project No.:	
3	Site Address:	
4	Date Incident Occurred:	
5	Time Incident Occurred:	
6	Date Incident Reported to Supervisor:	
7	Date Report Completed:	
8	Was WorkCare Contacted? ☐ Yes ☐ No	
9	Client:	

TRC Employee Information			
10	Name:		
11	Address:		
12	Employee Phone:		
13	Title or Occupation:		
14	Sector/Practice:		
15	Supervisor Name/Phone:		
TRC Employee Information (to be completed by Worker's Compensation Claims Administrator)			
16	Employee Date of Birth:		
17	Employee Social Security Number:		
18	Employee Marital Status:	☐ Married	☐ Single
19	Number of Dependant under the age of 18:		
20	Date of Hire:		
21	Rate of Pay:		Hours per week:

Type of Employee Injury or Illness (To be determined by Safety Director)			
22	☐ First Aid Only	20	☐ Extended Time Away From Work (3 days or more)
23	☐ Medical Treatment Only	21	☐ Fatality
24	☐ Restricted Work-case	22	☐ Other (specify):
25	☐ Lost Workday		
26	Estimated Number of Days on Restricted Work:		
27	Estimated Number of Days Away from Work:		

Employee Injury or Illness Description	
28	Describe the Injury or Illness:
29	First Aid/Medical Treatment Administered:
30	Name of Doctor's Office, Clinic, or Hospital: Concentra
31	Address and Phone Number:

Incident Description	
32	Equipment Involved:
33	Site Description:
34	What task was being performed at time of incident?
35	Describe Incident in Detail :
36	Conditions at time of Incident: (weather, lighting, etc.):
37	Motor Vehicle Accident:
38	TRC Vehicle ID:

39	Year/Make/Model:	
	☐ DOT Regulated Vehicle ☐ Towed From Scene ☐ Airbag Deployed ☐ Seatbelt in Use ☐ TRC Fleet ☐ Rental ☐ Personal Vehicle	
40	Other Vehicle License Plate	
41	Other Vehicle Year/Make/Model	
42	Other Vehicle Driver Name	
43	Other Vehicle Year/Make/Model	
44	Other Injured Parties ☐ Yes ☐ No	
43	Description of other injuries:	

	Subcontractor Involvement / Description of Incident
44	Subcontractor Involved: ☐ Yes ☐ No
45	Name of Company:
46	Address:
47	Contact Name and Phone Number:
48	Subcontractor Description of Incident:

	Witness Involvement / Description of Incident
49	Witnesses to Incident: ☐ Yes ☐ No
50	Name(s) and Address(s):
51	Phone Number(s):
52	Witness Description of Incident:

	Personal Protective Equipment (PPE)
53	List PPE required to complete the task: (glasses, gloves, shoes, hard hat, respirator, hearing protection, etc.)
54	Was the employee using the proper PPE at the time of the Incident?

	Immediate Corrective Actions		
55	Describe the immediate corrective actions taken:		
56	Immediate Supervisor:	Signature:	Date:
57	Employee:	Signature:	Date:

Supervisor's Post-Incident Review and Recommendations

Safety Violation ☐ Yes ☐ No

58	State the company safety rule, OSHA regulation, or specific training that was violated:
59	Describe the training the employee received to prevent this violation:

#	Root Cause Factors (RCF)
1	Lack of skill or knowledge
2	In the past, did not follow procedures or acceptable practices and no incident occurred (injury, product quality incident, equipment damage, regulatory assessment or production delay)
3	Doing the job according to procedures or acceptable practices takes more time/effort
4	Short-cutting procedures or acceptable practices are positively reinforced or tolerated
5	Lack of or inadequate operational procedures
6	Inadequate communication of expectations regarding procedures or acceptable practices
7	Inadequate tools or equipment (available, operable and safely maintained, proper task and workplace design)
8	External factors

60	Root Cause(s)	Identified Root Cause(s):							
		#1	#2	#3	#4	#5	#6	#7	#8
A		☐	☐	☐	☐	☐	☐	☐	☐
B		☐	☐	☐	☐	☐	☐	☐	☐
C		☐	☐	☐	☐	☐	☐	☐	☐
D		☐	☐	☐	☐	☐	☐	☐	☐
E		☐	☐	☐	☐	☐	☐	☐	☐
F		☐	☐	☐	☐	☐	☐	☐	☐
G		☐	☐	☐	☐	☐	☐	☐	☐
H		☐	☐	☐	☐	☐	☐	☐	☐

61	**Conclusion: Why did the Incident Occur?**

62	Item No.	RCF No.	Recommended Corrective Action(s) How to Prevent Incident from Reoccurring	Responsible Person	Due Date	Completed (date)	Verified/ Validated (date)

Supervisor: ____________________________ Signature: _______________________________ Date: __________

TRC Safety Director: ________________________ Signature: _______________________________ Date:__________

TRC Incident Reporting Guidelines

Incident Response:

1. For life threatening injuries and medical emergencies call 911 or go to the closest emergency room.
2. An injured worker must report an injury to their supervisor immediately.
3. Supervisor is required to complete The TRC Incident Report Form within 24 hours of the reported accident and forward to Bill Russell at Sargent & Associates with a copy to Mike Glenn.

   Bill Russell – Sargent &Associates
   Office: (978) 256-7459; Fax: (978) 256-4941
   bill@sargentandassociates.com

   Mike Glenn, National Safety Director
   Office: (949) 727-7347; Mobile: (949) 697-7418
   mglenn@trcsolutions.com

4. WorkCare can provide assistance in providing first aid advice and directing an injured worker to non-emergency medical care. WorkCare is a service that provides 24/7 access to an Occupational Healthcare physician or clinician.

   WorkCare Incident Intervention
   (888) 449-7787

Return to Work:

1. The injured worker is responsible for providing the Supervisor with a copy of the doctor's note detailing the injury and "return to work" status within 24 hours of the doctor's visit. The supervisor must email or fax the completed TRC Incident Report and Doctor's notes to Sargent & Associates.
2. Sargent & Associates will contact the injured worker and the Supervisor to confirm the facts surrounding the injury.
3. Sargent & Associates will report the injury to the workers' compensation insurance carrier, Zurich.

4. Zurich may contact the injured worker and supervisor to conduct an accident investigation.
5. Sargent & Associates will maintain communication with all parties in order to monitor the medical treatment, and the injured worker's return to work status. They will act as liaison between the injured worker, TRC, and Zurich.
6. Sargent & Associates will work with TRC's Health & Safety, Human Resources, and/or Supervisors to determine if modified duty work is an option, until the injured worker is able to return to full duty work activities.

Incident Investigation:

1. All incidents that result in injuries that require reporting for OSHA recordkeeping purposes and all high potential first aid and near miss events require an incident investigation.
2. The Supervisor with assistance from the National Safety Director and/or Safety Coordinator, must complete the incident investigation report/contributing cause analysis within 7 days of the incident and must develop a corrective action plan within 14 days of the incident.

Appendix I
Job Safety Analysis Forms

Direct Push Sampling Job Safety Analysis (JSA)

COMPANY/ PROJECT NAME or ID/ LOCATION (City, State)	DATE PREPARED FOR HASP:	
TRC Engineers, Inc.	**9/13/2022**	☒ NEW ☐ REVISED
JSA WORK ACTIVITY (Description): **Soil Borings (Direct Push)**	List of Contractor(s) and key work activity: **Site Specific**	

SITE SPECIFIC JSA AUTHOR	POSITION / TITLE	DEPT	SIGNATURE
Owen Maskell	**Environmental Scientist**	**ECR**	

TRC HEALTH AND SAFETY MANAGEMENT	POSITION / TITLE	APPROVAL DATE
Emily Ebert	**Office Safety Coordinator**	**9/13/2022**

PERSONAL PROTECTION EQUIPMENT (PPE) QUICK SUMMARY
Required PPE (indicate with "R") vs. Must Have Available On-site (indicate "A")

__R__ REFLECTIVE VEST __R__ HARD HAT __R__ GLOVES: **ANSI Cut Level 4 & 5 Kevlar** __R__ SAFETY GLASSES _____ GOGGLES _____ FACE SHIELD	__R__ HEARING PROTECTION __R__ SAFETY SHOES: Protective Toe _____ 5pt.HARNESS / LANYARD PPE CLOTHING: ____Coveralls ____Tyvek Suit ____Nomex ____Other (specify):	RESPIRATORY PROTECTION: ☒ NA ____½ face Air Purifying Respirator (APR) ___ Cartridge: ☐ P100 ☐ Multigas_ _____Full face ARP; specify cartridge type: _____ Air Supplied Respirator ____SCBA _____Air-line	Additional PPE/Notes: As per defined in the job/site specific Health and Safety Plan (HASP) wear PPE at all times when performing site work. Face Mask required at all times per COVID-19 Guidelines.

Always perform a Safety Assessment (Hazard Hunt): 1) prior to starting work; 2) when changing tasks; and 3) throughout the day. Focus on each new task, procedures, and skill sets to be used.

[1] JOB TASKS	[2] POTENTIAL HAZARDS	[3] HAZARD CONTROLS (beyond wearing "Required" PPE)
1) Set-up	a. Lack of concentration or focus.	a1. Review all plans (HASP, Work, Utility, Site Plans, etc.), logs, and field notes prior to starting a new task. Identify daily tasks and required personnel actions. a2. Conduct safety tailgate meeting with subcontractor personnel prior to beginning work activities. Explain the site safety hazards and work precautions outlined in the HASP and obtain signatures indicating the HASP was discussed.
	b. Fire and explosion.	b1. No smoking or open flame. Periodically monitor ambient air concentrations with PID/LEL Meters. Shut down job and move personnel and equipment upwind if hydrocarbon concentrations are HASP defined action levels. b2. Deploy 2-20lb ABC Fire extinguishers in accordance site safety officer's direction.
	c. Electric shock/ electrocution.	c1. Have a qualified electrician cut all power connections to the site and remove main breaker from power panel. c2. De-energize all circuits/power sources and follow TRC's Lock-Out, Tag-Out (LOTO) procedures for circuits within 3-feet of boring location or 10-feet' of overhead utilities.

Always perform a Safety Assessment (Hazard Hunt): 1) prior to starting work; 2) when changing tasks; and 3) throughout the day. Focus on each new task, procedures, and skill sets to be used.		
1 JOB TASKS	**2 POTENTIAL HAZARDS**	**3 HAZARD CONTROLS (beyond wearing "Required" PPE)**
1) Cont'd	d. Malfunctioning heavy equipment safety devices.	d1. Inspect drill rig to determine if in good condition. Perform all equipment and safety checks prior to event startup (per operating manual).
	e. Being struck by moving vehicles or equipment onsite.	e1. Always wear safety vest, establish eye contact with operators utilizing flag men wear appropriate. e2. Vehicles shall use reverse beepers or flagmen. e3. Create an exclusion zone at least 10-feet beyond the limits of the boring to limit access to staging/work area using snow fencing, barricades, delineators, cones and/or caution tape. e4. Face the direction of oncoming traffic during work activities when possible.
	f. Bad organization creating confusion and hazard.	f1. Identify staging area with good lateral and vertical access for loading and unloading of trucks.
	g. Unauthorized personnel in exclusion zone.	g1. Use visitor check-in log and allow no-one in exclusion area without proper PPE (as defined on this JSA) and training documentation (e.g., HAZWOPER, other as defined in the HASP).
2) Drilling	a. Contact with subsurface water, gas, electrical, and/or fiber optic lines in the vicinity of drilling locations.	a1. If unknown lines or obstructions are encountered, stop drilling and notify PM. Do not undermine any utilities.
	b. Broken rod.	b1. Do not stand in close proximity of the rods being pushed into the ground. Stand off to the side and wear required PPE.
	c. Distracted driller.	c1. Always communicate with the driller before approaching the operating drill stem.
	d. Slips, trips, and falls.	d1. Spread absorbent to soak up any pools of water that accumulate during drilling. d2. Maintain a clean, unobstructed work area by good housekeeping and placing unused equipment away from work area.
	e. Soil cross contamination.	e1. Ensure downhole sampling equipment is cleaned between samples. e2. Create a clean sample collection area with removable poly sheeting/aluminum foil or other method ensure a clean work surface that is refreshed between each sample.
	f. Cut/pinched fingers or toes; and strained muscles.	f1. See PPE Quick Summary. f2. Use proper lifting techniques and 2-man rule as outlined in TRC's Employee IIPP Handbook and "Back Safety: A User's Guide" training module" handbook, when moving heavy objects (>50 lbs).

Always perform a Safety Assessment (Hazard Hunt): 1) prior to starting work; 2) when changing tasks; and 3) throughout the day. Focus on each new task, procedures, and skill sets to be used.		
[1] JOB TASKS	**[2] POTENTIAL HAZARDS**	**[3] HAZARD CONTROLS (beyond wearing "Required" PPE)**
2) Cont'd	g. Noise.	g1. All personnel will use hearing protection within work area while heavy machinery is operating at >85 dB.
	h. Flying particles, dust and hazardous substances from clearance activities.	h1. See PPE Quick Summary.
	i. Exposure to impacted soil or groundwater.	i1. Wear latex or nitrile gloves during handling of soil or ground water.
	j. Toxic or explosive atmosphere.	j1. Periodically monitor ambient atmosphere with PID or LEL meter. Shut down job and move personnel and equipment upwind if concentrations are detected above HASP defined action levels.
	k. Opening/handling core sleeves.	k1. Do not attempt to open retrieved core sleeves. Request the driller to open the plastic sleeves using ANSI cut level 5 Kevlar gloves. TRC personnel must have ANSI cut level 4 Kevlar gloves when handling/transporting open core sleeves.
	l. Inclement weather/ lightning.	l1. Monitor forecasted weather prior to and during drilling activities. Hault drilling activities if lightning is observed or anticipated and wait in personal/company vehicle until weather passes or until directed otherwise by the project manager.
	m. Heat illness.	m1. Refer to Activity Performed in Hot Illness Prevention JSA.
	n. Cold illness.	n1. Refer to Activity Performed in Cold Illness Prevention JSA.
3) Boring Completion	a. Bad organization causing cross-contamination of soil, groundwater, or personnel.	a1. Waste management—Identify and delineate soil stockpile area or storage area if soil cuttings/purge water are to be drummed. a2. Blot up puddles of standing water and the work area will be swept.
	b. Moving heavy objects (>50-lbs) and mixing grout/concrete.	b1. Get assistance for moving heavy objects and mixing grout/concrete. Use mechanical aids to move objects or mix grout/concrete.
	c. Opening/closing/ moving drums.	c1. Wear must wear ANSI cut rated 4 or 5 Kevlar gloves during the opening and closing of drums to protect fingers. c2. Use only drum dolly to move drums with soil, hydrated bentonite grout, or concrete or other heavy contents. c3. Empty metal drums could also cause strain or injury if not moved properly. Use caution and appropriate tools (e.g., dolly).
	d. Slips, trips, falls and physical injury during auger removal.	d1. Place all removed rods to side, so as not to become a trip hazard.

Always perform a Safety Assessment (Hazard Hunt): 1) prior to starting work; 2) when changing tasks; and 3) throughout the day. Focus on each new task, procedures, and skill sets to be used.		
[1] JOB TASKS	**[2] POTENTIAL HAZARDS**	**[3] HAZARD CONTROLS (beyond wearing "Required" PPE)**
3) Cont'd	e. Overspray and cross-contamination during rod decontamination.	e1. See PPE Quick Summary. e2. Do not overspray while cleaning rods. Create a "clean zone" with plastic liner for placement of decontaminated rods.
	LOCATION(S) WHERE HAZARD IS TO BE EXPECTED	**[3] HAZARD CONTROLS (beyond wearing "Required" PPE)**
1.	a.	a.
2.	a.	a.
3.	a.	a.

PID—photoionization detector; LEL—lower explosive limit; PPE—Personal Protective Equipment; ANSI—American National Standards Institute

Field Notes:

____

____

TRC JOB SAFETY ANALYSIS

(Revised July 2006)

COMPANY/ PROJECT NAME or ID/ LOCATION (City, State)	DATE	
TRC ENGINEERS, Inc.	9/13/22	☐ NEW ☒ REVISED

WORK ACTIVITY (Description):
Groundwater Sampling and Gauging

DEVELOPMENT TEAM	POSITION / TITLE	REVIEWED BY:	POSITION / TITLE
Owen Maskell	Environmental Scientist	Emily Ebert	Office Safety Coordinator

MINIMUM REQUIRED PERSONAL PROTECTIVE EQUIPMENT (SEE CRITICAL ACTIONS FOR TASK-SPECIFIC REQUIREMENTS)

☒ REFLECTIVE VEST ☒ HARD HAT ☐ LIFELINE / HARNESS ☒ SAFETY GLASSES	☐ GOGGLES ☐ FACE SHIELD ☐ HEARING PROTECTION ☒ SAFETY SHOES ProtectiveToe	☐ AIR PURIFYING RESPIRATOR ☐ SUPPLIED RESPIRATOR ☐ PPE CLOTHING Nomex if LPH detected)	☒ GLOVES ANSI Cut Level - Kevlar ☐ OTHER

- **ALWAYS CONDUCT A MENTAL JSA PRIOR TO STARTING WORK; WHEN CHANGING TASKS; AND THROUGHOUT THE DAY.**
- **THROUGHOUT THE DAY - MENTALLY FOCUS UPON EACH NEW TASK, DIFFERENT PROCEDURES, AND SKILL SETS TO BE USED.**

[1]JOB STEPS	[2]POTENTIAL HAZARDS	[3]CRITICAL ACTIONS TO MITIGATE HAZARDS
1. Groundwater Measurements	a. Lack of concentration and unfamiliarity with site	a. Review all plans and logs in field notebook prior to starting a new task. a. Follow cell phone use procedures when working.
	b. Moving vehicles.	b. Always face traffic or moving equipment when working (establish eye contact with drivers). b. Follow work area exclusion Zone Procedures Use “buddy system” when unable to observe traffic of moving equipment (> 50 lbs).
	c. Pinched fingers or toes; and strained muscles.	c. Wear leather gloves when opening barrels & well lids, lifting sharp or heavy equipment. Use proper tools for opening and closing purge water storage barrels. c. Lift heavy objects utilizing leg muscles rather than depending entirely on your back. Get assistance when equipment exceeds 50-lbs.
	d. Lost equipment and damage to well from foreign objects.	d. Fasten equipment raising and lowering ropes or cables to object larger than well diameter. Carry no loose pens or tools in pockets, place well lid fasteners away from well opening.
	e. Fire/Explosions	e. No Smoking or Open Flames while on site. Request anyone smoking to please extinguish cigarettes. Identify location(s) of all emergency shut-off devices.
	f. Electrocution	f. Perform all necessary equipment and safety checks prior to event startup (per operating manual). Check sounding and measurement equipment for shorts, frayed wires, or loose connections.
	g. Contamination	g. Wear nitrile or latex gloves with handling water or soil. Wear Safety glasses with splash guards when handling groundwater. g. Always cap open wells and replace surface covers when finished. Don’t leave any open well unattended.
	h. Slip/trips and falls	h. Maintain good house keeping - place unused equipment out walkways and work areas. Clean-up all spills. h. Use portable steps to mount and dismount sampling vehicle. Place equipment and tools down on truck bed before mounting and dismounting sampling vehicle.
	i. Noise	i. Use hearing protection when working with operating equipment (>75db).
	j. Visitors/spectators	j. Control entry in work area using exclusions zones and check-in log in field notebook.
1. Sample Storage and Well Closure	a. Damage to Samples b. Well Damage	a. Use procedures outlined in TRC’s Groundwater Monitoring and Sampling Procedures. b. Cap and lock sampled well, then securely fasten drive-over cover before moving onto next well to be sampled.

[1] Each Job or Operation consists of a set of steps. Be sure to list all the steps in the sequence that they are performed. Specify the equipment or other details to set the basis for the associated hazards in Column 2

TRC JOB SAFETY ANALYSIS
(Revised July 2006)

[2] A hazard is a potential danger. What can go wrong? How can someone get hurt? Consider, but do not limit, the analysis to: **Contact -** victim is struck by or strikes an object; **Caught -** victim is caught on, caught in or caught between objects; **Fall** - victim falls to ground or lower level (includes slips and trips); **Exertion** - excessive strain or stress / ergonomics / lifting techniques; **Exposure -** inhalation/skin hazards. Specify the hazards and do not limit the description to a single word such as "Caught"

[3] Aligning with the first two columns, describe what actions or procedures are necessary to eliminate or minimize the hazards. Be clear, concise and specific. Use objective, observable and quantified terms. Avoid subjective general statements such as, "be careful" or "use as appropriate".

LIMITATION: As part of TRC's EHS Policy, a JSA is provided by TRC for its employees. The purpose of a JSA is NOT to identify all hazards associated with a task, but to identify some potential hazards to get TRC and other onsite personnel thinking about other potential safety hazards and mitigating actions for unsafe conditions and behavior during various works. TRC recognizes that JSA's may not cover every conceivable step or hazard that emerges during a job, so we've provided a "Field Change" section below to amend a JSA if required. The JSA does not supersede or replace any local, state or federal permit, regulation, statute or other entities policies and procedures but is simply a tool for enhancing the execution of safe work at a jobsite under TRC's supervision. Similarly, all subcontractors are required to provide their own JSA(s) for their specialty prior to performing any work for TRC or its customers in accordance with TRC's EHS Policy; however, any unsafe condition or hazard not covered in any JSA is ultimately the direct responsibility of the person or entity performing the work.

Field Changes:

Appendix J
Acknowledgement

PERSONAL ACKNOWLEDGEMENT

A component of the HASP, designed to provide personnel safety during work activities described herein, requires that you receive training as described in the HASP prior to working at this site. Additionally, you are required to read and understand the HASP. When you have fulfilled these requirements, please sign and date this personal acknowledgement:

Name (Printed)	Signature	Date
Name (Printed)	Signature	Date
Name (Printed)	Signature	Date
Name (Printed)	Signature	Date
Name (Printed)	Signature	Date
Name (Printed)	Signature	Date
Name (Printed)	Signature	Date
Name (Printed)	Signature	Date
Name (Printed)	Signature	Date
Name (Printed)	Signature	Date

APPENDIX C
Community Air Monitoring Plan

APPENDIX C
COMMUNITY AIR MONITORING PLAN

This Community Air Monitoring Plan (CAMP) has been prepared in general accordance with the New York State Department of Health Generic Community Air Monitoring Plan presented in Appendix 1A of the Division of Environmental Remediation (DER)-10 Technical Guidance for Site Investigation and Remediation dated May 3, 2010. The CAMP requires real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) at the upwind and downwind perimeter of each designated work area at the Site. The CAMP is not intended for use in establishing action levels for worker respiratory protection. Rather, its intent is to provide a measure of protection for the downwind community (i.e., off-site receptors including residences, nearby schools, and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative work activities. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that work activities do not spread contamination off-site through the air.

Community Air Monitoring Plan

Real-time air monitoring for VOCs and observations of particulate levels at the perimeter of the work areas will be completed during ground-intrusive activities. Note that the CAMP will not be implemented during geophysical or land surveying, groundwater monitoring well development, or groundwater sampling. CAMP data will be summarized in reports submitted to NYSDEC during each day of field work. All CAMP data will be provided in the Remedial Investigation Report.

VOC Monitoring, Response Levels, and Actions

VOCs will be monitored at the downwind and upwind perimeters of each designated work area on a continuous basis. The monitoring work will be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment will be calibrated daily. The equipment will be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

1. If the ambient air concentration of total organic vapors at the downwind perimeter of the work area exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities will be temporarily halted and monitoring will continue. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.
2. If total organic vapor levels at the downwind perimeter of the work area 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 will continue. After these steps, work activities can resume provided that the total organic vapor level 200 feet downwind of the work area or half the distance to the nearest potential receptor or residential structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.
3. If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown.
4. All 15-minute readings will be recorded and will be available for State (NYSDEC and NYSDOH) personnel to review.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations will be monitored continuously at the upwind and downwind perimeter of the work area 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 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.

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

2. If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 $\mu g/m^3$ above the upwind level, work will be stopped and a re-evaluation of activities will be initiated. Work will be able to be resumed provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 $\mu g/m^3$ of the upwind level and in preventing visible dust migration.

3. All readings will be recorded and be available for State (NYSDEC and NYSDOH) personnel to review.

Odor Monitoring and Mitigation Plan

The purpose of this Odor Monitoring and Mitigation Plan is to detail the monitoring and, if necessary, mitigation of odor potentially generated during the RI. Based on the scope of the RI, generation of significant odor is not anticipated. However, work activities will be performed to minimize the potential for generation of odor.

Odor Monitoring

Odor will be monitored within the work area and CAMP stations. If nuisance odors are identified at the Site boundary, or if odor complaints are received, work will be halted and the source of odors will be identified and corrected. Work will not resume until all nuisance odors have been abated. NYSDEC and NYSDOH will be notified of all odor events and of any other complaints about the project. Odor or dust complaints from any owner or occupant of an adjacent or nearby property will be immediately addressed and managed by the Environmental Monitor in a manner equivalent to an exceedance of an air monitoring action level.

Odor Mitigation

All necessary means will be employed to prevent on- and off-Site nuisances. These measures may include containerizing drill cuttings immediately and using tarps to cover exposed odorous soil (if encountered).

Soil will not be stockpiled as part of the implementation of the RI Work Plan. If odors develop and cannot be otherwise controlled, additional means to eliminate odor nuisances will include: use of chemical odorants in spray or misting systems; and, use of staff to monitor odors in surrounding neighborhoods. Based on the scope of the RI, it is anticipated that any nuisance odors developed during intrusive work can be corrected, without the use of a temporary containment structure equipped with appropriate air venting/filtering systems.

APPENDIX D
Citizen Participation Plan

CITIZEN PARTICIPATION PLAN
FOR
INDIAN POINT ENERGY CENTER

September 19, 2022

Holtec Decommissioning International, LLC
1 Holtec Blvd.
Camden, New Jersey 08104

Table of Contents

* * * * *

Note: The information presented in this Citizen Participation Plan was current as of the date of its approval by the New York State Department of Environmental Conservation. Portions of this Citizen Participation Plan may be revised during the Site's investigation and cleanup process.

Respondent: **Holtec Decommissioning International, LLC** ("HDI" or "Respondent")
Site Name: **Indian Point Energy Center** ("IPEC" or "Site")
Site Address: **450 Broadway, Buchanan, NY 10511**
Site County: **Westchester County**
Site Numbers: 360038 (Units 1 & 2) and 360040 (Unit 3)

1. Introduction

HDI entered into an Order on Consent and Administrative Settlement ("Order") with The New York State Department of Environmental Conservation ("Department" or "NYSDEC") regarding the overall program for characterization, followed by subsequent investigation and remediation of IPEC. The Order is intended to memorialize a framework for developing and implementing work plans for corrective actions/remedial activities as part of the overall decommissioning of IPEC by HDI and its affiliates and other contractors. The Order is attached to this document in **Appendix E**.

The Order ensures that non-radiological and radiological contamination at IPEC is remediated to levels protective of public health and the environment, such that IPEC will be rendered ready for future safe reuse/redevelopment. As part of the Order, the development of a Citizen Participation Plan ("CP Plan") is required to provide information on how HDI and the NYSDEC will inform and involve the public during the investigation and cleanup of the Site.

2. Citizen Participation Activities

Objectives

During significant activities pursuant to the Order, HDI and the NYSDEC will inform key stakeholders including local officials and residents in the environmental studies and cleanup activities. Informing local citizens interested in Site investigations and cleanup is important for many reasons. These include:

- Promoting the development of timely, effective investigation and remediation of the IPEC Site.
- Improving public access to, and understanding of, issues and information related to the investigation and cleanup process for IPEC.
- Obtain public input that reflects the interests and perspectives found within the affected community.
- Encouraging dialogue to promote the exchange of information among the interested local community and State agencies.

General Outreach Activities

A variety of CP activities will be used to communicate with affected property owners and stakeholders. These communications activities may include meetings, comment periods, fact sheets, mailings, placement of materials in the document repositories, and correspondence via a compiled mailing list. HDI will cooperate with the Department and provide reasonable assistance in soliciting public comment on the documents identified for public comment in this Plan, proposed remedial action plans, and additional work plans and/or reports as the Department may require.

Project Contacts

Appendix A identifies HDI and NYSDEC project contacts to whom the public should address questions or request information about the Site's investigation and cleanup program. The public's suggestions regarding this Plan for the Site are welcome.

Locations of Reports and Information

The location(s) of the reports and information related to the Site's investigation and cleanup program also are identified in **Appendix A.** These document repository locations provide convenient access to important project documents for public review and comment. Some documents may be also placed on the HDI and NYSDEC Websites. If this occurs, the public will be informed using fact sheets or similar means, as appropriate.

A copy of this approved CP Plan is posted in the document repositories.

Contacting Local Stakeholders

NYSDEC and HDI are committed to provide the interested public and key local project stakeholders information regarding project status updates, notifications of upcoming significant activities (as defined in **Table 1**), access to project documents, and announcements about public comment periods.

Appendix B contains the key local stakeholder list. This list has been developed to keep the community informed about, and involved in, the Site's investigation and cleanup process. The contact list will be used to distribute fact sheets that provide updates about the status of the project. For the initial public outreach and information sharing *i.e.*, sharing the first "fact sheet"; the individuals listed in Appendix B will receive a hardcopy by mail which will include instructions for interested parties to register to receive future communications electronically. Subsequent fact sheets will be distributed exclusively through the document repositories as stated in Appendix A. Hardcopies of the uploaded documents will also be available for public review at the locations specified in Appendix A. <u>Note that a list of the names, addresses, and email addresses of private property owners and residents are being maintained confidentially in HDI and NYSDEC project files and are not included in the CP Plan or repositories.</u>

The contact list in Appendix B will be reviewed periodically by HDI and NYSDEC and updated as appropriate. Individuals and organizations may be added upon request and such requests should be submitted to the HDI project contact(s). Other additions to the contact list may be made at the discretion of the NYSDEC project manager, in consultation with other NYSDEC staff, as appropriate.

Plan Activities

At the end of this Section, **Table 1** identifies the CP Plan activities, at a minimum, that will be conducted during the Site's investigation and cleanup. The public is informed about these activities through fact sheets and notices distributed at significant points during the program. Elements of the investigation and cleanup process that match up with the CP Plan activities are explained briefly in Section 5 and are illustrated in **Appendix D**.

Notices and fact sheets help the interested and affected public to understand potential contamination issues related to the Site, and the nature and progress of subsequent efforts to investigate and clean-up the Site. Public forums, comment periods, and contact with project managers provide opportunities for the public to contribute information, opinions and perspectives. It is important to note that information presented with respect to these activities may include multiple areas and Work Plans. This will be done at the discretion of HDI with NYSDEC concurrence.

The public may contact the designated project contacts with questions, comments, or requests for information.

This Plan may be revised due to the nature and scope of investigation and cleanup activities subject to NYSDEC approval. Modifications may include additions to the Site contact list and changes in the CP Plan activities.

Handling Public Comments

The process for sharing fact sheets and handling public comments is generally described as follows:

- In the case of fact sheets, HDI will prepare the fact sheet and provide to NYSDEC for review. NYSDEC will provide comments and the parties will work in good faith to diligently finalize the fact sheet.
- NYSDEC will issue the finalized fact sheet to the key stakeholders identified and the other public recipients who register for electronic communications.
- NYSDEC will issue any Proposed Remedial Action Plan (PRAP) or Draft Statement of Basis (Draft SOB) requiring a 30-day public comment and public meeting.
- NYSDEC will be the recipient of comments received during the comment period and will exercise its discretion to organize and initially assess the comment, and then forward to HDI.
- HDI will prepare draft responses to the comments and refer to the NYSDEC for their review and input. The parties will work in good faith to diligently finalize the responses.
- NYSDEC will be responsible for sharing the final responses to the appropriate recipients.
- NYSDEC's final Record of Decision/Statement of Basis (ROD/SOB) will include a responsiveness summary of significant comments about the PRAP.

All documents will be placed in the document repositories.

Table 1 - Citizen Participation Activities

Citizen Participation Activities	Timing of Plan Activities
Before Start of Remedial Investigation (RI):	
• Prepare Site contact list for initial mailing / public notice • Establish document repository • Prepare Citizen Participation Plan • Place approved RI Work Plan in document repository • Distribute fact sheet to Site contact list that announces availability of RI Work Plan and describes upcoming RI field work	Before start of RI. Note: Draft Citizen Participation Plan must be submitted to NYSDEC within 20 days of effective date of Consent Order. The Plan must be approved by NYSDEC before distribution.
Remedial Investigation Report:	
• Distribute fact sheet to Site contact list that describes RI results • Place approved RI Report in document repository	When NYSDEC approves RI Report
Proposed Remedial Action Plan or Draft Statement of Basis (PRAP/Draft SOB):	
• Place PRAP/Draft SOB in document repository • Distribute fact sheet to Site contact list that describes PRAP and announces 30-day comment period and public meeting • **Conduct 30-day public comment period** • **Hold public meeting about PRAP/ Draft SOB**	When NYSDEC releases PRAP/Draft SOB. Comment period begins/ends as per dates identified in fact sheet. Public meeting is held during the comment period.
Record of Decision or Statement of Basis (ROD/SOB):	
• Place ROD/SOB in document repository • Distribute notice to Site contact list that announces availability of ROD/SOB. ROD/SOB includes responsiveness summary of significant comments about PRAP	When NYSDEC issues ROD/SOB
Before Start of Remedial Action:	
• Distribute fact sheet to Site contact list that describes upcoming remedial action	Before start of remedial action at the Site
Cleanup Requirements Achieved:	
• Distribute fact sheet to Site contact list that announces cleanup requirements achieved • DEC issues Satisfactory Completion Letter	When NYSDEC certifies cleanup requirements achieved, or within 10 days after NYSDEC issues Satisfactory Completion Letter or other similar Site closure document

3. Major Issues of Public Concern

There has been a significant degree of public interest in the forthcoming Site assessment and remedial work that will be undertaken in connection with the decommissioning of IPEC, which the Nuclear Regulatory Commission (NRC) and NYSDEC will oversee, and the Site's redevelopment. Issues of concern include but are not limited to: 1) the potential migration of airborne radiological and non-radiological contaminants during demolition activities; 2) potential contamination of groundwater and soils beneath the Site; and 3) standard(s) to which the Site will be remediated for future redevelopment.

When subsurface remediation commences, significant issues of community concern may include noise, odor, dust and/or truck traffic associated with removal of contaminated soil. Utilizing Best Management Practices (BMPs), these impacts will be mitigated through implementation of a Health and Safety Plan (HASP), Soil Management Plan and a Stormwater Pollution Prevention Plan (SWPPP), as required, and approved by the NYSDEC. A Community Air Monitoring Plan may also be implemented to monitor dust and vapors to ensure the community is not impacted. These plans may be developed as part of the Remedial Investigation Work Plan but may also be incorporated into other Work Plans developed by HDI and approved by the NYSDEC.

4. Site Information

Appendix C shows an overhead view of the Site and adjacent properties.

Site Description

- **Location: 450 Broadway, Buchanan, NY 10511**

- **Tax Parcels:**

  - Section 43.10 Block 2 – Lot 1
  - Section 43.10 Block 2 – Lot 2
  - Section 43.14 Block 2 – Lot 1.1
  - Section 43.14

- **Setting: Industrial**

- **Site size: approximately 254 acres**

- **Adjacent properties: residential, commercial, industrial**

History of Site Use and Prior Investigations

IPEC is a shutdown nuclear power plant (3 units) located on approximately 254 acres[1] of land on the east bank of the Hudson River at Indian Point, Village of Buchanan, in northern Westchester County, New York. The Site is about 25 miles north of New York City. The nearest city is Peekskill, 2.5 miles northeast of Indian Point.

The principal structures at IPEC include:

- three reactor containment buildings
- three turbine generator buildings
- three fuel handling/storage buildings
- administrative buildings
- warehouses
- maintenance and outage support buildings
- emergency diesel generator buildings
- intake/screenwell structures
- discharge canal
- Independent Spent Fuel Storage Installation (ISFSI)
- other auxiliary buildings

Operation and shutdown dates are as follows:

- Unit 1, 1962-1974
- Unit 2, 1974-April 2020
- Unit 3, 1976-April 2021

Units 1 and 2 were purchased by Entergy in August 2001 from Consolidated Edison. Entergy purchased Unit 3 in November 2000 from the Power Authority of the State of New York.

Holtec International acquired all three units from Entergy, through a wholly owned subsidiary, on May 28, 2021. HDI was then designated to act as the operator of the Site with responsibility to supervise decommissioning.

Assessments identifying known contamination have been previously performed at the Site, including a Historical Site Assessment (HSA) performed by a third party in 2019.

[1] 239 acres are covered by licenses with the U.S. Nuclear Regulatory Commission

The HSA identified radiological and non-radiological Areas of Concern, identified data gaps and recommended additional investigation and characterization activities needed to support the development of other decommissioning documents.

The recommendations have been utilized to identify Areas of Concern in the Remedial Investigation Scoping Work Plan and any such contamination will be investigated and remediated as described in a NYSDEC-approved Plan. This process is further described in Section 5 below.

5. Investigation and Cleanup Process

Pursuant to the Order, HDI has agreed to perform additional Site "remedial investigation" with NYSDEC oversight. The Site investigation has several goals:

- define the nature and extent of contamination in soil, surface water, groundwater and any other parts of the environment that may be affected;
- identify the source(s) of the contamination;
- assess the impact of the contamination on public health and the environment; and
- provide information to support the development of a proposed remedy to address the contamination or the determination that cleanup is not necessary.

The first step of the Site remedial investigation process is the development of a "Scoping Work Plan" as described in the ORDER. HDI developed a Remedial Investigation Scoping Work Plan (RISWP), using the HSA and other historical environmental documentation as input, which describes the overall program of remedial investigation of areas at IPEC to be addressed in close coordination with NRC decommissioning efforts. The RISWP was originally submitted by HDI to the NYSDEC on October 25, 2021, as required.

The RISWP summarized known environmental and sampling data at IPEC. The RISWP also established an overall plan including conceptual schedule for remedial investigations of discrete areas at IPEC where releases to environmental media are known or suspected to have occurred and may remain at concentrations above regulatory criteria, and discrete areas where a realistic potential for a release to environmental media exists. Environmental media to be investigated pursuant to the ORDER requirements generally include soil and groundwater.

The specific objectives of the RISWP are described below.

- Identify potential areas of concern (PAOC) through a comprehensive review of available relevant information and Site conditions.
- Develop screening criteria to identify areas that will be retained for RI (areas of concern [AOCs]).
- Review PAOCs against screening criteria and identify AOCs.
- Coordinate remedial investigations for each AOC with the overall decommissioning schedule.
- Develop "packages" of AOCs to be addressed in Remedial Investigation Work Plans (RIWPs).

- Coordinate scheduled preliminary RIWP submittal dates for each RI package and develop a general schedule for the overall RI program.
- Describe the regulatory pathway for obtaining NYSDEC approval for meeting the state radiological contamination cleanup criterion of 10 millirem per year (mRem/yr), as needed, after meeting the NRC's 25 mRem/yr standard and obtaining partial Site release1 for most of the Site (excluding the ISFSI) from the NRC.
- Describe the regulatory pathway for obtaining NYSDEC approval of ISFSI closure after the spent fuel is removed from the Site and license release for the ISFSI is obtained from the NRC.

Following Department approval of the RISWP, other work plans will be proposed by HDI for review and approval by the Department. As specified by the Order, any proposed Work Plan must include, at a minimum, a chronological description of the anticipated activities, a schedule for performance of those activities, and sufficient detail to allow the Department to evaluate that Work Plan.

A "Work Plan" may take the following form:

1. Remedial Investigation or Remedial Facility Investigation Work Plan (RIWP or RFIWP) – a work plan that provides for the investigation of the nature and extent of contamination at IPEC.
2. Feasibility Study or Corrective Measures Study Work Plan (FSWP or CMSWP) – a work plan that evaluates remedial alternatives/corrective measure alternatives at IPEC or a portion of IPEC. This work plan will include a range of remedial/corrective measures, at least one of which must be remediation of the facility to "its original state" Other remedial alternatives will take into consideration the reasonably anticipated reuse of IPEC or a portion of IPEC.
3. Remedial Action Work Plan or Corrective Measure Implementation Work Plan (RAWP or CMIWP) – provides for the development and implementation of a remedial/corrective measure program for contamination at IPEC or a portion of IPEC, in compliance with a Department-issued Statement of Basis/Record of Decision (SOB/ROD).
4. Interim Remedial Measure or Interim Corrective Measure Work Plan (IRMWP or ICMWP) – provides for the implementation of an interim remedial/corrective measure at IPEC or a portion of IPEC. An Interim Remedial Measure is an action that can be undertaken when a source of contamination or exposure pathway can be effectively addressed before the Site investigation and analysis of alternatives are completed. If an interim measure is likely to represent all or a significant part of the final remedy, NYSDEC will require a 30-day public comment period.
5. Site Management Plan (SMP) – provides for the identification and implementation of institutional and/or engineering controls as well as any necessary monitoring and/or operation and maintenance of the remedy(ies) at IPEC.
6. "Supplemental" if an additional work plan other than those set forth above is required to be prepared or implemented, whether proposed by Respondent or requested by the Department.

Remedial Investigation

Following NYSDEC approval of the Remedial Investigation Scoping Work Plan, HDI will submit other draft Work Plans, as described above, to the NYSDEC for review and approval based on decommissioning activities.

AOCs identified in the RISWP will be grouped into Remedial Investigation Packages based on location and coordination with the overall decommissioning schedule. The approved Work Plans will be made available to the public through the issuance of a NYSDEC-approved fact sheet.

Remedy Selection

When the investigation of the AOCs is completed in accordance with an approved RIWP, the project likely would proceed down two parallel paths:

1. HDI will develop a Remedial Investigation Report that documents any contamination identified. The Report may also include a Feasibility Study or Corrective Measures Study Work Plan, which will evaluate the different remedial alternatives for the Site and will describe HDI's preferred remedy for addressing the contamination. The report will then be submitted to the NYSDEC for review and approval.
2. HDI may also recommend in its Remedial Investigation Report that no action is necessary for portions of the Site. In this case, NYSDEC would make the Report available for public comment for 30 days. NYSDEC then would complete its review, make any necessary revisions, and, if appropriate, approve the Report. NYSDEC may then issue HDI a Satisfactory Completion Letter, further described below, for the applicable Site portions.

Proposed Cleanup and Remedial Action

NYSDEC will propose a cleanup plan in a Proposed Remedial Action Plan or Draft Statement of Basis (PRAP/Draft SOB), which will select one or more alternatives evaluated in the Feasibility Study or Corrective Measures Study Work Plan. There will be a 30-day public comment period and public meeting for the PRAP/Draft SOB. Public comments will be reviewed and disposition prior to approving the proposed remedy in a final SOB/Record of Decision (ROD). The New York State Department of Health ("NYSDOH") must also concur with the proposed remedy(ies). NYSDOH contacts are also listed in Appendix A.

HDI will then perform the selected remedial action(s) with oversight from the NYSDEC and NYSDOH. When remediation is completed, HDI will prepare a Final Engineering Report that certifies that cleanup requirements have been achieved or will be achieved within a specific time frame. NYSDEC will review the report to ensure that the cleanup and/or any future actions associated with the cleanup is protective of public health and the environment for the intended use of the Site.

Satisfactory Completion Letter

When NYSDEC is satisfied that the cleanup requirements have been achieved, or will be achieved for the Site, it will approve the Final Engineering Report. NYSDEC may then issue a Satisfactory Completion Letter to HDI. Essentially, the letter will confirm that HDI has achieved cleanup at applicable portions of the Site. The Site owners would be eligible to redevelop the applicable portions of the Site after HDI receives a letter, subject to any Site Management controls described below.

Site Management

The purpose of Site Management is to ensure the safe reuse of the property if contamination will remain in place. Site management incorporates any institutional and engineering controls required to ensure that the remedy implemented for the Site remains protective of public health and the environment. All significant activities will be detailed in a Site Management Plan as required.

An *institutional control* is a non-physical restriction on use of the Site, such as an environmental easement that would prevent or restrict certain uses of the property. An institutional control may be used when the cleanup action leaves some contamination that makes the Site suitable for some, but not all, uses.

An *engineering control* is a physical barrier or method to manage contamination. Examples include caps, covers, barriers, fences, and treatment of water supplies.

Site management also may include the operation and maintenance of a component of the remedy, such as a system that pumps and treats groundwater. Site management continues until NYSDEC determines that it is no longer needed.

Appendix A - Project Contacts and Locations of Reports and Information

Project Contacts

For information about the Site's investigation and cleanup program, the public may contact any of the following project staff:

Organization:	Contact(s):
New York State Department of Environmental Conservation (NYSDEC)	Attn: Kelly Turturro Regional Director, NYS Department of Environmental Conservation, Region 3 Office 21 South Putt Corners Road New Paltz, New York 12561-1620 Phone: (845) 256-3033 Email: Kelly.turturro@dec.ny.gov Kieran McCarthy NYSDEC Project Attorney NYS Department of Environmental Conservation 625 Broadway Albany, NY 12233 Phone: (518) 402-9185 Email: Kieran.mccarthy@dec.ny.gov Daniel J. Evans Director, Bureau of Hazardous Waste and Radiation Management 625 Broadway Albany, NY 12233-7256 Phone: (518) 402-8652 Email: Daniel.evans@dec.ny.gov Lynn Winterberger Chief, RCRA Permitting Section 625 Broadway Albany, NY 12233-7256 Phone: (518) 402-9267 Email: Lynn.Winterburger@dec.ny.gov
New York State Department of Health (NYSDOH)	Anthony Perretta NYS DOH Bureau of Environmental Exposure Investigation Empire State Plaza Corning Tower, Rm 1717 Albany, New York 12237 Phone: 518-402-7860 Email: Anthony.perretta@health.ny.gov

	Nicole Vitello Center for Environmental Health NYS DOH Corning Tower Albany, NY 12237 Phone: 518-402-7802 Email: Nicole.Vitillo@health.ny.gov Cynthia Costello NYS DOH Bureau of Environmental Radiation Protection Corning Tower, Room 1218 Empire State Plaza Albany, NY 12237 Phone: (518) 402-7556 Email: Cynthia.costello@health.ny.gov
Holtec Decommissioning International	Richard Burroni Site VP, IPEC Frank Spagnuolo Decommissioning Director, IPEC Kristin Maddalo IPEC Site Characterization Project Manager 450 Broadway Buchanan, NY 10511 Phone: 914-254-6703 Email: IPECSiteCharacterization@Holtec.com

Locations of Reports and Information

The on-line document repository identified below are being used to provide the public with convenient access to important project documents:

Hendrick Hudson Free Library
185 Kings Ferry Road
Montrose, NY 10548
(914) 739-5654
info@henhudfreelibrary.org

NYSDEC Region 3
21 S. Putt Corners Road
New Paltz, NY 12561

Indian Point Digital Repository:
indianpointSitecharacterizati.sharevault.net

Indian Point Decommissioning Site:
https://holtecinternational.com/company/divisions/hdi/our-fleet/indian-point/

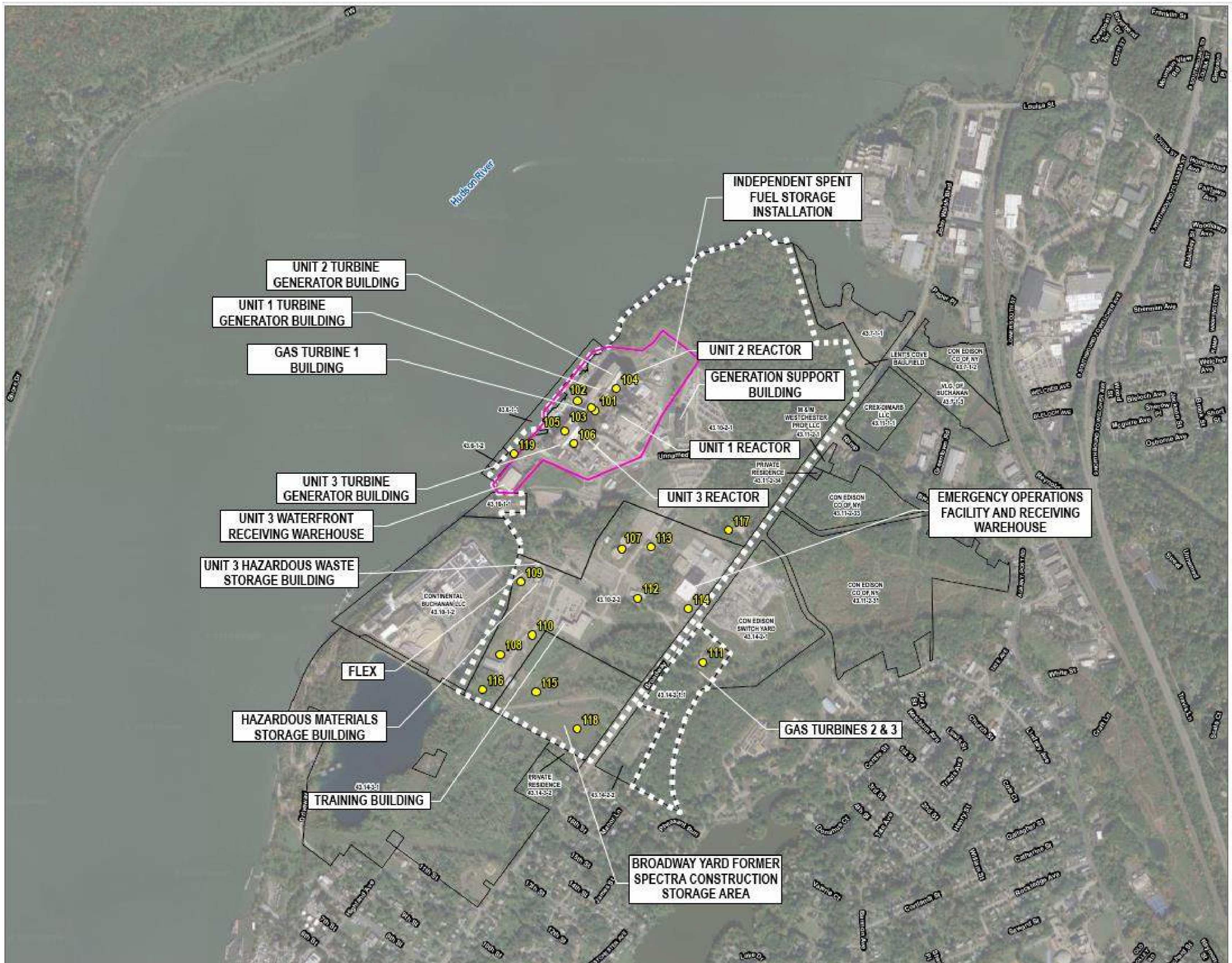
NYSDEC Document Repository Link:
Hazardous Waste Management - NYS Dept. of Environmental Conservation

NYS Department of Public Service – Indian Point Decommissioning Oversight Board
www.dps.ny.gov/indianpoint

Appendix B - Key Local Stakeholder Contact List

Organization:	Contact(s):
Indian Point Decommissioning Oversight Board	
www.dps.ny.gov/indianpoint	Attn: Tom Congdon, Chair
Local Government Officials	
Village of Buchanan	Theresa Knickerbocker, Mayor
Town of Cortlandt	Rich Becker, Supervisor
West Chester County	Susan Spear, Deputy Commissioner of Emergency Services
Other NY Elected Officials	
NYS Governor	Kathleen Hochul
Lieutenant Governor	Antonio Delgado
State Senate	Peter Harckham
Assembly	TBD
Congress	Mondaire Jones
Senate	Kirsten Gillibrand
Senate	Chuck Schumer
Local School District	
Henry Hudson School District	Joseph Hochreiter, Superintendent
Switchyard Owner/Operator	
Con Edison	
Pipeline Owner/Operator	
Enbridge	

Appendix C – IPEC Boundary and Adjacent Properties



LEGEND

- PROTECTED AREA
- SITE BOUNDARY
- WESTCHESTER COUNTY TAX PARCELS
- AREA OF CONCERN (AOC) AND REFERENCE NUMBER

NOTES:

AOC REFERENCE NO. AND DESCRIPTION:

101 - GAS TURBINE 1 BUILDING
102 - U1 FORMER TRANSFORMER AREA
103 - U1 HELLGATE TRANSFORMER
104 - U2 TRANSFORMER YARD
105 - U3 TURBINE GENERATOR BUILDING
106 - U3 TRANSFORMER YARD
107 - BULK STORAGE TANKS 11 AND 12
108 - U3 SOIL PILE POSTED AS LEAD HAZARD
109 - TRAINING FIREWATER TANK
110 - U3 SPARE MAIN TRANSFORMER/SPARE STATION AUXILIARY TRANSFORMER
111 - GAS TURBINE 2 & 3 AREA
112 - MAINTENANCE TRAINING FACILITY & FUEL OIL STORAGE TANK
113 - SALT BARN
114 - FORMER BUCHANAN SERVICE CENTER
115 - FORMER DUMPING AREA
116 - CLAY-LINED SEPTIC STORAGE AREA
117 - FORMER RAD STORAGE AREA
118 - LAFARGE EASEMENT FORMER SPECTRA CONSTRUCTION STORAGE AREA
119 - DISCHARGE CANAL
120 - STORM DRAIN SYSTEM (SITE WIDE AOC, NOT SHOWN ON MAP)
121 - 138 KV UNDERGROUND CABLE (SITE WIDE AOC, NOT SHOWN ON MAP)

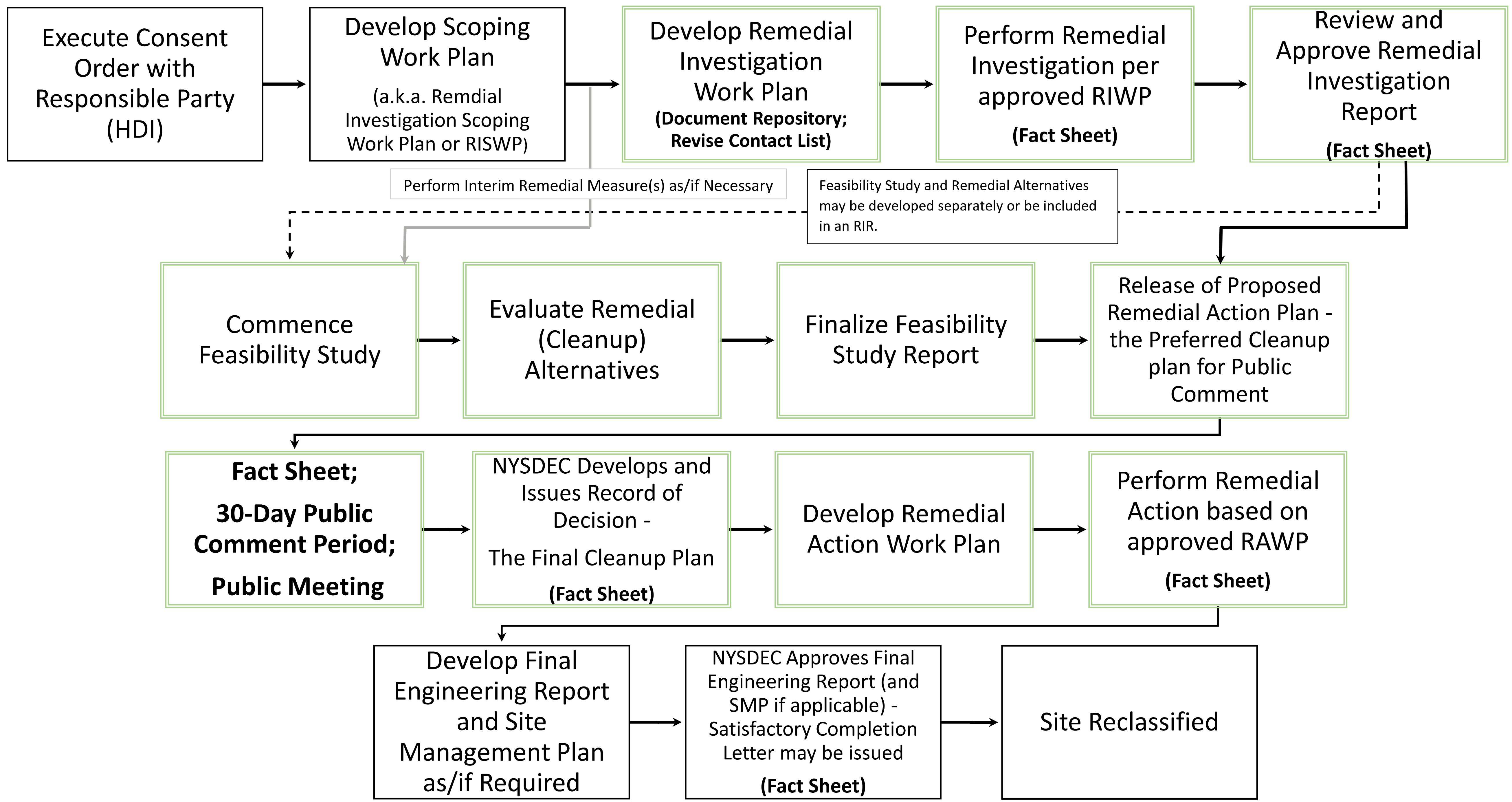
ADDITIONAL NOTES:

1. SITE BOUNDARIES AND FEATURES ARE APPROXIMATE.

1:12,000
1" = 1,000'
0 500 1,000 FEET

BASE MAP: GOOGLE EARTH IMAGERY
DATA SOURCES: TRC, WESTCHESTER COUNTY GIS

Appendix D – Remedial Process for Indian Point Energy Center



Notes:

- CP Activities are in **Bold**.
- Work Plans may have multiple AOCs a described in the RISWP. Green boxes being used to illustrate that many Work Plans may be in circulation with respect to NYSDEC review/approval and CP activities simultaneously
- Any proposed Work Plan submitted under the ORDER must be submitted for the Department's review and approval and must include, at a minimum, a chronological description of the anticipated activities, a schedule for performance of those activities, and sufficient detail to allow the Department to evaluate that Work Plan.

Appendix E - Order on Consent and Administrative Settlement, dated April 14, 2021

Attachment A

Order on Consent and Administrative Settlement

STATE OF NEW YORK: DEPARTMENT OF ENVIRONMENTAL CONSERVATION

In the Matter of the Implementation of Corrective Action for a Hazardous Waste Management Facility and Remedial Program for an Inactive Hazardous Waste Disposal Site, Pursuant to Article 27, Titles 9 and 13; and Article 71, Title 27 of the Environmental Conservation Law of the State of New York by:

Order on Consent and
Administrative Settlement
re Indian Point Energy Center

Holtec Decommissioning International, LLC

Respondent.

WHEREAS:

Jurisdiction

1. Consistent with the authority granted to the New York State Department of Environmental Conservation ("Department") and the Department's Commissioner by the Environmental Conservation Law of the State of New York ("ECL") Article 1 Title 3, the Department is responsible for carrying out the "policy of the state of New York to conserve, improve and protect its natural resources and environment and to prevent, abate and control water, land and air pollution".

Applicable Law

2. This Order on Consent and Administrative Settlement ("Order and Settlement") is issued pursuant to the Department's authority under the ECL, including, but not limited to:

a. ECL Article 27, Title 9 and Parts 370-374 and 376 of Title 6 of the Official

Compilation of Codes, Rules and Regulations ("6 NYCRR") that govern the implementation of the Resource Conservation and Recovery Act Program ("RCRA") via the Industrial Hazardous Waste Management Program;

b. ECL Article 27, Title 13 and 6 NYCRR Part 375 that govern the implementation of Inactive Hazardous Waste Disposal Site remedial programs through the State Superfund Program ("SSF");

c. ECL Article 71, Title 27 that governs the enforcement of the provisions of Article 27, and authorizes the Department to enter into orders requiring corrective action;

d. The New York State Navigation Law, Article 12, which governs liability and cleanup of releases of petroleum in New York State, and provisions of 6 NYCRR, Part 613, that regulate the bulk storage of petroleum.

3. Consistent with the authority granted to the Commissioner, the Department may issue orders pursuant to *inter alia* ECL Article 27, Titles 9 and 13 and ECL 71-2727(3) and 71-1929 requiring corrective action/remedial programs, site management and such other measures as necessary to protect public health and the environment from releases of hazardous waste or constituents.

Parties & Facility Background

4. Holtec Decommissioning International, LLC ("HDI" or "Respondent"), is a Delaware limited liability company with its principal place of business at 1 Holtec Blvd., Camden, NJ 08104.

5. The Indian Point site and facilities, referred to in this Order and Settlement as the Indian Point Energy Center ("IPEC"), is a three-unit nuclear generating facility located in the Town of Cortlandt and the Village of Buchanan, New York. Units 1 and 2 have permanently ceased operation (although Unit 2 Spent Fuel Pool operation continues); Unit 3 will cease operation in April 2021. For purposes of this Order and Settlement, IPEC shall be defined herein to include the property and infrastructure shown and described on the map provided as Exhibit A.

6. On April 15, 2019, a Membership Interest Purchase and Sale Agreement ("MIPA")

was signed by: Nuclear Asset Management Company, LLC and Holtec International (collectively the "Purchaser"), and Entergy Nuclear Indian Point 2, LLC and Entergy Nuclear Indian Point 3, LLC (collectively, the "Seller"). Under the terms of the MIPA, Purchaser will acquire all of the equity interest of two newly formed limited liability companies created by Seller, which at the time of closing of the transaction, will own IPEC and the associated real property, equipment, and other interests (collectively, the "Owners"), all as specifically described in the MIPA (the foregoing is collectively referred to as the "Transaction").

7. After the Transaction closes, the Owners will sign a Consent Form, attached to this Order and Settlement as Exhibit B, which will make them additional respondents to this Order and Settlement.

8. In connection with the Transaction, on November 21, 2019 HDI, Purchaser and Seller filed a License Transfer Application ("LTA") with the U.S. Nuclear Regulatory Commission ("NRC"), and thereafter supplemented the application with additional information including a decommissioning cost estimate. After finalizing the Transaction, HDI would be the NRC-licensed operator of IPEC with responsibility, among other things, to decommission IPEC Units 1, 2 and 3. HDI will engage and supervise a decommissioning general contractor for the majority of this effort. None of the reactors will be authorized to operate after permanent defueling and notification to the NRC occurs, which must be the case prior to the license transfer. At the time of the Transaction and license transfer, the Unit 3 reactor will be permanently defueled, and HDI will hold the NRC licenses for Unit 1, Unit 2, Unit 3, and the on-site Independent Spent Fuel Storage Installation(s) (ISFSI) until the NRC releases the Indian Point site from NRC regulation. The Unit 2 and Unit 3 spent fuel pools and the ISFSI will continue to operate after the completion of the Transaction.

9. As detailed below, this Order and Settlement requires investigation, evaluation, and corrective action of IPEC.

Objectives of this Order and Settlement

10. The Department and Respondent agree that the objectives of this Order and

Settlement are to:

a. Resolve outstanding issues with the Department regarding the corrective action and remedial obligations at IPEC, by following the requirements of this Order and Settlement;

b. Subject to Section I(a), coordinate, as necessary and appropriate, the corrective actions under this Order and Settlement with the radiological decommissioning process under the jurisdiction of the NRC. Completion of radiological decommissioning will culminate in NRC issuance of a "partial site release." Partial site release is when the NRC gives written approval to release a portion of a nuclear facility or site for unrestricted use at any time before approving a license terminaton plan.[1]

c. Complete the evaluation and implementation of corrective actions/remedial activities, as well as site management requirements at IPEC;

d. Establish the terms and conditions that govern the parties' rights and responsibilities should there be a dispute, a violation of the ECL or its implementing regulations, or a violation of this Order and Settlement;

e. Provide certain funding for Department and the New York State Department of Health's costs;

f. Provide financial assurance for corrective measures/remedial actions, and necessary site management requirements for IPEC. Such financial assurance shall also contain any required funds for additional radiological remediation beyond the NRC's 25 millirem level to attain the Department's guidance value (see DEC's DER-38, Cleanup Guidelines for Soils Contaminated with Radioactive Materials) of maintaining a total effective dose equivalent (TEDE) to the maximally exposed individual of the public, to a level as low as reasonably

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[1] See 10 CFR 50.83(a). Also, under NRC guidelines, a site will be considerd for "unrestricted use" when the requirements of 10 CFR 20.1402 are met.

achievable (ALARA), and less than 10 millirem in any one year (mRem/yr.)

g. Implement any future Statement of Basis/Record of Decision ("SOB/ROD") issued in connection with this Order and Settlement, to be prepared by the Department, as well as supplements or amendments thereto which will detail the corrective actions and site management requirements for IPEC;

h. Ensure that contamination associated with previous spills, explosions or other releases from IPEC at the areas referenced in Exhibit A, including but not limited to radiological contamination, petroleum, polychlorinated biphenyls (PCBs), and per- and polyfluoroalkyl substances (PFAS), is remediated to levels protective of public health and the environment;

i. Support citizen participation in the development of the corrective measures/remedial actions at IPEC, and

j. Allow for the future safe reuse of IPEC after successful decomissioning and necessary corrective actions are undertaken.

11. Respondent consents to the issuance of this Order and Settlement without (i) an admission or finding of liability, fault, wrongdoing, or violation of any law, regulation, permit, order, requirement, or standard of care of any kind whatsoever; (ii) an acknowledgment that there has been a release or threatened release of hazardous waste at or from IPEC; and/or (iii) an acknowledgment that a release or threatened release of hazardous waste at or from IPEC constitutes a significant threat to the public health or environment.

12. By entering into this Order and Settlement, Respondent hereby waives its rights to a hearing concerning this Order and Settlement as may be provided by law (while preserving its rights to dispute resolution as set forth below), consents to and agrees not to contest the authority or jurisdiction of the Department to issue or enforce this Order and Settlement, and agrees to be bound by its terms.

NOW, having considered this matter and being duly advised**, IT IS ORDERED THAT**:

I. <u>Effect of Order and Settlement</u>

A. Hereinafter, investigation, corrective action, remedial action, and site management activities undertaken by Respondent at IPEC will be subject to the terms and provisions of this Order and Settlement, recognizing that the NRC, as the federal radiological licensing authority for nuclear reactors, has the primary responsibility over the radiological decommissioning of IPEC pursuant to NRC requirements, and that the Department has authority over radiological remediation beyond the scope of NRC requirements, as well as other aspects of site restoration.

B. Necessary investigation and corrective action will be taken pursuant to one or more Department-approved work plans ("Work Plan" or Work Plans") to be developed under and in accordance with the terms of this Order and Settlement.

C. This Order and Settlement shall control in the event of any conflicts between it and any prior order, agreement or authorization on the matters contained herein between the Department and the Seller, Purchaser, or Respondent concerning IPEC. As reflected by correspondence annexed as Exhibit C, the Department has confirmed that there are no existing administrative or judicial orders or obligations pertaining to unresolved regulatory duties or actions applicable to IPEC, excluding ongoing obligations related to the 2017 agreement between New York State and Entergy regarding monitoring and environmental benefit projects that New York and others are administering.

II. <u>Financial Assurance</u>

A. Within sixty (60) days of the Effective Date of this Order and Settlement, Respondent will post $110,597,000 in financial assurance in the form of a surety bond or letter of credit, which will name "New York State Department of Environmental Conservation" as beneficiary. Respondent will provide the Department with an advance copy of the surety bond or letter of credit, for the Department's prompt review and approval. Once approved and executed, Respondent will provide documentation to the Department of the amount posted within that timeframe. If Respondent fails to post and provide this documentation within that timeframe, this Order and Settlement will terminate and all terms and conditions within it will be null and void. The financial assurance required by this subparagraph covers the anticipated cost of remedial/corrective actions required by this Order and Settlement.

B. At the request of Respondent or on its own initiative, but no more frequently than on an annual basis, the Department will assess the status of work under this Order and Settlement, including the completion of work plans, as well as other information contained in reports submitted by Respondent (including their annual submission to the NRC). The Department will then determine if, and the degree to which, the amount of then existing financial assurance will be adjusted, based on information which shows changes to the estimates of costs of remaining corrective or remedial action.

i. In the case where Respondent makes a request, the Department may contest the information or estimates provided by Respondent, but it will approve the adjustment if it agrees with Respondent's analysis. The parties agree to timely discuss divergent positions. The Department will notify Respondent of its adjustment and the basis for any denial no later 90 days after HDI's submittal request with supporting information.

ii. In the case where the Department seeks an adjustment on its own initiative, it will notify Respondent in writing and justify the basis of the adjustment. Respondent may contest the adjustment per Section XVII (Dispute Resolution). If Respondent does not contest the adjustment, it will update the financial assurance amount within 90 days of the Department's request. Despite the foregoing, if the estimated cost for corrective action or remedial action changes by less than [10%],Respondent shall have 24 months to perform corrective or remedial actions to bring costs in-line with the existing amounts of financial assurance, and Respondent will not be required to adjust the financial assurance during that time frame. If Respondent does not perform the required corrective or remedial actions during that 24-month period, it shall then update the financial assurance amount to meet the required adjustment.

C. Within sixty (60) days of the Effective Date of this Order and Settlement, Respondent will procure a Pollution Liability Insurance policy in the amount of $30M, which will remain in place and be renewed as needed by Respondent until issuance of a Satisfactory Completion Letter as set forth in Section VIII. Respondent will provide the Department with an advance copy of the insurance policy, for the Department's prompt review and approval. Following the completion of site investigations and the commencement of the work plans as described in Section III, the Department will also consider in good faith Respondent's reasonable request (with supporting information) to reduce the amount of coverage prior to issuance of the Satisfactory Completion Letter. The Department will notify Respondent of its decision no later than ninety (90) days after HDI's request with supporting information and the basis for any denial. The policy shall name "New York Department of Environmental Conservation" as an additional insured on the policy.

D. Respondent's agreement to post financial assurance and maintian insurance in Sections II(A) and (C) above satisfies the financial requirements found in 6 NYCRR Section 373-2.8(h).

E. While this Order and Settlement remains in effect, the financial assurance will remain in effect subject to adjustment as set forth in subsection II.B. above and subject to adjustment for inflation as provided for in 6 NYCRR §373-2.8(c)(2) and 373-2.8(e)(2).

III. <u>Initial Work Plan and future Work Plans at IPEC</u>

A. Within one hundred and fifty (150) days of the effective date of this Order and Settlement, Respondent shall submit for the Department's review and approval a "Scoping Work Plan, " which is a work plan that will describe the overall program of remedial investigation of areas at IPEC to be addressed in close coordination with NRC decommissioning efforts.

B. The Scoping Work Plan must summarize known environmental and sampling data at IPEC, include the schedule for investigation of discrete areas, and identify steps in order to fully understand the nature and extent of both radiological and non-radiological contamination (i.e., hazardous substances and petroleum) in soils, groundwater, and any other environmental media at IPEC. For additional clarity, with respect to radiological contamination, the Scoping Work Plan referenced in Section III, A. will include a schedule for completing radiological characterization and other related activities, however, any other Work Plan regarding radiological investigation or remediation (other than work plans developed under this Order and Settlement to achieve reductions from 25 to 10 mRem/yr) will be developed under NRC regulations using the MARSSIM process. As part of the final Scoping Work Plan, Respondent will certify that in compiling the plan and summarizing the data, it requested and exercised diligent, good faith efforts to review environmental records from the Sellers and their affiliates.

C. After approval and implementation of the Scoping Work Plan, other work plans will be proposed by Respondent for review and approval by the Department, under the procedures described in this Section, and those set forth in 6 NYCRR Part 375.

D. Any proposed Work Plan submitted under this Order and Settlement must be submitted for the Department's review and approval and must include, at a minimum, a chronological description of the anticipated activities, a schedule for performance of those activities, and sufficient detail to allow the Department to evaluate that Work Plan. Respondent may also submit requests to the Department for approval through email for incidental tasks or administrative issues not otherwise covered herein. During approval review, Respondent is able to continue work with the understanding that the work is being performed at risk. Notwithstanding the foregoing, Department understands schedule variances are expected throughout decommissioning and the Department will not unreasonably withhold approval of any proposed schedule change so as to impact the ability to implement it as requested. Other than providing notice to the Department, Respondent is not required to seek Department approval for schedule variances estimated to be less than sixty (60) days, which are (i) related to radiological cleanup performed under NRC oversight, or (ii) related to other cleanup subject to this Order and Settlement; and such schedule delays shall not be subject to penalties under Section XII.

E. <u>Types of Future Work Plans</u>: A “Work Plan” may take the following form:

1. “Remedial Investigation or Remedial Facility Investigation Work Plan” or “RIWP/RFIWP” – a work plan that provides for the investigation of the nature and extent of contamination at IPEC;

2. “Feasibility Study or Corrective Measures Study Work Plan” or “FSWP/CMSWP” – a work plan that evaluates remedial alternatives/corrective measure alternatives at IPEC or a portion of IPEC. This work plan will include a range of remedial/corrective measures, at least one of which must be remediation of the facility to “its original state” as required by Article 27, Title 9, of the ECL. Other remedial alternatives will take into consideration the reasonably anticipated reuse of IPEC or a portion of IPEC.

3. “Remedial Action Work Plan or Corrective Measure Implementation Work Plan” or “RAWP/CMIWP” – provides for the development and implementation of a remedial/corrective measure program for contamination at IPEC or a portion of IPEC, in compliance with a Department-issued SOB/ROD.

4. “Interim Remedial Measure or Interim Corrective Measure Work Plan” or “IRMWP/ICMWP” – provides for the implementation of an interim remedial/corrective measure at IPEC or a portion of IPEC; and

5. “Site Management Plan” or “SMP” – provides for the identification and implementation of institutional and/or engineering controls as well as any necessary monitoring and/or operation and maintenance of the remedy(ies) at IPEC.

6. “Supplemental” if an additional work plan other than those set forth above is required to be prepared or implemented, whether proposed by Respondent or requested by the Department.

F. <u>Review of Work Plans:</u>

The Department will make a good faith effort to review and respond in writing to each submittal Respondent make pursuant to this Order and Settlement within ninety (90) days. The Department’s response will include an approval, modification request, or disapproval of the submittal, in whole or in part.

1. <u>Approval of Work Plan</u>

Upon the Department's written approval of a Work Plan, such Department-approved Work Plan shall be deemed to be incorporated into and made a part of this Order and Settlement and shall be implemented in accordance with the schedule contained therein.

2. <u>Modification to Work Plan</u>

If the Department modifies or requests modifications to a submittal, it shall specify the reasons for such modification(s). Within thirty (30) days after the date of the Department's written notice that Respondent's submittal must be modified, Respondent must notify the Department in writing of its election in accordance with 6 NYCRR 375-1.6(d)(3). If Respondent elects to modify or accept the Department's modifications to the submittal, Respondent shall transmit a revised submittal that incorporates all of the Department's modifications to the first submittal in accordance with the time period set forth in 6 NYCRR 375-1.6(d)(3). In the event that Respondent's revised submittal is disapproved, the Department will set forth its reasons for such disapproval in writing and Respondent will be in violation of this Order and Settlement unless it invokes dispute resolution pursuant to Section XVII and its position prevails. Failure to make an election or failure to comply with the election is a violation of this Order and Settlement.

3. <u>Disapproval of Work Plan</u>

If the Department disapproves a submittal, it shall specify the reasons for its disapproval. Within thirty (30) days after the date of the Department's written notice that Respondent's submittal has been disapproved, Respondent shall notify the Department in writing of its election in accordance with 6 NYCRR 375-1.6(d)(4). If Respondent elects to modify the submittal, Respondent shall make a revised submittal that addresses all of the Department's stated reasons for disapproving the first submittal in accordance with the time period set forth in 6 NYCRR 375-1.6(d)(4). In the event that Respondent's revised submittal is disapproved, the Department shall set forth its reasons for such disapproval in writing and Respondent shall be in violation of this Order and Settlement unless it invokes dispute resolution pursuant to Section XVII and its position prevails. Failure to make an election or failure to comply with the election is a violation of this Order and Settlement.

G. Upon completion of the RIWP/RFIWP and submission of the applicable final report issued pursuant to Section VI, the Department will determine if one or more areas do not require further remedial or corrective action. The Department shall make such determination in writing within ninety (90) days of accepting the final report. The Department may request additional time for review, for good reason. Respondent understands that areas no longer subject to further remedial or corrective action may still be subject to other conditions that would need to be satisfied in order for such areas to be no longer subject to the terms of this Order and Settlement (i.e., specified site management or institutional controls).

H. The Department will notify Respondent in writing if the Department determines that any element of a Department-approved Work Plan needs to be modified in order to achieve the objectives of the Work Plan or to ensure that the corrective action/remedial program otherwise protects public health and the environment. Upon receipt of such notification, Respondent must, subject to dispute resolution pursuant to Section XVII, modify the Work Plan.

I. During field activities conducted under a Department-approved Work Plan, Respondent must have an on-site licensed and registered Professional Engineer, or an on-site representative that is directly supervised by a Professional Engineer, for activities involving hazardous waste or petroleum remediation.

J. Following partial site release, and assuming Respondent has not yet achieved the Department's requirements for radiological cleanup, whenever radiological field activities are occurring (meaning characterization, radiological material handling, remediation, and waste management), Respondent must have an on-site entity licensed by the DOH as a Decontamination and Decommissioning Health Physics Consultant (D&D consultant), or an entity recognized as meeting reciprocity requirements by the DOH.

K. A Professional Engineer, licensed, and registered in New York State, must sign, stamp and certify all Work Plans, Work Plan Reports, other reports (including any final engineering report), and design documents submitted in final form - all in accordance with 6 NYCRR 373-1.4(a)(5)(iv).Respondent should only undertake work required under this Order and Settlement pursuant to one or more approved Work Plans. However, Respondent may proceed to implement work while awaiting Departmental approvals on Work Plans or other determinations, upon notice to the Department, at its own risk. Such unapproved work could result in the imposition of penalties, corrective actions, or other enforcement against Respondent if the work violates the Department's regulations or the ECL. Furthermore, Respondent risks that the Department will require additional or re-implementation of work to the Department's standards at IPEC or a portion of IPEC upon its ultimate approval. For additional clarity, the foregoing is not meant to restrict or prohibit work regulated under the NRC's authority.

L. The work required under this Order and Settlement is extensive and is expected to take many years to complete. The Department agrees to provide flexibility, extensions of schedules, and other accommodations to Respondent based on legitimate and justifiable delays in progress or unforeseen changes in circumstances. Respondent can request extensions for notice/submittal deadlines set forth in this Order and Settlement, which the Department will not unreasonably withhold, condition, or delay.

IV. Citizen Participation Plan

A. Within (30) days of the Effective Date of this Order and Settlement, Respondent must submit for review and approval a written Citizen Participation Plan ("CPP") prepared consistent with the requirements of 6 NYCRR 375-1.10. Upon approval, the CPP will be deemed to be incorporated into and made a part of this Order and Settlement.

B. Respondent must cooperate with the Department and provide reasonable assistance, consistent with the CPP, in soliciting public comment on the work plans and reports identified for public comment in the CPP, proposed remedial action plans, and additional work plans and/or reports as the Department may require.

C. The CPP may need to be supplemented, modified, or updated as mutually agreed by Respondent and the Department with respect to the corrective measure/remedial action activities, site management activities, or decommissioning activities from time to time.

V. Department's Issuance of a SOB/ROD

A. Respondent must cooperate with the Department and provide reasonable assistance, consistent with their CPP discussed above, to solicit public comment on any proposed remedial action plans ("PRAPs") issued pursuant to a draft SOB/ROD at IPEC.

B. After the close of the public comment period on a PRAP, the Department will select the remedial action(s)/corrective measure(s) to be implemented by Respondent at IPEC or a portion of IPEC.

C. A final SOB/ROD will incorporate the appropriate soil cleanup objective (SCO) based on the factors in 6 NYCRR 375-1.8(f) and CP-51. The final SOB/ROD will also incorporate the 10 millirem per year guidance value in the Department's "Cleanup Guidelines for Soils Contaminated with Radioactive Materials" (DER-38).

D. Should contamination be discovered during corrective measure/remedial action work under this Order and Settlement, that was unknown and unexpected when the SOB/ROD was issued, Respondent must provide written notice to the Department, within timeframes required pursuant to applicable laws, but no later than within five (5) business days of the discovery. Discovery of unknown or unexpected contamination may include a tank, visibly stained soils, or surficially-scanned soils or groundwater, or unexpected or unique contamination in buildings or environmental media.

E. For the purposes of satisfying this notice requirement (in addition to any required spills reporting), Respondent may utilize the Department's Project Manager's electronic mail address and phone number. Should the Department then determine that the previously unknown contamination requires remediation, the scope of the required corrective measure/remedial action work will be expanded to include such newly-discovered contamination.

VI. <u>Submission of Final Reports and Periodic Reports:</u>

A. In accordance with the schedule to be contained in an approved Work Plan, or any subsequent schedule agreed to and approved by the Department, Respondent shall submit a draft final report for each Work Plan as provided at 6 NYCRR 375-1.6(b). Such draft final report shall contain all relevant data gathered and drawings and submittals made pursuant to such Work Plan, in an electronic format acceptable to the Department. If any document cannot be converted into electronic format, Respondent shall submit such document in an alternative format acceptable to the Department.

B. The Department will review the draft final report, and will make a good faith effort to provide comments or approve the draft final report within one hundred twenty (120 days) of the submittal of the draft final report.

C. Within sixty (60) days after the Department's approval of a final report, Respondent must submit such additional Work Plans as is reasonably required by the Department in its approval letter of such final report. Subject to Section XII, failure to submit additional Work Plans within such period will be a violation of this Order and Settlement.

D. Any final report or final engineering report that includes construction activities shall include “as built” drawings showing any changes made to the corrective measure/remedial design or the IRM/ICM.

VII. IPEC Facility Institutional Controls and Use

A. If the Department-approved SOB/ROD for IPEC relies upon one or more institutional and/or engineering controls, Respondent must submit to the Department for approval an Environmental Easement to run with the land in favor of the State which complies with the requirements of ECL Article 71, Title 36, and 6 NYCRR 375-1.8(h)(2). Upon acceptance of the Environmental Easement by the Department, Respondent must comply with the requirements of 6 NYCRR 375-1.8(h)(3).

B. Failure to cause such environmental easement to be recorded in accordance with 6 NYCRR 375-1.8(h)(2), will be a violation of this Order and Settlement and may result in the Department filing an Environmental Notice on the Site. If the Department files an Environmental Notice, Respondent will not be entitled to the satisfactory completion letter detailed in Section VIII of this Order and Settlement.

C. Respondent must notify the Department at least sixty (60) days in advance of any change of use, which is proposed for IPEC in accordance with the provisions of 6 NYCRR 375-1.11(d). For purposes of this Order and Settlement, “change of use” shall be as defined in 6 NYCRR 375-2.2(a). If the Department determines that the proposed change of use is prohibited, the Department will make a good faith effort to notify Respondent of such determination, with a reasonable basis for the determination, within forty-five (45) days of receipt of such notice.

VIII. Termination of Order and Settlement and Satisfactory Completion Letter

A. This Order and Settlement will terminate upon the Department’s written determination that Respondent has completed all phases of the corrective action/remedial program (other than site management) at IPEC, which Respondent anticipates will be at or near the time of “partial site release” from the NRC in its decommissioning process. Any site management for the ISFSI or as otherwise required under this Order and Settlement will remain in place until such time as the Department determines it is no longer necessary.

B. Such written determination will be in the form of a Satisfactory Completion Letter from the Department. Such Satisfactory Completion Letter will document that Respondent has completed its obligations under this Order and Settlement, including all necessary corrective/remediation actions, and that no further action (other than site management) is required to render IPEC (or a portion thereof) acceptable for the land use provided for in an SOB/ROD or Environmental Easement. Notwithstanding the foregoing, nothing in this Section shall limit the Department's ability under Section III.G. hereof to determine that one or more areas of IPEC do not require further remedial or corrective action and release such areas of IPEC from coverage under this Order and Settlement.

C. Notwithstanding the foregoing, the provisions contained in Section XIV shall survive the termination of this Order and Settlement.

IX. Public Notice & Transfer Requirements

A. Within thirty (30) days after the effective date of this Order and Settlement, Respondent must provide notice consistent with the requirements set forth in 6 NYCRR 375-1.5(a). Within sixty (60) days of such submission, Respondent must provide the Department with a copy of such instrument certified by the recording officer to be a true and faithful copy.

B. Upon sale of IPEC to Purchaser, the Owners, or another entity that purchases IPEC or any portion of IPEC, shall sign a "Consent of Owner" attached as Exhibit B, which will require Owners to comply with all of the provisions of this Order and Settlement, in the same manner as Respondent is bound.

C. Respondent (and Owners thereafter) shall not transfer by sale or by lease the whole or any part of its interest in IPEC without giving the Department at least one hundred and eighty (180) days prior notice. No transfer in ownership, management, or operation of IPEC, or any portion thereof, shall relieve Respondent or Owners or their managers, officers, directors, agents, successors, assigns, heirs, and/or servants of any obligation under this Order and Settlement, unless:

1. The proposed transferee[2] agrees, in writing, to undertake the obligations required by this Order and Settlement and to be substituted for Respondent,

2. The proposed transferee obtains all necessary NRC approvals for license transfer, permit, or other required authorizations, if applicable,

3. The proposed transferee maintains all required financial assurance and liability insurance set forth in Section II at the time of transfer and any financial assurance and liability insurance required into the future, and

4. The proposed transferee maintains all required site management until the Department determines it is no longer necessary and completed.

D. The notice required in this Section must be in writing, and identity the transferee and of the nature and proposed, or actual, date of the conveyance, and must notify the transferee in writing, with a copy to the Department, of the applicability of this Order and Settlement.

E. The restrictions and requirements set forth in Section IX, A-D are not meant to apply to leases for (i) use of some or all of the administration building or training center,

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[2] Any entity that leases, owns, or exerts operational control of IPEC or a portion of IPEC.

or (ii) other short-term leases of one year or less for a portion of the site, provided in all cases the lessee is not expected to cause adverse material environmental impacts to the site. Respondent will provide notice to the Department of such leases, as soon as reasonably possible.

X. Entry Upon IPEC facility and State Costs

A. Respondent hereby consents, upon reasonable notice and safety preparation to allow an authorized representative of the Department to visit IPEC for purposes of observing and inspecting major work activities, obtaining samples and reviewing/copying records (not related to personnel or business confidential information) related to contamination, testing, and any other activities reasonably necessary to ensure Respondent's compliance with this Order and Settlement. The Department's representative shall present appropriate identification and shall abide by access, health, and safety rules in effect for IPEC. Review and copying of documents may also be subject to confidentiality restrictions to protect proprietary information. Respondent will clearly identify what it believes constitutes proprietary or confidential business information. Access to confidential business information would be limited to appropriate Department staff and any consultants assisting the Department with oversight, monitoring, etc. will enter into appropriate confidentiality agreements with HDI. Further, the Department's safety representative shall undertake reasonable efforts to minimize disruptions to work activities unless for immediate safety-related concerns.

B. To facilitate the Department's role in monitoring decommissioning activities, obtaining samples, and monitoring Respondent's compliance with the ECL and this Order and Settlement, Respondent agrees to reimburse the Department's costs as detailed in Section XI.

C. Upon request and at least five (5) business days advance notice, Respondent shall (i) provide the Department with suitable workspace at the IPEC facility including access to a telephone, to the extent available and (ii) permit the Department full access to non-privileged records relating to matters addressed by this Order and Settlement. Raw data related to testing, sampling, radiological surveying, and other environmental monitoring is not considered privileged and that portion of any privileged document containing raw data must be provided to the Department. In the event Respondent is unable to obtain any authorization from third-party property owners necessary to perform its obligations under this Order and Settlement (e.g., accessing NYSERDA-owned real property), the Department may, consistent with its legal authority, assist in obtaining such authorizations.

XI. Payment of State Costs

A. In consideration of the Department's and the New York State Department of Health's ongoing monitoring and other costs related to IPEC, Respondent agrees to provide the Department with annual funding as follows:

- An annual amount that will not exceed $300,000.
- The annual funding estimate not to exceed $300,000 will be updated annually for inflation at 1% for the Department's first ten (10) fiscal years following the effective date of this Order and Settlement.
- The Department and the Department of Health may employ contractors or consultants to perform the oversight required by this Order and Settlement, and the Department may provide those invoices to Respondent as laid out below, which would reimbursed up to the annual cap number of $300,000 plus inflation. Contractor costs shall be in line with industry norms.

B. After incurring costs, the Department will provide Respondent invoices representing the costs of monitoring IPEC and the costs of ensuring fulfillment and compliance with this Order. Respondent will make the required payment within forty-five (days) after receipt of an invoice from the Department. Failure to timely pay any undisputed invoice will be subject to interest at a rate of 9% from the date the payment is due until the date the payment is made.

C. Invoices to Respondent will be sent electronically, if possible, to the following address:

accountspayable@holtec.com

with a copy to:

Holtec Decommissioning International, LLC
Attn: Vice President Regulatory and Environmental Affairs
1 Holtec Blvd.
Camden, NJ 08104

Each such payment must be made payable to the New York State Department of Environmental Conservation and shall be sent to:

New York State Department of Environmental Conservation
Division of Management & Budget, 10th Floor
625 Broadway
Albany, NY 12233-4900

D. Each party shall notify the other within thirty (30) days after any change in the addresses listed in this Section.

XII. Penalties

A. Subject to the provisions below regarding Force Majeure Events, Respondent's failure to comply with any material term of this Order and Settlement constitutes a violation of this Order and Settlement and the ECL. If the Department determines that Respondent has failed to materially comply with this Order and Settlement, the Department will notify Respondent in writing, specifying such noncompliance and giving Respondent a reasonable opportunity to cure before any penalties are imposed. Such cure period shall not be less than thirty (30) days from the date Respondent receives the Department's notice. Payment of any penalty shall not in any way alter Respondent's obligation to comply with any term of this Order and Settlement or to complete performance under the terms of this Order and Settlement. The payment of penalties as set forth below will not limit the Department's right to seek such other relief as may be authorized by law. Nothing herein abridges Respondent's right to contest any allegation that it has failed to comply with this Order and Settlement.

B. Civil and administrative sanctions: As provided by ECL §71-2705, the civil penalty for failing to comply with the requirements of this Order and Settlement shall not exceed thirty-seven thousand five hundred dollars ($37,500), with additional penalty of not more than thirty-seven thousand five hundred dollars ($37,500) for each day during which such violation continues. In the case of a second and any further violation, the liability is for a civil penalty not to exceed seventy-five thousand dollars ($75,000) for each such violation, with additional penalty not to exceed seventy-five thousand dollars ($75,000) for each day during which that violation continues.

C. Any penalty assessed pursuant to the terms and conditions of this Order and Settlement must be paid by submitting a certified or cashier's check or money order, payable to the Department of Environmental Conservation, to: Andrew Guglielmi, Esq., Department of Environmental Conservation, Office of General Counsel, 625 Broadway, Albany, New York 12233-1500. Unpaid and undisputed penalties imposed by this Order and Settlement will be subject to interest at the rate of 9 percent per annum for each day the penalty, or any portion thereof, remains unpaid. Payments received will first be applied to accrued interest charges and then to the unpaid balance of the penalty.

D. Default of Payment: The penalties assessed pursuant to the Order and Settlement constitutes a debt owed to the State of New York. Failure to pay the assessed penalty or any part thereof may result in referral to the New York State

Attorney General for collection of the entire amount owed (including the assessment of interest, and a charge to cover the cost of collecting the debt), or referral to the New York State Department of Taxation and Finance, which may offset any tax refund or other monies owed by the State of New York by the penalty amount.

XIII. Force Majeure

A. Respondent shall not suffer any penalty or be subject to any proceeding or action in the event it cannot comply with any requirement of this Order and Settlement as a result of any event arising from causes beyond the reasonable control of Respondent, of any entity controlled by Respondent, and of Respondent’s contractors, that delays or prevents the performance of any obligation under this Order and Settlement despite Respondent's efforts to fulfill the obligation, such as where the failure is a result of acts of God, work stoppages due to labor disputes or strikes, fires, explosions, epidemics, pandemics, riots, war, rebellion, sabotage or any other condition which was not caused by the negligence or willful misconduct of Respondent and which could not have been avoided by the Respondent through the exercise of due care ("Force Majeure Event").

B. The requirement that Respondent exercise efforts to fulfill the obligation includes using efforts to anticipate the potential Force Majeure Event, efforts to address any such event as it is occurring, and efforts following the Force Majeure Event to minimize delay to the greatest extent possible. As referenced above, Respondent’s efforts to fulfill its obligations includes using diligent, good faith actions to anticipate the potential Force Majeure event and minimize delays to the extent reasonably possible. "Force Majeure" does not include Respondent’s economic inability to comply with any obligation; failure to perform work due to obligations in other states or with respect to other agreements with state or federal governments; the failure of Respondent to make, complete, or timely file an application for any required approval or permit; and non-attainment of the goals, standards, and requirements of this Order and Settlement (unless the non-attainment is caused by the Force Majeure Event).

C. Respondent must notify the Department as soon as practicable by email or other writing, but in any event no later than fifteen (15) days after it obtains knowledge of any Force Majeure Event. Respondent must, as applicable, include in such notice the measures taken and to be taken to prevent or minimize any delays and shall request an appropriate extension or modification of this Order and Settlement. Failure to give such notice within such fifteen (15) day period constitutes a violation of the Order and Settlement and is a waiver of any claim that a delay in not subject to penalty. Respondent shall be deemed to know of any circumstance that it, any entity controlled by it, or its contractors knew or should have known by exercise of reasonable diligence.

D. Respondent shall have the burden of proving, by a preponderance of the evidence, that (i) the delay or anticipated delay has been or will be caused by a Force Majeure Event; (ii) the duration of the delay or the extension sought is supported by the circumstances; (iii) efforts were exercised to avoid and mitigate the effects of the delay; and (iv) Respondent complied with the requirements of Section XIII(C) regarding timely notification.

E. If the Department agrees that the delay or anticipated delay is attributable to a Force Majeure Event, the time for performance of the obligations that are affected by the Force Majeure Event shall be extended for such time as is reasonably necessary to complete those obligations.

F. If the Department rejects Respondent's assertion that an event provides a defense to non-compliance with this Order and Settlement, Respondent will be in violation of this Order and Settlement unless it invokes dispute resolution pursuant to Section XVII and Respondent's position prevails.

XIV. Reservation of Rights

A. Nothing contained in this Order and Settlement shall be construed as barring, diminishing, adjudicating or in any way affecting (i) any legal, administrative or equitable rights or claims, actions, suits, causes of action or demands whatsoever that the Department may have against anyone other than Respondent; (ii) any right of the Department to enforce administratively or at law or in equity, the terms, provisions and conditions of this Order and Settlement; (iii) any right of the Department to bring any future action, either administrative or judicial, for natural resource damages, or for any other violations of the ECL, the rules and regulations promulgated thereunder, or conditions contained in orders or permits, if any, issued by the Department to Respondent; (iv) the summary abatement powers of the Department, either at common law or as granted pursuant to statute or regulation.

B. Except as otherwise provided in this Order and Settlement, Respondent reserves all rights and defenses under applicable law regarding remedial liability and/or natural resource damages and further reserves all rights respecting the enforcement of this Order and Settlement, including the rights to notice, to be heard, to appeal, and to any other due process.

XV. Indemnification

To the fullest extent permitted by law, Respondent shall indemnify and hold the Department, the Commissioner, the State of New York, and their representatives and employees harmless for all claims, suits or actions for personal injury or property damage and costs, arising out of, or resulting from, Respondent's fulfillment or attempted fulfillment of this Order and Settlement, except for those claims, suits, actions and costs arising from the gross negligence or willful or intentional misconduct by the State of New York and/or its representatives and employees during the course of any activities conducted pursuant to this Order and Settlement.

XVI. Progress Reports and Communications

A. In addition to any reports required by individual work plans approved pursuant to this Order and Settlement, Respondent must provide monthly reports to the parties identified in this Section.

B. The monthly reports are to be submitted on or before the last business day of the month in question, with the first submission by the end of the first full month following the Effective Date of this Order and Settlement.

C. All monthly reports must, at a minimum, include a description of the following: safety record, status of major activities (e.g., reactor segmentation, building demolition, spent nuclear fuel loading, waste management), project schedule, project budget (including a comparison of budgeted costs against actual costs), and regulatory compliance. Department acknowledges that the monthly reports will typically report on progress through the end of the preceding month.

D. Following the submission of each monthly report, the Department may request that one or more members of Respondent's team be made available at a mutually agreeable time and place (which may be in-person or by teleconference or videoconference) to answer any questions the Department may have about the report, and Respondent must comply with such requests.

E. Communications

1. All written communications required by this Order and Settlement shall be transmitted by electronic transmission whenever possible, including e-mail.

2. Communication from Respondent to the Department shall be sent to:

Lynn Winterberger
NYS Department of Environmental Conservation
Division of Materials Management
625 Broadway
Albany, NY 12233-7256
lynn.winterberger@dec.ny.gov

Timothy Rice
NYS Department of Environmental Conservation
Division of Materials Management
625 Broadway
Albany, NY 12233-7255
timothy.rice@dec.ny.gov

With copies to:

Andrew Guglielmi, Esq.
NYS Department of Environmental Conservation
Office of General Counsel
625 Broadway
Albany, NY 12233-1500
andrew.guglielmi@dec.ny.gov

Cynthia A. Costello, MS, MPH, CHP
Chief, Environmental Radiation/Radon Section
NYS Department of Health
Bureau of Environmental Radiation Protection
Corning Tower, Room 1218
Empire State Plaza
Albany, NY 12237
Phone (518) 402-7556
cynthia.costello@health.ny.gov

3. Communication from the Department to Respondent shall be sent to:

Holtec Decommissioning International, LLC
Attn: Andrea L. Sterdis, Vice President Regulatory and Environmental Affairs
1 Holtec Blvd.
Camden, NJ 08104
a.sterdis@holtec.com

Holtec Decommissioning International, LLC
Attn: Katherine L. Perkins, Esq.
1 Holtec Blvd.
Camden, NJ 08104
k.perkins@holtec.com

F. The Department and Respondent reserve the right to designate additional or different addressees for communication on written notice to the other.

G. Each party shall notify the other within thirty (30) days after any change in the addresses listed in this Section.

H. The Department has implemented an Environmental Information Management System (EIMS). The EIMS requires that electronic data be provided in specific formats. In an effort to better manage environmental data, the Department requests that Respondent make reasonable efforts to provide data submissions in a Department-accepted Electronic Data Deliverable (EDD) format. Respondent shall make reasonable efforts to supply Work plans and reports (including all attachments and appendices) required by the Order and Settlement in an accessible electronic format. Respondent may instead provide the Department with a paper copy if difficulties in providing the submittals through the EIMS are encountered. The Department reserves the right to request that Respondent provide a paper copy of any Work Plan or report.

XVII. <u>Dispute Resolution</u>

A. In the event a dispute arises under this Order and Settlement, the parties will first undertake to resolve such dispute through informal negotiations. Respondent may commence this negotiation by sending the Department written notice describing the objection(s) in reasonable details. Within fifteen (15) days of receipt of the notice, the parties shall commence good faith discussions at a mutually agreeable time and place.

B. If the dispute is not resolved within thirty (30) days of the date of the meeting described above, Respondent may, initiate formal dispute resolution in accordance with the provisions of 6 NYCRR 375-1.5(b)(2).

C. All costs incurred by the Department associated with dispute resolution are State costs subject to reimbursement (and subject to the “do not exceed” figure in Section XI above) pursuant to this Order and Settlement.

D. Nothing contained in this Order and Settlement shall be construed to authorize Respondent to invoke dispute resolution with respect to any remedy selected by the Department in the SOB/ROD, or any element of such remedy, nor to impair any right of Respondent to seek judicial review of the Department's selection of any remedy. As used herein, "remedy" means the technical approach to address contamination subject to RCRA (or New York's analogous regulations).

E. With respect to disputes relating to State costs the provisions of 6 NYCRR 375-1.5 (b)(3) apply.

XVIII. <u>Modifications</u>

A. The terms of this Order and Settlement constitute the complete and entire agreement between Department and Respondent with respect to the matters contained herein. No term, condition, understanding, or order purporting to modify or vary any term of this Order and Settlement shall be binding unless made in writing and signed by both parties.

B. No informal advice, guidance, suggestion, or comment by the Department regarding any report, proposal, plan, specification, schedule, or any other submissions shall be construed as relieving Respondent of their obligation to obtain such formal approvals as may be required by this Order and Settlement.

C. If Respondent desires that any provision of this Order and Settlement be changed, Respondent must make timely written application to the Department setting forth reasonable grounds for the relief sought. Respondent has the burden of proving entitlement to any modification requested. Copies of such written application shall be sent to the New York State Department of Environmental Conservation at the addresses provided in Section XVI(E).

D. Respondent's request for modification shall not be unreasonably denied by the Department, which may impose such additional conditions upon Respondent as the Department deems appropriate. Notwithstanding the foregoing, if Respondent seeks to modify an approved Work Plan, a written request must be made to the Department's project manager, with copies to the parties listed in Section XVI(E).

E. No change or modification to this Order and Settlement shall become effective except as specifically set forth in writing and approved by the Commissioner or a duly authorized representative.

XIX. Tolling Agreement

Any time limitations set forth in Section 113(g)(1) of CERCLA, as amended, 42 U.S.C. § 9613(g)(1), Section 1012(h)(2) of the Oil Pollution Act, as amended, 33 U.S.C. § 2712(h)(2), the Federal Water Pollution Control Act, the New York Navigation Law, the New York Environmental Conservation Law, or any other federal or state statute or regulation with respect to potential claims for natural resource damages against Respondent or any other time limitations for the filing of potential natural resource damages claims against Respondent under any other applicable state or federal law are tolled in their entirety until termination of this Order and Settlement. This tolling agreement shall not serve to revive any claims that are untimely as of the effective date of this Order and Settlement.

XX. Permits

Permits issued by the Department and currently held by Seller shall be transferred to Purchaser or its designees as described in the letter attached hereto as Exhibit D.

XXI. Miscellaneous

A. Respondent shall retain (as employees or contractors) qualified professional consultants, engineers, contractors, laboratories, quality assurance/quality control personnel, third party data validators, and ELAP[3] Certified Analytical Laboratories to perform the technical, engineering, and analytical obligations required by this Order and Settlement. The Department may object to Responent using certain persons or firms and Respondent agrees to undertake good faith efforts to find a replacement. If no qualified replacment is available, Respondent will consult Departmnet about alternatives.The responsibility for the performance of the professionals retained by Respondent rests solely with Respondent.

B. The Department has the right to obtain split samples, duplicate samples, or both, of all substances and materials sampled by Respondent, and the Department also has the right to take its own samples. Respondent must make available to the Department the results of all sampling and/or tests or other data generated by Respondent with respect to implementation of this Order and Settlement and must submit these results in the progress reports required by this Order and Settlement. Respondent has the right to obtain split samples, duplicate samples, or both of all substances and materials sampled by the Department, and the Department will promptly make available to Respondent the results of all sampling, tests or other data generated by the Department with respect to this Order and Settlement.

C. Respondent must obtain all permits, easements, rights-of-way, rights-of-entry, approvals, or authorizations necessary to perform Respondent's obligations under this Order and Settlement.

D. Notwithstanding Section IX above, if there are multiple parties signing this Order and Settlement the obligations of each party under this Order and Settlement are joint and several, and the insolvency of or failure by any Respondent to implement any

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[3] The Environmental Laboratory Accreditation Program (ELPA) was established in 1984 under NYCL, Public Health Law - PBH § 502 and is responsible for the certification of laboratories performing environmental analyses on samples originating from New York State.

obligations under this Order and Settlement shall not affect the obligations of the remaining Respondent under this Order and Settlement.

E. The provisions, terms, and conditions of this Order and Settlement shall be deemed to bind Respondent and Respondent's heirs, legal representatives, receivers, trustees in bankruptcy, successors, and assigns.

F. Subject to Section IX, any change in ownership including, transfer of assets orreal property at IPEC shall in no way alter Respondent's responsibilities under this Order and Settlement.

G. Respondent is responsible for ensuring that its contractors and subcontractors perform the work in satisfaction of the requirements of this Order and Settlement.

H. All references to "days" in this Order and Settlement are to calendar days unless otherwise specified.

I. The Section headings set forth in this Order and Settlement are included for convenience of reference only and shall be disregarded in the construction and interpretation of any of the provisions of this Order and Settlement.

J. The Effective Date of this Order and Settlement shall be the later of the date that the Commissioner or his designee signs this Order and Settlement or the date the Transaction closes. The Department will provide Respondent (or Respondent's counsel) with a fully executed electronic copy of this Order and Settlement as soon as practicable after the Commissioner or his designee signs it.

K. In the event of an inconsistency between the provisions of any attachment or appendix of this Order and Settlement and any term, condition, or provision contained in Sections I through XX of this Order and Settlement, the term, condition, or provision contained in that Section, and not that in any attachment or appendix of this Order and Settlement, shall control.

L. Respondent and Respondent's corporate successors and assigns hereby affirmatively waive any right they had, have, or may have to make a claim against the New York environmental protection and spill compensation fund, pursuant to New York

State Navigation Law, Article 12, Part 3, Sections 179 and 179-A.

M. This Order and Settlment may be executed in one or more counterparts, each of which shall be deemed an original, but all of which shall together constitute one and the same instrument. Electronic signatures are acceptable.

N. Service of a duly executed copy of this Order and Settlement upon Respondent's counsel by electronic mail, shall be deemed good and sufficient service.

[Signatures Follow]

DATED: April 14, 2021

Albany, New York

Commissioner
New York State Department of
Environmental Conservation

By: ______________________

Basil Seggos
Commissioner

CONSENT BY RESPONDENT

Respondent Holtec Decommissioning International, LLC hereby consents to the issuing and entering of this Order and Settlement, waives its right to a hearing herein as provided by law, and agree to be bound by this Order and Settlement.

By: Andrea L Sterdis

Name: Andrea L. Sterdis

Title: Vice President Regulatory and Environmental Affairs

Date: April 14, 2021

STATE OF NEW JERSEY)
) s.s.:
COUNTY OF CAMDEN)

On this 14th day of April, 2021, before me personally came Andrea L. Sterdis, to me known, who being duly sworn, did depose and say that she is the Chief Operating Officer of Holtec Decommissioning International, LLC, the limited liability company (Respondent) described herein and that he/she is authorized by the governing body of said Corporation to sign on behalf of the Corporation, and that he/she did sign the foregoing instrument on behalf of, and with the authority to bind, said Corporation.

Erika Grandrimo

Notary Public

Erika Grandrimo
NOTARY PUBLIC
STATE OF NEW JERSEY
MY COMMISSION EXPIRES January 17, 2022

EXHIBIT "A"

Map of IPEC subject to this Order and Settlement

EXHIBIT A

Indian Point Energy Center

Notes:

1. Property boundary locations are approximate, and do not necessarily represent the limits of the required extent of investigation or remediation. If site-related contamination is discovered during investigatory activities at or near the boundaries, the Department may require further investigation beyond the boundary to confirm corrective actions are required in those areas.
2. Indian Point Energy Center boundaries adjacent to the Hudson River coincide with the approximate high-water line.

EXHIBIT A

Indian Point Energy Center

3. The boundary line for the ISFSI is the anticipated fence line after expansion.
4. The dark blue line is the approximate location of property owned by the State of New York through the New York State Energy Research and Development Authority (NYSERDA), and represents the discharge canal and associated property currently leased by Entergy from NYSERDA. This property will be subject to further refinement and survey, as investigatory actions progress.

EXHIBIT "B"

CONSENT OF OWNER

The party executing this form, __________, hereby consents to being added as a Respondent to the Order on Consent and Administrative Settlement, Index No. _______ regarding the Indian Point Energy Center, and further consents to the issuing and entering of the referenced Order and Settlement, waives Respondent's right to a hearing herein as provided by law, and agrees to be bound by this Order and Settlement.

By: ________________________________

Title: __________________________________

Date: __________________________________

STATE OF NEW YORK)
) s.s.:
COUNTY OF)

On the _______ day of _________, in the year 20 __, before me, the undersigned, personally appeared _________, personally known to me or proved to me on the basis of satisfactory evidence to be the individual(s) whose name is (are) subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their capacity(ies), and that by his/her/their signature(s) on the instrument, the individual(s), or the person upon behalf of which the individual(s) acted, executed the instrument.

____

Signature and Office of individual taking acknowledgment

EXHIBIT "C"

Correspondence regarding prior orders

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Office of the General Counsel
625 Broadway, 14th Floor, Albany, New York 12233-1500
P: (518) 402-9185 | F: (518) 402-9018
www.dec.ny.gov

April 9, 2021

Peter C. Trimarchi, Esq.
Partner
Nixon Peabody LLP | 677 Broadway, 10th Floor
Albany, NY 12207-2996

ptrimarchi@nixonpeabody.com

Re: Close out of Indian Point Consent Orders with Entergy

Dear Mr. Trimarchi –

This letter is sent to confirm that Entergy Nuclear Indian Point 2, LLC and Entergy Nuclear Indian Point 3, LLC (collectively “Entergy”) have complied with the Consent Orders issued by the Department of Environmental Conservation (DEC) to date regarding the Indian Point Energy Center.

These Consent Orders include a 2011 mixed waste order, and a 2011 and 2015 enforcement order relating to releases from equipment, including transformers at the Indian Point Entergy Center. Specifically, Entergy has transported and disposed of the known mixed waste present which was required to be disposed of in the 2011 mixed waste order and Entergy paid the required penalties and damages and took whatever corrective actions were necessary arising from releases related to the 2011 and 2015 enforcement orders. DEC considers these orders closed.

Please note that Entergy has ongoing obligations related to the 2017 agreement between New York State and Entergy (which required the wind down and cessation of nuclear power operation of Indian Point) regarding monitoring and environmental benefit projects that New York and others are administering.

Additionally, please note that nothing in this letter waives rights that DEC may have against Entergy, Holtec, or any other party that are available under applicable law.

Sincerely,

Andrew Guglielmi

Andrew Guglielmi

Chief, Bureau of Remediation

EXHIBIT "D"

Correspondence regarding permit transfers

NIXON PEABODY

NIXON PEABODY LLP
ATTORNEYS AT LAW

NIXONPEABODY.COM
@NIXONPEABODYLLP

Peter C. Trimarchi
Partner
T 518-427-2671
ptrimarchi@nixonpeabody.com

677 Broadway, 10th Floor
Albany, NY 12207-2996
518-427-2650

April 8, 2021

VIA EMAIL

Christopher Hogan
Chief, Bureau of Energy Projects Management
NYS Department of Environmental Conservation
625 Broadway, 14th Floor
Albany, NY 12233-1500

Andrea L. Sterdis
Vice President Regulatory and Environmental Affairs
Holtec Decommissioning International
Krishna P. Singh Campus
1 Holtec Boulevard
Camden, NJ 08104

RE: Indian Point Energy Center - Transfer of SPDES Permits (0004472, 0234826, 0250414), 401 Water Quality Certificate, Air State Facility Permits (#3-5522-00011/00026), and Major Oil Storage Facility License (3-2140), Water Withdrawal Permit application and Endangered Species Permit application (the "DEC Permits")

Dear Chris:

As you are aware, Holtec International, Nuclear Asset Management Company, LLC, Entergy Nuclear Indian Point 2, LLC ("ENIP 2") and Entergy Nuclear Indian Point 3, LLC ("ENIP 3") signed an agreement in 2019 by which Nuclear Asset Management Company, LLC (a subsidiary of Holtec International) ("NAMco") would acquire ownership of the Indian Point Energy Center (the "Transaction"). This letter is intended to memorialize the agreement between the New York State Department of Environmental Conservation ("DEC"), the Entergy entities identified as permittees under the above-referenced DEC Permits and applications (collectively, "the DEC Permits"), Holtec International, and NAMco regarding the procedures for transferring the DEC Permits following the closure of the sale of the Indian Point Entergy Center.

As we have discussed, Entergy Corporation is in the process of undertaking an internal restructuring, which has resulted in the creation of two new Entergy subsidiaries – Indian Point 1&2 LLC and Indian Point 3 LLC (the "New Entergy Subsidiaries"). Prior to the closing of the Transaction, Entergy Corporation will have transferred the assets and liabilities of ENIP 2 and ENIP 3 to the New Entergy Subsidiaries. NAMco will then acquire the membership interests of the New Entergy Subsidiaries upon the closing of the Transaction. To complete the transfer of the DEC Permits, DEC, ENIP 2, ENIP 3, and Holtec International/NAMco agree that the parties will each take the following actions:

- No less than 30 days prior to the anticipated closing date of the Transaction, ENIP 2, ENIP 3, and, as necessary, Entergy Nuclear Operations Inc. ("ENOI") will submit separate permit transfer requests for each of the DEC Permits on DEC form "Application for Permit Transfer and Application for Transfer of Pending Application." The forms will identify ENIP 2, ENIP 3, and/or ENOI as the "Transferor," and the New Entergy Subsidiaries as the "Transferee." ENIP 2, ENIP 3, and ENOI will submit the forms to you and to the Regional Permit Administrator in Region 3.
- Upon Entergy's completion of the transfer of assets and liabilities of ENIP 2 and ENIP 3 to the New Entergy Subsidiaries, Entergy will notify DEC that the transfer has taken place.
- Upon receipt of such notice, DEC will immediately (i.e., same day) provide to ENIP 2, ENIP 3, ENOI, and the New Entergy Subsidiaries a copy of the Application for Permit Transfer and Application for Transfer of Pending Application that has been fully approved and counter-signed by DEC.
- Upon completion of the closing of the Transaction (expected to be completed 24 hours after the transfer of assets and liabilities to the New Entergy Subsidiaries has been completed), NAMco will provide notice to DEC that the closing has occurred.

The New Entergy Subsidiaries will be subsidiaries of Entergy until the closing of the Transaction, at which point they will become subsidiaries of NAMco. In the unlikely event a permit violation was to occur following the transfer of the assets and liabilities to the New Entergy Subsidiaries, but before closing (a situation that would seem unlikely given that Unit 3 will be shut down at that point), the New Entergy Subsidiaries would be responsible for such violations as the permittees on the DEC Permits.

If this letter accurately sets forth your understanding of the parties' intentions and agreements with respect to the transfer of the DEC Permits, please sign the acknowledgment below and forward a copy to my attention at your earliest convenience.

Thanks very much for your assistance and cooperation in this matter.

Respectfully submitted,

Peter C. Trimarchi
Counsel for Entergy Corporation

PCT/kmp

NIXON PEABODY LLP
ATTORNEYS AT LAW

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cc: Mark Sanza, Esq.
Gene Kelly, Esq. (Counsel for Holtec International)
Andrea Sterdis (Holtec International)
Susan Floyd, Esq. (Senior counsel for Entergy)
Carlos Garcia (Entergy)
Anthony DeNully (Entergy)

Acknowledged and agreed to by the NYS Department of Environmental Conservation

Christopher M. Hogan

Name: Christopher M. Hogan
Title: Chief, Bureau of Energy Project Management
Date: April 8, 2021

Acknowledged and agreed to by Nuclear Asset Management Company, LLC

Andrea Sterdis

Digitally signed by Andrea Sterdis
DN: cn=Andrea Sterdis, c=US, o=Holtec Decommissioning International, ou=HDI, email=a.sterdis@holtec.com
Date: 2021.04.13 11:21:08 -04'00'

Name: Andrea L. Sterdis
Title: VP Regulatory and Environmental Affairs
Date: April 13, 2021

APPENDIX E

Key Personnel Qualifications

RICHARD E. WETHERBEE, PG, PMP

EDUCATION

M.A., Hydrogeology, Boston University, 1995

B.A., cum laude, History, Geology minor, Boston University, 1994

PROFESSIONAL REGISTRATIONS/CERTIFICATIONS

Professional Geologist, New York (#935), 2018

Registered Geologist, Missouri (#2011012934), 2011

Licensed Professional Geologist, Illinois (#196001413), 2015

Project Management Professional (PMP) Certification, 2016

AREAS OF EXPERTISE

Mr. Richard E. Wetherbee, PMP, has program management and technical experience in the following general areas:

- Project Management
- Power Plant Decommissioning and Demolition
- Environmental Assessments and Audits
- Remedial Investigation Work Plan Preparation and Implementation

REPRESENTATIVE EXPERIENCE

A proven operational team leader and business program developer, Mr. Wetherbee has 25 years of technical and management experience for power generation, state/local, and commercial clients in engineering, planning, environment, infrastructure, and development. Mr. Wetherbee is an excellent communicator able to relate complex technical concepts to diverse stakeholders.

Mr. Wetherbee's background includes extensive service to power generation clientele, including American Electric Power; Associated Electric Cooperative, Inc.; Consolidated Edison of New York; Exelon Generation; and South Texas Electric Cooperative. He has managed large, complex projects, including site investigations, site assessments, engineering design, and construction projects, as well as performed site management, and operations and maintenance assignments. His qualifications include project scoping, budgeting, management, implementation, reporting, health and safety, and close-out of large-scale, multi-faceted projects. Mr. Wetherbee's project management experience includes strategic planning, program development, resource management, and project team mentoring. Financial experience includes competitive bids, cost proposals, budget management, and invoicing.

He currently serves in the capacity of National Director of TRC's RE POWER® Program with responsibility for the technical, financial, and administrative aspects of multiple decommissioning projects.

Exelon Power, RE POWER™ Playbooks, Richmond Steam Generating Station, Philadelphia Cromby Station – Phoenixville, PA, and New Boston Station – South Boston, MA

Project Manager and primary author for the RE POWER™ Playbooks for three Exelon generating stations. The 732 MW Richmond Steam Generating Station was constructed in 1924 and consisted of 12 boilers. Richmond ceased operations in 1985 and has been mothballed for more than 25 years. The 350

MW Cromby Station was constructed in the mid-1950s and consisted of two boilers. Cromby was retired in 2011 and has been decommissioned. New Boston Station's oil-fired Units 1 and 2 were constructed in the mid-1960s and generated a combined 700 megawatts. Units 1 and 2 ceased operations in 2007 and 2002, respectively. Current generation capacity at New Boston consists of one 20 MW oil-fired peaking unit. The RE POWER™ Playbooks identify the plant-specific concerns associated with site redevelopment, including health and safety; structural safety; regulated and hazardous materials; asset valuation; abatement and demolition means and methods; environmental liabilities; utilities; and community relations, as well as the range of associated costs. Using the results of the Playbook, coupled with additional detailed studies, TRC supported Exelon's sale of the New Boston Station for $24 MM earlier this year.

American Electric Power, RE POWER™ Playbooks, Picway Plant – Lockbourne, OH, and Kanawha River Plant – Glasgow, WV

Managed TRC's interdisciplinary team and was the primary author of TRC's RE POWER™ Playbooks for two AEP coal-fired plants located in Ohio and West Virginia. Playbooks are engineering and environmental studies that identify the plant-specific issues that drive the scope of decommissioning, cost, and schedule. Responsibilities also included identification of health and safety issues and compliance with facility requirements, constraints on abatement means and methods, and development of a community relations plan.

Associated Electric Power Cooperative, Inc., Engineering Services for Chamois Power Plant – Chamois, MO

Project Manager for the engineering services in support of the decommissioning, decontamination, and demolition (DDD) of the 73 MW Chamois Power Plant, which ceased operations in September 2013. Responsible for the scoping and execution of permitting support, develop of budgetary cost estimates and schedules for project planning, performing environmental surveys (e.g., Phase I ESA, Regulated Materials Survey), preparation of a Decommissioning Plan, and assisting AECI in determining the End State Condition (ESC). Managed the development of plans and specifications for the removal of coal combustion residuals (CCRs) and residual coal pad from the plant and closure of a beneficial use site; abatement/removal of regulated and hazardous materials; and, once-through cooling water intake and discharge line abandonment. Leading the Detailed Site Investigation required by the Missouri Department of Natural Resources (MDNR) to close their on-site CCR impoundments. Currently supporting AECI in the sale of the plant for abatement and demolition.

Independence Power & Light, Decommissioning Study, Removal, Abatement, Management, and Disposal of Regulated Materials, Missouri City Plant – Missouri City, MO

Served as the Project Manager responsible for evaluating the presence of hazardous and regulated materials at the 38 MW coal-fired Missouri City Plant. Through a review of the plant and review of existing documentation, TRC developed budgetary cost estimates for the removal, abatement, and management of these materials. TRC's study identified data gaps and included the recommendations on the scope of additional investigation.

South Texas Electric Cooperative, RE POWER™ Playbook and Engineering Services, Sam Rayburn Power Plant Unit 3 – Nursery, TX

Served as the Program Manager for the RE POWER™ Project for demolition and redevelopment of the Unit 3 generating and control building of South Texas Electric Cooperative's (STEC) Sam Rayburn Power Plant. The 25 MW steam plant ceased operations in 2012. Mr. Wetherbee was primary author for the RE POWER™ Playbook which identified the plant-specific concerns associated with site redevelopment, including: health and safety; structural safety; regulated and hazardous materials; asset valuation; abatement and demolition means and methods; environmental liabilities; utilities; and community relations, as well as the range of associated costs. Based on the ESCs evaluated developed during the Playbook, STEC elected to proceed with abatement and partial demolition (in order to permit reuse of the generation building for offices). TRC performed environmental surveys, supported permitting requirements, and developed plans and specifications for plant decommissioning and demolition. TRC identified qualified abatement and demolition contractors, assisted STEC with contractor selection and procurement, and provided construction management for the duration of the project, resulting in a safe and cost effective project.

Consolidated Edison Company of New York, First Avenue Properties – New York, NY

Member of TRC's project team responsible for scoping and bidding the decommissioning, demolition, and remediation of the 7-acre Waterside Steam Generating Station site located in Midtown Manhattan. Key components of the work included the asbestos abatement of the circa-1900 steam and electric generating station, the removal of a 255,000 gallon fuel oil underground storage tank, decommissioning and removal of acid and caustic tanks, demolition of three 200-foot high steel and brick smokestacks, demolition of six eight-story high boilers, sealing of twelve-foot–diameter cooling water tunnels, remedial investigations, excavation and disposal of 20,000 tons of contaminated soil, and sheeting and shoring to protect adjacent roadways and public right-of-ways.

National Grid, Engineering and Consulting Services for Abatement, Decommissioning, and Demolition: Glenwood Power Station – Glenwood Landing, NY; Far Rockaway Power Station – Far Rockaway, Queens, NY; E.F. Barrett Power Station – Island Park, NY; Port Jefferson Power Station – Port Jefferson, NY

TRC was contracted for engineering and consulting services prior to abatement, decommissioning, and demolition of four of National Grid's generating stations in New York City and Long Island. Performed Quality Assurance/Quality Control (QA/QC) reviews of Phase I ESA reports prepared for the power stations. The purpose of the Phase I ESA reports was to identify recognized environmental conditions and environmental concerns that may affect facility demolition and reuse.

Consolidated Edison Company of New York, Site Remediation, Arthur Kill Generating Station – Staten Island, NY

Field Manager for the remediation of polychlorinated biphenyl (PCB)-contaminated media (soil, asphalt, sediment, concrete) released due to catastrophic transformer failure at a power generating station. Implemented the Interim Remedial Measures (IRMs) and RAWPs, and documented the actions taken to achieve the clean-up criteria. Directed field team efforts to collect more than 500 soil, sediment, and concrete samples. Managed and evaluated laboratory analytical data and directed field activities to remediate soils expeditiously and in accordance with NYSDEC directives. Responsible for documenting the results of the remediation and demonstrating compliance with NYSDEC cleanup objectives.

New York Power Authority, Soil and Groundwater Investigation Program, Poletti Generating Station – Astoria, NY

Managed the field investigation of soil and groundwater at the site of the proposed Poletti Generating Station. The investigation consisted of the advancement of soil borings and the collection of soil samples to determine the extent of petroleum contamination, coal ash, and manufactured gas plant (MGP) waste present at the site to assess developmental restraints and requirements.

Confidential Utility Company, Due Diligence Support – Various Sites, NY, NJ, PA, DE, MD

Performed an evaluation of existing environmental data for more than 20 coal-fired and hydroelectric power generating facilities being considered for acquisition. Results were incorporated into a confidential report of findings, which presented a summary of the identified and potential environmental concerns for corrective actions with associated costs.

SPECIALIZED TRAINING

- Forty-Hour OSHA Health and Safety Training, 1995
- Supervisory OSHA Health and Safety Training, 2010

JENNA RAUP

EDUCATION
B.A., Chemistry, University at Buffalo, SUNY, 2010

PROFESSIONAL REGISTRATIONS/CERTIFICATIONS
OSHA 10-Hour Construction Safety and Health
OSHA 40-Hour HAZWOPER
OSHA 8-Hour HAZWOPER Refresher
Brownfield Industry Professional, Gold Level; New York City Mayor's Office of Environmental Remediation (OER) (2016)
Analytical Chemist (2010-2012)

AREAS OF EXPERTISE
Ms. Raup has project management and technical experience in the following general areas:

- Project Management
- Potable Water Quality Testing and Investigation
- Environmental Site Assessment and Investigation
- Environmental Regulatory Compliance
- Remedial Activity Oversight and Management
- Non-Hazardous and Hazardous Waste Management
- Soil, Groundwater, and Soil Vapor Remedial Investigations
- Soil Vapor Intrusion Investigation
- Remedial Action
- Ambient and Community Air Monitoring
- Indoor Air Quality Assessments

REPRESENTATIVE EXPERIENCE
Ms. Raup is an environmental project manager specializing in due diligence and remediation services. She is proficient at overseeing environmental site assessments and investigations, as well as project scoping, budgeting, and closeout. Ms. Raup has performed, reviewed, and managed staff in connection with more than 100 Environmental Site Assessments (ESAs) and Environmental Site Investigations (ESIs) in accordance with current ASTM International, New York State Department of Environmental Conservation (NYSDEC), New York State Department of Health, New York City Department of Environmental Protection, New York City Mayor's Office of Environmental Remediation, and client-specific standards.

NYSDEC Standby Environmental Engineering Services – Senior Project Scientist
Coordinated Remedial Investigations at several New York State Superfund sites. Ms. Raup's responsibilities included preparation and review of complex Remedial Investigation Reports, quality assurance/quality control review of analytical data summary tables presenting soil and groundwater sampling results, and implementation of groundwater sampling. She was also responsible for uploading sample data to the EarthSoft Environmental Quality Information System (EQuIS) data management software in accordance with NYSDEC requirements.

NYCSCA Hazardous Materials Consulting Services – Contract/Project Manager/Lead Scientist
For 9 years Ms. Raup has provided environmental consulting services to the NYCSCA's IEH Division. In that time, Ms. Raup has managed an array of assignments including: due diligence (Phase I ESAs/Phase II ESIs/IAQs); design of remediation and mitigation systems to address environmental contaminants; petroleum storage tank investigations and closure designs; emergency responses related to water intrusion and odors; product evaluations; preparation of cost estimates for remedial actions, remedial programs, and design implementation; construction-phase support; potable water supply system

investigations and city-wide sampling; and, New York State Department of Environmental Conservation remedial sites. Ms. Raup is well-versed in federal, state, and local regulations pertaining to the assignments on this contract, and supports NYCSCA in navigating regulatory changes, as necessary. Since April 2018, Ms. Raup has served as the Program Manager, responsible for performance on the former and current $6 million, 3-year on-call services contracts, contributing greatly by methodically and diligently training new staff on the requirements of the contract, and implementing quality control procedures within the organization to ensure responsive, high quality service. Accomplished under Ms. Raup's supervision during this timeframe include over 70 site inspections for potential lease spaces in Queens to support the 3-K and ACS lease properties programs, more than 70 Phase I ESAs, 30 IAQs, seven Phase II ESIs, implementation of emergency remedial actions at two sites, potable water system disinfection oversight and sampling at over 70 sites, inspections and closure reports for about ten tank systems, and ongoing construction-phase services for eight capacity sites. In addition, Ms. Raup transformed the administrative management of the contract to improve invoice generation time, quality, and approval rate, and worked closely with IEH to close-out dormant projects and de-obligate funds. Further, Ms. Raup worked with the IEH Division to modify due diligence templates to ensure that the documents facilitate adherence to current standards and NYCSCA protocols, and to improve efficiency and functionality.

Although she is responsible for management of the contract, her role on this contract spans all technical and administrative needs. She performs technical reviews of all work products, and is responsible for the exceptional technical performance, which is a result of her programmatic vision and day-to-day hands-on involvement. Her long-standing relationships with NYCSCA staff form her understanding and approach to solving NYCSCA's problems as if they were TRC's, and her technical guidance to junior level staff ensure that the service provided by TRC is delivered consistently and at the highest quality.

NYCHA PACT Round 9 Due Diligence – Project Manager and Senior Environmental Scientist
Scoped and managed preparation of two Phase I ESAs in connection with two NYCHA development land transactions in Manhattan and Bronx, NY that will unlock federal funding to allow private developers to take on property upgrades and management responsibilities. Ms. Raup reviewed sites that spanned several hundred acres to determine the most efficient way to perform Site reconnaissance and review regulatory agency and historical records. She prepared a streamlined Phase I ESA template that effectively presented findings and captured NYCHA-specific out-of-scope services. Reports were prepared and reviewed by Jenna within a short timeframe to meet NYCHA's project schedule. NYCHA's review of the Phase I ESAs yielded no comments, and reports were finalized for distribution.

NYCDPR Red Hook Recreation Area Environmental Remediation – Senior Environmental Scientist
Coordinated the investigation, remediation, and reconstruction of several ballfields located within the 57-acre Red Hook Recreation Area in Brooklyn, NY, for the New York City Department of Parks and Recreation (NYCDPR) with regulatory oversight from EPA. Ms. Raup prepared Quality Assurance Project Plans for two remedial sites in accordance with the EPA Universal Federal Policy format and guidelines; implemented these plans; supervised field staff, including subcontractor forces, who performed investigations and remediation; and prepared laboratory analysis summary tables.

KIRSTEN MYERS, PE

EDUCATION
B.S., Civil Engineering, Cornell University, 2004

PROFESSIONAL REGISTRATIONS/CERTIFICATIONS
Professional Engineer, Massachusetts, No. 48184
Professional Engineer, New York, No. 089236

AREAS OF EXPERTISE
Ms. Myers, based in TRC's New York City office, has over 16 years of environmental consulting experience with emphasis in the following areas:

- Power Plant Decommissioning
- Remedial Construction Inspection and Management
- Remedial Design
- Groundwater and Soil Remediation
- Remedial Investigation and Site Assessment

REPRESENTATIVE EXPERIENCE

National Grid - Engineering Services during Decommissioning: Glenwood and Far Rockaway Power Stations – Glenwood Landing, NY
Ms. Myers served as the project engineer for engineering during decommissioning of the Glenwood and Far Rockaway Power Stations. The Glenwood Power Station was a 210 megawatt natural gas fired steam electric generating peaking facility and Far Rockaway Power Station was a 100 megawatt natural gas-fired steam electric generating peaking facility. Ms. Myers served as the project engineer for the following Decommissioning services provided to National Grid by TRC: pre-demolition assessment of structures, buildings and cooling water intake and discharge structures; preparation of specifications and drawings for hazardous materials removal, structure demolition, and site restoration; preparation of engineer's cost estimate and bid documents. Additionally, between October 2013 and June 2015, Ms. Myers served as the on-site environmental monitor/inspector, and was responsible for confirming compliance with all permits and regulatory agency requirements, review of construction submittals, oversight of spill closure contractor, investigation and closure of underground injection control wells, coordination with the utility company, and all required notifications and reporting related to deviations from approved construction documents and plans during the active decommissioning at both Power Stations.

LS Power – Professional and Technical Services for Decommissioning: Ravenswood Generating Facility, Queens, NY
Ms. Myers served as the project manager and lead cost estimator for engineering and consulting services in support of abatement, decommissioning, demolition and limited remediation of the existing gas turbine facilities located in Queens, New York. Ms. Myers developed cost estimates related to the demolition, soil and subgrade removals, and fill importation.

National Grid - Engineering and Consulting Services for Abatement, Decommissioning, and Demolition: Northport Power Station, Northport, NY
Ms. Myers served as the lead cost estimator for engineering and consulting services in support of abatement, decommissioning, demolition and limited remediation of the Northport Power Station located in Northport, New York. Ms. Myers developed cost estimates based on inputs from client regarding possible phased demolition of existing facilities.

National Grid - Engineering and Consulting Services for Abatement, Decommissioning, and Demolition: E.F. Barrett Power Station, Island Park, NY and Port Jefferson Power Station, Port Jefferson, NY
Ms. Myers served as the technical expert for engineering and consulting services in support of abatement, decommissioning, demolition and limited remediation of the E.F. Barrett Power Station located in the Village of Island Park, Nassau County, New York and the Port Jefferson Power Station located in the Village of Port Jefferson, Suffolk County, New York. Ms. Myers provided technical support during topographic surveys; asbestos and regulated material surveys; structural evaluations; Phase I Environmental Site Assessments; drawings and specifications for abatement, decommissioning and demolition; engineer's cost estimates and schedules; and preparation of bid documents.

Engineering Services during Demolition: City of Glen Cove Incinerator – Glen Cove, NY
Ms. Myers served as the project engineer for engineering during deconstruction of the City of Glen Cove Incinerator. The City of Glen Cove Incinerator was a municipal solid waste and sludge co-disposal and energy recovery facility. Ms. Myers served as the project engineer for the following services provided to the City of Glen Cove by TRC: preparation of specifications and drawings and bid documents.

New York Power Authority - Engineering Services during Deconstruction: Charles Poletti Power Plant – Astoria, NY
Ms. Myers served as the project engineer for engineering during deconstruction of the Charles Poletti Power Plant. The Charles Poletti Power Plant was a steam-electric 825 megawatt facility capable of firing natural gas and fuel oil. Ms. Myers served as the project engineer for the following deconstruction services provided by TRC to New York Power Authority: pre-demolition hazardous materials assessment of buildings and cooling water intake and discharge structures, preparation of specifications and drawings, oversight of on-site subcontractors and asset recovery, preparation of engineer's cost estimate and bid documents.

Gowanus Canal Superfund Site (USEPA ID#: NYN000206222) – Brooklyn, NY
Ms. Myers served as the construction project manager during the Dredging and Capping Pilot Study of the 4th Street Turning Basin within the Gowanus Canal Superfund Site. The 4th Street Turning Basin is located at the intersection of 4th Street and 3rd Avenue and is approximately 750 feet in length. The Dredging and Capping Pilot Study will be used to evaluate and finalize the design elements for the full canal dredging and capping portion of the remediation of the Gowanus Canal. The activities have included monitoring of water, air, noise, and vibration, dredging to remove debris to allow equipment and barges to enter the turning basin, screening of debris to identify culturally significant materials, installing of steel sheet piling to support the existing bulkheads, dredging of soft sediments and three (3) targeted areas of natural sediment, capping with non-reactive, low permeability materials, and placing an anchor layer to provide marine habitat and protect the underlying cap. Ms. Myers responsibilities include facilitation of the contractor, Engineer of Record, the Gowanus Environmental Remediation Trust (GERT) and its subcontractors, NYSDEC, and USEPA for the success of the completion of the overall pilot study project. Ms. Myers provides on-site oversight to ensure that the work is being performed in accordance with drawings, specifications, and contractor work plans. Additionally, Ms. Myers supervises the work of health and safety, archaeological, community air monitoring, structural engineering, and vibration/noise firms subcontracted by GERT.

SPECIALIZED TRAINING

- OSHA 40-Hour Hazardous Waste Operations and Emergency Response Training
- OSHA 8-Hour Hazardous Waste Operations and Emergency Response Refresher Training
- Supervisory OSHA Health and Safety Training
- OSHA 30-Hour Construction Safety Training

Emily Ebert

Emily P. Ebert, CHMM
Project Manager

Phase I+II Site Investigations and Site Characterizations

Location: New York, NY

eebert@trccompanies.com

(908) 451-0203

Areas of Expertise:

- *Project Management*
- *Environmental Site Assessment and Investigation*
- *Environmental Regulatory Compliance*
- *Remedial Activity Oversight and Management*
- *Non-Hazardous and Hazardous Waste Management*
- *Soil, Groundwater, and Soil Vapor Remedial Investigations*
- *Soil Vapor Intrusion Investigation*
- *Remedial Action*
- *Ambient and Community Air Monitoring*
- *Indoor Air Quality Assessments*

Emily Ebert serves as a Project Manager based in TRC's Engineering, Construction and Remediation (ECR) Practice in midtown Manhattan and possesses more than eight years of environmental consulting experience. Ms. Ebert's experience includes preparing Phase I Environmental Site Assessment (ESA) reports, implementing Phase II Environmental Site Investigations (ESIs) and preparing Phase II ESI reports, managing Remedial Investigation (RI) activities for sites with petroleum, chlorinated solvent, PCB, and heavy metal contamination; oversight of Remedial Actions and IRMs; environmental health and safety oversight; and managing a variety of environmental sampling programs for groundwater, surface water, soil, sediment, and soil gas and soil vapor intrusion.

CREDENTIALS

Education:

- M.P.H., Environmental and Occupational Health Sciences, CUNY Graduate School of Public Health & Health Policy, 2021
- BS, Environmental Science, University of Vermont, 2013

Professional Registrations/Certifications/Training:

- Certified Hazardous Materials Manager
- 40-Hour OSHA HAZWOPER Training and 8-hour Refresher
- 10-Hour OSHA Construction Safety Training
- 24-Hour USEPA Asbestos Inspector
- State of New York Asbestos Consultant
- Transit Worker Identification Credential (TWIC) holder
- Red Cross First Aid/CPR/AED Certified

PROJECT EXPERIENCE

New York City Economic Development Corporation

Ms. Ebert serves as a project manager for tasks relating to environmental due diligence. Ms. Ebert has prepared Phase I ESA reports for submittal to the New York City Economic Development Corporation. In addition, Ms. Ebert has successfully managed the implementation of Indoor Air Quality Investigations for over 80 properties located in New York City in support of the Learning Bridges project. Ms. Ebert's project management responsibilities included communication with NYCEDC project managers and building operators; supervision of field staff performing on-site sampling; review of analytical data generated; and preparation and review of all work products including daily summary emails and Indoor Air Quality Survey Letter Reports. The Surveys were completed on an expedited turnaround time.

Ms. Ebert also served as a project manager for tasks related to the St. George Ferry Landing Upland Scope for the Ballpark at St. George Stadium in Staten Island, NY. Ms. Ebert's responsibilities included coordination with contractors and NYSDEC; submittal review for soil reuse and import; and preparation of daily summary reports.

New York City School Construction Authority (NYCSCA) – Multiple Sites – New York City

Ms. Ebert is a Project Manager responsible for performing site assessments, investigations, and oversight of remediation actions for new construction and renovation of New York City public schools. Responsibilities include Phase I ESAs, Phase II ESIs, indoor air quality (IAQ) investigations, outdoor air assessments, and SVI assessments. Ms. Ebert has successfully prepared over 75 Phase I Environmental Site Assessments for properties located in Queens, Brooklyn, Manhattan, and the Bronx. Additionally, Ms. Ebert routinely provides recommendations and prepares Phase II Environmental Site Investigation Scopes of Work which adequately address all recognized environmental conditions identified during completion of the Phase I Environmental Site Assessment. Ms. Ebert's project management responsibilities include all aspects of scope of work and cost estimate preparation, emergency response, and coordination with NYCSCA project managers, contractors, and supervision of field staff.

Additionally, Ms. Ebert serves as Project Manager for tasks relating to investigation and remediation of a Brownfield Cleanup Program (BCP) site in Brooklyn, New York. Ms. Ebert attended the pre-application meeting with NYSDEC Region 2, prepared the BCP Application and RI Work Plan for submission to the NYSDEC. Ms. Ebert has also served as project scientist for management of remedial activities and IRMs for public school sites that are in the BCP, including authoring Interim Remedial Measure (IRM) work plans, RI reports, Remedial Action Work Plans (RAWPs), and Construction Completion Reports (CCRs).

Ms. Ebert has also served as Project Manager for PCB remedial actions at public schools. Ms. Ebert's responsibilities have included daily communication and project coordination with NYCSCA Project Managers and contractors, supervision of field staff, and review of work products (including summary reports, surface soil investigation reports and PCB soil remediation reports).

The Port Authority of NY & NJ (PANYNJ)

Ms. Ebert serves as project scientist for activities related to Howland Hook Marine Terminal (HHMT) - Port Ivory Facility, which includes three former Voluntary Cleanup Program (VCP) Sites. Ms. Ebert's responsibilities include periodic inspections of the environmental caps, review of annual groundwater and surface water monitoring data, and preparation of annual periodic review reports in accordance with Site Management Plans (SMP) for each Site. Additionally, Ms. Ebert serves as a project scientist responsible for conducting biannual site-wide gauging events (at over 200 wells) at the Bulk and Satellite Fuel Farms to track remedial progress.

New York City Department of Parks and Recreation – Multiple Sites – New York City

Ms. Ebert serves as project manager in connection with the construction and reconstruction of park facilities in New York City. Specifically, Ms. Ebert serves as Project Manager for the Environmental Engineering Services in connection with Plant 2 at Fresh Kills Park. Ms. Ebert's responsibilities include preparation of a Remedial Investigation Work Plan and implementation of a Geotechnical Investigation. In addition, Ms. Ebert serves as Project Manager for the Environmental Engineering Services in connection with Mariners Marsh Park. Ms. Ebert's responsibilities include review of existing background materials and preparation of a Records Search Report. Ms. Ebert also served as a project scientist providing consulting services in connection with the environmental design, construction and reconstruction of park buildings and facilities in New York City. Responsibilities included implementation and oversight during permeability testing and subsurface investigations and preparation of subsurface investigation reports.

New York State Department of Environmental Conservation (NYSDEC) Superfund Standby Contract

Under TRC's contract with the NYSDEC to provide environmental engineering services for investigation and remediation of State Superfund sites, Ms. Ebert has served as a project scientist in connection with Remedial Investigations at several project sites including Bridge Cleaners Site in Long Island City, NY and Gem Cleaners in Rockville Centre, NY. Her responsibilities have included implementation of soil vapor intrusion and groundwater sampling, quality assurance/quality control reviews of analytical data summary tables presenting soil and groundwater sampling results, and preparation of remedial investigation reports.

MTA Long Island Rail Road – New York

Ms. Ebert serves as a Project Manager performing due diligence assessments and investigation for Metropolitan Transportation Authority (MTA) Long Island Rail Road (LIRR). Ms. Ebert's responsibilities have included management and review of two (2) Phase I ESAs prior to site investigation activities. Ms. Ebert has assisted in managing remedial investigation activities associated with a spill and review of the RI report, leading to spill closure by the NYSDEC in May 2021. In addition, Ms. Ebert manages quarterly groundwater monitoring for a Site that is being remediated under a NYSDEC Order on Consent.

Cypress Creek Renewables – New York State

Ms. Ebert serves as a Project Manager performing due diligence assessments in support of development of solar facilities. Responsibilities included completion of Phase I Environmental Site Assessments (ESAs), Phase I ESA updates, and Phase II Environmental Site Investigations (ESIs) for over 40 sites throughout New York State. Each site encompasses between approximately two and 150 acres and up to 6 Phase I ESAs were completed concurrently. Additionally, Ms. Ebert served as project manager for underground storage tank (UST) investigation, UST removal, and spill closure activities at a proposed solar facility.

Civic Builders

Ms. Ebert serves as project manager for tasks relating to environmental due diligence and subsurface investigation services for Civic Builders, a developer of new charter schools in New York City. Ms. Ebert has been responsible for preparation of Phase I Environmental Site Assessment reports and Phase II Environmental Site Investigation reports. In addition, Ms. Ebert has prepared Remedial Investigation Work Plans and Remedial Investigation (RI) Reports for redevelopment projects enrolled in the New York City Office of Environmental Remediation (OER) Voluntary Cleanup Program.

ForeFront Power – New York State

Ms. Ebert serves as a Project Manager performing due diligence assessments in support of development of solar facilities. Responsibilities included completion of Phase I Environmental Site Assessments (ESAs), for over 14 sites throughout New York State. She successfully managed the completion of 11 Phase I ESA's throughout New York State concurrently within 4 weeks.

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TRC

ELIZABETH A. DENLY, ASQ, CMQ/OE

EDUCATION
B.A., Chemistry, University of New Hampshire, 1987

PROFESSIONAL REGISTRATIONS/CERTIFICATIONS
Certified Manager of Quality/Organizational Excellence, American Society of Quality, 2016

AREAS OF EXPERTISE
Ms. Elizabeth Denly, ASQ, CMQ/OE has project management and technical experience in the following general areas:

- Field and Laboratory Analyses
- Quality Assurance/Quality Control
- Data Validation/Data Management
- Field and Laboratory Analyses
- Emerging Contaminants
- Consultant for Regulatory Agencies
- Field and Laboratory Audits

REPRESENTATIVE EXPERIENCE
Ms. Denly serves as TRC's Quality Assurance & Chemistry Director, responsible for the creation and implementation of the Quality Management Plan and SOPs for field sampling and documentation protocols. Ms. Denly's experience includes 10 years in an analytical laboratory performing GC and GC/MS analyses and 24 years of environmental chemistry consulting. Ms. Denly's responsibilities include defining data quality objectives, preparing QAPPs (including UFP format), conducting data validation, oversight of data management, and laboratory and field audits.

Ms. Denly also serves as a Quality Assurance Manager, responsible for development and communication of quality initiatives within the organization and leads Quality Coordinator networks, which are responsible for the development and communication of quality initiatives within the organization. The quality initiatives that have been implemented or created under Ms. Denly's leadership include the following:

- Procedures for Peer Review of Deliverables
- Tracking of Peer Review Documentation via Monthly Random Audits
- Project Planning Checklist Tool
- Analytical Data Review Checklist and Training
- Practice Self-Assessments with Follow-up Corrective Actions
- Biweekly Quality Messaging
- Publication of Quality Lessons Learned Reports
- Development of Standard Operating Procedures for Field Sampling Activities

As a project QA chemist at TRC, Ms. Denly is responsible for providing QA/QC oversight in support of a variety of environmental investigations, including risk-based soil cleanups, remediation programs, delineation, contaminant ambient air monitoring, and human health and ecological risk assessments. Ms. Denly has provided this oversight under different state and federal regulatory programs, including NYSDEC, NJDEP, and USEPA Regions 1, 2, 3, and 5.

The City of New York Department of Parks and Recreation – New York City, NY
Ms. Denly assisted in the preparation of several Quality Assurance Project Plans (QAPPs) in connection with subsurface investigations, remediation and reconstruction of several ballfields under the direction of the USEPA located within the 57-acre Red Hook Recreation Area. Ms. Denly was responsible for

providing oversight of the analytical laboratory and coordinating data validation. She was responsible for frequent communication with the laboratories to ensure proper receipt of samples, proper utilization of project-specific analytical protocols in order to achieve necessary project action levels, and monitored the overall performance of the laboratories to confirm the highest level of data defensibility.

New York City School Construction Authority – New York, NY
Ms. Denly assisted in the preparation of QA protocols for a pilot study to evaluate the possible presence of PCB in building materials and preferred remedial actions in select schools constructed between 1950 and 1978. QA protocols included sampling and analysis procedures for PCBs in several matrices (caulk, wipes, soil, air and bulk). Ms. Denly was responsible for reviewing field team documentation, providing oversight of the analytical laboratory, and coordinating data validation. She was responsible for frequent communication with the laboratories to ensure proper receipt of samples, proper utilization of project-specific analytical protocols in order to achieve necessary project action levels, and monitored the overall performance of the laboratories. Ms. Denly coordinated with the laboratories to ensure proper cleanup procedures were performed on difficult bulk matrices from the school buildings to confirm the highest level of data defensibility.

Emerging Contaminants
Ms. Denly is currently serving on the Interstate Technology & Regulatory Council (ITRC) Per- and Poly-fluoroalkyl Substances (PFAS) team and won the Industry Affiliates Program Member of the year award in 2017 for her work on the ITRC PFAS Team. She led the development of ITRC's PFAS Naming Conventions and Physical/Chemical properties fact sheet and is currently working on the ITRC PFAS Technical and Regulatory Guidance Document where she has led the development of the Data Evaluation section. Ms. Denly educates representatives of regulatory agencies, attorneys, and our clients about chemistry, investigation, fate and transport, and remediation of PFAS. She also assisted MassDEP in the development of their PFAS fact sheet. Ms. Denly is also serving on the ITRC 1,4-Dioxane Team and is co-chairing the development of the Sampling & Analysis fact sheet for 1,4-dioxane. She provides oversight of field investigations involving the collection of groundwater, drinking water, soil and sediment samples for PFAS and 1,4-dioxane under different regulatory authorities. Ms. Denly has written QAPPs for PFAS and 1,4-dioxane sampling programs. She has also been responsible for the update of TRC's field sampling SOPs to include collection of samples for PFAS.

Preparation of Project-specific QAPPs
Ms. Denly provides consultation on proper sampling procedures, analytical method selection, and quality control requirements, and has prepared QAPPs for a wide body of regulatory programs, including NYSDEC, New York City Department of Environmental Protection (NYCDEP), and USEPA Regions 1 and 2. This experience includes the more detailed format in the Uniform Federal Policy (UFP) for QAPPs, currently required by many of the USEPA Regions. In addition, Brownfields QAPPs are routinely prepared using Quality Assurance Guidance for Conducting Brownfields Site Assessments, September 1998, EPA 540-R-98-038 in USEPA Regions I, II, and III.

PROFESSIONAL AFFILIATIONS

- Massachusetts Licensed Site Professional Association (LSPA)
- American Chemical Society (ACS)
- American Society for Quality (ASQ)