DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

June 30, 2021

DAIM-ODB-LO

Ms. Lauren Poulos
U.S. Environmental Protection Agency
Federal Facilities Section R6
1201 Elm Street, Suite 500
Dallas, TX 75202-2102

Re: Final Revised Proposed Plan for LHAAP-47, Plant 3 Area, Solid Rocket Motor Fuel Production Longhorn Army Ammunition Plant, Karnack, Texas

Dear Ms. Poulos,

An electronic copy of the above-referenced document is being transmitted to you for your records.

The document was prepared by HDR Environmental, Operations and Construction, Inc. (HDR) on behalf of the Army as part of HDR's contract for the facility. I ask that Phil Werner, HDR's Project Manager, be copied on any communications related to the project.

The point of contact for this action is the undersigned. I may be contacted at 479-635-0110, or by email at rose.m.zeiler.civ@mail.mil.

Sincerely,

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Copies furnished:
B. Follin, USEPA Region 6, Dallas, TX (1 electronic only)
A. Palmie, TCEQ, Austin, TX (1 electronic only)
A. Williams, USACE, Tulsa District, OK (1 electronic only)
R. Smith, USACE, Tulsa District, OK (1 electronic only) A. Maly, USAEC, San Antonio, TX (1 electronic only)
P. Bruckwicki, Caddo Lake NWR, TX (1 hard copy, 1 CD)
K. Nemmers, Bhate, CNTR (1 electronic only)

DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

June 30, 2021

DAIM-ODB-LO

Ms. April Palmie
Texas Commission on Environmental Quality
Superfund Section MC-136
12100 Park 35 Circle, Bldg D
Austin, TX 78753

Re: Final Revised Proposed Plan for LHAAP-47, Plant 3 Area, Solid Rocket Motor Fuel Production Longhorn Army Ammunition Plant, Karnack, Texas

Dear Ms. Palmie,

An electronic copy of the above-referenced document is being transmitted to you for your records.

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Rose M. Zeiler, Ph.D.
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P. Bruckwicki, Caddo Lake NWR, TX (1 hard copy, 1 CD)
K. Nemmers, Bhate, CNTR (1 electronic only)

Comments Response Matrix
Draft Report: Revised Proposed Plan for LHAAP-47, Building 46A Plant 3 Area,
Solid Rocket Motor Fuel Production, Longhorn Army Ammunition Plant, Karnack, Harrison County, Texas
Submitted: April 20, 2021

Document Submitted by: Rose Zeiler - Longhorn Site Manager
Comments Submitted by: Lauren Poulos- EPA Remedial Project Manager, 6/9/2021
Responded by: Joy Rogalla, HDR
Date Responded: 6/14/2021

1. **Respondent concurs (C) or does not concur (D)**
2. **Commenter agrees (A) or does not agree (D) or there is an exception (E) with response**

Number	Section/Page	Paragraph/Line	Comment	C,D	Response	A,D
Reviewer #1:						
1.	Page 2 Introduction	First paragraph	Was the 2012 Revised Proposed Plan provided for community review and public comment? Consider noting the date(s) here.	C	The first sentence will be revised and a second sentence will be added to address this comment and Comment 3: *The purpose of this Revised Proposed Plan is to present for public review proposed modifications to Alternative 2 for LHAAP-47, which was selected in 2013 (AECOM, 2013). The public comment period was January 1 – January 31, 2013 and the public meeting held January 9, 2013 at the Karnack Community Center in Karnack, Texas (TX). Alternative 2 was selected from among the following Alternatives: Alternative 1 – No Action; Alternative 2 -Excavation, In-situ Bioremediation (ISB), Biobarriers, Monitored Natural Attenuation (MNA), Long-term Monitoring (LTM), Land Use Controls (LUC)s; Alternative 3 - Excavation, Re-circulating ISB, MNA, LTM, LUCs; and, Alternative 4 - Excavation, Pump and Treat, In-situ Bioremediation, MNA, LTM and LUCs. The proposed modifications are…..*	A

Number	Section/Page	Paragraph/Line	Comment	C,D	Response	A,D
2.	Page 2 Introduction	Second paragraph	Minor editorial: Define PP here since first use.		Proposed Plan will be spelled out at each use throughout the document. See TCEQ Comment 2.	A
3.	Page 2	Third paragraph, second sentence	Text states, "The primary purpose of this Revised Proposed Plan is to facilitate public involvement in the technology selection process." Suggested revision: "The purpose of the proposed plan is to highlight key aspects of the RI/FS, provide a brief analysis of remedial alternatives under consideration, identify the preferred alternative, and provide members of the public with information on how they can participate in the remedy selection process."	E	Because this revised proposed plan does not provide a brief analysis of the remedial alternatives (only remedial technologies), the suggested revision is added as a new sentence at the beginning of the paragraph as general information about the purpose of a proposed plan. The sentence following it is modified as follows: This Revised Proposed Plan follows the 2012 Proposed Plan and identifies the preferred remedial technologies that supplement Alternative 2 for the Building 46A area within LHAAP-47.	A
4.	Page 2	Third paragraph, third sentence	Suggested revision: "This Revised Proposed Plan provides the public with the following: new significant information around Building 46A, basic background information about LHAAP-47, a summary of the site risks, the previously selected remedy, alternatives considered, and the rationale for the preferred alternative."	E	The text will be revised as suggested, but the reference to "alternatives considered" is struck: *"This Revised Proposed Plan provides the public with the following: new significant information for the area near Building 46A, basic background information about LHAAP-47, a summary of the site risks, the previously selected remedy, ~~alternatives considered,~~ and the rationale for the revised preferred alternative."*	A

Number	Section/Page	Paragraph/Line	Comment	C,D	Response	A,D
5.	Page 2	Rest of third paragraph	The text states "The preferred technology for Building 46A is in-situ thermal desorption (ISTD) for residual DNAPL in groundwater and excavation for TCE in soil, if necessary, following ISTD. The Modified Alternative 2 is excavation, ISTD, enhanced in-situ bioremediation (EISB), biobarriers, monitored natural attenuation (MNA) and land use controls (LUCs)." It may be unclear to the reader why this Revised Proposed Plan is specifying a preferred technology in addition to the preferred alternative. Typically, Proposed Plans just identify preferred alternatives which will include the selected remedy components (i.e., excavation, ISTD, LUCs, etc). The **Scope and Role of the Response Supplemental Proposed Action** (Page 11) states that "By instituting an ISTD of the groundwater near Building 46A, this active treatment will be applied to the highest concentration areas in the TCE groundwater plumes and soil … Suggested revised text: "The preferred technology for Building 46A is in-situ thermal desorption (ISTD) for residual DNAPL in groundwater and unsaturated soil near Building 46. If necessary, excavation of TCE soil hot spots will follow ISTD."	C	The text will be revised as suggested.	A

Number	Section/Page	Paragraph/Line	Comment	C,D	Response	A,D
6.	Page 2	Second column, first paragraph	Might need some clarification here since text states the preferred technology is ISTD, but then describes Modified Alternative 2. Maybe say the original PP for Alternative 2 was EISB, etc, but now modified alternative 2 is the preferred with ISTD.	C	The following text has been added before the identification of the preferred technology (now on pg. 3): "*The 2013 Draft Final ROD included ISB to remediate the TCE in groundwater near Building 46A, however, additional investigation identified the presence of residual DNAPL, and EISB would not be effective because the higher TCE concentrations would inhibit microbial activity. Therefore, additional technologies that would be suitable to treat the DNAPL must be considered.*"	A
7.	Page 2	Second column, second paragraph	Change Section 300.430(f)(2), to "Section 300.430(f)(2) and (3)." Note that § 300.430(f)(3)(ii) states that after publication of the Proposed Plan and prior to the adoption of the Selected Remedy in the ROD, if new information is made available that significantly changes the basic features of the remedy with respect to scope, performance, or cost, such that the remedy significantly differs from the original proposal in the Proposed Plan and the supporting analysis and information, the lead agency must: Seek additional public comment on a revised Proposed Plan, when the lead agency determines the change could not have been reasonably anticipated by the public based on the information available in the Proposed Plan or the supporting analysis and information in the Administrative Record file. The lead agency must, prior to adoption of the Selected Remedy in the ROD, issue a revised Proposed Plan, which must include a discussion of the significant changes and the reasons for such changes.	C	The text will be revised as suggested. Clarification: Does EPA suggest this text be added?	A
8.	Page 3	Third paragraph	Please add reference to text for RI report (Jacobs ??)	C	Reference is added	

Number	Section/Page	Paragraph/Line	Comment	C,D	Response	A,D
9.	Page 4	Second paragraph	The text states, "Finally, an evaluation of the preferred technology and a summary of the modified Alternative 2 are presented." It may be unclear to the reader why the Proposed Plan is specifying a preferred technology and modified Alternative. Consider reiterating the original PP had a preferred Alternative 2, but now modified alternative 2 is the preferred with ISTD.	C C	The text will be revised as stated. The text will be revised as recommended.	A
10.	Page 5	First column, last paragraph	Change the NPL listing date to, "August 30, 1990." *See* 55 Fed. Reg. 35509. The August 9 date is incorrect.	C	The date is changed as stated.	A
11.	Page 5	Second column, second paragraph	For the publics information consider including a general depth for shallow, upper intermediate, and intermediate. Suggest not capitalizing these zones.	C	The text will be changed as stated.	A
12.	Page 5	Last paragraph, bottom of page	Suggest adding references to all of the Jacobs reports.	C	The Phase I-II investigations and additional investigations conducted from 1996-2001 were all reported in the RI report. This information has been added to the paragraph describing the RI.	A
13.	Page 6	First column, last paragraph	Change 40 CFR 300.430(D)(4), to "40 CFR 300.430(d)(4)."	C	The text will be changed as stated.	A
14.	Page 6	2nd column, third paragraph	Suggest changing COC on acronym page to Contaminants of Concern instead of Chemical of Concern or adjust text to Chemical of Concern for consistency throughout document(s).	C	To be consistent with EPA guidance, COC will be defined as contaminant of concern.	A
15.	Page 6	Last paragraph, second column	Figure 5 shows shallow and upper immediate contamination, but previously, intermediate contamination is mentioned. The site characterization section the text discusses four zones, one with an additional second name (i.e., upper intermediate). For clarity for the public, consider adding some text here explaining contamination in each zone.	C	The 3rd paragraph of the Site Characteristics section has been revised to include a description of the groundwater zones as defined in the RI and modified based on PSI results.	A
16.	Page 12	Second column, second paragraph	Add citation for TCEQ values. Reference is already in reference section.	C	The citation has been added.	A

Number	Section/Page	Paragraph/Line	Comment	C,D	Response	A,D
17.	Page 13	Table 2	If possible, suggest some edits to the table to keep from having headers such as Background getting cut off. No need for units on perchlorate (first COC listed) since already in header. Might want to list background reference in notes at bottom. Define TRRP in Notes section, and remove NE since it's not used in table.	C	The table formatting has been revised as requested in TCEQ comment 8 to include headings for classes of chemicals, alphabetize the chemicals, adjust the column headings, and indicate whether the value cited is the MCL, PCL, or background.	A
18.	Page 13	Table 2 Groundwater Chemicals of Concern	Table includes eight chemicals (silver, vanadium, antimony, cadmium, bis(2-ethylhexyl)phthalate, 2,4,6-Trinitrotoluene, 2,4-Dinitrotoluene, 2,6-Dinitrotoluene) with the Maximum Concentration listed as NA (not analyzed). If these chemicals were not analyzed for, why are they listed as a Groundwater COCs? The maximum concentrations for multiple chemicals are less than the MCL/TRRP PCL/Background concentrations. Why are these chemicals listed as Groundwater COCs?	C	These chemicals were included as COCs in the 2013 DF ROD based on risk assessment results or previous samples that had one or more historical detections greater than MCLs or GW-Ind (silver, vanadium, antimony, cadmium, BEHP, 2,4-DNT, 2,6-DNT, or had a HQ greater than 0.1 (2,4,6-TNT). Table 2 has been revised to include the prior maximum concentrations with a note to indicate the results were for samples prior to the PSI. The following has been added to the groundwater COC discussion: *" Chemicals that were not analyzed during the PSI but were previously identified as COCs in the DF ROD have been retained based on historical MCL or TCEQ groundwater medium specific concentration (MSC) for industrial use (GW-Ind) exceedances or showed Hazard Quotients greater than 0 in the BHHRA."*	A
19.	Page 14	First column, fourth paragraph	Minor editorial comment: The acronym NAPL is introduced here, but DNAPL has been defined before, so suggest just us DNAPL here or if not add NAPL to acronym list.	C	NAPL has been added to the acronym list. It is included as part of the description for steam enhanced extraction technology.	A
20.	Page 14	Second column, second paragraph	Please add SVE to acronym list.	C	The acronym has been added.	A
21.	Page 16	First column, section 5	Please add GWTP to acronym list.	C	The acronym has been added.	A

Number	Section/Page	Paragraph/Line	Comment	C,D	Response	A,D
22.	Page 16	Second column, section 9	The text states, "Community acceptance of the preferred supplemental technology will be evaluated after the public comment period ends and will be described in the revised Draft Final ROD for the site." Suggested revised text: "Community acceptance of the preferred supplemental technology will be evaluated after the public comment period ends and will be described in the Final ROD for the site."	C	The text has been revised as requested.	A
23.	References		Suggest removal of references not cited in PP: AGEISS 2014, and Lyntech, 2001	C	The references have been removed.	A
24.	Acronyms		Suggest removal ones not used in PP include: DNT, ECP, GWing, LTM, TCLP, and TNT	C	LTM has been retained since it is included in the document. All other acronyms cited have been removed.	A
25.	General comment		It appears that the TCE-contaminated soil will be excavated if the ISTD treated soil remains at levels not amenable to MNA. Just to confirm, that level is TCE – 0.5, GWP-Ind MSC (mg/kg), correct?	C	The TCE GWP-Ind is 0.5 mg/kg as noted.	A
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Comments Response Matrix
Draft Report: Revised Proposed Plan for LHAAP-47, Building 46A Plant 3 Area,
Solid Rocket Motor Fuel Production, Longhorn Army Ammunition Plant, Karnack, Harrison County, Texas
Document Submitted for Review: April 20, 2021

Document Submitted by: Rose Zeiler – Longhorn Site Manager
Comments Submitted by: April Palmie, TCEQ, 6/2/2021
Draft Final Comments Submitted by; April Palmie, TCEQ, 6/17/2021
Responded by: Joy Rogalla, HDR
Date Responded: 6/9/2021, 6/21/2021

1. **Respondent concurs (C) or does not concur (D)**
2. **Commenter agrees (A) or does not agree (D) or there is an exception (E) with response.**

Number	Section/ Page	Paragraph /Line	Comment	C,D	Response	A,D	Draft Final Comment	C,D	Draft Final Response
Reviewer #1: April Palmie, TCEQ									
1.	Pg. 2	Public notice box	a) Where do they submit written comments? I see it on comment form, last page, but please include in the box too. b) Consider adding "For further information" box with Rose's contact information. c) Could also reference comments form on last page of proposed plan.	C	a) Comment submittal information has been added to the notice box on pg. 1. b) Contact information for Rose Zeiler has been added. c) Reference to the comment form has been added.	A			

Number	Section/ Page	Paragraph /Line	Comment	C,D	Response	A,D	Draft Final Comment	C,D	Draft Final Response
2.	Intro, pg. 2		a) First sentence - Correct selection date 2011 to 2013. Remedy was selected in DF ROD 2013. b) 2nd paragraph - Please don't use PP as acronym for Proposed Plan. c) 3rd paragraph – please revise this sentence "This Revised Proposed Plan provides the public with new information for the area near Building 46A, as well as basic background information about LHAAP-47. The Revised Proposed Plan also identifies the previously selected remedy and the preferred additional technology needed to protect human health and the environment from the contamination detected in soil and groundwater at Building 46A. It also explains the rationale for the preferred remedy and describes other technologies considered." Or similar.	C C E	a) The date has been revised as requested. b) Proposed Plan is spelled out. c) The text has been revised with some of the suggested modifications. The text has also been revised to address USEPA comment 4 on the same paragraph: *"This Revised Proposed Plan provides the public with the following: new significant information for the area near Building 46A, basic background information about LHAAP-47, a summary of the site risks, the previously selected remedy, and the rationale for the revised preferred alternative."*	A			

Number	Section/ Page	Paragraph /Line	Comment	C,D	Response	A,D	Draft Final Comment	C,D	Draft Final Response
3.	Intro, pg. 3		2nd complete paragraph: a) Can you put Figure 1 before this paragraph? It is referenced in 1st full paragraph on page. b) RI Report needs a date. c) Revise to Marshall Public Library (remove ", Texas") d) Fix break after word "Environmental"	E C C C	a) The figure follows at the top of the next page because there isn't sufficient space to retain the same figure size after changing the two column formatting in the middle of the page. b) The RI report reference for Jacobs, 2002 has been added. c) The text has been revised as requested d) The formatting has been corrected.	A/D	Please remove the comma in "Marshall Public Library"	C	The comma has been removed.
4.	Pg. 5		Figure 2 is not very clear. Please insert a higher resolution image.	C	The figure has been replaced with a higher resolution site location figure.	A			
5.	COC list pg. 10		a) Please add headings (Anions, Metals, Volatile Organic Compounds, Semivolatile Organic Compounds, and Explosives) between types of COCs. b) List alphabetically within types. c) List in same order on pgs. 10 and 13.	C C C	a) Headings have been added b) The contaminant order has been alphabetized. c) The lists on both pages have been revised to be consistent.	A/D	In COC lists put "Anions" below "Soil" as shown above in the groundwater section.	C	The text has been revised as requested.
6.	Pg. 11	Scope	First sentence revise to "hypothetical future maintenance worker"	C	The text has been revised as requested.	A			
7.	Pg. 12	Soil, 2nd paragraph	First use of MSC – please don't capitalize Medium (for consistency)	C	The text has been revised as requested.	A			

Number	Section/ Page	Paragraph /Line	Comment	C,D	Response	A,D	Draft Final Comment	C,D	Draft Final Response
8.	Pg. 13	Table 2	a) Thank you for including this table. It will help for the ROD. b) Fix wrapping on column headings. c) Please add headings (Anions, Metals, Volatile Organic Compounds, Semivolatile Organic Compounds, and Explosives) between types of COCs. d) List alphabetically within types. e) List in same order on pgs. 10 and 13. f) Assuming you re-sort, check the numbers to make sure they are correct for the COC. g) TRRP PCLs should be from most recent table (January 2021). h) Add note to distinguish between MCL and PCL. i) Remove NE	C C C C C C C C C	a) Thank you b) Column formatting has been adjusted c) Headings have been added for classes of compounds d) The order has been revised and is consistent with the COC list on p. 10. e) The order has been revised to be consistent. f) The values have been confirmed with current MCLs and PCLs, date for PCL table has been updated in the notes. g) Values have been checked against current tables from TCEQ and EPA. h) The source of the values has been added to the table entries and notes identify MCL, PCL, or background. i) NE has been removed.	A/D	Table 2, remove ug/L after 38,400 shown for perchlorate. Also a few metals not in alphabetical order. Revise this note (first use of PCL)– from "TRRP PCL from January 2021 TRRP PCLs" to "TRRP Protective Concentration Levels (PCLs) from January 2021 TRRP PCL tables" Revise note 3 from "TRRP PCL" to "TRRP Tier 1 PCL for residential groundwater use". Need to say at least once <u>which</u> PCL is referenced.	C	The units have been removed from the perchlorate entry The order for metals has been revised to be in alphabetical order. The note has been revised as requested. Note 3 has been revised as requested.
9.	Pg. 17	Summary	First sentence, LUCs listed twice, suggest removing first use. Second use change to LUCs for soil and groundwater.	C	The first use of LUCs has been deleted and the LUC reference revised to include both soil and groundwater.	A			

Number	Section/ Page	Paragraph /Line	Comment	C,D	Response	A,D	Draft Final Comment	C,D	Draft Final Response
10.	Glossary of Terms, pg. 20		For most terms listed, define the term and include acronym. If glossary just has the **acronym**, add the full name. If term is used as acronym in text, add acronym here. Format examples: **Applicable or Relevant and Appropriate Requirements (ARARs)** - Refers to the federal and state requirements that a selected remedy will attain. **Remedial Design (RD)** - The phase of the CERCLA process that follows the selection of a …	C	The glossary has been revised to spell out the terms and include the acronym where applicable.	A			
Draft Final Comments – 6/17/2021									
1	8						There is one capitalized "Zones" near end of first paragraph – change to lowercase.	C	The text has been revised as requested.

FINAL

REVISED

PROPOSED PLAN

FOR LHAAP-47

PLANT 3 AREA, SOLID ROCKET MOTOR FUEL PRODUCTION

LONGHORN ARMY AMMUNITION PLANT, KARNACK, TEXAS

ISSUED BY: U.S. ARMY

Longhorn Army Ammunition Plant

Karnack, Texas

June 2021

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List of Figures

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INTRODUCTION

The purpose of this Revised Proposed Plan is to present for public review proposed modifications to Alternative 2 for LHAAP-47, which was selected in 2013 after public review (AECOM, 2013). The public comment period was January 1 – January 31, 2013 and the public meeting held January 9, 2013 at the Karnack Community Center in Karnack, Texas (TX). Alternative 2 was selected from among the following Alternatives: Alternative 1 – No Action; Alternative 2 - Excavation, In-situ Bioremediation (ISB), Biobarriers, Monitored Natural Attenuation (MNA), Long-term Monitoring (LTM), Land Use Controls (LUCs); Alternative 3 -Excavation, Re-circulating ISB, MNA, LTM, LUCs; and, Alternative 4 - Excavation, Pump and Treat, ISB, MNA, LTM and LUCs. The proposed modifications are necessary to address significant new information at LHAAP-47. This Revised Proposed Plan supplements the Proposed Plan completed in 2012 (AECOM, 2012) and incorporates the results of the 2021 Addendum to the 2011 Feasibility Study (FS) (HDR, 2021a).

Investigations were conducted in 2018 - 2020 to address aging data and a prolonged drought in an effort to inform the 2013 Draft Final Record of Decision (ROD) prior to signature. The investigations revealed the presence of trichloroethylene (TCE) in soil and residual TCE Dense Non-aqueous Phase Liquid (DNAPL) in groundwater around Building 46A, conditions not addressed by the previous FS and Proposed Plan. The FS Addendum was prepared to screen and evaluate additional remedial technologies that would address the residual TCE DNAPL in groundwater and TCE in soil.

Dates to remember: July 7, 2021 to August 6, 2021

MARK YOUR CALENDER
PUBLIC COMMENT PERIOD:

July 7, 2021 to August 6, 2021

The U.S. Army will accept written comments (see comments form at the end of this Revised Proposed Plan) on the Proposed Plan during the public comment period. Comments should be mailed to Dr. Rose M. Zeiler, P.O. Box 220, Ratcliff, Arkansas 72951 or emailed to the U.S. Army via at the following e-mail address: rose.m.zeiler.civ@mail.mil.

PUBLIC MEETING: The U.S. Army will hold a public meeting to explain the Revised Proposed Plan for LHAAP-47. Oral and written comments will be accepted at the meeting. The meeting will be held on July 21, 2021 from 6:00 p.m. to 7:30 p.m. at Caddo Lake State Park.

For more information, see the Longhorn AAP website: http://www.longhornaap.com/, contact Dr. Rose M. Zeiler at the email address provided above, or visit the Administrative Record at the following location:

Marshall Public Library
300 S. Alamo
Marshall, Texas 75670
Business Hours:
Monday - Friday (9:30 AM – 5:30 PM)

The purpose of a proposed plan is to highlight key aspects of the Remedial Investigation (RI)/FS, provide a brief analysis of remedial alternatives under consideration, identify the preferred alternative, and provide members of the public with information on how they can participate in the remedy selection process. This Revised Proposed Plan follows the 2012 Proposed Plan and identifies the preferred remedial technologies that supplement Alternative 2 for the Building 46A area within LHAAP-47.

This Revised Proposed Plan provides the public with the following: new significant information for the area near Building 46A, basic background information about LHAAP-47, a summary of the site risks, the previously selected remedy, and the

rationale for the revised preferred alternative. The Revised Proposed Plan also identifies the previously selected remedy and the preferred additional technology needed to protect human health and the environment from the contamination detected in soil and groundwater at Building 46A. It also explains the rationale for the preferred remedy, and describes other technologies considered.

The 2013 Draft Final ROD included ISB to remediate the TCE in groundwater near Building 46A, however, additional investigation identified the presence of residual DNAPL, and ISB would not be effective because the higher TCE concentrations would inhibit microbial activity. Therefore, additional technologies that would be suitable to treat the DNAPL must be considered. The preferred technology for Building 46A is in-situ thermal desorption (ISTD) for residual DNAPL in groundwater and unsaturated soil near Building 46A. If necessary, excavation of TCE hot spots will follow ISTD. The Modified Alternative 2 is excavation, ISTD, EISB, biobarriers, MNA and LUCs.

The U.S. Army is issuing this Revised Proposed Plan for public review, comment, and participation to fulfill part of its public participation responsibilities under Section 117(a) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, and under Section 300.430(f)(2) and (3) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 Code of Federal Registry Part 300).

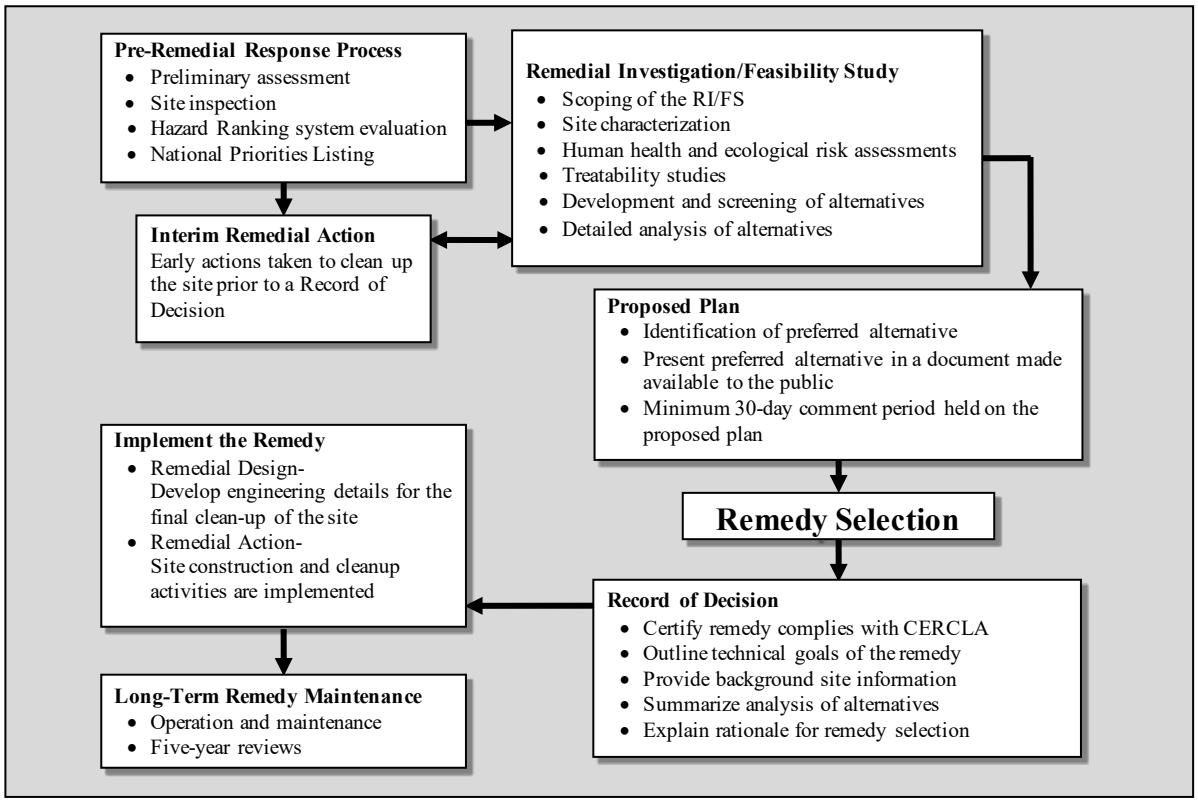
CERCLA prescribes a step-wise progression of activities to respond to risk posed by contaminated sites **(Figure 1)**.

The preparation and review of a Proposed Plan is a distinct step required by CERCLA. This Revised Proposed Plan provides background information that can be found in greater detail in the Remedial Investigation (RI) Report (Jacobs, 2002), Post-Screening Investigation (PSI) Report (HDR, 2019) and PSI No. 2 Addendum Report (HDR, 2021b), Final Feasibility Study for LHAAP-47 (Shaw, 2011), Feasibility Study Addendum (HDR, 2021a) and other supporting documents. These documents are contained in the LHAAP-47 Administrative Record which is publicly available in the Marshall Public Library and on the Longhorn AAP Environmental Restoration Program website http://www.longhornaap.com/.

The project management team, including the U.S. Army, U.S. Environmental Protection Agency (USEPA), and the Texas Commission on Environmental Quality (TCEQ), encourages the public to review these documents and comment on the technologies presented in this Proposed Plan.

The U.S. Army is acting in partnership with USEPA Region 6 (lead oversight agency) and TCEQ (support agency). As the lead agency for environmental response actions at LHAAP, the U.S. Army is charged with planning and implementing remedial actions at LHAAP. The regulatory agencies assist the U.S. Army by providing technical support, project review, project comment, and oversight in accordance with CERCLA and the NCP as well as the Federal Facility Agreement (FFA).

Figure 1. CERCLA Remedial Response Process for Site Cleanup

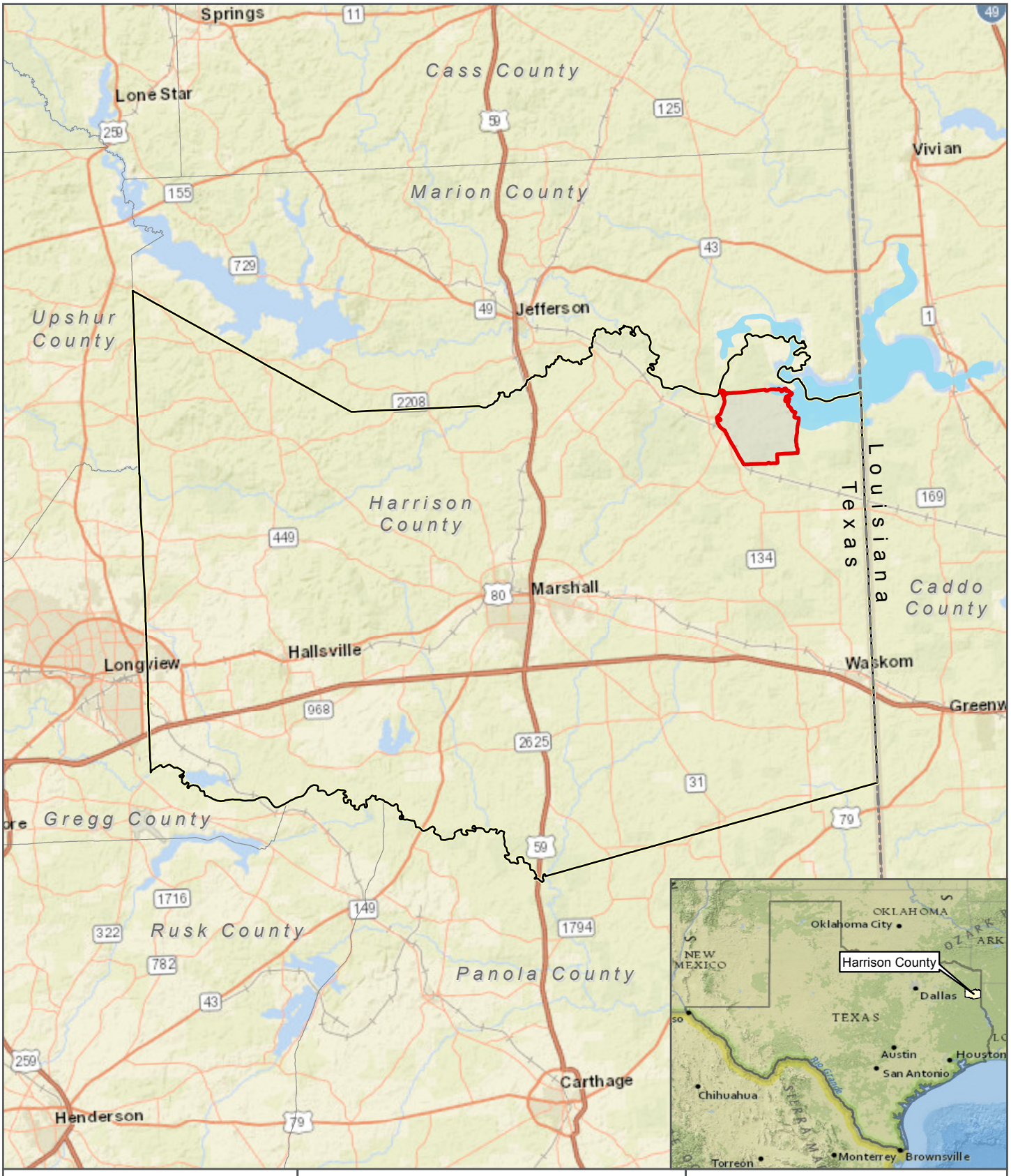


The Army, in consultation with USEPA Region 6 and TCEQ, will select a final remedy for the site after reviewing and considering all information submitted during the 30-day public comment period. The modified Alternative 2 may be further modified based on public comments. Therefore, the public is encouraged to review and comment on the new technologies presented in this Revised Proposed Plan.

The 2012 Proposed Plan identified Alternative 2 as the preferred alternative; this Revised Proposed Plan adds ISTD to the preferred alternative to address the residual TCE DNAPL identified near Building 46A. This Revised Proposed Plan presents significant new information about the Building 46A area of LHAAP-47, summarizes site characteristics, scope and role of the additional response action, and site risks. This is followed by a presentation of the remedial action objectives (RAOs) and identification of supplemental remedial technologies for groundwater and soil near Building 46A. Finally, an evaluation of the preferred technology and a summary of the modified Alternative 2 are presented.

SITE BACKGROUND

LHAAP is located in central-east Texas in the northeastern corner of Harrison County **(Figure 2)**. The installation occupies approximately 1,100 of its former 8,416 acres between State Highway 43 at Karnack, Texas, and the western shore of Caddo Lake. The nearest cities are Marshall, Texas, approximately 14 miles to the southwest, and Shreveport, Louisiana, approximately 40 miles to the southeast. Caddo Lake, a large freshwater lake situated on the Texas-Louisiana border, bounds LHAAP to the north and east. The U.S Army has transferred nearly



LEGEND

- LHAAP Installation Boundary
- Harrison County
- State Boundary

SITE LOCATION

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

DATA SOURCES: USACE 2011, LHAAP-16 Record of Decision

DISCLAIMER: Map information was compiled from the best available sources. No warranty is made for its accuracy or completeness.

FIGURE 2

PATH: J:\2018\18-025_LHAAP_SITES29_47_18AND24_ROD_(WERNER)\7.2_WORK_IN_PROGRESS\MAP_DOCS\DRAFT\LHAAP47\LHAAP47_ROD_LHAAP_SITE_LOCATION.MXD - USER: KLOFGREN - DATE: 5/17/2019

7,300 acres to the U.S. Fish and Wildlife Service (USFWS) for management as the Caddo Lake National Wildlife Refuge.

The property transfer process is continuing as responses are completed at individual sites. The local restoration advisory board has been kept informed of previous investigations at this site through quarterly meetings. Additionally, the administrative record is updated quarterly and is available at the Marshall Public Library.

Due to releases of chemicals from facility operations, LHAAP was placed on the Superfund National Priorities List (NPL) on August 30, 1990. Activities to remediate contamination associated with the listing of LHAAP as a Superfund site began in 1990. The U.S. Army, the USEPA, and the Texas Water Commission (currently known as the TCEQ) entered into a CERCLA Section 120 FFA for remedial activities at LHAAP. The FFA became effective December 30, 1991. LHAAP operated until 1997 when it was placed on inactive status and classified by the U.S. Army Armament, Munitions, and Chemical Command as excess property.

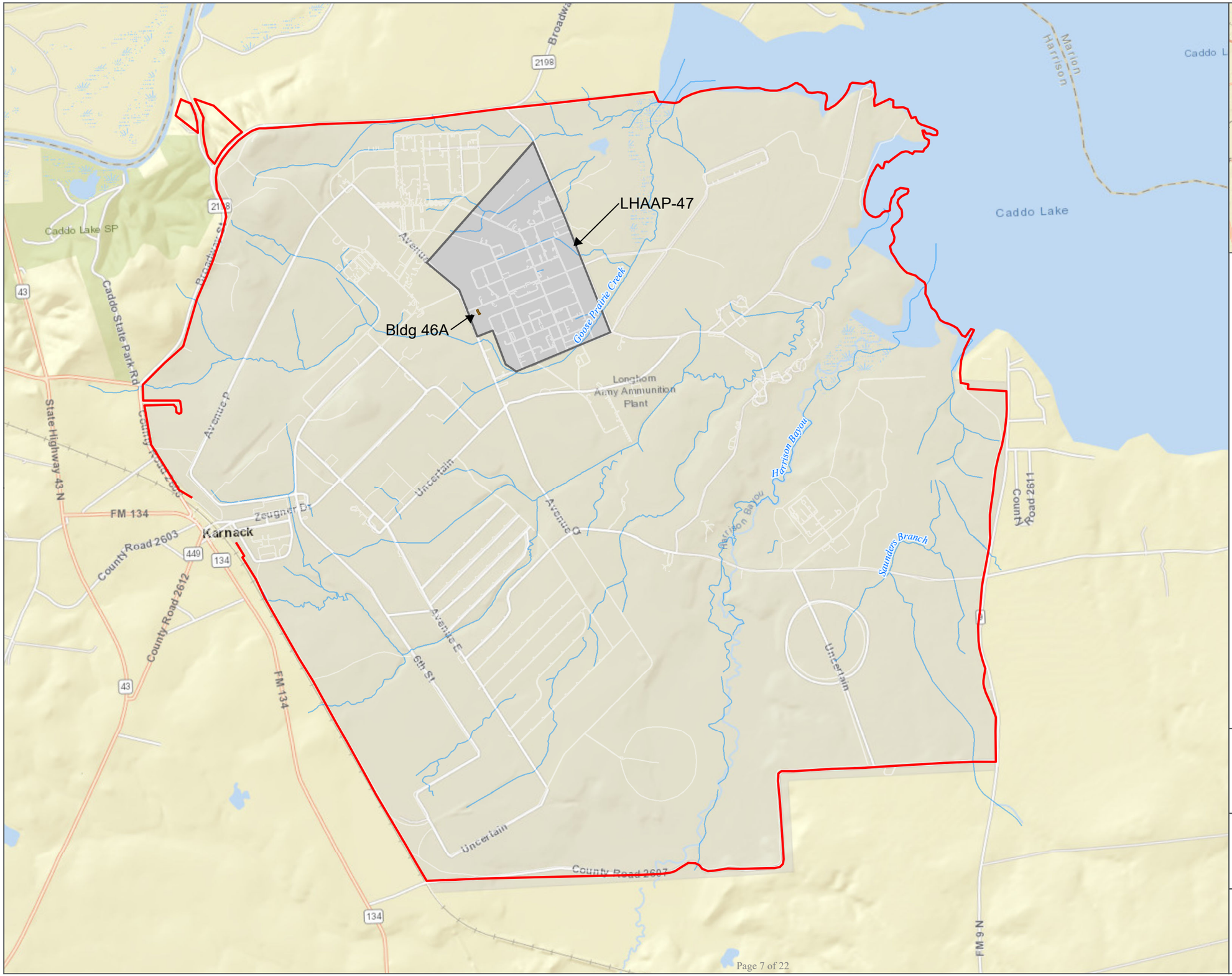
The Shallow, Upper Intermediate, and Intermediate groundwater zones and the soil at LHAAP-47 are contaminated.

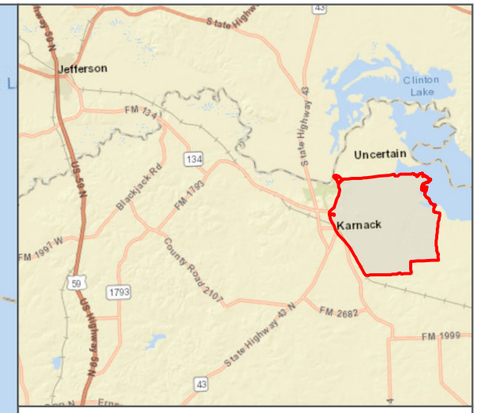
LHAAP-47, known as Site 47, was identified in historical records as Plant 3 (or Plant 3 Area) and is located in the north-central portion of the former plant covering an area of approximately 275 acres (**Figure 3**).

The Plant 3 site produced rocket motor, pyrotechnic, and illumination devices. Construction of Plant 3 began in July 1953 and production of rocket motors began in December 1954. Rocket motor production continued until the early 1980s. Some of the rocket motor production facilities were converted to produce pyrotechnic and illumination devices and were active until approximately 1997. Industrial solid wastes and hazardous wastes, such as parts cleaners and spent solvents, may have been generated by these activities. Fifty waste process sumps and three waste rack sumps were located within the LHAAP-47 site (Shaw, 2011). Production activities at Building 46A began in 1960 when it was constructed as a casting and curing building. Among other things, it contained two degreasers. A sump was located on the north end of the building.

The environmental media (soil, groundwater, surface water, and sediment) at the LHAAP-47 site have been the subject of numerous investigations to identify potential contamination (Shaw, 2011). Jacobs Engineering conducted Phase I, Phase II, and Phase III remedial investigations in 1993, 1995, and 1998, respectively, and additional remedial investigations from 1996 through 2001. The RI report included the results from all of these investigations and was completed in 2002 (Jacobs, 2002).

Several follow-up investigations at the site were performed to delineate the extent of contamination including a data gaps investigation in 2004 (Shaw, 2007a) and a 2006 soil sampling event for the evaluation of waste process sumps (Shaw, 2008). The Army completed additional groundwater investigations in 2007, 2008, and 2009. In 2010, a soil investigation program was conducted and soil samples were collected from the vicinity of Building 25C and Building 25D, located in the southern part of the LHAAP-47 site and analyzed for perchlorate (Shaw, 2011).





LEGEND

- Building 46A
- Site
- LHAAP Installation Boundary
- Road
- Stream

DATA SOURCES: ESRI

DISCLAIMER: Map information was compiled from the best available sources. No warranty is made for its accuracy or completeness.

LHAAP-47 SITE MAP

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

N

0 0.5 1
MILES

ON THE LINE

HDR

Figure 3

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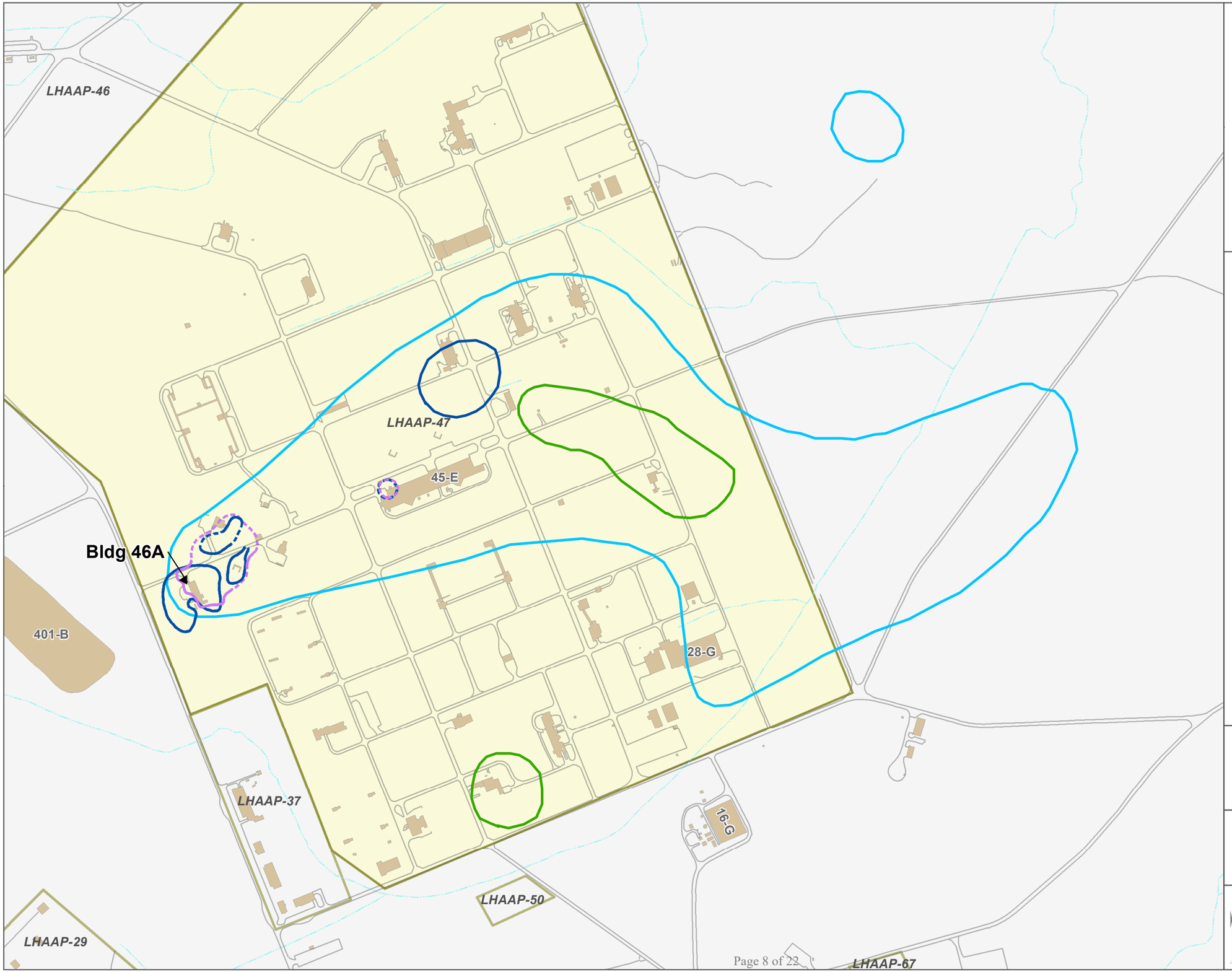
A PSI was performed between 2018 and 2020 (HDR, 2019; HDR, 2021b) after a prolonged drought and to update aging data in an effort to inform the ROD before finalization. The PSI objective was to re-assess and update groundwater contaminant levels for shallow and intermediate zone groundwater. The PSI was conducted during 3 field efforts, the initial site-wide PSI in 2018, and 2 follow-on investigations (PSI No. 2) to further evaluate the extent of groundwater contamination near Building 46A in November 2019 and summer of 2020 (HDR, 2021b). **Figure 4** shows the current extent of TCE and perchlorate contamination in the shallow (10-35 ft bgs), upper intermediate (35-40 ft bgs), and intermediate zones (40-60 ft bgs) across the site. TCE is the most widespread Volatile Organic Compound (VOC) contaminant and represents the maximum extent of VOC contamination in each groundwater zone.

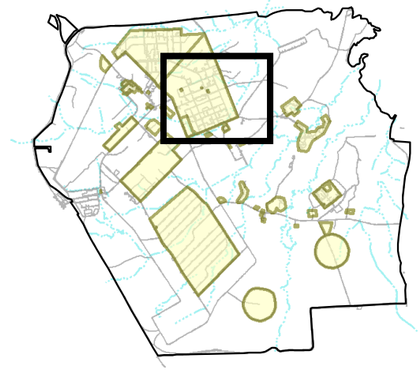
A Baseline Human Health Risk Assessment (BHHRA, 40 CFR 300.430(d)(4)) and Screening Level Ecological Risk Assessment were performed for the Group 4 sites, which includes the LHAAP-47 site, in 2003 (Jacobs, 2003). Subsequent to the risk evaluation in the BHHRA, an installation-wide Baseline Ecological Risk Assessment (BERA) was performed in 2007 (Shaw, 2007b).

Perchlorate in soil near Building 25C is identified as a potential residual source for groundwater perchlorate contamination and a principal threat waste. In November 1999, plastic liner material was placed around Building 25C by the U.S. Army over areas known to contain perchlorate in the soil to prevent migration of perchlorate into the Goose Prairie Creek. The extent of liner was noted in the site-wide perchlorate investigation report (STEP, 2005).

A FS that presented the Contaminants of concern (COCs) at the LHAAP-47 site and developed remedial alternatives for soil and groundwater was completed in 2011 (Shaw, 2011). A Final Proposed Plan and a Draft Final Record of Decision were completed in 2012 and 2013, respectively, based on the RI and other investigations.

The results of the PSI investigations were used to prepare a FS Addendum (HDR, 2021a) to evaluate supplemental remedial technologies to address VOCs in soil and residual TCE DNAPL in groundwater near Building 46A (**Figure 5**). The concentrations reported indicate TCE in the saturated zone in this area is a principal threat waste. Reports associated with all of the investigations mentioned above are included in the Administrative Record file for the LHAAP-47 site.





LEGEND

- Intermediate Zone Perchlorate Exceeding TRRP PCL (17µg/L), July 2018
- Intermediate Zone Trichloroethene Exceeding USEPA MCL (5 µg/L), July 2018
- Shallow Zone Trichloroethene Exceeding USEPA MCL (5 µg/L), July 2018 and 2020
- Upper Intermediate Groundwater Zone Trichloroethene Exceeding USEPA MCL (5 µg/L), 2020
- Road
- Stream
- Former Buildings or Concrete Slab
- LHAAP-47
- LHAAP Site

* Building 46A plumes are based on 2020 data.

2018 - 2020 EXTENT OF TCE AND PERCHLORATE CONTAMINATION IN SHALLOW, UPPER INTERMEDIATE AND INTERMEDIATE ZONE GROUNDWATER, LHAAP-47

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

N

0 500 1,000
FEET

FIGURE 4

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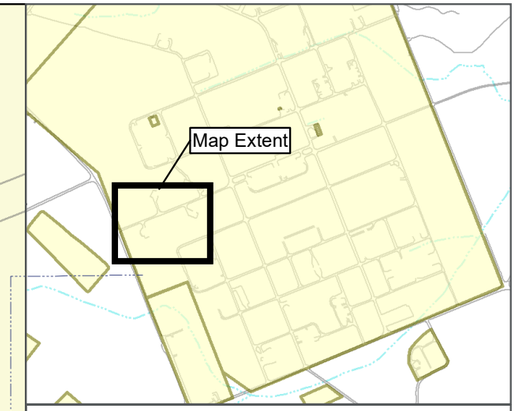

50-B

49-B

47-B

46-B

LHAAP-47

Bldg 46A

42-B

41-B-1

41-B

LEGEND

Upper Intermediate Groundwater Zone TCE Iso-Concentration Contours

TCE > 20,000 µg/L

TCE > 10,000 µg/L

TCE > 5 µg/L

Shallow Groundwater Zone TCE Iso-Concentration Contours

TCE > 20,000 µg/L

TCE > 10,000 µg/L

TCE > 5 µg/L

Road

Stream

Former Buildings or Concrete Slab

LHAAP-47

* TCE concentrations greater than 10,000 ug/L used to define DNAPL.

EXTENT OF TCE IN GROUNDWATER NEAR BUILDING 46A, LHAAP-47

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

N

0 50 100
FEET

ON THE LINE

HDR

FIGURE 5

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SITE CHARACTERISTICS

The surface features at the LHAAP-47 site are a mixture of asphalt-paved roads, parking areas, remnants of building foundations, and overgrown wooded and grassy vegetation-covered areas (Shaw, 2011). The topography in this area is relatively flat with surface water drainage flowing into tributaries of Goose Prairie Creek. Surface water runoff from the site enters Caddo Lake via Goose Prairie Creek (**Figure 3**).

The soil at the LHAAP-47 site consists of layers of silty clay, underlain by silty sand to clayey sand. Below this are units of the Wilcox Group, generally consisting of interbedded silts and clays (Shaw, 2011).

Groundwater at the site is divided into four zones: shallow, shallow/ intermediate (referenced as the upper intermediate Zone in the PSI reports), intermediate, and deep. The RI report identified shallow (10-35 ft bgs), intermediate (40-60 ft bgs) and deep (0-95 ft bgs) groundwater zones. During the PSI, the saturated zone was determined to occur at 23 ft bgs since wells screened at shallower depths were dry so the shallow zone is currently identified as 23-35 ft bgs. During the PSI, an additional zone, defined as the shallow/intermediate or upper intermediate zone, was established for wells screened to 40 ft bgs, into the upper sand below the clay aquitard separating the shallow and intermediate zones. The intermediate and deep zones did not change based on the PSI results. The groundwater flow direction in the shallow and intermediate saturated zones is to the northeast, with groundwater in the deep zone flowing to the north/northeast (Shaw, 2011, HDR, 2019).

Conceptual Site Model

The initial conceptual site model for the LHAAP-47 site identified that a risk of exposure to groundwater for a hypothetical future maintenance worker is the driver for remediation based upon conclusions of the 2003 BHHRA.

Neither the results of the additional data collected in 2010, nor the recent results collected during the PSI in 2018 through 2020 changed the overall outcome of the risk assessment, even though the list of COCs was modified. COCs have been detected in the soil and Shallow, Upper Intermediate, and Intermediate Zone groundwater beneath LHAAP-47. The deep groundwater zone is not contaminated.

The COCs for LHAAP-47 groundwater and soil are listed below:

Groundwater:

Anions

- Perchlorate

VOCs

- Acetone
- Chloroform
- Cis-1,2-dichloroethene
- 1,1-Dichloroethene
- 1,2-Dichloroethane
  Tetrachloroethene
- Trans-1,2-dichloroethene
- Trichloroethene
- Vinyl chloride

SVOCs

- Bis(2-ethylhexyl) phthalate
- Pentachlorophenol

Explosives

- 2,4-dinitrotoluene
- 2,6-dinitrotoluene
- 2,4,6-trinitrotoluene

Metals

- Aluminum
- Antimony

- Arsenic
- Cadmium
- Chromium
- Cobalt
- Manganese
- Nickel
- Silver
- Strontium
- Thallium
- Tin
- Vanadium

Soil:

Anions

- Perchlorate

VOCs

- TCE

Within the Shallow and Upper Intermediate Zones near Building 46A in the western part of LHAAP-47, TCE concentrations have been detected at very high concentrations with a maximum concentration of 140,000 micrograms per liter (µg/L). The high TCE concentration indicates the presence of residual DNAPL. Concentrations greater than 1-10% of the effective solubility are considered indicative of DNAPL (ITRC, 2003). For TCE, this solubility threshold is 11,000 µg/L. TCE greater than 10,000 µg/L was used as a conservative estimate for evaluating the presence of residual DNAPL in the vicinity of Building 46A. The PSI results indicated the presence of three small residual DNAPL groundwater plumes with a combined estimated volume of 237,799 - 532,669 gallons in the Shallow Zone, and one larger residual DNAPL groundwater plume in the Upper Intermediate Zone with an estimated volume of 261,890 – 586,634 gallons. These estimates are based on an average thickness between 7.8 ft and 12.6 ft for each plume, and a porosity of 25% (the same porosity as cited in the 2011 FS) to 56%. This porosity range is representative of inorganic silts, silty or clayey fine sands as are found at the site.

SCOPE AND ROLE OF THE SUPPLEMENTAL PROPOSED ACTION

The overall strategy for remediation activities at the LHAAP-47 site is to eliminate risks to the hypothetical future maintenance worker. The scope of the supplemental remedial technology presented in this Revised Proposed Plan is to address the residual TCE DNAPL in groundwater and soil near Building 46A.

Laboratory results from groundwater samples collected near Building 46A at LHAAP-47 have indicated that DNAPL may be residing as residual source material in pores in the subsurface. As a component of this groundwater, the hazardous contaminant TCE is characterized as a highly toxic source material and, thus, potentially a principal threat waste (USEPA, 1991). In accordance with the NCP (40 CFR 300.430(a)(1)(iii)(E)), treatment technologies have been evaluated through the technology screening process and used to develop supplemental remedial technologies to address the residual TCE DNAPL. The preferred supplemental treatment technology to modify Alternative 2 includes an active remedial component that will mitigate the potential principal threat. The preferred technology for Building 46A is ISTD for residual DNAPL in groundwater and unsaturated soil near Building 46. If necessary, excavation of TCE soil hot spots will follow ISTD. This active treatment will comply with NCP expectations regarding treatment of affected media where principal threat waste may be present. If TCE concentrations in soil are greater than the cleanup level following ISTD,

excavation of soil hot spots may be implemented.

SUMMARY OF SITE RISKS

The reasonably anticipated future use of this site is nonresidential use as part of the Caddo Lake National Wildlife Refuge. This anticipated future use is based on a Memorandum of Agreement (MOA) (U.S. Army, 2004) between the USFWS and the U.S. Army which documents the transfer process of the LHAAP acreage to USFWS to become the Caddo Lake National Wildlife Refuge. Presently the Caddo Lake National Wildlife Refuge occupies nearly 7,300 acres of the former installation. Under this MOA, the property must be kept as a national wildlife refuge unless there is an act of Congress which removes the parcel or the land is exchanged in accordance with the National Wildlife Refuge System Administration Act of 1966 and the National Wildlife Refuge System Act Amendments of 1974.

According to the 2003 BHHRA, for the hypothetical future maintenance worker, groundwater at the LHAAP-47 site presented a total cancer risk of 7.1×10^{-3}, which is greater than the acceptable cancer risk range of 1×10^{-6} to 1×10^{-4}. The total Hazard Index (HI) from groundwater was 1,100, which is greater than the acceptable HI of 1. The risk and HI values are based on the industrial exposure scenario that includes drinking the water or using the water for hand washing or showering. Perchlorate was the only soil contaminant retained as a COC in the FS. For groundwater, perchlorate and the VOCs, semi-volatile organic compounds (SVOCs), explosives, and metals listed in the Site Characteristics discussion were retained as COCs.

Additional groundwater data collected in 2009 and 2010 did not change the outcome of the human health risk assessment (Shaw, 2011).

Evaluation of Additional Data Collected 2018 - 2020

The PSI soil and groundwater data collected near Building 46A between 2018 and 2020 showed VOC concentrations higher than previously reported. In particular, the high TCE concentrations discovered in groundwater indicate that the risk levels would also be higher than calculated in the BHHRA, however, the outcome is the same. The remedial actions proposed for the site will address all of the groundwater contamination, and additional risk evaluation was not performed.

Soil

TCE was identified as a new soil contaminant during the PSI. The discovery of TCE in unsaturated soil near Building 46A (defined as depths less than 23 feet below ground surface (bgs)) may indicate a potential for groundwater impacts. The depth of the reported contamination (10 feet bgs and deeper) indicates there is no potential for direct human exposure. The depth of the reported TCE in soil also precludes the potential for exposure via overland flow that might reach surface water. The migration pathway, soil to surface water, is not a likely pathway for the TCE in soil due to the depth of the contamination. However, because TCE is considered to have the potential to impact groundwater it is considered as a soil COC.

The TCE concentrations were compared to the TCEQ soil medium-specific concentration (MSC) for industrial use based on groundwater protection (GWP-Ind) value (TCEQ, 2006) because it is a

potential source of continuing groundwater contamination. The GWP-Ind MSC value is the proposed soil cleanup level for human health. The maximum detected concentrations of the soil COCs and GWP-Ind are presented in **Table 1**.

Table 1 Soil Contaminants of Concern

Chemical	Maximum Concentration (mg/kg)	GWP-Ind MSC (mg/kg)
Perchlorate	8.6	7.2
TCE	16	0.5

Notes:

mg/kg milligrams per kilogram

GWP-Ind Texas Commission on Environmental Quality soil MSC for industrial use based on groundwater protection

Results for perchlorate samples collected 12/2004 and 2/2005; results for TCE samples collected 11/2019 and 6/2020

Groundwater

The list of groundwater contaminants identified as COCs contributing to human health cancer risk and non-cancer hazard did not change. They are listed in **Table 2**. Chemicals that were not analyzed during the PSI but were previously identified as COCs in the DF ROD have been retained based on historical MCL or TCEQ groundwater MSC for industrial use (GW-Ind) exceedances, or showed Hazard Quotients greater than 0 in the BHHRA.

Table 2 Groundwater Contaminants of Concern

Chemical	Maximum Concentration (ug/L)[1]	MCL[2]/ TRRP PCL[3]/Background[4] (ug/L)
Anions		
Perchlorate	38,400	17[3]
VOCs		
Acetone	12.1	22,000[3]
Chloroform	1.16	80[3]
cis-1,2-Dichloroethene*	5,260	70[2]
1,1-Dichloroethene*	176	7[2]
1,2-Dichloroethane	4.18	5[2]
Tetrachloroethene	9.99	5[2]
trans-1,2-Dichloroethene*	56.5	100[2]
Trichloroethene	120,000	5[2]
Vinyl chloride*	1,190	2[2]
SVOCs		
bis(2-Ethylhexyl)phthalate	21[5]	6[3]
Pentachlorophenol	46.1	1[2]
Explosives		
2,4,6-Trinitrotoluene	6.8[5]	12[3]
2,4-Dinitrotoluene	1.4[5]	1.3[3]
2,6-Dinitrotoluene	1.4[5]	1.3[3]
Metals		
Aluminum	194	24,000[3]
Antimony	7.5[5]	12.2[4]
Arsenic	26.2	34.2[4]
Cadmium	5.07[5]	5.1[4]
Chromium	131	100[2]
Cobalt	11.5	240[3]
Manganese	1370	7,820[4]
Nickel	529	490[3]
Silver	1,000[5]	120[3]
Strontium	3780	15,000[3]
Thallium	0.112	2[2]
Tin	439	15,000[3]
Vanadium	1,820[5]	44[3]

Notes:

* trichloroethene daughter products

TRRP Protective Concentration levels (PCLs) from January 2021 TRRP PCL tables, https://www.tceq.texas.gov/remediation/trrp/trrppcls.html

µg/L micrograms per liter

MCL maximum contaminant level

[1] Samples collected during the PSI (2018-2020)

[2] MCL

[3] TRRP Tier 1 PCL for residential groundwater use

[4] Background

[5] Results prior to PSI

Ecological Risks

The 2007 BERA and the 2014 explosives assessment confirmed no potential risk to ecological receptors in the industrial sub-area, which includes the LHAAP-47 site. Because the contamination at Building

46A was found at depth, below a receptor pathway, no potential ecological risk was identified for the Building 46A area. Thus there are no modifications required for the remedial alternative due to ecological risk from contaminants near Building 46A.

REMEDIAL ACTION OBJECTIVES

The identification of RAOs must consider the environmental issues at the site and the receptors that are affected. The RAOs established in the Draft Final ROD included:

- Protect future maintenance workers by preventing exposure to unacceptable levels of contaminants in groundwater via the groundwater ingestion pathway;
- Prevent perchlorate in soil from migrating to groundwater and surface water;
- Prevent groundwater contaminated with perchlorate from migrating into nearby surface water;
- Return of groundwater to its potential beneficial use, wherever practicable, within a reasonable time period given the particular site circumstances.

The RAO to address soil perchlorate contamination has been updated to also address the TCE in soil and is revised to:

- Prevent perchlorate in soil from migrating to groundwater and surface water, and prevent TCE in soil from migrating to groundwater;

The existing RAO to return groundwater to its potential beneficial use, wherever practicable (40 CFR 300.430(a)(1)(iii)(F)) also encompasses the residual TCE DNAPL.

IDENTIFICATION OF SUPPLEMENTAL REMEDIAL TECHNOLOGIES FOR GROUNDWATER AND SOIL NEAR BUILDING 46A

The FS Addendum evaluated supplemental technologies to remediate the residual TCE DNAPL in groundwater and TCE in unsaturated soil near Building 46A.

Two ISTD technologies, Electrical Resistance Heating (ERH) and Thermal Conduction Heating (TCH), and Steam Enhanced Extraction (SEE) were evaluated as possible technologies to treat the residual TCE DNAPL near Building 46A.

SEE involves the use of injection and extraction wells to inject steam into the subsurface while simultaneously extracting steam, vapors, mobile non-aqueous phase liquid (NAPL), and groundwater. The injected steam is used to heat the subsurface to target treatment temperatures, typically the boiling point of the contaminant of concern at the site. Injection rates and pressure are determined by the permeability of the soil matrix which can be too tight for SEE applications. Low permeability layers may interfere with steam migration. SEE was screened out because the subsurface conditions indicate the low soil permeability would interfere with steam migration and prevent effective implementation.

The two ISTD technologies, ERH and TCH were considered as viable technologies to thermally treat the high dissolved TCE and residual DNAPL in the Shallow and Upper Intermediate Zone groundwater near Building 46A.

TCH utilizes wells to spread heat via conduction through the subsurface to

volatilize and increase hydrolysis of VOCs. It is effective in a fine-grained aquifer matrix for removal of TCE. It is also effective on sorbed VOCs and DNAPL. TCH is readily implementable and requires soil vapor extraction (SVE) or multi-phase extraction (MPE) to capture mobilized TCE. It has a high cost. Heating rates may be affected by differences in water content and flow rates between layers.

ERH involves the application of electrical current through the subsurface, resulting in the generation of heat. When the subsurface temperature is increased to the boiling point of the pore water or the saturated media in the treatment zone, steam is generated. The steam strips contaminants from the aquifer matrix and enables them to be extracted from the subsurface. In addition, contaminants are directly volatilized from unsaturated soil. ERH is particularly suited to the treatment of lower permeability strata and to DNAPLs that have become consolidated within lower permeability zones with higher organic content.

Two ISTD vendors evaluated the site conditions and groundwater concentrations and determined that ERH would be the most effective ISTD technology.

An ERH system consists of subsurface electrodes connected to direct current through the subsurface, and a vapor extraction system to capture the volatilized water and contaminants. In some cases, groundwater extraction is also used to lower the water table within the treatment zone during initial stages of treatment (prior to temperatures exceeding the boiling point of subsurface water) or to provide hydraulic control.

For application of thermal treatment, the volume of groundwater within the Building 46A residual TCE DNAPL plumes in Shallow and Upper Intermediate Zones is needed. The volumes were calculated based on the areal extent of TCE greater than 10,000 µg/L in the 3 Shallow Zone and single Upper Intermediate Zone plumes and a range of porosity from 25% (the porosity assumed in the 2011 FS) to 56%. This range is based on the porosity of inorganic silts, silty or clayey fine sands, with slight plasticity. The cited porosity for these soil types is a minimum of 0.21 (21%) to maximum of 0.56 (56%). The duration for active treatment using ERH for the Building 46A residual TCE DNAPL is estimated at 137-183 days.

EVALUATION OF PREFERRED SUPPLEMENTAL REMEDIAL TECHNOLOGY

Nine criteria identified in the NCP, 40 CFR §300.430(e)(9)(iii), are used to evaluate the different remediation alternatives individually and against each other in order to select a remedy. This revised proposed plan evaluates the performance of the preferred supplemental remedial technology of ERH against the nine criteria. The nine evaluation criteria are discussed below. The detailed analysis of the supplemental ISTD technology is presented in the FS Addendum for LHAAP-47 (HDR, 2021a).

1. Overall Protection of Human Health and the Environment

Overall protection of human health and the environment is the primary objective of a remedial action. Using ISTD to remediate the Shallow and Upper Intermediate Zone TCE residual DNAPL plumes would protect human health from exposure to contaminated groundwater,

reducing the COCs and their by-products within the groundwater plume to below groundwater cleanup standards/levels in these plumes more quickly and effectively. The ISTD is also expected to remediate the TCE in soil near Building 46A.

2. Compliance with ARARs

The "Applicable or Relevant and Appropriate Requirements" (ARARs) can be found in the FS Addendum for LHAAP-47 (HDR, 2021). The ISTD complies with all chemical-specific ARARs for soil and groundwater, as well as the location-specific and action-specific ARARs.

3. Long-Term Effectiveness and Permanence

The supplemental technology of ISTD offers long-term effectiveness and permanence because contaminants within the treatment zone are permanently removed.

The thermal treatment process is not expected to negatively affect the MNA of the groundwater outside of the treatment zones. Even if some heating were to occur, it would be beneficial to the long-term biodegradation processes that drive MNA. The halo effect of the heating is also expected to remediate the TCE in soil within the immediate area.

4. Reduction of Toxicity, Mobility, or Volume through Treatment

ISTD satisfies the EPA statutory preference for remedial actions that permanently reduce contaminant toxicity, mobility and volume of COCs and utilize treatment as a principal element. In the Shallow and Upper Intermediate Zone VOC plumes near Building 46A, ISTD will reduce the toxicity and volume of the major contaminants, including the TCE residual DNAPL and the TCE in unsaturated soil.

5. Short-Term Effectiveness

The activities associated with ISTD would be protective to the surrounding community from short-term risks during remedy implementation primarily because all activities would occur on site with very little exposure of contaminated media to the community. Air emissions from the ISTD process will be captured and treated before discharge to the atmosphere. Condensate and extracted water, if applicable, will be treated on site in the Groundwater Treatment Plant (GWTP).

6. Implementability

ISTD is a very robust technology for treatment of VOCs, even if present as DNAPL, and minimal technical concerns exist that will hinder its implementation. The equipment and materials required are generally commercially available, although some parts may be covered under patents. All equipment, services and materials are readily available to conduct the activities for this technology, although provision of power to the site will be required. The GWTP is already operational and can be used to dispose of any extracted groundwater associated with the ISTD implementation.

7. Cost

Cost estimates are used in the CERCLA FS process to eliminate those technologies that would be significantly more expensive than competing technologies without offering commensurate increases in performance or overall protection of human health or the environment. The cost estimate developed is a preliminary estimate with an intended accuracy range of –30 to +50 percent. Final costs will depend on actual labor and material costs,

actual site conditions, productivity, competitive market conditions, final scope, final schedule, final engineering design, and other variables.

The cost estimate for ISTD ($3,161,400) is a capital cost (including fixed-price remedial construction). The additional technology would not incur long-term O&M costs (post-remediation). The ISTD costs have been added to the previously identified components for Alternative 2, including remedial construction and long-term costs, which are included in the original Alternative 2 costs.

8. State/Support Agency Acceptance

The USEPA and TCEQ have reviewed the Revised Proposed Plan. Comments received from the USEPA and TCEQ during the Revised Proposed Plan development have been incorporated. Both agencies concur with the preferred supplemental technology.

9. Community Acceptance

Community acceptance of the preferred supplemental technology will be evaluated after the public comment period ends and will be described in the Final ROD for the site.

SUMMARY OF THE PREFERRED REMEDIAL TECHNOLOGY AND MODIFIED ALTERNATIVE 2

Alternative 2 (excavation and off-site disposal for soil; ISTD using ERH for residual TCE DNAPL in groundwater and TCE in soil; EISB, biobarriers; MNA, and LUCs for soil and groundwater) is the preferred alternative for LHAAP-47 and is consistent with the intended future use of the site as a national wildlife refuge.

Alternative 2 has been modified to add ISTD technology to remediate the TCE in unsaturated soil and residual TCE DNAPL in groundwater near Building 46A. ERH is the recommended ISTD technology, considered to be the technology that would be most effective based on the subsurface conditions.

The costs for Alternative 2 components included in the 2011 FS were escalated to 2020 costs using the construction cost index published by RS Means (https://www.rsmeansonline.com/references/unit/refpdf/hci.pdf), and adding the estimated cost for the ERH technology. The total estimated cost for Modified Alternative 2 is $10,245,821, with a net present value (NPV) of $9,326,411.

This alternative will satisfy the RAOs for the site through the following:

- Perchlorate-contaminated soil removal with off-site disposal to protect the hypothetical future maintenance worker and eliminate the soil-to-groundwater and surface water pathway, followed by LUCs;
- ISTD treatment using ERH to remediate the residual TCE DNAPL in Shallow and Upper Intermediate Zone groundwater and TCE in unsaturated soil near Building 46A to reduce concentrations to levels amenable to MNA;
- MNA after ISTD treatment near Building 46A and groundwater outside of the Building 46A area to reduce contaminant levels to cleanup levels and confirm the contaminated groundwater remains localized with minimal migration;
- EISB including installation of biobarriers near wells 47WW09, 47WW30, 47WW34, LHSMW43,

LHSMW56, and LHSMW60 to treat contaminants and mitigate the risk of contaminant migration from groundwater into surface water in Goose Prairie Creek. EISB would be implemented following ISTD near Building 46A if the remaining TCE concentrations are high enough to warrant its use;

- LUCs for shallow and intermediate zone groundwater and soil that will ensure protection of human health by preventing exposure until levels that allow for unlimited use and unlimited exposure have been attained.

Long-term monitoring and reporting will continue until the cleanup levels are achieved.

The ISTD treatment using ERH will reduce TCE concentrations to make conditions more amenable for MNA of TCE. If necessary, EISB could be implemented if TCE concentrations have not been reduced sufficiently following completion of ISTD treatment. If TCE concentrations in unsaturated soil remain above cleanup levels following ISTD, a contingency remedy to excavate soil hot spots may be required.

The selected alternative offers a high degree of long-term effectiveness and can be easily and immediately implemented.

Based on information currently available, the U.S. Army believes the preferred alternative meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the CERCLA §121(b) requirement used to evaluate remedial alternatives. The preferred alternative will: 1) be protective of human health and the environment; 2) comply with ARARs; 3) be cost-effective; 4) utilize a permanent solution; and 5) utilize an active treatment as a principal element. The selected remedy addresses the statutory preference for treatment to the maximum extent possible.

The U.S. Army intends to present details of the soil excavation plan, groundwater treatment plan, LUC implementation plan, groundwater monitoring plan, and MNA remedy implementation in the Remedial Design (RD) for LHAAP-47.

The remedy selected in the ROD may change from the modified alternative presented here, based on public comment.

Notification that the site is suitable for nonresidential use will accompany all transfer documents and will be recorded in the Harrison County Courthouse. CERCLA Five-Year Reviews will be performed to determine whether the remedy remains protective of human health and the environment.

COMMUNITY PARTICIPATION

The U.S. Army, USEPA, and TCEQ provide information regarding LHAAP-47 through public meetings, the Administrative Record file for the facility, and announcements published in the Shreveport Times and Marshall News Messenger newspapers.

The dates for the public comment period, the date, location, time of the public meeting, and the locations of the Administrative Record files are provided on the front page of this Revised Proposed Plan.

Any significant changes to the Revised Proposed Plan, as presented in this document, will be identified and explained in the ROD.

PRIMARY REFERENCE DOCUMENTS FOR LHAAP-47

AECOM, 2012. Final Proposed Plan for LHAAP-47, Plant 3 Area Solid Rocket Motor Fuel Production Longhorn Army Ammunition Plant Karnack, Texas. December.

AECOM, 2013. Draft Final Record of Decision, LHAAP-47, Longhorn Army Ammunition Plant, Karnack, Texas. July.

HDR, 2019. Draft Final Post Screening Investigation Report, LHAAP-47, Longhorn Army Ammunition Plant, Karnack, Texas. March.

HDR, 2021a. Draft Final LHAAP-47 Building 46A, Plant 3 Area, Solid Rocket Motor Fuel Production Feasibility Study Addendum. March.

HDR, 2021b. Draft Final Post Screening Investigation Addendum No. 2 Report, LHAAP-47, Longhorn Army Ammunition Plant, Karnack, Texas. January.

IRTC, 2003. An Introduction to Characterizing Sites Contaminated with DNAPLs. September.

Jacobs, 2002. Final Remedial Investigation report, Volume 1: Report, Group 4 Sites, Sites 35A, 35B, 35C, 46, 47, 48, 50, 60, and Goose Prairie Creek. Longhorn Army Ammunition Plant, Karnack Texas. January

Jacobs, 2003, Final Baseline Human Health and Screening Ecological Risk Assessment for the Group 4 Sites (Sites 04, 08, 35A, 35B, 35C, 46, 47, 48, 50, 60, 67, Goose Prairie Creek, Saunders Branch, Central Creek, and Caddo Lake), Longhorn Army Ammunition Plant, Karnack, Texas, Final, Oak Ridge, Tennessee, June.

Shaw, 2007a, Final Data Gaps Investigation, Longhorn Army Ammunition Plant, Karnack, Texas, April 2007.

Shaw, 2007b, Final Installation-Wide Baseline Ecological Risk Assessment, Longhorn Army Ammunition Plant, Karnack, Texas, Houston, Texas, February 2007.

Shaw, 2008, Final Data Evaluation Report Chemical Concentrations in Soil Samples Associated with LHAAP-35/36 Sumps, (Final Sump Report), January 2008.

Shaw, 2011, Final Feasibility Study Report for LHAAP-47, Plant Area 3, Group 4, Longhorn Army Ammunition Plant, Karnack, Harrison County, Texas, July 2011.

Solutions to Environmental Problems (STEP), 2005, Plant-Wide Perchlorate Investigation, Longhorn Army Ammunition Plant, Karnack, Texas, Final, Oak Ridge, Tennessee, April.

Texas Commission on Environmental Quality (TCEQ), 2006. *Updated Examples of Standard No. 2, Appendix II, Medium-Specific Concentrations*, March.

U.S. Army, 2004, Memorandum of Agreement Between the Department of the Army and the Department of the Interior for the Interagency Transfer of Lands at the Longhorn Army Ammunition Plant for the Caddo Lake National Wildlife Refuge, Harrison County, Texas. Signed by the Department of the Interior on April 27, 2004 and the Army on April 29, 2004.

U.S. EPA, 1991, A Guide to Principal Threat and Low Level Threat Wastes. 9380.3-06FS. November.

GLOSSARY OF TERMS

Administrative Record—The body of reports, official correspondence, and other documents that establish the official record of the analysis, cleanup, and final closure of a CERCLA site.

ARARs (ARAR)—Applicable or relevant and appropriate requirements. Refers to the federal and state requirements that a selected remedy will attain.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)—This law authorizes the Federal Government to respond directly to releases (or threatened releases) of hazardous substances that may be a danger to public health, welfare, or the environment. The U.S. Army currently has the lead responsibility for these activities.

Daughter Product—A compound that results directly from the degradation of another through chemical, biological, or physical action on a chemical compound.

Dense non-aqueous liquid (DNAPL)—A liquid that is both denser than water and is immiscible in or does not dissolve in water.

Environmental Media—Major environmental categories that surrounds or contact humans, animals, plants, and other organisms (e.g., surface water, ground water, soil or air) and through which chemicals or pollutants move.

Electrical Resistance Heating (ERH)—An intensive in situ environmental remediation method that uses the flow of alternating current electricity to heat soil and groundwater and evaporate contaminants.

Exposure—Contact of an organism with a chemical or physical agent. Exposure is quantified as the amount of the agent available at the exchange boundaries of the organism (e.g., skin, lung, digestive tract, etc.) and available for absorption.

Feasibility Study (FS)—The process used for the development, screening, and detailed evaluation of alternative remedial actions.

Groundwater—Underground water that fills pores in soil or openings in rocks to the point of saturation.

Hazard Index (HI)—The hazard index is the sum of the hazard quotients for all chemicals to which an individual is exposed. A hazard index value of 1.0 or less indicates that no adverse non-cancer human health effects are expected to occur. Each hazard quotient is a comparison of an estimated chemical intake (dose) with a reference dose level below which adverse health effects are unlikely. Each hazard quotient is expressed as the ratio of the estimated intake (numerator) to the reference dose (denominator). The value is used to evaluate the potential for non-cancer health effects, such as organ damage, from chemical exposures.

In-situ thermal desorption (ISTD)—An intensive thermally enhanced environmental remediation technology that uses conductance or resistance heating elements to directly transfer heat to environmental media.

Land Use Control (LUC)—Administrative and legal controls or engineered and physical barriers to restrict land use that are put in place to minimize the potential for exposure to contamination and/or protect the integrity of a response action.

Maximum Contaminant Level (MCL)—The MCL is based on the National Primary Drinking Water Standard. The TCEQ has adopted MCLs at the regulatory cleanup level for both industrial and residential uses. Any detected compound in the groundwater samples with an MCL was evaluated by comparing it to its associated MCL.

Monitored Natural Attenuation (MNA)—The process by which a compound is reduced in concentration over time, through absorption, adsorption, degradation, dilution, and/or transformation.

Proposed Plan—A report for public comment highlighting the key factors that form the basis for the selection of the preferred remediation alternative.

Remedial Action (RA)—The actual construction or implementation phase of a Superfund site cleanup that follows remedial design.

Remedial Design (RD)—The phase of the CERCLA process that follows the selection of a remedial action and includes development of technical specifications and engineering drawings and other requirements for implementing cleanup remedies and technologies.

Remedial Investigation (RI)—An in-depth study designed to gather data needed to determine the nature and extent of contamination at a CERCLA site.

Risk Assessment—An analysis of the potential adverse health effects (current and future) caused by hazardous substances at a site in the absence of any actions to control or mitigate these releases (i.e., under an assumption of no action). The assessment contributes to decisions regarding appropriate response alternatives.

Record of Decision (ROD)—A public document that explains the cleanup method that will be used at a Superfund site, based on USEPA studies, public comments, and community concerns.

Superfund—The common name used for CERCLA; also referred to as the Trust Fund. The Superfund Program was established to help fund cleanup of hazardous waste sites. It also allows legal action to force those responsible for sites to clean them up.

Thermal Conductance Heating (TCH)—An in-situ thermal desorption remediation process whereby heat is applied to subsurface soils and groundwater through an array of vertical or horizontal heater wells placed in the subsurface that heat the impacted area to temperatures that volatize the compounds of concern.

Thermal Desorption—An environmental remediation technology that utilizes heat to increase the volatility of contaminants such that they can be removed from the solid matrix. The volatilized contaminants are then either collected or thermally destroyed.

ACRONYMS

ARARs	applicable or relevant and appropriate requirements
BERA	Baseline Ecological Risk Assessment
bgs	below ground surface
BHHRA	baseline human health risk assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	contaminant of concern
DNAPL	dense non-aqueous phase liquid
ECP	environmental condition of property
EISB	enhanced in-situ bioremediation
ERH	electrical resistance heating
FFA	Federal Facility Agreement
FS	Feasibility Study
GWP-Ind	soil MSC for industrial use based on groundwater protection
GWTP	Groundwater treatment plant
HI	hazard index
ISTD	in-situ thermal desorption
Jacobs	Jacobs Engineering Group, Inc.
LHAAP	Longhorn Army Ammunition Plant
LTM	long-term monitoring
LUC	land use control
MCL	maximum contaminant level
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
MNA	monitored natural attenuation
MOA	Memorandum of Agreement
MPE	multi-phase extraction
MSC	medium-specific concentration
NAPL	non-aqueous phase liquid
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
NPV	Net Present Value
O&M	operation and maintenance
PCL	protective concentration level
PSI	Post-Screening Investigation
RAO	remedial action objective
RD	remedial design
RI	remedial investigation
ROD	record of decision
SEE	Steam Enhanced Extraction
Shaw	Shaw Environmental, Inc.
STEP	Solutions to Environmental Problems, Inc.
SVE	soil vapor extraction
SVOC	semi-volatile organic compound
TCE	trichloroethene
TCEQ	Texas Commission on Environmental Quality
TCH	thermal conductance heating
TRRP	Texas Risk Reduction Program
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compound

COMMENTS FORM

USE THIS SPACE TO WRITE YOUR COMMENTS

Your input on the Proposed Plan for LHAAP-47 is important to the U.S. Army. Comments provided by the public are valuable in helping the U.S. Army select a final remedy for these sites.

You may use the space below to write your comments, then fold and mail to Dr. Rose M. Zeiler, P.O. Box 220, Ratcliff, Arkansas 72951. Comments must be postmarked by August 6, 2021. If you have questions about the comment period, please contact Dr. Rose M. Zeiler directly at (479) 635-0110. Those with electronic communications capabilities may submit their comments to the U.S. Army via Internet at the following e-mail address: rose.m.zeiler.civ@mail.mil