Final Subsurface Investigation Plan
Remediation of Operable Unit 1 and 2
Former Harshaw Chemical Company Site – Cleveland, Ohio

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ACRONYMS AND ABBREVIATIONS

APP	Accident Prevention Plan
ASTM	American Society for Testing and Materials
AEC	(U.S.) Atomic Energy Commission
bgs	below ground surface
COC	Constituents of Concern
CEC	Civil & Environmental Consultants Inc.
DoD	Department of Defense
DPT	Direct Push Technology
EFS	Enviro-Fix Solutions LLC
ELAP	Environmental Laboratory Accreditation Program
EM	engineer manual
EZ	exclusion zone
ft	feet
FUSRAP	Formerly Utilized Sites Remedial Action Program
GPS	global positioning system
HCCS	Former Harshaw Chemical Company Site
ID #	identification number
LLC	Limited Liability Corporation
MED	Manhattan Engineer District
OU	operable unit
PWI	Parratt Wolf Inc.
QAPP	Quality Assurance Project Plan
QC	Quality Control
Ra	Radium
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RPP	Radiation Protection Plan
RPT	Radiation Protection Technician
SAP	Sampling Analysis Plan
SF	square feet
SOP	Site Operations Plan
SSHP	Site Safety and Health Plan
SVOC	Semi-volatile Organic Compound
Th	Thorium
U	Uranium
UFGS	Unified Facilities Guide Specifications
UFP	Uniform Federal Policy
USACE	United States Army Corps of Engineers
USEPA	United State Environmental Protection Agency
VOC	Volatile Organic Compound

SIGNATURES

This Final Subsurface Investigation Plan has been prepared by Enviro-Fix Solutions Limited Liability Corporation (EFS LLC) to describe the plan for conducting a subsurface investigation to fill data gaps as soon as possible after mobilization. Information acquired from this investigation will assist in the initial segregation and management of the planned material storage cells for the Former Harshaw Chemical Company Site (HCCS) Remediation of Operable Units 1 and 2, Cleveland, Ohio, in accordance with the Unified Facilities Guide Specifications (UFGS) 01 45 00.00 QUALITY CONTROL.

EFS is committed to providing products and services to its clients that consistently meet or exceed their requirements. This is accomplished through a clearly communicated quality objective that establishes a plan and expectations for effective management of daily site operations. All staff and subcontractors are responsible for ensuring the quality of their work meets our established Quality Control (QC) criteria. All managers and employees are responsible for continual improvement in the products and services provided, for identifying and eliminating poor work products and deliverables, and for applying appropriate QC and processes to achieve these requirements.

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1.0 BACKGROUND INFORMATION

1.1 Introduction and Purpose

Work implemented under this Final Subsurface Investigation Plan is consistent with the *Technical Approach Volume II- Remediation of Operable Unit 1 and 2 Former Harshaw Chemical Company Site* approved by the United States Army Corps of Engineers (USACE) October 25, 2023. The work is for pre-excavation subsurface characterization to develop/confirm the remedial designs and direct materials for appropriate material storage or disposal.

The Former Harshaw Chemical Company Site (HCCS) is located at 1000 Harvard Avenue in Cleveland, Ohio, approximately three miles south of downtown Cleveland (**Figure 1**). It is a 55-acre property that includes several developed and undeveloped land parcels near the intersection of Harvard Avenue and Jennings Road. The site has been separated into two operable units (OU) identified as OU-1 and OU-2, with OU-1 being further separated into sections of north and south. Site features and parcel boundaries for OU-1 and OU-2 are shown in **Figure 2** and **Figure 3**, respectively.

The planned site remediation includes excavation of impacted soils from previously defined areas and initial placement of excavated material onto constructed material storage cells. Once placed into storage cells, EFS will implement a sampling protocol to determine and segregate soil into appropriate waste categories. This approach was developed to minimize material handling and efficiently process soil. Existing subsurface data does not provide sufficient resolution on the levels of radioactive contamination for efficient management of the excavated material. The purpose of the Subsurface Investigation is to collect additional subsurface data focusing on excavation areas where EFS needs to better define the presence or absence of Formerly Utilized Sites Remedial Action Program (FUSRAP) contamination and collect groundwater elevation data, specifically at the deeper proposed excavations. Results of the subsurface investigation will be used to direct materials to the appropriate material storage cells. By managing placement of materials in storage cells based on general levels of activity, EFS can minimize any comingling of higher activity materials with lower activity soils determined after final sampling within the cells.

1.2 Site Background

The HCCS was used for various manufacturing operations from 1918 through the 1990s, which included the processing and refinement of uranium by the Manhattan Engineer District (MED) and the Atomic Energy Commission (AEC) from 1944 to 1953. As a result, site soil and groundwater contain varying concentrations of residual radioactive materials from previous operations and ongoing storage of materials. The site was designated for inclusion under FUSRAP in June 1999 by USACE, followed by Resource Conservation and Recovery Act (RCRA) corrective action by United State Environmental Protection Agency (USEPA) in March 2010.

1.3 Geology and Hydrogeology

HCCS is located west of the Cuyahoga River. OU-1 is located north of Big Creek and is divided by Harvard Avenue. OU-2 is located south of Big Creek. The northern portion of the site is characterized by low relief and a gradual eastward slope toward the river. A relatively steep bank is present along the western side of the river. The land surface in the middle of the site sits approximately 10 to 15 feet (ft) higher than the river and creek channel bottoms. In the northern portion of the site, the land surface has been modified to permit the construction of buildings, with

paved surfaces and drainage. All developed parcels within the site have been filled to raise the land surface elevation and limit the potential for flooding. Ponding of surface water occurs in various areas throughout the site. The southern portion of the site is mainly undeveloped. Surface water runoff from this area is controlled by drainage ditches and culverts associated with adjacent railroad tracks.

The site is underlain by up to 22 ft of unconsolidated material (i.e., overburden) over shale bedrock. The bedrock is relatively shallow beneath the central and northern part of the site and becomes deeper to the north, east, west, and south where the thickness of the unconsolidated material increases.

A uranium-contaminated groundwater plume is present in OU-1, beneath and near former Building G-1. FUSRAP-contaminated groundwater has not been identified beneath OU-2. Depth to groundwater at the site varies seasonally. Potentiometric maps indicate that groundwater flow in the overburden generally flows from west to east across the site. Groundwater elevations appear to be influenced by bedrock elevation and changes in surface water levels of Big Creek and the Cuyahoga River. Groundwater flow in OU-1 is impacted in the western section by the active extraction well system and in the western and northern portions by a belt line sewer trench.

1.4 Contamination and Constituents of Concern

As a result of historical industrial use, site soil and groundwater contain varying concentrations of residual radioactive materials from previous operations. FUSRAP Constituents of Concern (COCs) for OU-1 and OU-2 soils include radium (Ra)-226, thorium (Th)-230, Th-232, and total uranium (U). The extent of soil contamination and estimated quantities of material to be excavated is shown on **Figure 4**, as indicated by the shaded polygons. The quantities in **Figure 4** do not include place-back, which is essentially the over-excavated soil for safe excavation of known impacted areas. Place-back criteria for radionuclides are listed in Tables 2 and 3 of the UFGS Section 02 61 13 (Excavation and Handling of Contaminated Material) and are included herein as **Table 2** to this plan. Place-back criteria for inorganics, volatile organic compounds (VOCs), and semi-volatile compounds (SVOCs) are listed in Tables 2 and 3 of the UFGS Section 02 61 13 (Excavation and Handling of Contaminated Material) and are included herein as **Table 3** to this plan.

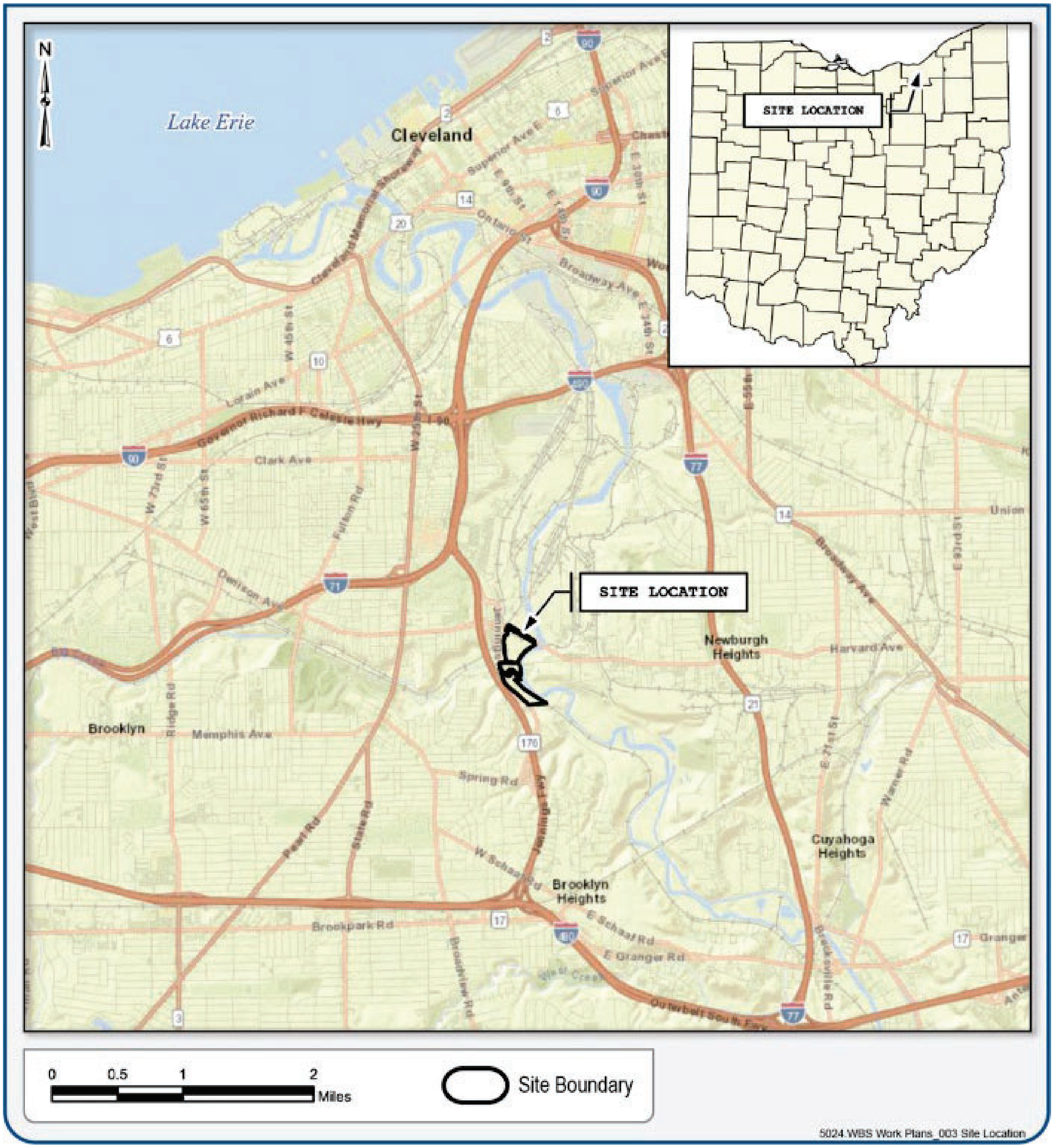


Figure 1: Site Location Map

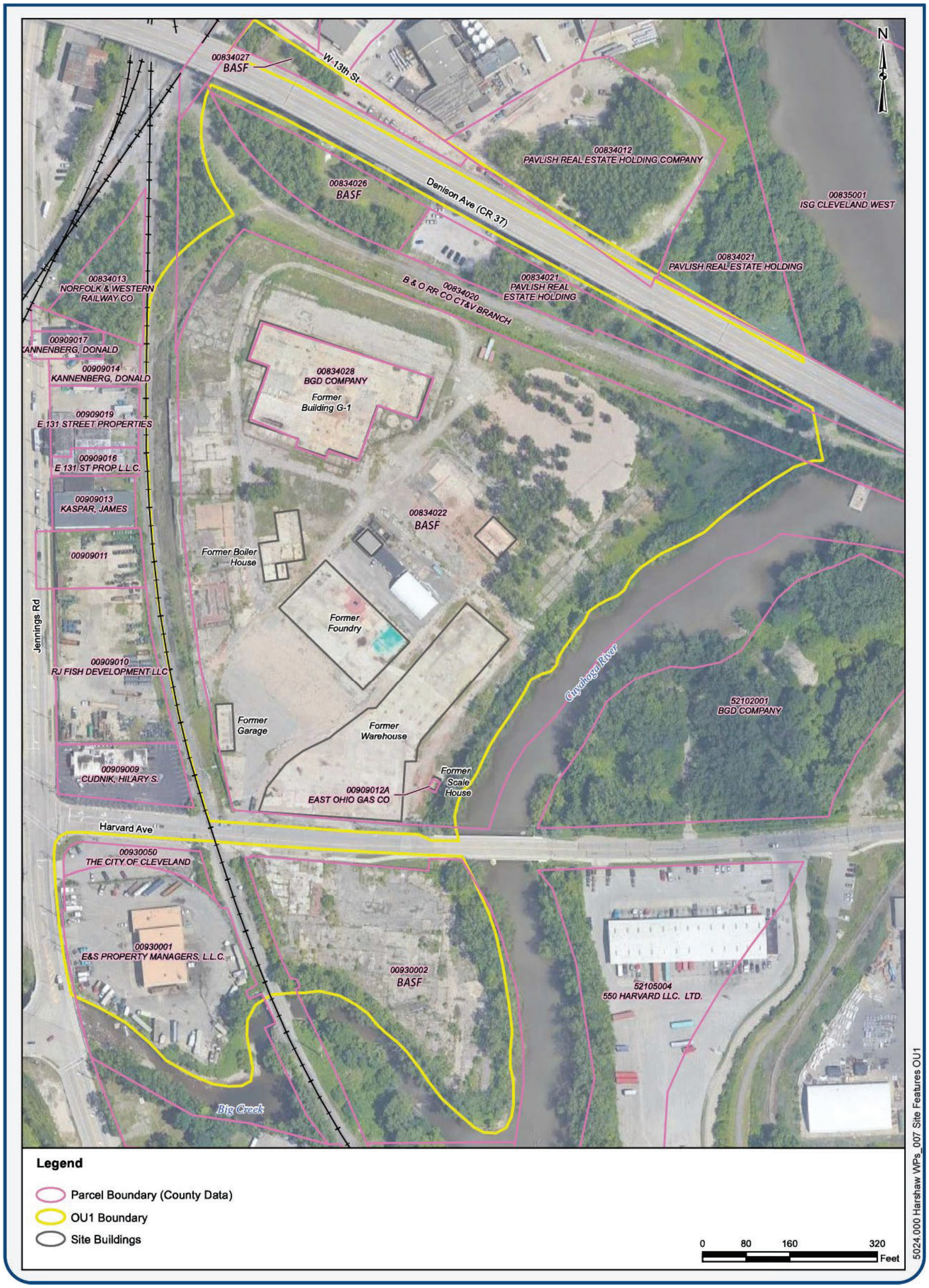


Figure 2: OU-1 Site Features and Parcel Boundaries

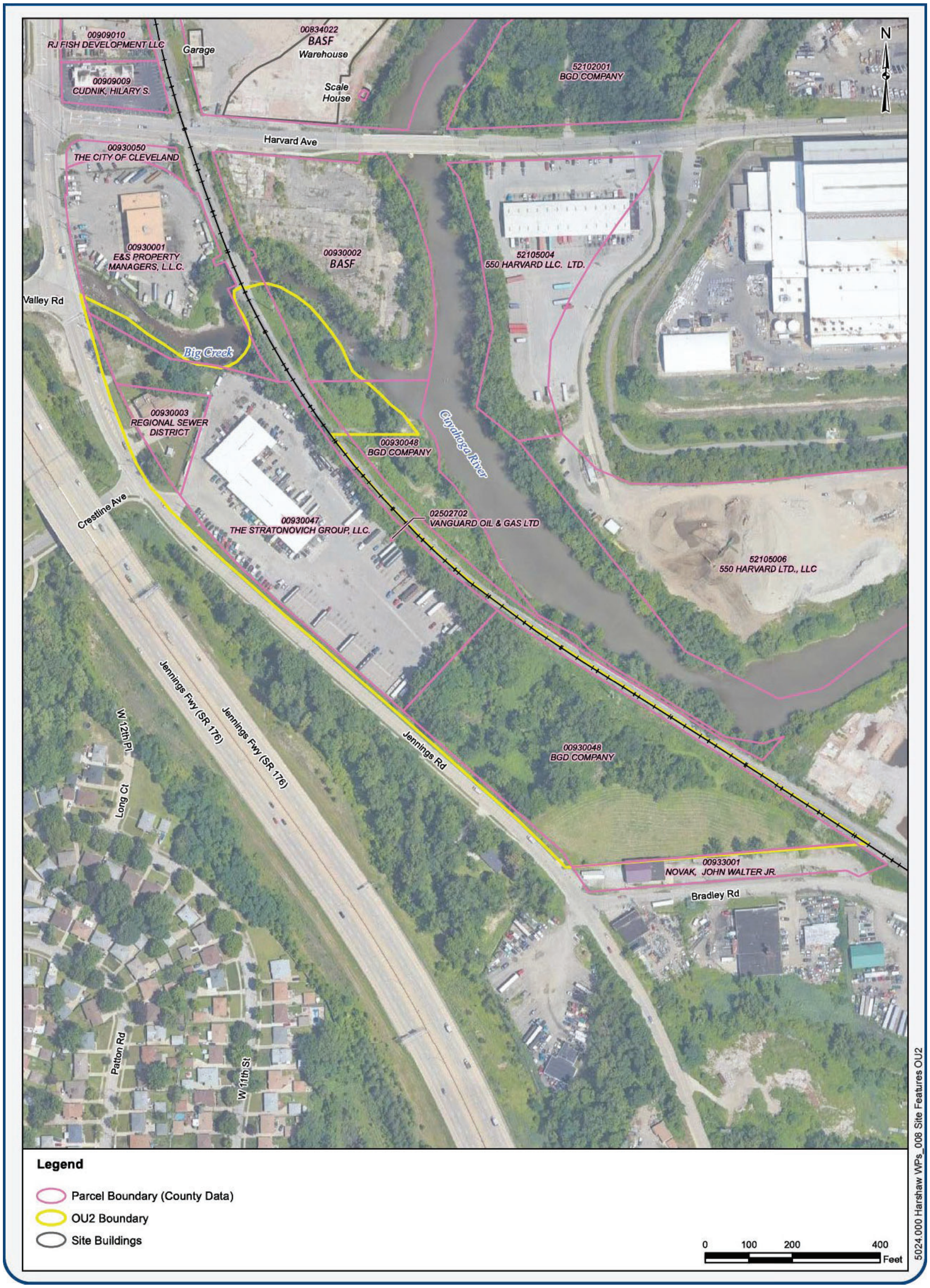
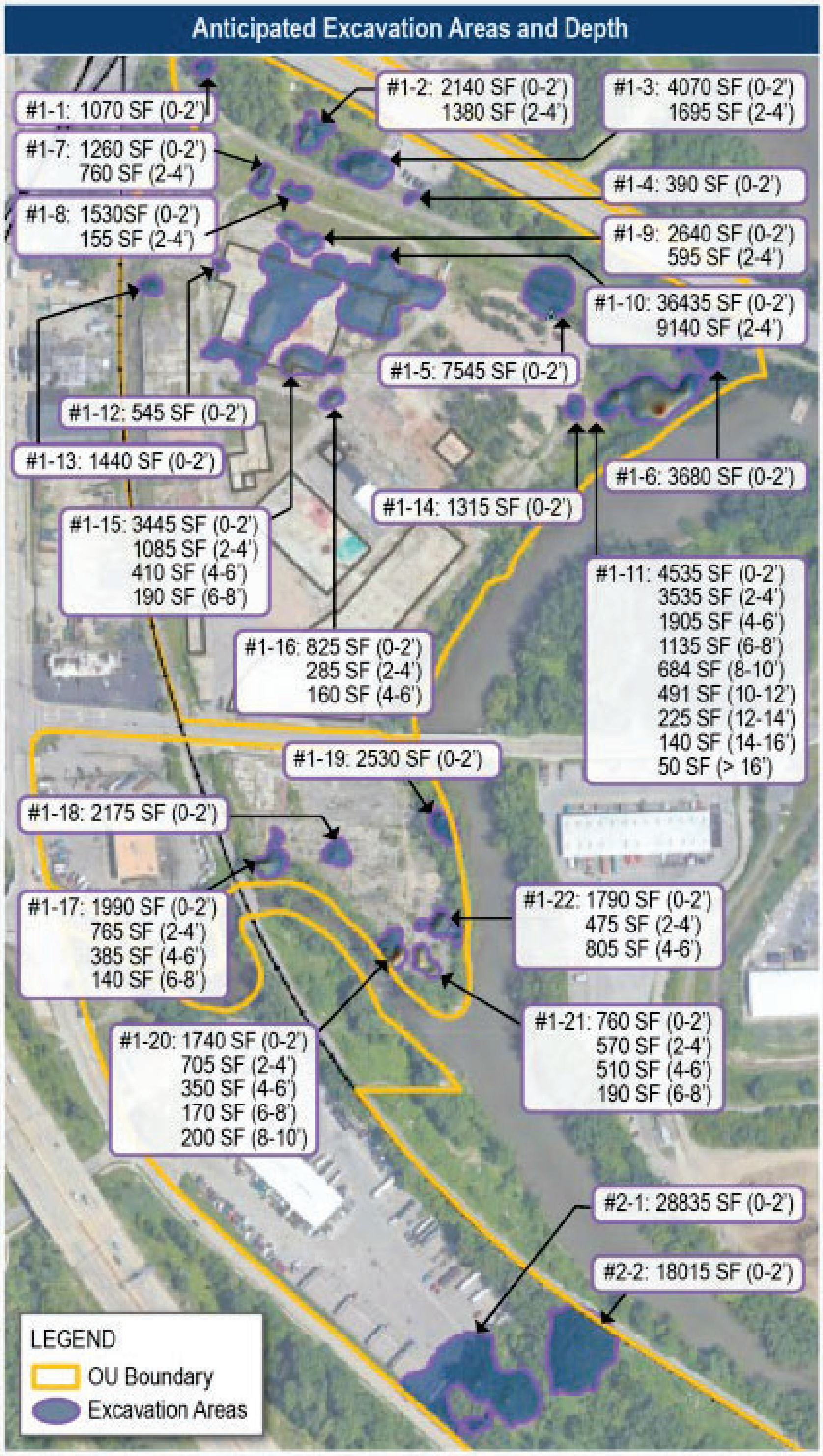


Figure 3: OU-2 Site Features and Parcel Boundaries



Excavation Sequence: Operable Unit/ ID Number	Estimated Soil Quantities (CY): FUSRAP	Non-FUSRAP	Total
OU-2			
#2-2	62	249	311
#2-1	199	298	497
OU-1 South			
#1-19	80	79	159
#1-22	188	153	341
#1-21	254	28	282
#1-20	278	119	397
#1-17	155	188	343
#1-18	0	137	137
OU-1 North			
#1-11	1,708	455	2,163
#1-6	186	46	232
#1-14	83	0	83
#1-5	0	474	474
#1-4	0	25	25
#1-3	281	188	469
#1-2	93	215	308
#1-1	67	0	67
#1-9	0	241	241
#1-8	115	0	115
#1-7	96	79	175
#1-12	0	34	34
#1-13	0	91	91
#1-16	0	121	121
#1-15	149	346	495
#1-10	1,722	1,721	3,443
Total	**5,716**	**5,287**	**11,003**

5024 WBS Work Plans_004 Excavation Areas

Figure 4: Soil Excavation Areas

2.0 INVESTIGATION ACTIVITIES

This section outlines the activities of the subsurface investigation within OU-1 South, OU-1 North and OU-2. All activities will be conducted in accordance with this Subsurface Investigation Plan and other work plans established for soil remediation at HCCS. Sampling locations were established for further characterization of select excavation areas within OU-1 North, OU-1 South and OU-2. Samples will generally be compared to Place-back Soil testing requirements for radionuclides outlined in UFGS Section 02 61 13 at a sufficient resolution to facilitate placement of the material into the appropriate material storage cells.

2.1 Subsurface Investigation Team

The subsurface investigation will be completed under the direction of EFS. EFS will be supported by Civil and Environmental Consultants, Inc. (CEC) who will provide investigation oversight with a qualified licensed Geologist, experienced in subsurface investigations, to complete the drilling and soil sampling portion of the investigation. EFS will provide a Radiation Protection Technician (RPT) to perform radiological surveying and air monitoring. Parratt Wolf Inc. (PWI), a USACE approved drilling contractor, will provide and operate mechanical drilling equipment. PWI is an experienced and licensed driller in the state of Ohio. Eurofins is the Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP) analytical laboratory contracted to perform all chemical and radiological laboratory analysis and data reporting to EFS.

2.2 Soil Boring Locations and Sampling Depths

Proposed soil boring locations are illustrated on **Figure 5**. Actual locations will be established in the field to be as close to the originally selected location as possible. If original locations are unsatisfactory, supplemental locations will be selected based on proximity to the original location and intended purpose of the boring. Surface elevations will be collected prior to the start of work. Locations will be surveyed in North American Datum of 1983 (NAD83), Ohio State Plane Coordinate System North Zone (horizontal) and North American Vertical Datum of 1988 (NAVD88) (vertical). Site wide utilities will be identified and marked prior to drilling as detailed in the Site Operations Plan (SOP) Section 6.3.3.

A summary of the proposed soil sample locations (borings) within each operable unit, number of samples per OU, approximate sampling depth and drilling method is identified in **Table 1**. Sample locations outlined below were selected based on the level of activity provided in the RI. OU-1 North and OU-1 South boring locations were selected based on a typical range of activities presented in the RI in the excavation areas selected. Results from additional screening and analysis of material from these excavation areas obtained from the Subsurface Investigation will be compared to results of the RI. This comparison analysis will be used to extrapolate activity to excavations not selected for drilling to prepare for storage cell management of the excavated material. OU-2 boring locations were selected to obtain an even distribution of borings over the two excavation areas based on the nature of activities within these areas presented in the RI. Final locations may be adjusted based on field observations or field screening results. Subsurface Investigation field work will initiate with hand auger borings in OU-2 then proceed to hand auger borings in OU-1 South and finish with Direct Push Technology (DPT) borings in OU-1 North.

Table 1: Summary of Proposed Soil Borings and Samples per Operable Unit

Operable[1] Unit - Excavation Number	Matrix[2]	Number of Soil Borings per ID Number	Number of Soil Samples per Boring	Total Screening Samples Collected per ID Number	Total Sampling[3] Depth (ft bgs)	Drilling Method	Analysis[4]
OU-1 North							
#1-5	S	1	1	1	(0-2')	Direct Push	2
#1-9	S	1	2	2	(0-4')	Direct Push	2
#1-10	S	1	2	2	(0-4')	Direct Push	2,3
#1-11	S	3	3	9	(0-17')	Direct Push	2
#1-12	S	1	1	1	(0-2')	Direct Push	2,3
#1-16	S	1	2	2	(0-6')	Direct Push	2,3
OU-1 South							
#1-17	S	1	1	1	(0-2')	Hand Auger	2,3
#1-19	S	1	1	1	(0-2')	Hand Auger	2
#1-20	S	2	1	2	(0-2')	Hand Auger	2
#1-22	S	1	1	1	(0-2')	Hand Auger	2
OU-2							
#2-1	S	10	1	10	(0-2')	Hand Auger	2,3*
#2-2	S	10	1	10	(0-2')	Hand Auger	2,3*
Totals							
--	--	8	--	17	--	Direct Push	--
--	--	25	--	26	--	Hand Auger	--
--	--	33	--	42	--	Combined	--

Note:
[1] ID number- a specific location or area within operable unit
[2] S- soil
[3] Sampling depths may change based on results of radiation field screenings or in consultation with the USACE Contracting Officer Representative.
[4] Number corresponds to in-text laboratory analysis tables: (2) Table 2 – Radionuclides and (3) Table 3 – RCRA
*Only one hand auger sample from #2-1 and #2-2 excavations will be analyzed for both parameter lists outlined in in-text laboratory analysis tables: Table 2 and Table 3; remaining samples will be analyzed for parameters listed in Table 2 only.

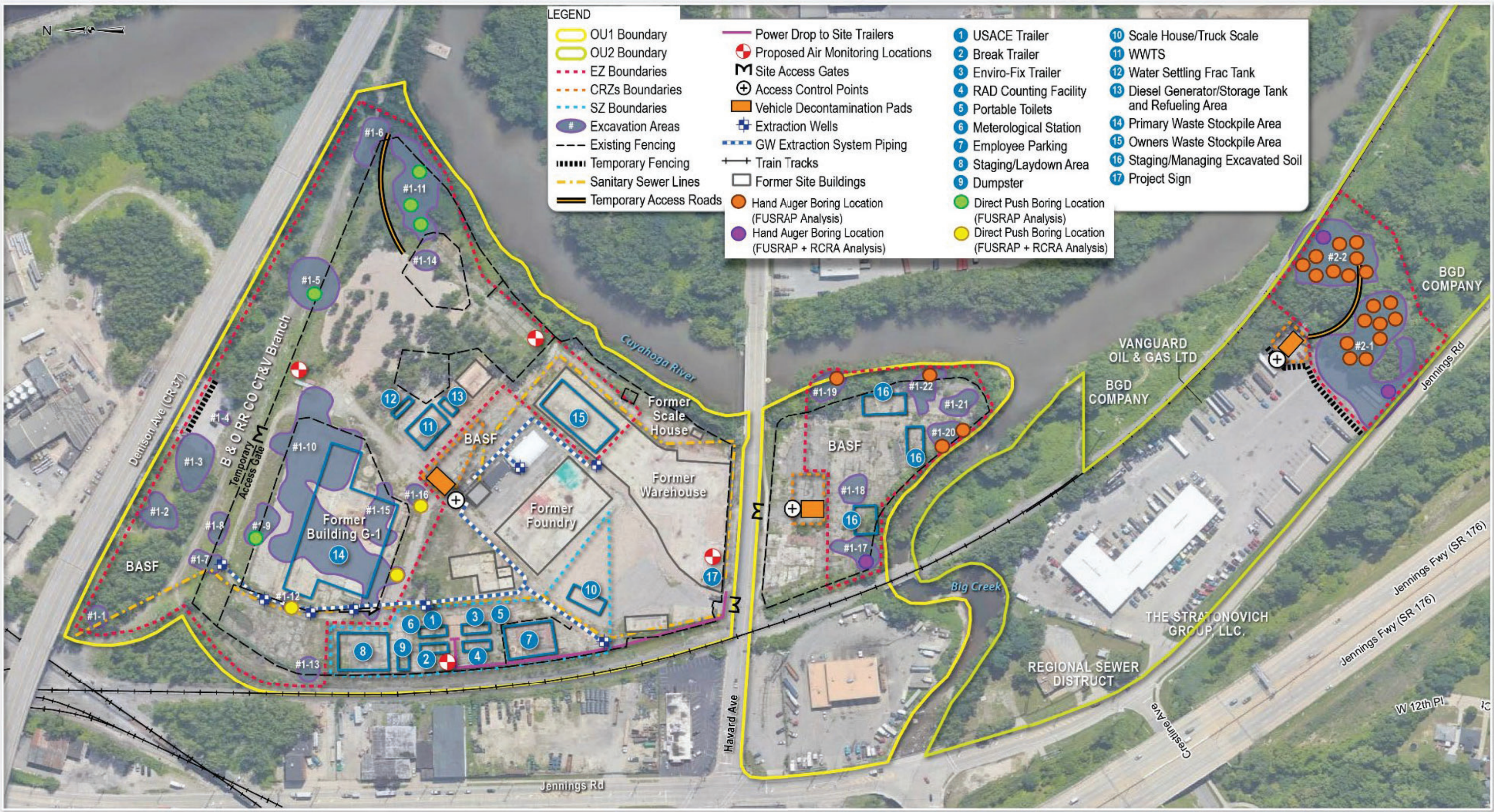


Figure 5: Proposed Boring Locations

2.3 Methods

This section outlines the methodology to be used for drilling, collecting soil samples, and backfilling the boreholes once the sampling is complete.

2.3.1 Drilling Methods

Drilling will be performed in accordance with UFGS Section 02 32 13. Drilling methods to be used include hand auger borings and drive sample borings in accordance with engineer manual (EM)-1110-1-1906, American Society for Testing and Materials (ASTM) D6282-98 (2005), procedures detailed in this Plan, and as directed by the Contracting Officer, including but not limited to:

- DPT Borings – A boring made in unconsolidated soils or partially consolidated sediments using a single tube rod system and power-driven machinery for the purpose of obtaining samples of subsurface material.
- Auger Borings – A boring made in unconsolidated soils with a conventional manually or powered earth auger for the purpose of obtaining samples of subsurface material.

DPT drilling activities and equipment will be brought to the site by PWI. PWI will provide equipment needed to collect the planned number of DPT samples. Such equipment may include but are not limited to: drill rig, hand tools, rods, probe liners, etc. CEC will perform hand-auger sample collection using their own tools.

CEC will provide an experienced geologist to oversee drilling and soil sampling operations in conjunction with a qualified RPT provided by EFS. The EFS technician will oversee radiological screenings throughout the entire subsurface investigation per the Radiation Protection Plan (RPP).

2.3.2 Soil Sampling Methods and Analysis

To characterize the targeted soil across OU-1 and OU-2, a series of soil borings (42 total) will be advanced to the required depth and samples collected for laboratory analysis for radionuclides for Place-back Soil Testing Requirements as described in UFGS Section 02 61 13, Tables 2 and 3 (**Table 2**). Soil boring procedures and sampling will be performed in accordance with standards outlined in UFGS Section 02 32 13. Soil samples will be collected by a combination of hand auger borings and DPT borings. Any remaining soil not used for sample collection will be placed on top of a liner in the Primary Waste Stockpile Area at the Former G-1 Building Slab.

2.3.2.1 Hand Auger Sampling

Shallow soil boring locations in OU-1 South and OU-2 are scheduled to be advanced to a depth of 2 ft below ground surface (bgs) utilizing hand auger methods. Hand auger boring locations in OU-1 South (**Figure 5**) were selected to characterize soils on slopes above the river inaccessible to a drill rig, and specific areas of interest not covered by concrete. Hand auger boring locations in OU-2 were selected to obtain an even distribution of locations across the two excavation areas (**Figure 5**).

Prior to advancing the hand auger, vegetation or debris at the surface will be scraped away with a shovel or trowel. The stainless-steel auger assembly will be decontaminated prior to use and between each boring location. The hand auger will be advanced by rotating the auger into the soil.

The auger assembly holds six inches of soil. After the auger reaches the six-inch depth, it will be removed from the borehole and the soil will be extracted onto a clean working tray. This procedure will be repeated approximately three more times to achieve the required 2-ft depth with the soil from each depth interval laid in the tray adjacent to the previous. If soil samples are unsatisfactory, or the auger cannot reach the desired depth, a supplemental boring will be installed at an adjacent location.

Soil from the 2-ft interval will be described by the geologist using the Visual-Manual Procedure (ASTM D2488). The 2-ft soil section will be incrementally screened for radioactivity by the RPT with a Ludlum Model 44-10 2-inch by 2-inch sodium iodide detector. Soil description and screening results will be recorded on the boring log, similar to the example shown in **Appendix A**.

Soil will be composited by homogenizing the soil in a decontaminated stainless-steel bucket and composite samples will be collected for the constituents listed in **Table 2**. Samples will again be screened with the sodium iodide detector prior to being placed into laboratory-provided sample containers.

One sample from hand auger borings at #1-17, #2-1, and #2-2 will also being submitted for inorganics, VOCs, and SVOCs analytical analysis. The 1-ft sample interval exhibiting most visible impacts will be submitted for RCRA analysis (**Table 3**). If no visible impacts are observed, then the same interval being used for radiological analysis will be used for RCRA analysis, assuming enough soil volume is present. If not enough soil volume is present at that interval, the sample will be collected from the nearest depth feasible.

2.3.2.2 DPT Sampling

Deeper soil boring locations in OU-1 North (**Figure 5**) are scheduled to be advanced to the maximum depth anticipated for excavation outlined in **Figure 4** and described in **Table 1.** DPT methods will utilize a GeoProbe drill rig fitted with a Macro-Core Soil Sampler. The Macro-Core Sampler consists of a barrel direct-push device for collecting continuous core samples of unconsolidated materials at depth. A one-use, thin-walled plastic liner is inserted inside the Macro-Core tube for the purposes of containing and storing soil samples. For the purposes of this investigation, it is anticipated that the Macro-Core will be used as an open-tube sampler in which coring will begin at ground surface with the sampler open at the leading end. The sampler is driven into the subsurface to the total length of the sample barrel, typically 36 to 60 inches, before being pulled from the ground to retrieve the soil core. Successive samples are drilled through the same hole if the borehole stays open giving a continuous soil sample through the entire depth of the borehole.

For unstable soils, the Macro-Core sampler can be equipped with a piston rod point assembly to prevent collapsed soil from entering the sampler as it is advanced to the desired depth, as well as a Macro-Core Core Catcher to keep loose soils from falling out of the barrel.

The soil liners from each depth will be extruded from the core barrel, opened and laid out on a working tray for field screening, and visual description similar to the hand auger method. Soil description and screening results will be recorded on the boring log, similar to the example shown in **Appendix A**.

For borings where one sample will be collected for analysis, (borings at #1-5 and #1-12), the 1-ft sample interval exhibiting the highest gamma scan measurement will be submitted for radiological analysis (**Table 2**).

For borings where two samples will be collected for analysis (borings at #1-9, #1-10, and #1-16), the 1-ft sample interval exhibiting the highest gamma scan measurement will be submitted for radiological analysis (**Table 2**).

A sample from borings within excavations #1-10, #1-12, and #1-16 will also being submitted for inorganics, VOCs, and SVOCs analytical analysis. The 1-ft sample interval exhibiting most visible impacts will be submitted for RCRA analysis (**Table 3**). If no visible impacts are observed, then the same interval being used for radiological analysis will be used for RCRA analysis, assuming enough soil volume is present. If not enough soil volume is present at that interval, the sample will be collected from the nearest depth feasible.

The three deeper borings at #1-11 will be extended to 17 ft bgs and three samples will be collected for laboratory analysis from each boring for a total of nine samples. The three samples will be collected from the three, 1-ft sampling intervals with the highest gamma scan measurement for radiological analysis outlined in **Table 2**.

If soil samples are unsatisfactory, or the auger cannot reach the desired depth a supplemental boring will be installed at an adjacent location. The Contracting Officer or Contracting Officer will be notified of the final locations and any supplemental borings.

In the event that groundwater is encountered at deeper soil boring locations such as the three borings at #1-11, efforts will be made to collect a groundwater elevation to support excavation dewatering planning. A Hydropunch will be driven to a depth assumed to be below the saturated interval based on the soil description. The Hydropunch is a driven rod assembly similar to the Geoprobe sample and installed with the same drill rig. The stainless-steel rod contains a protected well screen that is exposed by pulling back a portion of the drill rod. The well screen then collects groundwater. Water levels will be collected with an electronic water level meter until the water level stabilizes. The Hydropunch assembly is then removed with the drill rig.

2.3.3 Backfill Method

Backfilling of DPT borings will be in accordance with UFGS Section 02 32 13. This work will include, at a minimum, grout pumped into the bore using a tremie pipe from the bottom of the hole to within 2-ft of the ground surface. The grout mixture must be six to eight gallons of water per 94-pound bag of Portland cement. The grout mixture will also contain 4 to 7 percent bentonite to inhibit shrinkage and ensure a good seal. The remaining 2 ft must be filled with local soil and tamped down.

Backfilling of the 2-ft deep hand auger borings will be completed with available cuttings and material from soils immediately adjacent to the boring.

2.3.4 Laboratory Analysis for Place-back Soils

Samples will be analyzed for the radionuclides methods and place-back criteria listed in Tables 2 and 3 of the UFGS Section 02 61 13 (Excavation and Handling of Contaminated Material). These parameters are outlined in **Table 2** below.

Table 2: Summary of Radionuclide Laboratory Analysis

Parameter	Test Method	Testing Frequency	Place-back Criteria	Reference
Radionuclides				
Ra-226	EPA 901.1M/HASL 300	1/100 BCY or 1/excavation area	10.041 pCi/g	1
Th-230	EPA 901.1M/HASL 300	As Above	35.878 pCi/g	1
Th-232	EPA 901.1M/HASL 300	As Above	6.981 pCi/g	1
Total U	HASL 300	As Above	191.27 pCi/g	1

References:

1 USACE 2021. Record of Decision for Operable Unit (OU)-1 and OU-2 Former Harshaw Chemical Company Site Cleveland, Ohio. September

Notes:

BCY bank cubic yard(s)

pCi/g picocuries per gram

Samples from DPT locations 1-10, 1-12, and 1-16 will also be analyzed for the RCRA inorganics, volatile organic compounds, and semi-volatile organic compounds based on the methods and place-back criteria listed in Tables 2 and 3 of the UFGS Section 02 61 13 (Excavation and Handling of Contaminated Material). These parameters are outlined in **Table 3** below.

Table 3. Summary of RCRA Laboratory Analysis

Parameter	Test Method	Testing Frequency	Place-back Criteria	Reference
Inorganics				
Antimony	EPA 6010C	1/100 BCY or 1/excavation area	1,200 mg/kg	2
Arsenic	As Above	As Above	82 mg/kg	2
Cadmium	As Above	As Above	2,300 mg/kg	2
Chromium (III)	As Above	As Above	1,000,000 mg/kg	2
Cobalt	As Above	As Above	23,000 mg/kg	2
Iron	As Above	As Above	820,000 mg/kg	2
Lead	As Above	As Above	1,800 mg/kg	2
Mercury	EPA 7171 B	As Above	290 mg/kg	2
Nickel	EPA 6010C	As Above	44,000 mg/kg	2
Selenium	As Above	As Above	15,000 mg/kg	2
Silver	As Above	As Above	15,000 mg/kg	2
Thallium	As Above	As Above	230 mg/kg	2
Vanadium	As Above	As Above	26,000 mg/kg	2
Zinc	As Above	As Above	880,000 mg/kg	2

Parameter	Test Method	Testing Frequency	Place-back Criteria	Reference
Fluoride	EPA 9214	As Above	4,500 mg/kg	2
Sulfate	ASTM C 1580	As Above	None	--
Chloride	EPA 9212	As Above	None	--
Volatile Organic Compounds (VOC)				
Ohio EPA Table II VOCs	EPA 8260D	1/100 BCY or 1/excavation area	See OAC 3745-300-08	2
Semi-Volatile Organic Compounds (SVOC)				
Ohio EPA Table II SVOCs	EPA 8260D	1/100 BCY or 1/excavation area	See OAC 3745-300-08	2

References:

2 OAC 3745-300-0(c)(3), Table 1 Generic direct-contact Standards for Carcinogenic and Non-carcinogenic Chemicals of Concern - Residential Land Use Category.

Notes:

BCY bank cubic yard(s)

mg/kg milligrams per kilogram

2.4 Equipment Decontamination.

Drilling/sampling equipment (i.e. Vehicles, drill rods, and tools) must be cleaned prior to arrival on site. Equipment or tools containing soil, grease or other contaminants is prohibited. Additionally, down-hole equipment (e.g. augers, rods, samplers, and spoons) will be decontaminated prior to arrival on site and between sample locations.

Equipment decontamination procedures detailed in the RPP are summarized below. Any equipment used in an exclusion zone (EZ) will be decontaminated at the excavation area by removing all loose soil. Subsequent decontamination will be performed as necessary until verified clean, and may include:

- Washing and/or wiping until visibly clean,
- Low pressure, non-phosphate, detergent wash with wiping.

A conditional release survey will be completed at the excavation area prior to moving the equipment to the next work location on site. Small tools and other equipment (i.e., field meters, etc.) will be wrapped in plastic prior to being moved between contaminated areas of the site and will be decontaminated prior to being moved to un-contaminated areas of the site or off site. All equipment will be decontaminated and surveyed in accordance with requirements of the Contamination Control Plan and UFGS 01 35 13.43 10 Section 3.1.6. As much equipment as possible will be dedicated for single use for the duration of the project and, upon final release, will be surveyed and verified in conformance with the site unrestricted release in accordance with the RPP. Disposable materials used for the subsurface investigation will be containerized on site in the area of the former G-1 building and in accordance with the RPP.

2.5 Sample Containers, Preservation and Hold Times

Laboratory bottle ware for sampling will be provided by the laboratory. EFS will coordinate the delivery of bottle ware. Shipping of sample coolers including chains of custody will be prepared by EFS and completed following the guidance outlined in UFGS Section 01 35 45 (3.6.3 through 3.10). Sample labels must be waterproof and written with waterproof pen or ink. Each sample label must contain the following information:

- Contractor name
- Sample Identification number (Sample ID#)
- Site name
- Sample station number
- Requested analysis
- Type of sample (discrete, grab or composite)
- Type of chemical preservative present in container
- Date and time of sample collection
- Samplers' initials or name

Coolers will be packed in accordance with Uniform Federal Policy-Quality Assurance Project Plan/Sampling Analysis Plan (UFP-QAPP/SAP) Worksheets #19 and #30 in order to meet preservation requirements by matrix and analyte.

2.5.1 Sample Container Labeling

A unique sample numbering system will be used to identify each sample collected and submitted for laboratory analysis per UFGS Section 01 35 45. Sample ID's for purposes of the HCCS subsurface investigation will be numbered and identified as follows:

Operable Unit – Excavation # -Boring # - Sample # within boring (sample depth)

For example, the first sample collected from B-1 at a depth of 0-2 ft from OU-1 at excavation number 1-11 would be written as: Sample ID#: OU-1-1-11-B-01-01(0-2').

2.6 Laboratory Analysis

Off-site laboratory analysis will be completed by Eurofins. Samples will be submitted for the radionuclide analyses listed in Tables 2 and 3 of UFGS 02 61 13 (**Table 2** and **Table 3**). Samples and shipping containers will be screened by an RPT prior to shipment offsite in accordance with guidance outlined in the RPP.

2.6.1 Analytical Methods

All samples will be analyzed for required constituents by the methods listed on **Table 2** and **Table 3**. Soil results of the investigation will then be compared to place-back standards.

2.7 Worker Health and Safety Monitoring

Worker health and safety monitoring will be performed in accordance with the approved project RPP, and the Accident Prevention Plan (APP) / Site Safety and Health Plan (SSHP).

2.8 Documentation and Records

Boring logs and other field records will be prepared as described below.

2.8.1 Boring Logs and Field Records

Drilling logs will be prepared by a qualified field geologist/engineer in accordance with the UFGS Section 02 32 13 and ASTM Standards. Drilling logs and field records are to follow items outlined in sub-section 3.12 of UFGS Section 02 32 13. Dimensions and coordinates will be noted on logs where applicable**.** An example of the boring log format to be used is shown in **Appendix A**.

2.8.2 Locational Information

Geospatial data will be recorded in accordance with UFGS 01 35 13.43 10. All soil boring locations will be documented using global positioning system (GPS) equipment. Boring coordinates and dimensions will be noted on the associated logs. Surveyed ground elevations as noted in **Section 2.2** will also be included on the boring logs. Soil boring locations will be surveyed in North American Datum of 1983 (NAD83), Ohio State Plane Coordinate System North Zone (horizontal) and North American Vertical Datum of 1988 (NAVD88) (vertical).

2.8.3 Laboratory Samples

Samples will be handled in accordance with the Sampling and Analysis Plan. Samples will be placed into laboratory-prepared containers immediately following collection and caps and labels promptly affixed to the sample containers. The samples will be transported via overnight delivery service under Chain-of-Custody control to the off-site subcontract laboratory for analysis. An example of the Chain-of-Custody form to be used is shown in **Appendix B**.

3.0 SUBSURFACE INVESTIGATION REPORT

A subsurface investigation report will be prepared and submitted to USACE in accordance with UFGS 02 32 13, Section 3.12. The report will include the following information:

- Executive Summary
- Purpose, objectives, and report organization.
- Background, including site history and site description
- Physical Settings including geology, hydrogeology, and physical features
- Contaminants of Concern
- Description of site investigation activities, methodologies, and laboratory analysis.
- Presentation of investigation results.
    - Subsurface conditions
    - Field Screenings
    - Analytical Results
- Interpretation of the investigation results and conclusions

- Attachments:
  - Boring logs (for both drilled and hand augered)
  - Field notes
  - Industrial hygiene monitoring results
  - Laboratory analytical reports

4.0 SCHEDULE

Subsurface Investigation is scheduled to occur in the mobilization and initial site work phase, prior to beginning excavation activities. Subsurface investigations are anticipated to take one week to complete, depending on weather conditions and subcontractor availability. Laboratory analysis and receipt of all results will take approximately 30-days, after-which the Subsurface Investigation Report is prepared and the draft submitted. At that time, excavation of OU-2 excavation area will commence, followed by OU-1 South and OU-1 North.

APPENDIX A

Example Boring Log

Civil & Environmental Consultants, Inc.
700 Cherrington Parkway
Moon Township, PA 15108

MONITORING WELL NUMBER MW-1

CLIENT Client
PROJECT NAME CEC Example Project
PROJECT NUMBER Example Log
PROJECT LOCATION Site
DATE STARTED
DATE COMPLETED
CEC FIELD REPRESENTATIVE
REVIEWED BY
GROUND ELEVATION
CASING ELEVATION
LATITUDE
LONGITUDE
DRILLING CONTRACTOR
DRILLER
DRILLING METHOD
BACKFILL
BOREHOLE DIAMETER
CORE SIZE
MONITORING EQUIPMENT
OUTER CASING
WELL INSTALLED
WELL STICKUP
DEVELOPMENT METHOD
WELL KEY
RESULTS
NOTES
YIELD

WATER LEVELS

At Time of Drilling:
End of Drilling:
After Drilling:

Temporary Well:
Permanent Well :

NA - Not Available; bgs - below ground surface; amsl - above mean sea level

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (ft)	RECOVERY %	WELL DIAGRAM
0			0		
5					
10			-10		
15					
20			-20		
25					
30			-30		
35					
40			-40		
45					
50			-50		
55					
60			-60		
65					
70			-70		
75					
80			-80		
85					
90			-90		
95					
100			-100		

APPENDIX B

Example Chain of Custody

Civil & Environmental Consultants, Inc.

Chain of Custody Record:

Project Name:	Former Harshaw Chemical Company –Remediation of OU1 and OU2		
Project Number:	331-800.0005	Project Location:	Cleveland, Ohio
Project Manager:	Brianne Hastings		
Field Personnel:			
Contact Information:	BHastings@cecinc.com		
CEC Office:	Moon Twp / PGH	Number of Coolers in Shipment:	

Data Delivery:
___ CD (EDD and Report) ___ Paper Report
_X_ Email (EDD and Report) ___ Preliminary Results (ASAP)
Email Address: see above

Turn-Around Time:
_X_ Standard ___ 7 day ___ 72 hr ___ 48 hr ___ 24 hr

Requested Sample Analyses

Page of

Matrix Key:	Preservative Key:
A - Air	1 - HCl
W - Water	2 - HNO_3
S - Soil	3 - H_2SO_4
D - Sediment	4 - NaOH
P - Wipe	5 - Na_2S2O_3
O - Other	6 - $NaHSO_4$
	7 - Other
	8 - 4°C

Date	Time	Sample ID	Matrix	Preservative	Number of Containers	Ra-2226, Th-232, Th-230, Total U (EPA Method 901.1M/HASL 300)										Special Instructions/ Sample Conditions/ Comments
			S													

Relinquished By:	Date:	Time:	Received By:	Date:	Time:
Relinquished by:	Date:	Time:	Received By:	Date:	Time:

Custody Seals Intact? ___ Yes ___ No Jars Intact? ___ Yes ___ No

Cooler Temperature Upon Receipt? ___ °C Ice Present? ___ Yes ___ No

General Comments/Remarks: Send analytical cost directly to Range Resources; attn: Chris O'Connor

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Columbus (888)598-6808
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Houston (800)365-2324
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