4825 Glenbrook Road N.W.

Feasibility Study

Overview:

4825 Glenbrook Road N.W. Property

The project site is a residential property located at 4825 Glenbrook Road within the Spring Valley Formerly Used Defense Site (FUDS) in Northwest Washington, D.C. During the World War I era, the property was part of a larger area known as the American University Experiment Station (AUES), where the U.S. government researched and tested chemical agents, equipment and munitions. AUES related waste, including munitions, laboratory glassware and contaminated soil has been recovered and safely removed from the property during investigations from 2000-2002 and then again from 2007-2010. In August 2010, several agencies within the Department of Defense as well as the regulatory partners, the U.S. Environmental Protection Agency and District Department of the Environment, made the decision to separate the 4825 Glenbrook Road N.W. property from the Spring Valley neighborhood site to expedite the cleanup process. This decision was based on the nature and extent of the AUES related items found on the property, and the determination that these items were distributed across the property during the construction of the house in the early 1990s. The Comprehensive Environmental Response, Compensation and Liability Act process will guide the selection and implementation of the remaining cleanup activities to achieve closure at the 4825 Glenbrook Road site.

What is a Feasibility Study?

A Feasibility Study develops, screens, and evaluates the response alternatives required to address the potential risks outlined in the 4825 Glenbrook Road Remedial Investigation Report. This report outlines the alternatives in detail, discussing the strengths and weaknesses of each and the trade-offs made in selecting one alternative over another. A summary of the five alternatives developed for the 4825 Glenbrook Road site is presented below.

What are the objectives of the cleanup alternatives?

The objectives of the cleanup alternatives include:

- Preventing direct contact with arsenic-contaminated soil, and
- Reducing the potential hazards from an encounter with a military munition or exposure to chemical agent, such as mustard agent, and environmental contamination, such as arsenic.

Alternative 1: No further action

All identified potential risks would be left "as is," without any response actions (e.g., removal, treatment, land use controls or other protective actions) taken. This alternative provides a comparative baseline against which the other alternatives may be evaluated.

Alternative 2: Land use controls

The house at 4825 Glenbrook Road N.W. would remain in place and land use controls (e.g., fencing, covering suspect areas with a patio) would be implemented to limit access to contaminated areas on the property. This alternative would also include developing environmental covenants to legally bind the current and any future property owners to compliance with the land use controls implemented.

Effectiveness: This alternative, which prevents physical contact with potentially contaminated soil and reduces the potential for an encounter with any AUES items remaining at the property, is protective of human health and the environment. However, this alternative is not considered effective for reducing the potential hazards from exposure to any AUES related items remaining at the property.

Alternative 3: Cleanup to *residential* standards without removing the house; restricted future use through land use controls

The area surrounding the house would be excavated to undisturbed saprolite or bedrock. Land use controls would be implemented to prevent contact with any AUES items or contaminated soil beneath the house and limit digging around the foundation and through the foundation and basement slab.

Effectiveness: This alternative is protective of human health and the environment. However, the soils beneath the house may still exhibit some level of contamination, and munitions, munitions debris and other AUES related items may remain present.

Alternative 4: Remove the house and cleanup to *recreational* standards; restricted future use through land use controls

The house and soil at the property would be removed to a depth of 4 feet below ground surface, removing any potential hazards and allowing for the property's use for non-residential land uses (e.g., green space, a park). Land use controls would be used to limit intrusive activities to less than 4 feet below ground surface (except for utility repair workers).

Effectiveness: Alternative 4 is protective of human health and the environment for recreational users only.

Alternative 5: Remove the house and cleanup to *residential* standards; providing for unrestricted future use of the property

The property, including the area beneath the house, but excluding most of the area behind the backyard retaining wall, would be excavated to undisturbed saprolite or bedrock. This alternative would allow AUES related items to be removed from the property, allowing the property to be returned to its owner for residential use.

Effectiveness: This alternative is protective of human health and the environment. It would remove the contaminated soils, munitions debris, and other AUES related items from the site, including those beneath the house, by excavating to undisturbed saprolite or bedrock.

How are the alternatives for cleanup evaluated?

The five response alternatives were screened against three broad criteria: effectiveness, implementability and cost. Alternative 1 and Alternative 2, which did not meet these criteria, were not further evaluated. The remaining alternatives were subjected to a detailed analysis intended to allow decision makers to select the most appropriate response.

During the detailed analysis, each alternative was assessed against the nine evaluation criteria described to the right. The Environmental Protection Agency developed these criteria to address the requirements in the Comprehensive Environmental Response, Compensation and Liability Act, and technical and policy considerations that have proven important for comparing response alternatives. These criteria serve as the basis for analyzing proposed response alternatives given site-specific conditions to determine and select the most appropriate response for the site. The nine criteria are divided into three categories: threshold, balancing and modifying. All of the remaining alternatives met the threshold criteria. In regards to the balancing criteria, Alternative 5 was most favorable ranking 'favorable' in 4 out of 5 of the criteria. The modifying criteria will be evaluated based on comments received during the public comment period on the Proposed Plan, which identifies the Army's preferred response alternative.

SUMMARY OF EVALUATION CRITERIA

Threshold criteria:

Overall Protectiveness of Human Health and the Environment - Alternative must eliminate, reduce, or control threats to public health and the environment.

Compliance with ARARs - Alternative must meet Federal and State environmental statutes, regulations, and other requirements that pertain to the site, or a waiver must be justified.

Primary balancing criteria:

Long-term Effectiveness and Permanence - Considers the ability of an alternative to maintain protection of human health and the environment over time.

Reduction in Toxicity, Mobility or Volume through Treatment - Evaluates an alternative's use of treatment to reduce the harmful effects of contaminants, their ability to move in the environment, and the amount of contamination present.

Implementability - Considers the technical and administrative feasibility of implementing the alternative, including factors such as the relative availability of goods and services.

Short-Term Effectiveness - Considers the length of time needed to implement an alternative and the risks the alternative poses to workers, residents, and the environment during implementation.

Cost - Includes the estimated capital and annual operations and maintenance costs, as well as present worth cost. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of plus or minus 50 percent.

Modifying criteria:

State/Support Agency Acceptance - Considers the acceptance of the state or support agency of the preferred alternative.

Community Acceptance - Considers the acceptance of the community of the preferred alternative.

Where can I learn more?

The CERCLA related documents for the 4825 Glenbrook Road site are posted on USACE's Spring Valley website (see below). Also posted are additional summary materials discussing the ***Overview, Remedial Investigation Report,*** *and* ***Proposed Plan****. To learn more, call our Community Outreach Office at 410-962-0157.*

U.S. ARMY CORPS OF ENGINEERS – BALTIMORE DISTRICT
10 SOUTH HOWARD STREET, BALTIMORE, MD 21201
www.nab.usace.army.mil/Projects/ Spring%20Valley/index.html

FINAL FEASIBILITY STUDY
4825 GLENBROOK ROAD
SPRING VALLEY FORMERLY USED DEFENSE SITE
WASHINGTON, D.C.

Contract No.: W912DR-06-D-0002, Delivery Order 0011
DERP FUDS HTRW Project No. C03DC091802 and
DERP FUDS MEC/CWM Project No. C03DC091801

US Army Corps of Engineers.
BUILDING STRONG®

Prepared for:

US ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT

Prepared by:

Earth Resources Technology, Inc.
Laurel, MD 20707

SEPTEMBER 26, 2011

September 26, 2011

Attn: Brenda Barber, P.E., CHMM
CENAB-EN-HN
10 S. Howard Street
Baltimore, MD 21201-1715

Dear Ms. Barber,

Earth Resources Technology, Inc. (ERT) is pleased to present the Final Feasibility Study for the 4825 Glenbrook Road property, Spring Valley FUDS Integrated Site-Wide Remedial Investigation/Feasibility Study, Washington, DC.

The document incorporates comments on the Draft-Final received from CENAB, CEHNC, USEPA, DDOE, AU, and RAB TAPP during the August 23, 2011 on-board (Partnering) meeting.

Electronic pdf file and hard copy (HC) distribution will be made as shown below.

Please do not hesitate to call me at 301-323-1442 if you need anything more.

Sincerely,

Thomas J. Bachovchin
Project Manager

DISTRIBUTION:

CENAB – Barber (7 HC)
CEHNC – Anderson-Hudgins (2 HC)
USEPA – Hirsh (2 HC)
DCDOE – Sweeney (2 HC)
RAB TAPP – deFur (1 HC)
AU – Bridgham (2 HC)

SUMMARY OF USEPA VERBAL COMMENTS DURING ON-BOARD PARTNER REVIEW (8-23-11) of DRAFT-FINAL FEASIBILITY STUDY FOR 4825 GLENBROOK ROAD (Note: EPA comments summarized below based on the Partner Meeting Minutes)

1. **Comment:** ES.1: second paragraph (and 3rd paragraph of Introduction 1.0), EPA noted that this paragraph should specify that previous activities at Glenbrook Road were a removal action, instead of "in the form of a removal action." Potential revisions include "conducted using the Army CERCLA removal authority" or similar language. Further, EPA questioned the meaning of "officially" transitioning to a remedial action, and requested that the word "officially" be removed. EPA noted that their agency would consider previous investigation efforts to be a continuous removal action, and asked whether the investigation is transitioning from a removal action to a remedial action.
RESPONSE: The second paragraph of ES.1 (and the equivalent language in the Introduction, 1.0) has been revised as follows:
"USACE performs (and has been performing) its response activities throughout SVUFDS (including 4825 Glenbrook Road) in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and its implementing regulations, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This FS is based on historical information, site characterization, analytical data, and determination of potential risk to human health which is contained in the *Remedial Investigation Report for 4825 Glenbrook Road* (USACE July 29, 2011) (RI Report), and the conclusions and recommendations presented in the RI Report. The CERCLA response action, to date, at 4825 Glenbrook Road, has been a "removal action" (which has included investigation activities, along with limited-scope cleanup activities). Pursuant to CERCLA, USACE is transitioning from a "removal action" to a "remedial action" for 4825 Glenbrook Road. Ultimately, this process will result in a Decision Document (following the FS, a Proposed Plan, and a public comment period). The purpose of this FS is to develop, screen, and provide a detailed analysis of remedial alternatives to address soil contamination and potential Munitions and Explosives of Concern (MEC) and Chemical Warfare Materiel (CWM) hazards at the 4825 Glenbrook Road property. Although most CWM is also considered MEC, the term MEC is generally used in this report to address conventional munitions, with CWM used to address chemical munitions and chemical agent (CA) in other than a munitions configuration".

2. **Comment:** Table 2.1, ARARS. EPA requested that the ARARs and TBCs be presented in two separate tables in the final Decision Document. Although the separate presentation of these requirements in the Final FS is less important, they represent two different types of requirements and should be treated as such in the final DD.
RESPONSE: Concur. This change has been made.

3. **Comment:** Table 2.1, ARARS. EPA questioned why there were no CWM-related ARARS in the table.
RESPONSE: Additional ARARs associated with the chemical munitions treaty (aside from the U.S. Chemical and Biological Warfare program) are specific to the Federal property where CWM items are stored in the interim holding facility (IHF). From the U.S. Army's perspective, these CWM items become reportable treaty items after full assessment by the munition assessment review board (MARB). Table 2.2 includes standard RCRA ARARs, and the Federal property IHF is considered separate from the 4825 Glenbrook Road site with respect to the chemical munitions treaty. The ARARs table also includes 50 U.S.C. 1518, which specifically addresses chemical warfare material).

4. **Comment:** EPA questioned the specifics regarding the buffer zone behind the backyard retaining wall, i.e., provide additional language justifying this distance.

RESPONSE: USACE provided language explaining that any major debris fields behind the Area A retaining wall will be cleared, and confirmed that the debris clearance margin will be defined in the Remedial Design and Remedial Action work plan. EPA mentioned that the 1-foot clearance margin used during previous investigations is insufficient, as shown by subsequent AUES-related findings in areas such as Lot 18. USACE indicated that appropriate specific approaches will be provided in the work plan.

5. **Comment:** EPA questioned why a 5-year review is not included in the anticipated costs for the five potential remedial alternatives, and noted that this aspect is often included in cost evaluations with a standard cost of roughly $30,000 dollars.
RESPONSE: USACE replied that a 5-year review is considered unnecessary for Alternative 5 because it allows unrestricted future use of the property, but would be appropriate, and will be added to Alternatives 2, 3, and 4.

Steven R. Hirsh
U.S. EPA Region III (3HS12)
Philadelphia, PA 19103-2029

Comments on the Draft-Final Feasibility Study and Proposed Plan
4825 Glenbrook Road
Spring Valley FUDS, Washington DC

Dr. Peter L. deFur, TAPP Contractor
ESC, LLC
September 2, 2011

The *Draft-Final Feasibility Study for 4825 Glenbrook Road* clearly presents a series of remedial alternatives to address contamination at the site. I agree that the recommended remedial action alternative, Alternative 5, is the best and most comprehensive cleanup measure. By removing the house, Alternative 5 will address the entire site and restore it to standards appropriate for unrestricted future use. I concur with the changes made to the draft during the August 23, 2011 Inter-Agency Partners meeting. I have these comments as well:

- Section 2.1.1 states that COPCs are L, aluminum, arsenic, cobalt, manganese, thallium, and vanadium in the soil, all of which exceeded their respective preliminary screening values. In section 2.1.3, however, a remediation goal is only presented for arsenic. Additional language should be added to either or both sections to clarify that, according to the HHRA, significant cancer and non-cancer risks are not associated with the remaining COPCs, and that is why there are no remediation goals set for these contaminants. This point is not entirely clear, as section 2.1.1 currently reads, "remaining site risks are *primarily* attributable to arsenic in soil."

  RESPONSE: Section 1.3.6.1 (page 8, lines 10-14 and lines 25-28) which summarizes the conclusions of the July 29, 2011 HHRA, clarifies that the COPCs do not present unacceptable risks or hazards, with the notable exception of arsenic; the arsenic risks or hazards are explained in some detail in those paragraphs.

- Section 2.3 refers to the use of low- and high-probability protocols during the remediation process. The designations depend on the likeliness of encountering MEC/CWM in a particular area. A vague statement, "formal determinations will be made through probability assessments developed as part of the remedial action planning," describes the designation process. If possible, a more detailed description of low- and high-probability designation activities should be included in this section, so that it will assure that the process will be objective, consistent, and adequate.

RESPONSE: Figure 3 is presented as a preliminary indication of which areas will likely end up as high probability and which will be low probability. At the FS stage, the work efforts are insufficiently detailed to state with certainty the exact dimensions and justifications for each area, and therefore, these discussions are presented for planning purposes only. It is during the remedial action planning that USACE will prepare formal probability assessments to be used as the basis of completing the work.

- Section 3.0 should assess excavation with soil treatment as a remedial technology. This is a relevant technology that could be considered more applicable than several other technologies screened in this section.

  RESPONSE: Per discussion at the Partner meeting, this section will be slightly revised. The section is currently written to acknowledge that no single technology can appropriately address all situations that could be encountered at 4825 Glenbrook Road. Given the nature of the items that may be encountered, such as conventional munitions, munitions containing CWM, and AUES-related items (CWM in lab containers), the section screens out these technologies and concludes that Excavation and Disposal is the only practical technology. The consensus of the Partner meeting was to change 'Landfill' Disposal to 'Off-site' Disposal, adding specific disposal procedures for each wastestream expected to be encountered. These discussions will include off-site soil treatment such as stabilizing RCRA hazardous soils prior to landfilling, as has been done in the past at this site.

The *Draft-Final Proposed Plan for 4825 Glenbrook Road*, just as it should, briefly analyzes remedial alternatives, succinctly presents the rationale for recommending the preferred alternative, and instructs the public on how to submit comments on the plan. My minimal comments are as follows:

- Section 2.2, page 5, states that "The compound classes analyzed for the soil samples include the following" but, for the sake of clarity, the statement should read "The soil samples were analyzed for the following compound classes."

- Section 3.1 states that, "the HI estimated for potential future child residents exposed to mixed soil (0-12 ft bgs) at the property exceeds the benchmark of 1 under the RME scenario, due to arsenic." Please state the actual HI value. This would be more telling of the actual noncancer risks related to arsenic at 4825.

- In Section 5.0 “Alternative 5: Remove the House and Cleanup to Residential Standards; Unrestricted Future Use,” should be in bold font to be consistent with the rest of the alternative assessment sections.

AMERICAN UNIVERSITY COMMENTS ON DRAFT FINAL FEASIBILITY STUDY : 4825 GLENBROOK ROAD

American University (AU) appreciates this opportunity to submit comments on the Draft Final Feasibility Study for 4825 Glenbrook Road dated August 18, 2011 (FS). In general AU supports the contents and conclusions of the FS, however, AU does not consider any remedial alternative other than “Alternative 5, Removing the House and leaning up to Residential standards with Unrestricted Future Use”, to be acceptable. As we have mentioned in previous comments, AU is concerned that the issue of uncertainty has been neglected in the documentation at this site. There is uncertainty in sampling and chemical analysis and also toxicological uncertainty. Our comments on the RI should be consulted for a more detailed discussion of these issues. At the very least, the FS should acknowledge the existence of this uncertainty and discuss how the uncertainty will be addressed in the selected remedy. Our detailed comments are as follows:

E.S.5, line 21-23 includes COPCs that were not quantitatively addressed in the human health risk assessment (HHRA). Therefore the statement regarding “unacceptable hazards” cannot be supported and should be deleted. The document should be searched for any similar statements which should also be deleted.

RESPONSE: As discussed at the Partner meeting, thallium and vanadium will be deleted from this discussion—as well as equivalent discussions anywhere else in the document.

Page vii, line 1. Change “rendered safe” to “secured”. There is no reason to believe this situation is “safe”.

RESPONSE: Concur. This will be changed to secured.

Section 1.3.6. As AU has noted in previous comments, the risk as calculated in the risk assessment is highly uncertain and probably under-estimated.

RESPONSE: The conclusions presented in the Final HHRA are summarized in this section.

Section 2.1.1. Line 9. This statement is too strong given the uncertainties and should be deleted.

RESPONSE: This sentence has been revised to clarify that the statement is in reference to potential chemical soil contamination and does not refer to MEC or AUES-related items that may be in the soil.

Section 2.1.3. AU has commented repeatedly regarding the arsenic cleanup level of 20 mg/kg and has been repeatedly ignored. While 20 mg/kg may be appropriate as an action level or screening level, it is not appropriate as remedial goal especially at a site where there are so many chemical and toxicological uncertainties in the assessment of the nature and extent of contamination. Even a rough calculation reveals that the residual lifetime cancer risk associated with residential exposure to 20 mg/kg exceeds 5×10^{-5}. EPA guidance is explicit on using risk-based cleanup levels[1]:

- "In the absence of ARARs for chemicals that pose carcinogenic risks, PRGs generally should be established at concentrations that achieve 10^{-6} excess cancer risk ,modifying as appropriate based on exposure, uncertainty, and technical feasibility factors"
- "The Agency has expressed a preference for cleanups achieving the more protective end of the risk range (i.e. 10^{-6})".

It is also EPA's preference to assume future maximum beneficial use in remediating a property. Given the large degree of uncertainty and the increase in arsenic carcinogenic potency reflected in the current drinking water MCL and the imminent cancer re-evaluation to be published by NCEA, the use of 10^{-6} is certainly justified. Technical feasibility and EPA guidance argues, however, that arsenic levels below background cannot and should not be the basis of a remediation, therefore remediation to background is both appropriate and health protective.

RESPONSE: The remediation endpoint for arsenic of 20 mg/kg was jointly proposed by the Partners. The Scientific Advisory Panel, established to assist the community in understanding the overall approach to technical issues affecting Spring Valley, recommended adoption of this remediation endpoint, saying that "the level should not pose a health hazard to the community and should not threaten the natural ecological systems of northwest Washington, DC." (*Scientific Advisory Panel Report*, May 29, 2002 Meeting).

Section 2.1.4. Proposed RAOs are not protective as stated. AU recommends the following:

- Prevent direct contact with soil with cancer risk $>10^{-6}$.
- Prevent direct contact with soil with concentrations of chemicals associated with the former AUES above background levels.
- Eliminate (rather than reduce) potential to encounter containerized CWM, MEC, and AUES-related items.
- Reduce uncertainty associated with the site investigation and risk assessment to acceptable levels.

[1] EPA 1997. Rules of Thumb for Superfund Remedy Selection. EPA 540-R-97-013.

The residual risk remaining after remediation should be calculated to determine if RAOs have been attained.

RESPONSE: Noted. However, the RAOs as presented in the FS have not been changed based on this comment.

Section 2.3. As discussed in previous comments and at the July 23, 2011 Partnering Meeting, an operational definition of “saprolite” is required so that AUES-related materials will not escape remediation. AU suggests that competent saprolite is a geological material that cannot be readily disturbed by a typical worker using hand tools. Line 35-37 of this section is not known with any certainty and should be deleted.

RESPONSE: The document has been revised to incorporate this operational definition of saprolite.

Section 3.0. Phytoremedition, stabilization, and washing are only useful for chemically contaminated soil and not for MEC, containerized CWM, AUES-associated debris, etc. Further all references to “landfill” should be removed here and in all subsequent discussions. Disposal should be conducted at an appropriate facility in accordance with all applicable federal, state, and local regulations.

RESPONSE: As discussed in the Partnering meeting, this section has been revised as follows: the Excavation and <u>Landfill</u> Disposal ‘technology’ will be rewritten as Excavation and <u>Off-site</u> Disposal with specific discussions of disposal practices for each wastestream expected to be encountered at the site (based on previous disposals from this and nearby SVFUDS areas).

Section 4.3.5. Post-excavation sampling and analysis at sidewalls and excavation bottoms should be performed to ascertain if chemical contamination has been removed. Page 32, line 3 of this section has unsubstantiated language about “over excavation” that should be deleted.

RESPONSE: Post-excavation sampling will be developed in the appropriate work plans for the remedial effort. With regard to the referenced sentence about over-excavation, digging to bedrock or competent saprolite will result in over-excavation based on the remediation goals as presented in this document.

Section 5.2.3.2. It should be noted that MEC, CWM, and/or AUES-related items should be managed such that the statutory preference for treatment is attained.

RESPONSE: The revised section 3 does make the point that these items are treated in some fashion, e.g., incineration, prior to final disposal.

Regarding alternative 4 in general, it cannot be ascertained if it meets the criterion of human health protection due to the ambiguity of the concepts of “recreational use”.

RESPONSE: This discussion in the FS summarizes statements from the Final HHRA; no change has been made to the document.

FINAL

FEASIBILITY STUDY
4825 GLENBROOK ROAD

Remedial Investigation/Feasibility Study
Spring Valley Formerly Used Defense Site (SVFUDS)
Washington, DC

Prepared for:

U.S. Army Corps of Engineers
Baltimore District

DERP FUDS HTRW Project No. C03DC091802
DERP FUDS MEC/CWM Project No. C03DC091801
Contract: W912DR-06-D-0002, Delivery Order 0011

US Army Corps of Engineers
BUILDING STRONG

September 26, 2011

Approvers:

ELECTRONIC SIGNATURE

Thomas Bachovchin **Date: 09/26/11**
Project Manager

COMPLETION OF SENIOR TECHNICAL REVIEW

This document has been produced within the framework of the Earth Resources Technology, Inc. (ERT) quality management system. As such, a senior technical review has been conducted. This included review of all elements addressed within the document, proposed or utilized technologies and alternatives and their applications with respect to project objectives and framework of U.S. Army Corps of Engineers regulatory constraints under the current project, within which this work has been completed.

09/26/11

Amy B. Rosenstein, Risk Assessor — Date
Senior Technical Reviewer

COMPLETION OF INDEPENDENT TECHNICAL REVIEW

This document has been produced within the framework of ERT's quality management system. As such, an independent technical review, appropriate to the level of risk and complexity inherent in the project, has been conducted. This included a review of assumptions; alternatives evaluated; the appropriateness of data used and level of data obtained; and reasonableness of the results, including whether the product meets the project objectives. Comments and concerns resulting from review of the document have been addressed and corrected as necessary.

09/26/11

Barry Millman — Date
Independent Technical Reviewer

TABLE OF CONTENTS

List of Tables

List of Appendices

ACRONYMS and ABBREVIATIONS

ARARS	Applicable or Relevant and Appropriate Requirements
$AsCl_3$	Arsenic Trichloride
AU	American University
AUES	American University Experiment Station
Bgs	Below Ground Surface
CA	Chemical Agent
CABP	Chemical Agent Breakdown Product
CAFS	Chemical Agent Filtration System
CENAB	U.S. Army Corps of Engineers, Baltimore District
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CN	Chloroacetophenone
COPC	Chemical of Potential Concern
CT	Central Tendency
CWM	Chemical Warfare Materiel
DA	Diphenylchloroarsine
DC	Diphenlycyanoarsine
DC	District of Columbia
DDOE	District of Columbia Department of the Environment
DERP	Defense Environmental Restoration Program
DoD	Department of Defense
ECBC	Edgewood Chemical Biological Center
ECS	Engineering Control Structure
EE/CA	Engineering Evaluation/Cost Analysis
EMS	Environmental Management Systems
ERT	Earth Resources Technology
FS	Feasibility Study
Ft	Feet
FUDS	Formerly Used Defense Site
H	Mustard
HA	Hazard Assessment
HHRA	Human Health Risk Assessment
HI	Hazard Index
HTW	Hazardous and Toxic Waste
L	Lewisite
LUCs	Land Use Controls
MD	Munitions Debris
MEC	Munitions and Explosives of Concern
MEC HA	MEC Hazard Assessment
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NTCRA	Non-time Critical Removal Action
OSR	Operation Safe Removal
OU	Operable Unit

POI	Point of Interest
RACER	Remedial Action Cost Engineering and Requirements
RBCs	Risk-Based Concentrations
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RME	Reasonable Maximum Exposure
ROE	Right of Entry
RSLs	Regional Screening Levels
SESOIL	Seasonal Soil Compartment
SVFUDS	Spring Valley Formerly Used Defense Site
SVOC	Semi-volatile Organic Compound
TBC	To Be Considered
TP	Test Pit
TIC	Tentatively Identified Compound
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
VCS	Vapor Containment Structure
VOC	Volatile Organic Compound
XRF	X-Ray Fluorescence

EXECUTIVE SUMMARY

ES.1 The U.S. Army Corps of Engineers (USACE), Baltimore District (CENAB) contracted with Earth Resources Technology, Inc. (ERT) to complete a Feasibility Study (FS) for the 4825 Glenbrook Road residential property, which is currently owned by American University (AU), and is part of the Spring Valley Formerly Used Defense Site (SVFUDS) located in northwest Washington, District of Columbia (DC).

USACE performs (and has been performing) its response activities throughout SVUFDS (including 4825 Glenbrook Road) in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and its implementing regulations, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This FS is based on historical information, site characterization, analytical data, and determination of potential risk to human health which is contained in the *Remedial Investigation Report for 4825 Glenbrook Road* (USACE July 29, 2011) (RI Report), and the conclusions and recommendations presented in that report. The CERCLA response action, to date, at 4825 Glenbrook Road, has been a "removal action" (which has included investigation activities, along with limited-scope cleanup activities). Pursuant to CERCLA, USACE is transitioning from a "removal action" to a "remedial action" for 4825 Glenbrook Road. Ultimately, this process will result in a Decision Document (following the FS, a Proposed Plan, and a public comment period). The purpose of this FS is to develop, screen, and provide a detailed analysis of remedial alternatives to address soil contamination and potential Munitions and Explosives of Concern (MEC) and Chemical Warfare Materiel (CWM) hazards at the 4825 Glenbrook Road property. Although most CWM is also considered MEC, the term MEC is generally used in this report to address conventional munitions, with CWM used to address chemical agent (CA) in other than a munitions configuration.

ES.2 The 4825 Glenbrook Road property, which lies within Operable Unit 3 (OU-3), has been the subject of various investigations since broken glassware was encountered during development of the lot in 1992. The property contains a single family home that is not currently occupied.

ES.3 During the most recent (2007-2009) high probability investigation of Burial Pit 3, partially located on 4825 Glenbrook Road, a total of 108 munitions-related and AUES-related items were recovered and categorized as 22 MEC, six CWM and 80 MD items. These items were identified as 75mm projectiles, 2-inch and 3-inch pipes with end caps, 4.7-inch projectiles, and an intact glass container. Grab sample results indicated metals, including aluminum, arsenic, cobalt, iron, magnesium, mercury, and vanadium, were detected at concentrations exceeding the accepted comparison levels. Analytical results for Burial Pit 3 confirmation samples show that aluminum, arsenic, cobalt, iron, magnesium, manganese, thallium and vanadium exceeded the accepted comparison levels in some of the samples.

High Probability Test Pits 120, 134, and 138 on the property were investigated and the findings included: closed and open cavity items, of which 37 items were identified as CWM, two items identified as MEC, three items identified as Munitions Debris (MD), with other items identified as American University Experimental Station (AUES)-related non-munitions scrap. CA and chemical agent breakdown products (CABPs) were detected in intact containers and soil uncovered in the vicinity of the excavation. Other industrial chemicals were also detected in the intact containers. Metals detected in agent/CABP-cleared grab samples that exceeded the accepted comparison levels included aluminum, arsenic, iron, magnesium, and thallium. Sample results indicate that soil exceeding the SV remediation level for arsenic still remains in these pits. The investigation was halted due to detection of arsenic trichloride ($AsCl_3$) in a vapor and a solid sample. The pits were secured by backfilling and currently await remedial action.

ES.4 Based on the results of these investigations, which indicated that MEC, CWM, and AUES-related items may be present in uninvestigated areas, particularly surrounding and beneath the house, the RI Report concluded that an FS should be prepared to address potential risk identified through the Human Health Risk Assessment (HHRA) and MEC Hazard Assessment (HA).

ES.5 The HHRA contained in the RI Report determined that the carcinogenic risks estimated individually for future adult residents, child residents, child recreational green space users, and outdoor workers, are within the U.S. Environmental Protection Agency (USEPA) acceptable risk range of 1×10^{-6} and 1×10^{-4}. However, the cumulative cancer risk estimate of 2×10^{-4} for residents (combining the adult and child exposure periods) exposed to mixed soil (0-12 feet (ft) below ground surface (bgs)) for the Reasonable Maximum Exposure (RME) scenario exceeds 1×10^{-4} (due to arsenic).

The Hazard Index (HI) estimated for future adult residents, child recreational green space users, and outdoor workers exposed to surface soil (*i.e.*, 0-0.5 ft or 0-2 ft bgs) or mixed soil (0-12 ft bgs) was below the HI benchmark of 1 for noncarcinogenic effects under both the RME and the Central Tendency (CT) scenarios. Thus, unacceptable hazards to these receptors at the property in the future are not expected from assumed exposures to chemicals of potential concern (COPCs) lewisite (L), aluminum, arsenic, cobalt, and manganese, in soil. However, the HI for potential future child residents exposed to mixed soil (0-12 ft bgs) at the property exceeds the benchmark of 1 under the RME scenario (due to arsenic). This indicates that assumed future exposures to mixed soil containing arsenic at the property may result in adverse noncarcinogenic health effects for this receptor.

A MEC HA was also performed for 4825 Glenbrook Road. A MEC HA provides a conservative assessment of the potential risk of injury or death from explosive hazards potentially present at a site. Hazard Levels range from 1 to 4, with a Hazard Level of 1 indicating the highest potential explosive hazard condition and 4 indicating the lowest potential explosives hazard conditions. USACE evaluated three remedial alternatives. The alternatives evaluated were (a) Subsurface Removal, Future Residential Use; (b) Subsurface Removal, Land Use Controls (LUCs), Future Recreational Use; and (c) No Subsurface Removal, LUCs. The first two remedial alternatives reduced the property to a Hazard Level 4 (low potential explosive hazard conditions). The third alternative, which does not include subsurface removal, would lower the MEC HA score to 565, but the Hazard Level of 3 would not be reduced.

The previous investigation activities indicate that containerized CWM and non-containerized mustard (H), lewisite (L), and their CABPs, were detected in the vicinity of TPs 120, 134, and 138. While TP 138 was completely excavated, the TP 120 and 134 investigation was not completed. The widespread distribution of contaminants, especially AUES-related glassware, suggests that burial pit contents may have been redistributed during property development prior to the current investigations and that there is the potential for MEC, CWM, and AUES-related items to be present outside the specific disposal pit locations.

ES.6 Based on information provided in the RI Report, the following remedial action objectives that specify the contaminants and media of concern, receptors and exposure pathways, and preliminary remediation goals, were developed:

- Prevent direct contact with soil having noncarcinogenic HI exceeding 1
- Prevent direct contact with soil having a cancer risk in excess of 1×10^{-4}
- Reduce the MEC hazard to a low potential for explosive hazard conditions (Level 4)
- Reduce the potential to encounter containerized CWM and AUES-related items

ES.7 To develop remedial alternatives to address the 4825 Glenbrook Road property, Applicable or Relevant and Appropriate Requirements (ARARs) were identified. Following this, remedial technologies were screened for effectiveness in remediating the property, using the significant previous experience with similar contamination in the SVFUDS. Excavation and off-site disposal of contaminated soil and debris was determined to be the most effective cleanup technology.

ES.8 With excavation and disposal established as the cleanup technology to be used, alternatives to achieve the remedial action objectives were developed and broadly screened against the criteria of effectiveness, implementability, and cost. Five remedial alternatives were identified for the 4825 Glenbrook Road property:

- Alternative 1: No Further Action
- Alternative 2: Land Use Controls (LUCs)
- Alternative 3: Cleanup to residential standards without removing the house; restricted future use (LUCs)
- Alternative 4: Remove the house and cleanup to recreational standards; restricted future use (LUCs)
- Alternative 5: Remove the house and cleanup to residential standards; unrestricted future use of the property

ES.9 Following the broad screen, Alternatives 1 and 2 were eliminated from further consideration because they failed key elements of the effectiveness and implementability criteria. The remaining three remedial alternatives underwent a detailed analysis intended to allow decision makers to select the appropriate response. During the detailed analysis, each alternative was assessed against the nine evaluation criteria developed by the USEPA (and required by the NCP) to address CERCLA requirements and technical and policy considerations. The results of the detailed comparison were tabulated in a table presented at the end of Section 5.0.

ES.10 The most important evaluation is against the threshold criteria, as these must be met. All three alternatives retained for detailed analysis were considered protective of human health and the environment, although Alternative 5 was the most protective of human health and the environment because it provides the greatest amount of removal of soil and debris. All three alternatives are compliant with ARARs.

With regard to the balancing criteria, Alternative 3 and Alternative 4 were only moderately effective in the long term as residual risk could remain in the soils remaining beneath the house (note that even though the house is removed in Alternative 4, soils are not removed to bedrock or competent saprolite beneath the house). Alternative 5 was the most effective in the long term as it is a permanent remedy that leaves the least amount of residual risk at the site.

ES.11 All three alternatives were ranked as moderately favorable with regard to reducing toxicity, mobility, and volume of contaminants in that excavation and off-site disposal (assumes landfill disposal) does not treat the soil contaminants, but transfers them to a proper landfill (note that MEC, CWM, and AUES-related items would not be landfilled). All three alternatives were ranked favorably with regard to short-term effectiveness as protection of workers and the community, using standard good engineering practice, has been previously achieved for excavation and disposal at this property.

ES.12 Alternative 3 was moderately favorable for the implementability criterion. Alternatives 4 and 5 were ranked as favorable overall for the implementability criterion because technical feasibility and availability of materials and services are well established for excavation and disposal in the SVFUDS; however, Alternative 4 was only moderately favorable for the sub-criterion of administrative feasibility because of the coordination requirements with the property owner and supporting agencies to obtain approval as greenspace (one possible use may be a neighborhood park).

ES.13 Alternative 5 is the most costly of the three alternatives based on the total volume of removal, including soils and house removal. Alternative 3 was the least costly, differing from Alternative 5 in the cost of house removal and excavation of soil beneath the house. Alternative 4 falls between the other two alternatives with regard to cost, but is relatively close to Alternative 5 because the high-probability soil volume to be excavated under Alternative 4 is just slightly less than for Alternative 5.

ES.14 Regulator and community acceptance cannot be fully assessed until comments are processed following the public review period on the Proposed Plan. Therefore, these modifying criteria have not been included in this analysis, but will be included following their final review and input from those parties on the Proposed Plan.

ES.15 Alternative 5, <u>Removing the House and Cleaning up to Residential Standards with Unrestricted Future Use</u>, is the recommended remedial action alternative. While it is the most expensive alternative, it was ranked as favorable in five out of six of the nine criteria that were ranked (not including the two modifying criteria and cost criterion). The other two alternatives carried over for the detailed analysis have fewer criteria ranked as favorable. Only Alternative 5 was ranked as favorable for the critical long-term effectiveness criterion in that it leaves the least amount of residual risk.

1.0 INTRODUCTION

The U.S. Army Corps of Engineers (USACE), Baltimore District (CENAB), contracted with Earth Resources Technology, Inc. (ERT) to prepare a Feasibility Study (FS) for the 4825 Glenbrook Road residential property. This property is currently owned by American University (AU), and is part of the Spring Valley Formerly Used Defense Site (SVFUDS) located in northwest Washington, District of Columbia (DC).

Under the Defense Environmental Restoration Program (DERP), the U.S. Army is the Department of Defense's (DoD) Executive Agent for FUDS, and USACE executes FUDS for the Army. FUDS is administered pursuant to the DERP statute, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Executive Orders 12580 and 13016, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), and DoD and Army policies in managing and executing the FUDS program. (The NCP constitutes the regulations that implement CERCLA.) USACE is the lead agency for the response action at this CERCLA site. Information supporting response actions at SVFUDS is or will be contained in the Administrative Record file for SVFUDS. This record is available at the DC Public Library, Tenley-Friendship Library Branch, 4450 Wisconsin Avenue, N.W., Washington, DC 20016.

USACE performs (and has been performing) its response activities throughout SVUFDS (including 4825 Glenbrook Road) in accordance with the CERCLA and the NCP. This FS is based on historical information, site characterization, analytical data, and determination of potential risk to human health which is contained in the *Remedial Investigation Report for 4825 Glenbrook Road* (USACE July 29, 2011) (RI Report), and the conclusions and recommendations presented in that report. The CERCLA response action, to date, at 4825 Glenbrook Road, has been a “removal action” (which has included investigation activities, along with limited-scope cleanup activities). Pursuant to CERCLA, USACE is transitioning from a “removal action” to a “remedial action” for 4825 Glenbrook Road. Ultimately, this process will result in a Decision Document (following the FS, a Proposed Plan, and a public comment period). The purpose of this FS is to develop, screen, and provide a detailed analysis of remedial alternatives to address soil contamination and potential Munitions and Explosives of Concern (MEC) and Chemical Warfare Materiel (CWM) hazards at the 4825 Glenbrook Road property. Although most CWM is also considered MEC, the term MEC is generally used in this report to address conventional munitions, with CWM used to address chemical agent (CA) in other than a munitions configuration.

The RI Report documents the site characterization work and removal action initiated by USACE to ensure that the immediate threats to the public and environment from MEC, CWM (i.e., chemical munitions and chemical agent in other than a munitions configuration), and Hazardous and Toxic Waste (HTW)-impacted soil were addressed concurrently. The FS will address remaining risks identified as potentially being present at this property.

1.1 Purpose of the FS

The purpose of an FS, in accordance with U.S. Environmental Protection Agency (USEPA) guidance, is “to provide the decision makers with an assessment of the remedial alternatives, including their relative strengths and weaknesses, and trade-offs in selecting one alternative over another." An FS typically develops alternatives, screens alternatives, and finally, provides a detailed analysis of alternatives, recommending the preferred alternative.

The purpose of this FS is to develop, screen, and provide a detailed analysis of remedial alternatives to address soil contamination resulting from chemicals of potential concern (COPCs) and potential MEC, CWM, and AUES-related hazards present at the 4825 Glenbrook Road property.

1.2 Report Organization

The organization of this FS follows both the *USEPA's Guidance for Conducting RI/FS Studies under CERCLA* (USEPA 1988) and the *US Army Munitions Response RI/FS Guidance* (USACE 2009a). However, it most closely aligns with the suggested FS Report Format provided by Table 6-5 of the USEPA Guidance. It is organized into six sections and two appendices:

- Section 1.0: Introduction
- Section 2.0: Remedial Action Objectives
- Section 3.0: Identification and Screening of Technologies
- Section 4.0: Development and Screening of Alternatives
- Section 5.0: Detailed Analysis of Alternatives
- Section 6.0: References
- Appendix A: Site Figures
- Appendix B: Costing Backup

1.3 Background Information

1.3.1 Site Description

All background and site history presented in this FS is summarized from the *Remedial Investigation Report for 4825 Glenbrook Road* (USACE July 29, 2011). The 4825 Glenbrook Road property is an approximate 0.4-acre residential property located within Operable Unit 3 (OU-3) in the south central portion of the SVFUDS in northwest Washington D.C. OU-3 comprises the 4801, 4825, and 4835 Glenbrook Road properties.

1.3.2 Site History

During World War I, the U.S. Government established the American University Experiment Station (AUES) to research the testing, production, development and effects of noxious gases, CWM, antidotes and protective masks. Mustard (H) and lewisite (L) agents, adamsite, irritants and smokes were among the chemicals researched and tested. The SVFUDS includes property occupied by the former AUES between 1917-1920. The AUES was located on the grounds of the present AU and used portions of the adjoining properties. Figure 1 shows the SVFUDS boundary (all figures are presented in Appendix A).

The 4825 Glenbrook Road property lies within OU-3 and has been the subject of various investigations since broken glassware was encountered during development of the lot in 1992. The property lies within the Spring Valley residential community and is owned by AU. It contains a single family home (Figure 2) with a basement; it is bordered on two sides by private residences, by the AU campus to the east, and Glenbrook Road to the west.

1.3.3 4825 Glenbrook Road Previous Investigation Activities

Many investigations have been conducted over the years to characterize soil contamination and determine whether MEC, CWM, and AUES-related items from historic operations associated with the AUES, may be present. The descriptions of previous investigations are summarized briefly below for context. More detailed descriptions of these investigations can be found in the RI Report.

1.3.3.1 *Environmental Management Systems (EMS) – 1992*

In 1992, AU contracted EMS to investigate conditions discovered during construction activities in the vicinity of what would become the 4825 and 4835 Glenbrook Road properties. At that time, the properties were under construction and the EMS letter reports from May and June 1992 (EMS 1992) are not detailed sufficiently to determine the exact locations of the incidents described or the sampling performed. Workers reportedly experienced eye and respiratory irritation during construction activities. A rusted drum, laboratory glassware, and a white granular material were reportedly encountered. EMS conducted soil gas probes, hand excavations around the drum, and collected various samples, including the white powder.

1.3.3.2 *Surface Soil Sampling – 1994*

In support of the 1995 Operation Safe Removal (OSR) FUDS RI Report (USACE 1995), USACE collected a soil sample (SV-Baker-10) from 4825 Glenbrook Road in March 1994 as part of the Baker Valley Point of Interest (POI). Also, as part of the OU-3 investigations, USEPA Region 3 collected seven surface soil samples in and around 4801, 4825, and 4835 Glenbrook Road to supplement their risk assessment (USEPA Region 3 1999).

1.3.3.3 *USACE Geophysical Investigation - 1999*

In 1999, a geophysical investigation was performed at 4825 Glenbrook Road that was concurrent with the reacquisition of Burial Pits 1 and 2 at the adjacent 4801 Glenbrook Road property. The results of the investigation were inconclusive and therefore, USACE determined that a test pit (TP) investigation was warranted.

1.3.3.4 *X-Ray Fluorescence Sampling Event – 1999*

In April 1999, USACE contractor, Parsons, completed X-Ray fluorescence (XRF) arsenic screening on a soil sample collected from a soil boring at the 4825 Glenbrook Road property. A soil sample was collected and the analytical results showed that the arsenic concentration was below the accepted comparison level.

1.3.3.5 *Surface and Subsurface Soil Sampling Event - 1999*

In June 1999, USEPA collected six surface soil samples and surface and subsurface soil samples from three borings. Results of the USEPA Region 3 sampling indicated that the soil at these properties could have been affected by AUES activities in the vicinity of Burial Pits 1 and 2 at 4801 Glenbrook Road. Consequently, the USACE performed an Engineering Evaluation/Cost

Analysis (EE/CA) for the three OU-3 properties (USACE 2000). The OU-3 EE/CA and baseline risk assessments for 4801, 4825, and 4835 Glenbrook Road addressed the potential hazard associated with arsenic contamination in the soil. The EE/CA was conducted to recommend and justify the preferred alternative to address arsenic soil contamination. The conclusion of the risk assessment was that there was unacceptable risk with regard to exposure to arsenic in the surface soil. The preferred alternative was excavation and disposal of the soil.

1.3.3.6 *Grid and Driveway Soil Sampling – 2000-2001*

In September 2000, Parsons collected arsenic grid surface soil samples at 4825 Glenbrook Road. On 23 January 2001, Parsons collected six driveway soil borings at 4825 Glenbrook Road for arsenic analysis in response to a District of Columbia Department of the Environment (DDOE) request.

1.3.3.7 *Arsenic Soil Removal – 2000-2001*

From December 2000 to March 2001, arsenic-contaminated soil from 25 grids at the 4825 Glenbrook Road property was excavated under a non-time critical removal action (NTCRA) that was based on the OU-3 EE/CA (USACE 2000). While the area now identified as the Burial Pit 3 south extension was sampled during this EE/CA, elevated arsenic concentrations were not detected there.

1.3.3.8 *Test Pit Investigations – 2001*

In May 2001, a test pit investigation began in the backyard of 4825 Glenbrook Road due to inconclusive geophysical results and the elevated arsenic concentrations in soil. USACE excavated 23 test pits and two trenches were excavated at the property. There were no significant findings in any of the test pits, except for Test Pit 23.

1.3.3.9 *4825 Test Pit Investigation (Test Pit 23) – 2001-2002*

A Vapor Containment Structure (VCS) was used as an Engineering Control Structure (ECS) during the investigation of TP 23 after a MEC item was discovered. All the other test pits and trenches were investigated under a tent. All the test pits were excavated to a depth of approximately 6 feet (ft) below the historic 1918 ground surface or the maximum depth achievable by equipment. Other than TP 23, the maximum depth reached during the test pits investigation was 12 ft below the existing ground surface. There were no significant findings in any of the test pits except for TP 23.

During the investigation of TP 23, a total of 18 CWM-related items and 406 munitions-related items were recovered. Eleven headspace samples were positive for H and/or L. All CWM items were subsequently safely demilitarized. Various types of glassware, artifacts, and general debris also were recovered from TP 23. Some of the glassware contained unknown liquids. Some of the bottles were found to contain H and L Chemical Agent Breakdown Products (CABPs). Items also were observed and removed from beneath a retaining wall near the house foundation.

1.3.3.10 *Temporary Backfill of Test Pit 23 - 2002*

The southern portion of TP 23 (on 4801 Glenbrook Road) was excavated and cleared of MEC/CWM items; however, items that were observed under a retaining wall in close proximity to the 4825 Glenbrook Road house foundation remained in the northern portion. The northern portion of TP 23 was temporarily backfilled in March 2002 due to right-of entry (ROE) issues. Subsequently, TP 23 has been referred to as Burial Pit 3 for purposes of further investigations.

1.3.3.11 *Soil Gas Investigation – 2007*

In 2007, a soil gas investigation was performed to assess the driveway and the remaining contents of TP 23 (USACE 2009b). Soil gas samples were collected using active soil gas sampling with summa canisters and passive soil gas sampling using Gore sorber modules. Due to the detections of the H CABPs 1,4-oxathiane and 1,4-dithiane in one co-located Summa and Gore sorber sample, six CABP confirmation soil samples were collected in the driveway. However, CABPs were not detected in any of the six confirmation soil samples.

1.3.4 4825 Glenbrook Road Current Investigation Activities

1.3.4.1 *Burial Pit 3 Investigation (2007-2009)*

In October 2007, the high probability investigation commenced at Burial Pit 3 (former TP 23) at 4825 Glenbrook Road. The primary goal of the high probability intrusive investigation was to remove all potential AUES-related material from the suspect disposal area. All intrusive operations were conducted inside a negative pressure ECS with Edgewood Chemical Biological Center (ECBC) performing air monitoring for chemical agent (CA). During this period, the original 50 ft by 16 ft proposed investigation area was excavated and cleared of debris.

Between April 28 and July 24, 2008, investigation of the east extension of Burial Pit 3 was conducted. The excavation was extended to the east due to evidence found during the Burial Pit 3 investigation indicating AUES-related items remained in the soil. The ECS was extended by addition of a 17 ft by 16 ft structure that was connected to the original structure. Between October 20 and 28, 2008, investigation of the south extension was conducted and 19 single-item anomalies and one exploratory trench were excavated and no munitions debris (MD) or AUES-related glassware items were found. Between January 12 and March 12, 2009, investigation of the 2nd eastern extension of Burial Pit 3 was conducted based on the investigation findings of more targets present east of the first eastern extension.

During the investigation of Burial Pit 3, a total of 108 munitions-related and AUES-related items were recovered and categorized as 22 MEC, six CWM and 80 MD items. These items were identified as 75mm projectiles, 2-inch and 3-inch pipes with end caps, 4.7-inch projectiles, and an intact glass container. The 22 MEC items included 75mm projectiles and a 4.7-inch projectile. One intact glass vial recovered from the excavation was found to contain CWM and was destroyed by ECBC. Five 75mm projectiles were also categorized as CWM and later destroyed in the Explosive Destruction System (EDS). A total of 80 MD items and 37 non-munitions scrap items were also recovered. All MEC and MD items were demilitarized and disposed. All non-munitions scrap items were also disposed in a nonhazardous landfill.

In June and July 2009, additional confirmation samples were collected in the Pit 3 investigation and extension areas; additional soil removal was performed based on the confirmation soil sampling results.

1.3.4.2 *Low and High Probability Test Pits Investigations and Additional Arsenic Removal (2009 to 2010)*

Upon completion of the Pit 3 investigation, USACE proposed investigation of an additional 39 test pits (TPs 95 through 133) at 4825 Glenbrook Road (USACE 2008). USACE believed investigation of these test pits would provide a 95 percent confidence that any other burial pit or trench with dimensions of not less than 10 ft by 20 ft on the property would be located. Later, USACE added 12 more test pits (TPs 134 through 145), creating a total of 51 test pits to be investigated on the property. On March 24, 2009, the investigation commenced. The original 39 test pits (TP 95-133) were completed on July 17, 2009 with the exception of TP 120. An elevated concentration of arsenic was detected in a grab sample associated with discolored soil collected from TP 120.

USACE identified three grids on the driveway of 4825 Glenbrook Road with arsenic concentrations higher than the SVFUDS remediation level of 20 mg/kg. Concurrent with the investigation of the test pits along the driveway, arsenic contaminated grids were removed by excavation. All arsenic impacted soil exceeding 20 mg/kg was removed except for a small area north of TP 109 near the 4835 Glenbrook Road retaining wall. This area was not excavated at that time because it is near where the wall curves and further excavation might have undermined the retaining wall. The small area north of TP 109 was excavated to 6 ft below ground surface (bgs); however, two samples of in-place soil still contain concentrations exceeding the remediation level of 20 mg/kg (596 mg/kg and 597 mg/kg).

In July 2009, intrusive investigations began on the 12 additional test pits (TPs 134 through 145). These investigations continued until August 4, 2009 when a confirmed detection of H and L CABPs were reported for a substance inside of a glassware flask from TP 138. In addition, H and L agent and CABPs were detected in white powdery soils encountered in TP 120 as the investigation proceeded towards TP 134.

In November 2009, high probability test pit investigations started on TP 138. Agent and CABPs were detected in intact containers and soil in this test pit. In January 2010, high probability test pit investigations started on TPs 120 and 134. Agent and CABPs were detected in intact containers and soil in these test pits. Samples collected from intact containers were analyzed for agent, CABPs and unknown compounds. The high probability test pit investigations were halted due to detection of arsenic trichloride ($AsCl_3$) in one closed cavity container in April 2010.

Geotechnical borings and backyard sampling was completed in August 2010. For the backyard sampling, 15 soil sample locations (27 samples) were chosen in a grid pattern to investigate for agent and CABPs in the backyard soils. In two of these samples, L was detected; the remaining samples were cleared for agent and CABPs. Of the 27 samples, three were randomly selected for further HTW analysis. Of these three samples, two were cleared for agent/CABPs and further analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), explosives, and 12 AU-requested metals. The results for aluminum, manganese, and vanadium exceeded the accepted comparison levels. Six geotechnical boring samples were collected inside of the house through the basement foundation. The geotechnical boring soil samples were cleared for agent and CABPs, and further analyzed for VOCs and tentatively identified compounds (TICs), SVOCs and TICs, explosives, metals, and other individual parameters.

1.3.5 **Nature and Extent of Contamination**

The conclusions regarding nature and extent of contamination presented in the RI Report are summarized in this discussion.

In 2001, a test pit investigation began in the backyard of 4825 Glenbrook Road due to inconclusive geophysical results and the elevated arsenic concentrations in soil. Twenty-three test pits and two trenches were excavated at the property. There were no significant findings in any of the test pits, except for TP 23, which became Burial Pit 3. During the investigation of TP 23, a total of 18 CWM-related items and 406 munitions-related items were recovered. In 2002, the 4825 Glenbrook Road portion of the pit was temporarily backfilled in March 2002 due to ROE issues.

During the high probability Burial Pit 3 investigations (2007-2009), the excavated areas included the original pit, the east extension, the south extension, and east second extension. As previously described, 108 munitions-related and AUES-related items were recovered during this high probability investigation and categorized as 22 MEC, six CWM and 80 MD items. These items were identified as 75mm projectiles, 2-inch and 3-inch pipes with end caps, 4.7-inch projectiles, and an intact glass container. Metals including aluminum, arsenic, cobalt, iron, magnesium, mercury, and vanadium were detected at concentrations exceeding the accepted comparison levels in four grab samples. Note: the SVFUDS accepted comparison levels are the higher of the SVFUDS background levels or the USEPA Regional Screening Levels (adjusted by 0.1 for non-carcinogens). Analytical results for 11 test pit characterizations and 13 confirmation samples show that metals including aluminum, arsenic, cobalt, iron, magnesium, manganese, thallium and vanadium exceeded the accepted comparison levels in some of the samples.

USACE completed an additional 41 low probability test pit investigations; only one test pit contained suspect AUES-related glassware (at 6 ft bgs). There are seven low probability test pits that were not completed. All arsenic impacted soil exceeding the 20 mg/kg SVFUDS remediation level was removed except for the small areas under the driveway near the 4835 Glenbrook Road retaining wall, and the floor of TP 138.

High Probability Test Pits 120, 134 and 138 were investigated from November 2009 – April 2010. Among the closed and open cavity items (glass bottles, glass vial, glass test tubes, glass jars, metal bottles, and 75mm projectiles) uncovered during the excavation, 26 items were identified as CWM, two items were identified as MEC (one closed cavity 75mm projectile and one 75 mm unfuzed, unfired shrapnel round), three items were identified as MD (two open cavity 75mm projectiles and one 75mm unfuzed with hexagonal plug), and the remaining items were identified as suspected AUES-related non-munitions scrap. Agent/CABPs were detected in intact containers and soil uncovered in the vicinity of the excavation. Other industrial chemicals such as chloroacetophenone, diphenylchloroarsine, and $AsCl_3$, were also detected in the intact containers. The intact containers were destroyed by ECBC after analysis was performed. Agent/CABPs impacted soil excavated during the investigation was placed in drums and properly disposed. Metals detected in agent/CABP-cleared grab samples that exceeded the accepted comparison levels included aluminum, arsenic, iron, magnesium, and thallium. Sample results show that soil exceeding the accepted comparison levels still remains in this area. The investigation was ceased due to detection of $AsCl_3$ in a vapor and solid samples. The property was rendered safe by backfilling and awaits further investigation/removal.

Based on the above property status, the RI Report concluded that an FS should be prepared to address risk identified through the Human Health Risk Assessment (HHRA) and MEC Hazard Assessment (HA), as well as the risk of encountering containerized CWM, CABPs and agent/HTW contaminated soil associated with the uninvestigated areas, especially surrounding and beneath the house.

1.3.6 **Risk Assessment Summary**

1.3.6.1 ***Human Health***

The following discussion summarizes the conclusions of the HHRA presented as Appendix Q of the RI Report. The COPCs as determined in the HHRA are lewisite, aluminum, arsenic, cobalt, manganese, thallium, and vanadium in the soil (exceeded their respective preliminary screening values).

Carcinogenic risks were estimated for the four potential future receptor groups (adult residents, child residents, child recreational green space users, and outdoor workers) assumed to be exposed to COPCs in soils (via ingestion, dermal contact, the inhalation of dusts, the inhalation of volatiles in indoor air, and ingestion of homegrown vegetables) at the 4825 Glenbrook Road property.

It was determined that the carcinogenic risks estimated individually for future adult residents, child residents, child recreational green space users, and outdoor workers, are within the USEPA acceptable risk range of 1×10^{-6} and 1×10^{-4}. This was found to be true regardless of depth interval (i.e., 0-2 vs. 0-12 ft bgs, or 0-0.5 ft bgs for child recreational green space users) to which the potential future receptors were assumed to be exposed, or the assumed exposure scenario [i.e., Reasonable Maximum Exposure (RME) or Central Tendency (CT)]. This indicates that assumed future exposures to COPCs at the property are unlikely to result in unacceptable carcinogenic risks for the receptors evaluated. However, the cumulative cancer risk estimate of 2×10^{-4} for residents (combined adult and child exposure periods) exposed to arsenic in mixed soil (0-12 ft bgs) for the RME scenario exceeds 1×10^{-4}. Elevated arsenic areas were identified in two areas of the driveway and the TP 138 location. The 0-12 ft bgs arsenic exposure point concentrations (EPC) were recalculated by removing the three arsenic samples (two in the driveway retaining wall area and one in TP 138) that exceed the SVFUDS remediation level of 20 mg/kg. The results indicate that the estimated cancer risk was reduced to a level considered acceptable by USEPA (less than 1×10^{-4}) for the future residential scenario of exposures to mixed soil (0-12 ft bgs).

The Hazard Index (HI) estimated for adult residents, child recreational green space users, and outdoor workers potentially exposed to surface soil (*i.e.*, 0-0.5 ft or 0-2 ft bgs) or mixed soil (0-12 ft bgs) in the future was below the HI benchmark of 1 for noncarcinogenic effects under both the RME and CT scenarios. Thus, unacceptable hazard to these future receptors at the property are not expected from assumed exposures to COPCs in soil. However, the HI estimated for potential future child residents exposed to mixed soil (0-12 ft bgs) at the property exceeds the benchmark of 1 under the RME scenario, due to arsenic. This indicates that the assumed exposures to arsenic in mixed soils at the property could result in adverse noncarcinogenic health effects for this receptor. Removal of the arsenic-contaminated soil as described above would similarly reduce the noncarcinogenic HI to an acceptable level.

The carcinogenic and noncarcinogenic risks, both due to arsenic, are summarized as follows:

- Carcinogenic risk to residents (adult and child) exposed to mixed soil exceeds 1×10^{-4}
- Noncarcinogenic HI for child resident (RME) exposed to mixed soil exceeds 1

H and CABPs were not selected as the COPCs in the HHRA because they were not detected in any of the in-place soil samples; therefore they were not evaluated in the HHRA. However, L was selected as a COPC because it was detected in two of the in-place soil samples (near TP 138) at concentrations exceeding the residential screening level, and was quantitatively evaluated in the HHRA. The HHRA concluded that the HI from L is less than 1, and therefore, noncarcinogenic health effects are not expected from this potential exposure. However, since TP 120 and TP 134 were not cleared and no soil confirmation samples were collected, there are probable risks associated with exposure to CWM containers, and agent/CABPs impacted soil may still remain at these locations.

COPCs in soil were also evaluated using the Seasonal Soil Compartment (SESOIL) model to determine whether they could leach to, and impact, groundwater. The site-specific SESOIL modeling results indicated that it is unlikely that the COPCs detected in soil will impact groundwater beneath the property.

1.3.6.2 *Explosive Hazard*

Based on the findings of this and previous investigations, a MEC HA was performed for 4825 Glenbrook Road. A MEC HA provides a conservative assessment of the potential risk of injury or death from explosive hazards potentially present at a site. Hazard Levels range from 1 to 4, with a Hazard Level of 1 indicating the highest potential explosive hazard condition and 4 indicating the lowest potential explosives hazard conditions.

USACE evaluated two baseline-condition scenarios for the property. These were the Current Site Conditions (No Residential Use or Subsurface Clearance) and No Action (Residential Use, No Subsurface Clearance) without the current fence barrier. As a result, these received MEC HA scores of 615 and 640, respectively. Both MEC HA scores equate to a Hazard Level of 3 (moderate potential explosive hazard conditions). USACE evaluated three remedial alternatives MEC HA: (a) Subsurface Clearance, Future Residential Use; (b) Subsurface Clearance, Land Use Controls (LUCs), Future Recreational Use; and (c) No Subsurface Clearance, LUCs. The first two remedial alternatives reduced the property’s MEC HA scores to 355 (Residential Use) and 360 (Recreational Use), respectively. Both reduce the property to a Hazard Level 4 (low potential explosive hazard conditions). The last alternative, which does not include subsurface removal, would lower the MEC HA score to 565, but the Hazard Level of 3 would not be reduced.

1.3.6.3 *CWM Hazard*

The previous investigations indicate that containerized CWM and non-containerized H, L, and their CABPs, were detected in the vicinity of TPs 120, 134, and 138. While TP 138 was completely excavated, USACE did not complete the TP 120 and 134 investigations. Therefore, it is not known whether agent/CABP contaminated soil extends beyond the boundaries of the excavation footprint.

The widespread distribution of contaminants, especially AUES-related glassware, suggests that burial pit contents may have been redistributed during property development prior to the current investigations. As a result, there is the potential for MEC, CWM, and AUES-related items to be present outside the TP 120 and 134 locations. The HHRA concludes that based on finding 25 CWM items, 2 MEC items, 2 MD items, and AUES-related glassware during the TP 120 and 134 investigations, there is a likelihood of encountering MEC, containerized CWM, CABPs and HTW contaminated soil in the uninvestigated areas of TPs 120 and 134.

During the sewer line restoration in 2011, an intact closed cavity AUES-related glass flask with a dirt or cork plug containing a small quantity of brown solids was uncovered in an area adjacent to an area that had been previously excavated area in 2001. L was detected in the solid sample collected from the flask. This discovery further indicates that potential risk exists in uninvestigated areas at the property.

2.0 REMEDIAL ACTION OBJECTIVES

2.1 Remedial Action Objectives

Remedial action objectives specify the contaminants, military munitions, and media of concern, receptors and exposure pathways, and preliminary remediation goals that permit a range of treatment and containment alternatives to be developed.

2.1.1 Contaminants and Media of Concern

Based on the RI Report and the HHRA, the COPCs are L, aluminum, arsenic, cobalt, manganese, thallium, and vanadium in the soil (exceeded their respective preliminary screening values). However, remaining site risks associated with chemical contamination of soil are primarily attributable to arsenic in soil. With regard to military munitions (i.e., the potential presence of MEC, including CWM), the MEC HA identifies a Hazard Level of 3 (moderate potential explosive hazard conditions) for current site conditions. Also, as described in 1.3.6.3, containerized CWM and AUES-related items remain a concern at this property.

2.1.2 Receptors and Exposure Pathways

Receptors and exposure pathways discussed below are based on the HHRA.

Current Receptors – The 4825 Glenbrook Road property is a vacant residential property located between the AU President's house and the Republic of South Korea Ambassador's residence. The property is currently fenced to restrict access; only USACE contractors visit the property to perform weekly inspections, including routine landscaping.

Future Receptors – The property may reasonably be anticipated to be returned to residential use in the future. Therefore, the future residential exposure scenario was evaluated. Additionally, future receptors could include the outdoor (landscaping) workers, as well as construction workers. Conservative exposure assumptions were used for outdoor workers so that risks estimated for outdoor workers are anticipated to be protective of construction workers. Therefore, construction workers were not evaluated separately. A recreational green space (e.g., small park) user was also evaluated because green space is a potential future use (the structure could be removed and property converted to a community park area). This receptor is assumed to be a child (0 to 6 years of age) who goes to a park for recreational purposes.

Complete exposure pathways are required for potential risk to be present. Based on the projected future land use at 4825 Glenbrook Road, the receptors potentially present include 1) residents, 2) outdoor workers, and 3) green space users.

The complete exposure pathways for the receptors potentially present at 4825 Glenbrook Road are:

- Soil - direct contact pathways
  - Inhalation of volatiles
  - Incidental soil ingestion
  - Dermal contact with soil
  - Inhalation of particulates

    - Ingestion of home grown vegetables (residents only)
- Soil – groundwater protection
    - Leaching to groundwater
- Soil gas
    - Inhalation of volatiles in indoor air (residents only)

Specific soil exposures evaluated in the HHRA were:

- Residents exposed to the surface soil (0-2 ft bgs) and mixed soil (0-12 ft bgs).
- Outdoor workers exposed to surface soil (0-2 ft bgs) and mixed soil (0-12 ft bgs).
- Green space users exposed to surface soil (0-0.5 ft bgs)

Finally, the MEC, CWM, and AUES-related items pathway is considered to be complete for 4825 Glenbrook Road because there is a source, potential receptors, and the potential for interaction between them.

2.1.3 **Remediation Goals**

Based on the HHRA and the MEC HA, remediation goals are: 20 mg/kg for arsenic and a MEC HA ranking of Hazard Level 4 (low potential explosive hazard conditions). Note that the 20 mg/kg SVFUDS remediation goal for arsenic was jointly proposed by the Spring Valley Partners as the soil arsenic concentration above which remediation will be recommended. The Scientific Advisory Panel, established to assist the community in understanding the overall approach to technical issues affecting Spring Valley, recommended adoption of this remediation goal (*Scientific Advisory Panel Report*, May 29, 2002 Meeting). This remediation goal was formalized in the Action Memorandum for the 2003 EE/CA addressing OU-4 and OU-5 (an SVFUDS site-wide analysis of technologies to address arsenic in soil).

2.1.4 **Proposed Remedial Action Objectives**

Combining the COPCs, the affected media, the exposure pathways, and the remediation goals, the remedial action objectives for the 4825 Glenbrook Road property include:

- Prevent direct contact with soil having noncarcinogenic HI exceeding 1
- Prevent direct contact with soil having a cancer risk in excess of 1×10^{-4}
- Reduce MEC hazard to a low potential for explosive hazard conditions (Level 4)
- Reduce potential to encounter containerized CWM and AUES-related items

2.2 Applicable or Relevant and Appropriate Requirements (ARARs)

Applicable or Relevant and Appropriate Requirements (ARARs) must be identified during the development of remedial alternatives. ARARs include federal and/or state promulgated standards, requirements, criteria, and limitations. Chemical-, location-, and action-specific ARARs are identified. Pursuant to CERCLA/NCP, compliance with ARARs is a threshold requirement that a remedial alternative must meet in order to be eligible for selection (unless the ARAR is waived).

The ARAR analysis is directed at substantive, promulgated regulations with regard to on-site activities. CERCLA § 121(d), 42 U.S.C. § 9621(d); NCP, 40 C.F.R. § 300.5. Furthermore, CERCLA response actions, per CERCLA/NCP, are exempt from permits and similar procedural requirements with regard to on-site activities. 42 U.S.C. § 9621(e)(1); 40 C.F.R. § 300.400(e)(1). 4825 Glenbrook Road is "on-site" for purposes of CERCLA and the NCP (as are other areas related to the SVFUDS, such as the Interim Holding Facility). As for off-site activities (e.g., transportation), compliance is required for applicable substantive and procedural requirements. NCP, 40 C.F.R. § 300.400(e)(2). Such off-site activities are not part of the ARAR analysis, but rather may be discussed under the Implementability factor -- to the extent they pose challenges for certain alternatives.

2.2.1 Definition of ARARs

Pursuant to the NCP, 40 C.F.R. § 300.5, a regulation may qualify as an ARAR if it meets the definition of being either "applicable" or "relevant and appropriate." Each of these components is discussed below.

"Applicable" requirements means those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable.

"Relevant and appropriate" requirements means those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal environmental or state facility siting laws that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a site, address problems or situations sufficiently similar to those encountered at the site that their use is well suited to the particular site. Only those state standards that are promulgated, are identified by a state in a timely manner, and are more stringent than federal requirements may be relevant and appropriate.

Pursuant to the NCP, the term "State" includes the District of Columbia (DC). 40 C.F.R. § 300.5.

Whether or not a requirement is appropriate (in addition to being relevant) will vary depending on factors such as the existence of wetlands or endangered species on or near the site, the duration of the response action, the form or concentration of the chemicals present, the nature of the release, the availability of other standards that more directly match the circumstances at the site, and other factors. In some cases only a portion of the requirement may be relevant and appropriate. The identification of relevant and appropriate requirements is a two-step process; only those requirements that are considered both relevant and appropriate must be addressed at CERCLA sites.

In addition to ARARs, advisories, criteria, or guidance may be identified as "to be considered" (TBC) information for a particular scenario. TBC information may be developed by EPA, other

Federal agencies, or states. TBCs are typically considered only if no promulgated requirements exist that are either applicable or relevant and appropriate.

2.2.2 Identification of ARARs

Because of their site-specific nature, identification of ARARs calls for evaluation of federal and state environmental and facility siting laws regarding contaminants of concern, site characteristics, and proposed remedial alternatives. Requirements that pertain to the remedial response at a CERCLA site can be categorized into three different categories:

- **Chemical-specific ARARs** set health- or risk-based concentration limits in various environmental media for specific hazardous substances, pollutants, or contaminants. These ARARs establish either protective cleanup levels for the COPCs in the designated media or indicate the appropriate level of concern.
- **Location-specific ARARs** protect against damage to unique or sensitive areas such as floodplains, wetlands, and fragile ecosystems. They also restrict activities that may be harmful as a result of the characteristics of the site or the immediate environment.
- **Action-specific ARARs** set controls or restrictions on specific removal/remedial activities at a site. They specify performance levels, actions, or technologies, as well as specific levels for discharges or residual chemicals.

Table 2.1 lists the TBCs while Table 2.2 lists the federal and state chemical-, location-, and action-specific ARARs for the remedial alternatives under evaluation for the 4825 Glenbrook Road property. The ARARs that pertain to each remedial alternative are discussed in greater detail in Section 5.0, Detailed Analysis of Alternatives.

Because no endangered species or wetlands will be impacted by the remediation activities at the 4825 Glenbrook Road property, no location-specific ARARs associated with the protection of endangered species or wetlands are included for this property. The project area is developed with few large contiguous wooded areas, and it provides very little habitat for rare, threatened, or endangered species. According to the U.S. Fish and Wildlife Service, “Except for occasional transient individuals, no proposed or federally listed endangered or threatened species are known to exist within the Spring Valley site” (U.S. Department of the Interior, 2003). There is a small intermittent stream near the property, which is not expected to be impacted by contaminants from the property. Groundwater is not used for public water supply at the property and surrounding area. Municipal water is provided to the area.

All appropriate control measures will be in place to prevent impacts to local air and water during property remediation. For alternatives requiring excavation and removal of contaminated soils to an off-site location, the selected remedial action will comply with all applicable substantive and procedural construction management and hazardous waste transportation requirements, as to the off-site activities. In particular, all applicable Resource Conservation and Recovery Act (RCRA) and other hazardous waste identification and transportation requirements, both substantive and procedural, will be complied with for off-site activities.

Table 2.1: Summary of TBCs

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
Chemical-Specific:				
U.S. EPA, Regional Screening Levels (RSLs) (formerly Risk-Based Concentrations (RBCs))	EPA Region III Regional Screening Table	TBC	Tables of risk-based screening levels, calculated using the latest toxicity values, default exposure assumptions, and physical and chemical properties.	Used for screening chemicals in soil in the HHRA (Appendix Q of the RI Report).
U.S. EPA, Toxicity values for selected chemicals of concern (Cancer Slope Factors and Reference Doses)	U.S. EPA, Integrated Risk Information System	TBC	Values used to estimate potential cancer and non-cancer human health risks due to site-related exposures.	These values were used in the HHRA (Appendix Q of the RI Report) in the calculation of site risks.

1

Table 2.2: Summary of ARARs

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
Action-Specific:				
U.S. EPA, RCRA, Closure and Post-Closure Care	40 Code of Federal Regulations (CFR) 264.111, 264.114, 264.1202 (munitions)	ARAR	RCRA closure and post-closure requirements may be applicable to remedial alternatives in which cleanup is performed, but hazards (e.g., chemicals, CWM, or conventional munitions) remain.	RCRA's substantive closure and post-closure requirements for hazardous waste facilities are relevant and appropriate. 40 C.F.R. 264.111 (closure performance standards), 264.114 (disposal or decontamination of equipment, structures and soils), 264.1202 (closure and post-closure care).
US Chemical and Biological Warfare Program	50 United States Code (USC) 1518	ARAR	No chemical or biological warfare agent shall be disposed "unless such agent has been detoxified or made harmless to man and his environment" (unless immediate disposal is clearly necessary, in an emergency, to safeguard human life).	Action-Specific ARAR for alternatives involving disposal/destruction of CWM.
District of Columbia Municipal Regulations (DCMR)	20 DCMR § 2804. EXPLOSIVES	ARAR	2804.1 Noise emanating from explosives shall be prohibited during the hours specified in this section irrespective of its compliance with § 2701 of Chapter 27 of this subtitle. 2804.2 No blasting with explosives shall be performed on any Sunday or legal holiday or at nighttime on weekdays, except by special permit as provided in § 1301 of the Second Amendment to the 1972 Building Code of the District of Columbia (Title 12 DCMR).	Action-Specific ARAR for Alternatives 3, 4, and 5.
District of Columbia Municipal Regulations (DCMR)	20 DCMR § 2803. CONSTRUCTION IN RESIDENTIAL ZONES	ARAR	2803.1 Noise emanating from construction in residential zones shall be prohibited during the hours specified in this section irrespective of its compliance with § 2701 of Chapter 27 of this subtitle. 2803.2 No noise from construction, excluding minor home repairs, shall be permitted within a residential, special purpose, or waterfront zone on any Sunday or legal holiday, or after 7:00 p.m. and before 7:00 a.m. on any weekday. MAXIMUM NOISE LEVEL: Commercial or light-manufacturing zone	Action-Specific ARAR for Alternatives 3, 4, and 5 (and Alternative 2 – to the extent land use controls involve construction).

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
			Daytime 65 dB(A), Nighttime 60 dB(A) Industrial zone Daytime 70 dB(A), Nighttime 65 dB(A) Residential, special purpose, or waterfront zone Daytime 60 db(A), Nighttime 55 db(A)	
District of Columbia Municipal Regulations (DCMR)	20 DCMR § 605.1	ARAR	CONTROL OF FUGITIVE DUST 605.1 Reasonable precautions shall be taken to minimize the emission of any fugitive dust into the outdoor atmosphere. The reasonable precautions shall include, but not be limited to, the following etc.	Action-Specific ARAR for Alternatives 3, 4, and 5 (and Alternative 2 – to the extent land use controls involve construction).
District of Columbia Municipal Regulations (DCMR)	21 DCMR § 542.3	ARAR	EROSION CONTROL PRINCIPLES: BUILDING, DEMOLITION, AND SITE DEVELOPMENT PROJECTS	Action-Specific ARAR for Alternatives 3, 4, and 5 (and Alternative 2 – to the extent land use controls involve construction).
District of Columbia Municipal Regulations (DCMR)	20 DCMR § 606.	ARAR	VISIBLE EMISSIONS	Action-Specific ARAR for Alternatives 3, 4, and 5.
District of Columbia Municipal Regulations (DCMR)	20 DCMR § 700. ORGANIC SOLVENTS	ARAR	700.1 Sources subject to the requirements of §§ 701 through 713 shall not be subject to § 700. 700.2 No person shall discharge into the atmosphere more than fifteen (15) pounds of photochemically reactive solvents in any one (1) day, nor more than three (3) pounds in any one (1) hour, from any article, machine, equipment, or other contrivance, unless the uncontrolled organic emissions are reduced by at least eighty-five percent (85%). 700.3 No person shall discharge into the atmosphere more than forty (40) pounds of nonphotochemically reactive solvents in any one (1) day, nor more than eight (8) pounds in any one (1) hour, from any article, machine, equipment, or other contrivance, unless the uncontrolled organic emissions are reduced by at least eight-five percent (85%).	Action-Specific ARAR for Alternatives 3, 4, and 5 (if organic solvents are used).

2.3 General Response Actions

General response actions are actions that must be taken to satisfy the remedial action objectives for the property. These are developed for each medium of interest defining containment, treatment, excavation, or other actions. Volumes or areas of media are identified for which the general response actions might be applicable. The actions consider the requirements for protectiveness as identified in the remedial action objectives and the chemical and physical characterization of the property.

The areas of the 4825 Glenbrook Road property that require a response action are derived from the information presented in the RI Report's nature and extent of contamination discussion and the HHRA conclusions. However, based on the history of investigations and findings at the property, the relatively small size of the property, and the uncertainty associated with remaining MEC, CWM, and AUES-related items, USACE recommends that the soil contamination rationale for determining excavation depths be supplemented by administrative and practical considerations. The original Conceptual Site Model was based on historical information and photographic interpretation. Further, it was assumed that any burial pit(s) could be located and remediated. It became clear however, that during development of the property, contents of the original pit(s) were disturbed and pit contents may have been distributed across the property. Consequently, there is a high potential for MEC, CWM, and AUES-related items to be located in areas not completely excavated to bedrock or competent saprolite.

Based on the results of the investigation, USACE recommends that for areas where there is a high probability that debris may be encountered (i.e., near and, possibly under, the foundation of the house and slightly beyond the backyard retaining wall) that these areas be excavated to the depth of bedrock or competent saprolite.

Saprolite is thoroughly decomposed parent 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 saprolite has been used throughout SVFUDS investigations to represent the limits of past intrusive activities. For this project, competent saprolite is defined as saprolite that cannot be excavated by hand tools, but can be excavated by powered equipment. Excavation depth calculation for this FS conservatively assumes a one-foot layer of competent saprolite overlying the bedrock, even though thicker layers of saprolite have been found at 4825 Glenbrook Road.

Although digging to bedrock or competent saprolite will result in an over-excavation of soil relative to cleanup goals based on soil contamination alone, it may be appropriate as a means of removing MEC, CWM, and AUES-related items, and achieving a MEC Hazard Level 4 (low potential for explosive hazard conditions).

Figure 3 shows the areas for which a response action is required to meet the remedial action objectives. Table 2.3 presents the dimensions and soil volumes of the areas requiring a response action. In addition to indicating soil volumes, it will be crucial to identify those areas that, based on property history, will need to be completed under low-probability or high-probability protocols.

Low-probability protocols are for areas where it is unlikely that MEC/CWM will be encountered. A "low" determination may only be assigned to those areas for which a search of available historical records and on-site investigation data indicates that, given the military or munitions related activities that occurred at the property, the likelihood that MEC/CWM is present is low.

High-probability protocols are for areas where MEC/CWM are suspected. A "high" determination may be assigned to those areas for which a search of available historical records or on-site investigation data indicates that, given the military or munitions-related activities that occurred at the property, there is more than a low probability that MEC/CWM is present.

For this document, the designation of low or high probability is tentative and for planning purposes only based on analysis of existing data; formal determinations will be made through probability assessments developed as part of the remedial action planning. Section 3.4 details the basic differences in level of effort depending on these considerations.

Table 2.3: Soil Areas Requiring a Response Action

Area	Area (length x width) in (ft^2)	Depth to Bedrock (ft)\1	Calculated Soil Volume (yd^3)	Comments (Protocols)
A	1,109	7	288	Low Probability
B	2,786	5	516	Low Probability
C	**NO FURTHER ACTION**			
D	2,202	4	326	High Probability
E	3,260	5	604	High Probability
F	2,478	5	459	High Probability
	TOTAL		**2,193**	

\1 – These are average depths to bedrock for a given area (minus 1 ft for an overlying competent saprolite layer) based on data from field activities performed and based on estimations from field personnel who have worked at this property.

Typical response actions for soil contamination include: No Action, LUCs (fencing and/or environmental covenants), containment (capping, barriers), excavation (and disposal), and treatment. The excavation and treatment actions are reviewed in more detail in the next section.

3.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

At this step of the FS process, the universe of potentially applicable technology types for contaminated soil was reduced by evaluation with respect to implementability. In general, this is accomplished by using site characterization data to screen out and eliminate those technologies that are clearly ineffective or unworkable at the property.

For the SVFUDS, multiple EE/CAs were conducted, each relevant to the 4825 Glenbrook Road situation. The EE/CAs presented comprehensive screenings of remedial technologies to address soil contamination. The first EE/CA, as described in Section 1.3.3.5, focused on arsenic contaminated soil for OU-3 (USACE 2000). The second EE/CA effort, addressing OU-4 and OU-5, was an SVFUDS site-wide analysis of technologies to address arsenic in soil (USACE 2003). Both EE/CAs concluded that excavation and disposal was the preferred technology to address soil contamination in the SVFUDS.

Four technologies have been identified for potential use in performing remedial activities for contaminated soil at the SVFUDS:

- Phytoremediation
- Soil Stabilization
- Soil Washing
- Excavation and Off-site Disposal

A brief description of each technology, their applicability to SVFUDS in general, a screening of each against the needs of 4825 Glenbrook Road, and the rationale for recommending excavation and off-site disposal as the appropriate method to achieve the remedial action objectives, is provided in the sections below.

3.1 Phytoremediation

Phytoremediation is a remedial technology that uses plants to remove contaminants from the environment. In the case of arsenic or other metals-contaminated soils, this method can also be described as phytoaccumulation/phytoextraction and refers to the uptake and translocation of metal contaminants in the soil by plant roots into the aboveground portions of the plants. Plants called hyperaccumulators absorb unusually large amounts of metals in comparison to other plants. One or a combination of these plants is selected and planted at a site based on the type of metals present and other site conditions.

Individual treatability studies need to be conducted to determine the effectiveness and site-specific feasibility of this technology. USACE conducted a greenhouse and feasibility study for phytoremediation in 2004 following the OU-4/OU-5 EE/CA (USACE 2003) recommendations and it was concluded that phytoremediation was an acceptable alternative for arsenic-contaminated soil in very limited applications, primarily to save mature landscape and hardscape features at individual residences. Phytoremediation has been used on a small number of properties throughout the SVFUDS.

Even though studies showed this alternative to be protective of human health and the environment in the long-term, the need for site-specific studies negates short-term effectiveness. More importantly, for this property, COPCs in addition to arsenic need to be addressed. Additionally, this technology could take a substantial length of time to reach remediation endpoints, further preventing short-term effectiveness. Although phytoremediation may reduce mobility and toxicity in the soils, the toxic constituents would be transferred to the plants which would then require scheduled harvesting, disposal and replacement to achieve the remediation endpoint. Long-term availability of materials and administrative support would be required as the remediation duration for this technology is site-specific and varies dependent upon cleanup goals, contaminant concentrations, growth rate of the plantings, depth of contamination, and climate (e.g., temperature, precipitation, etc.). Temporary land use controls (e.g., fencing) would also be required to limit access to the remediation locations, affecting use of the property on a potentially long-term basis.

Finally, while phytoremediation could prove to be effective in remediating site-specific COPCs in soil, this technology would not address the potential explosive or CWM hazards, which may include AUES-related items present at the property; therefore, its use is not considered viable.

3.2 Soil Stabilization

Soil stabilization is a remediation technique in which contaminated soil is treated with a binding/stabilizing agent, such as iron or Portland cement, to minimize the rate of contaminant migration and to reduce the toxicity of the soil. Stabilization may be achieved through in situ (in place) or ex situ (out of place) treatment approaches. Soil in those areas identified as requiring removal would be treated on site, either in situ or excavated and transported to an on-site treatment facility, and then replaced in the excavation. Proper controls would minimize dust generated during the excavation and mixing process. Backfill from an off-site source would be used on top of the replaced soil to fill the excavation to grade.

Additional site-specific feasibility and treatability studies would be required to determine the appropriateness of this technology. Although this technology could achieve protection of human health and the environment through immobilization of metals, thus reducing toxicity and mobility, short-term effectiveness would be negated due to the need for further research. Long-term effectiveness of this technology is questionable; one consideration would be residual risks associated with the long-term stability of the treated material (i.e., the potential that the material would degrade under site conditions, thus releasing metals back into the environment). The clayey silt soils at the site may cause problems with the stabilization process. In general, the higher the clay content the more difficult successful soil stabilization becomes. Construction of an on-site treatment plant would be labor intensive and may not be permitted due to the location within a residential neighborhood, thereby preventing ex situ treatment. Physical bulking or hardening of soil during soil stabilization could also potentially cause future difficulties for landscaping and construction activities.

In situ treatment would not address the potential explosive or CWM hazards, as no excavation would be performed. Additionally, soil stabilization has previously been screened as a remedial technology for arsenic-contaminated soils at the SVFUDS; it was rejected due to limited favorable criteria.

3.3 Soil Washing

Soil washing is a remediation technique in which contaminants are separated from the soil particles to which they are sorbed. This is achieved through excavating and washing the soil with a leaching agent, surfactant, or chelating agent or through pH adjustments. An on-site treatment facility would be designed and constructed. A portion of the treated soil could be used as backfill although it would be necessary to supplement this soil with backfill from off site. This is due to the fact that some of the soil volume would be included in the contaminated sludge generated during the process. This sludge would be disposed at an appropriate off-site facility.

Additional site-specific feasibility and treatability studies would be required to determine the appropriateness of soil washing which would negate the short-term effectiveness. This technology could provide protection of human health and the environment by removing the metals from site soils, thus reducing the mobility, toxicity, and volume of contaminated soil; however, it is unknown if the materials used in the washing process may pose a risk to human health and the environment during implementation of this technology. Further, this technology has the potential to impact landscaping efforts due to soil sterility issues. Similar to soil stabilization, the clayey silt content of the soils at the site would make it more difficult to achieve the desired remedial action objectives using this technology.

This technology is labor intensive and the materials and services required to implement it are not widely available. Construction of an on-site treatment plant may not be permitted due to the chemicals used in washing and the potential release or spill of chemicals within a residential neighborhood. This technology would be complicated by the potential for explosive or CWM hazards to be encountered in the soil. Soil washing has previously been screened as a remedial technology for arsenic-contaminated soils in the SVFUDS; it was rejected due to limited favorable criteria and was not considered further for this property.

3.4 Excavation and Off-site Disposal

Previously, excavation and landfill disposal was selected as the preferred technology to address arsenic-contaminated soil in the OU-3 EE/CA (USACE 2000) and the OU-4/OU-5 EE/CA (USACE 2003). Accordingly, excavation and landfill disposal of arsenic contaminated soil has been done extensively at the SVFUDS. More than 150 residential properties with arsenic-contaminated soil have been cleaned up using this method.

However, to address those items that can be expected to be encountered in the excavated soil at the 4825 property, including MEC, CWM, and AUES-related items, this discussion more appropriately focuses on excavation and <u>off-site</u> disposal to reflect that multiple wastestreams may be generated and that not all of them can be landfilled. Excavation and off-site disposal would involve excavating soils in areas identified as requiring removal. Soil and MEC, CWM, and AUES-related items (if present), would be segregated and then transported to an appropriate off-site disposal facility following characterization in accordance with specific procedures that would be detailed in the Remedial Design/Remedial Action Work Plan.

Excavation and off-site disposal is protective of human health and the environment. It will remove any chemical contaminants from site soils eliminating their mobility and reducing the toxicity and volume of contaminated soil at the site. However, it is recognized that, unless treated, the mobility, toxicity, or volume of the contaminated soil is not reduced, but simply transferred to another site (i.e. a permitted landfill). Excavation and off-site disposal is effective in the long-term as the soils with elevated chemical concentrations will be removed from the site, significantly reducing any residual risk. This also provides short-term effectiveness as the remedial action objectives can be achieved in a short period of time and no further treatability or feasibility studies are required. The materials and services required to implement this technology are also readily available. DDOE, USEPA, property owner, and community acceptance has been established during the previous excavations performed throughout the SVFUDS.

Specific wastestreams that are expected to be encountered at the 4825 property, and their likely off-site disposal methods based on previous experience at this and other sites throughout the SVFUDS, are presented below.

3.4.1 Soil

Excavated soil will be disposed of, consistent with 40 CFR § 300.440, in a treatment, storage, or disposal facility permitted to receive such material. If the excavated soils are characterized as RCRA hazardous, they would have to be stabilized by the RCRA Subtitle C hazardous waste treatment facility and then deposited in the landfill. If they are not RCRA hazardous, they can be disposed of directly into a sanitary landfill. Note that the extensive previous experience at the SVFUDS suggests that the vast majority of the soil would be characterized as non-hazardous.

Excavated soils characterized as containing CWM would go to an incineration facility, with the ash ultimately placed in a Subtitle C landfill.

3.4.2 Water

Aqueous investigation derived waste, primarily water from equipment or personnel decontamination, will similarly be characterized as RCRA hazardous or non-hazardous, and disposed accordingly.

3.4.3 MD and Non-munitions, Non-AUES Scrap

MD from the SVFUDS has historically been incinerated prior to landfill disposal. More recently, MD has been disposed at a metal smelter facility. All non-munitions, non-AUES related scrap items will be disposed in a nonhazardous waste landfill.

3.4.4 MEC, DMM, RCWM, and MDEH

MEC, Discarded Military Munitions (DMM), including Recovered Chemical Warfare Materiel (RCWM), Conventional DMM, and Material Documented as an Explosive Hazard (MDEH) recovered during the remedial action will be disposed of in accordance with USACE's February 2010 *Action Memorandum, Disposal of Discarded Military Munitions (DMM), including Recovered Chemical Warfare Materiel (RCWM), Conventional DMM, and Material Documented as an Explosive Hazard (MDEH), Spring Valley Formerly Used Defense Site, Washington, D.C* (hereinafter, "February 2010 Action Memorandum"). The selected removal action for RCWM in the Action Memo is On-site Demilitarization using the Explosive Destruction System (EDS) at the Spring Valley federal property. The selected removal action for conventional DMM/MDEH is On-Site Demilitarization using Contained Destruction Technologies at the Spring Valley federal property.

3.4.5 **Excavation and Off-site Disposal Logistics**

It is crucial to identify which areas of the property may need to be excavated and which areas would be done under low-probability protocols or high-probability protocols. As described in Section 2.3, the designation of low or high-probability is tentative and for planning purposes only; formal determinations will be made through probability assessments developed as part of the remedial action planning.

Figure 3 shows these areas, based on the property history and past investigation findings. While the low or high-probability protocol determinations for Areas A through F are projected based on past findings, the individual footprint for each area is broadly based on general property logistics.

For example, Area A represents the backyard, 10 feet behind the current retaining wall, representing a realistic practical extent of possible redistribution of burial pit contents during property development. The area depicted represents a 10 foot wide zone of excavation from the retaining wall to the back of the property. Additionally, the depth of excavation will be 2 feet below the retaining wall footers and/or to competent saprolite or bedrock. The delineation of Area A takes into account the estimated area of disturbance by the developer to re-route the sanitary sewer line behind the backyard retaining wall. Based on the depth of the sanitary sewer line which is 6 ft and the location of the sanitary sewer line which is approximately 2 feet east of the retaining wall, plus the assumption of an excavation approach using benching and sloping, the potentially disturbed area is approximately 9 feet behind the retaining wall. Additional excavation may be warranted if debris is encountered in Area A. In that case, any debris fields would be cleared in accordance with the procedures outlined in the Remedial Design/Remedial Action Work Plan (to be prepared) until no additional debris is encountered, at which point the excavation of the area would be considered complete.

Area B represents the flat of the driveway. Area C includes the area worked as Pit 3 and its associated extensions, and based on the extensive work performed previously, no further action is proposed there. Area D is the flat terrain between the retaining wall and the house, while Area F is the front yard down to Glenbrook Road. Area E represents the house and the soil beneath, with the removal of the house (if determined to be necessary) as a low-probability operation while the excavation of the foundation and the soil beneath would be done under high-probability protocols.

Low-probability work involves construction-type excavation activity with standard safety procedures observed. This will include screening and sifting of the soil to ensure no MEC, CWM, or AUES-related items are present. High-probability work entails an assumption of MEC or CWM as ‘unlikely but possible’ to be encountered and therefore incorporates significant safety protocols including engineering controls such as working within vapor containment structures. As described in the Section 1.3 background, many previous investigations have been completed under high-probability protocols and USACE has significant experience implementing these operations. As discussed in Sections 4.0 and 5.0, high probability procedures, costs, and timeframes, are based on actual site experience provided by USACE.

4.0 DEVELOPMENT AND SCREENING OF ALTERNATIVES

4.1 Introduction

At this stage of the FS, the technology screening and the media of concern are combined to develop and assemble alternatives that meet the remedial action objectives. Defined alternatives are evaluated against the short and long-term aspects of three broad criteria: effectiveness, implementability, and cost. The purpose of the screening evaluation at this stage is to reduce the number of alternatives that will undergo the more thorough and detailed analysis in the next section (Section 5.0), and is therefore, a broader, more general screening.

The technology screening process performed in Section 3.0 concluded that the most favorable remedial technology for 4825 Glenbrook Road was cleanup through excavation and off-site disposal. Excavation and off-site disposal demonstrates short-term and long-term protection of human health and the environment against COPCs and MEC, CWM, and AUES-related items; reduces toxicity, mobility, and volume at the site; is technically and administratively feasible; requires materials that are readily accessible; and has been implemented throughout the SVFUDS for many years, demonstrating both supporting agency and community acceptance. Excavation also allows any MEC, CWM, and AUES-related items, that are detected or encountered to be removed and disposed.

The remedial alternatives presented in Section 4.2 represent scenarios for this property that meet the remedial action objectives to varying degrees. The broad criteria against which they are screened are defined as follows:

4.1.1 <u>Effectiveness</u>

This criterion is evaluated with respect to effectiveness in protecting human health and the environment, and providing reduction in toxicity, mobility, and volume. The short-term (construction and implementation period) and long-term components (effective period after the remedial action is complete) are also evaluated.

4.1.2 <u>Implementability</u>

This criterion is evaluated as a measure of both the technical and administrative feasibility of constructing, operating, and maintaining a remedial alternative. Technical feasibility is the ability to construct, reliably operate and maintain (as required) an alternative, while administrative feasibility refers to the ability to obtain approvals from agencies, and the availability of required goods and services.

4.1.3 <u>Cost</u>

The cost of each alternative is also evaluated. However, at this stage, it is not necessary to define the cost with the same level of detail or accuracy required for the detailed analysis (Section 5.0). Prior estimates, sound engineering judgment, and most importantly, real-world site cost experience, are sufficient to help evaluate one alternative against another. USACE's Remedial Action Cost Engineering and Requirements software (RACER™), version 10.4, was used as necessary to supplement these costs.

4.2 Identification of Alternatives

Five remedial alternatives have been identified for the 4825 Glenbrook Road property:

- Alternative 1: No Further Action
- Alternative 2: Land Use Controls (LUCs)
- Alternative 3: Cleanup to residential standards without removing the house; restricted future use (LUCs)
- Alternative 4: Remove the house and cleanup to recreational standards; restricted future use (LUCs)
- Alternative 5: Remove the house and cleanup to residential standards; unrestricted future use of the property

Note that for Alternatives 3, 4, and 5, as described above, cleanup is defined to be through excavation and off-site disposal of soil. These remedial alternatives also incorporate/include the selected disposal actions from the February 2010 Action Memorandum with regard to MEC, DMM, RCWM, Conventional DMM, and MDEH.

4.3 Screening of Remedial Alternatives

The following sections provide a brief description of each alternative.

4.3.1 Alternative 1: No Further Action

The NCP requires that a no further action alternative be developed for an FS. The no further action alternative would involve leaving the property in its current condition. This alternative provides a comparative baseline against which other alternatives can be evaluated. Under this alternative, no remedial action will be taken, and any identified contaminants are left "as is," without the implementation of any containment, removal, treatment, or other protective actions. This alternative would leave any MEC, CWM, or AUES-related items potentially present, in place, without further investigation or removal. This alternative does not provide for the monitoring of soil, additional investigation for or removal of MEC, CWM, and AUES-related items, and does not provide for any active or passive land use controls to reduce the potential for exposure (e.g., physical barriers, deed restrictions).

Effectiveness: The no further action alternative would not provide for protection of human health and the environment. Contaminant concentrations in soil and the hazards associated with MEC, CWM, or AUES-related items would not be expected to decrease significantly over time without removal or treatment. Therefore, this alternative would not be effective in achieving the remedial objectives in the short-term or the long-term, and it does not reduce toxicity, mobility, or volume.

Implementability: The no further action alternative is easy to implement. No services or materials would be required to implement this alternative. However, it will be technically ineffective and administratively unfavorable and will fail to achieve the remedial objectives.

Cost: There are no costs associated with the no further action alternative.

Outcome: Alternative 1 will not be evaluated further because it fails the effectiveness and implementability criteria.

4.3.2 Alternative 2: Land Use Controls

The "LUCs" alternative would include limiting access to all or portions of the property and would call for environmental covenants, among other controls. Access could be limited in a variety of ways. The success of access limitations would depend on what portions of the property they involve and the effectiveness of their implementation including the cooperation of the regulators, the government, stakeholders, and the current and future property owners.

Options for limiting access include fencing specific areas (e.g., areas known to contain soil contaminations, areas suspected to contain explosive or CWM hazards); covering the areas with concrete or brick (e.g., restricting the use as a patio or sitting area); or planting the areas with groundcover plants that do not require routine maintenance. With regard to contaminated soil, these options would prevent physical contact with contaminated soil and reduce or eliminate runoff from contaminated surface soil, thereby, reducing the potential spread of contamination. This option would also limit potential encounters with any MEC, CWM, and AUES-related items present by preventing people from digging to depths where they may be encountered.

The LUC alternative would also include the development of environmental covenants to legally bind the current and future property owner to the appropriate access and use restrictions. The environmental covenants would include prohibition of routine landscaping activities in these areas. USACE would develop an LUC plan, which would include a delineation of enforcement and maintenance responsibilities, in coordination with the property owner and local agencies.

Periodic reviews (commonly referred to as "5-year reviews") would be part of this alternative. These generally are required by CERCLA when hazardous substances remain on site above levels which permit unrestricted use and unlimited exposure (UU/UE). Periodic reviews provide an opportunity to evaluate the implementation and performance of a remedy to determine whether it remains protective of human health and the environment. The objective is to ensure that USACE is aware of and responds to new information or data that affects the selected response action. A Periodic Review Plan would be prepared describing periodic site visits and stakeholder interviews to determine whether or not the level of risk should be changed. If the level of risk should change, the recommended response alternative would be reviewed to determine if it is still applicable.

Effectiveness: The LUCs alternative would provide protection of human health and the environment by preventing physical contact with the contaminated soil and limiting the potential for an encounter with MEC, CWM, or AUES-related items that may be present. However, this alternative would not be effective in achieving the remedial objectives, nor does it reduce toxicity or volume. This alternative can be effective in the short-term and the long-term with the cooperation of the current owner and the proper protection of workers involved in the implementation. Instituting LUCs calls for cooperation and coordination between the federal government, state environmental regulators, local governments, private stakeholders and current and future property owners. In order for LUCS to be effective, the parties must consult and work collaboratively to take responsibility for their implementation, management and enforcement.

<u>Implementability</u>: The LUCs alternative can be readily implemented by designing and installing physical barriers such as fences, concrete or brick patios, or groundcover plantings to limit access to the surface soils. Environmental covenants can be developed. LUCs would be placed on the deed. The materials and services required to implement this alternative are available. The administrative feasibility of LUCs is less certain as it would call for the cooperation of current and future property owners who would have to reside in a limited access environment. An LUC plan describing the controls and delineating responsibility for enforcement and maintenance of the controls would need to be developed. Significant administrative services would be necessary in the implementation of this alternative to draft deed restrictions and land use control documentation. Although the "LUCs" alternative is protective, it does not achieve the remedial objectives.

<u>Cost</u>: The costs for this alternative would not be prohibitive. LUCs would include decorative fencing, concrete patio installation, ground cover plants, and legal fees for development of environmental covenants. Access to the property could cost approximately ten percent, at most, of the remedial alternative costs. The cost for periodic reviews would also be included.

<u>Outcome</u>: Alternative 2 is not effective in reducing toxicity or volume of contaminants, MEC, CWM, or AUES-related items. Acceptance by the property owner, and the ability to commit future owners to living in restricted surroundings, would be difficult to obtain. The LUCs alternative will not be evaluated further because it does not meet key elements of the effectiveness and implementability criteria.

4.3.3 <u>Alternative 3: Cleanup to Residential Standards Without Removing the House; Restricted Future Use (LUCs)</u>

Alternative 3 entails cleaning up the property to residential standards, to eliminate unacceptable risk to human health and the environment, without removing the house. LUCs to prevent contact with the soils beneath the house would limit any subsurface intrusive activities associated with the soil, including excavations in or around the foundation or through the basement slab. These LUCs would prevent physical contact with the contaminated soil beneath the house and would also include the development of environmental covenants to legally bind the current and future property owner to the appropriate access and use restrictions.

This alternative would include the excavation of potentially contaminated soil and MEC, CWM, and AUES-related items from locations around the house, including patios and stairs and hardscapes, up to the building foundation. Shoring and stabilization techniques would be required to ensure the structural integrity of the house, as well as neighboring border fences, retaining walls, etc., when excavating close to those structures. Upon completion, the property would revert back to residential use.

In theory, to meet residential standards and to eliminate unacceptable risk to human health and the environment, only the areas of arsenic-contaminated soil described in Section 1.3.6.1 would need to be removed. Additionally, any munitions or AUES-related items encountered would be removed, with any debris field encountered fully excavated. As mentioned previously, all MEC will be inspected to determine its explosive or CWM safety status and disposed of in accordance with the February 2010 Action Memorandum.

However, as described in Section 2.3, as a conservative measure, it is proposed that the excavation depth be controlled by the depth of bedrock or competent saprolite, rather than just soil contamination. Although there will be an over-excavation of soil relative to cleanup goals based on soil contamination alone, the proposed excavation depth would also accomplish the goals of removing any MEC, CWM, and AUES-related items and achieving a MEC Hazard Level 4 (low potential for explosive hazard conditions). The MEC HA evaluated a similar scenario for the property and recommended subsurface MEC clearance to a minimum depth of 12 ft bgs throughout the property, a depth assumed to be sufficient to address any remaining burial pits or trenches that could be present at the 4825 Glenbrook Road property. Excavating to bedrock or competent saprolite will exceed that recommended depth (where bedrock is deeper than 12 ft bgs). Following excavation, the property would be backfilled to approximate original contour, achieving a residential standard for the soil.

Periodic reviews would also be part of this alternative to ensure that USACE is aware of and responds to new information or data that affects the selected response action. A Periodic Review Plan would be prepared describing periodic site visits and stakeholder interviews to determine whether or not the level of risk should be changed. If the level of risk should change, the recommended response alternative would be reviewed to determine if it is still applicable.

<u>Effectiveness</u>: This alternative would be protective of human health and the environment. It will remove most of the contaminated property soils not covered by the house by excavating to bedrock or competent saprolite, thus eliminating contaminant mobility, and reducing the toxicity and volume of contaminated soil at the property. However, soils beneath the house may still exhibit some levels of contamination although the geotechnical borings indicated only minor metals exceedances (arsenic was not among them).

Instituting LUCs calls for cooperation and coordination between the federal government, state environmental regulators, local governments, private stakeholders and current and future property owners. In order for LUCS to be effective, the parties must consult and work collaboratively to take responsibility for their implementation, management and enforcement.

During implementation of this alternative, controls would be required to ensure the safety of the workers and the community. As discussed in Section 3.4.5, work would be performed under low and high-probability procedures. Low-probability work involves construction-type excavation activity with standard safety procedures observed. This will include screening and sifting of the soil to ensure no MEC, CWM, or AUES-related items are present. High-probability work incorporates significant safety protocols including engineering controls such as working within vapor containment structures. Detailed procedures would be established in the Remedial Design/Remedial Action Work Plan.

Effectiveness in protecting human health and the environment, and reducing toxicity, mobility, and volume of contaminants is limited in that the areas beneath the house will remain in their current state. This includes any MEC, CWM, or AUES-related items that may be present beneath the house.

<u>Implementability:</u> At this screening stage, this alternative is considered technically and administratively feasible. The materials and services required to implement this alternative are readily available. While DDOE, USEPA, property owner, and community acceptance has been established for excavation during the previous activities performed throughout the SVFUDS, the administrative feasibility of obtaining approvals from those parties when leaving potential areas of contamination beneath the house is less certain. Once remediation is completed, LUCs would be established to prohibit any excavation under the footprint of the existing house.

An assessment of technical feasibility includes a formal determination of whether the excavation can be done as a low-probability operation, or a high-probability operation. Figure 3 indicates that Areas A and B would be completed as low-probability while Areas D and F would be excavated under high-probability protocols. Area E (the house and beneath the house) would not be addressed under this alternative.

<u>Cost</u>: The cost to implement this alternative is significant due to the volume of soil to be excavated. If the property is excavated to bedrock or competent saprolite, approximately 1,589 yds^3 would be removed and properly disposed off site. Approximately 785 yds^3 would be excavated under high-probability protocols and 804 yds^3 under low-probability protocols. For disposal, USACE assumed that 75% of the soil would be non-hazardous and 25% of the soil would be hazardous, and that special shoring procedures may be required as the excavation approaches the house.

Access to the property could cost approximately ten percent, at most, of the remedial alternative costs. The costs of periodic reviews are also included.

<u>Outcome</u>: Alternative 3 meets key elements of the effectiveness and implementability criteria and will be retained for the detailed comparative analysis in the next section.

4.3.4 <u>Alternative 4: Remove the House and Cleanup to Recreational Standards; Restricted Future Use (LUCs)</u>

Alternative 4 entails removing the house at 4825 Glenbrook Road and cleaning up the property to a recreational standard, appropriate for use as non-residentially used property (one potential usage, among others, would be a green space). This alternative would incorporate LUCs and allow restricted future use of the property.

Implementation of this alternative would include removing the house completely, including building foundation, and excavating contaminated soil and soil containing MEC, CWM, and AUES-related items from the entire property to a depth determined by the recreational standard. Using backfill, the property would be landscaped and be utilized as a non-residentially used property (one potential usage, among others, would be a green space). However, in accordance with the conclusions of the HHRA, there is no potential risk for recreational receptors. Further, USACE used the MEC HA to evaluate a similar scenario, recommending subsurface MEC clearance to a minimum depth of 3 ft bgs throughout the property, a depth assumed to be sufficient to address remaining MEC down to the recreational standard depth. Therefore, for this alternative, it is proposed that soil be removed to a depth of 4 ft bgs.

Conservatively accounting for MEC and frost heave conditions, a 4 foot depth would also be sufficient to address most utility repair needs. However, as shown on Figure 4, there are known utilities that are greater than 4 ft bgs; the utility corridors would be excavated to the depths shown on the figure. (Note that unless indicated on the figure, utilities are either shallower than 4 ft or have already been cleared through the previous investigations). There are also two remaining areas of soil with arsenic exceeding the 20 mg/kg remediation level that are greater than 4 ft bgs; under this alternative, these arsenic soil areas would also be excavated to the depths shown on the figure.

After the remedial action, LUCs would be implemented to limit all intrusive activities at the remediated property to no deeper than 4 ft bgs (with the exception of utility repair workers). Under this alternative, activities at the property would be limited to non-residentially used activities (one potential usage, among others, would be a green space) and landscape maintenance (e.g., groundskeeping, etc.). With these particular LUCs in effect, fencing would not be necessary.

A periodic review would also be part of this alternative to ensure that USACE is aware of and responds to new information or data that affects the selected response action. A Periodic Review Plan would be prepared describing periodic site visits and stakeholder interviews to determine whether or not the level of risk should be changed. If the level of risk should change, the recommended response alternative would be reviewed to determine if it is still applicable.

Effectiveness: This alternative would be protective of human health and the environment for recreational receptors. It will remove contaminated property soils down to 4 ft bgs thus reducing contaminant mobility, toxicity and volume. Instituting LUCs requires cooperation and coordination between the federal government, state environmental regulators, local governments, private stakeholders and current and future property owners. In order for LUCS to be effective, all parties must consult and work collaboratively to take responsibility for their implementation, management and enforcement.

During implementation of this alternative, controls would be required to ensure the safety of the workers and the community. As discussed in section 3.4.5, work would be performed under low and high probability procedures. Low-probability work involves construction-type excavation activity with standard safety procedures observed. This will include screening and sifting of the soil to ensure no MEC, CWM, or AUES-related items are present. High probability work incorporates significant safety protocols including engineering controls such as working within vapor containment structures. Detailed procedures would be established in the Remedial Design/Remedial Action Work Plan.

Effectiveness in protecting human health and the environment is limited to recreational receptors, and reduction of toxicity, mobility, and volume is only proportional to the recreational standard concentrations removed. The long-term effectiveness of these access restrictions and limitations assumes the cooperation of the owner.

Although the limited removal of soil would allow the removal of any MEC, CWM, or AUES-related items encountered, it may not allow for these items that may potentially exist below those depths to be addressed.

Implementability: This alternative is technically and administratively feasible. The materials and services required to implement this alternative are readily available. While DDOE, USEPA, property owner, and community acceptance has been established for excavation during the previous activities performed throughout the SVFUDS, the administrative feasibility of obtaining approvals from those parties when returning a residential property to restricted usage as a neighborhood park is less certain.

Once remediation is completed, LUCs will be established to prevent excavation more than 4' deep. Usage would be restricted to non-residential uses.

An assessment of technical feasibility includes a formal determination of whether the excavation can be done as a low-probability operation, or a high-probability operation. Figure 3 indicates that Areas A and B would be completed as low-probability while Areas D, E, and F would be excavated under high-probability protocols. As described previously, removal of the house would be done under low-probability protocols to the foundation. Removing the foundation and soil beneath the house would be a high-probability operation.

Cost: The cost to implement this alternative is also significant. If the property was excavated to 4 ft bgs, approximately 1,771 yds^3 would be removed and properly disposed off site. Approximately 1,179 yds^3 would be excavated under high-probability protocols and 592 yds^3 under low-probability protocols. These volumes include the two remaining areas of soil where arsenic exceeds the 20 mg/kg remediation level at depths greater than 4 ft bgs. For disposal, USACE assumed that 75% of the soil would be non-hazardous and 25% would be hazardous and that special shoring procedures that may be required to ensure proper support of the neighboring properties (e.g., fencing and retaining walls).

Access to the property could cost approximately ten percent, at most, of the remedial alternative costs. The cost of periodic reviews is included in the total costs for this alternative.

Outcome: Alternative 4 meets key elements of the effectiveness and implementability criteria and will be retained for the detailed comparative analysis in the next section.

4.3.5 Alternative 5: Remove the House and Cleanup to Residential Standards; Unrestricted Future Use

Alternative 5 entails removing the house at 4825 Glenbrook Road and cleaning up the property to residential standards, and to eliminate unacceptable risk to human health and the environment. Following excavation, the property would be backfilled to approximate original contour and landscaped, resulting in a grassy lot suitable for future residential use.

Implementation of this alternative would include removing the house completely, including building foundation, and excavating contaminated soil and soil containing MEC, CWM, and

AUES-related items from the entire property. Shoring and stabilization techniques would be required to ensure structural integrity of neighboring border fences, retaining walls, etc., when excavating close to those structures. The property would become a grassy lot ultimately suitable for full residential use.

In theory, to meet residential standards, only the areas of arsenic-contaminated soil described in section 1.3.6.1 would need to be removed. Additionally, any munitions or AUES-related items encountered would be removed, with any debris field encountered fully excavated. All MEC will be inspected to determine its explosive or CWM safety status and disposed of per applicable policy and regulations.

However, as described in Section 2.3 and Alternative 3, excavation depth will be to bedrock or competent saprolite rather than just to depth of the soil contamination. Although there will be an over-excavation of soil relative to cleanup goals based on soil contamination alone, the proposed excavation depth would also accomplish the goals of removing any MEC, CWM, or AUES-related items, and achieving a MEC Hazard Level 4 (low potential for explosive hazard conditions). Under this alternative no LUCs would be needed.

Effectiveness: This alternative would be protective of human health and the environment. It will remove the contaminated property soils, MEC, CWM, and AUES-related items, including those beneath the house, by excavating to bedrock or competent saprolite, thus eliminating contaminant mobility, and the toxicity and volume of contaminated soil at the property.

During implementation of this alternative, controls would be required to ensure the safety of the workers and the community. As discussed in section 3.4.5, work would be performed under low and high probability procedures. Low-probability work involves construction-type excavation activity with standard safety procedures observed. This will include screening and sifting of the soil to ensure no MEC, CWM, or AUES-related items are present. High probability work incorporates significant safety protocols including engineering controls such as working within vapor containment structures. Detailed procedures would be established in the Remedial Design/Remedial Action Work Plan.

Implementability: This alternative is technically and administratively feasible. The materials and services required to implement this alternative are readily available. DDOE, USEPA, property owner, and community acceptance has been established for excavation during the previous activities performed throughout the SVFUDS in general and for previous removals at 4825 Glenbrook in particular.

The property would be remediated to residential standards and no LUCs would be required. American University would retain ownership of the property.

An assessment of technical feasibility includes a formal determination of whether the excavation can be done as a low probability operation, or a high probability operation. Figure 3 indicates that Areas A and B would be completed as low probability while Areas D, E, and F would be excavated under high probability protocols. As described previously, removal of the house would be done under low probability protocols to the foundation. Removing the foundation and soil beneath the house down to bedrock or competent saprolite would be a high probability operation.

Cost: The cost to implement this alternative is significant due to the volume of soil to be excavated. Based on excavation to bedrock or competent saprolite, approximately 2,193 yds^3 would be removed and properly disposed off site. Approximately 1,389 yds^3 would be excavated under high-probability protocols and 804 yds^3 under low-probability protocols. For disposal, USACE assumed that 75% of the soil would be non-hazardous and 25% would be hazardous, and that special shoring procedures that may be required to ensure proper support of the neighboring properties (e.g., fencing and retaining walls).

Access to the property could cost approximately ten percent, at most, of the remedial alternative costs.

Outcome: Alternative 5 meets key elements of the effectiveness and implementability criteria and will be retained for the detailed comparative analysis in the next section.

5.0 DETAILED ANALYSIS OF ALTERNATIVES

5.1 Introduction

In Section 4.0 the five remedial alternatives were screened against the three broad criteria of effectiveness, implementability, and cost. Alternative 1 (No Further Action), and Alternative 2 (Land Use Controls), did not pass the broad criteria screening and were not retained for further evaluation. In this section, the remaining three remedial alternatives undergo a detailed analysis that is intended to allow decision makers to select the appropriate response.

During the detailed analysis, each alternative is assessed against the evaluation criteria described below. The results compare the alternatives and identify the key tradeoffs among them. This approach is designed to provide decision makers with sufficient information to adequately compare the alternatives, select the appropriate remedy for the property, and demonstrate satisfaction of the CERCLA remedy selection requirements.

Nine evaluation criteria have been developed by the USEPA to address CERCLA requirements and technical and policy considerations that have proven to be important for selecting among remedial alternatives. These criteria serve as the basis for analyzing proposed remedial alternatives to determine the most appropriate alternatives to address remediation. The nine criteria are divided into three categories; threshold, balancing and modifying. They are as follows:

- Threshold
  - Overall Protection of Public Health and Environment
  - Compliance with ARARs
- Balancing
  - Long-Term Effectiveness
  - Reduction of Toxicity, Mobility and Volume Through Treatment
  - Short-Term Effectiveness
  - Implementability
    - Technical Feasibility
    - Administrative Feasibility
    - Availability of Materials and services
  - Cost
- Modifying
  - State (Regulator) Acceptance
  - Community Acceptance

5.1.1 Threshold Criteria

Assessments against two of the criteria relate directly to statutory findings that must ultimately be made in the Decision Document; therefore, these are categorized as threshold criteria and the remedial alternative chosen must meet the two criteria within this category (USEPA 1988).

5.1.1.1 ***Overall Protection of Public Health and Environment***

This threshold criterion assesses whether each alternative provides adequate protection of human health and the environment. The overall assessment of protection considers assessments conducted under other evaluation criteria, including long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

5.1.1.2 ***Compliance with ARARs***

This threshold criterion is used to determine whether each alternative will meet all of its ARARs (as defined in CERCLA Section 121) that have been identified in Table 2.2. For each alternative, the following should be addressed: compliance with chemical-specific ARARs, location-specific ARARs, and action-specific ARARs, and compliance with other criteria, advisories, or guidance.

5.1.2 **Balancing Criteria**

Balancing criteria are those that form the basis for comparison among alternatives that meet the threshold criteria. The five criteria in this category represent the primary criteria upon which the analysis is based.

5.1.2.1 ***Long-Term Effectiveness***

This criterion addresses the remedial action in terms of the risk remaining at the site after response objectives have been met. The primary focus of this evaluation is the extent and effectiveness of the controls that may be required to manage the risk posed by residuals and/or any untreated wastes. The primary focus of the analysis is on:

- The magnitude of residual risk following completion of the remedial activities; and
- The adequacy and reliability of any controls (e.g., access limitations, deed restrictions, long-term monitoring, etc.) used to manage the treated residuals or untreated wastes that remain at the site.

5.1.2.2 ***Reduction of Toxicity, Mobility or Volume Through Treatment***

Based on USEPA's preference that a chosen removal alternative will reduce toxicity, mobility, or volume through treatment, an alternative must be evaluated based upon the following specific factors:

- The treatment processes employed and the materials it will treat;
- The amount of hazardous materials to be destroyed or treated;
- The degree of reduction expected in toxicity, mobility or volume;
- The degree to which the treatment will be irreversible;
- The type and quantity of residuals that will remain after treatment; and
- Whether the alternative meets the USEPA's preference for treatment.

5.1.2.3 ***Short-Term Effectiveness***

This criterion addresses the effects of an alternative during the implementation phase, until the removal objectives are met. More specifically, each alternative will be evaluated for:

- Protection of the community and workers during the remedial action;
- Adverse environmental impacts resulting from construction and implementation; and
- The time required to meet the remedial objectives.

5.1.2.4 *Implementability*

The implementability criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation. This criterion focuses on analysis of the following sub-criterion factors:

Technical Feasibility

This sub-criterion evaluates the ease of implementing a specific alternative. This criterion evaluates:

- The reliability of the alternative and any technical operational difficulties;
- The reliability of the alternative to complete the remediation without significant schedule delays;
- The ease of conducting additional remedial actions following the initial undertaking; and
- The environmental conditions with respect to set-up, construction and operation of the alternative.

Administrative Feasibility

This sub-criterion focuses on the planning stages for each alternative and includes evaluation of:

- Adherence to non-environmental laws (e.g., siting of a treatment plant in a residential neighborhood);
- Coordinating services needed to carry out an alternative;
- Arranging the delivery of services in a timely manner; and
- Addressing the concerns of other regulatory agencies.

Availability of Materials and Services

This sub-criterion evaluates the following:

- Availability of the personnel needed to perform the operations based on schedule;
- Availability of adequate off-site treatment, storage and disposal for materials; and
- Availability of supporting services (e.g., power lines, laboratory services, etc.).

5.1.2.5 *Cost*

This criterion evaluates projected costs associated with implementing the alternative. These costs include direct capital costs (i.e., costs of the technology or to perform the alternative), indirect capital costs (e.g., design expenses, legal fees, and permit fees), and post remedial site control costs (e.g., monitoring, and operation and maintenance costs). The USEPA RI/FS Guidance (USEPA 1988) indicates that order-of-magnitude cost estimates having an accuracy of -30% to +50% should suffice for the detailed analysis of response alternatives.

5.1.3 Modifying Criteria

The final two criteria will be evaluated following comment on the RI/FS reports and the Proposed Plan and will be addressed once a final decision is being made (USEPA 1988).

5.1.3.1 *State (Regulator) Acceptance*

This criterion evaluates the technical and administrative issues and concerns the state may have for each of the alternatives (for this project, State/Regulator is defined as including both the USEPA and the DDOE). This criterion will be fully addressed in the Decision Document once comments on the RI/FS reports and Proposed Plan have been processed during the public comment period.

5.1.3.2 *Community Acceptance*

This criterion evaluates the issues and concerns the public may have for each of the alternatives. Similar to regulator acceptance, this criterion will be fully addressed in the Decision Document once comments on the RI/FS reports and Proposed Plan have been processed during the public comment period.

5.2 Individual Analysis of Alternatives

The broad screening performed in Section 4.2 against effectiveness, implementability, and cost, eliminated remedial Alternative 1 - No Further Action, and Alternative 2 – Land Use Controls, from further consideration. This section individually evaluates the three remaining alternatives against the nine criteria. The following discussions focus on how, and to what extent, the alternatives address each of the criteria by qualitatively assessing whether the alternative is favorable, moderately favorable, or not favorable, relative to the criterion. Table 5.1 presents the summary of the detailed analysis.

5.2.1 Alternative 3: Cleanup to Residential Standards Without Removing the House; Restricted Future Use (LUCs)

5.2.1.1 *Threshold Criteria*

Alternative 3 is protective of public health and the environment based on the significant volume of soil excavated and the fact that the excavation will remove any MEC, CWM, or AUES-related items encountered, with any debris field encountered fully excavated. All MEC removed will be inspected to determine its explosive or CWM safety status and disposed of per applicable policy and regulations. This alternative assumes the LUCs are effective in preventing contact or interaction with the soil remaining beneath the house.

Alternative 3 was reviewed with respect to compliance with ARARs and TBCs (see Tables 2.1 and 2.2). Chemical-specific TBCs for soil are applicable and focus on ensuring that health-protective cleanup standards are met (CERCLA), that soil is defined appropriately as hazardous or non-hazardous, and that hazardous materials are dealt with in an appropriate manner. This alternative will comply with CERCLA criteria for soil by excavating soils to bedrock or competent saprolite in the 4825 Glenbrook Road property, which will remove a greater volume of soil than would be necessary to meet residential soil cleanup goals, but will allow for any munitions or AUES-related items to be removed. RCRA requirements will be met with Alternative 3.

Location-specific ARARs focus on site-specific characteristics and whether the remedial alternative will impact any sensitive locations or receptors. Because there are no sensitive locations or receptors identified for the property (as discussed in Section 2.2.2), no location-specific ARARs were identified for the property.

Action-specific ARARs will be complied with for Alternative 3. Action-specific ARARs focus on the protection of public health and the environment following completion of remedial activities, such as disposal of soil defined as hazardous under RCRA or other laws pertaining to hazardous wastes or munitions, as listed in Table 2.2.

Alternative 3 is compliant with ARARs and TBCs.

5.2.1.2 *Balancing Criteria*

Alternative 3 is moderately favorable for the long-term effectiveness criterion due to the possible presence of residual risk if contaminated soil, MEC, CWM, or AUES-related items remains beneath the house.

Alternative 3 is moderately favorable in reducing toxicity, mobility and volume of contaminants at the property (with the exception of beneath the house) because while the material is excavated and disposed off site, the preference to permanently and significantly reduce contaminants through treatment may not be met (assuming landfill disposal) as contaminants in the soil will simply transfer to a landfill (note that MEC, CWM, and AUES-related items would not be landfilled).

Alternative 3 is favorable in meeting the short-term effectiveness criterion because the community, workers, and the environment can be protected during implementation. The engineering controls to do this work safely and effectively have been well established for this type of operation in the SVFUDS.

Alternative 3 is moderately favorable in meeting the implementability (technical and administrative feasibility, and availability of materials and services) criterion. Construction and operational considerations and the reliability of the alternative are well established. While all services, materials, and equipment required to perform the excavation are readily available, the technical feasibility sub-criterion is only moderately favorable in that the significant shoring requirements as the excavation nears the house foundation would present challenges. The administrative feasibility sub-criterion is moderately favorable in that it will require extensive coordination with the property owner, regulatory agencies, and surrounding community members.

The cost to implement this alternative is significant due to the volume of soil to be excavated. If the property was excavated to bedrock or competent saprolite, approximately 1,589 yds^3 would be removed and properly disposed off site. Approximately 785 yds^3 would be excavated under high-probability protocols and 804 yds^3 under low-probability protocols.

As detailed in Appendix B, the total estimated cost for Alternative 3 is \$6.5M-\$8.5M. Access to the property could cost approximately ten percent, at most, of the remedial alternative costs.

These estimates are based on the RACER costing software, prior estimates for similar work, sound engineering judgment, and real-world site cost experience provided by USACE.

5.2.1.3 *Modifying Criteria*

Regulator and community acceptance cannot be fully assessed until comments are processed following the public review period on the Proposed Plan. Therefore, these modifying criteria have not been included in this analysis, but will be included following review and input from those parties.

5.2.2 Alternative 4: Remove the House and Cleanup to Recreational Standards; Restricted Future Use (LUCs)

5.2.2.1 *Threshold Criteria*

Alternative 4 provides adequate protection of public health and the environment in that a recreational standard can be achieved following sufficient excavation of contaminated soil and removal of any MEC, CWM, and AUES-related items encountered, and the imposition of restrictions against future intrusive activities. Under this alternative, areas of potential contaminated soil, MEC, CWM, or AUES-related items that are deeper than the depth required to achieve the recreational standard may be present. This alternative assumes that LUCs would effectively limit all intrusive activities to no deeper than 4 ft bgs (with the exception of utility repair workers) to protect potential receptors against possible contaminated soils, MEC, CWM, or AUES-related items that might remain below this depth. Therefore, Alternative 4 is protective of human health and the environment.

Alternative 4 was also reviewed with respect to compliance with ARARs and TBCs. Chemical-specific TBCs for soil are applicable and focus on ensuring that health-protective cleanup standards are met (CERCLA), that soil is defined appropriately as hazardous or non-hazardous, and that hazardous materials are dealt with in an appropriate manner. This alternative would comply with CERCLA criteria for soil by excavation of soils to approximately 4 ft bgs to meet a recreational cleanup goal. RCRA requirements will be met with Alternative 4. Additionally, any MEC, CWM, or AUES-related items encountered would be removed, with any debris field encountered fully excavated. All MEC removed will be inspected to determine its explosive or CWM safety status and disposed of per applicable policy and regulations.

Location-specific ARARs focus on site-specific characteristics and whether the remedial alternative will impact any sensitive locations or receptors. Because there are no sensitive locations or receptors identified for the property (as discussed in Section 2.2.2), no location-specific ARARs were identified for the property.

Action-specific ARARs will be complied with for Alternative 4. Action-specific ARARs focus on the protection of public health and the environment following completion of remedial activities, such as disposal of soil defined as hazardous under RCRA or other laws pertaining to hazardous wastes or munitions, as listed in Table 2.2.

Alternative 4 is compliant with ARARs and TBCs.

5.2.2.2 ***Balancing Criteria***

Alternative 4 is moderately favorable regarding the long-term effectiveness criterion as the alternative could be a permanent solution assuming usage limitations and LUCs can be maintained. However, some residual risk may remain if contaminated soil, MEC, CWM, or AUES-related items are present below the excavation depth. Alternative 4 is also moderately favorable in reducing toxicity, mobility and volume of contaminants at the property because the material is excavated and disposed off site. However, the preference to permanently and significantly reduce contaminants through treatment may not be met (assuming landfill disposal) as the soils contaminants will simply transfer to a landfill (note that MEC, CWM, and AUES-related items would not be landfilled). Finally, there will be no reductions of toxicity, mobility, or volume for any remaining areas of contaminated soil, MEC, CWM, or AUES-related items below the recreational standard depth, if present.

Alternative 4 is favorable in meeting the short-term effectiveness criterion because the community, workers, and the environment can be protected during implementation. The engineering controls to do this work safely and effectively have been well established for this type of operation in the SVFUDS.

Overall, Alternative 4 is favorable in meeting the implementability (technical and administrative feasibility, and availability of materials and services) criterion. Construction and operational considerations and the reliability of the alternative are well established. All services, materials, and equipment required to perform the excavation are readily available. However, Alternative 4 is only moderately favorable for the administrative feasibility sub-criterion because of the coordination requirements with the property owner and supporting agencies to obtain approval as greenspace (one possible use may be a neighborhood park).

The cost to implement this alternative is also significant due to the volume of soil to be excavated. Based on excavation to 4 ft bgs, approximately 1,771 yds^3 would be removed and properly disposed off site. Approximately 1,179 yds^3 would be excavated under high-probability protocols and 592 yds^3 under low-probability protocols.

As detailed in Appendix B, the total estimated cost for Alternative 4 is $10.5M-$12.5M. Access to the property could cost approximately ten percent, at most, of the remedial alternative costs. These estimates are based on the RACER costing software, prior estimates for similar work, sound engineering judgment, and real-world site cost experience provided by USACE.

5.2.2.3 ***Modifying Criteria***

Regulator and community acceptance cannot be fully assessed until comments are processed following the public review period on the Proposed Plan. Therefore, these modifying criteria have not been included in this analysis, but will be included following review and input from those parties.

5.2.3 Alternative 5: Remove the House and Cleanup to Residential Standards; Unrestricted Future Use

5.2.3.1 *Threshold Criteria*

Alternative 5 is protective of public health and the environment in that soil is excavated in the areas shown in Figure 3 down to bedrock or competent saprolite, resulting in the removal of contaminated soil, MEC, CWM, or AUES-related items that might be present. Additionally, any debris field encountered will be fully excavated.

Alternative 5 was also reviewed with respect to compliance with ARARs and TBCs. Chemical-specific TBCs for soil focus on ensuring that health-protective cleanup standards are met (CERCLA), that soil is defined appropriately as hazardous or non-hazardous, and that hazardous materials are dealt with in an appropriate manner. This alternative will comply with CERCLA criteria for soil by excavation of soils to bedrock or competent saprolite and replacing the soil with backfill to meet a residential soil standard. RCRA requirements will be met with Alternative 5. Although digging to bedrock or competent saprolite will result in an over-excavation of soil relative to remediation goals based on soil contamination alone, it may be appropriate as a means of removing MEC, CWM, and AUES-related items, and achieving a MEC Hazard Level 4 (low potential for explosive hazard conditions.

Location-specific ARARs focus on site-specific characteristics and whether the remedial alternative will impact any sensitive locations or receptors. Because there are no sensitive locations or receptors identified for the property (as discussed in Section 2.2.2), no location-specific ARARs were identified for the property.

Action-specific ARARs will be complied with for Alternative 5. Action-specific ARARs focus on the protection of public health and the environment following completion of remedial activities, such as disposal of soil defined as hazardous under RCRA or other laws pertaining to hazardous wastes or munitions, as listed in Table 2.2.

Alternative 5 is compliant with ARARs and TBCs.

5.2.3.2 *Balancing Criteria*

The long-term effectiveness and permanence criterion is met by Alternative 5 as it leaves the least amount of residual risk by excavating all soils down to bedrock or competent saprolite and removing any encountered MEC, CWM, and AUES-related items. Alternative 5 is assessed as only moderately favorable in reducing toxicity, mobility and volume of contaminants because although virtually all the material is excavated and properly disposed off site, the preference to permanently and significantly reduce contaminants through treatment may not be met (assuming landfill disposal) as contaminants in the soils will simply transfer to a landfill (note that MEC, CWM, and AUES-related items would not be landfilled).

Alternative 5 is favorable in meeting the short-term effectiveness criterion because the community, workers, and the environment can be protected during implementation. The engineering controls to do this work safely and effectively have been well established for this type of operation in the SVFUDS.

Alternative 5 is favorable in meeting the implementability (technical and administrative feasibility, and availability of materials and services) criterion. Construction and operational considerations and the reliability of the alternative are well established. All services, materials, and equipment required to perform the excavation are readily available. While the administrative feasibility sub-criterion will require extensive coordination with the property owner, regulatory agencies, and surrounding community members, it is favorable in that there are no LUCs or long term administrative requirements.

The cost to implement this alternative is significant due to the volume of soil to be excavated. Based on excavation to bedrock or competent saprolite, approximately 2,193 yds^3 would be removed and properly disposed off site. Approximately 1,389 yds^3 would be excavated under high-probability protocols and 804 yds^3 under low-probability protocols.

As detailed in Appendix B, the total estimated cost for Alternative 5 is $11.5M-$13.5M. Access to the property could cost approximately ten percent, at most, of the remedial alternative costs. These estimates are based on the RACER costing software, prior estimates for similar work, sound engineering judgment, and real-world site cost experience provided by USACE.

5.2.3.3 *Modifying Criteria*

Regulator and community acceptance cannot be fully assessed until comments are processed following the public review period on the Proposed Plan. Therefore, these modifying criteria have not been included in this analysis, but will be included following review and input from those parties.

5.3 Comparative Analysis of Alternatives

While Section 5.2 described and individually assessed each alternative against the nine criteria, without a consideration of the other alternatives, this section evaluates the relative performance of each alternative in relation to each other. The purpose of this comparative analysis is to identify the advantages and disadvantages of each alternative relative to one another so that the key tradeoffs can be identified.

The most important evaluation is against the threshold criteria, as these must be met. All three alternatives were considered protective of human health and the environment, although Alternative 5 was the most protective of human health and the environment because soil and potential MEC, CWM, and AUES-related items down to bedrock or competent saprolite would be removed.

All three alternatives were compliant with ARARs.

With regard to the balancing criteria, Alternative 3 and Alternative 4 were only moderately effective in the long term as residual risk could remain in the soils remaining beneath the house. Alternative 5 was the most effective in the long term as it is a permanent remedy that leaves the least amount of residual risk at the site.

All three alternatives were ranked as moderately favorable with regard to reducing toxicity, mobility, and volume of contaminants because excavation and off-site disposal (assuming landfill disposal) does not treat the soil contaminants, but transfers them to a proper landfill (note that MEC, CWM, and AUES-related items would not be landfilled, but instead would be destroyed in accordance with the February 2010 Action Memorandum). As assessed by reduction of toxicity, mobility, and volume of contaminants at the property, Alternative 5 is the most favorable because soil and potential MEC, CWM, and AUES-related items are removed to bedrock or competent saprolite. All three alternatives were ranked favorably with regard to short-term effectiveness, as protection of workers and the community – using standard engineering practices – has been previously achieved for excavation and disposal at this property.

Alternative 3 was moderately favorable for the implementability criterion because significant shoring would be required as the excavation nears the house foundation, presenting challenges to the technical feasibility sub-criterion. The administrative feasibility sub-criterion is also moderately favorable in that it will require extensive coordination with the property owner, regulatory agencies, and surrounding community members. Alternatives 4 and 5 were ranked as favorable overall for the implementability criterion because technical feasibility and availability of materials and services are well established for excavation and disposal in the SVFUDS; however, Alternative 4 was only moderately favorable for the sub-criterion of administrative feasibility because of the coordination requirements with the property owner and supporting agencies to obtain approval as greenspace (one possible use may be a neighborhood park). With regard to the implementability of LUCs and/or the acquisition of real estate interests, the difficulty level for Alternatives 3, 4, and 5 are relatively equivalent to each other.

Costs generally are a function of volume of soil to be removed and the procedure required to perform the excavation, i.e., low or high-probability. Excavation under high-probability protocols is more costly that working under low–probability conditions. While all three alternatives include both low and high-probability excavation, Alternative 5 is the most costly of the three alternatives based on the total volume of removal, including soils and house removal. Alternative 3 was the least costly, differing from Alternative 5 in the cost of house removal and excavation of soil beneath the house; Alternative 3 would require excavation of approximately one-half the high-probability soil volume compared to Alternative 5. Alternative 4 falls between the other two alternatives with regard to cost, but is relatively close to Alternative 5 in cost because the high-probability soil volume to be excavated under Alternative 4 is just slightly less than for Alternative 5.

Regulator and community acceptance cannot be fully assessed until comments are processed following the public review period on the Proposed Plan. Therefore, these modifying criteria have not been included in this analysis, but will be included following review and input from those parties.

5.4 Recommended Remedial Action Alternative

Table 5.1 presents the summary of the detailed analysis of remaining alternatives for the 4825 Glenbrook Road property. **Alternative 5, Removing the House and Cleaning up to Residential Standards with Unrestricted Future Use, is the recommended remedial action alternative.** While it is the most expensive alternative, it was ranked as favorable in five out of six of the nine criteria that were ranked (not including the two modifying criteria and cost criterion). The other two alternatives carried over for the detailed analysis have fewer criteria ranked as favorable. Only Alternative 5 was ranked as favorable for the critical long-term effectiveness criterion that leaves the least amount of residual risk at the site. It is protective of human health and the environment, highly implementable, addresses community concerns by removing hazardous materials from the site, and allows for unrestricted use of the property for a future urban resident. Alternative 5 provides the best long term solution for the project by minimizing potential for future risk at the site.

Table 5.1: Summary of Detailed Analysis of Remaining Alternatives

	Screening Criterion	**Alternative 3: Cleanup to Residential Standards Without Removing the House; LUCs**	**Alternative 4: Remove the House and Cleanup to Recreational Standards; LUCs**	**Alternative 5: Remove the House and Cleanup to Residential Standards; Unrestricted Use**
Threshold	Overall Protection of Human Health and Environment	●	●	●
	Compliance with ARARs	●	●	●
Balancing	Long-Term Effectiveness	◑	◑	●
	Reduction of Toxicity, Mobility and Volume Through Treatment[\1]	◑	◑	◑
	Short-Term Effectiveness	●	●	●
	Implementability	◑	●	●
	Technical Feasibility	◑	●	●
	Administrative Feasibility	◑	◑	●
	Availability of Materials and Services	●	●	●
	Cost[\2]	**$6.5 - $8.5 million**	**$10.5 - $12.5 million**	**$11.5 - $13.5 million**
Modifying[\3]	Regulator Acceptance	TBD	TBD	TBD
	Community Acceptance	TBD	TBD	TBD
	Recommended			●

● Favorable (‘YES’ for threshold criteria)

◑ Moderately Favorable

○ Not Favorable (‘NO’ for threshold criteria)

\1 – While excavation and off-site disposal reduce toxicity, mobility, and volume at the property, the statutory preference is permanent reduction through treatment; therefore, assuming landfill disposal, this criterion is not assessed as ‘Favorable’, even where excavation goes to bedrock or competent saprolite.
\2 - Costs are detailed in Appendix B.
\3 – The Modifying criteria of regulator and community acceptance are ‘To Be Determined’ following review and input from these parties.

6.0 REFERENCES

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Appendix A: Site Figures

Data Source: ESRI Street Map 2005

Legend

- Buildings
- Roads
- Spring Valley FUDS
- 4825 Glenbrook Road

US Army Corps of Engineers. BUILDING STRONG.

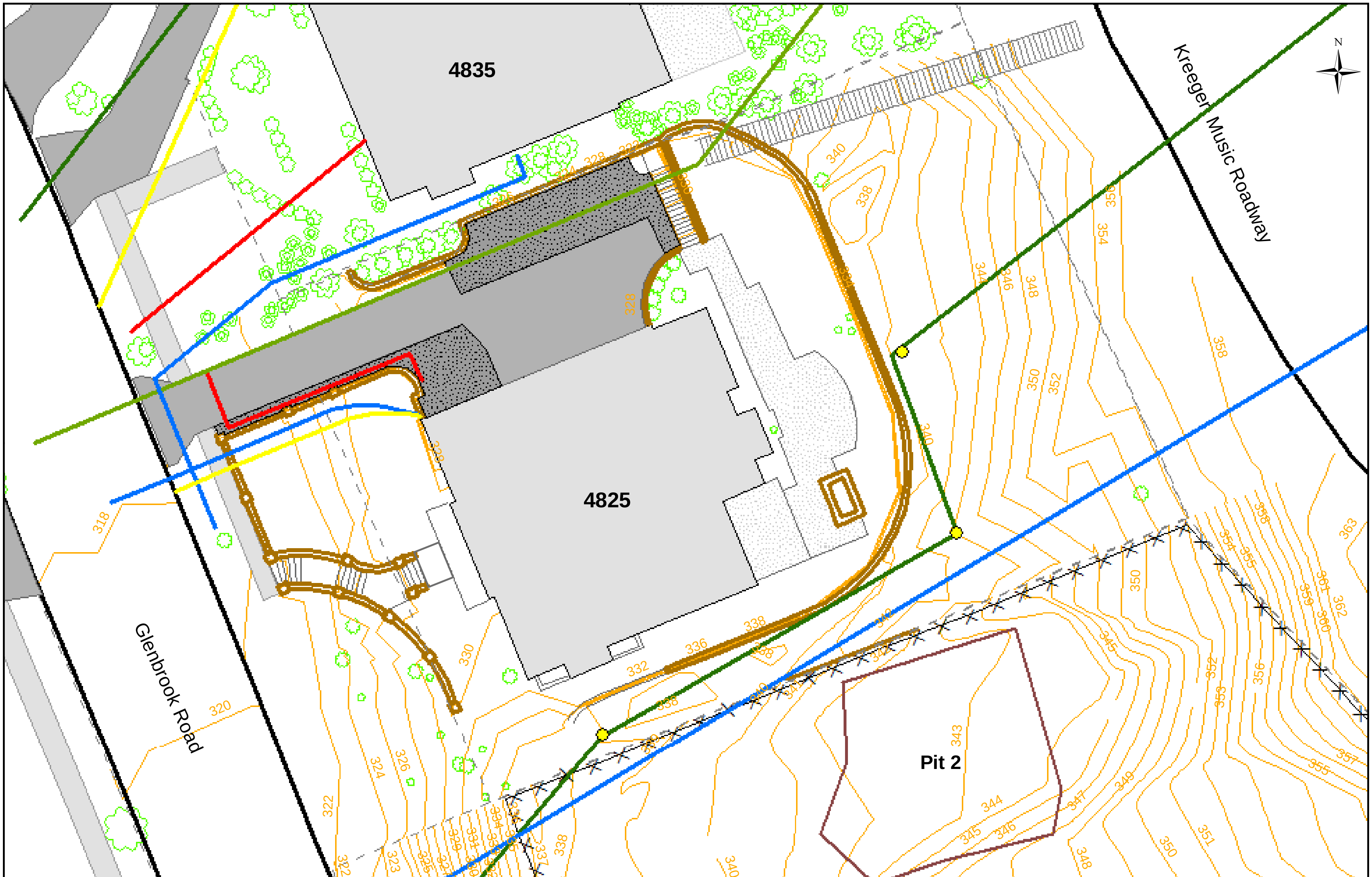
ERT

4825 Glenbrook Road
Feasibility Study
Spring Valley FUDS, Washington, DC

Figure 1
Site Location Map

0 0.25 0.5 Miles

Date:September 2011	Created By: JLB	Verified by: TJB	Approved by: TJB



Legend

- Elevation
- Fence
- Wall
- Roads
- Vegetation
- Manhole
- Gas Line
- Electric Line
- Water Line
- Sanitary Sewer
- Storm Sewer
- Parcels
- Buildings
- Driveway
- Gravel Surface
- Sidewalk
- Deck/Porch

US Army Corps of Engineers
BUILDING STRONG

ERT

4825 Glenbrook Road
Feasibility Study
Spring Valley FUDS, Washington, DC

Figure 2

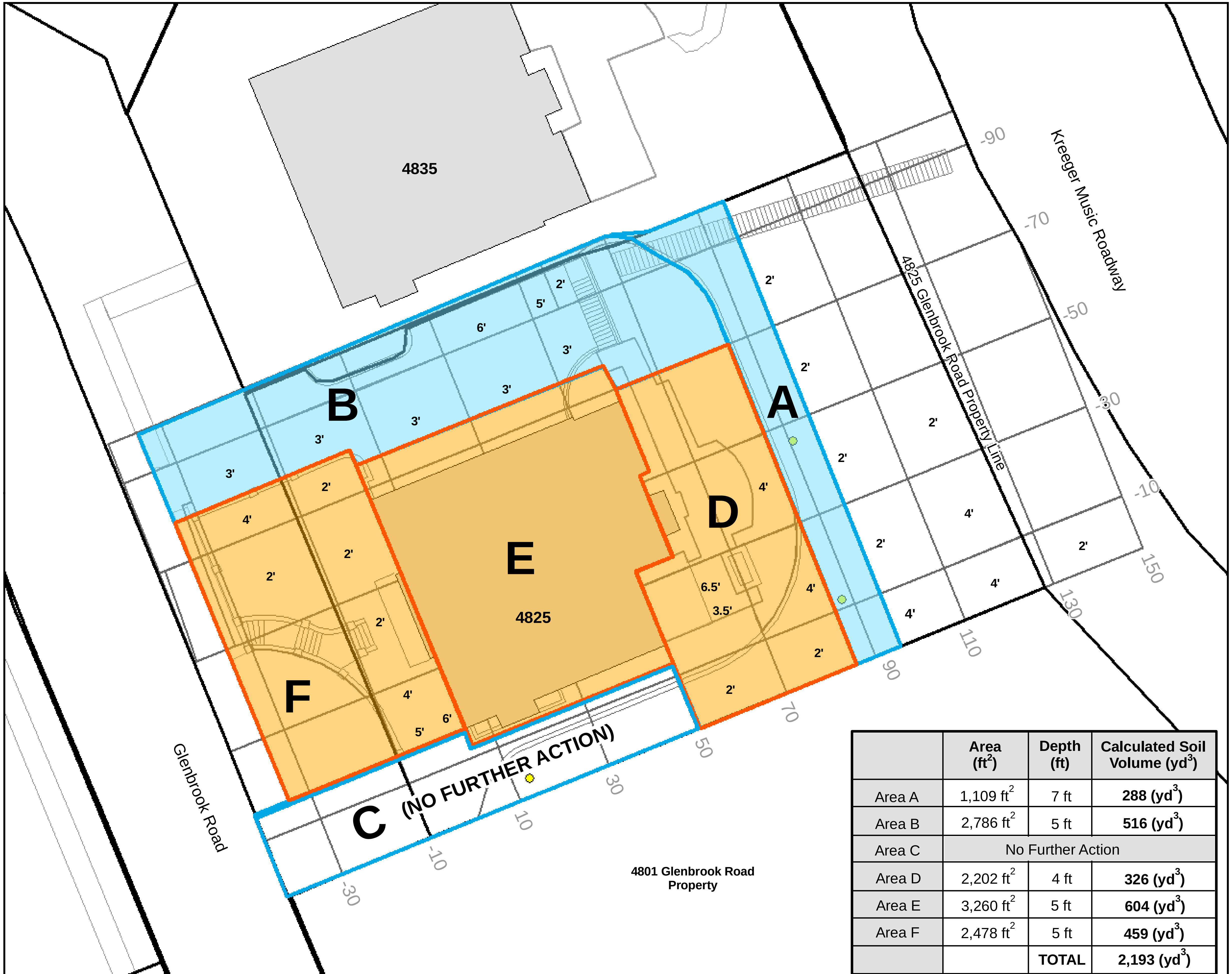
Site Map

0 20 40 Feet

Created By: JLB	Verified by: TJB	Approved by: TJB	Date: September 2011

Figure 3
Response Action Areas at 4825 Glenbrook Road

Spring Valley FUDS
Washington, DC



	Area (ft^2)	Depth (ft)	Calculated Soil Volume (yd^3)
Area A	1,109 ft^2	7 ft	**288 (yd^3)**
Area B	2,786 ft^2	5 ft	**516 (yd^3)**
Area C	No Further Action		
Area D	2,202 ft^2	4 ft	**326 (yd^3)**
Area E	3,260 ft^2	5 ft	**604 (yd^3)**
Area F	2,478 ft^2	5 ft	**459 (yd^3)**
		TOTAL	**2,193 (yd^3)**

Legend

- Property Boundaries
- Buildings
- 20' Grid
- Manhole
- 4' Previous Excavation Depth
- Low-Probability
- High-Probability

0 10 20 40 Feet

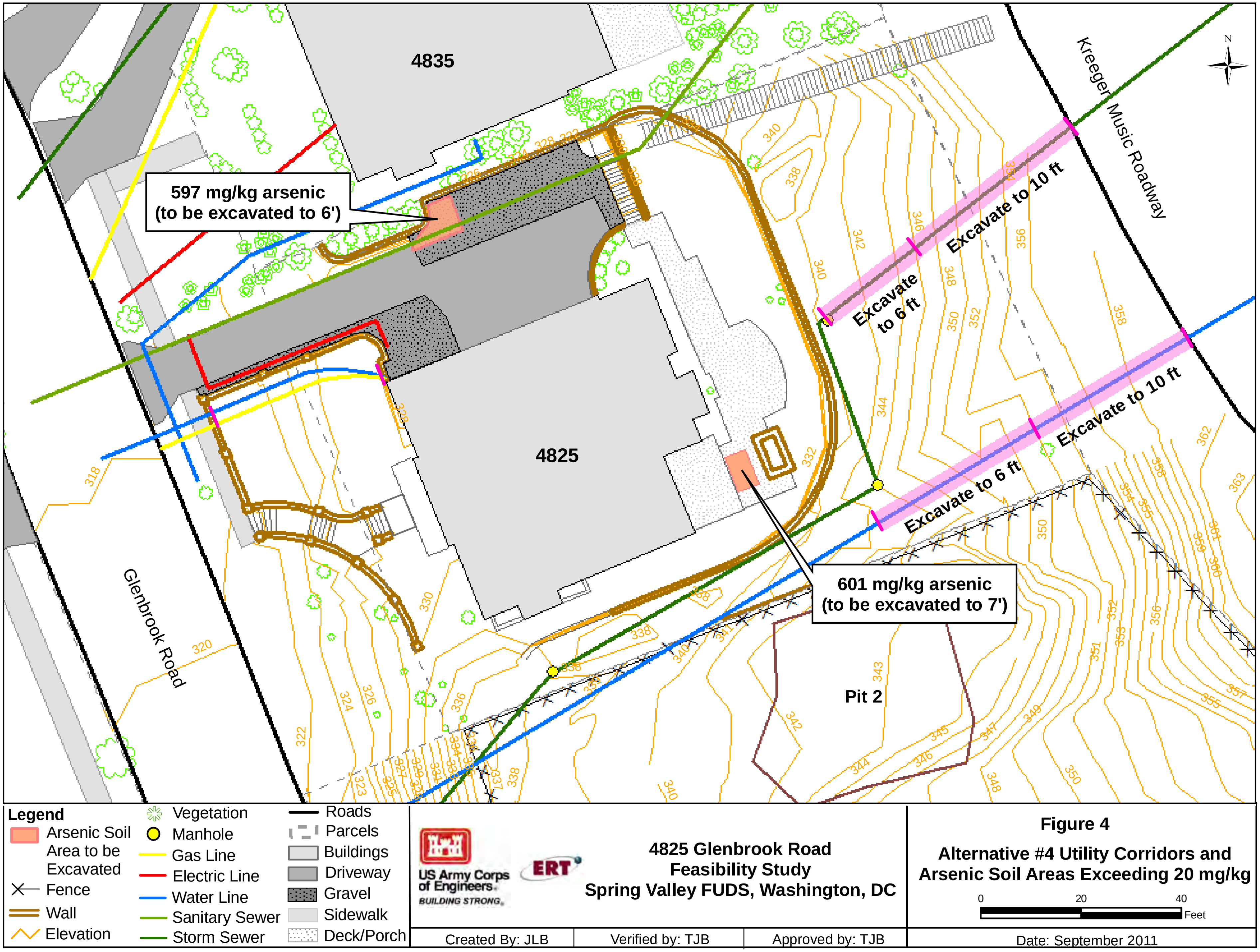
1 inch = 20 feet

N

US Army Corps of Engineers
BUILDING STRONG

ERT

Date:
September 2011



4825 Glenbrook Road
Feasibility Study
Spring Valley FUDS, Washington, DC

Figure 4

Alternative #4 Utility Corridors and Arsenic Soil Areas Exceeding 20 mg/kg

Created By: JLB	Verified by: TJB	Approved by: TJB	Date: September 2011

Appendix B: Costing Backup

4825 GLENBROOK ROAD FEASIBILITY STUDY COSTS - DRAFT-FINAL

Alternative	TOTAL COST SUMMARY		
	Task	**Total per Task**	
Alternative #3 - Cleanup to <u>Residential</u> Standard WITHOUT removing the house	A. PLANNING	$ 555,000	
	B. ADMINISTRATION	$ 253,500	*Implementation through Restoration approximately 29 weeks*
	C. IMPLEMENTATION	$ 6,705,380	
	D. MATERIAL TRANSPORT/DISPOSAL	$ 160,324	
	E. SITE RESTORATION	$ 85,976	
	F. POST REMEDIATION REPORT	$ 21,300	
	TOTAL Alternative #3	**$ 7,781,480**	

Alternative	TOTAL COST SUMMARY		
	Task	**Total per Task**	
Alternative #4 - Remove House and Cleanup to <u>Recreational</u> Standard	A. PLANNING	$ 555,000	
	B. ADMINISTRATION	$ 1,788,250	*Implementation through Restoration approximately 37 weeks*
	C. IMPLEMENTATION	$ 9,060,038	
	D. MATERIAL TRANSPORT/DISPOSAL	$ 178,756	
	E. SITE RESTORATION	$ 93,376	
	F. POST REMEDIATION REPORT	$ 21,300	
	TOTAL Alternative #4	**$ 11,696,720**	

Alternative	TOTAL COST SUMMARY		
	Task	**Total per Task**	
Alternative #5 - Remove House and Cleanup to <u>Residential</u> Standard	A. PLANNING	$ 555,000	
	B. ADMINISTRATION	$ 1,156,750	*Implementation through Restoration approximately 42 weeks*
	C. IMPLEMENTATION	$ 10,362,141	
	D. MATERIAL TRANSPORT/DISPOSAL	$ 221,204	
	E. SITE RESTORATION	$ 118,944	
	F. POST REMEDIATION REPORT	$ 21,300	
	TOTAL Alternative #5	**$ 12,435,339**	

Alternative #3
Detailed Cost Estimate for Excavation and Removal (DO NOT Remove House, Residential Standard)
4825 Glenbrook Road - Spring Valley FUDS

Cost Item					Costs				
	Task/Subtask	**Item**	**Quantity**	**Units**	**Unit Cost**	**Subtotal**			**Total**
A	**PLANNING**								
	-Remediation Design	Plans	1	LS	$ 75,000	$ 75,000		$ -	$ 75,000
	Plans include Chemical Safety Submission	CENAB Review	8	WK	$ 15,000	$ 120,000		$ -	$ 120,000
	and Remedial Action Work Plans required	CEHNC Review	8	WK	$ 15,000	$ 120,000		$ -	$ 120,000
	to address all site activities	TE Review	8	WK	$ 15,000	$ 120,000		$ -	$ 120,000
		ECBC Review	8	WK	$ 15,000	$ 120,000		$ -	$ 120,000
		SUBTOTAL A				**$ 555,000**		**$ -**	**$ 555,000**
B	**ADMINISTRATION**								
	- Access to Property		1	LS	$ 166,250	$ 166,250	$ -	$ -	$ 166,250
	- 5-yr Review (including WP, Site Visit, Report)		1	LS	$ 35,000	$ 35,000			$ 35,000
	- Misc (including minimal LUCs admin costs)		1	LS	$ 52,250	$ 52,250	$ -	$ -	$ 52,250
		SUBTOTAL B				**$ 253,500**		**$ -**	**$ 253,500**
C	**IMPLEMENTATION**								
	- Construction team Mob/Demob		1	LS	$ 5,000	$ 5,000	$ -	$ -	$ 5,000
	- Surveying		5	DAY	$ 1,000	$ 5,000	$ -	$ -	$ 5,000
	- House Demolition		1	LS		$ -	$ -		$ -
	- Shoring/stabilization	Specifics TBD (see assumption)	1	LS	$ 40,000	$ 40,000	$ -		$ 40,000
	- Erosion/Sediment Control	Silt Fence	2000	LF	$ 1.0	$ 2,000			$ 2,000
		Hay Bales	800	LF	$ 8.0	$ 6,400	$ -	$ -	$ 6,400
		Remove Hay Bales	3	TON	$ 400.0	$ 1,200	$ -	$ -	$ 1,200
	- Fencing	Installing as Temporary	1000	LF	$ 20	$ 20,000	$ -		$ 20,000
		Fence Material Allowance	1	LS	$ 10,000	$ 10,000	$ -		$ 10,000
		Reinstall Fence (Labor Only)	1000	LF	$ 8	$ 8,000		$ -	$ 8,000
	- Sample Soil	Analytical Costs	50	EA	$ 250	$ 12,500	$ -		$ 12,500
	- Construction Management	Subcontractor's overhead	1	LS		$ 60,280		$ -	$ 60,280
	- Miscellaneous Equipment Contingencies		1	LS	$ 10,000	$ 10,000		$ -	$ 10,000
	LOW PROBABILITY								
	- Soil Excavation								
	Areas A+B = 804 CY	$5000/day includes 4 man team plus	16	DAY	$ 5,000	$ 80,000	$ -	$ -	$ 80,000
	50 CY/day (five 10 CY trucks/day)	per diem plus $1000/day equipment							
	- ECBC onsite		3	WK	$ 30,000	$ 90,000			$ 90,000
	- Contractor Management		3	WK	$ 10,000	$ 30,000			$ 30,000
	- CENAB Management		3	WK	$ 15,000	$ 45,000			$ 45,000
	- CEHNC Management		3	WK	$ 45,000	$ 135,000			$ 135,000

Alternative #3
Detailed Cost Estimate for Excavation and Removal (DO NOT Remove House, Residential Standard)
4825 Glenbrook Road - Spring Valley FUDS

	HIGH PROBABILITY **- Soil Excavation** Areas D+F = 785 CY assumes 10 CY/day	$15,000/day includes 3 4-man teams including per diem and equipment	79	DAY	$ 15,000	$ 1,185,000		$ -	$ 1,185,000
	- TE onsite		16	WK	$ 70,000	$ 1,120,000			$ 1,120,000
	- ECBC onsite		16	WK	$ 50,000	$ 800,000			$ 800,000
	- Contractor Management		16	WK	$ 45,000	$ 720,000			$ 720,000
	- CENAB Management		16	WK	$ 15,000	$ 240,000			$ 240,000
	- CEHNC Management		16	WK	$ 45,000	$ 720,000			$ 720,000
	- Engineering Control Structure	Specifics TBD (see assumption)	1	LS	$ 200,000	$ 200,000	$ -		$ 200,000
	- Preparation/Set-up/Demobilization								
	- TE onsite	This is 4 weeks on the front end and 4 weeks on the back end for these parties at the low probability weekly rate	8	WK	$ 45,000	$ 360,000			$ 360,000
	- ECBC onsite		8	WK	$ 30,000	$ 240,000			$ 240,000
	- Contractor Management		8	WK	$ 10,000	$ 80,000			$ 80,000
	- CENAB Management		8	WK	$ 15,000	$ 120,000			$ 120,000
	- CEHNC Management		8	WK	$ 45,000	$ 360,000			$ 360,000
	1,589 CY total to excavate, low + high	**SUBTOTAL C**				**$ 6,705,380**		**$ -**	**$ 6,705,380**
D	**MATERIAL TRANSPORT and DISPOSAL**								
	- Non-Hazardous Soil to Landfill (1,192 CY)	$18/ton disp and $25/ton transp	1,788	tons	$ 43	$ 76,884	$ -	$ -	$ 76,884
	- Hazardous Soil to Landfill (397 CY)	$90/ton disp and $50/ton transp	596	tons	$ 140	$ 83,440			$ 83,440
	- 1,589 total CY, assume 75% non-haz and 25% hazardous								
		SUBTOTAL D				**$ 160,324**		**$ -**	**$ 160,324**
E	**SITE RESTORATION**								
	- Backfill Material	Material Only (1589 CY + 10%)	1,748	CY	$ 12	$ 20,976		$ -	$ 20,976
	- Labor (assumes 140 CY/day)	2-1/2 CY Loader w/ Operator	13	DAY	$ 5,000	$ 65,000		$ -	$ 65,000
		SUBTOTAL E				**$ 85,976**		**$ -**	**$ 85,976**
F	**POST REMEDIATION REPORT**								
	-Closure Report	PM	100	hr	$ 100	$ 10,000		$ -	$ 10,000
		Sr Engineer	100	hr	$ 75	$ 7,500		$ -	$ 7,500
		GIS	60	hr	$ 50	$ 3,000		$ -	$ 3,000
		Admin, misc	20	hr	$ 40	$ 800		$ -	$ 800
		SUBTOTAL F				**$ 21,300**		**$ -**	**$ 21,300**

Alternative #3
Detailed Cost Estimate for Excavation and Removal (DO NOT Remove House, Residential Standard)
4825 Glenbrook Road - Spring Valley FUDS

TOTAL COST SUMMARY	
Task	**Total per Task**
A. PLANNING	$ 555,000
B. ADMINISTRATION	$ 253,500
C. IMPLEMENTATION	$ 6,705,380
D. MATERIAL TRANSPORT/DISPOSAL	$ 160,324
E. SITE RESTORATION	$ 85,976
F. POST REMEDIATION REPORT	$ 21,300
TOTAL	**$ 7,781,480**

ASSUMPTIONS		
A.	**PLANNING**	-Assumes a new Chemical Safety Submission will be required.
B.	**ADMINISTRATION**	-Access to Property: Costs are estimates only and are subject to required internal approvals. Furthermore, agreements have not been reached yet with the property owner.
C.	**IMPLEMENTATION**	-Assumes a 1.5 factor for the soil conversion of CY to TON. -Day rate is for 4 man team (3 diggers and one safety). $3000 for 10 hr day, $1000 per diem, $1000 equipment/gas. -Shoring primarily needed as the excavations approach the house; specific engineering procedures to be determined. -50 CY/day soil removed under LOW PROBABILITY and 10 CY/day soil removed under HIGH PROBABILITY -High probability operations will require some type of ECS, details to be determined. -Sampling assumes 50 TAL metals or TCLP samples at $225/sample. -Construction Management Costs: 20% markup on non-labor costs.
D.	**MATERIAL TRANSPORT and DISPOSAL**	-Assumes 75% of soil will be nonhazardous soil and 25% will be hazardous. -Assumes trucks rather than roll-offs.
E.	**SITE RESTORATION**	-Assumes 10% more soil required from backfill to allow for compaction. Assume 140 CY/day.
F.	**POST REMEDIATION ACTIVITIES**	-Assumes a basic closure report that simply describes the activities conducted.

Alternative #4
Detailed Cost Estimate for Excavation and Removal (Remove House, Recreational Standard)
4825 Glenbrook Road - Spring Valley FUDS

Cost Item					Costs				
	Task/Subtask	**Item**	**Quantity**	**Units**	**Unit Cost**	**Subtotal**			**Subtotal**
A	**PLANNING**								
	-Remediation Work Plan	Plans	1	LS	$ 75,000	$ 75,000		$ -	$ 75,000
	Plans include Chemical Safety Submission	CENAB Review	8	WK	$ 15,000	$ 120,000		$ -	$ 120,000
	and Remedial Action Work Plans required	CEHNC Review	8	WK	$ 15,000	$ 120,000		$ -	$ 120,000
	to address all site activities	TE Review	8	WK	$ 15,000	$ 120,000		$ -	$ 120,000
		ECBC Review	8	WK	$ 15,000	$ 120,000		$ -	$ 120,000
		SUBTOTAL A				**$ 555,000**		**$ -**	**$ 555,000**
B	**ADMINISTRATION**								
	- Access to Property (includes, e.g., removal of house)		1	LS	$ 1,662,500	$ 1,662,500	$ -	$ -	$ 1,662,500
	- 5-yr Review (including WP, Site Visit, Report)		1	LS	$ 35,000	$ 35,000			$ 35,000
	- Misc (including minimal LUCs admin costs)		1	LS	$ 90,750	$ 90,750	$ -	$ -	$ 90,750
		SUBTOTAL B				**$ 1,788,250**		**$ -**	**$ 1,788,250**
C	**IMPLEMENTATION**								
	- Construction team Mob/Demob		1	LS	$ 5,000	$ 5,000	$ -	$ -	$ 5,000
	- Surveying		5	DAY	$ 1,000	$ 5,000	$ -	$ -	$ 5,000
	- House Demolition	(see separate tab for additonal detail)	1	LS	$ 60,826	$ 60,826	$ -		$ 60,826
	- Shoring/stabilization	Specifics TBD (see assumption)	1	LS	$ 15,000	$ 15,000	$ -		$ 15,000
	- Erosion/Sediment Control	Silt Fence	2000	LF	$ 1.0	$ 2,000			$ 2,000
		Hay Bales	800	LF	$ 8.0	$ 6,400	$ -	$ -	$ 6,400
		Remove Hay Bales	3	TON	$ 400.0	$ 1,200	$ -	$ -	$ 1,200
	- Fencing	Installing as Temporary	1000	LF	$ 20	$ 20,000	$ -		$ 20,000
		Fence Material Allowance	1	LS	$ 10,000	$ 10,000	$ -		$ 10,000
		Reinstall Fence (Labor Only)	1000	LF	$ 8	$ 8,000		$ -	$ 8,000
	- Sample Soil	Analytical Costs	25	EA	$ 250	$ 6,250	$ -		$ 6,250
	- Construction Management	Subcontractor's overhead	1	LS		$ 70,362		$ -	$ 70,362
	- Miscellaneous Equipment Contingencies		1	LS	$ 10,000	$ 10,000		$ -	$ 10,000
	LOW PROBABILITY								
	- Soil Excavation	**Assumes excavation to 4 ft bgs**							
	Areas A+B+ Utilities = 592 CY	$5000/day includes 4 man team plus	12	DAY	$ 5,000	$ 60,000	$ -	$ -	$ 60,000
	50 CY/day (five 10 CY trucks/day)	per diem plus $1000/day equipment							
	- ECBC onsite		2.5	WK	$ 30,000	$ 75,000			$ 75,000
	- Contractor Management		2.5	WK	$ 10,000	$ 25,000			$ 25,000
	- CENAB Management		2.5	WK	$ 15,000	$ 37,500			$ 37,500
	- CEHNC Management		2.5	WK	$ 45,000	$ 112,500			$ 112,500

Alternative #4
Detailed Cost Estimate for Excavation and Removal (Remove House, Recreational Standard)
4825 Glenbrook Road - Spring Valley FUDS

	HIGH PROBABILITY **- Soil Excavation** Areas D+E+F = 1,179 CY assumes 10 CY/day	**Assumes excavation to 4 ft bgs** $15,000/day includes 3 4-man teams including per diem and equipment	118	DAY	$ 15,000	$ 1,770,000		$ -	$ 1,770,000
	- TE onsite		24	WK	$ 70,000	$ 1,680,000			$ 1,680,000
	- ECBC onsite		24	WK	$ 50,000	$ 1,200,000			$ 1,200,000
	- Contractor Management		24	WK	$ 45,000	$ 1,080,000			$ 1,080,000
	- CENAB Management		24	WK	$ 15,000	$ 360,000			$ 360,000
	- CEHNC Management		24	WK	$ 45,000	$ 1,080,000			$ 1,080,000
	- Engineering Control Structure	Specifics TBD (see assumption)	1	LS	$ 200,000	$ 200,000	$ -		$ 200,000
	- Preparation/Set-up/Demobilization								
	- TE onsite	This is 4 weeks on the front end	8	WK	$ 45,000	$ 360,000			$ 360,000
	- ECBC onsite	and 4 weeks on the back end for	8	WK	$ 30,000	$ 240,000			$ 240,000
	- Contractor Management	these parties at the low probability	8	WK	$ 10,000	$ 80,000			$ 80,000
	- CENAB Management	weekly rate	8	WK	$ 15,000	$ 120,000			$ 120,000
	- CEHNC Management		8	WK	$ 45,000	$ 360,000			$ 360,000
	1,771 CY total to excavate, low + high	**SUBTOTAL C**				**$ 9,060,038**		**$ -**	**$ 9,060,038**
D	**MATERIAL TRANSPORT and DISPOSAL**								
	- Non-Hazardous Soil to Landfill (1,328 CY)	$18/ton disp and $25/ton transp	1,992	tons	$ 43	$ 85,656	$ -	$ -	$ 85,656
	- Hazardous Soil to Landfill (443 CY)	$90/ton disp and $50/ton transp	665	tons	$ 140	$ 93,100			$ 93,100
	- 1,771 total CY, assume 75% non-haz and 25% hazardous								
		SUBTOTAL D				**$ 178,756**		**$ -**	**$ 178,756**
E	**SITE RESTORATION**								
	- Backfill Material	Material Only (1,771 CY + 10%)	1,948	CY	$ 12	$ 23,376		$ -	$ 23,376
	- Labor (assumes 140 CY/day)	2-1/2 CY Loader w/ Operator	14	DAY	$ 5,000	$ 70,000		$ -	$ 70,000
		SUBTOTAL E				**$ 93,376**		**$ -**	**$ 93,376**
F	**POST REMEDIATION REPORT**								
	-Closure Report	PM	100	hr	$ 100	$ 10,000		$ -	$ 10,000
		Sr Engineer	100	hr	$ 75	$ 7,500		$ -	$ 7,500
		GIS	60	hr	$ 50	$ 3,000		$ -	$ 3,000
		Admin, misc	20	hr	$ 40	$ 800		$ -	$ 800
		SUBTOTAL F				**$ 21,300**		**$ -**	**$ 21,300**

Alternative #4

Detailed Cost Estimate for Excavation and Removal (Remove House, Recreational Standard)

4825 Glenbrook Road - Spring Valley FUDS

TOTAL COST SUMMARY	
Task	**Total per Task**
A. PLANNING	$ 555,000
B. ADMINISTRATION	$ 1,788,250
C. IMPLEMENTATION	$ 9,060,038
D. MATERIAL TRANSPORT/DISPOSAL	$ 178,756
E. SITE RESTORATION	$ 93,376
F. POST REMEDIATION REPORT	$ 21,300
TOTAL	**$ 11,696,720**

ASSUMPTIONS		
A.	**PLANNING**	-Assumes a new Chemical Safety Submission will be required.
B.	**ADMINISTRATION**	-Access to Property (includes, e.g., removal of house): Costs are estimates only and are subject to required internal approvals. Furthermore, agreements have not been reached yet with the property owner.
C.	**IMPLEMENTATION**	-For Volume calculations, assumes excavation to 4 ft bgs. -Day rate is for 4 man team (3 diggers and one safety). $3000 for 10 hr day, $1000 per diem, $1000 equipment/gas. -House demolition detail included in RACER House Demo tab. -Shoring stabilization primarily involved with supporting neighboring facilities; specific engineering procedures to be determined. -50 CY/day soil removed under LOW PROBABILITY and 10 CY/day soil removed under HIGH PROBABILITY - Utility corridor excavations deeper than 4 ft bgs are only in backyard as low probability. They are 3 feet wide (see Figure 4). -High probability operations will require some type of ECS, details to be determined. -Sampling assumes 25 TAL metals or TCLP samples at $225/sample. -Construction Management Costs: 20% markup on non-labor costs.
D.	**MATERIAL TRANSPORT and DISPOSAL**	-Assumes 75% of soil will be nonhazardous soil and 25% will be hazardous. -Assumes trucks rather than roll-offs.
E.	**SITE RESTORATION**	-Assumes 10% more soil required from backfill to allow for compaction. Assume 140 CY/day.
F.	**POST REMEDIATION ACTIVITIES**	-Assumes a basic closure report that simply describes the activities conducted.

Alternative #5
Detailed Cost Estimate for Excavation and Removal (Remove House, Residential Standard)
4825 Glenbrook Road - Spring Valley FUDS

Cost Item					Costs				
	Task/Subtask	**Item**	**Quantity**	**Units**	**Unit Cost**	**Subtotal**			**Subtotal**
A	**PLANNING**								
	-Remediation Work Plan	Plans	1	LS	$ 75,000	$ 75,000		$ -	$ 75,000
	Plans include Chemical Safety Submission	CENAB Review	8	WK	$ 15,000	$ 120,000		$ -	$ 120,000
	and Remedial Action Work Plans required	CEHNC Review	8	WK	$ 15,000	$ 120,000		$ -	$ 120,000
	to address all site activities	TE Review	8	WK	$ 15,000	$ 120,000		$ -	$ 120,000
		ECBC Review	8	WK	$ 15,000	$ 120,000		$ -	$ 120,000
		SUBTOTAL A				**$ 555,000**		**$ -**	**$ 555,000**
B	**ADMINISTRATION**								
	- Access to Property (includes, e.g., removal of house)		1	LS	$ 1,066,000	$ 1,066,000	$ -	$ -	$ 1,066,000
	- Misc (including minimal LUCs admin costs)		1	LS	$ 90,750	$ 90,750	$ -	$ -	$ 90,750
		SUBTOTAL B				**$ 1,156,750**		**$ -**	**$ 1,156,750**
C	**IMPLEMENTATION**								
	- Construction team Mob/Demob		1	LS	$ 5,000	$ 5,000	$ -	$ -	$ 5,000
	- Surveying		5	DAY	$ 1,000	$ 5,000	$ -	$ -	$ 5,000
	- House Demolition	(see separate tab for additonal detail)	1	LS	$ 60,826	$ 60,826	$ -		$ 60,826
	- Shoring/stabilization	Specifics TBD (see assumption)	1	LS	$ 15,000	$ 15,000	$ -		$ 15,000
	- Erosion/Sediment Control	Silt Fence	2000	LF	$ 1.0	$ 2,000			$ 2,000
		Hay Bales	800	LF	$ 8.0	$ 6,400	$ -	$ -	$ 6,400
		Remove Hay Bales	3	TON	$ 400.0	$ 1,200	$ -	$ -	$ 1,200
	- Fencing	Installing as Temporary	1000	LF	$ 20	$ 20,000	$ -		$ 20,000
		Fence Material Allowance	1	LS	$ 10,000	$ 10,000	$ -		$ 10,000
		Reinstall Fence (Labor Only)	1000	LF	$ 8	$ 8,000		$ -	$ 8,000
	- Sample Soil	Analytical Costs	50	EA	$ 250	$ 12,500	$ -		$ 12,500
	- Construction Management	Subcontractor's overhead	1	LS		$ 81,215		$ -	$ 81,215
	- Miscellaneous Equipment Contingencies		1	LS	$ 10,000	$ 10,000		$ -	$ 10,000
	LOW PROBABILITY								
	- Soil Excavation								
	Areas A+B = 804 CY	$5000/day includes 4 man team plus	16	DAY	$ 5,000	$ 80,000	$ -	$ -	$ 80,000
	50 CY/day (five 10 CY trucks/day)	per diem plus $1000/day equipment							
	- ECBC onsite		3	WK	$ 30,000	$ 90,000			$ 90,000
	- Contractor Management		3	WK	$ 10,000	$ 30,000			$ 30,000
	- CENAB Management		3	WK	$ 15,000	$ 45,000			$ 45,000
	- CEHNC Management		3	WK	$ 45,000	$ 135,000			$ 135,000

Alternative #5
Detailed Cost Estimate for Excavation and Removal (Remove House, Residential Standard)
4825 Glenbrook Road - Spring Valley FUDS

	HIGH PROBABILITY								
	- Soil Excavation								
	Areas D+E+F = 1,389 CY assumes 10 CY/day	$15,000/day includes 3 4-man teams including per diem and equipment	139	DAY	$ 15,000	$ 2,085,000		$ -	$ 2,085,000
	- TE onsite		28	WK	$ 70,000	$ 1,960,000			$ 1,960,000
	- ECBC onsite		28	WK	$ 50,000	$ 1,400,000			$ 1,400,000
	- Contractor Management		28	WK	$ 45,000	$ 1,260,000			$ 1,260,000
	- CENAB Management		28	WK	$ 15,000	$ 420,000			$ 420,000
	- CEHNC Management		28	WK	$ 45,000	$ 1,260,000			$ 1,260,000
	- Engineering Control Structure	Specifics TBD (see assumption)	1	LS	$ 200,000	$ 200,000	$ -		$ 200,000
	- Preparation/Set-up/Demobilization								
	- TE onsite	This is 4 weeks on the front end	8	WK	$ 45,000	$ 360,000			$ 360,000
	- ECBC onsite	and 4 weeks on the back end for	8	WK	$ 30,000	$ 240,000			$ 240,000
	- Contractor Management	these parties at the low probability	8	WK	$ 10,000	$ 80,000			$ 80,000
	- CENAB Management	weekly rate	8	WK	$ 15,000	$ 120,000			$ 120,000
	- CEHNC Management		8	WK	$ 45,000	$ 360,000			$ 360,000
	2,193 CY total to excavate, low + high	**SUBTOTAL C**				**$ 10,362,141**		**$ -**	**$ 10,362,141**
D	**MATERIAL TRANSPORT and DISPOSAL**								
	- Non-Hazardous Soil to Landfill (1645 CY)	$18/ton disp and $25/ton transp	2,468	tons	$ 43	$ 106,124	$ -	$ -	$ 106,124
	- Hazardous Soil to Landfill (548 CY)	$90/ton disp and $50/ton transp	822	tons	$ 140	$ 115,080			$ 115,080
	- 2193 total CY, assume 75% non-haz and 25% hazardous								
		SUBTOTAL D				**$ 221,204**		**$ -**	**$ 221,204**
E	**SITE RESTORATION**								
	- Backfill Material	Material Only (2193 CY + 10%)	2,412	CY	$ 12	$ 28,944		$ -	$ 28,944
	- Labor (assumes 140 CY/day)	2-1/2 CY Loader w/ Operator	18	DAY	$ 5,000	$ 90,000		$ -	$ 90,000
		SUBTOTAL E				**$ 118,944**		**$ -**	**$ 118,944**
F	**POST REMEDIATION REPORT**								
	-Closure Report	PM	100	hr	$ 100	$ 10,000		$ -	$ 10,000
		Sr Engineer	100	hr	$ 75	$ 7,500		$ -	$ 7,500
		GIS	60	hr	$ 50	$ 3,000		$ -	$ 3,000
		Admin, misc	20	hr	$ 40	$ 800		$ -	$ 800
		SUBTOTAL F				**$ 21,300**		**$ -**	**$ 21,300**

Alternative #5
Detailed Cost Estimate for Excavation and Removal (Remove House, Residential Standard)
4825 Glenbrook Road - Spring Valley FUDS

TOTAL COST SUMMARY		
Task	**Total per Task**	
A. PLANNING	$	555,000
B. ADMINISTRATION	$	1,156,750
C. IMPLEMENTATION	$	10,362,141
D. MATERIAL TRANSPORT/DISPOSAL	$	221,204
E. SITE RESTORATION	$	118,944
F. POST REMEDIATION REPORT	$	21,300
TOTAL	**$**	**12,435,339**

ASSUMPTIONS		
A.	**PLANNING**	-Assumes a new Chemical Safety Submission will be required.
B.	**ADMINISTRATION**	-Access to Property (includes, e.g., removal of house): Costs are estimates only and are subject to required internal approvals. Furthermore, agreements have not been reached yet with the property owner.
C.	**IMPLEMENTATION**	-Assumes a 1.5 factor for the soil conversion of CY to TON. -Day rate is for 4 man team (3 diggers and one safety). $3000 for 10 hr day, $1000 per diem, $1000 equipment/gas. -House demolition detail included in RACER House Demo tab. -Shoring stabilization primarily involved with supporting neighboring facilities; specific engineering procedures to be determined. -50 CY/day soil removed under LOW PROBABILITY and 10 CY/day soil removed under HIGH PROBABILITY -High probability operations will require some type of ECS, details to be determined. -Sampling assumes 50 TAL metals or TCLP samples at $225/sample. -Construction Management Costs: 20% markup on non-labor costs.
D.	**MATERIAL TRANSPORT and DISPOSAL**	-Assumes 75% of soil will be nonhazardous soil and 25% will be hazardous. -Assumes trucks rather than roll-offs.
E.	**SITE RESTORATION**	-Assumes 10% more soil required from backfill to allow for compaction. Assume 140 CY/day.
F.	**POST REMEDIATION ACTIVITIES**	-Assumes a basic closure report that simply describes the activities conducted.

RACER - House Demolition

Remedial Action Cost Engineering and Requirements software (RACERTM), version 10.4

Project: Spring Valley FUDS, 4825 Glenbrook Road
Phase: RI/FS

Subcontracted Portion of Work

	Professional Labor	Material, Labor, Equipment	SubBid	Total
Total Direct Cost	$0	$0	$0	$0
Overhead %	132.00%	25.00%	0.00%	
Overhead	$0	$0	$0	$0
Subtotal	$0	$0	$0	$0
Subcontractor Profit %	8.00%	8.00%	0.00%	
Subcontractor Profit	$0	$0	$0	$0
Total Subcontract Cost	$0	$0	$0	$0

Prime Contractor Portion of Work

	Material, Labor, Equipment Details					
	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Extended Cost
Assembly						
17020103	39,120.00	CF	0	0.12	0.05	6,703.21
Multilevel, Masonry, Nonexplosive, Building Demoltion, Excludes Foundatin Demolition, Excludes Dump Fees						
17020401	1,076.00	EA	20	0	0	21,520.00
Dump Charges						
17030222	15	HR	0	68.96	38.07	1,605.42
926, 2.0, CY, Wheel Loader						
17030287	93	HR	0	64.35	51.37	10,762.33
20 CY, Semi Dump						
Total Cost						**40,591**

	Professional Labor	Material, Labor, Equipment	SubBid	Total
Total Direct Cost	$0	$40,591	$0	$40,591
Overhead %	132.00%	25.00%	0.00%	
Overhead	$0	$10,148	$0	$10,148
Prime Subtotal	$0	$50,739	$0	$50,739
Prime + Subcontract	$0	$50,739	$0	$50,739
Prime Profit %	8.00%	8.00%	8.00%	
Prime Profit Cost	$0	$4,059	$0	$4,059
Prime + Subcontract + Prime Profit	$0	$54,798	$0	$54,798
Other Project Costs				
Contingency %	0.00%	0.00%	0.00%	
Contingency Allowance	$0	$0	$0	$0
Total Contract Cost + Contingency	$0	$54,798	$0	$54,798
Owner Cost %	11.00%	11.00%	11.00%	
Owner Cost	$0	$6,028	$0	$6,028
Total Contract Cost + Contingency + Owner Cost	$0	$60,826	$0	$60,826
Total No-Markup Items				$0
Grand Total				**$60,826**

Date: 4/26/2011
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