SITE-SPECIFIC FINAL REPORT

for

REMEDIAL ACTION

at 4825 GLENBROOK ROAD

SPRING VALLEY FORMERLY USED DEFENSE SITE,

OPERABLE UNIT 3

SPRING VALLEY, WASHINGTON, D.C.

Prepared for:
U.S. Army Engineering & Support Center, Huntsville

Geographic District:
U.S. Army Corps of Engineers, Baltimore District

Contract No. W912DY-09-D-0062
Delivery Order No. 0006

FUDS Project No. C03DC091809: 4825 Glenbrook Road

October 2021

SITE-SPECIFIC FINAL REPORT

Approval Signature Sheet

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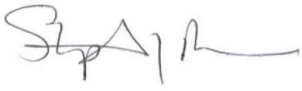
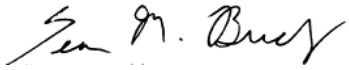
Risk Assessor	Mr. Stephen Rembish, Ph.D. Principal Risk Assessor	
Project Manager	Mr. Sean Buckley, P.G., PMP Senior Project Manager, Program Director	
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ACRONYMS AND ABBREVIATIONS

ABP	agent breakdown product
AS	arsine
ASTM	American Society of Testing and Materials
AU	American University
AUES	American University Experiment Station
bgs	below ground surface
CA	chemical agent
CACM	chemical agent contaminated media
CAFS	chemical agent filtration system
CARA	CBRNE Analytical and Remediation Activity
CBRNE	Chemical Biological Radiological Nuclear and Explosives
CCDC	Combat Capabilities Development Command – Chemical Biological Center
CEHNC	U.S. Army Engineering and Support Center, Huntsville
CENAB	U.S. Army Corps of Engineers, Baltimore District
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CG	phosgene
CK	cyanogen chloride
COPC	chemical of potential concern
CTF	Chemical Transfer Facility
CV	comparison value
CWM	chemical warfare materiel
DAAMS	Depot Area Air Monitoring System
DD	Decision Document
DERP	Defense Environmental Restoration Program
DID	Data Item Description
DMM	discarded military munitions
DoD	Department of Defense
DOEE	Department of Energy and Environment
DQCR	daily quality control report
DQO	data quality objective
DVR	data validation report

ECBC	Edgewood Chemical and Biological Center
ECS	engineering control structure
ELAP	Environmental Laboratory Accreditation Program
EML	Environmental Monitoring Laboratory
EPC	exposure point concentration
EZ	exclusion zone
ft	foot
FT-IR	Fourier transfer infrared spectroscopy
FUDS	Formerly Used Defense Site
GCMS	gas chromatography mass spectrometry
GIS	geographic information system
HCl	hydrochloric acid
HCN	hydrogen cyanide
HD	mustard agent
HE	high explosive
HTW	hazardous and toxic waste
IDW	investigation derived waste
IHF	Interim Holding Facility
L	Lewisite
LCS	laboratory control sample
LD	local disposition
MAP	Mobile Analytical Platform
MARB	Materiel Assessment Review Board
MC	munitions constituents
MD	munitions debris
MDAS	material documented as safe
MEC	munitions and explosives of concern
MINICAMS	Miniature Continuous Air Monitoring System
Mg	Manor Glenelg
MPPEH	material potentially presenting an explosive hazard
MMRP	Military Munitions Response Program
MRC	multiple round container
MRS	Munitions Response Site
MS	matrix spike

MSD	matrix spike duplicate
OESS	Ordnance and Explosives Safety Specialist
OU	Operable Unit
PDS	personnel decontamination station
PDT	project delivery team
PID	photoionization detector
PINS	Portable Isotopic Neutron Spectroscopy
PLS	professional land surveyor
PP	Proposed Plan
PRARRS	Post-Removal Action Risk Reduction Summary
PS	chloropicrin
PWS	performance work statement
QA	quality assurance
QAM	Quality Assurance Manual
QC	quality control
QSM	Quality System Manual
RI	Remedial Investigation
RA	remedial action
RAGS	Risk Assessment Guidance for Superfund
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RCWM	recovered chemical warfare materiel
RI	Remedial Investigation
RME	reasonable maximum exposure
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
SSFR	Site-Specific Final Report
SSWP	Site-Specific Work Plan
STEL	short term exposure limit
SVFUDS	Spring Valley Formerly Used Defense Site
SUXOS	Senior UXO Supervisor
TCLP	toxicity characteristic leaching procedure
TNT	trinitrotoluene
TP	test pit

UFP-QAPP	Uniform Federal Policy for Quality Assurance Project Plan
ULB	Urban Land Brandywine
ULMg	Urban Land-Manor Glenelg
ULSC	Urban Land-Sassafras Chillum
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
UU/UE	unlimited use/unrestricted exposure
UXO	unexploded ordnance
UXOQCS	UXO Quality Control Specialist
VOC	volatile organic compound
WERS	Worldwide Environmental Remediation Services
WPL	worker population limit
XSD	Halogen Specific Detector

EXECUTIVE SUMMARY

ES.1 The U.S. Army Corps of Engineers (USACE) performed a remedial action (RA) at 4825 Glenbrook Road located in the Spring Valley Formerly Used Defense Site (SVFUDS), Operable Unit 3 (OU-3) in Washington, D.C. This project was conducted under Delivery Order No. 0006 of Contract No. W912DY-09-D-0062, which was administered by the U.S. Army Engineering and Support Center, Huntsville (CEHNC). The Project Delivery Team (PDT) consists of CEHNC, USACE Baltimore District, the RA contractor, as well as other government and non-government agencies with specific expertise for implementation of specialized components of the field operations including the Combat Capabilities Development Command – Chemical Biological Center, formerly known as Edgewood Chemical Biological Center, and the Chemical Biological Radiological Nuclear and Explosives Analytical Remediation Activity support team.

ES.2 Based on the selected remedy described in the final Decision Document (DD) for 4825 Glenbrook Road issued on June 13, 2012, the objective of this task order was removal of the house and remediation of the site such that there are no unacceptable risks to residential receptors, providing for the property's unrestricted future use. To achieve this objective, having completed the necessary site preparation activities, soil was excavated down to competent saprolite and/or bedrock, and removed from the 4825 Glenbrook Road site for disposal. Soil samples were collected to support conclusions that the remediation goal and remedial action objectives (RAOs) were achieved.

ES.3 Mobilization to the site occurred in April 2012. Demolition of the residence at 4825 Glenbrook Road occurred from November 2012 to December 2012. Intrusive remedial activities began in January 2013 and were completed in June 2020. Site restoration was completed and demobilization occurred in August 2021. The following items were recovered during the RA: one munitions and explosives of concern (MEC) item, 14 chemical warfare materiel (CWM) American University Experiment Station (AUES) glass intact containers, 26 non-CWM AUES glass intact containers, approximately 1,061 pounds of scrap metal, approximately 678 pounds of AUES scrap glass, and approximately 1,311 pounds of munitions debris (MD) that was certified as material documented as safe (MDAS) and transported offsite for disposal. In addition to the items summarized above, approximately 3,127 cubic yards of soil were removed from the site during the remedial activities at 4825 Glenbrook Road. Of the 3,127 cubic yards removed from the site, 2,813 cubic yards (approximately 90 percent) was disposed of at a Subtitle D landfill and 314 cubic yards (approximately 10 percent) was disposed of at a hazardous waste incineration facility.

ES.4 Following completion of the remedial activities at 4825 Glenbrook Road, the project site has been cleared of all military munitions and AUES-related items to allow for unlimited use/unrestricted exposure (UU/UE). All soil exceeding 20 mg/kg arsenic was removed and a human health risk assessment was performed to ensure the prevention of direct contact with soil remaining at the site having a non-carcinogenic hazard index exceeding one and cancer risk exceeding 1×10^{-4}. A USACE geologist conducted quality assurance evaluations to confirm all areas included in the scope of work for the RA at 4825 Glenbrook Road (areas A, B, D, E, and F) were excavated to competent saprolite and/or bedrock. This demonstrated the remediation goal

and RAOs described in the final DD for 4825 Glenbrook Road have been met and the site has been remediated such that there are no unacceptable risks to residential receptors allowing for UU/UE. USACE completed the RA in 275,466 exposure hours with only one lost workday accident, one lost workday, and no property damage accidents causing damage exceeding $2,000.

ES.5 After the completion of the RA at 4825 Glenbrook Road, the site was backfilled with clean soil and compacted to meet the standards specified in the Site-Specific Work Plan (SSWP). The backfill source was sampled, analyzed, and approved by USACE, USEPA, American University (AU), and the District of Columbia Department of Energy and Environment (DOEE). The site was graded in accordance with the final grading plan agreed to by the PDT and AU. Final grading was completed in May 2021. After final grading was completed, topsoil was placed across the site. The topsoil source was sampled, analyzed, and approved by USACE, USEPA, AU, and DOEE. Hydroseeding was completed in July 2021 and the property fence was installed and completed in August 2021.

ES.6 The RA at 4825 Glenbrook Road was performed in accordance with accepted industry practices, the performance work statement (PWS) for Task Order No. 0006, the approved SSWP, technical instructions, and the final DD for 4825 Glenbrook Road issued on June 13, 2012.

CHAPTER 1
PROJECT ACTIVITIES AND OPERATIONS

1.1 GENERAL

1.1.1 Project Authorization

1.1.1.1 The U.S. Army Corps of Engineers (USACE) performed a remedial action (RA) at 4825 Glenbrook Road located in the Spring Valley Formerly Used Defense Site (SVFUDS), Operable Unit 3 (OU-3) in Washington, D.C. This project was conducted under Task Order No. 0006 of Contract No. W912DY-09-D-0062, which was administered by the U.S. Army Engineering and Support Center, Huntsville (CEHNC). The Project Delivery Team (PDT) consists of CEHNC, USACE Baltimore District (CENAB), the RA contractor, as well as other government and non-government agencies with specific expertise in the implementation of specialized components of field operations including the Combat Capabilities Development Command (hereafter referred to as "CCDC"), formerly known as Edgewood Chemical Biological Center (ECBC), and the Chemical Biological Radiological Nuclear and Explosives (CBRNE) Analytical Remediation Activity (CARA) support team.

1.1.1.2 The project was executed under the performance work statement (PWS) dated May 10, 2011 and falls under the Military Munitions Response Program (MMRP). The Department of Defense (DoD) established the MMRP under the Defense Environmental Restoration Program (DERP) to address Chemical Warfare Materiel (CWM), unexploded ordnance (UXO), discarded military munitions (DMM), and munitions constituents (MC) located on current and former military installations. The work under this task order was also conducted in compliance with DoD, Department of Army, USACE, federal, state, and local requirements regarding personnel, equipment, and procedures, and DoD requirements and safety regulations. The CEHNC is the organization responsible for this MMRP project.

1.1.1.3 As specified in the PWS, this Site-Specific Final Report (SSFR) summarizes the work performed during the MMRP project, presents an accounting of the recovered items, and demonstrates the remediation goal and the remedial action objectives (RAOs) were achieved. This report is prepared in accordance with the Data Item Description (DID) HNC-011.02 approved on November 1, 2015.

1.1.2 Purpose and Scope

1.1.2.1 A final Decision Document (DD) for 4825 Glenbrook Road was issued on June 13, 2012. The intent of the DD was to record the remedial response decisions for 4825 Glenbrook Road and to describe the selected remedy of removal of the house and remediation such that there are no unacceptable risks to residential receptors, providing for the property's unrestricted future use. The remedy for 4825 Glenbrook Road was selected in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S. Code § 9601 *et*

seq., as amended by the Superfund Amendments and Reauthorization Act of 1986, and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan, 40 CFR Part 300 *et seq.*, as amended. The District of Columbia Department of Energy and Environment (DOEE) and Region III of the U.S. Environmental Protection Agency (USEPA) concurred with the selected remedy.

1.1.2.2 The DD for 4825 Glenbrook Road (USACE 2012b) established a remediation goal and RAOs for the 4825 Glenbrook Road RA. The remediation goal is the removal of all soil with a concentration greater than 20 mg/kg arsenic.

1.1.2.3 The RAOs for the site are:

1. Prevent direct contact with soil having a non-carcinogenic Hazard Index (HI) exceeding 1.
2. Prevent direct contact with soil having a cancer risk in excess of 1×10^{-4}.
3. Remove military munitions from the site, allowing for Unlimited Use/Unrestricted Exposure (UU/UE).

1.1.2.4 Achieving the remediation goal and RAOs required the following tasks:

- Demolish and remove the residence, including the house, foundation, slabs, all utilities (i.e., to include relocation and replacement as needed), driveway, sidewalks, and landscaping adjacent to the house;
- Excavate down to competent saprolite and/or bedrock and dispose of the soil at 4825 Glenbrook Road to ensure the removal of all military munitions, recovered CWM (RCWM), chemical agent contaminated media (CACM) hazards, and any other American University Experiment Station (AUES) related items and debris;
- Remove chemical agent (CA), agent breakdown product (ABP), and/or hazardous and toxic waste (HTW) impacted soil and collect samples to ensure the soil remaining at 4825 Glenbrook Road achieves the remediation goal of 20 mg/kg arsenic and RAOs 1 and 2 in paragraph 1.1.2.3 above.

1.1.2.5 In addition to the above tasks, the scope of the RA also included investigating 11 test pits (TPs 144-154) and one trench in accordance with the Site-Specific Work Plan for the Test Pit Investigations at 4825 and 4835 Glenbrook Road Properties (USACE 2009).

1.1.3 Site Description

1.1.3.1 The SVFUDS is located in the Spring Valley neighborhood of northwest Washington, D.C. (**Figure 1-1**). The 661-acre formerly used defense site (FUDS) property currently includes approximately 1,600 private residences, foreign embassies, American University (AU), Wesley Seminary, and numerous commercial properties. 4825 Glenbrook Road, also referred to as "the site" throughout this report, was a private residential parcel of approximately 0.4 acres that included a single family, detached residential dwelling (the house) owned by AU. **Figure 1-2** shows the site map for 4825 Glenbrook Road.

1.1.3.2 The environmental setting of the SVFUDS is described in detail in Subchapter 1.5 of the SVFUDS Site-Wide Work Plan (USACE 2007). The Washington, D.C. area climate is classified as modified continental with an average yearly temperature of 54.5 F. Surface water in the vicinity of the SVFUDS consists of intermittent streams that generally flow to the west. There are various groundwater aquifer systems within the vicinity of the SVFUDS including terrace gravel aquifers and fracture system aquifers that are associated with the Piedmont formations, saprolite systems, and fill systems. Groundwater is present in both of these aquifer systems; however, the majority of the groundwater at the SVFUDS is likely to be found in the underlying bedrock that comprises the fracture system aquifer.

1.1.3.3 Four soil associations are present within the SVFUDS: the Urban Land-Sassafras Chillum (ULSC), the Urban Land-Manor Glenelg (ULMg), Manor Glenelg (Mg), and Urban Land Brandywine (ULB). The ULMg soil association is a well to moderately well drained soil resulting from the weathering of the basement rocks (schist). The ULSC soil results from the weathering of coastal deposits; however, the soils typically have been greatly disturbed by construction and landscaping activities. The bedrock consists of a variety of metasedimentary rocks of actinolite schist. Saprolite material is encountered at depths that range between three to 15 feet below ground surface (bgs). This material appears to be the transition between loose soil material and bedrock within the SVFUDS including the 4825 Glenbrook Road property. Saprolite is thoroughly decomposed rock formed by in-place chemical weathering. It retains characteristics (such as cross-stratification) that were present in the original rock from which it formed, thus providing a strong indication that man-made activities have not impacted the layer. For this reason, competent saprolite was used during previous SVFUDS investigations and the RA to represent the limits of past intrusive activities. Therefore, achieving competent saprolite in an excavated area indicated the depth reasonably possible beyond which CWM, MEC, and AUES-related items would not be encountered. For the purposes of the RA conducted at 4825 Glenbrook Road, competent saprolite is defined as saprolite that cannot be excavated by hand tools, but can be excavated by powered equipment, and exhibits no evidence of disturbance.

1.1.4 Site History

1.1.4.1 During World War I, the U.S. Government established the AUES to investigate the testing, production, and effects of noxious gases, antidotes, and protective masks. The AUES was located on the grounds of the current AU and used additional portions of property in the vicinity to conduct research and development of CWM, including mustard agent, arsenical agents lewisite and adamsite, irritants, and smokes. Areas not used for testing were used to house and train troops (Camp Leach). In the years after the war, these activities were transferred to other locations and the site was restored and returned to the owners.

1.1.4.2 Various parts of the land formerly occupied by the AUES were sold and subsequently developed into private residential properties. The property at 4825 Glenbrook Road is one of the properties located within the former AUES footprint. The residence at 4825 Glenbrook Road was constructed in 1992. During the construction of the residence, a buried 55-gallon drum and obsolete laboratory equipment were encountered. The AU Office of Risk Management retained a private company to investigate potentially hazardous conditions. Soil gas vapor probes and exploratory hand excavation were utilized to determine that there were no hazardous or volatile

substances, nor explosive ordnance present at the property. However, within a month of this initial investigation, the construction workers experienced eye and respiratory irritation from an unknown source. The private company returned to investigate a white substance in the soil, which was determined to be Silvex, an herbicide. The construction of the residence at 4825 Glenbrook Road was completed without further documented incident. Subsequent investigations were conducted at 4825 Glenbrook Road and are described in section 1.1.5 below.

1.1.5 Previous Investigations

1.1.5.1 Previous investigations across the entire SVFUDS are described in detail in Subchapter 1.8 of the Site-Wide Work Plan (USACE 2007). Previous investigations conducted at 4825 Glenbrook Road are summarized in the Remedial Investigation (RI) Report for 4825 Glenbrook Road (USACE 2011a). The RI evaluation of 4825 Glenbrook Road was based on data collected from the past investigations from 1992 to 1999 and more recent investigations from 2000 to 2010 listed below.

1.1.5.2 During the 1999 investigation, the United States Environmental Protection Agency (USEPA) Region III performed soil sampling and a risk assessment. The risk assessment (USEPA 1999) identified potential "hot spots" of arsenic at 4801 and 4825 Glenbrook Road. The USEPA's risk assessment concluded the soil of the three properties (4801, 4825, and 4835 Glenbrook Road) may have been impacted by AU activities. USACE performed an investigation at these properties to determine the nature and extent of the potential impact. The elevated arsenic concentrations detected at 4825 Glenbrook Road as a result of the arsenic sampling in 2000 led to a series of investigations and removal activities at the site through 2010. The investigations listed below were performed previously at 4825 Glenbrook Road and were included in the RI for 4825 Glenbrook Road (USACE 2011a). It should be noted that the terms "high" and "low probability" in the investigations below refer to the likelihood of encountering MEC/CWM as determined by a Probability Assessment conducted by USACE discussed further in paragraph 1.1.6.3.

1. Geophysical Investigation (February 1999)
2. Arsenic Sampling and Removal (2000-2001)
3. Test Pits and Trenches Investigation (2001-2002)
4. 4825 Test Pit Investigation (Test Pit 23) – (May 2001 – March 2002)
5. Soil Gas and Driveway Boring ABP Soil Sampling (March – June 2007)
6. Burial Pit 3 Investigation and Burial Pit 3 Extensions (October 2007 – March 2009)
7. Low Probability Test Pit Investigation (March – August 2009)
8. Arsenic Sampling and Removal in the Driveway (May – July 2009)
9. High Probability Test Pits Investigation (November 2009 – April 2010)
10. Geotechnical Soil Boring and Backyard Soil Sampling (August 2010)

1.1.5.3 **RI Report (USACE 2011a) Summary and Conclusions** - Approximately 530 tons of non-hazardous soil were excavated during the Burial Pit 3 investigation (Burial Pit 3 is shown on **Figure 1-3** for location reference only). Approximately 2,326 tons of arsenic-contaminated soil and non-hazardous soil excavated during the high probability test pit investigations were removed from the property and disposed of offsite as non-Resource Conservation and Recovery Act (RCRA) hazardous waste. Disposal samples were collected, analyzed, and met regulatory limits prior to disposal as non-hazardous soil. Approximately 75 tons of CA/ABP-impacted waste was

removed from the property and disposed of offsite. Aqueous investigation derived waste (IDW) generated from the investigation activities were characterized and disposed of offsite. The RI (USACE 2011a) concluded that high probability test pits 120 and 134 required further remedial action and seven low probability test pits (135, 136, 139, 140, 143, 144, and 145) remained to be investigated as shown in **Figure 1-3**.

1.1.6 Rationale for Conducting the RA at 4825 Glenbrook Road

1.1.6.1 During the RI at 4825 Glenbrook Road, USACE investigated 41 low probability test pits from March – August 2009 (investigation 7 in the list above). Only one test pit contained suspect AUES-related glassware at 6 feet (ft) bgs. An additional seven low probability test pits (numbered 135, 136, 139, 140, 143, 144, 145 on **Figure 1-3)** still required investigation. These areas were previously inaccessible due to the conditions at the site, such as retaining walls, access steps, etc. The investigation of the seven remaining low probability test pits was completed during the RA.

1.1.6.2 High probability test pits (numbered 120, 134, and 138) were investigated from November 2009 – April 2010 (investigation 9 in the list above). The closed and open cavity items uncovered during the excavation included glass bottles, glass vials, glass test tubes, glass jars, metal bottles, and 75mm projectiles. Of these items, 26 were identified as CWM, two were identified as MEC (one closed cavity 75mm projectile and one unfuzed, unfired 75mm shrapnel round), three were identified as munitions debris (MD) (two open cavity 75mm projectiles and one unfuzed 75mm projectile with hexagonal plug), and the remaining items were identified as suspected AUES-related non-munitions scrap. CA and ABPs were detected in intact containers and soil uncovered in the vicinity of the excavation. Other industrial chemicals such as chloroacetophenone, diphenylchloroarsine, and arsenic trichloride ($AsCl_3$), were also detected in the intact containers. Intact containers were destroyed by CCDC (formerly known as ECBC) at Aberdeen Proving Ground, Maryland, after analysis was performed. CA/ABP impacted soil excavated during the investigation was placed in drums and properly disposed of offsite. Metals detected in soil samples that had no detections of CA/ABPs that exceeded the accepted comparison values (CVs) included aluminum, arsenic, iron, magnesium, and thallium. Sample results showed that soil with concentrations of analytes exceeding the accepted CVs still remained in this area. $AsCl_3$ was detected in a vapor and soil sample, which was not previously detected at the SVFUDS. Because of this, USACE ceased investigation/removal activities to perform an analysis of the safety control measures to adequately contain and filter the unanticipated chemical. The results of this analysis concluded that the Chemical Agent Filtration System (CAFS) operated and maintained by CCDC was capable of filtering arsenic trichloride (ECBC 2011). When USACE ceased operations, the property was rendered safe by backfilling. The suspended remedial activities were completed under this RA as previously outlined in paragraphs 1.1.2.4 and 1.1.2.5.

1.1.6.3 The risk assessment completed in support of the RI (USACE 2011a) determined that CWM and MEC hazards may still be present at the site. RCWM and CACM were known to be present in the high probability test pits. Based on the results of the previous investigations, the Probability Assessment (USACE 2012a) delineated the 4825 Glenbrook Road site into “high probability areas” or “low probability areas” based on whether there was a high or low probability that MEC/CWM may be encountered. The Probability Assessment (USACE 2012a) determined

that there was a high probability of encountering CWM in areas D, E and F and there was a low probability of encountering CWM in areas A and B (see **Figure 1-4**). Based on the Probability Assessment (USACE 2012a), and with the concurrence of the PDT comprising CEHNC, CENAB, and the RA contractor, encountering MEC was not likely at 4825 Glenbrook Road, but was still a possibility. The DD (USACE 2012b) stated that removing the house and remediating the property such that there are no unacceptable risks to residential receptors, provided the best long-term solution providing for the property's unrestricted future use as described in the Proposed Plan (PP) (USACE 2011c).

1.2 OVERALL APPROACH AND METHODS

1.2.1 House Demolition

Before remedial activities were performed, the house at 4825 Glenbrook Road was demolished to provide access to the underlying soil. House demolition field activities occurred from November 29, 2012 – December 7, 2012. A demolition subcontractor removed and disposed of the residence in accordance with the Demolition Plan in the SSWP for the Remedial Design/Remedial Action at 4825 Glenbrook Road, Revision 6 (USACE 2017). No subsurface work was performed during the demolition work; this included leaving in place the foundation slab, exterior walls of the basement that were below the existing ground surface, the front porch, and the rear patio. No unexpected site conditions or challenges were encountered during this phase of the RA.

1.2.2 Test Pits and Trench Investigation

1.2.2.1 Seven test pits (numbered 135, 136, 139, 140, 143, 144, 145 on **Figure 1-3**) remained after the low probability test pit investigation performed from March – August 2009 and were investigated during the RA. Of these seven test pits, five test pits (135, 136, 139, 140, and 143) fell within the high or low probability areas delineated by the Probability Assessment (USACE 2012a) where there was either a high or low probability that MEC/CWM may be encountered and were excavated in accordance with the RA SSWP (USACE 2017). The Probability Assessment (USACE 2012a) determined that there was a high probability of encountering CWM in areas D, E and F and there was a low probability of encountering CWM in areas A and B. As stated previously in paragraph 1.1.6.3, encountering MEC during the RA was not anticipated, but was still possible. In preparation for relocating the utility lines, ten (10) test pits (numbered 144, 145, 146, 147, 148, 149, 150, 151, 152, and 154) and one trench (referred to as the "J-trench" due to its shape) were investigated in accordance with the SSWP for the Test Pit Investigations at 4825 and 4835 Glenbrook Road Properties (USACE 2009). On February 27, 2013, the PDT decided not to investigate TP 153 because there was a water line running through it and TP 152 was subsequently rotated 90 degrees. This decision is documented in the February 28, 2013 weekly PDT call meeting minutes in Appendix P. For the 10 test pits, approximate dimensions of 3 feet by 6 feet were investigated. For the J-trench, a dimension of 3 feet wide by approximately 57 feet long (parallel to the Kreeger Music Roadway) and approximately 3 feet wide and 39 feet long (parallel to the 4801 and 4825 Glenbrook Road boundary) was investigated.

1.2.2.2 A test pit was considered "cleared for debris" when the excavated soil from a six-inch lift contained no debris, as determined by the intrusive team. Once the soil was considered to be "cleared for debris," the excavation was advanced six inches deeper for confirmation of debris clearance (i.e. a total of one foot contained no debris). The excavation was advanced to competent saprolite and/or bedrock, or to the maximum extent of the equipment reach, whichever came first. The J-trench was dug to the depth needed to install the temporary sewer line, except where test pits 152 and 154 were located within the J-trench. No unexpected site conditions or challenges were encountered during this phase of the RA.

1.2.3 Soil Removal from High and Low Probability Areas

1.2.3.1 Based on the results of the previous investigations, the Probability Assessment (USACE 2012a) delineated the 4825 Glenbrook Road site into high or low probability areas, based on whether there was a high or low probability that MEC/CWM may be encountered. The Probability Assessment (USACE 2012a) determined that there was a high probability of encountering CWM in areas D, E and F and there was a low probability of encountering CWM in areas A and B (see **Figure 1-4**). As stated previously in paragraph 1.1.6.3, encountering MEC during the RA was not anticipated, but was still possible. The site was further delineated into smaller 20-foot by 20-foot squares, called "grids." The excavation in each area was conducted on a grid-by-grid basis to facilitate tracking, and to make sampling and disposal record keeping more thorough and manageable.

1.2.3.2 Both high and low probability areas were excavated to the depth of competent saprolite. The RA contractor geologist determined when competent saprolite was reached with concurrence being required by a USACE geologist. After competent saprolite was reached and confirmed by a USACE geologist, confirmation soil samples were collected. Based on the results of the confirmation samples after competent saprolite was reached, additional excavation, referred to as **over excavation** throughout this report, was performed in certain grids to remove HTW-impacted soil. After over excavation, additional confirmation samples were collected and analyzed for the parameters that exceeded the CVs in the original confirmation sample after competent saprolite was initially reached. For example, a grid was excavated down to competent saprolite during high probability operations and the confirmation floor sample contained no detections of CA or ABPs; however, the sample contained arsenic exceeding the remediation goal of 20 mg/kg. This grid was then over excavated 2 feet down and an additional confirmation floor sample was collected and analyzed for arsenic only to ensure the remediation goal for arsenic had been achieved for that particular grid. If the remediation goal of 20 mg/kg arsenic was not achieved after the initial 2 foot over excavation, then the area was over excavated in additional 1 foot increments and sampled until the remediation goal was met or the excavated area reached bedrock, whichever came first. The RA contractor geologist determined when bedrock was reached with concurrence being required by a USACE geologist.

1.2.3.3 Excavation was conducted using hand-digging tools and mechanical equipment (i.e., mini excavator or equivalent-sized equipment operated by a heavy equipment operator). The high and low probability excavations were conducted in six-inch lifts, with each lift of excavated material being inspected then re-inspected by a UXO Technician II or III for items of interest (e.g., suspect items, labware, etc.) before the next lift was excavated. After visual screening and

inspection with a Schonstedt magnetic detector, the excavated material was collected in roll-offs or 55-gallon drums. Items of interest discovered during the excavation were removed, documented, photographed, stored, and disposed of in accordance with the SSWP (USACE 2017). Items of interest recovered during the high and low probability intrusive operation of the RA are discussed in Chapter 2.

1.2.3.4 Remediation of the high probability areas was conducted within an Engineering Control Structure (ECS), which was repositioned twice to cover the entire high probability area as delineated in the DD (USACE 2012b). The three ECS positions are shown in **Figure 1-4**. The ECS was positioned and anchored such that the excavation did not compromise the ECS foundation elements. Negative pressure was maintained within the ECS using an attached CAFS during all high probability remedial activities. Prior to remedial activities commencing inside the ECS at each location, the ECS was smoke tested to demonstrate adequate containment. High probability operations were conducted from September 2013 – July 2016. ECS location 1, the area in front of the former house and the front portion of the soil beneath the house (area F and part of area E), was excavated to competent saprolite first. ECS location 2, the back portion of the former house and the backyard (remaining part of area E and area D), was excavated to competent saprolite next, and ECS location 3, the soil beneath the house (part of area E), was excavated to competent saprolite last of the high probability areas.

1.2.3.5 Challenges were encountered during the high probability excavation of area F under ECS location 1. An unknown chemical interferent triggered re-occurring false positive alarms for Lewisite (L) on the air monitoring equipment (discussed in section 2.4). Numerous intact containers and chemical agent-impacted soil were removed from grids (-10, -10) and (-10, -30) within area F. No significant challenges were encountered during the high probability excavations under ECS locations 2 and 3.

1.2.3.6 Intrusive excavation of the low probability areas was conducted in open air without an ECS; however, air monitoring for public and worker safety was still conducted and is described in section 1.2.4. A portion of area B [grids (-50, -50), (-50, -30), (-50, -10), and (-50, 10)] along Glenbrook Road was excavated to competent saprolite from January 2013 – February 2013. Area A comprising grids (70, -10), (70, 10), (90, 10), (90, -10), (70, -30), (70, -50), (90,- 30), (90, -50) was excavated from August 2016 – October 2016. No unforeseen site conditions or significant challenges were encountered during these low probability operations.

1.2.3.7 A portion of area B [grids (-10, -70), (-10, -90), (-30, -70), (-30, -90)] was excavated to competent saprolite from October 2016 – March 2017. Unforeseen site conditions were encountered during this phase of low probability intrusive operations. CACM was first encountered in the soil in grid (-10, -90) in February 2017. The CACM was sampled and analysis identified it as solidified mustard agent (HD). Due to encountering CACM in area B along the 4825 and 4835 Glenbrook Road property line, CEHNC and CENAB determined that additional sampling was needed to determine whether CACM and/or CA/ABP impacted soil from the 4825 Glenbrook Road property did not extend on to the 4835 Glenbrook Road property. This additional sampling effort is discussed in Chapter 8.

1.2.3.8 A portion of area B [(10, -90), (30, -90), and (50, -90)] was excavated from March 2017 – August 2017. Unforeseen site conditions and challenges were encountered during this phase of the RA. AUES glass and CACM, in the form of solidified HD, were encountered throughout these three grids. This required the development of standard operating procedure (SOP) 48 - Low Probability Soil Excavation, which was incorporated into the SSWP (USACE 2017) to safely complete the excavation of the remaining low probability areas. SOP 48 established an enhanced air monitoring approach that included additional air monitoring locations and procedures. SOP 48 also delineated five remaining low probability areas (numbered 1 through 5) that required excavation under the enhanced air monitoring approach as shown in **Figure 1-5**. These included the southern portion of area 1 on the 4825 Glenbrook property, area 3, and area 4 and additional areas including the northern portion of area 1 on the 4835 Glenbrook property, area 2, and area 5. The RA contractor obtained permission from the CEHNC contracting officer to expand the excavation of areas 1, 2, and 3 onto the 4835 Glenbrook Road property.

1.2.3.9 While performing low probability intrusive operations under SOP 48, additional challenges were encountered when an unknown chemical interferent triggered re-occurring false positive alarms for Lewisite (L) on the air monitoring equipment (discussed in section 2.4). SOP 49 - Additional Low Probability Soil Excavation was developed to safely complete the excavation to competent saprolite in the remaining low probability areas including area 4 and the north wall of grid (-10, -90) as shown in **Figure 1-6**. The RA contractor obtained permission from the CEHNC contracting officer to expand the excavation of the north wall of grid (-10, -90) onto the 4835 Glenbrook Road property. SOP 49 established additional air monitoring locations and site procedures in the event that additional false positive air monitoring alarms occurred for L.

1.2.3.10 While SOPs 48 and 49 were being developed, HTW-impacted soil was over excavated from former high and low probability grids where confirmation samples had detected no CA or ABPs, but contained arsenic concentrations exceeding the remediation goal of 20 mg/kg. From March 2018 – August 2018, the former high probability grids shown in **Figure 1-7** were over excavated and re-sampled until the remediation goal of 20 mg/kg arsenic was achieved or bedrock was reached, whichever came first. In June 2019, former high probability grid (30, -50), and former low probability grids (-30, -70) and (10, -90) shown in **Figure 1-8** were over excavated until the remediation goal of 20 mg/kg was achieved. The final extent of the excavation at the conclusion of the 4825 Glenbrook Road RA is shown in **Figure 1-9** and results of the RA are discussed in Chapter 2.

1.2.4 Air Monitoring Overview

Air monitoring for CA and industrial chemicals was conducted during the RA for public and worker safety. The air monitoring methods employed during intrusive activities at 4825 Glenbrook Road depended upon whether intrusive operations were being conducted in a high probability area or a low probability area. CA and industrial chemical air monitoring were conducted during all intrusive operations in accordance with the SSWP (USACE 2017), in addition to supplemental Air Monitoring Plans developed for SOP 48 and 49 specifically. During intrusive operations, the CCDC Air Monitoring Team continuously monitored the exclusion zone (EZ) (which was the ECS for high probability areas and at the excavation location for low probability areas) for the presence of CA in near real-time. The purpose of CA air monitoring was to indicate whether a hazardous

atmosphere was present and to maintain a record of possible worker exposure to airborne CA, thus ensuring the safety of the onsite personnel, surrounding communities, and the environment. Notable air monitoring results are discussed in Chapter 2.

1.2.4.1 Air Monitoring Equipment Used During Intrusive Operations

1.2.4.1.1 Air monitoring equipment was used and positioned in a variety of configurations throughout high and low probability intrusive operations. Air monitoring for HD, L, phosgene (CG), cyanogen chloride (CK), and chloropicrin (PS) was conducted by the CCDC Air Monitoring Team during all intrusive operations in accordance with the SSWP (USACE 2017) and supplemental SOPs. When detections occurred, results were conveyed to all site personnel via radio, discussed with the onsite USACE Ordnance and Explosives Safety Specialist (OESS) and RA contractor Site Manager, reported daily in the CCDC Daily Situation Reports (Appendix H), and summarized in the RA Contractor Daily Reports (Appendix C).

1.2.4.1.2 Near real-time air monitoring was performed using the Miniature Continuous Air Monitoring System (MINICAMS). A MINICAMS is an automatic air monitoring system that collects compounds on a solid sorbent trap, thermally desorbs them into a capillary gas chromatography column for separation, and detects the compounds with a Halogen Specific Detector (XSD). It is a lightweight, portable, low-level monitor designed to respond in less than ten minutes with alarm capability. During high probability intrusive operations under the ECS, MINICAMS monitored for HD, L, CG, CK, and PS at the CAFS pre-filter, CAFS Filter 1 midbed, CAFS Filter 2 midbed, CAFS Filter 3 midbed, and the personnel decontamination station (PDS). Results were reported in terms of the chemical-specific short-term exposure limits (STEL), and the units were set to alarm at 0.4 times the STEL for L, HD, CG, CK, and PS. MINICAMS functionality was calibrated at least twice a day, with more frequent calibration when detections occurred.

1.2.4.1.3 Depot Area Air Monitoring System (DAAMS) pumps were used for confirmation of MINICAMS results and worker population limit (WPL) monitoring. The DAAMS is a portable air-sampling unit which is designed to draw a controlled volume of air through a glass tube filled with a solid sorbent collection material. As the air is passed through the solid sorbent tube, CA is collected on the sorbent bed. After sampling for the predetermined period of time and flow rate, the tube was removed from the vacuum line and transferred to the CCDC Mobile Analytical Platform (MAP) for analysis. The purpose of DAAMS confirmation samples was to confirm or refute a near real time (MINICAMS) alarm.

1.2.4.1.4 Electrochemical detectors were used to detect hydrochloric acid (HCl), arsine (AS), and hydrogen cyanide (HCN) during all intrusive operations. Any alarms or detections on the electrochemical detectors were recorded in the RA Contractor Daily Reports (Appendix C).

1.2.4.1.5 A photoionization detector (PID) was used to monitor for volatile organic compounds (VOCs) near the excavation area during all intrusive operations. Any alarms or detections on the PID were recorded in the RA Contractor Daily Reports (Appendix C).

1.2.4.1.6 An ADR-1500 dust monitor was positioned at a perimeter location upwind of the excavation area and another was placed at a perimeter location downwind of the excavation to continuously monitor for dust emissions during low probability and HTW excavation operations.

1.2.5 Investigation Derived Waste (IDW) Disposal Overview

1.2.5.1 Soil excavated from the site was either placed in 55-gallon polyethylene drums, which could hold approximately 0.125 cubic yards of excavated soil, or in a polyethylene-lined roll-off box, which could hold approximately eight (8) cubic yards of excavated soil. Soil waste characterization samples were collected as the roll-offs or drums were filled. If CA or ABPs were detected in the soil waste characterization samples, the associated roll-off or drums were categorized and disposed of as hazardous waste. If no CA or ABPs were detected in the samples, then the remaining split samples were sent to a commercial lab for further toxicity characteristic leaching procedure (TCLP) analysis. If these sample results were below all EPA regulatory limits, the associated roll-off or drums were disposed of as non-hazardous waste by the waste handling subcontractor. If any of these sample results were above EPA regulatory limits, the associated roll-off or drums were disposed of as hazardous waste by the waste handling subcontractor.

1.2.5.2 Decontamination water was collected in drums. Sumps were constructed throughout the excavation to collect ponding water from heavy rainfall events and pumped into 21,000-gallon Baker tanks. Aqueous laboratory waste was also generated by the onsite CCDC laboratory. Aqueous waste samples were analyzed for CA, ABPs, and TCLP parameters. If no CA and/or ABPs were detected in the samples and other results were below EPA regulatory limits, the associated water was disposed of as non-hazardous waste by the waste handling subcontractor. If CA and/or ABPs were detected in the samples and/or other results were above EPA regulatory limits, the associated water was disposed of as hazardous waste by the waste handling subcontractor.

1.2.5.3 Concrete waste was generated during the RA during the removal of the basement walls, footers, and foundation from the former house. Concrete that was deemed hazardous waste through CA/ABP sampling was broken up into approximately 6-inch by 6-inch by 6-inch blocks and transferred to 55-gallon drums for offsite disposal. Non-hazardous concrete waste was transferred into roll-offs for offsite disposal. Other forms of solid IDW including PPE, construction debris, soil sampling jars, and solid laboratory waste from the onsite CCDC laboratory were placed in 55-gallon polyethylene drums. The drums were disposed of as hazardous waste if the contents came into contact with CA and/or ABP-contaminated soil based on the sampling results from that particular workday's activities.

1.2.5.4 As the generator of the site's HTW, CENAB was responsible for signing waste manifests and required documentation for the transportation and disposal of HTW from 4825 Glenbrook Road. Waste manifests are included in Appendix N. A summary of IDW removed from 4825 Glenbrook Road is included in Chapter 2.

1.2.6 Site Restoration Activities

After the completion of the RA at 4825 Glenbrook Road, the excavated areas were surveyed by a licensed professional surveyor. The utilities (sewer and water lines) were returned to service

in accordance with local and industry standards. The site was then backfilled with clean soil and compacted to meet the standards referred to in the SSWP (USACE 2017). The backfill source was sampled, analyzed, and approved by USACE, USEPA, and DOEE. The site was graded in accordance with the final grading plan agreed to by the PDT and AU. Final grading was completed in May 2021. After final grading was completed, topsoil was placed across the site. The topsoil source was sampled, analyzed, and approved by USACE, USEPA, and DOEE. Hydroseeding was completed in July 2021 and the property fence was installed and completed in August 2021.

1.3 FIELD ACTIVITY DATES

The dates of major activities conducted during the 4825 Glenbrook Road RA are presented below in **Table 1-1**.

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Table 1-1: 4825 Glenbrook Road RA Field Activity Timeline

Task	Start	Finish
Mobilization to 4825 Glenbrook Road and Set-Up Activities	**April 18, 2012**	**March 14, 2013**
Residence Demolition	**November 29, 2012**	**December 7, 2012**
Initial Low Probability Excavation	**January 31, 2013**	**June 6, 2013**
Excavated Area B (former front yard area)	January 31, 2013	February 14, 2013
CENAB geologist confirmed competent saprolite in Area B grids: (-50, -50), (-50, -30), (-50, -10), (-50, 10)		February 7, 2013
Confirmation samples collected from the grids listed in the row above		February 11, 2013
Excavated 10 Test Pits	February 20, 2013	March 5, 2013
J-Trench Excavated	March 20, 2013	April 12, 2013
Soldier Pile Installation	April 30, 2013	May 10, 2013
Set-Up for High Probability Work	**May 28, 2013**	**September 18, 2013**
CCDC Equipment Installation	May 28, 2013	May 29, 2013
Erected ECS over Area F/E (ECS Location 1)	June 10, 2013	July 25, 2013
CAFS System Installation and Maintenance	August 1, 2013	August 7, 2013
ECS Electrical, Video System Set-up	August 5, 2013	September 4, 2013
Smoke Tested ECS	September 18, 2013	September 18, 2013
Pre-Operational Exercises	July 29, 2013	September 20, 2013
Performed High Probability Excavation	**September 23, 2013**	**July 1, 2016**
Excavated Area F/E (ECS Location 1)	September 23, 2013	August 21, 2014
False MINICAMS alarms for L while excavating grid (-10, -30) under ECS		March 25, 26, and 28, 2014 and April 1, 2014
CENAB geologist confirmed competent saprolite in Area F grids: (-10, -10), (-10, -30), (-10, -50), (-10, -70), (-30, -10), (-30, -30), (-30, -50), (-30, -70)		July 30, 2014
Confirmation samples collected from the grids listed in the row above		July 31, 2014
Repositioned ECS over Area E/D	September 22, 2014	October 17, 2014
Excavated Area E/D (ECS Location 2)	December 3, 2014	August 17, 2015
CENAB geologist confirmed competent saprolite and confirmation samples collected in Area D grids: (30, -70), (50, -70)		September 16, 2015
CENAB geologist confirmed competent saprolite in Area D grids: (30, -50), (50, -50), (70, -50), (30, -30), (50, -30), (70, -30), (30, -10), (50, -10), (70, -10), (50, 10), (70, 10)		October 16, 2015
Confirmation samples collected from the grids listed in the row above		October 19, 2015
Basement Wall and Floor Demolition	August 25, 2015	September 24, 2015

Table 1-1: 4825 Glenbrook Road RA Field Activity Timeline

Task	Start	Finish
Repositioned ECS over Area E/F	November 12, 2015	February 23, 2016
Excavated Area E/F (ECS Location 3)	February 24, 2016	July 1, 2016
CENAB geologist confirmed competent saprolite in Area E grids: (10, -10), (10, -30), (10, -50), (10, -70)		May 17, 2016
Confirmation samples collected from the grids listed in the row above		May 18, 2016
Demobilized/Tear Down High Probability	**July 6, 2016**	**August 15, 2016**
Resumed Low Probability Excavation	**August 15, 2016**	**June 16, 2020**
Set-Up to Excavate Area A	August 15, 2016	September 15, 2016
9/16/15 and 10/19/15 Confirmation samples re-collected for HTW parameters only		August 31, 2016
Excavated Area A	September 20, 2016	October 24, 2016
CENAB geologist confirmed competent saprolite in Area A grids: (70, -10), (70, 10), (90, 10), (90, -10), (70, -30), (70, -50), (90, -30), (90, -50)		October 11, 2016
Confirmation samples collected from the grids listed in the row above		October 17, 2016 and October 24, 2016
Began Area B excavation	October 25, 2016	November 16, 2016
Dug Trench for Sewer Re-route	November 28, 2016	December 8, 2016
Continued Area B excavation	January 24, 2017	August 9, 2017
First recovered CACM (solidified HD) in Area B grid (-10, -90)		February 23, 2017
CENAB geologist confirmed competent saprolite in Area B grids: (-10, -70), (-10, -90), (-30, -70), (-30, -90)		March 1, 2017
Confirmation samples collected from the grids listed in the row above		March 2, 2017
Continued Area B excavation	March 8, 2017	August 9, 2017
CACM encountered in grid (10, -90)		March 16, 2017
CACM encountered in grid (10, -90)		April 5, 2017
Continued Area B excavation of grids (50, -70) and (50, -90) AUES glass and CACM encountered	April 12, 2017	April 18, 2017
Continued Area B excavation of grids: (10, -90), (30, -90), (50, -90)	June 5, 2017	August 9, 2017
Worker exposure incident occurred. Low probability intrusive operations suspended to revise SSWP (SOP 48)		August 9, 2017
Temporarily Backfill Area B	September 6, 2017	September 14, 2017
Concrete Demolition and Containerization	October 5, 2017	November 13, 2017
4835 Glenbrook Road Sampling Effort	**November 24, 2017**	**February 1, 2018**

Table 1-1: 4825 Glenbrook Road RA Field Activity Timeline

Task	Start	Finish
Set Up and Over Excavation of HTW Impacted Grids: (10, -10), (30, -30), (50, -10), (50, -30), (70, 10)	**February 5, 2018**	**August 2, 2018**
Resumed Low Probability Excavation (under SOP 48)	**August 6, 2018**	**June 8, 2020**
Completed excavation of Area 1	October 29, 2018	April 8, 2019
CENAB geologist confirmed competent saprolite in Area A and B grids: (90, -90), (90, -70), (70, -70), (70, -90)	February 25, 2019	February 25, 2019
Confirmation samples collected from the grids listed in the row above	February 26, 2019	February 26, 2019
Completed excavation of Areas 2 and 3	February 27, 2019	March 6, 2019
Began over excavation of Area 4 under SOP 48	March 7, 2019	March 28, 2019
False MINICAMS alarms for L	March 26, 2019 and March 28, 2019	
Intrusive operations suspended in Area 4 to revise SSWP (SOP 49) to complete over excavation of Area 4 and north wall of grid (-10, -90)	March 29, 2019	February 25, 2020
CENAB geologist confirmed competent saprolite in Area B grids: (10, -70), (10, -90), (30, -90), (50, -70), (50, -90), (30, -70), (-50, -70), (-50, -90)	April 18, 2019	April 18, 2019
Confirmation samples collected from the grids listed in the row above	May 9, 2019 and May 15, 2019	
Excavated Area 5 (eastern portion of grid 90, -50)	May 22, 2019	May 23, 2019
Over Excavation of HTW Impacted Grids: (30, -50), (-30, -70), (10, -90)	**June 3, 2019**	**July 22, 2019**
Compacted Existing Backfill	September 30, 2019	December 5, 2019
Resume Low Probability Excavation Under SOP 49	**February 3, 2020**	**June 15, 2020**
Completed over excavation of Area 4 (under SOP 49)	February 3, 2020	March 20, 2020
CENAB geologist confirmed bedrock refusal in southern half of grid (-10, -30)	March 31, 2020	
Completed over excavation of north wall of grid (-10, -90)	June 8, 2020	June 15, 2020
Site Restoration	**June 16, 2020**	**August 27, 2021**
Demobilization from 4825 Glenbrook Road	**August 27, 2021**	

1.4 PUBLIC INVOLVEMENT

Communications and contacts with the public were under the direction of CENAB. Public relations and community involvement were managed by the RA contractor. Multiple public

meetings were held throughout the course of the RA to keep the public informed and to address the community's questions. The community relations staff published a weekly update on CENAB's website (https://www.nab.usace.army.mil/Home/Spring-Valley/4825-Glenbrook-Road/) to inform the Spring Valley community and general public on the project's progress and provided direct communication and coordination with the Spring Valley residents.

1.5 FUTURE REMEDIATION ACTIVITIES

No additional future remedial activities are necessary for 4825 Glenbrook Road.

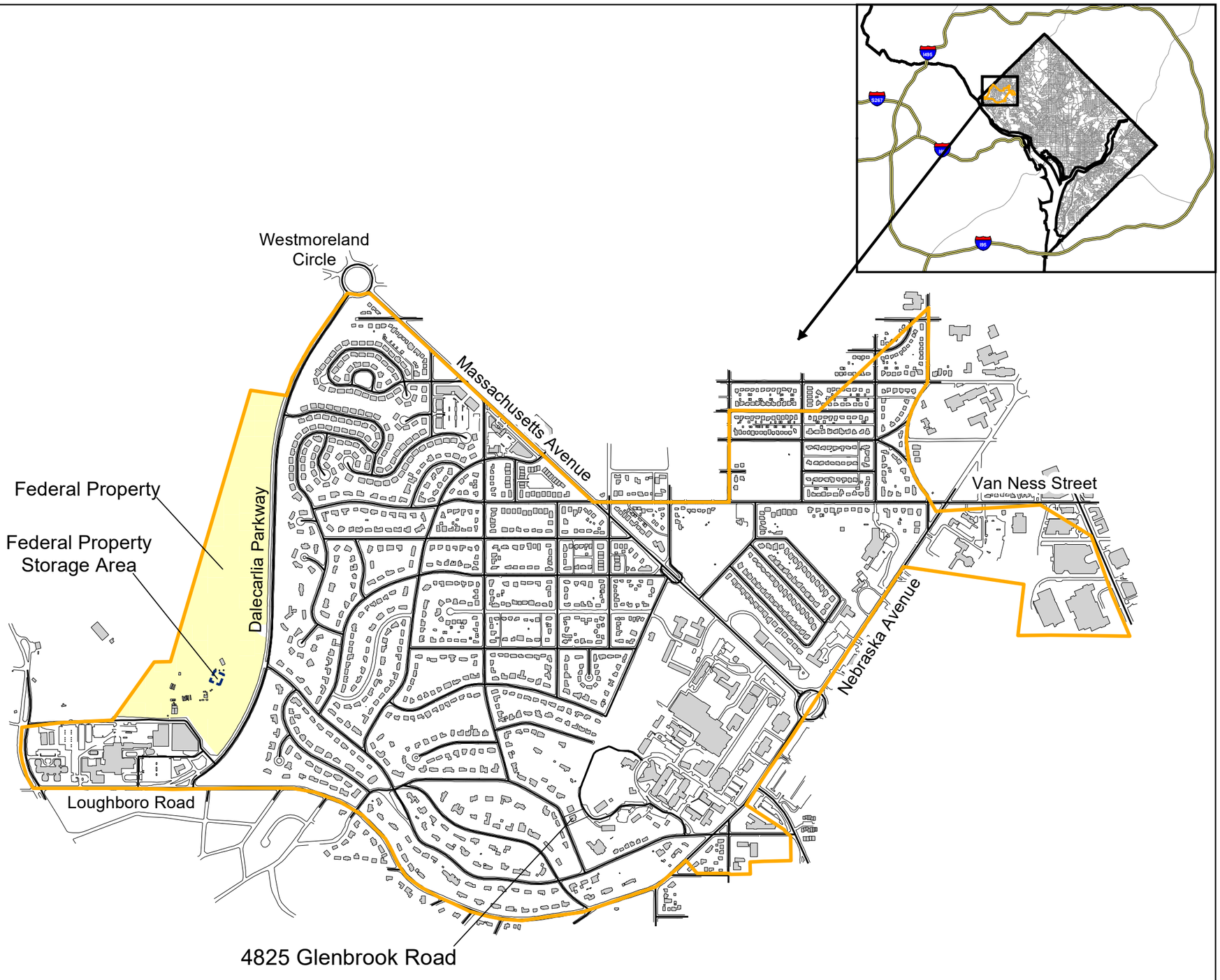

Figure 1-1
Spring Valley FUDS Location

Spring Valley
Washington, D.C.

Legend

- Buildings
- Spring Valley FUDS Boundary
- Federal Property
- Federal Property Storage Area
- Road

1,200 600 0 1,200 Feet

1 inch = 1,000 feet

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Date:	1/12/2021
Figure Number:	1-1
Page Number:	1-17

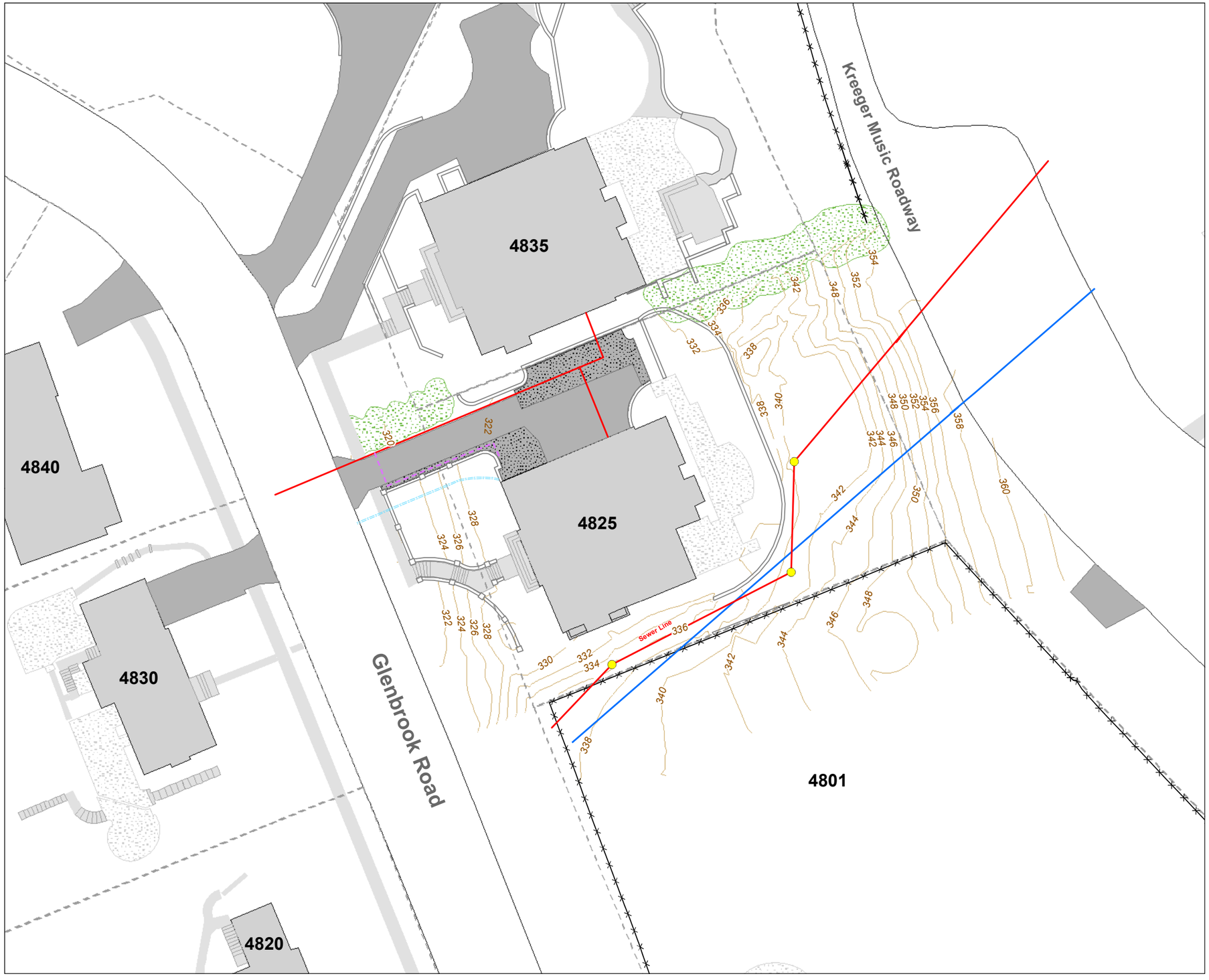

Figure 1-2
Site Map of
4825 Glenbrook Road

Spring Valley
Washington, D.C.

Legend

- Buildings
- Parcels
- Driveway
- Gravel Surface
- Sidewalk
- Deck/Porch
- Shrubbery
- Property Fence
- Retaining Wall
- Manhole
- Sewer Line
- Water Line
- Gas Line
- Electric Line
- Elevation Contours

30 15 0 30 Feet

1 inch = 32 feet

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Date:	1/12/2021
Figure Number:	1-2
Page Number:	1-18

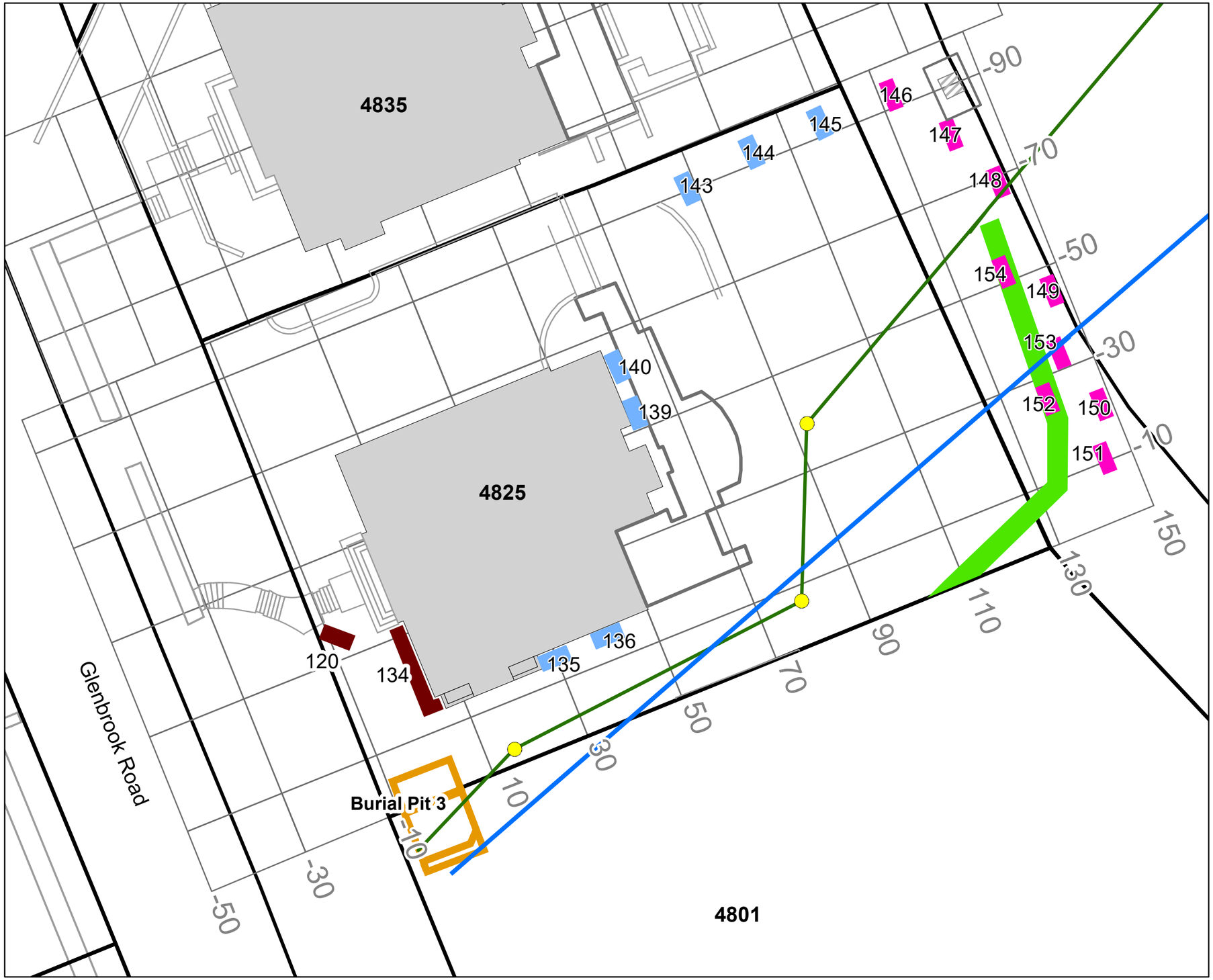

Figure 1-3
Test Pits and Trench Locations
4825 Glenbrook Road

Spring Valley
Washington, D.C.

Legend

- Additional TPs Investigated During RA
- Trench for Rerouted Sewer Line (J Trench)
- High Probability Test Pits (2 TPs)
- 7 TPs Remaining from 2009 Investigation to be Completed During RA
- Burial Pit 3
- Property Boundaries
- Buildings
- 20' Grid
- Manhole
- Sewer Line
- Water Line

0 10 20 40 Feet

1 inch = 20 feet

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Date:	1/12/2021
Figure Number:	1-3
Page Number:	1-19

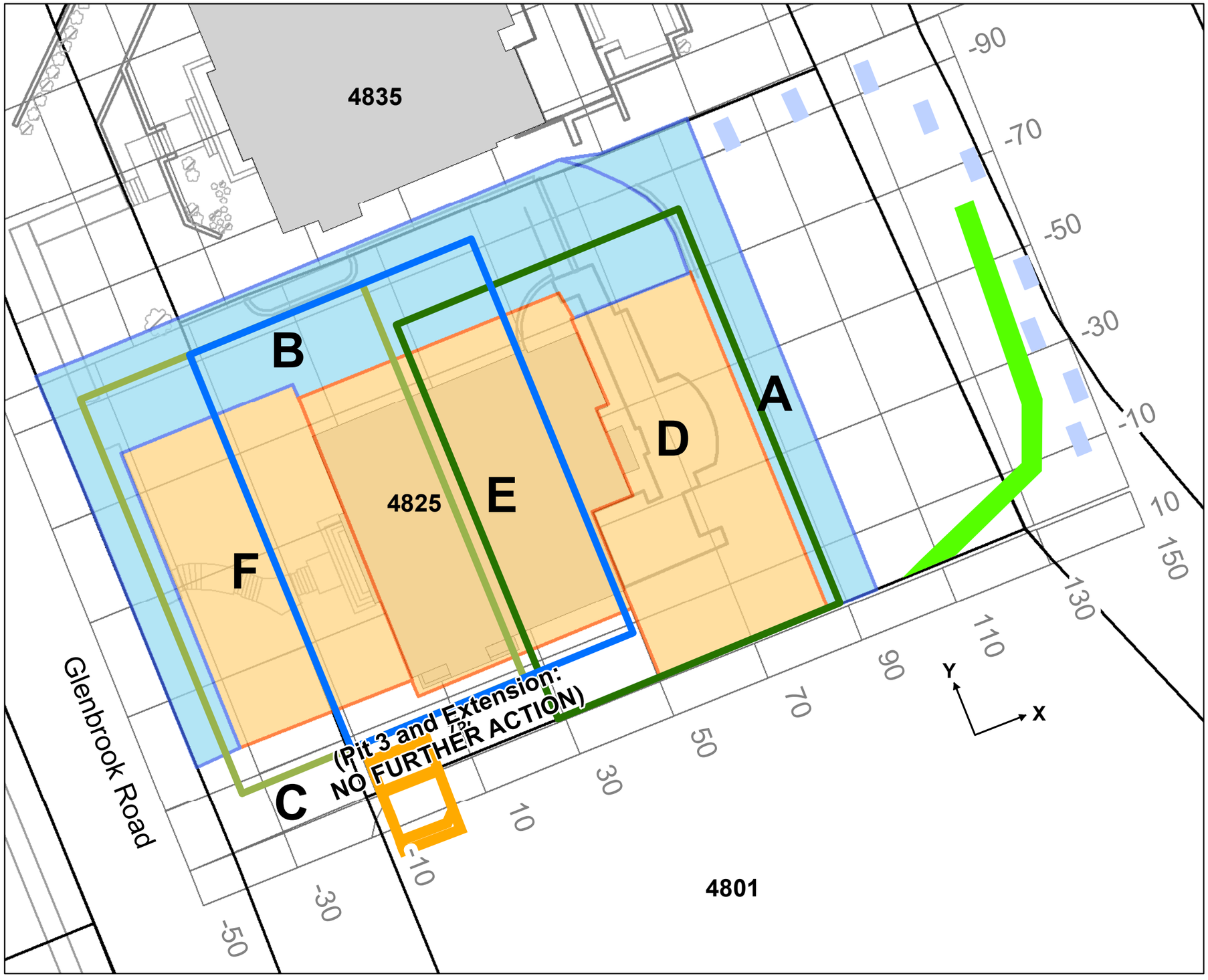

Figure 1-4
High and Low Probability
Areas and ECS Locations
4825 Glenbrook Road

Spring Valley
Washington, D.C.

Legend

- Buildings
- Property Boundaries
- 20' Grid

ECS Locations

- 1st Tent Location
- 2nd Tent Location
- 3rd Tent Location
- Burial Pit 3

Additional Low Probability Investigation

- Test Pits
- Trench for Rerouted Sewer Line

Excavated Areas

- High-Probability
- Low-Probability

0 10 20 40 Feet

1 inch = 20 feet

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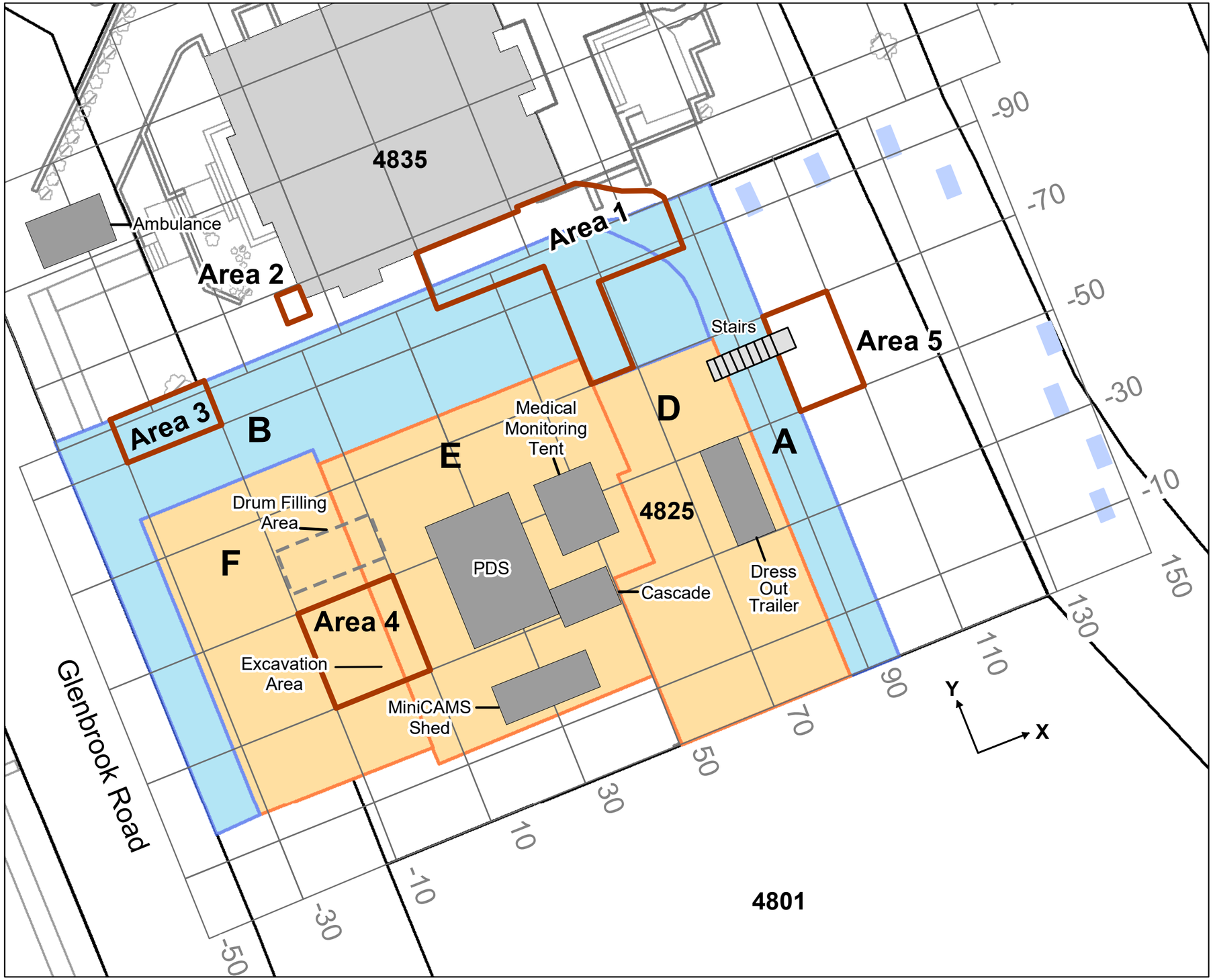
File:	20200923 4825 Glenbrook Road Hi-Lo Areas.mxd
Date:	1/12/2021
Figure Number:	1-4
Page Number:	1-20

Figure 1-5
Five Low Probability Areas Delineated in SOP 48
4825 Glenbrook Road

Spring Valley
Washington, D.C.



Legend

- Buildings-Structures
- Property Boundaries
- Proposed Area of Soil Removal
- 20' Grid

Additional Low Probability Investigation

- Test Pits

Excavated Areas

- Low-Probability
- Completed High-Probability

0 10 20 40 Feet

1 inch = 20 feet

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Date:	1/12/2021
Figure Number:	1-5
Page Number:	1-21

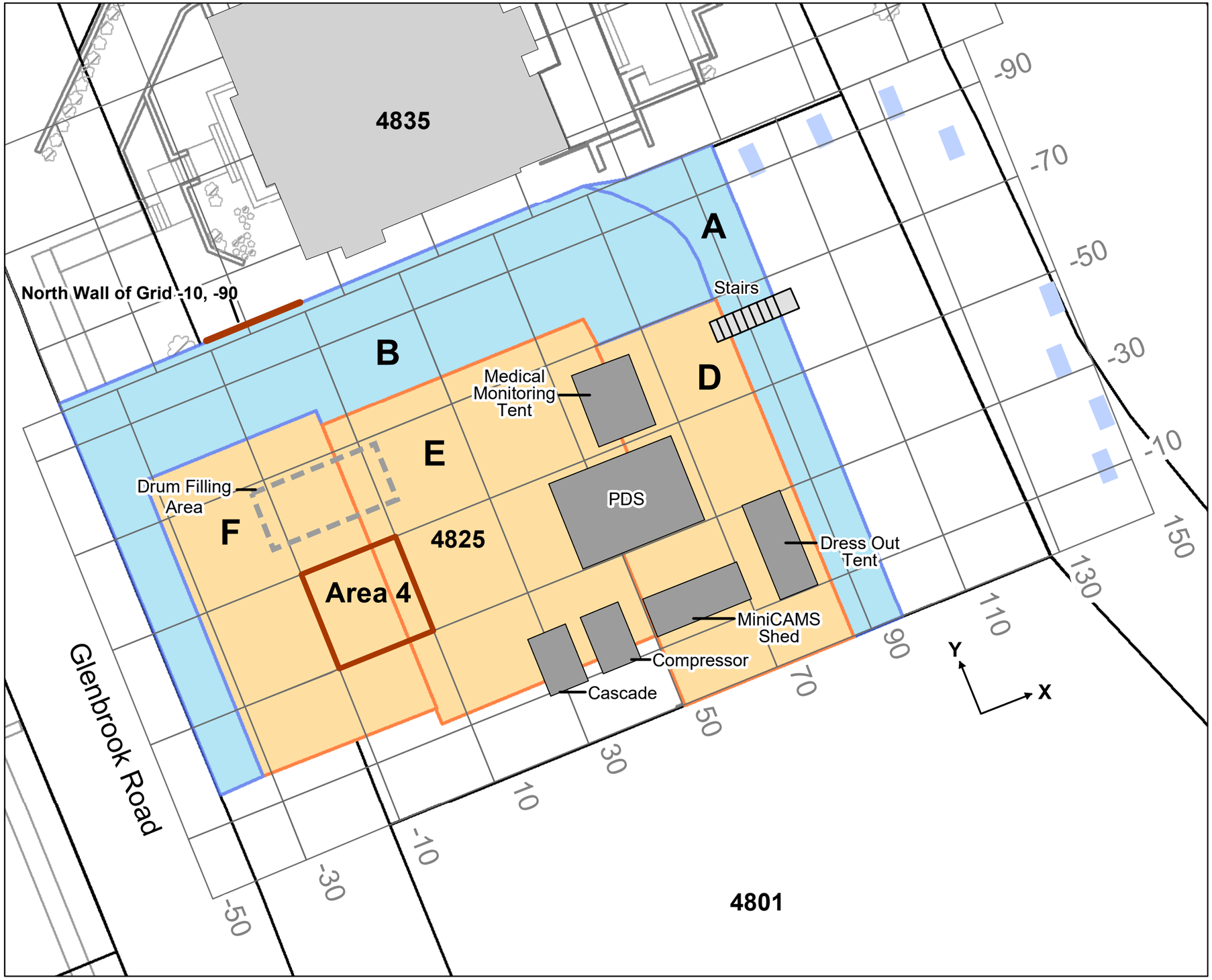

Figure 1-6
Two Low Probability Areas Delineated in SOP 49 – Area 4 and North Wall of Grid -10, -90
4825 Glenbrook Road

Spring Valley
Washington, D.C.

Legend

- Buildings-Structures
- Excavation Support Equipment/Structures
- Drum Fill Area
- Property Boundaries
- Proposed Area of Soil Removal
- 20' Grid

Additional Low Probability Investigation

- Test Pits

Excavated Areas

- Low-Probability
- Completed High-Probability

0 10 20 40 Feet

1 inch = 20 feet

Scale:	1:240
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Date:	1/12/2021
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Page Number:	1-22

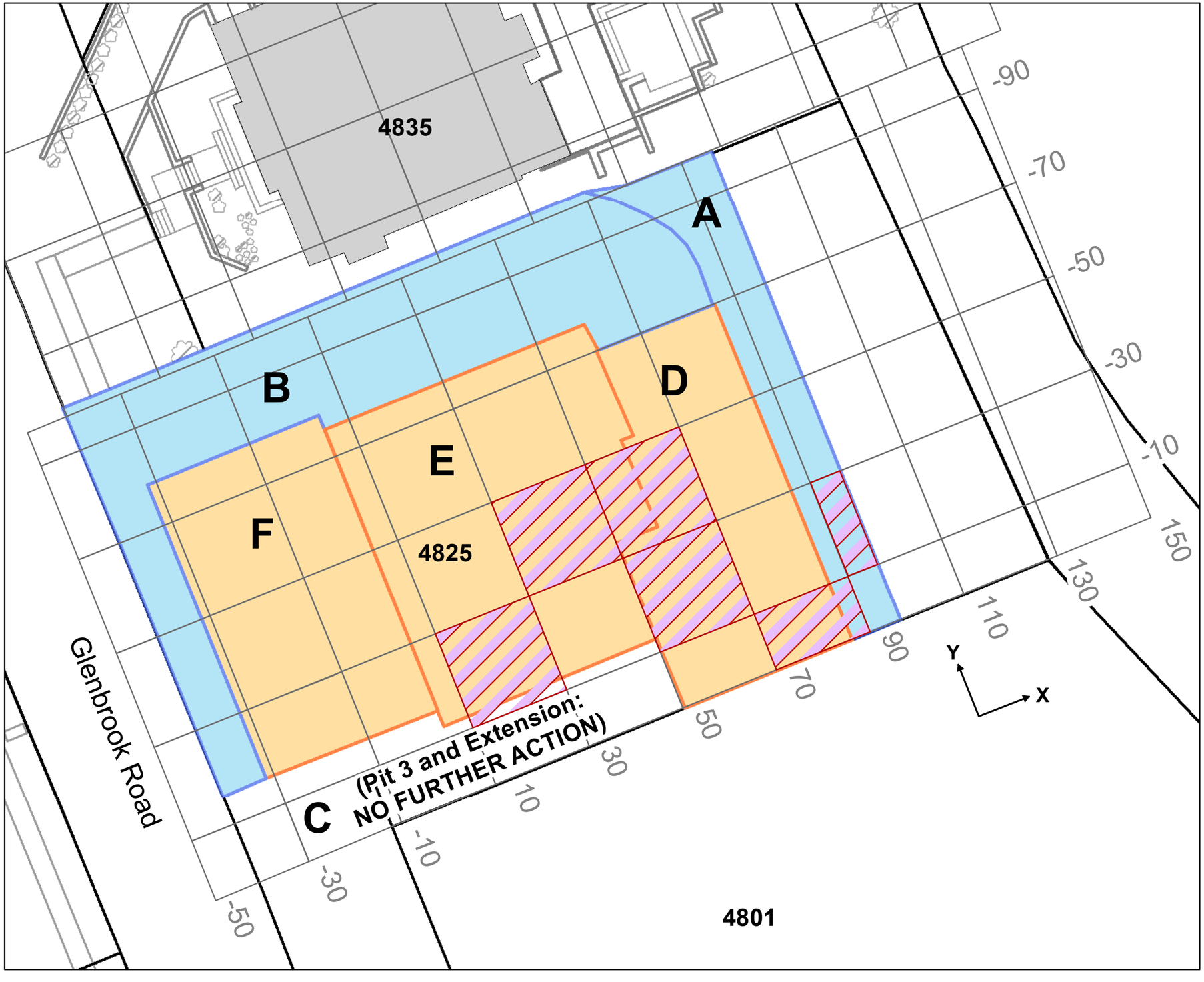

Figure 1-7
HTW-Contaminated Grids Over
Excavated March 2018 – August 2018
4825 Glenbrook Road

Spring Valley
Washington, D.C.

Legend

- Buildings
- Property Boundaries
- 20' Grid
- Grid with Arsenic Exceedance

Excavated Areas

- High-Probability
- Low-Probability

0 10 20 40 Feet

1 inch = 20 feet

Scale:	1:240
File:	20200925 4825 Glenbrook Arsenic Exceedances.mxd
Date:	1/12/2021
Figure Number:	1-7
Page Number:	1-23

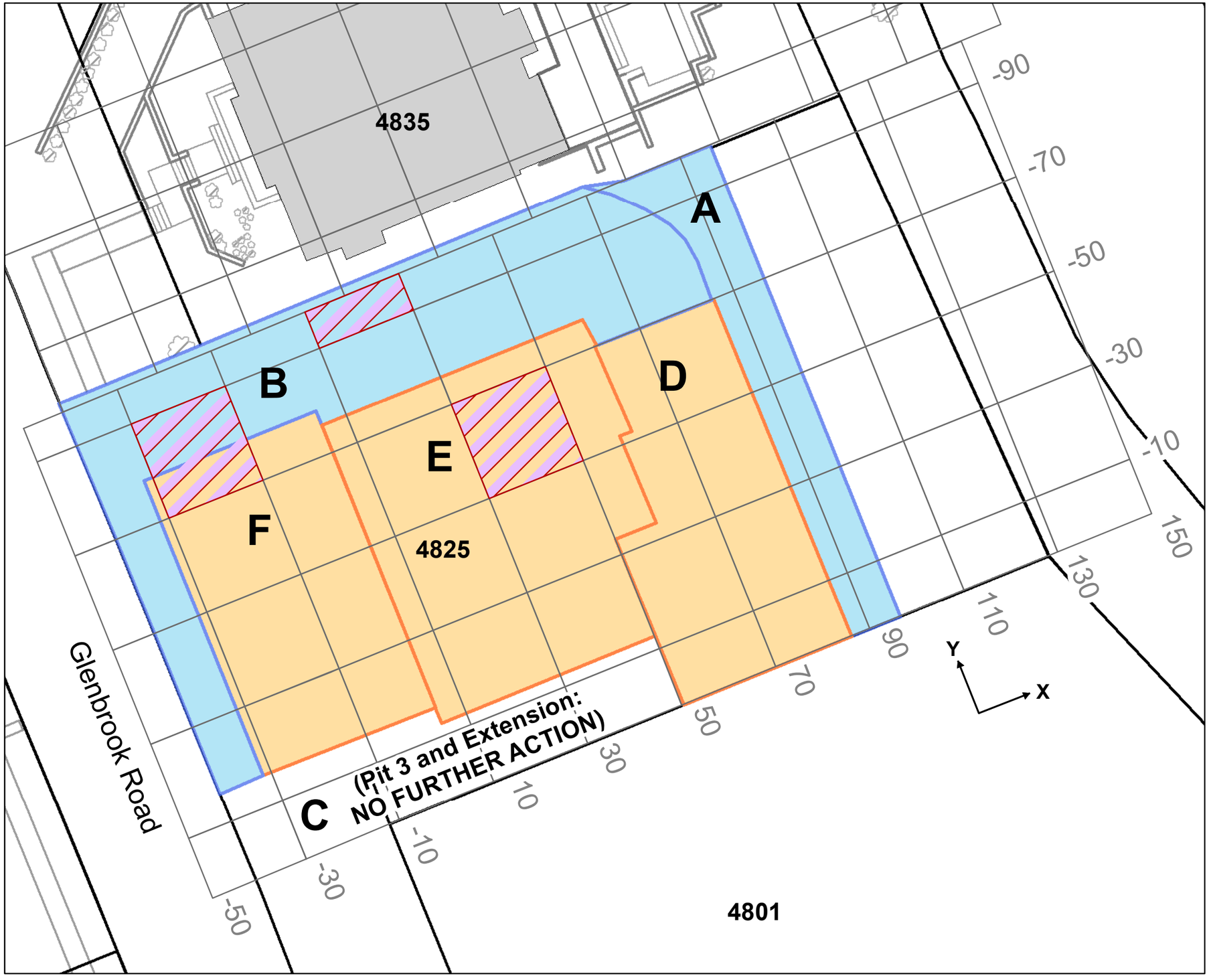

Figure 1-8
HTW-Contaminated Grids
Over Excavated June 2019
4825 Glenbrook Road

Spring Valley
Washington, D.C.

Legend

- Buildings
- Property Boundaries
- 20' Grid
- Grid with Arsenic Exceedance

Excavated Areas

- High-Probability
- Low-Probability

0 10 20 40 Feet

1 inch = 20 feet

Scale:	1:240
File:	20200924 4825 Glenbrook Arsenic Grids.mxd
Date:	1/12/2021
Figure Number:	1-8
Page Number:	1-24

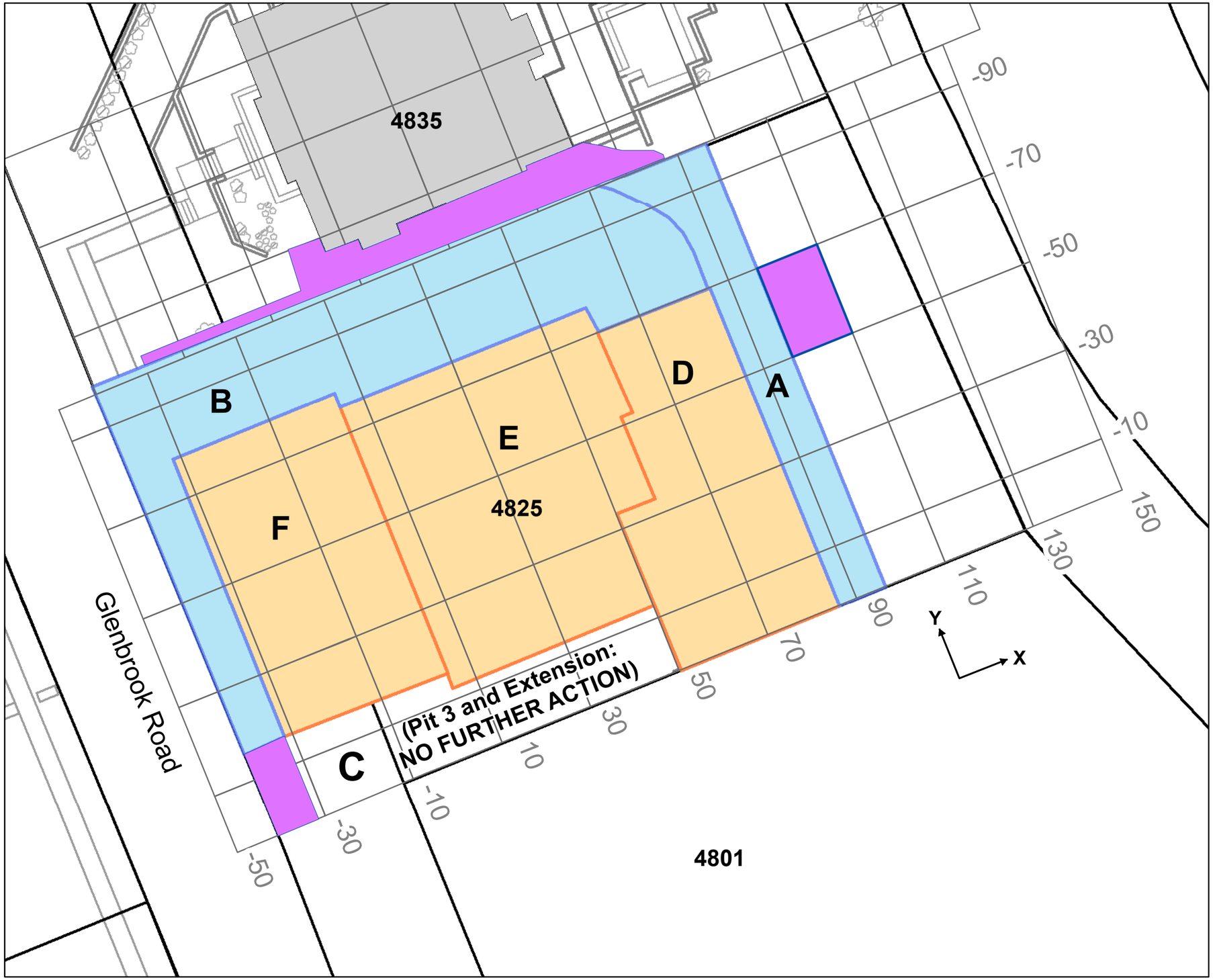

Figure 1-9
Final Excavation Extent
4825 Glenbrook Road

Spring Valley
Washington, D.C.

Legend

- Buildings-Structures
- Property Boundaries
- 20' Grid

Excavated Areas

- Additional Area Excavated
- Low-Probability Area Excavated
- High-Probability Area Excavated

0 10 20 40 Feet

1 inch = 21 feet

Scale:	1:256
File:	20201007 4825 Glenbrook Final Excavation Extent.mxd
Date:	1/12/2021
Figure Number:	1-9
Page Number:	1-25

CHAPTER 2
REMOVAL/REMEDIAL ACTION RESULTS

2.1 HOUSE DEMOLITION RESULTS

House demolition field activities occurred from November 2012 – December 2012. A demolition subcontractor demolished the residence and removed and disposed of the associated debris in accordance with the Demolition Plan from the SSWP (USACE 2017). No intrusive operations were conducted during the house demolition; therefore, the foundation slab, exterior walls of the basement below the existing ground surface, the front porch, and the rear patio were left in place. These features were demolished and disposed of during high and low probability intrusive operations.

2.2 TEST PITS AND TRENCH INVESTIGATION RESULTS

The investigation of 10 test pits and one J-trench was conducted at 4825 Glenbrook Road from January 2013 – April 2013. No items of interest were recovered during this phase of the RA; therefore, no soil samples were collected. Dig sheets for each of the 10 test pits investigated are included in Appendix C.

2.3 HIGH AND LOW PROBABILITY INTRUSIVE OPERATION RESULTS

2.3.1 Overview

Intrusive operations in the high and low probability areas were conducted at 4825 Glenbrook Road from January 31, 2013 to June 15, 2020. Grids were excavated down to competent saprolite and/or bedrock or when a site boundary wall was reached. Over excavation was conducted in specific grids until the arsenic concentrations in subsequent confirmation samples were below the remediation goal of 20 mg/kg.

2.3.2 Summary and Material Reporting

Material recovered during the intrusive investigation at 4825 Glenbrook Road RA is described in the following sections and is also summarized in **Table 2-1**.

2.3.2.1 Munitions and Explosives of Concern and Chemical Warfare Materiel

One (1) MEC item was recovered during the RA. No CWM munitions items were recovered during the RA. AUES glass intact containers that contained HD and/or L were determined to be CWM. Fourteen (14) AUES glass intact containers were determined to be CWM based on the detection of chemical agent (HD and/or L) in their contents.

Table 2-1: Summary of Intrusive Investigation Finds

Classification	Quantity	Disposition
MEC	1	Item TE-4825GR-Area F-001, a booster adapter from a 75mm projectile, was destroyed by EOD at Marine Corps Base (MCB) Quantico.
CWM (munitions)	0	N/A
CWM (AUES glass intact containers)	14	Disposed of by CCDC.
Non-CWM AUES Intact Glass Containers	26	Disposed of by CCDC.
Other Intact Containers (non-munitions or AUES related)	1	One (1) closed cavity copper spherical vessel (RA-4825GR-IC-012) was packaged in an MRC and transported by CCDC to the CTF for analysis. The item was determined to be empty and was disposed of by CCDC.
MD	Approximately 1,311 lbs.	MD was certified as MDAS and disposed of offsite.
Scrap Metal	Approximately 1,061 lbs.	Disposed of offsite.
AUES Scrap Glass	Approximately 678 lbs.	Disposed of offsite.

2.3.2.2 Resolution of Material Potentially Presenting an Explosive Hazard (MPPEH)

2.3.2.2.1 One item recovered during the RA was initially classified as MPPEH and was later determined to be MEC by the PDT. Item TE-4825GR-Area F-001 was recovered on January 13, 2014 from grid (-10, -30). The item was identified as a booster adapter (hex plug) from a 75mm projectile. The U.S. Army CBRNE Analytical and Remediation Activity (CARA) support team probed and x-rayed the item to determine the amount of liquid fill present, the condition of the fuze, and determine if energetic material was present. The x-ray determined the item had a fuze socket with a small quantity of trinitrotoluene (TNT) or tetryl (approximately 35.4 grams). The quantity was too small to assess using the Portable Isotopic Neutron Spectroscopy (PINS) Chemical Assay System. The PDT classified the item as MEC and it was stored in the high explosives (HE) bunker at the Federal Property until it was destroyed by detonation by EOD at MCB Quantico on January 27, 2020. The Explosive Ordnance Incident Report for this item in included in Appendix A.

2.3.2.2.2 Fifteen (15) closed cavity munition items, which were initially classified as MPPEH, were recovered during the RA (see **Table 2-2** below). MPPEH item (RA-4825GR-IC-006), a closed cavity 75mm projectile, was recovered on January 13, 2014 from grid (-10, -30). X-ray results revealed a flash tube and pusher plate present, no fuze or energetics, and the item was 100% full of a solid fill. The item was then assessed using the PINS. PINS analysis identified the item as containing a possible magnesium arsenide fill, which is not recognized as chemical warfare agent, but is still considered a highly hazardous chemical. The Materiel Assessment Review Board (MARB) recommended local disposition (LD) for the item. The item was packaged in a multiple round container (MRC) and CCDC transported the item to the Chemical Transfer Facility (CTF) in Aberdeen Proving Ground, Maryland for further analysis. The PDT classified this item as MD containing an HTW fill. CCDC demilitarized the item and disposed of it at a hazardous waste incineration facility. The disposal record for this item is included in Appendix A.

2.3.2.2.3 Thirteen (13) closed cavity munitions items including 11 75mm projectiles, one 4.7” projectile, and one Livens type projectile recovered during the RA were initially classified as MPPEH. SOP 50 – Munitions Cutting Operations was developed to cut open these 13 MPPEH items to facilitate their inspection and certification as material documented as safe (MDAS). After these 13 items were determined to be free of explosive hazards, the Senior UXO Supervisor (SUXOS) certified and signed, and the UXO Quality Control Specialist (UXOQCS) verified and signed DD Form 1348-1A to certify the material as MDAS. All MDAS was containerized and stored in a secure storage area until it was transported offsite to a metal recycling facility. Records of MDAS disposition (DD Form 1348-1A and chain of custody) are provided in Appendix A.

2.3.2.2.4 Custody of one MPPEH item (RA-4825GR-IC-055), a closed cavity Livens type projectile, was transferred to CENAB on December 3, 2020 for disposal at a later date.

2.3.2.3 Munitions Debris

The weight of all MD recovered during the RA and disposed of by the RA contractor totaled approximately 1,311 pounds. Additionally, 41 pounds of MD from a T-30 operation associated with a previous 4825 Glenbrook Road investigation was disposed of with the MD recovered during the RA. All drums containing MD were weighed and certified as MDAS on DD Form 1348-1A

and signed by a SUXOS. Signed 1348-1A and chain of custody forms are included in Appendix A. MDAS was disposed of at a metal recycling facility.

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Table 2-2: Closed Cavity Munitions Recovered

Date Recovered	Item ID	Item Description	Assessment	Grid Location	Disposition
5/7/2013	RA-4825GR-IC-001	75mm, closed cavity	X-rayed, empty	70, -30	Metal recycling facility
11/18/2013	RA-4825GR-IC-003	75mm, closed cavity	X-rayed, no energetics	-10, -30	Metal recycling facility
12/16/2013	RA-4825GR-IC-004	75mm, closed cavity	X-ray and PINS performed. No energetics. Less than 1% liquid fill. MARB recommended LD for item	-10, -30	Metal recycling facility
1/10/2014	RA-4825GR-IC-005	75mm, closed cavity	X-rayed, no energetics	-10, -30	Metal recycling facility
1/13/2014	RA-4825GR-IC-006	75mm, shrapnel, closed cavity	X-ray and PINS performed. Contained solid magnesium arsenide filler. No energetics. MARB recommended LD for item	-10, -30	CCDC disposed of item at a hazardous waste incineration facility
1/27/2014	RA-4825GR-IC-008	75mm, closed cavity	X-rayed, no energetics	-10, -30	Metal recycling facility
3/12/2014	RA-4825GR-IC-017	75mm, closed cavity	X-rayed, no energetics	-10, -10	Metal recycling facility
4/18/2014	RA-4825GR-IC-047	4.7” projectile, closed cavity	X-rayed, no energetics	-10, -10	Metal recycling facility
12/10/2014	RA-4825GR-IC-050	75mm, closed cavity	X-rayed, no liquid line, no filler, weight indicated of empty round	50, -70	Metal recycling facility
2/11/2015	RA-4825GR-IC-051	75mm, closed cavity	X-rayed, no energetics	70, -10	Metal recycling facility
3/3/2015	RA-4825GR-IC-052	75mm, closed cavity	X-rayed, no energetics	70, -10	Metal recycling facility

Table 2-2: Closed Cavity Munitions Recovered

Date Recovered	Item ID	Item Description	Assessment	Grid Location	Disposition
7/31/2015	RA-4825GR-IC-053	75mm, closed cavity	X-rayed, no energetics	30, -10	Metal recycling facility
8/3/2015	RA-4825GR-IC-054	75mm, closed cavity	X-rayed, no energetics	30, -10	Metal recycling facility
8/4/2015	RA-4825GR-IC-055	Livens like cylinder item	X-ray and PINS performed. No energetics, contained bleach solution (30% full). MARB recommended LD for item	30, -10	Custody transferred to CENAB
12/11/2018	4825GR-RDW-SCR-569	Livens like cylinder item	X-rayed, no energetics, no liquid line	50, -70	Metal recycling facility

2.3.2.4 Scrap Metal

The estimated weight of metal scrap recovered during the RA totaled approximately 1,061 pounds. Scrap metal was double-bagged, labeled, and transferred to the onsite CCDC MAP for headspace vapor screening analysis for HD and L. All metal scrap recovered during the RA cleared headspace analysis for HD and L and was transported offsite in 55-gallon drums to a hazardous waste incinerator facility. All headspace results are included in Appendix G.

2.3.2.5 AUES Glass Recovered - Intact Containers and Scrap

2.3.2.5.1 A comprehensive summary of the AUES glass intact containers recovered during the RA is provided in Appendix I-2. A brief summary of the AUES intact containers and scrap glass recovered during the RA is as follows:

- 40 AUES-related glass intact containers recovered from 4825 Glenbrook Road
  - 38 recovered from grid (-10, -10)
    - 13 classified as CWM for containing HD and/or L
  - 1 recovered from grid (-10, -30)
    - Item classified as CWM for containing L
  - 1 recovered from grid (70, -30)
    - Item did not contain HD and/or L
- Approximately 678 lbs. of AUES-related scrap glass recovered from 4825 Glenbrook Road
- 1 AUES-related glass intact container was recovered from 4835 Glenbrook Road
  - Item was empty

2.3.2.5.2 40 AUES-related glass intact containers were recovered during the RA, which included various laboratory-related bottles and test tubes. AUES glass intact containers recovered from 4825 Glenbrook Road were packaged in MRCs and transported to the CTF in Aberdeen Proving Ground, Maryland for analysis via gas chromatography mass spectrometry (GCMS) full-scan and Fourier transfer infrared spectroscopy (FT-IR) analysis. Of the 40 AUES glass intact containers recovered, 14 were identified as CWM for containing HD and/or L. The CTF disposed of all AUES glass intact containers after analysis.

2.3.2.5.3 Of the 40 AUES glass intact containers recovered, 38 were recovered from grid (-10, -10) during the high probability excavation of former area F under ECS location 1. Of the 38 AUES glass intact containers recovered from grid (-10, -10), 13 contained HD and/or L. One AUES glass intact container (RA-4825GR-IC-002) was recovered from grid (70, -30) while installing lagging during construction of ECS location 1. This item did not contain CA and was determined to primarily contain 2-Chloroacetophenone. One AUES glass intact container (RA-4825GR-IC-007) was recovered from grid (-10, -30) during the high probability excavation of area F under ECS location 1 and contained L.

2.3.2.5.4 Approximately 678 pounds of AUES-related scrap glass was recovered during the RA. Scrap glass was double-bagged, labeled, and transferred to the onsite CCDC MAP for headspace analysis for HD and L. All scrap glass recovered cleared headspace analysis and

transported offsite in 55-gallon drums and disposed of at a hazardous waste incinerator facility. All scrap glass cleared headspace analysis. All headspace results are included in Appendix G.

2.3.2.5.5 In addition to the 40 AUES glass intact containers discussed above, on July 26, 2019, an AUES glass intact container fell from a ledge of soil on the 4835 Glenbrook property while the north wall of grid (-10, -90) was being over excavated two feet due to arsenic exceeding 20 mg/kg. CCDC recovered and packaged this item and transported it to the CTF where it was determined to be empty. The item was returned to the government project site office for use as a display item.

2.4 NOTABLE AIR MONITORING RESULTS

2.4.1 Air monitoring was conducted throughout the RA (see section 1.2.4). The notable air monitoring results described in **Table 2-3** include all MINICAMS alarms triggered during intrusive operations. There were no confirmed ring-offs (one or more MINICAMS alarms that have been confirmed by DAAMS tube analysis) throughout the RA. There were no alarms or detections exceeding the action levels established in the SSWP (USACE 2017) on any other air monitoring equipment throughout the RA.

Table 2-3: Notable MINICAMS Air Monitoring Results

Date	Intrusive Work Location (Grid)	MINICAMS Location	MINICAMS Results (mg/m3) (STEL)	DAAMS Tube Results	Interpretation of Results
3/25/2014	-10, -10	CAFS Pre-Filter	Lewisite 1.09 STEL	Negative for L	False Positive for L
3/26/2014	-10, -10	CAFS Pre-Filter	Lewisite - 0.52 STEL	Negative for L	False Positive for L
3/28/2014	-10, -10	CAFS Pre-Filter	Lewisite - 0.76 STEL	Negative for L	False Positive for L
4/1/2014	-10, -10	CAFS Pre-Filter	Lewisite- 0.89 STEL	Negative for L	False Positive for L
3/26/2019[1]	-10, -30	Drum Filling Location	Lewisite – 0.58 STEL	Negative for L	False Positive for L
3/28/2019[1]	-10, -30	Drum Filling Location	Lewisite – 0.45 STEL	Negative for L	False Positive for L
3/28/2019[1]	-10, -30	Excavation Area	Lewisite – 0.40 STEL	Negative for L	False Positive for L
3/19/2020	-10, -30	Downwind of Excavation	Lewisite - 0.41 STEL	Negative for L	False Positive for L

Notes: 1. Multiple MINICAMS alarms occurred during the workday. Highest result is provided in the table.

2.4.2 As shown in **Table 2-3**, there were multiple re-occurring false positive MINICAMS alarms for L during intrusive operations in grids (-10, -10) and (-10, -30) on the dates listed. DAAMS tubes were collected and analyzed, but none confirmed detections of L. CCDC conducted a study in April 2014 to determine what might be causing the false positive MINICAMS alarms and they concluded the likely chemical interferent was dichloronaphthalene. Dichloronaphthalene has a chemical structure and a molecular weight that would be expected to be detected on a MINICAMS and it has a retention time within one minute of the expected retention time for L when analyzed by GCMS. Compound retention times are not exactly equal between MINICAMS and GCMS because of the differences in method parameters, but CCDC considered this the most likely interferent. While dichloronaphthalene did not appear on the available list of chemicals used at the SVFUDS, it can be associated with Halo Wax, which was a chemical listed as being used at the SVFUDS.

2.5 INVESTIGATION DERIVED WASTE DISPOSAL

2.5.1 A variety of types of IDW were generated during the RA and disposed of offsite. The IDW summarized in the tables below includes roll-off boxes and drums containing soil and concrete originating from the residence basement floor, walls, and footers, drums containing various solid and liquid waste, and 21,000-gallon Baker tanks containing aqueous waste. The IDW summarized in the tables below does not include construction waste generated during the demolition of the above ground structure of the residence at 4825 Glenbrook Road. Ultimate disposal of IDW was based on analytical results and generator knowledge. Waste manifests for all IDW transported and disposed of offsite is included in Appendix H.

2.5.2 During the RA, 363 roll-off boxes of soil waste were generated and transported offsite for disposal. Soil represented the bulk of the material removed during the RA. Additionally, roll-offs containing concrete rubble and construction debris were removed from the site. **Table 2-4** summarizes the final disposal for the roll-off boxes.

Table 2-4: Summary of IDW Roll-Off Disposition

Matrix	Non-Hazardous	Hazardous	Total	Approximate Total Volume (yd^3)
Soil	351[1]	12[2]	363	2,904
Concrete/Construction Debris	69[1]	0	69	552
Total	420	12	432	3,456

1-King and Queen County Landfill, Little Plymouth, Virginia
2-Veolia Environmental Services Incinerator, Port Arthur, Texas

2.5.3 During the RA, 3,301 drums of various solid and liquid IDW were generated and transported offsite for disposal. Soil represented the bulk of the material removed in drums during the RA followed by liquid waste, which consisted of decontamination water and dewatering IDW. Additionally, drums containing PPE, concrete and hardscape rubble, various construction material,

soil sampling jars, and scrap metal and glass were also generated during the RA**. Table 2-5** summarizes the final disposal for drums containing various IDW.

2.5.4 In addition to 55-gallon drums, 21,000-gallon capacity Baker tanks containing aqueous IDW were generated throughout the RA. Once a Baker tank was full, the contents were pumped into tanker trucks and transported offsite for disposal. Baker tanks primarily contained water collected from temporary sumps constructed throughout the RA to collect ponding water in the excavation area. **Table 2-6** summarizes the final disposal for 12 Baker tanks containing aqueous IDW.

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Table 2-5: Summary of IDW 55-Gallon Drum Disposition

Matrix	Non-Hazardous	Hazardous	Total	Approximate Total Volume (yd^3)
Soil	37[1]	1,746[3]	1,783	223
Aqueous	476[4]	204[3]	680	85
PPE	250[2]	235[3]	485	61
Concrete/Rubble	0	252[3]	252	32
Construction Material	0	68[3]	68	9
Soil Sampling Jars	0	25[3]	25	4
Scrap Metal and Glass	0	8[3]	8	1
Total:	763	2,538	3,301	413

1-Modern Landfill, York, PA
2-King and Queen County Landfill, Little Plymouth, VA
3-Veolia Environmental Services Incinerator, Port Arthur, TX
4-EQ Detroit Inc., Detroit, MI

Table 2-6: Summary of Aqueous IDW Baker Tank Disposition

Matrix	Non-Hazardous	Hazardous	Total	Approximate Total Volume (gal)
Aqueous	12[1]	0	12	252,000

1 – EQ Detroit Inc., Detroit, MI

2.6 CWM AND MEC CLEARANCE SUMMARY

Approximately 3,127 cubic yards of soil was removed from the high and low probability areas at 4825 Glenbrook Road. Excavation was completed to the depth of competent saprolite or bedrock, as determined by the RA contractor geologist and concurrence from a USACE geologist. Based on this excavation, the site has been cleared of all CWM, MEC, and AUES-related items to the depth of competent saprolite and/or bedrock.

CHAPTER 3
QUALITY CONTROL ACTIVITIES AND RESULTS

3.1 QUALITY CONTROL ACTIVITIES

A Quality Control Plan was prepared in accordance with DID MR-005-1 and included in the SSWP (USACE 2017) to ensure quality throughout the execution of the scope of work tasks. The Quality Control Plan dictated the methods and procedures that were used during the RA and included the following project elements:

- Project Requirements
- Project Team Responsibilities
- Instrument and Equipment Testing, Maintenance, and Troubleshooting
- Data Management
- Field Operations Documentation
- Corrective Actions
- Audits and Surveillances
- Documents and Submittals
- Personnel Selection, Qualifications, and Training
- Chemical Data Quality Management Plan

The following specific tasks were performed by the RA contractor and its subcontractors to ensure the remediation goal and RAOs were achieved:

- RA Contractor Geologist Evaluations
- Quality Control (QC) Field Documentation
- Chemical Sampling Data Validation

3.2 QUALITY CONTROL RESULTS

3.2.1 RA Contractor Geologist Evaluations

The RA contractor geologist was required onsite to determine when competent saprolite and/or bedrock had been reached after excavating a particular grid at various times throughout the RA. The RA contractor geologist made this determination for all grids excavated. A CENAB geologist confirmed this determination either concurrent with or following the RA contractor geologist's evaluation. The CENAB geologist's evaluation is discussed further in Chapter 4.

3.2.2 QC Field Documentation

Daily Quality Control Reports (DQCR) were prepared and submitted with the RA Contractor Daily Reports. The DQCRs included weather information, field instrumentation and

measurements, calibrations, identification of all field samples collected, items found, IDW generated, departures from the SSWP (USACE 2017), any problems encountered, and any government personnel directives. All DQCRs are included with the RA Contractor Daily Reports in Appendix D.

3.2.3 Chemical Sampling Data Validation

3.2.3.1 Chemical sampling data quality was ensured through appropriate sample collection, preservation, and transport methods combined with an evaluation of analytical performance through the analysis of QC samples. The data generated was used to:

- Determine the extent of excavation for contaminated soils;
- Make appropriate soil and/or water disposal determinations; and
- Characterize the contents of intact containers.

3.2.3.2 A Uniform Federal Policy for Quality Assurance Project Plan (UFP-QAPP) was prepared in accordance with the DoD Quality Assurance Manual (QAM) and WERS 009.01 as Attachment A to the Sampling and Analysis Plan (SAP) in the SSWP (USACE 2017). The UFP-QAPP described the quality management and QC testing programs related to the environmental sampling program onsite. It integrated the most recently approved DoD Quality System Manual (DoD QSM) Version 5.0 (DoD July 2013), the Army Three Phase Quality Assurance Program, and USEPA's Data Quality Objectives (DQO) Process into the project's technical approach. The QAPP described QA/QC procedures (including DQOs for laboratories) and included a description of the project's SAP with SOPs for field and analytical procedures. Worksheets 19 and 28.1 to 28.13 of the UFP-QAPP summarized the internal QC requirements including the frequency, acceptance criteria, and corrective action for each type of field or laboratory QC sample.

3.2.3.3 Data validation was performed in accordance with the DoD QSM version 5.0. One hundred percent of the data was validated at USEPA Level IV with the following exceptions: waste characterization samples, geotechnical parameters, and data collected by CCDC during the 4835 Glenbrook Road sampling effort discussed in Chapter 5. Data validation was performed in accordance with DoD protocol, laboratory SOPs, and QC criteria specified in the UFP-QAPP. All data validation reports (DVRs) are included in Appendix J.

3.2.3.4 Project DQOs were established in the SSWP (USACE 2017) for precision, accuracy, representativeness, completeness, comparability, and sensitivity. Precision and accuracy for the data collected during the RA were considered acceptable for the purposes of this project. The sampling program for the project met all relevant requirements for data representativeness. Data completeness, defined as the percentage of laboratory measurements judged to be valid on a method-by-method basis was acceptable. Valid data are those identified as acceptable or qualified as estimated ("J" flag) during the data validation process. Data qualified as rejected ("R" flag) were considered unusable and not valid. Although there were rejected data, the data completeness for each method met the project requirement of ≥ 95% for all the validated data. The use of USEPA protocols, specific and well-documented analytical methods, approved laboratories, and the standardized process of data review and validation give the project data a high degree of analytical comparability. The use of well-established analytical protocols ensured that the data are comparable.

Sensitivity was acceptable such that the laboratory qualified (as estimated, "J" flag) all results detected below the limit of quantitation down to the detection limit and adjusted any and all reporting limits based on dilution, aliquot size, or volume appropriately. All project DQOs were met for the analytical data collected during the RA at 4825 Glenbrook Road based on the above evaluation of precision, accuracy, representativeness, completeness, comparability, and sensitivity.

3.3 LESSONS LEARNED

There were lessons learned throughout the RA conducted at 4825 Glenbrook Road. Two of the primary lessons learned pertained to:

1. Identification and approval of backfill sources; and
2. Over reliance on MINICAMS to identify potentially hazardous environments

3.3.1 Identification and Approval of Backfill Sources

3.3.1.1 Throughout the RA, clean backfill was needed to temporarily fill and level certain areas of the site to prepare for work in other areas and for restoration purposes. Identifying clean backfill sources was a challenge throughout the RA. Local backfill sources were not readily available. When a potential source was identified, it took a considerable amount of time to coordinate a sampling event with the backfill source supplier. Once backfill samples were collected, the need for backfill at the site became more urgent to avoid schedule delays. Turnaround times for the sample results were often rushed, which is costly. Once the sample results were received, there were certain parameters (notably metals) that exceeded the CVs in the SSWP (USACE 2017). This led to time consuming discussions among the PDT to gain approval for use of a potential backfill source.

3.3.1.2 Ways to improve the identification and approval of clean backfill sources include:

1. Starting the identification process of potential backfill sources much sooner than when it is actually needed;
2. Establishing clean backfill standards in the work plan that consider the latest local regulations and requirements; and
3. Requiring a written agreement with the backfill source supplier to reserve the backfill source for a specified amount of time.

3.3.2 Over Reliance on MINICAMS

3.3.2.1 MINICAMS were utilized throughout the RA to monitor for CA in the air during intrusive operations. MINICAMS cannot monitor for ABPs in the air. In 2017, when CACM was first encountered during the low probability excavation of area B, there were no MINICAMS alarms for CA in the work area or perimeter monitoring location. Workers experienced various odors while excavating in this area, but did not immediately report the odors to the site management because there were no alarms on MINICAMS. This gave workers a false sense of safety. It was later determined that the odors the workers experienced were emanating from ABPs in the soil.

3.3.2.2 Ways to improve over reliance on MINICAMS:

1. During site-specific training, workers should be trained to understand exactly what CA the MINICAMS are monitoring for and that they do not monitor for ABPs;
2. Workers should be trained how to identify potential ABP-related odors;
3. Workers should be trained to communicate any unusual odors to the site management immediately. “Smell something, say something” should be emphasized at CWM sites.

CHAPTER 4
QUALITY ASSURANCE ACTIVITIES AND RESULTS

4.1 QUALITY ASSURANCE ACTIVITIES

The primary quality assurance (QA) activities performed by the government during the RA included:

- USACE OESS QA oversight throughout the duration of the RA; and
- CENAB geologist onsite confirmation of the RA contractor geologist's determinations when competent saprolite and/or bedrock had been reached after excavation.

4.2 QUALITY ASSURANCE RESULTS

4.2.1 A USACE OESS was present onsite throughout the RA to monitor that work during the RA was performed in accordance with the SSWP (USACE 2017). There were no QA failures documented or corrective action requests issued to the RA contractor during the RA.

4.2.2 **Table 4-1** below provides the dates on which the CENAB geologist was onsite at 4825 Glenbrook Road and confirmed that competent saprolite and/or bedrock had been achieved for a particular grid. These dates are also included in the RA Contractor Daily Reports (Appendix D). The table below encompasses the entire excavation area included in the scope of the RA, which was composed of 20 ft by 20 ft grids. There were 11 grids where two different areas (A, B, D, E, or F) fell within the same 20 ft by 20 ft grid.

Table 4-1: CENAB Geologist Confirmation Dates

Grid	Area	Excavated to Competent Saprolite or Bedrock	Date Confirmed by CENAB Geologist
-50, -50	B	Competent Saprolite	2/7/2013
-50, -30	B	Competent Saprolite	2/7/2013
-50, -10	B	Competent Saprolite	2/7/2013
-50, 10	B	Competent Saprolite	2/7/2013
-10, -10	F	Bedrock	7/30/2014
-10, -30	F	Competent Saprolite	7/30/2014
		Bedrock – Southern Half of Grid	3/31/2020
-10, -50	F	Competent Saprolite	7/30/2014
-10, -70	F	Competent Saprolite	7/30/2014
	B	Competent Saprolite	3/1/2017
-30, -10	F	Competent Saprolite	7/30/2014

Table 4-1: CENAB Geologist Confirmation Dates

Grid	Area	Excavated to Competent Saprolite or Bedrock	Date Confirmed by CENAB Geologist
-30, -30	F	Competent Saprolite	7/30/2014
-30, -50	F	Competent Saprolite	7/30/2014
-30, -70	F	Competent Saprolite	7/30/2014
	B	Competent Saprolite	3/1/2017
30, -70	D	Competent Saprolite	9/16/2015
	B	Competent Saprolite	4/18/2019
50, -70	D	Competent Saprolite	9/16/2015
	B	Competent Saprolite	4/18/2019
30, -50	D	Competent Saprolite	10/16/2015
50, -50	D	Competent Saprolite	10/16/2015
70, -50	D	Competent Saprolite	10/16/2015
	A	Competent Saprolite	10/11/2016
30, -30	D	Competent Saprolite	10/16/2015
50, -30	D	Competent Saprolite	10/16/2015
70, -30	D	Competent Saprolite	10/16/2015
	A	Competent Saprolite	10/11/2016
30, -10	D	Competent Saprolite	10/16/2015
50, -10	D	Competent Saprolite	10/16/2015
		Bedrock	5/30/2018
70, -10	D	Competent Saprolite	10/16/2015
	A	Competent Saprolite	10/11/2016
50, 10	D	Competent Saprolite	10/16/2015
70, 10	D	Competent Saprolite	10/16/2015
	A	Competent Saprolite	10/11/2016
10, -10	E	Competent Saprolite	5/17/2016
10, -30	E	Competent Saprolite	5/17/2016
10, -50	E	Competent Saprolite	5/17/2016
10, -70	E	Competent Saprolite	5/17/2016
	B	Competent Saprolite	4/18/2019
90, 10	A	Competent Saprolite	10/11/2016
90, -10	A	Competent Saprolite	10/11/2016
90, -30	A	Competent Saprolite	10/11/2016
90, -50	A	Competent Saprolite	10/11/2016
-10, -90	B	Competent Saprolite	3/1/2017
-30, -90	B	Competent Saprolite	3/1/2017
90, -90	A	Competent Saprolite	2/25/2019

Table 4-1: CENAB Geologist Confirmation Dates

Grid	Area	Excavated to Competent Saprolite or Bedrock	Date Confirmed by CENAB Geologist
90, -70	A	Competent Saprolite	2/25/2019
70, -70	A/B	Competent Saprolite	2/25/2019
70, -90	A/B	Competent Saprolite	2/25/2019
10, -90	B	Competent Saprolite	4/18/2019
30, -90	B	Competent Saprolite	4/18/2019
50, -90	B	Competent Saprolite	4/18/2019
-50, -70	B	Competent Saprolite	4/18/2019
-50, -90	B	Competent Saprolite	4/18/2019

CHAPTER 5
SAMPLING ACTIVITIES AND RESULTS

5.1 SAMPLING ACTIVITIES OVERVIEW

5.1.1 Various types of samples were collected throughout the remedial activities at 4825 Glenbrook Road. Media sampled included soil, water, and concrete. The following types of samples were collected:

- Waste Characterization Samples to categorize waste for appropriate disposal;
- Confirmation Soil Samples to ensure the remedial goal and RAOs for soil were achieved; and
- Backfill and Topsoil Samples to verify potential backfill and topsoil sources were acceptable for use.

5.1.2 The RA activities and results related to each of these sample types is described in the following sections. Comprehensive indices of all samples collected during the RA are included in Appendix I.

5.2 WASTE CHARACTERIZATION SAMPLING

Multiple forms of IDW were generated and disposed of during the RA (see section 2.5). The different types of waste characterization samples are described below and a summary of samples collected and results are presented in **Table 5-1**. An index of waste characterization samples collected during the RA at 4825 Glenbrook Road is presented in Appendix I.

5.2.1 Soil Waste Characterization Samples

As soil was excavated throughout the RA, soil was collected from the excavator bucket throughout the workday for a representative composite waste characterization sample. Soil waste characterization samples were first headspaced for HD and L onsite and then analyzed for CA and ABPs by CCDC. Samples determined to be clear of CA and ABPs were sent to a commercial laboratory for TCLP VOCs, semi-volatile organic compounds (SVOCs), metals, corrosivity, and ignitability analysis. If a soil waste characterization sample contained detections of CA and/or ABPs, the associated drum or roll-off of soil was deemed hazardous waste and the remaining split sample was not sent to a commercial laboratory for additional TCLP analysis.

5.2.2 Water Waste Characterization Samples

Aqueous IDW characterization samples were collected from drums and Baker tanks in accordance with the SSWP (USACE 2017). Aqueous IDW characterization samples were first analyzed for CA and ABPs by CCDC and then for TCLP VOCs, SVOCs, metals, corrosivity, and ignitability. If an aqueous IDW characterization sample contained detections of CA and/or ABPs,

the associated drum or Baker tank was deemed hazardous waste and the remaining split sample was not sent to the commercial laboratory for additional TCLP analysis.

5.2.3 Concrete Waste Characterization Samples

Concrete samples were collected in accordance with the SSWP (USACE 2017). Concrete samples were collected from the basement floor, walls, and footers of the house that may have come into contact with CA/ABP and/or CACM-contaminated soil. Concrete samples were analyzed for CA and ABPs only by CCDC. If a concrete waste characterization sample contained detections of CA and/or ABPs, the associated concrete section was deemed hazardous waste and disposed of accordingly.

Table 5-1: Summary of Waste Characterization Samples Collected

Matrix	Hazardous (contained CA/ABPs)	Hazardous (RCRA)	Non-Hazardous (RCRA)	Total Qty. of Samples Collected
Soil	299	0	749	1,048
Water	0	0	44	44
Concrete	3[1]	N/A	N/A	55

1. Concrete waste characterization samples were only analyzed for CA and ABPs. Generator knowledge was used to categorize non-CA/ABP contaminated concrete as non-hazardous waste under RCRA.

5.3 CONFIRMATION SOIL SAMPLING

5.3.1 Overview

5.3.1.1 Confirmation soil samples were collected at the outer boundaries of the excavation (floor and sidewalls) to demonstrate the remediation goal and RAOs for soil had been achieved during the RA. These samples were collected once a grid in an area (A, B, D, E, or F) was excavated down to competent saprolite (as confirmed by both the RA contractor geologist and CENAB geologist) or to the area boundary as defined by the DD. An index of the confirmation soil samples collected during the RA at 4825 Glenbrook Road is presented in Appendix I.

5.3.1.2 Confirmation soil samples were collected from the center point of the floor of each grid and from the sidewalls of grids located along the site perimeter. Multiple sidewall confirmation samples were collected if the depth of the sidewall exceeded two feet. For sidewalls two feet deep or less, one sample was collected from the vertical and horizontal midpoint of the wall. For sidewalls deeper than two feet, but less than five feet, one sample was collected six inches below the ground surface and one sample was collected six inches above the bottom of the excavation down from the lateral midpoint of the wall. For sidewalls deeper than five feet, an additional sample was collected from the vertical midpoint of the wall (three sample depths total). Confirmation soil samples were not collected from the floor of grids that were excavated to bedrock in accordance with the SSWP (USACE 2017).

5.3.1.3 Following collection, confirmation soil samples were analyzed in accordance with the SSWP (USACE 2017) for the Spring Valley Comprehensive List of Parameters which is comprised of the following analyses:

1. Headspace vapor screening for HD and L;
2. Low level CA and ABP analysis for HD, L, 1,4-dithiane, and 1,4-oxathiane; and
3. HTW parameters including VOCs, SVOCs, metals, explosives, pesticides and PCBs, total cyanide, fluoride, iodine, and perchlorate.

5.3.1.4 Headspace vapor screening analysis for HD and L was performed at the onsite MAP by CCDC. Low level CA and ABP analysis was performed by CCDC at the Environmental Monitoring Laboratory (EML) at Aberdeen Proving Ground, Maryland. Once a sample was determined to be free of CA/ABPs (no detections), HTW parameters were then analyzed by a third-party DoD Environmental Laboratory Accreditation Program (ELAP)-certified commercial laboratory. If CA/ABPs were detected in a sample, the remaining split samples were not sent to the commercial laboratory for HTW analysis and were disposed of in an appropriate drum.

5.3.1.5 If over excavation was required in grids to remove HTW-impacted soil with concentrations of arsenic exceeding the remediation goal of 20 mg/kg (discussed in paragraph 1.2.3.9), then additional confirmation samples were collected and analyzed after over excavation was performed. In these cases, the samples were only analyzed for parameters that exceeded the CVs in the original confirmation sample collected after competent saprolite and/or bedrock was confirmed by the CENAB geologist. Confirmation samples that were collected after competent saprolite was confirmed by the CENAB geologist are referred to in this report as **original** confirmation samples. Confirmation samples that were collected after over excavation was performed and analyzed for only the analytes that exceeded in the preceding co-located confirmation samples are referred to as **HTW** confirmation samples in this report.

5.3.2 Confirmation Soil Sample Locations and Results

5.3.2.1 A total of 86 original confirmation samples (not including QC samples) were collected during the RA after high and low probability operations when competent saprolite and/or bedrock was reached and confirmed by the CENAB geologist (see **Table 4-1**). All original confirmation sample locations are shown in **Figure 5-1**. A comprehensive index of confirmation samples collected throughout the RA and sample locations corresponding to **Figure 5-1** is included in Appendix I. **Table 5-2** below summarizes the results of all original confirmation samples collected from each grid encompassing the site. The results for each grid in **Table 5-2** fell into one of three categories: whether the results were below all the CVs (achieving the RAOs and remediation goal of 20 mg/kg arsenic), whether other metals excluding arsenic exceeded the CVs, whether arsenic exceeded the remediation goal of 20 mg/kg, or whether there were CA/ABP detections. The color-coded results in **Table 5-2** correspond to the sample locations shown in **Figure 5-1**.

Table 5-2: Results of Original Confirmation Samples

Grid	Area	Sample Collection Date	Sample Results			
			All Results Below the CVs (All RAOs and Remedial Goal Achieved)	Contained Other Metals Exceeding the CVs (Excluding Arsenic)	Contained Arsenic >20 mg/kg	Contained CA/ABP Detection(s)
-50, -50	B	2/11/2013		✓		
-50, -30	B	2/11/2013		✓		
-50, -10	B	2/11/2013	✓			
-50, 10	B	2/11/2013		✓		
-10, -10	F	7/30/2014	✓			
-10, -30	F	7/31/2014			✓	
-10, -50	F	7/31/2014		✓		
-10, -70	F	7/31/2014		✓		
	B	3/2/2017		✓		
-30, -10	F	7/31/2014	✓			
-30, -30	F	7/31/2014	✓			
-30, -50	F	7/31/2014	✓			
-30, -70	F	7/31/2014	✓			
	B	3/2/2017			✓	
30, -70	D	9/16/2015	✓			
	B	5/15/2019	✓			
50, -70	D	9/16/2015		✓		
	B	5/9/2019		✓		
30, -50	D	10/19/2015			✓	
50, -50	D	10/19/2015		✓		
70, -50	D	10/19/2015		✓		
	A	10/24/2016		✓		
30, -30	D	10/19/2015			✓	
50, -30	D	10/19/2015			✓	
70, -30	D	10/19/2015		✓		
	A	10/24/2016		✓		
30, -10	D	10/19/2015	✓			

Table 5-2: Results of Original Confirmation Samples

Grid	Area	Sample Collection Date	Sample Results			
			All Results Below the CVs (All RAOs and Remedial Goal Achieved)	Contained Other Metals Exceeding the CVs (Excluding Arsenic)	Contained Arsenic >20 mg/kg	Contained CA/ABP Detection(s)
50, -10	D	10/19/2015			✓	
70, -10	D	10/19/2015		✓		
	A	10/17/2016		✓		
50, 10	D	10/19/2015		✓		
70, 10	D	10/19/2015		✓		
10, -10	E	5/18/2016			✓	
10, -30	E	5/18/2016		✓		
10, -50	E	5/18/2016		✓		
10, -70	E	5/18/2016		✓		
	B	5/9/2019		✓		
70, 10	A	10/17/2016			✓	
90, 10	A	10/17/2016		✓		
90, -10	A	10/17/2016			✓	
90, -30	A	10/24/2016		✓		
90, -50	A	10/24/2016		✓		
-10, -90	B	3/2/2017			✓	
-30, -90	B	3/2/2017				✓
90, -90	A	2/26/2019		✓		
90, -70	A	2/26/2019		✓		
70, -70	A/B	2/26/2019		✓		
70, -90	A/B	2/26/2019		✓		
10, -90	B	5/9/2019		✓		
30, -90	B	5/9/2019		✓		
50, -90	B	5/9/2019		✓		
-50, -70	B	5/15/2019		✓		
-50, -90	B	5/15/2019		✓		

5.3.2.2 The results for the 14 sample locations shown in green on **Figure 5-1** were below all of the CVs confirming the remediation goal of 20 mg/kg arsenic and the RAOs were achieved for those locations. The results for the 38 sample locations shown in yellow on **Figure 5-1** contained exceedances for metals excluding arsenic. Metals exceeding the CVs were later evaluated in a Post-Remedy Assessment in Chapter 7. Eleven sample locations were identified as requiring over excavation due to concentrations of arsenic above 20 mg/kg or ABP detections as shown in orange and pink in **Figure 5-1**, respectively. These locations are summarized in **Table 5-3** below.

Table 5-3: Locations Requiring Over Excavation

Grid	Grid Location	Analytes Exceeding CVs
-10, -30	Floor	Arsenic, Vanadium
30, -50	Floor	Aluminum, Arsenic, Cobalt
30, -30	Floor	Aluminum, Arsenic, Cobalt
50, -30	Floor	Aluminum, Arsenic, Cobalt, Vanadium
50, -10	Floor	Aluminum, Arsenic, Cobalt, Vanadium
10, -10	Floor	Aluminum, Arsenic
70, 10	East Wall	Aluminum, Arsenic, Cobalt, Manganese, Vanadium
90, -10	East Wall	Aluminum, Arsenic, Cobalt, Manganese, Vanadium
-10, -90	North Wall	Aluminum, Arsenic, Cobalt, Vanadium
-30, -70	Floor	Aluminum, Arsenic, Cobalt, Manganese
-30, -90	North Wall	1,4-Dithiane[1], Aluminum, Cobalt

Note: 1. 1,4-Dithiane was detected, but did not exceed the CV.

5.3.2.3 A total of 71 HTW confirmation samples (not including QC samples) were collected during the RA after over excavation was performed in the former high and low probability areas listed in **Table 5-3** above. **Figure 5-2** shows the locations of HTW confirmation samples with the exception of grid (-10, -30). Six grids [(-10, -30), (30, -30), (50, -10), (90, -10), (-10, -90), (-30, -70), and (-10, -30)] required more than two feet of over excavation to achieve the remediation goal of 20 mg/kg arsenic. Grid (50, -10) was excavated down to bedrock due to persistent arsenic concentrations exceeding 20 mg/kg after multiple one ft iterations of over excavation and sampling. A CENAB geologist confirmed bedrock had been achieved in grid (50, -10) on May 30, 2018, which is documented in the May 31, 2018 weekly PDT call meeting minutes (Appendix P) and the May 30, 2018 RA Contractor Daily Report (Appendix D).

5.3.2.4 Grid (-10, -30), also referred to as "Area 4" in SOPs 48 and 49, was sampled extensively during the RA. Grids (-10, -30) and grid (-10, -10) to the south of grid (-10, -30) were areas where AUES intact containers and numerous glass fragments were uncovered during high probability operations under ECS location 1. Grid (-10, -30) was excavated down to competent saprolite and a floor confirmation sample was collected on July 31, 2014 (RA-4825GR-FL-(-10,-30)-01-10.5).

5.3.2.5 Sample RA-4825GR-FL-(-10,-30)-01-10.5 depicted as sample 14 on **Figure 5-1** was clear of CA and ABPs, but contained arsenic exceeding 20 mg/kg; therefore, grid (-10, -30) required over excavation to reduce the concentration of arsenic below 20 mg/kg. On July 2, 2018, an attempt was made to over excavate grid (-10, -30) two feet deeper due to the elevated arsenic concentration discussed above. After filling one roll-off container of soil, an odor indicative of HD ABPs was detected by the workers. A grab sample (RA-4825GR-AREA F-E GRAB-01-070218) was collected from the soil from which the odor was emanating. The grab sample collection procedure and parameters are the same as original confirmation samples which included analysis for all parameters listed in section 5.3.1. The grab sample had detections of HD ABPs (210 µg/kg of 1,4-dithiane and 23 µg/kg of 1,4-oxathiane). The PDT decided that grid (-10, -30) would be excavated an additional two feet deeper and two feet out from each sidewall at a later date. Intrusive work was postponed and the excavation area was temporarily backfilled. The plan to return to grid (-10, -30) at a later date was addressed in SOP 48.

5.3.2.6 In March 2019, intrusive work resumed in grid (-10, -30). The temporarily placed backfill was removed from the excavation area and intrusive work began on the native material in the east side of the excavation area. On March 26, 2019, there were multiple MINICAMS alarms for L. It was determined that the MINICAMS alarms for L were false positives and were likely triggered by dichloronaphthalene as discussed in section 2.4.2. Before work was stopped, eight (8) grab samples were collected from the floor and the walls of the excavation as it stood on April 29, 2019. Four wall and four floor samples were collected shown in **Figure 5-3**. Of the eight samples, four samples (two floor and two wall) had detections of HD ABP 1,4-dithiane. In addition to 1,4-dithiane, one floor sample (RA-4825GR-AREA 4-FL-(-10,-30)-01-2) had a detection of 1,4-oxathiane. HD ABP 1,4-oxathiane was detected at 0.059 mg/kg, which was well below the residential based CV of 61 mg/kg. The highest concentration of 1,4-dithiane was 0.094 mg/kg detected in the same sample where 1,4-oxathiane was detected (RA-4825GR-AREA 4-FL-(-10,-30)-01-2). This concentration was also well below the residential based CV of 78 mg/kg. Of the eight grab samples collected, five exceeded the remediation goal of 20 mg/kg arsenic, four samples exceeded the CV for cyanide, and all eight samples exceeded the CVs for aluminum and vanadium.

5.3.2.7 A human health risk assessment (HHRA) was performed in December 2019 to determine whether concentrations of arsenic remaining above the remediation goal, and other compounds remaining above the CVs, at grid (-10, -30) would pose an unacceptable risk if the grid was backfilled without over excavation. At the time of this HHRA, an additional arsenic hot spot [north wall of grid (-10, -90)] had not been over excavated for arsenic so this area was also included in the HHRA data set. Finally, the confirmation sample data representing soil remaining in place across the rest of the site, which contained exceedances for other analytes including aluminum, antimony, cobalt, manganese, nickel, thallium, and vanadium, was also evaluated in the HHRA. The results of the December 2019 HHRA are discussed in detail in Chapter 7 of this

report. The HHRA concluded that no unacceptable level risk remained at 4825 Glenbrook Road and all of the RAOs had been achieved, even with the sample data from the two arsenic hot spots included. However, to be conservative the PDT decided to over excavate the two arsenic hot spots and re-sample the soil for CA/ABPs and arsenic. Arsenic was the only metal sampled in this case since the detected concentrations of the other analytes evaluated in the HHRA including aluminum, antimony, arsenic, cobalt, cyanide, manganese, nickel, thallium, and vanadium did not pose an unacceptable risk. This decision is documented in the January 2020 RA contractor monthly report to CEHNC (Appendix P).

5.3.2.8 In March 2020, grid (-10, -30) was over excavated two feet deeper and two feet out from each sidewall in accordance with SOP 49. Eight (8) additional soil samples were collected on March 10 and 20, 2020 from the locations shown in **Figure 5-4** (sample numbers 9 through 16) and analyzed for CA, ABPs, and arsenic only. One sample (sample 10 on **Figure 5-4**) contained ABP 1,4-dithiane while the other seven samples were clear of CA and ABPs and the remediation goal of 20 mg/kg arsenic was achieved in each sample. The south wall of grid (-10, -30) was over excavated an additional one foot and sample 17 was collected (shown in **Figure 5-4**). Sample 17 was clear of CA and ABPs and the remediation goal of 20 mg/kg arsenic was achieved. Competent saprolite was previously achieved across the entire grid and confirmed by the CENAB geologist on July 30, 2014. After completing the additional over excavation, the southern half of grid (-10, -30) achieved bedrock refusal as confirmed by the CENAB geologist on March 31, 2020. **Table 5-4** below summarizes the confirmation/grab sampling results in grid (-10, -30).

5.3.2.9 In June 2020, the north wall of grid (-10, -90) was over excavated two feet to the north in accordance with SOP 49. The north wall of grid (-10, -90) was deeper than five feet; therefore, three samples were collected on June 8, 2020 from three different depths down the horizontal midpoint of the wall and analyzed for CA, ABPs, and arsenic only (sample location 42* on **Figure 5-2**). The two foot over excavation created a 2 ft by 20 ft grid, and one floor sample was collected on June 8, 2020 and analyzed for CA, ABPs, and arsenic only (sample location 43 on **Figure 5-2**). Of the four samples collected, the floor sample contained arsenic exceeding 20 mg/kg while the three sidewall samples contained no detections of CA or ABPs and achieved the remediation goal of 20 mg/kg arsenic. The 2 ft by 20 ft grid was over excavated an additional one foot deeper and another floor sample was collected on June 15, 2020 and analyzed for CA, ABPs, and arsenic only (sample location 44 on **Figure 5-2**). The final floor sample was clear of CA and ABPs and the remediation goal of 20 mg/kg arsenic was achieved.

Table 5-4: Confirmation/Grab Samples Collected from Grid (-10, -30)

Sample Location on Figures 5-3 and 5-4	Sample Collection Date	Sample Results			
		All Results Below the CVs (All RAOs and Remedial Goal Achieved)	Contained Other Metals Exceeding the CVs (Excluding Arsenic)	Contained Arsenic >20 mg/kg	Contained CA/ABP Detection(s)
1	4/29/2019			✓	
2	4/29/2019		✓		
3	4/29/2019		✓		
4	4/29/2019			✓	✓
5	4/29/2019	✓			
6	4/29/2019			✓	✓
7	4/29/2019			✓	✓
8	4/29/2019			✓	✓
9	3/10/2020	✓			
10	3/10/2020				✓
11	3/20/2020	✓			
12	3/20/2020	✓			
13	3/20/2020	✓			
14	3/20/2020	✓			
15	3/20/2020	✓			
16	3/20/2020	✓			
17	3/20/2020	✓			

5.3.2.10 The sample collection dates in **Table 5-5** reflect the day the last HTW confirmation samples were collected from a specific grid. The color-coded results in **Table 5-5** correspond to the sample locations shown in **Figure 5-2** except for grid (-10, -30) samples which are shown in **Figures 5-3** and **5-4**.

Table 5-5: Results of HTW Confirmation Samples from Locations Requiring Over Excavation

Grid	Sample Collection Date	Sample Results	
		All Results Below the CVs (All RAOs and Remedial Goal Achieved)	Contained Other Metals Exceeding the CVs (Excluding Arsenic)
-10, -30	3/20/2020	✓[1]	
30, -50	6/4/2019		✓
30, -30	5/24/2018		✓

50, -30	4/26/2018		✓
50, -10	5/16/2018	Excavated to Bedrock	
10, -10	6/20/2018		✓
70, 10	7/12/2018		✓
90, -10	7/25/2018		✓
-10, -90	6/15/2020	✓	
-30, -70	6/25/2019		✓
-30, -90	3/6/2019		✓

Notes: 1. See Table 5-4 for sampling history of grid (-10, -30).

5.3.2.11 **Tables 5-2** and **5-5** show that all grids included in the scope of work for the RA at 4825 Glenbrook Road achieved the remediation goal of 20 mg/kg arsenic and were clear of CA and ABP detections. Other metals exceeding the CVs are addressed in Chapter 7.

5.3.2.12 **Confirmation Soil Sampling Conclusions** – All areas included in the scope of work for the RA at 4825 Glenbrook Road (areas A, B, D, E, and F) were excavated to competent saprolite and/or bedrock, which was then confirmed by the CENAB geologist, and confirmation soil samples were collected and analyzed for CA, ABPs, and HTW parameters. If these confirmation samples contained arsenic exceeding the remediation goal of 20 mg/kg or detections of CA/ABPs, the corresponding sample locations (floor and/or sidewalls of the grid) were over excavated and then re-sampled for the analytes that exceeded the CVs in the preceding confirmation sample until the remediation goal of 20 mg/kg was achieved in all soil samples representing soil still remaining at the site. Other metals that exceeded the CVs in confirmation soil samples representing soil still remaining at the site were evaluated in the Post-Remedy Assessment in Chapter 7.

5.4 BACKFILL AND TOPSOIL SAMPLING AND RESULTS

5.4.1 Several potential backfill and topsoil sources were sampled during the RA to ensure they were suitable for use at 4825 Glenbrook Road. Backfill and topsoil samples were collected in accordance with the SSWP (USACE 2017). Four samples were collected per 1,000 cubic yards of homogeneous soil from random locations at the surface of each pile. One sample was a six-point composite and the remaining samples were collected as discrete samples. Composite samples were analyzed for:

- Target compound list (TCL) pesticides;
- TCL polychlorinated biphenyls (PCBs);
- TCL SVOCs; and

- Target analyte list (TAL) metals, plus boron and tin.

5.4.2 Discrete samples were analyzed for:

- TCL VOCs and tentatively identified compounds (TICs);
- TCL pesticides;
- TCL PCBs;
- TCL SVOCs; and
- TAL metals, plus boron and tin.

5.4.3 Backfill and topsoil sampling results were compared to the CVs in the SSWP (USACE 2017) for confirmation soil samples. In addition to the analyses listed above, potential backfill and topsoil sources were classified in accordance with American Society of Testing and Materials (ASTM) D 2487. Potential backfill and topsoil were tested for Atterberg limits, grain size distribution, and compaction characteristics at a frequency of once per 1,000 cubic yards.

5.4.4 Backfill material and topsoil for 4825 Glenbrook Road required approval by USACE, USEPA, and DOEE before use. Backfill and topsoil sampling results are included in Appendix L.

5.5 PLANNED SOIL SAMPLES NOT COLLECTED

5.5.1 **Confirmation Samples** – Eight sidewall confirmation soil samples were proposed to be collected during the RA in accordance with the SSWP (USACE 2017) (**Figure 5-1**). Five of these proposed samples were located along the 4825 and 4835 Glenbrook Road property boundary. These samples were not collected because the excavation extended to the foundation of the adjacent 4835 Glenbrook Road residence and there were no sidewalls present after grids (10, -90), (30, -50), and (50, -90) were excavated to competent saprolite. The PDT concurred that there were no sidewalls present to collect these five samples from and alternatively, the samples were collected from the floor of the excavation instead. This decision is documented in the April 11, 2019 Partner meeting minutes and presentation in Appendix P. Three proposed sidewall confirmation soil samples were not collected from the south sidewalls of grids (50, 10), (70, 10), and (90, 10). The sidewall sample proposed in grid (50, 10) was not collected because the wall was composed of rock. The south sidewall samples proposed in grids (70, 10) and (90, 10) were not collected because the excavation extended to the fence along the 4801 Glenbrook Road property boundary. Sidewall samples collected there would have been outside the 4825 Glenbrook property boundary which was not in accordance with the SSWP (USACE 2017). The PDT concurred that these samples were not warranted. This decision is documented in the August 18, 2016 weekly PDT meeting minutes in Appendix P.

5.5.2 A confirmation sample was planned to be collected from the floor of the additional area excavated in grid (90, -50) shown in purple in **Figure 1-9**. A grab sample was collected instead of a confirmation sample. This area (Area 5 under SOP 48) is where AUES related glass was encountered on April 24, 2018 after heavy rains eroded the hill that sloped into the area A portion of grid (90, -50). From May 22 to May 23, 2019, the area was excavated approximately 1.5 feet down where AUES glass was previously encountered on April 24, 2018. No additional AUES glass was recovered in May 2019. Saprolite was evident at the bottom of the excavation, but was

not confirmed by a USACE geologist. A waste characterization sample was collected on May 22, 2019 and was clear of CA/ABPs and was below all waste CVs in the SSWP (USACE 2017). A grab soil sample (RA-4825GR-Area 5-Grab-052319-01) was collected on May 23, 2019 from the floor of the excavated area. Grab samples are analyzed for the same parameters as original confirmation samples as described in section 5.3.3. The grab sample was clear of CA/ABPs and was below all of the CVs for grab samples with the exception of cobalt. The CVs for grab samples are the same as for confirmation samples in the SSWP (USACE 2017). The PDT agreed that collecting a confirmation soil sample was not warranted based on the results of the grab sample collected. The grab sample collected cannot be called a confirmation sample because a USACE geologist did not confirm the excavation reached competent saprolite. This decision is documented in the April 11, 2019 Partner meeting minutes and presentation slides in Appendix P.

5.5.3 **Area Characterization Samples** – 19 area characterization samples shown in **Figure 5-5** were proposed to be collected during the RA in accordance with the SSWP (USACE 2017). These sample samples were to be analyzed for the confirmation soil sample parameters outlined in section 5.3.3. The PDT, USEPA, and DOEE agreed that collecting these samples was not necessary for two primary reasons: 1. Debris was not encountered in any of the low probability test pits investigated in the former backyard area or during the significant excavation and grading activities to build the CAFS and re-route the sewer and water lines and 2. Confirmation soil samples collected along the eastern sidewall of area A were all clear of CA and ABPs and below 20 mg/kg arsenic. This decision is documented in the August 23, 2016 Partner meeting minutes and presentation included in Appendix P.

5.6 ADDITIONAL SAMPLES COLLECTED AT 4835 GLENBROOK ROAD

Due to CACM encountered in area B along the 4825 and 4835 Glenbrook Road property line from March – August 2017, CEHNC and CENAB determined that additional sampling was needed to determine whether CACM and/or CA/ABP impacted soil from the 4825 Glenbrook Road property did not extend on to the 4835 Glenbrook Road property. A brief history of the remedial work performed at 4835 Glenbrook Road and the results of the additional samples collected there during the RA at 4825 Glenbrook Road are discussed in detail in Chapter 8.

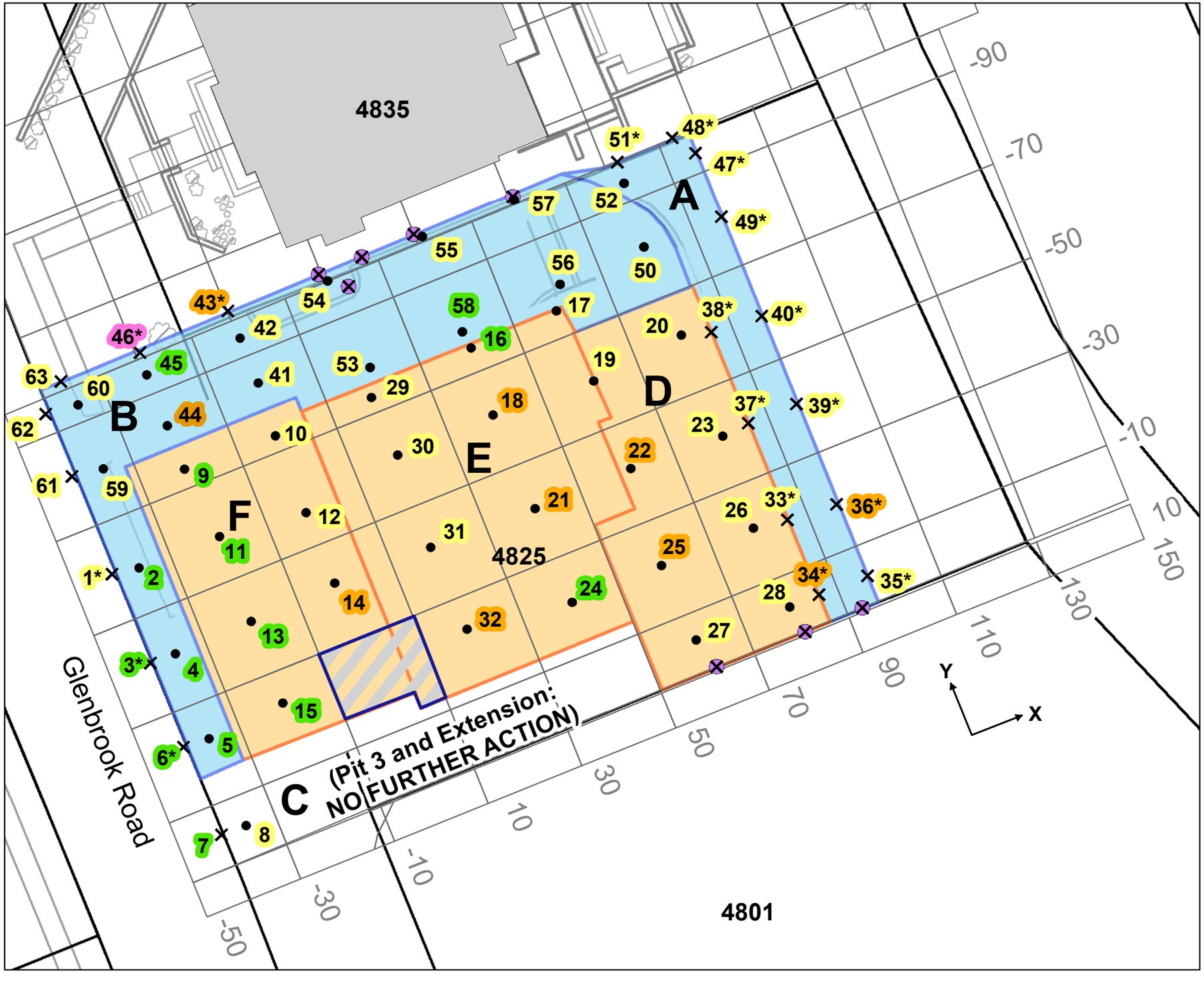


Figure 5-1
Original Confirmation
Sample Locations
4825 Glenbrook Road

Spring Valley
Washington, D.C.

Legend

- Floor Sample
- Sidewall Confirmation Sample
- No Sidewall to Sample
- Buildings
- Property Boundaries
- 20' Grid
- Bedrock Refusal

Excavated Areas

- High-Probability
- Low-Probability

Notes:
1. An asterisk on sample number(s) indicates multiple sample depths.

2. Green sample indicates all results below the CVs.

3. Yellow sample indicates sample contained metal exceedances (excluding Arsenic).

4. Orange sample indicates sample contained >20mg/kg Arsenic.

5. Pink sample indicates sample contained CA/ABP detection(s).

0 10 20 40 Feet

1 inch = 20 feet

Scale:	1:240
File:	20200928 4825 Glenbrook Confirmation Soil Sampling.mxd
Date:	1/12/2021
Figure Number:	5-1
Page Number:	5-13

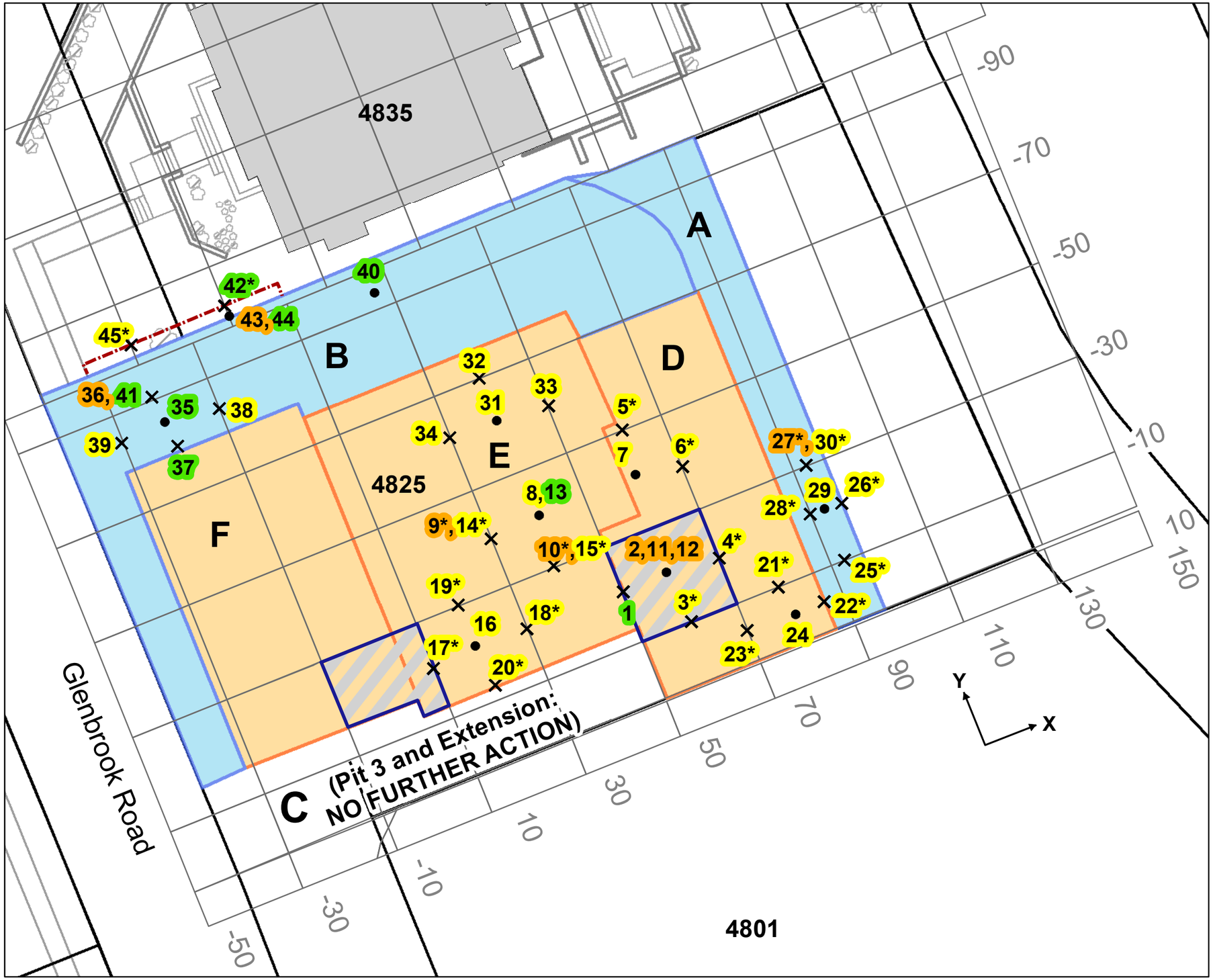


Figure 5-2
HTW Confirmation
Sample Locations
4825 Glenbrook Road

Spring Valley
Washington, D.C.

Legend

- Floor Sample Location
- Sidewall Confirmation Sample Location
- Buildings-Structures
- Property Boundaries
- 20' Grid
- Bedrock Refusal

Excavated Areas

- Low-Probability
- Completed High-Probability

Notes:
1. An asterisk on sample number(s) indicates multiple sample depths.

2. Green sample indicates all results below the CVs.

3. Yellow sample indicates sample contained metal exceedances (excluding Arsenic).

4. Orange sample indicates sample contained >20mg/kg Arsenic.

5. Pink sample indicates sample contained CA/ABP detection(s).

0 10 20 40 Feet

1 inch = 20 feet

Scale:	1:240
File:	20200929 4825 Glenbrook HTW Confirmation Sxs.mxd
Date:	1/12/2021
Figure Number:	5-2
Page Number:	5-14

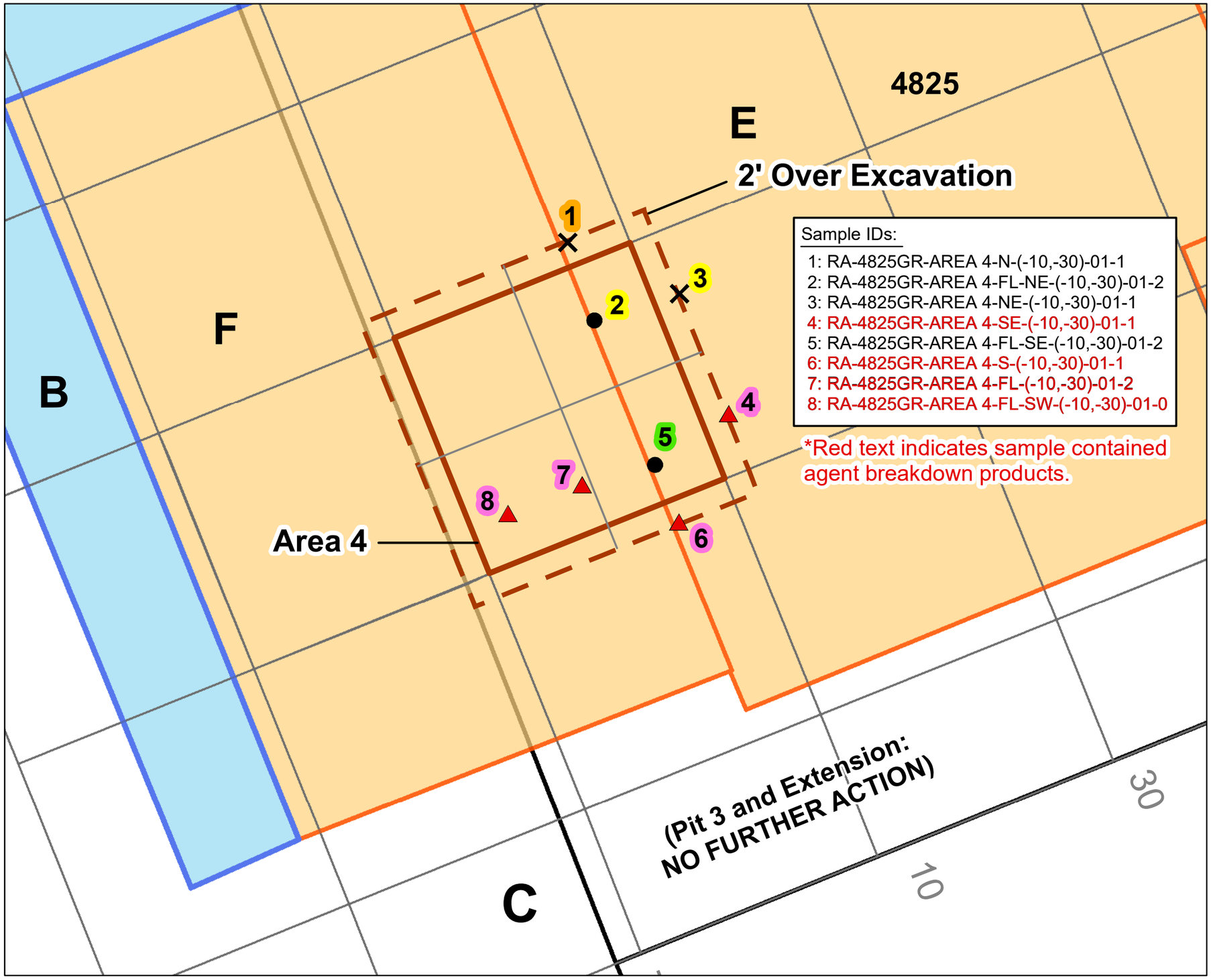


Figure 5-3
Grab Samples Collected
April 29, 2019 from Grid -10,-30
4825 Glenbrook Road

Spring Valley
Washington, D.C.

Legend

- Floor Sample Location
- Wall Sample Location
- Sample Contained Agent Breakdown Product(s)
- Property Boundaries
- 20' Grid
- Grid -10,-30 – Area 4

Excavated Areas

- High-Probability
- Low-Probability

Notes:
1. Excavation depths shown from previous arsenic removal.

2. Green sample indicates all results below the CVs.

3. Yellow sample indicates sample contained metal exceedances (excluding Arsenic).

4. Orange sample indicates sample contained >20mg/kg Arsenic.

5. Pink sample indicates sample contained CA/ABP detection(s).

0 4 8 16 Feet

1 inch = 8 feet

Scale:	1:96
File:	20201005 4825 Glenbrook Grid -10, -30 Grab Samples.mxd
Date:	1/12/2021
Figure Number:	5-3
Page Number:	5-15

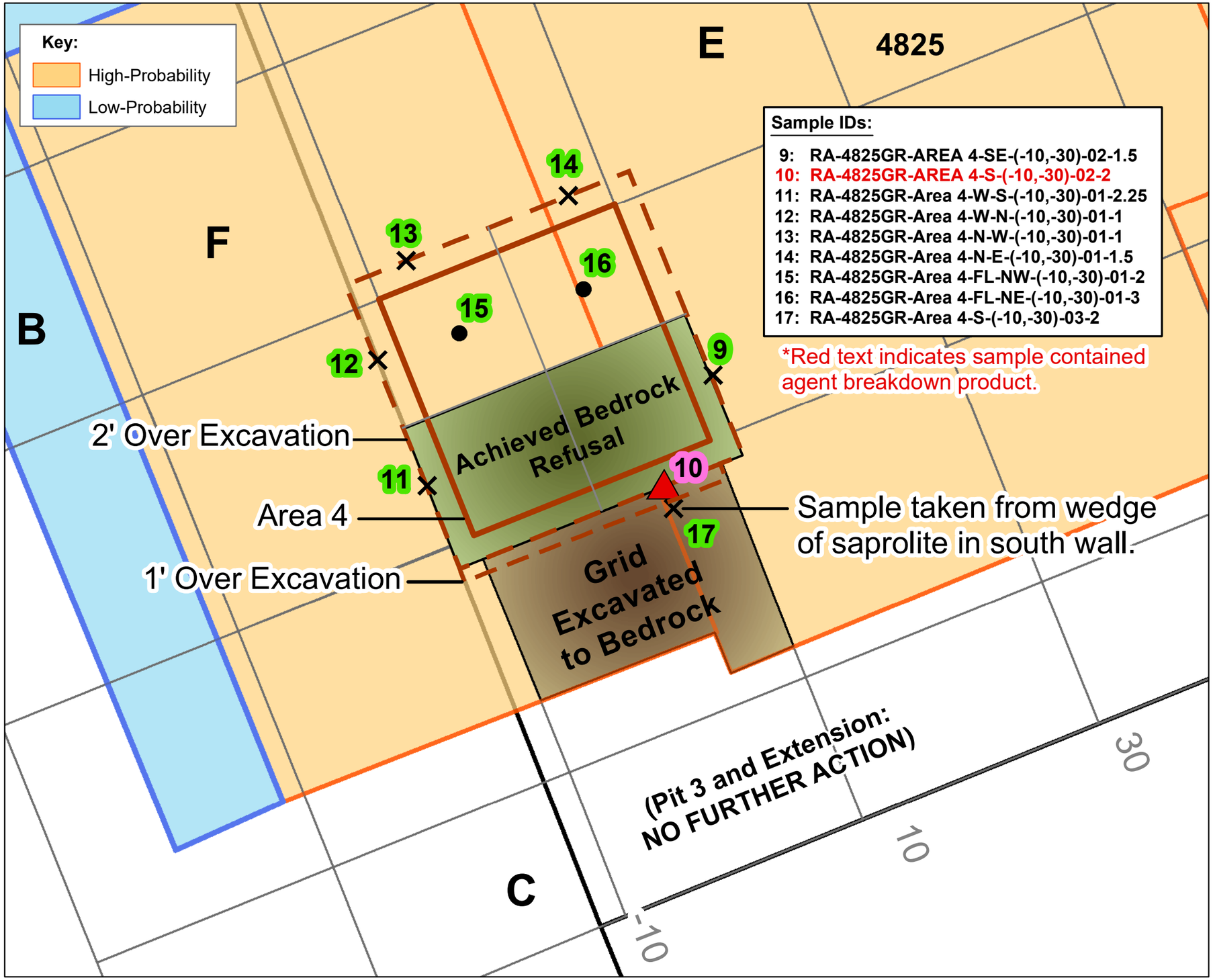


Figure 5-4
Samples Collected 3/10/20 and 3/20/20 from Grid -10, -30
4825 Glenbrook Road

Spring Valley
Washington, D.C.

Legend

- Wall Sample Location
- Floor Sample Location
- Sample Contained Agent Breakdown Product
- Property Boundaries
- 20' Grid
- Grid -10,-30 – Area 4

Excavated Areas

- High-Probability
- Low-Probability

Notes:
1. Excavation depths shown from previous arsenic removal.

2. **Green** sample indicates all results below the CVs.

3. **Pink** sample indicates sample contained CA/ABP detection(s).

0 4 8 16 Feet
1 inch = 8 feet

Scale:	1:96
File:	2020105 4825 Glenbrook Grid -10, -30 Sxs.mxd
Date:	1/12/2021
Figure Number:	5-4
Page Number:	5-16

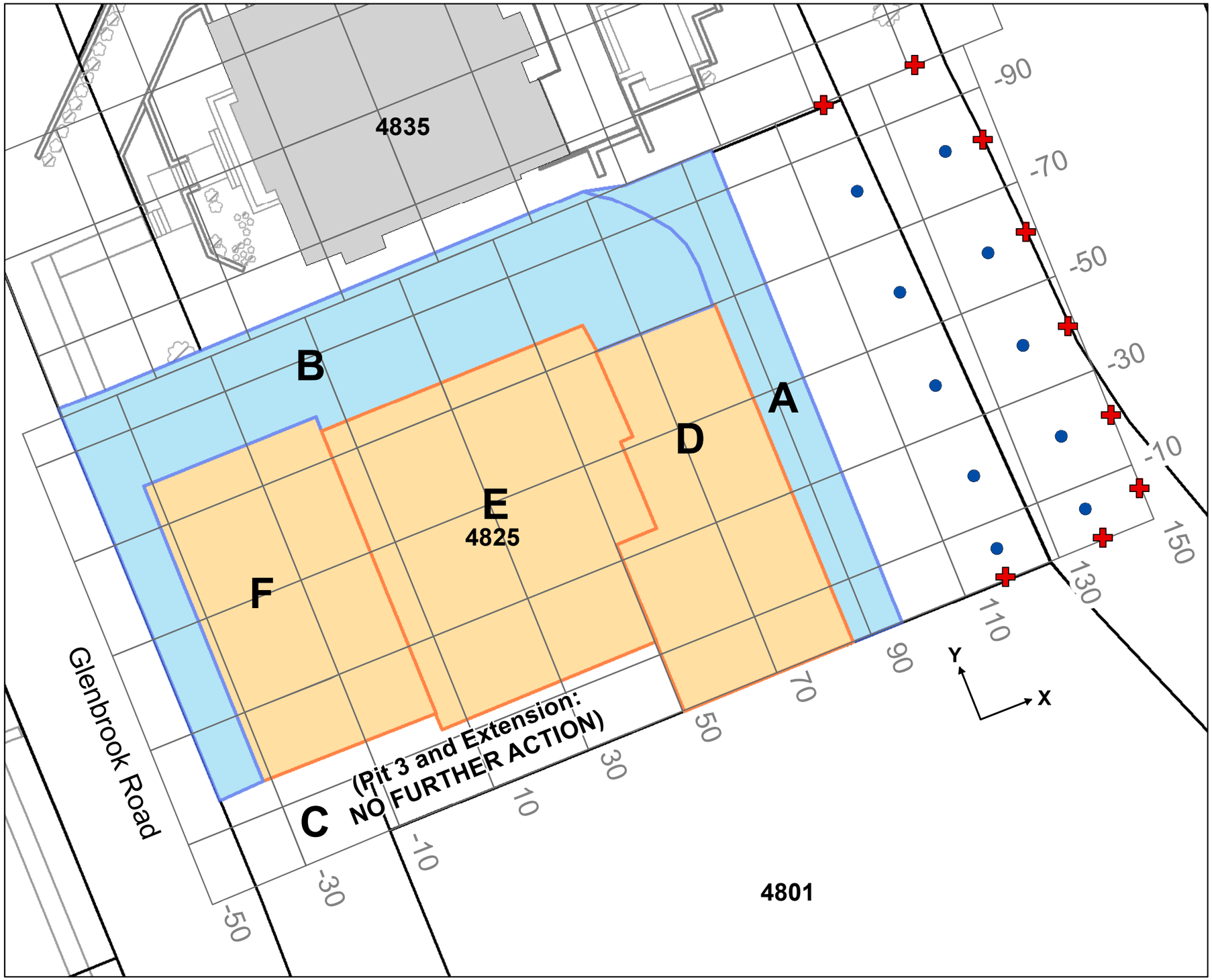


Figure 5-5
Area Characterization Samples
(Not Collected)
4825 Glenbrook Road

Spring Valley
Washington, D.C.

Legend

- Buildings
- Property Boundaries
- 20' Grid
- Area Characterization Sample Location
- Sidewall Area Characterization Sample Location

Excavated Areas

- High-Probability
- Low-Probability

0 10 20 40 Feet

1 inch = 20 feet

Scale:	1:240
File:	2020105 4825 Glenbrook Area Confirmation Sxs Not Collected.mxd
Date:	1/12/2021
Figure Number:	5-5
Page Number:	5-17

CHAPTER 6
EXPOSURE DATA

The exposure data for the RA at 4825 Glenbrook Road is presented in **Table 6-1**. This data includes the cumulative total hours worked in direct support of the contract by all full-time personnel and subcontractors. The RA at 4825 Glenbrook Road spanned 117 months from January 2012 through August 2021 and incurred one lost workday and one lost workday accident. The cumulative data presented below was updated monthly in the RA contractor's monthly reports to CEHNC. The hours shown do not include hours expended on corporate personnel issues, payroll, etc. The data also includes the cumulative total number of lost workday accidents during the project, the cumulative total number of lost workdays due to on-the-job accidents, and the cumulative total number of property damage accidents (including vehicles) with property loss value of $2,000 or more. **Table 6-1** below includes exposure data through August 27, 2021.

Table 6-1: Project Exposure Data 4825 Glenbrook Road RA

	Hours Worked Cumulative Total	Lost Workday Accidents Cumulative Total	Lost Workdays Cumulative Total	Property Damage Accidents (≥$2,000) Cumulative Total
Contractor	150,303	1	1	0
Subcontractors	125,163	0	0	0
Total	**275,466**	**1**	**1**	**0**

CHAPTER 7
POST-REMEDY ASSESSMENT

7.1 OVERVIEW

7.1.1 This chapter describes the post-remedy assessment that was conducted following the completion of the RA to support achievement of the remediation goal and RAOs. The DD for 4825 Glenbrook Road (CENAB 2012b) established the following remediation goal and RAOs for the 4825 Glenbrook Road RA:

Remediation Goal:

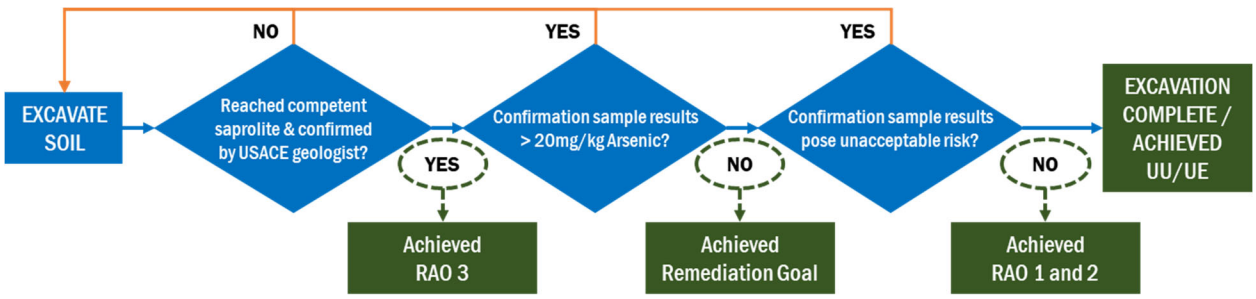
- Removal of all soil with a concentration greater than 20 mg/kg arsenic

Remedial Action Objectives:

1. Prevent direct contact with soil having a non-carcinogenic HI exceeding 1
2. Prevent direct contact with soil having a cancer risk in excess of 1 x 10^{-4}
3. Remove military munitions from the site, allowing for UU/UE

7.1.2 As described in the preceding chapters of this report, excavation and removal of soil was the primary method for achieving the remediation goal and the RAOs, with various evaluations being conducted throughout the process. **Figure 7-1** below summarizes the process through which the remediation goal and RAOs were evaluated and confirmed to be achieved:

Figure 7-1 Process for Achieving the Remediation Goal and RAOs at 4825 Glenbrook Road



7.1.3 The following sections discuss how the RAOs and remediation goal were achieved during the 4825 Glenbrook Road RA, including:

- Excavation and removal of soil to address the remediation goal and RAO 3; and
- HHRA to address RAOs 1 and 2.

7.2 EXCAVATION AND REMOVAL OF SOIL

7.2.1 The soil at the 4825 Glenbrook Road site was excavated down to competent saprolite (i.e., undisturbed soil) and/or bedrock. This ensured the removal of all military munitions from the site by examining all disturbed soil in the area for CWM and MEC/MPPEH. Achieving RAO 3, the removal all military munitions from the site, is demonstrated by **Table 4-1** which includes the dates a CENAB geologist confirmed that competent saprolite and/or bedrock had been reached in every grid comprising the areas included in the RA scope of work (areas A, B, D, E, and F).

7.2.2 Confirmation soil samples were collected to ensure that the remediation goal of the removal of all soil exceeding 20 mg/kg arsenic was achieved. Achieving the remediation goal is demonstrated by both **Tables 5-2** and **5-5**. **Table 5-2** summarizes the results of all original confirmation samples collected from each grid comprising the areas included in the RA scope of work. Grids with arsenic sample results exceeding 20 mg/kg in **Table 5-2** were over excavated and re-sampled until all samples representing soil remaining at the 4825 Glenbrook Road site contained no arsenic concentrations exceeding 20 mg/kg or bedrock was reached as confirmed by a CENAB geologist, whichever came first. **Table 5-5** demonstrates the remediation goal was met in that all arsenic results were below 20 mg/kg after over excavation was performed.

7.3 HUMAN HEALTH RISK ASSESSMENT

7.3.1 A draft Post-Removal Action Risk Reduction Summary (PRARRS) was prepared for CEHNC and CENAB in December 2019 to determine whether RAOs 1 and 2 had been achieved at 4825 Glenbrook Road. The draft final PRARRS was reviewed and accepted without further comment by CEHNC and CENAB in January 2020. The draft final PRARRS was reviewed and accepted without further comment by the USEPA and DOEE in June 2021. The final PRARRS (USACE 2021) is included in Appendix H. An HHRA was included in the PRARRS (USACE 2021) to quantitatively characterize the human health risk associated with current and reasonably expected future exposure to contaminated soils at 4825 Glenbrook Road. The primary objective of the HHRA was to evaluate whether RAOs 1 and 2 for direct contact with soil (see above) had been achieved by the RA to date. It did this by estimating the potential risks/hazards to current and future receptors from site-related contamination in the soil.

7.3.2 The type and magnitude of exposures to Chemicals of Potential Concern (COPCs) at the site were estimated, potential exposure pathways, receptors, and exposure scenarios were identified, and potential exposure was quantified.

7.3.3 During the RA activities conducted from 2012 through 2019, grids were excavated down to competent saprolite and/or bedrock or when a site boundary wall was reached, and confirmation samples were collected. Over excavation was conducted in specific locations until the arsenic concentrations in subsequent confirmation samples were below the remediation goal of 20 mg/kg, except for two small areas (hot spots): the north wall of grid (-10, -90) and grid (-10, -30) (also referred to as area 4).

7.3.4 149 soil samples, including field duplicate QC samples, were collected that were representative of the soil remaining at the site as of December 2019. Eighty-nine (89) samples

were analyzed for the Spring Valley comprehensive list of confirmation and/or grab sample parameters, including HD and L, ABPs, VOCs, SVOCs, metals, explosives, pesticides and PCBs, total cyanide, fluoride, iodine, and perchlorate. Sixty (60) HTW confirmation samples were collected that were representative of the soil remaining at the site as of December 2019 after the over excavation of HTW-contaminated soil. These samples were analyzed for only the analyte(s) that exceeded the CVs in the original corresponding confirmation sample results or preceding HTW confirmation samples if certain analytes continued to exceed the CVs after each iteration of over excavation. These analytes included aluminum, antimony, arsenic, cobalt, cyanide, manganese, nickel, thallium, and vanadium which were evaluated as COPCs in the HHRA. All other remaining compounds were below the CVs as prescribed in the SSWP (USACE 2017).

7.3.5 The HHRA evaluated potential future residents (adult and child). The exposure pathways evaluated include incidental soil ingestion, ingestion of homegrown vegetables, dermal contact with soils, and the inhalation of particulates.

7.3.6 The cumulative cancer risk estimates for adult and child residents exposed to surface soil (i.e. 0-2 feet below ground surface (ft bgs)); and combined surface and subsurface soil (0-12 ft bgs) are within the USEPA target risk range of 1×10^{-6} to 1×10^{-4}. Thus, unacceptable cancer risks to the receptors at the site are not expected from assumed exposures to COPCs in soil, which achieves the RAO of preventing direct contact with soil having a cancer risk in excess of 1×10^{-4}.

7.3.7 The hazard indices (HI) estimated for adult and child residents exposed to surface soil (0-2 ft bgs) and combined surface and subsurface soil (0-12 ft bgs) are below the benchmark of 1 following consideration of target organs. Thus, unacceptable hazards to residential receptors at the site are not expected from assumed exposures to COPCs in soil, which achieves the RAO of preventing direct contact with soil having a non-carcinogenic HI exceeding 1.

7.3.8 The human health risk associated with current and reasonably expected future exposure to contaminated soils at 4825 Glenbrook Road was quantitatively characterized. The metals concentrations in the remaining soil at 4825 Glenbrook Road are either below background concentrations or residential exposure to the COPCs in soil do not pose an unacceptable risk.

7.3.9 Based on the results of the December 2019 HHRA, RAOs 1 and 2 for the RA at 4825 Glenbrook Road have been achieved and no unacceptable risk is posed by the eight COPCs evaluated: aluminum, antimony, arsenic, cobalt, cyanide, manganese, nickel, thallium, and vanadium. However, as discussed in paragraph 5.3.2.7, the PDT decided to take a conservative approach and over excavate the two arsenic hot spots discussed in section 7.3.3 and re-sample for CA/ABPs and arsenic to ensure the remediation goal of the removal of all soil exceeding 20 mg/kg arsenic was achieved and there are no detections of CA/ABPs in any samples representing soil remaining at 4825 Glenbrook Road. This decision is documented in the January 2020 RA contractor monthly report to CEHNC and is included in Appendix P.

7.3.10 As discussed in paragraphs 5.3.2.8 and 5.3.2.9, over excavation was performed in accordance with SOP 49 in grid (-10, -30) and the north wall of grid (-10, -90) in March and June 2020, respectively. After this over excavation was completed in June 2020, there were no detections of CA/ABPs and the remediation goal of 20 mg/kg arsenic was achieved in all samples representing soil remaining at 4825 Glenbrook Road.

7.4 POST-REMEDY ASSESSMENT SUMMARY

With the remediation goal and all RAOs being met across the site following completion of the RA, UU/UE was achieved at 4825 Glenbrook Road. **Table 7-1** below summarizes the basis for the remediation goal and RAOs being met, along with references for where supporting information is presented in this report. The goals and objectives are presented in the order they were achieved throughout the project.

Table 7-1: Evidence Remediation Goal and RAOs were Achieved at 4825 Glenbrook Road

Goal/RAO	Evidence Goal/RAO Was Achieved
RAO 3	All soil in grids comprising the areas included in the RA scope of work (areas A, B, D, E, and F) were excavated to competent saprolite (i.e. undisturbed soil) or bedrock removing all military munitions from the site. **Table 4-1** demonstrates how RAO 3 was achieved by documenting the dates a USACE geologist confirmed competent saprolite or bedrock was reached in every grid.
Remediation Goal	All soil in grids comprising the areas included in the RA scope of work (areas A, B, D, E and F) with arsenic exceeding 20 mg/kg was removed from the site. **Section 5.3** and **Tables 5-2, 5-3, 5-4, and 5-5** document the process through which confirmation samples were collected and over excavation of HTW-impacted soil was performed until all samples representing soil remaining at the site had no concentrations of arsenic exceeding 20 mg/kg.
RAO 1 and 2	An HHRA was conducted in December 2019 to evaluate whether RAOs 1 and 2 were achieved. **Section 7.3** and **Appendix H** document how the chemicals of potential concern evaluated posed no unacceptable risk to residential receptors.

CHAPTER 8
SAMPLING PERFORMED AT 4835 GLENBROOK ROAD

8.1 BACKGROUND INFORMATION

4835 Glenbrook Road is a 0.5 acre property located to the north and adjacent to 4825 Glenbrook Road. Over the years, numerous investigations have been performed at the 4835 Glenbrook Road property. These investigations were conducted at different times, by different parties, and with different sampling objectives and analytical parameters. These investigations are summarized below. Additional sampling was performed at 4835 Glenbrook Road during the RA at 4825 Glenbrook Road and is discussed in section 8.3. A risk assessment was performed on soil data collected from 4835 Glenbrook Road and is presented in section 8.4. The data and information presented in this chapter is for informational purposes only and has no bearing on the successful achievement of the remedial goals as stated for 4825 Glenbrook Road.

8.2 PREVIOUS INVESTIGATIONS AT 4835 GLENBROOK ROAD

8.2.1 Soil Sampling (1992)

During construction of the residences at 4825 and 4835 Glenbrook Road in 1992, a 55-gallon drum and obsolete laboratory equipment were found in an area presumed to be in the driveway of 4825 Glenbrook Road. The AU Office of Risk Management retained a private company to investigate potentially hazardous conditions. Soil gas vapor probes and exploratory hand excavation were utilized to determine that there were no hazardous or volatile substances, nor explosive ordnance present at the property. However, within a month of this initial investigation, the construction workers experienced eye and respiratory irritation from an unknown source. The private company returned to investigate a white substance in the soil which was determined to be Silvex, an herbicide. The construction of the residences at 4825 and 4835 Glenbrook Road was completed without further documented incident.

8.2.2 Geophysical Investigations (1993 and 2002)

Geophysical surveys were performed at 4835 Glenbrook Road in 1993 and 2002. These surveys were not conclusive due to the presence of landscape and cultural features, as well as fill material; therefore, USACE determined that a test pit investigation was warranted.

8.2.3 Soil Investigation Activities (1996)

8.2.3.1 In June 1996, landscape workers at 4835 Glenbrook Road were excavating a large hole (about 6 ft diameter and 4 ft depth) to plant a tree in the front yard near the southwest corner of the house when workers were overcome by an odor and experienced irritation of the eyes and respiratory system. Related activities ceased. A private company under contract by AU completed an investigation of the front yard with a grid of 24 soil gas vapor probes on 2.5 ft centers, to a

depth of 4 ft, and collected four soil samples in addition to the 24 soil gas vapor probes to delineate an area of excavation.

8.2.3.2 Soil samples indicated elevated levels of certain metals and VOCs, with arsenic being of most concern. The hole where the tree was to be planted was over excavated to approximately 12 ft diameter and 6-ft depth. Laboratory glassware was encountered at approximately 2 ft bgs and was removed. Removal of contaminated soil was confirmed by five post-excavation soil samples. The backyard was intrusively investigated by digging two TPs to a depth of 9 ft and a third TP to a depth of 7 ft (these TPs were related to landscaping activities). A grid of 91 soil probes was also installed on 10 ft centers, to a depth of 4 ft without finding any evidence of additional contamination.

8.2.4 Soil Sampling (1999)

To address concerns of the DOEE, the USEPA Region III collected surface and subsurface soil samples in and around the 4801, 4825, and 4835 Glenbrook Road properties. On April 20, 1999, USEPA collected surface soil samples (0 to 6 inches bgs) from 4835 Glenbrook Road. The soil analytical results showed exceedances of the 1999 Risk Based Concentration of 0.43 mg/kg arsenic. The highest arsenic concentration of 26.7 mg/kg was detected in one surface soil sample.

8.2.5 Engineering Evaluation/Cost Analysis - 4801, 4825, and 4835 Glenbrook Road (2000)

8.2.5.1 Based on results of the USEPA Region III sampling, the soil at 4801, 4825, and 4835 Glenbrook Road was determined to have been affected by AUES activities. Consequently, USACE performed an Engineering Evaluation/Cost Analysis (EE/CA) for 4801, 4825, and 4835 Glenbrook Road (USACE 2000). This EE/CA included extensive sampling to determine the nature and extent of contamination identified in the surface and subsurface soil of the three properties. On October 31, 2000, the RA contractor collected surface soil samples at 4835 Glenbrook Road for HD ABPs 1,4-dithiane, 1,4-oxathiane, and thiodiglycol. Thiodiglycol was detected at low levels in all four samples; 1,4-dithiane and 1,4-oxathiane were not detected in any of the samples. A soil boring was also sampled at 0-2 ft bgs, 2-4 ft bgs, and 4-6 ft bgs near the southeast corner of the house at 4835 Glenbrook Road. These subsurface samples were analyzed for the three HD ABPs, all of which were non-detect in all three boring samples. Grid-level sampling for arsenic was also performed on October 31, 2000.

8.2.6 Risk Assessment for 4835 Glenbrook Road (2002)

The EE/CA (USACE 2000) and baseline risk assessments for 4801, 4825, and 4835 Glenbrook Road addressed the potential hazard associated with arsenic contamination in the soil (USACE 2002). The EE/CA (USCE 2000) was conducted to recommend and justify the preferred alternative for cleanup of arsenic contamination in the soil. The conclusion of the risk assessment (USACE 2002) was that there was unacceptable risk with regard to human exposure to arsenic in the surface soil at 4835 Glenbrook Road.

8.2.7 Final Site-Specific Investigation Report for 4835 Glenbrook Road (2013)

8.2.7.1 In response to the unacceptable risk posed by arsenic, TPs were excavated at 4835 Glenbrook Road from October 2007 – December 2008. The Site-Specific Investigation Report for 4835 Glenbrook Road was finalized by USACE in 2013. A total of 76 TPs were excavated. The TP investigations were performed in open air with near real-time air monitoring for various COPCs. Soil sampling was performed where conditions warranted (e.g., suspected AUES-related debris or munitions, discolored soil, or strange odor.)

8.2.7.2 No suspected AUES-related debris was recovered in 62 TP excavations. These excavations were cleared, backfilled, and cultural debris was disposed of at a RCRA Subtitle D landfill.8.2.7.3 In 14 TP excavations suspect AUES-related items were recovered. Of these 14 TPs, 13 TPs included suspect AUES-related labware fragments and one TP included a Livens projectile.

8.2.7.3 Approximately 539 cubic yards of arsenic impacted soil at concentrations exceeding 20 mg/kg were removed from the property and disposed of offsite. Grab soil samples and confirmation soil samples collected during soil removal indicated that benzo(a)pyrene, aluminum, copper, nickel, cobalt, and thallium detected in one or more samples exceeded their respective CVs. This data, along with the other data collected from the previous investigations (1992, 1996, 1999, and 2000) were evaluated in a HHRA (USACE 2009) that is summarized in the following section.

8.2.8 Human Health Risk Assessment for 4835 Glenbrook Road (2009)

8.2.8.1 Soil data collected in 2007 and 2008 from the TP investigation and arsenic removal activities along with other data collected from previous investigations in 1992, 1996, 1999, and 2000 were evaluated in a HHRA (USACE 2009a) for the 4835 Glenbrook Road property. The HHRA (USACE 2009a) concluded that the cumulative cancer risk estimates for child residents, adult residents, and outdoor workers are all well below the USEPA point of departure of 1 x 10-6 risk level. Thus, unacceptable cancer risks to the human receptors were not expected from assumed exposures to COPCs (aluminum, cobalt, copper manganese, mercury, nickel, thallium, and vanadium) in soil at 4835 Glenbrook Road. Additionally, the hazard indices (HI) estimated for assumed exposures at the property did not exceed the benchmark level of concern of 1. This indicated that unacceptable non-carcinogenic health effects were not expected from assumed exposures to COPCs in soil at 4835 Glenbrook Road.

8.2.8.2 Geotechnical soil samples were collected after performing the HHRA (USACE 2009). The aluminum, cobalt, thallium, and vanadium concentrations collected from the geotechnical soil samples were further evaluated by comparing the concentrations to the mixed soil reasonable maximum exposure (RME) exposure point concentrations (aluminum: 25,533 mg/kg, cobalt: 42 mg/kg, thallium: 1.35 mg/kg, and vanadium: 109 mg/kg) used in the HHRA (USACE 2009). Among the four subsurface soil samples collected, only two samples were within 0 to 10-ft interval, where the soil direct contact exposure pathways were potentially complete. The comparison results showed the exceeded concentrations (aluminum: 24,100 mg/kg, thallium: 2.7 mg/kg, and vanadium: 92.4 mg/kg) detected in these two samples were lower than the EPCs used in the HHRA (USACE 2009) except for thallium. The 95 percent UCL was recalculated for

thallium including the two additional data points. The recalculated 95 percent UCL was 1.36 mg/kg, which was close to the EPC of 1.35 mg/kg. Therefore, the conclusions of the HHRA (USACE 2009) were still valid for the property.

8.3 ADDITIONAL SAMPLES COLLECTED AT 4835 GLENBROOK ROAD

During the RA at 4825 Glenbrook Road, CACM encountered in area B along the 4825 and 4835 Glenbrook Road property line from March – August 2017. CEHNC and CENAB determined that additional sampling was needed to determine whether CACM and/or CA/ABP impacted soil from the 4825 Glenbrook Road property extended on to the 4835 Glenbrook Road property. Two sampling efforts were conducted on the adjacent 4835 Glenbrook Road property during the RA at 4825 Glenbrook Road, including:

1. Borehole soil sampling effort conducted by RA Contractor

2. Borehole soil and vapor sampling conducted by CCDC

8.3.1 Borehole Soil Sampling Effort

8.3.1.1 From December 2017 – January 2018, the RA contractor advanced 30 boreholes and collected 90 discrete soil samples and one water sample from the locations shown in **Figure 8-1**. Additionally, the RA contractor installed four sub-slab vapor monitoring points also shown in **Figure 8-1**. Boreholes 3-18 were located underneath the foundation and/or backyard patio of the house at 4835 Glenbrook Road.

8.3.1.2 Of the 90 borehole soil samples collected, the ABPs 1,4-dithiane and 1,4-oxathiane were detected in one sample from borehole 28 [4835/25GR-BH28-012618-(0-2)]. These ABP detections were 50 and 26 µg/kg, respectively, which were well below the 4825 Glenbrook Road confirmation sample CVs in the SSWP (USACE 2017) of 78,000 µg/kg for 1,4-dithiane and 61,000 µg/kg for 1,4-oxathiane.

8.3.1.3 Of the 16 boreholes that were sampled underneath the foundation and backyard patio of the house at 4835 Glenbrook Road, one soil sample collected from borehole 17 [4835GR-BH17-011618-(6-8)] contained cyanide at a concentration of 14 mg/kg, which exceeded the 4825 Glenbrook Road confirmation sample CV of 0.27 mg/kg. This sample was collected from under the backyard patio on the 4835 Glenbrook Road property at a depth of 6-8 feet. Cyanide is not a volatile compound and this result was considered an isolated occurrence. All other borehole soil samples collected from underneath the foundation and/or backyard patio of the house at 4835 Glenbrook Road during this effort contained analytes at concentrations below the 4825 Glenbrook Road confirmation sample CVs in the SSWP (USACE 2017), with the exceptions of aluminum, antimony, arsenic, cobalt, copper, manganese, nickel, and vanadium. Elevated arsenic concentrations were located in three boreholes (boreholes 16, 17 and 18 on **Figure 8-1**) underlaying the backyard patio's poured concrete slab. An additional evaluation was performed on the sampling data collected from underneath the foundation and backyard patio and is discussed in detail in section 8.4

8.3.1.4 One water sample (4835GR-SUMP-120717-01) was collected from the 4835 Glenbrook Road sump in the house basement. No CA or ABPs were detected in this sample. The sample was not analyzed for additional parameters.

8.3.1.5 All other borehole soil samples collected during this effort contained analytes at concentrations below the 4825 Glenbrook Road confirmation sample CVs in the SSWP (USACE 2017) with the exceptions of aluminum, antimony, arsenic, cobalt, copper, dieldrin, ethylbenzene, manganese, nickel, and vanadium. The results of this sampling effort are included in Appendix Q-2. All data from this sampling effort was validated at USEPA Level IV and all DVRs from this sampling effort are included in Appendix Q-2.

8.3.2 Soil and Vapor Sampling Effort Conducted by CCDC

8.3.2.1 In March and April 2018, CCDC cored through the 4835 Glenbrook Road basement slab in 36 locations. These locations were distributed across the basement including the crawlspace. The 36 boreholes were sampled by direct push sampling sleeves and resulted in the collection of 106 discrete soil samples. Ten boreholes were prepared as vapor sampling points distributed throughout the basement area. Borehole soil and vapor sample locations are shown in **Figure 8-2**.

8.3.2.2 All 106 discrete soil samples were non-detect for CAs HD and L and ABPs 1,4-dithiane and 1,4-oxathiane. The results of this sampling event are included in Appendix Q-3.

8.3.2.3 CCDC collected soil vapor samples from 10 boreholes under the 4835 Glenbrook Road property during three different sampling events. These sampling events occurred in August 2018, November 2019, and October 2020. During the August 2018 sampling event, 10 vapor samples were collected. ABP 1,4-oxathiane was detected in one sample (#11-Chem-3). ABP 1,4-dithiane was detected in eight samples (#23-Chem-2, #11-Chem-3, #7-Chem-4, #7P-Chem-5, #10P-Chem-6, #14P-Chem-7, #4P-Chem-9, and #18-Chem-10) as shown in **Figure 8-3**. The same 10 vapor monitoring points that were sampled in August 2018 were then sampled during the November 2019 and October 2020 sampling events. There were no detections of CA and/or ABPs during the November 2019 and October 2020 sampling events. This is because from October 2018 through February 2019, area 1 (located along the 4825 and 4835 Glenbrook Road property line) on **Figure 1-5** was excavated to competent saprolite; therefore, any contaminated soil (source material) that was contributing to the ABP detections in the August 2018 vapor samples was removed. An additional evaluation was performed on the sampling data collected from underneath the foundation and is discussed in detail in section 8.4 After the second sampling event in November 2019, CCDC installed a temperature logger on Borehole 11 located in the center of the basement. The temperature under the house was recorded from February 2020 to September 2020. The temperature data recorded showed that the temperature under the house remained relatively constant and was not significantly impacted by outside temperatures. The results of these three sampling events and the temperature data are included in Appendix Q-3.

8.4 4835 GLENBROOK ROAD RISK ASSESSMENT

8.4.1 During the 4825 Glenbrook Road RA samples were collected at 4835 Glenbrook Road underneath the foundation and backyard patio. Aluminum, antimony, arsenic, cobalt, copper, manganese, nickel, vanadium, and cyanide were detected in soil samples at concentrations exceeding their respective CVs in the SSWP (USACE 2017). These soil samples were collected after performing the HHRA for 4835 Glenbrook Road in 2009 (USACE 2009). Additional risk evaluations were conducted after combining the additional data collected at 4835 Glenbrook Road during the 4825 Glenbrook Road RA with the data used in the 4835 Glenbrook Road HHRA (USACE 2009) to determine if the conclusions of the HHRA (USACE 2009) are still valid for the 4835 Glenbrook Road property (see Appendix Q-1, Tables Q-1.1.1 through Q-1.2.24).

8.4.2 The receptors evaluated in this risk assessment include adult and child residents, as well as construction workers. Unrestricted use, represented by potential future residents (adult and child), was evaluated along with outdoor workers (represented by construction workers). Exposure to surface soil (i.e. 0-2 ft bgs); and combined surface and subsurface soil (0-10 ft bgs), to account for the potential mixing of soil that may occur in the future due to excavation and/or construction at the site, was evaluated. The exposure pathways evaluated include incidental soil ingestion, ingestion of homegrown vegetables, dermal contact with soils, and the inhalation of particulates and volatiles. This evaluation included the recent samples from underneath the foundation and backyard patio for the construction worker and the entire 4835 Glenbrook Road residential lot for the future resident. Soil remaining in place following excavation was evaluated.

8.4.1 Construction Worker

8.4.1.1 The data set consisted of the samples collected by the RA contractor and CCDC underneath the foundation and backyard patio during the 4825 Glenbrook Road RA, which included soil samples from boreholes 3 through 18 on **Figure 8-1** and boreholes 1 through 36 on **Figure 8-2**. This represents the scenario in which a construction worker is performing excavation under the foundation and backyard patio. To identify COPCs, the maximum detected concentration of each analyte was compared to the CVs in the SSWP (USACE 2017). COPCs evaluated include aluminum, antimony, arsenic, cobalt, copper, manganese, nickel, and vanadium (see Appendix Q-1, Table Q-1.1.1). Although cyanide was detected in a single sample at a concentration greater than the CV, it was not retained as a COPC. Cyanide was only detected in one sample out of 37 samples collected. Therefore, cyanide was detected in less than 5% of the site samples, it was not detected in other media; thus, as stated in Risk Assessment Guidance for Superfund (RAGS) Part A (USEPA 1989), it was not retained as a COPC. No other COPCs were identified.

8.4.1.2 Each COPC is evaluated by estimating a potential concentration in soil that would represent anticipated exposure. This concentration is called the exposure point concentration (EPC). EPCs are estimated using the 95% UCL on the mean as calculated by USEPA ProUCL. Surface soil EPCs were estimated from the analytical data collected from the residential lot for surface soil (0-≤2 feet bgs). Soil EPCs for the combined surface and subsurface soil were calculated by aggregating analytical data collected from combined surface and subsurface soil (0-≤10 feet bgs). When a 95% UCL could not be calculated (e.g., there was an insufficient sample

size to reliably calculate the 95% UCL), the maximum detected concentration was used as the EPC (see Appendix Q-1, Table Q-1.1.3).

8.4.2 Future Resident

8.4.2.1 The data set consisted of the samples used in the HHRA (USACE 2009) combined with the samples collected by the RA contractor and CCDC during the 4825 Glenbrook Road RA. To identify COPCs, the maximum detected concentration of each analyte was compared to the CVs in the SSWP (USACE 2017). COPCs evaluated include aluminum, antimony, arsenic, cobalt, copper, manganese, mercury, nickel, thallium, and vanadium (see Appendix Q-1, Table Q-1.2.1). Although cyanide was detected in a single sample at a concentration greater than the CV, it was not retained as a COPC. Cyanide was only detected in one sample out of 37 samples collected. Therefore, cyanide was detected in less than 5% of the site samples, it was not detected in other media; thus, as stated in RAGS Part A (USEPA 1989), it was not retained as a COPC. No other COPCs were identified.

8.4.2.2 Each COPC is evaluated by estimating an EPC. EPCs are estimated using the 95% UCL on the mean as calculated by USEPA ProUCL. Surface soil EPCs were estimated from the analytical data collected from the residential lot for surface soil (0-≤2 feet bgs). Soil EPCs for the combined surface and subsurface soil were calculated by aggregating analytical data collected from combined surface and subsurface soil (0-≤10 feet bgs). The 95% UCLs for thallium (1.0 mg/kg for 0-2 ft bgs and 1.1 mg/kg for 0-10 ft bgs) are less than the background Upper Tolerance Limit (UTL) (2.2 mg/kg) (USACE 2008) (see Appendix Q-1, Table Q-1.2.3). Therefore, thallium was not retained as a COPC.

8.5 4835 GLENBROOK ROAD CONCLUSIONS

8.5.1 Elevated arsenic concentrations were located in three boreholes (boreholes 16, 17 and 18 on **Figure 8-1**) underlaying the backyard patio's poured concrete slab and within a foundation wall supporting a roof and all current exposure pathways are incomplete. The risk assessment evaluated a future residential scenario that assumed the house would be removed, and in the process the soil would be mixed throughout the entire property. Any outliers (i.e., hotspots) would be mixed into the surrounding soil through regrading, etc. Therefore, the property and sample data contained within the boundaries represent one single exposure area. As arsenic was considered a COPC, it was retained for a quantitative risk assessment where the EPC was calculated using past as well as the most recent data. In this risk assessment, it was determined that arsenic did not exceed the risk threshold for the future residential exposure scenario.

8.5.2 The cumulative cancer risk estimates for adult and child residents and construction workers exposed to surface soil (i.e. 0-2 ft bgs); and combined surface and subsurface soil (0-10 ft bgs) are less than or within the USEPA target risk range of 1×10^{-6} to 1×10^{-4} (see Appendix Q-1, Table Q-1.1.12, Table Q-1.2.15, and Table Q-1.2.22). Thus, unacceptable cancer risks to the receptors at 4835 Glenbrook Road are not expected from assumed exposures to COPCs in soil.

8.5.3 The hazard indices (HI) estimated for adult and child residents and construction workers exposed to surface soil (0-2 ft bgs) and combined surface and subsurface soil (0-10 ft bgs) are less

than or equal to the benchmark of 1 following consideration of target organs, when needed (see Appendix Q-1, Table Q-1.2.17, and Table Q-1.2.24). Thus, unacceptable hazards to residential receptors at 4835 Glenbrook Road are not expected from assumed exposures to COPCs in soil and the conclusions of the HHRA (USACE 2009) are still valid for the 4835 Glenbrook Road property.

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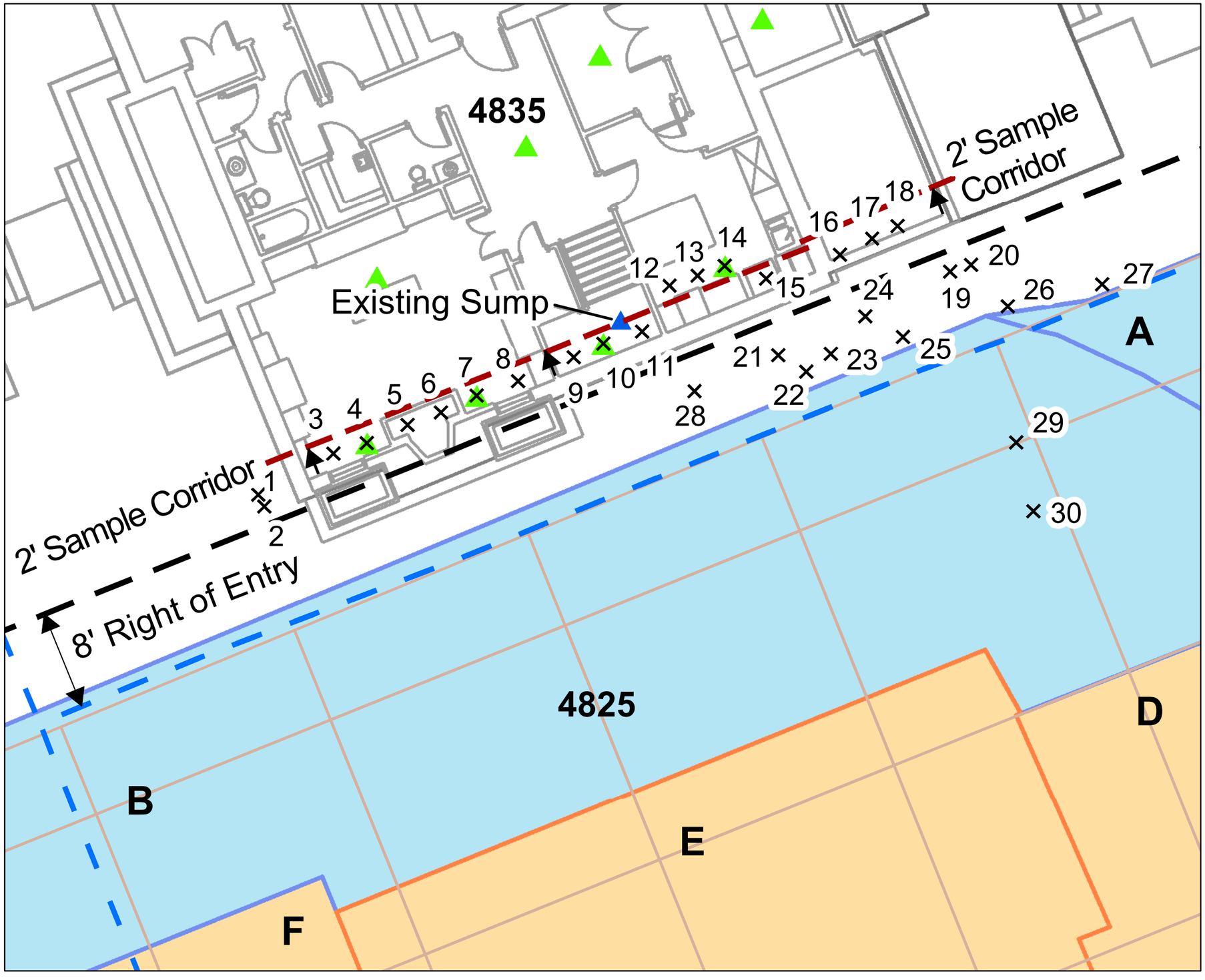

Figure 8-1
4825 / 4835 Glenbrook Road
2018 Borehole Sampling Effort
4835 Glenbrook Road

Spring Valley
Washington, D.C.

Legend

- Building
- Driveway
- Property Boundaries
- 20' Grid
- Right of Entry
- Sample Corridor
- Existing Sump
- Sub-slab Vapor Monitoring
- Sample Locations

Excavated Area

- High-Probability
- Low-Probability

0 4 8 16 Feet

1 inch = 8 feet

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Date:	1/12/2021
Figure Number:	8-1
Page Number:	8-9

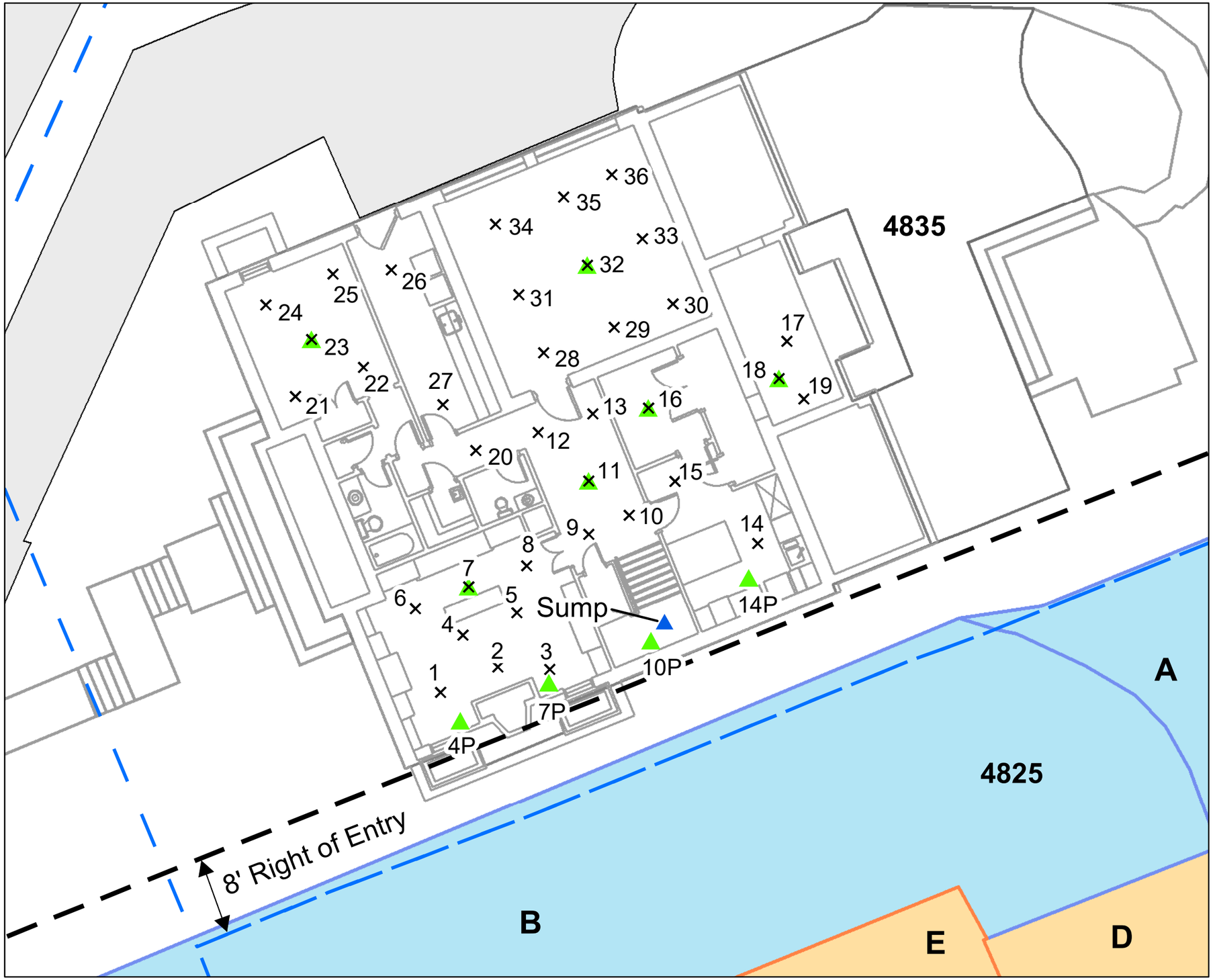

Figure 8-2
CCDC Borehole Soil and Vapor Sample Locations
4835 Glenbrook Road

Spring Valley
Washington, D.C.

Legend

- Building
- Driveway
- Property Boundaries
- Right of Entry
- Existing Sump
- Sub-slab Vapor Monitoring
- Sub-slab Soil Sample Location

Excavated Areas

- High-Probability
- Low-Probability

0 5 10 20 Feet

1 inch = 10 feet

Scale:	1:120
File:	20210126 4835 Glenbrook Basement Sampling.mxd
Date:	1/26/2021
Figure Number:	8-2
Page Number:	8-10

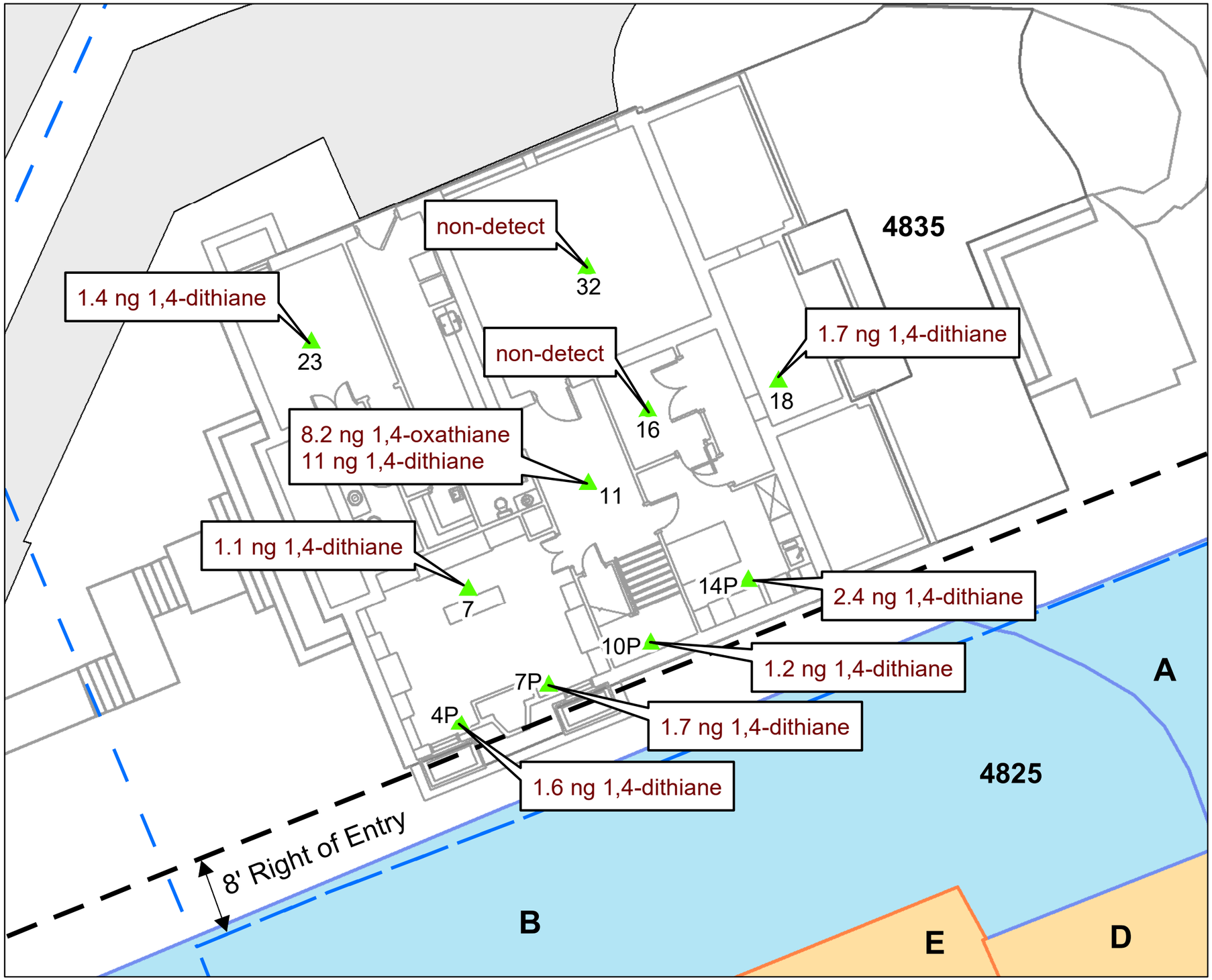

Figure 8-3
CCDC Vapor Sample Results
August 2018
4835 Glenbrook Road

Spring Valley
Washington, D.C.

Legend

- Building
- Driveway
- Property Boundaries
- Right of Entry
- Sub-slab Vapor Monitoring

Excavated Areas

- High-Probability
- Low-Probability

Note: “ng” is nanograms.

0 5 10 20 Feet

1 inch = 10 feet

Scale:	1:120
File:	20211005 4835 Glenbrook Basement Sampling.mxd
Date:	10/5/2021
Figure Number:	8-3
Page Number:	8-11

CHAPTER 9
CONCLUSIONS

9.1 GENERAL

The DD for 4825 Glenbrook Road (CENAB 2012b) established the following remediation goal and RAOs for the 4825 Glenbrook Road RA:

- Remediation Goal: Removal of all soil with a concentration greater than 20 mg/kg arsenic
- RAOs:
    1. Prevent direct contact with soil having a non-carcinogenic HI exceeding 1
    2. Prevent direct contact with soil having a cancer risk in excess of 1×10^{-4}
    3. Remove military munitions from the site, allowing for UU/UE

9.2 WORK PERFORMED TO ACHIEVE THE REMEDIATION GOAL AND RAOS

9.2.1 The following tasks were performed to achieve the remediation goal and RAOs:

- Demolition and disposal of the house at 4825 Glenbrook Road;
- Excavation and removal of soil to competent saprolite and/or bedrock; and
- Collection and analysis of samples to confirm contamination at the site was below applicable limits.

9.2.2 Before remediation activities were performed, the house at 4825 Glenbrook Road was demolished. House demolition activities occurred from November 2012 – December 2012. A demolition subcontractor removed and disposed of the residence in accordance with the SSWP (USACE 2017).

9.2.3 All areas included in the scope of work for the RA at 4825 Glenbrook Road (areas A, B, D, E, and F) were excavated to competent saprolite and/or bedrock, and this was confirmed by a CENAB geologist. By excavating the site to competent saprolite and/or bedrock, RAO 3 was achieved. Confirmation soil samples were collected to demonstrate the remediation goal of removing all soil with concentrations of arsenic exceeding 20 mg/kg was achieved. Grids with arsenic sample results exceeding 20 mg/kg were over excavated and re-sampled until all samples representing soil remaining in every grid at the 4825 Glenbrook Road site did not contain arsenic at concentrations exceeding 20 mg/kg or until bedrock was reached as confirmed by a CENAB geologist. This process verified that the remediation goal of the removal of all soil exceeding 20 mg/kg arsenic was achieved. A PRARRS (USACE 2021) was prepared to determine whether RAOs 1 and 2 related to direct contact with soil had been achieved at 4825 Glenbrook Road. An HHRA was included in the PRARRS (USACE 2021) that quantitatively characterized the human

health risk associated with current and reasonably expected future exposure to contaminated soils at 4825 Glenbrook Road. Based on the results of the HHRA, the PRARRS (USACE 2021) concluded RAOs 1 and 2 for the RA at 4825 Glenbrook Road have been achieved and no unacceptable risk is posed by the eight COPCs evaluated: aluminum, antimony, arsenic, cobalt, cyanide, manganese, nickel, thallium, and vanadium. The Post-Remedy Assessment included in this report summarizes these evaluations and their conclusions regarding the remediation goal and RAOs for 4825 Glenbrook Road. With the remediation goal and all RAOs met across the site, UU/UE was achieved at 4825 Glenbrook Road.

9.3 SITE RESTORATION

After the completion of the remediation activities at 4825 Glenbrook Road, restoration activities began in June 2020. The excavated areas were surveyed by a licensed professional surveyor. The utilities (sewer and water lines) were returned to service in accordance with local and industry standards. The site was then backfilled with clean soil and compacted to meet the standards referred to in the SSWP (USACE 2017). The backfill source was sampled, analyzed, and approved by USACE, USEPA, and DOEE. Approximately 3,264 cubic yards of clean backfill and topsoil were transported to the site for restoration purposes. The site was graded in accordance with the final grading plan agreed to by the PDT and AU. Final grading was completed in May 2021. After final grading was completed, topsoil was placed across the site. The topsoil source was sampled, analyzed, and approved by USACE, USEPA, and DOEE. Hydroseeding was completed in July 2021 and the property fence was installed and completed in August 2021.

CHAPTER 10
REFERENCES

10.1 DOCUMENTS REFERENCED IN THIS REPORT

Apex 1996. Final Report for President's Residence, 4835 Glenbrook Road.

ECBC June 2011. Arsenic Trichloride Filtration Performance with the Impregnated Carbon ASZMT.

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USACE 2002. Risk Assessment for 4835 Glenbrook Road, Spring Valley OU-3.

USACE 2007. Site-Wide Work Plan for the Spring Valley Formerly Used Defense Site Spring Valley, Washington D.C.

USACE 2009. Site-Specific Work Plan for the Test Pit Investigations at 4825 and 4835 Glenbrook Road Properties, Amendment 2, Spring Valley SVFUDS, Washington D.C.

USACE 2009a. Revised Final Human Health Risk Assessment 4835 Glenbrook Road, Spring Valley, Washington, D.C.

USACE 2011a. USACE, July 2011a. Remedial Investigation Report for 4825 Glenbrook Road Spring Valley FUDS, Operable Unit 3, Washington, D.C.

USACE 2011c. Proposed Plan, 4825 Glenbrook Road Spring Valley FUDS, Operable Unit 3, Washington, D.C.

USACE 2012a. MEC/CWM Probability Assessment, Intrusive Remedial Action at 4825 Glenbrook Road Spring Valley FUDS, Washington, D.C.

USACE 2012b. Final Decision Document for 4825 Glenbrook Road Spring Valley FUDS, Operable Unit 3, Washington, D.C.

USACE 2013. Final Site-Specific Investigation Report for 4835 Glenbrook Road Spring Valley FUDS, Operable Unit 3, Washington, D.C.

USACE 2017. Site Specific Work Plan for Remedial Design/Remedial Action at 4825 Glenbrook Road, Revision 6, Spring Valley Formerly Used Defense Site (SVFUDS), Operable Unit 3, Washington, D.C.

USACE 2021. Final Post-Removal Action Risk Reduction Summary, Spring Valley Formerly Used Defense Site (SVFUDS), Operable Unit 3, Washington, D.C.

USEPA 1999. Washington, D.C. Army Munitions Site, Spring Valley. Draft Risk Assessment Report. USEPA Region 3.

USEPA, 2015. ProUCL version 5.1.00. EPA/600/R-07/041. Technical Guide and Users Guide. October. http://www2.epa.gov/land-research/proucl-software

10.2 OTHER RELEVANT DOCUMENTS

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DA Pam 385-40, Army Accident Investigations and Reporting, published by Headquarters Department of the Army, Washington, DC, dated 18 March 2015.

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DID WERS-003.01, Safety Submissions, approved April 28, 2010.

DID WERS-004.01, Geophysics, approved April 28, 2010.

DID WERS-006.01, Accident Prevention Plan for Recovered Chemical Warfare Materiel (RCWM) Projects, approved April 28, 2010.

DID WERS-007.01, Geospatial Information and Electronic Submittals, approved April 28, 2010.

DID WERS-009.01, Munitions Constituents Chemical Data Quality Deliverables, approved April 28, 2010.

DID WERS-013.01, Site Specific Final Report, approved April 28, 2010.

Defense Explosives Safety Regulation (DESR) 6055.09, Edition 1, January 13, 2019.

DoD Ammunition and Explosive Safety Standards, Manual 6055.09-M, Volume 7 ”Criteria for Unexploded Ordnance, Munitions Response, Waste Military Munitions, and Material Potentially Presenting an Explosive Hazard,” dated August 4, 2010. (Now superseded by DESR 6055.09.)

DoD Quality Systems Manual for Environmental Laboratories (Version 5.3, approved May 7, 2019) and prior versions.

EM 200-1-2, Technical Project Planning Process. Engineer Manual. Dated 29 February 2016.

EM 200-1-15, Technical Guidance for Military Munitions Response Actions. Engineer Manual. Dated 30 October 2015. (Supersedes EM 1110-1-4009.)

EM 385-1-1, Safety and Health Requirements. Engineer Manual. Dated 15 September 2008.

EM 385-1-97, Explosives Safety and Health Requirements. Engineer Manual. Dated 12 April 2013.

EM 1110-1-4009, Military Munitions Response Actions. Engineer Manual. Dated 15 June 2007. (Now superseded by EM 200-1-15.)

Interim Guidance (Draft Army Regulation XXX), Chemical Warfare Materiel Responses and Related Activities, dated 1 April 2009.

Interim Guidance Document 06-04, Draft Engineering Pamphlet (EP) 1110-1-18, Military Munitions Response Process. Dated 15 June 2007. 6 March 2006.

Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP), Parts 1, 2A, and 2B. Intergovernmental Data Quality Task Force. March 2005.

APPENDIX A
DOCUMENTATION OF FINAL DISPOSITION OF MPPEH

This appendix contains the required documentation of the ultimate disposal of MDAS collected during the remedial action at 4825 Glenbrook Road. This appendix also contains disposal records of items disposed of by the government.

APPENDIX B
EXPLOSIVES ACCOUNTABILITY RECORDS

MEC demolition operations were not performed by the RA contractor during the remedial action at 4825 Glenbrook Road. This page is a placeholder only.

APPENDIX C
DIG SHEETS

APPENDIX D
DAILY REPORTS AND STANDARD FORM 948s

This appendix includes the RA Contractor Daily Reports. Standard Form 948s were not issued to the RA Contractor during the project.

APPENDIX E
BREAKOUT OF PROJECT COSTS

A breakout of Cost Plus Fixed Fee project costs was provided with each invoice submitted for payment by the RA contractor. This page is a placeholder only.

APPENDIX F
PROJECT PHOTOGRAPHS

APPENDIX G
CCDC DAILY SITUATION REPORTS

APPENDIX H
POST-REMOVAL ACTION RISK REDUCTION SUMMARY (PRARRS) (USACE 2021)

APPENDIX I
SAMPLE INDICES

This appendix contains indices of all samples collected during the RA at 4825 Glenbrook Road including:

I-1: Sample Index of all confirmation, grab, and waste characterization samples collected

I-2: Summary of all AUES glass intact containers recovered

I-3: Color Coded Confirmation Sample Index corresponding to all figures and tables in Chapter 5

APPENDIX J
DATA VALIDATION REPORTS (DVRS)

This appendix contains all DVRs for the sample data collected during the RA at 4825 Glenbrook Road and is organized as follows:

J-1: Confirmation Soil Sample DVRs

J-2: Grab Soil Sample DVRs

J-3: Backfill Soil Sample DVRs

J-4: CCDC Data DVRs

APPENDIX K
ELECTRONIC DATA DELIVERABLES (EDDS)

This appendix contains all EDDs for the sample data collected during the RA at 4825 Glenbrook Road and is organized as follows:

K-1: CCDC EDDs (Note: CCDC did not have EDD capability prior to March 2016.)

K-2: Commercial Laboratory EDDs

APPENDIX L
LABORATORY REPORTS

This appendix contains all Level 4 laboratory reports for the sample data collected during the RA at 4825 Glenbrook Road. All Level 4 laboratory reports include the signed chain-of-custody forms for all samples analyzed. Appendix L is organized as follows:

L-1: CCDC Level 4 Reports

L-2: Commercial Laboratory Level 4 Reports

- L-2a: Confirmation Soil Samples
- L-2b: Grab Soil Samples
- L-2c: Backfill Soil Samples

L-3: Waste Characterization Level 4 Reports

- L-3a: Soil Samples
- L-3b: Water Samples

APPENDIX M
VALIDATED DATABASE

This appendix contains all of the validated data collected during the RA at 4825 Glenbrook Road.

APPENDIX N
MANIFESTS

This appendix contains all of the signed manifests for waste generated and disposed of offsite during the RA at 4825 Glenbrook Road.

APPENDIX O
MRSPP SCORE SHEETS

APPENDIX P
OTHER SUPPORTING DOCUMENTS

The appendix contains documentation of critical decisions made throughout the RA at 4825 Glenbrook Road and is organized as follows:

P-1: Monthly Reports to CEHNC

P-2: Partner Meeting Presentations and Meeting Minutes

P-3: Weekly PDT Call Meeting Minutes

APPENDIX Q
4835 GLENBROOK ROAD DATA

The appendix contains risk assessment tables and the results of additional sampling efforts performed at 4835 Glenbrook Road and is organized as follows:

Q-1: 4835 Glenbrook Road Risk Assessment Tables

Q-2: 2018 Borehole Sample Effort performed by the RA Contractor

- Q-2a: CCDC Level 4 Reports
- Q-2b: Commercial Lab Level 4 Reports
- Q-2c: Data Validation Reports (DVRs)
- Q-2d: Electronical Data Deliverables (EDDs)

Q-3: CCDC Soil, Vapor, Temperature Data

- Q-3a: Discrete Soil Sample Results
- Q-3b: Soil Vapor Sample Results
- Q-3c: Temperature Data

End of Document