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FINAL

PROPOSED PLAN
FOR LHAAP-17
BURNING GROUND NO. 2/FLASHING AREA
GROUP 2

ISSUED BY: U.S. ARMY

Longhorn Army Ammunition Plant
Karnack, Texas

May 2010

INTRODUCTION

The purpose of this Proposed Plan is to present for public review the remedial alternatives for LHAAP-17. This Proposed Plan identifies the Preferred Remedial Alternative for LHAAP-17, site of the former Burning Ground No.2/ Flashing Area, at Longhorn Army Ammunition Plant (LHAAP). This plan includes summaries of other potential remedial alternatives evaluated for implementation at the site. The primary purpose of the Proposed Plan is to facilitate public involvement in the remedy selection process. The Proposed Plan provides the public with basic background information about LHAAP-17, identifies the preferred final remedy for the potential threats posed by the chemical contamination at the site, explains the rationale for the preference, and describes other remedial options considered. The preferred alternative for LHAAP-17 is Alternative 4 (excavation and off-site disposal of soil; groundwater extractions, monitored natural attenuation [MNA] and land use controls [LUCs] for groundwater). The extracted groundwater would be conveyed to the existing groundwater treatment plant for treatment.

The U.S. Army is issuing this 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 as amended by the Superfund Amendments and Reauthorization Act of 1986, and under Section 300.430(f)(2) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). CERCLA prescribes a step-wise progression of activities to respond to risk posed by contaminated sites **(Figure 1)**.

Dates to remember: June 10 to July 10, 2010
MARK YOUR CALENDER

PUBLIC COMMENT PERIOD:
June 10, 2010 to July 10, 2010
The U.S. Army will accept written comments on the Proposed Plan during the public comment period.

PUBLIC MEETING: The U.S. Army will hold a public meeting to explain the Proposed Plan for LHAAP-17. Oral and written comments will be accepted at the meeting. The meeting will be held on June 29, 2010 from 6:00 p.m. to 8:00 p.m. at Karnack Community Center.

For more information, see the Administrative Record at the following location:

Marshall Public Library
300 S. Alamo
Marshall, Texas 75670

Business Hours:
Monday – Thursday (10:00 a.m. – 8:00 p.m.)
Friday – Saturday (10:00 a.m. – 5:00 p.m.

For further information on LHAAP-17, please contact:
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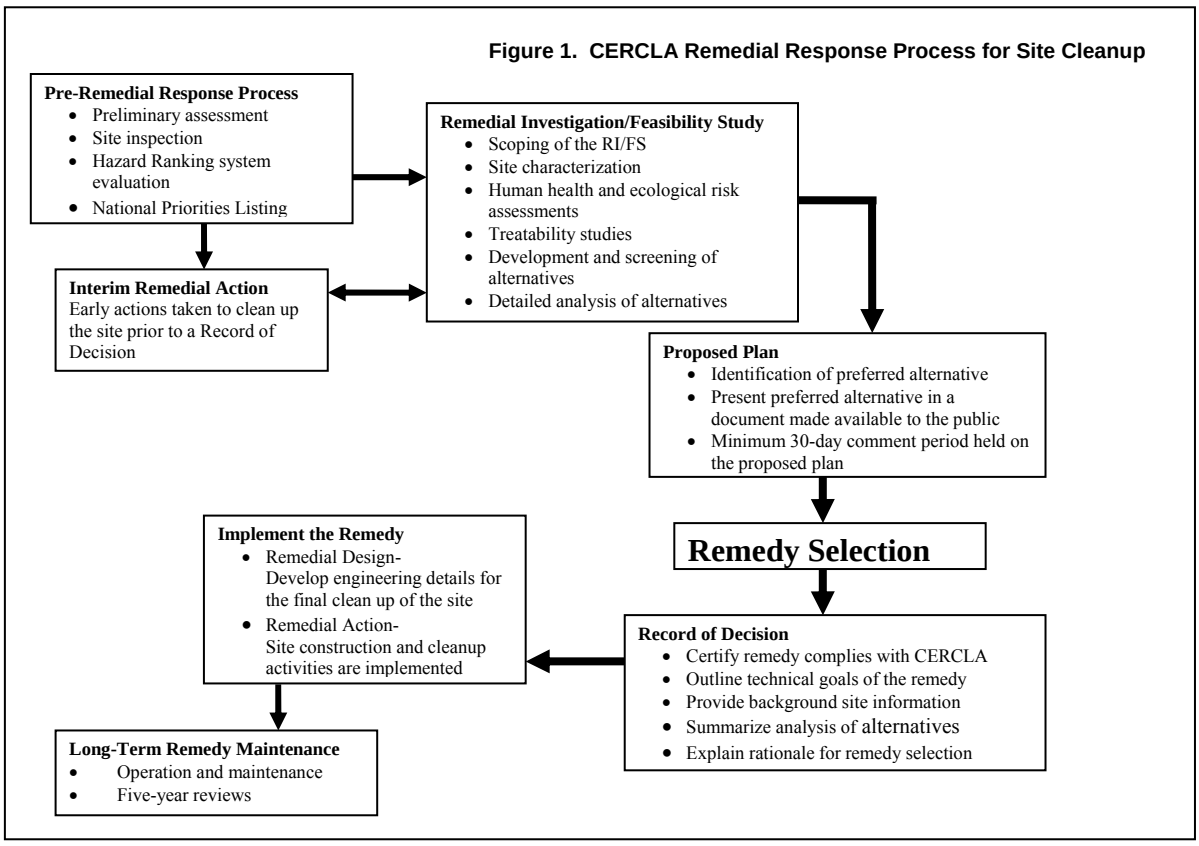
The preparation and review of a Proposed Plan is a distinct step required by CERCLA. This Proposed Plan summarizes information that can be found in greater detail in the Remedial Investigation (RI) Report, the Data Gaps Investigation, the Feasibility Study (FS) Report (including the Natural Attenuation Evaluation Report and the Additional Investigation Data Summary Report), the Installation-Wide Baseline Ecological Risk Assessment (BERA), and other supporting documents that are contained in the LHAAP-17 Administrative Record that is publically available in the Marshall Public Library. 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 to comment on the alternatives presented in this Proposed Plan.

The U.S. Army is acting in partnership with USEPA Region 6 and TCEQ. 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 the CERCLA and the NCP as well as the Federal Facility Agreement (FFA).

The Proposed Plan summarizes site characteristics, scope and role of the response action, and site risks. This is followed by a presentation of the remedial action objectives (RAOs) and a summary of remedial alternatives for LHAAP-17. Finally, an evaluation of alternatives and a summary of the preferred alternative are presented.

SITE BACKGROUND

LHAAP is located in central-east Texas in the northeastern corner of Harrison County **(Figure 2)**. The installation occupies approximately 1,400 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.

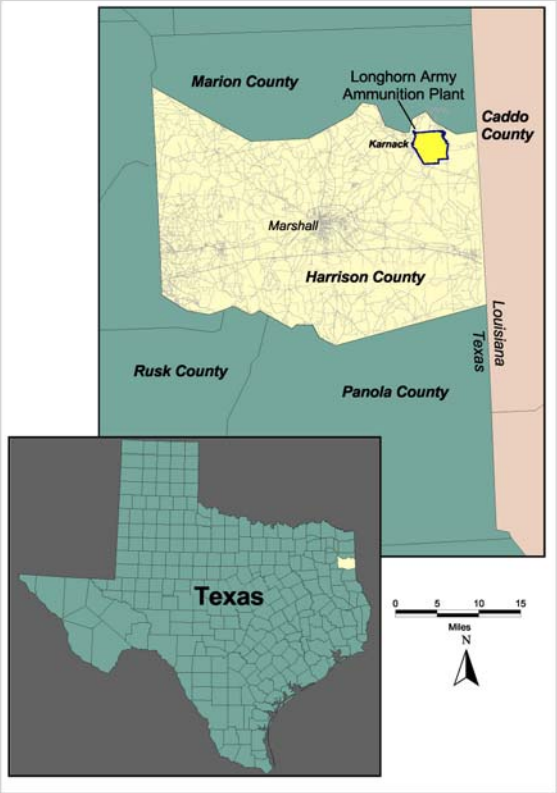


Figure 2 Location of the Longhorn Army Ammunition Plant, Harrison County, Texas

The U.S Army has transferred nearly 7,000 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 regularly held quarterly meetings. Additionally, the administrative record is updated at least twice per year 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 9, 1990. Activities to remediate contamination associated with the listing of LHAAP as a Superfund site began in 1990. After being listed on the NPL, 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.

LHAAP-17 was originally listed as an NPL site in the FFA due to threatened releases of hazardous substances, pollutants or contaminants. The shallow and intermediate groundwater zones and the soil at LHAAP-17 are contaminated.

LHAAP-17, known as the Burning Ground No. 2/Flashing Area, is located in the southeastern portion of LHAAP **(Figure 3)**. The site covers approximately 3.9 acres. The site was used as a burning ground from 1959 through 1980. In 1959, the materials removed from the TNT Production Area (LHAAP-29) and the TNT Waste Disposal Plant (LHAAP-32) during demolition were burned and/or flashed at LHAAP-17. Bulk trinitro-toluene (TNT), photo flash powder, and reject material from Universal Match Corporation operations were burned at LHAAP-17. The site was used as a flashing area to decontaminate recoverable metal byproducts until 1980, when it became inactive.

Between 1982 and 2009, numerous investigations were conducted to identify potential contamination at LHAAP-17. Media investigated included soil, groundwater, surface water, and sediment. These investigations included a Pre-RI investigation in 1982 and 1987; Phase I, Phase II, and Phase III RIs conducted in 1993, 1995, and 1998; and investigations by the U.S. Army in 1998. The results of these investigations are summarized in the Final Remedial Investigation Report –

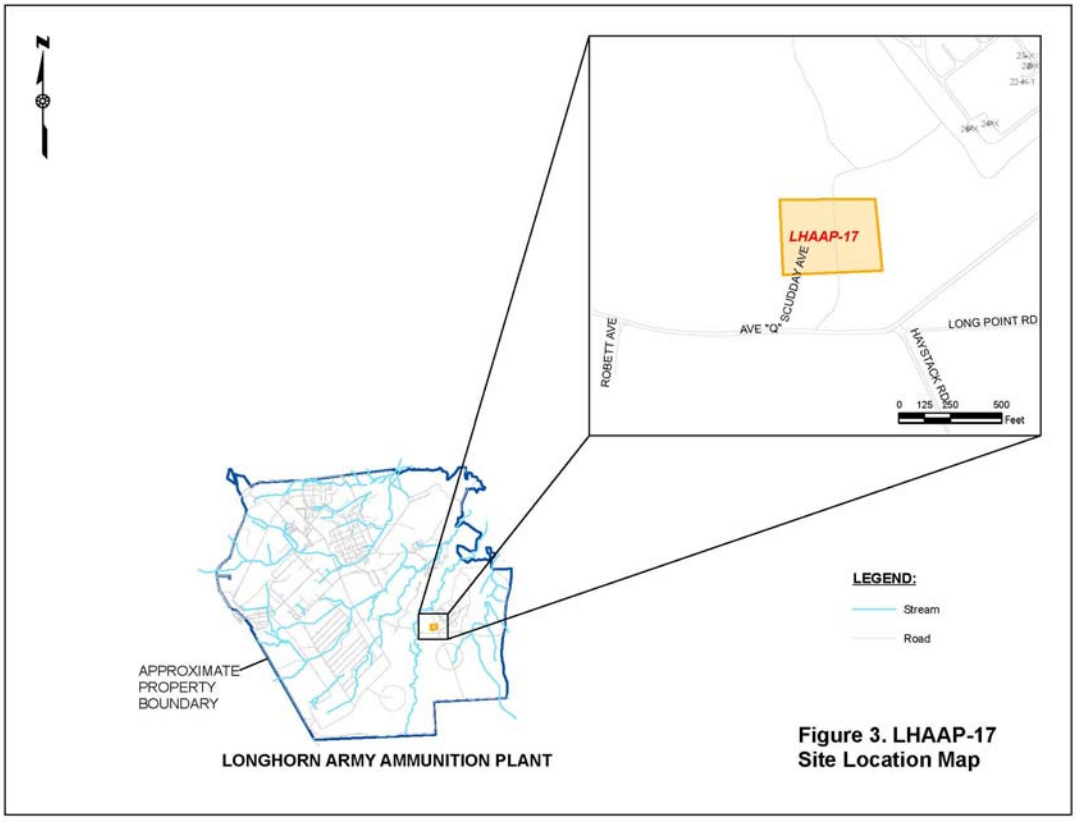


Figure 3. LHAAP-17 Site Location Map

Group 2 Sites (Group 2 RI) (Jacobs, 2001). The Final Baseline Human Health and Screening Ecological Risk Assessment for the Group 2 Sites (BHHRA) (Jacobs, 2002) was performed using the data presented in the Group 2 RI. The BHHRA identified explosives and dioxins as chemicals of concern (COCs) for soil and perchlorate, explosives, and chlorinated solvents as COCs for groundwater at LHAAP-17. The screening ecological risk assessment concluded that a site-wide baseline ecological risk assessment should be conducted.

Additional investigations were conducted after the BHHRA was completed. In 2002, a site-wide perchlorate investigation was conducted and reported in the Final Project Report – Plant-Wide Perchlorate Investigation (STEP, 2005). In 2003-2004, an Environmental Site Assessment Phase I and II was conducted (Plexus, 2005). In 2003 and early 2004, a perchlorate treatability study was conducted at LHAAP-17 and documented in the Treatability Demonstration Study (PEC, 2004).

Between 2004 and 2009, several follow-up investigations were performed to further delineate the extent of contamination identified during previous sampling events. These include the data gaps investigation in 2004 (Shaw, 2007a), the BERA in 2006 (Shaw, 2007b), sampling for attenuation evaluation in 2007, additional sampling and new wells in 2008, and additional sampling in 2009, which are reported in the Final FS (Shaw, 2010).

SITE CHARACTERISTICS

The surface features at LHAAP-17 include two 185-feet by 305-feet cleared areas, separated by a gravel access road. The site is covered with grass and

scattered brush and has been graded above the surrounding terrain. The topography is relatively flat. Surface drainage flows to ditches along the eastern and western boundaries of the site and then to Harrison Bayou. Harrison Bayou is located to the west of LHAAP-17 flowing approximately 1,200 feet northwest of the site towards Caddo Lake. The lake is a source of drinking water for several neighboring communities in Louisiana.

Groundwater at the site was encountered at 18 to 35 feet below ground surface (bgs) in the shallow groundwater zone, approximately 55 feet bgs in the intermediate zone, and about 152 feet bgs in the deep groundwater zone. The predominant groundwater flow in the shallow and intermediate zones at the site is generally to the northwest towards Harrison Bayou, but historical groundwater flow direction has varied to the west or to the north.

Contamination was found in the soil and groundwater (shallow and intermediate zones). However, no principal threat source material was identified at LHAAP-17.

The COCs for LHAAP-17 identified in the FS for the various media are:

- Soil COCs are explosives (2,4,6-TNT, 2,4-dinitrotoluene [DNT], 2,6-DNT), dioxin (2,3,7,8- tetrachlorodibenzo-p-dioxin [TCDD] toxicity equivalent quotient [TEQ]), perchlorate (potential soil COC based on groundwater concentrations), and barium.
- Shallow groundwater COCs are perchlorate and volatile organic compounds (VOCs) (1,2-dichloroethane [DCA], 1,1-dichloroethene [DCE], cis-1,2-DCE, trichloroethene [TCE] and vinyl chloride [VC]).
- Intermediate groundwater COCs are TCE and its daughter products (DCE and VC).

There are approximately 8,000 cubic yards of contaminated soil proposed to be removed for ecological and human health risk mitigation (see **Figure 4** for approximate areas). The maximum 2,4,6-TNT in the soil is 10,000 milligram per kilogram (mg/kg). Other explosives, 2,4-DNT and 2,6-DNT, have maximum concentrations of 4,000 mg/kg and an estimated concentration of 840 mg/kg, respectively. Additionally, perchlorate has been detected in the soil at a maximum concentration of 7.11 mg/kg. The concentrations of 2,3,7,8-TCDD TEQ and barium affecting ecological receptors are 1.9×10^{-4} mg/kg and 20,500 mg/kg, respectively.

The shallow groundwater zone has approximately 4,500,000 gallons of contaminated groundwater, and the intermediate zone has approximately 55,000 gallons; their areal extent is shown on **Figure 5**. The shallow groundwater perchlorate plume has the largest extent with detected concentrations at160,000 micrograms per liter (µg/L), but the intermediate zone does not have a perchlorate plume. The maximum TCE concentration in the shallow groundwater is 6,090 µg/L and in the intermediate zone is 10.8 µg/L. Other VOCs detected in the shallow groundwater are 1,2-DCA at an estimated concentration of 35.8 J µg/L and 1,1-DCE at 70 µg/L. Other COCs identified for the shallow and intermediate groundwater zones are degradation daughter products of VOCs that have not been detected above their MCLs.

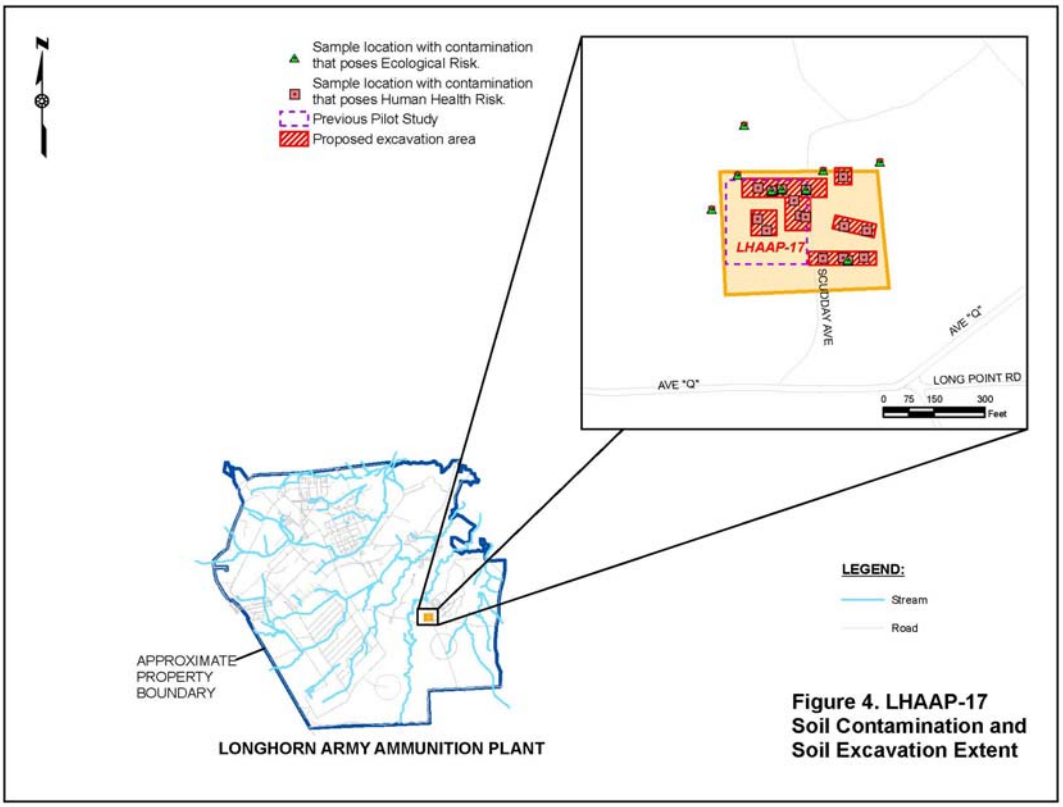


Figure 4. LHAAP-17 Soil Contamination and Soil Excavation Extent

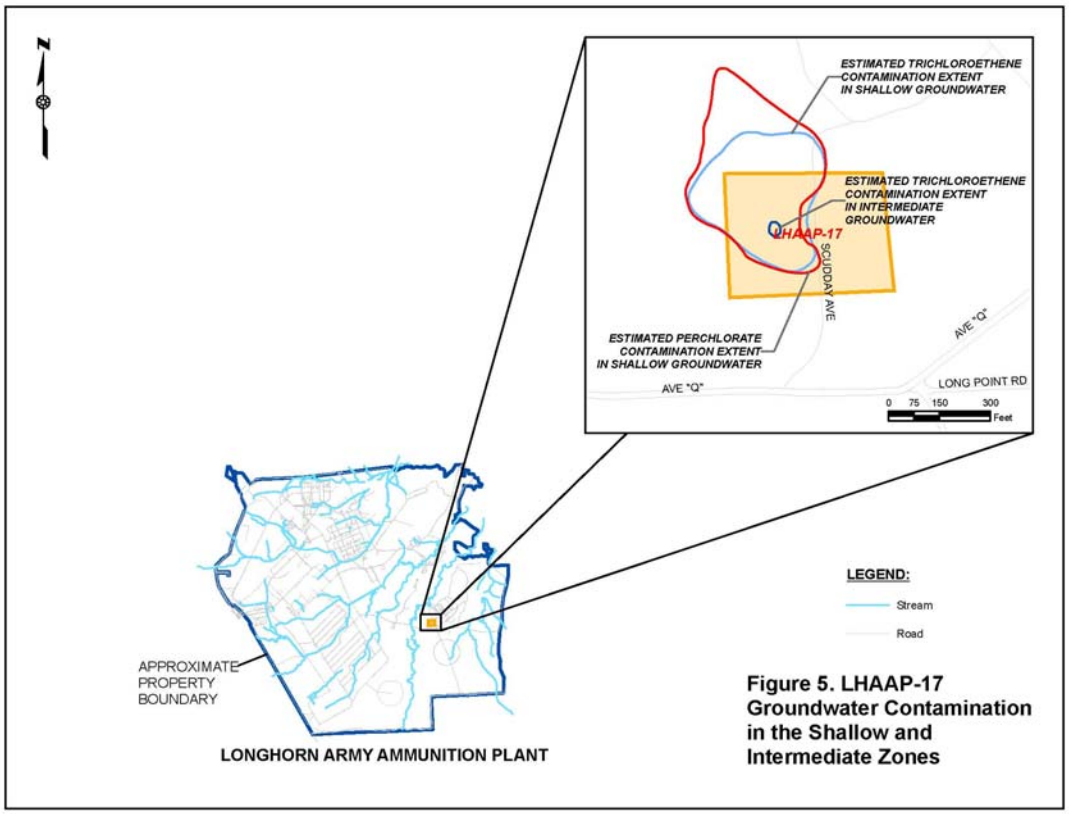


Figure 5. LHAAP-17 Groundwater Contamination in the Shallow and Intermediate Zones

SCOPE AND ROLE OF THE PROPOSED ACTION

The scope and role of the action discussed in this Proposed Plan includes all the remedial actions for this site. The recommended remedial action at LHAAP-17 will prevent potential risks associated with exposure to contaminated soil and groundwater in both the shallow and intermediate zones. Groundwater at Longhorn is not currently being used as drinking water, nor may be used in the future based on its reasonably anticipated use as a national wildlife refuge. However, when establishing the RAOs for this response action, the U.S. Army has considered the NCP's expectation to return useable groundwater to its potential beneficial use wherever practicable. The U.S. Army has also considered the State of Texas designation of all groundwater as potential drinking water, unless otherwise classified, consistent with Texas Administrative Code (TAC), Title 30, §335.563 (h)(1). The Army intends to return the contaminated shallow and intermediate groundwater zones at LHAAP-17 to its potential beneficial uses, which is considered to be the attainment of Safe Drinking Water Act maximum contaminant levels (MCLs) to the extent practicable, and consistent with Code of Federal Regulations, Title 40, §300.430(e)(2)(i)(B&C). If an MCL is not available for a chemical, the promulgated TCEQ medium-specific concentration (MSC) for groundwater that could be used for industrial purposes will be used (TCEQ, 2006). If return to potential beneficial uses is not practicable, the NCP expectation is to prevent further migration of the plume, prevent exposure to contaminated groundwater, and evaluate further risk reduction.

The remedial action will include groundwater monitoring to demonstrate that the plume is not migrating and to verify that contaminant levels are being reduced. Land use controls (LUCs) that restrict groundwater use may be terminated when groundwater contaminant levels are reduced to the cleanup levels.

The removal of source soils will positively impact groundwater by eliminating the potential for the leaching of contaminants from the soil into groundwater and will remove the contamination that poses a risk to ecological receptors.

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 (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 7,000 acres of the former installation. 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.

As part of the RI/FS, a baseline human health risk assessment and screening ecological risk assessment were conducted for LHAAP-17 to determine current and future effects of contaminants on human health and the environment to support technical review and risk management decisions.

Human Health Risks

Using data presented in the RI, the baseline risk assessment estimates the risk that the site poses if no action were taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. The applicable receptor scenario for future use as a national wildlife refuge is a hypothetical future maintenance worker. For carcinogens, risks are generally expressed as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the carcinogen and are expressed in scientific notation (e.g. 1×10^{-6}). USEPA's acceptable risk range for site-related exposures is 1×10^{-4} to 1×10^{-6}, i.e., one-in-ten thousand to one-in-one million. The potential for non-cancer effects is expressed by a ratio of the exposure to the toxicity. An individual chemical ratio less than 1 indicates that toxic non-cancer effects from that chemical are unlikely. A non-cancer hazard index (HI) is calculated when all the ratios for the individual chemicals are summed. An HI greater than 1 indicates that site-related exposures may present a risk to human health. Thus, an HI of less than 1 is acceptable since it indicates toxic non-cancer effects are unlikely.

The cancer risk and the non-cancer HI were calculated based on a hypothetical future maintenance worker exposure to the site environmental media (e.g., soil and groundwater) under an industrial scenario. The human health risk assessment concluded that chemicals in soil pose an unacceptable cancer risk (1.4×10^{-3}) and non-cancer hazard (HI of 37) to a hypothetical future maintenance worker under the industrial scenario. The groundwater was also determined to pose an unacceptable cancer risk (1.6×10^{-3}) and a non-cancer hazard (HI of 3,500) to a hypothetical future maintenance worker. 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. Soil contaminants retained as COCs in the FS contributing to human health cancer risk are 2,4-DNT, 2,4,6-TNT and 2,6-DNT, and to non-cancer hazard are 2,4-DNT and 2,4,6-TNT.

The potential soil-to-groundwater pathway was evaluated for the emerging contaminant perchlorate (found in groundwater) and the explosives posing risks or hazards in soil. The concentrations of these chemicals were compared to their TCEQ soil MSCs for industrial use based on groundwater protection (GWP-Ind), which is more stringent than the MSCs for industrial use based on inhalation, ingestion, and dermal contact. Because the GWP-Ind is more stringent, they are the proposed soil cleanup levels for human health. Those cleanup levels are:

- 2,4,6-TNT 5.1 mg/kg
- 2,4-DNT 0.042 mg/kg
- 2,6-DNT 0.042 mg/kg
- Perchlorate 7.2 mg/kg

Since these soil cleanup levels apply to the soil-to-groundwater pathway and not direct human contact, they would apply to the soil interval from the surface down to where groundwater is encountered.

Groundwater contaminants retained as COCs in the FS contributing to human health cancer risk are TCE, 1,1- DCE, and 1,2-DCE, and to non-cancer hazard are perchlorate, TCE, 1,2-DCE, and 1,1-DCE. TCE degrades to cis-1,2-DCE and vinyl chloride, which are also considered COCs. The MCLs are proposed as the cleanup levels for groundwater for the following:

- TCE 5 µg/L
- 1,1-DCE 7 µg/L
- 1,2-DCE 5 µg/L
- cis-1,2-DCE 70 µg/L
- Vinyl Chloride 2 µg/L

For perchlorate, the TCEQ groundwater MSC for industrial use (GW-Ind) of 72 µg/L is also a proposed cleanup level since an MCL has not been promulgated. Detected concentrations of COCs exceed the proposed cleanup level in the shallow zone. Currently only TCE has been detected above its proposed cleanup level in the intermediate zone.

Ecological Risks

The ecological risk for LHAAP-17 was addressed in the installation-wide BERA (Shaw, 2007b). For the BERA, the entire installation was divided into three large sub-areas (i.e., the Industrial Sub-Area, Waste Sub-Area, and Low Impact Sub-Area) for the terrestrial evaluation. The individual sites at LHAAP were grouped into one of these sub-areas, which were delineated based on commonalities of historic use, habitat type, and spatial proximity to each other. The conclusions regarding the potential for chemicals detected at individual sites to adversely affect the environment were made in the context of the overall conclusions of the sub-area in which the site falls. Site LHAAP-17 lies within the Waste Sub-Area.

For the Waste Sub-Area, the BERA concluded that unacceptable ecological risk was present (Shaw, 2007b) associated with barium, 2,4-DNT, 2,6-DNT, 2,4,6-TNT, and dioxin (reported as 2,3,7,8-TCDD TEQ]. Detected concentrations of these chemicals exceeded the Waste Sub-Area ecological preliminary remediation goal (EcoPRGs) and are targeted for excavation. Some of the areas are co-located with excavation for human health. For ecological receptors, the depth of excavation varies since they are based on the different ecological receptors (deer mouse from 0 to 0.5 feet and the short-tailed shrew from 0 to 3 feet).

Proposed soil cleanup levels for the ecological receptors are as follows:

- 2,4,6-TNT 4.7 mg/kg (0 to 3 feet)
- 2,4-DNT 12 mg/kg (0 to 3 feet)
- 2,6-DNT 6.8 mg/kg (0 to 3 feet)
  2.7 mg/kg (0 to 0.5 feet)
- 2,3,7,8-TCDD TEQ
  4×10^{-6} mg/kg (0 to 3 feet)
- Barium 222 mg/kg (0 to 0.5 feet)
  520 mg/kg (0 to 3 feet)

It is the current judgment of the U.S. Army that the preferred alternative identified in this Proposed Plan, or one of the other active measures considered in the Proposed Plan, is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

REMEDIAL ACTION OBJECTIVES

The Army recognizes USEPA's policy to return all groundwater to potential beneficial uses, based upon the non-binding programmatic expectation in the NCP.

The RAOs for LHAAP-17, which address contamination associated with the media at the site and take into account the future uses of LHAAP streams, land, and groundwater are:

- Protect human health for the hypothetical future maintenance worker by preventing exposure to contaminants in the soil and groundwater

- Prevent migration of contaminants to groundwater from potential sources in the soil
- Protect ecological receptors by preventing exposure to the contaminated soil
- Return groundwater to its potential beneficial use as drinking water, where practicable, within a reasonable time period given the particular site circumstances.

SUMMARY OF REMEDIAL ALTERNATIVES

The FS identified and screened remedial technologies and associated process options that may be appropriate for satisfying the RAOs for LHAAP-17 with respect to effectiveness, implementability, and cost. The following remedial alternatives were developed from the retained remedial technologies carried forward after the initial screening:

- Alternative 1 – No Action
- Alternative 2 – Excavation and Off-site Disposal for Soil; Monitored Natural Attenuation (MNA) and LUCs for Groundwater
- Alternative 3 – Excavation and Off-site Disposal for Soil; In Situ Bioremediation, MNA and LUCs for Groundwater
- Alternative 4 – Excavation and Off-site Disposal for Soil; Groundwater Extraction, MNA and LUCs for Groundwater

Common Elements. Four elements, LUCs, MNA, inspection and long-term monitoring (LTM), and soil excavation and off-site disposal, are common to Alternatives 2, 3, and 4. These elements are described below.

Land Use Controls (LUCs). The LUCs would be implemented to support the RAOs. The U.S. Army would be responsible for implementation, maintenance, inspection, reporting, and enforcement of the LUCs. The Army intends to provide details of the LUC implementation actions in a remedial design (RD) document. Until cleanup levels are met in the groundwater for Alternatives 2, 3, and 4, the LUCs would prevent human exposure to residual groundwater contamination presenting an unacceptable risk to human health by ensuring there is no withdrawal or use of groundwater beneath the sites for anything other than treatment, environmental monitoring, or testing. The groundwater restriction LUCs would be maintained until the concentrations of contaminants in groundwater have been reduced to cleanup levels. In addition, the Texas Department of Licensing and Regulation responsible for notifying well drillers of groundwater restrictions would be notified and a notification of LUCs with the Harrison County Courthouse would include a map showing the areas of groundwater restriction at the site.

In order to transfer this property (LHAAP-17), an Environmental Condition of Property (ECOP) document would be prepared and attached to the letter of transfer. The ECOP would include LUCs for groundwater as part of the Environmental Protection Provisions. The property would be transferred subject to the LUCs identified in the ECOP. These restrictions would prohibit or restrict property uses that may result in exposure to the contaminated groundwater (e.g., drilling restrictions, residential/ agricultural land use restrictions, drinking water well restrictions).

Monitored Natural Attenuation (MNA). MNA is a passive remedial action that relies on natural biological, chemical, and physical processes to reduce the mass and concentration of groundwater COCs under favorable conditions. MNA would assure the protection of human health and the environment by documenting that the contaminated groundwater remains localized with minimal migration and that contaminant concentrations are being reduced to cleanup levels. Monitoring activities would occur on a quarterly basis for the first two years and MNA effectiveness would be evaluated.

Inspection and Long-term Monitoring (LTM). Alternatives 2, 3, and 4 include inspection and long-term groundwater monitoring activities. Monitoring would be continued as required to demonstrate effectiveness of the remedies, to demonstrate compliance with applicable or relevant and appropriate requirements (ARARs), to-be-considered requirements, and RAOs, and to support CERCLA Five-Year Reviews. After the initial MNA monitoring period of 2 years, semiannual monitoring would be continued for 3 years. Then sampling frequency would be reduced to annually until the next CERCLA Five-Year Review. Future sampling frequencies would be evaluated in the CERCLA Five-Year Review.

Groundwater LUCs would remain in effect until cleanup levels are met.

Although the U.S. Army may later pass these procedural responsibilities to the transferee by property transfer agreement, the U.S. Army would retain ultimate responsibility for remedy integrity.

Excavation and Off-site Disposal of Contaminated Soil. Soil contamination would be excavated at LHAAP-17 under Alternatives 2, 3, and 4, and disposed off site. This action would eliminate ecological risk from direct contact as well as human health risk associated with both direct contact and the soil-to-groundwater pathway.

If soil is found that contains perchlorate that exceeds the TCEQ groundwater protection level of 7.2 mg/kg, it will be included with the remediation of the other soil. In 2004, a perchlorate study was performed by PLANTECO to identify suitable carbon sources for cleanup of perchlorate contaminated soil at LHAAP-17 (PEC, 2004); although the study reported to have reduced the perchlorate concentrations, final sampling results are not available. Thus, additional sampling will be conducted as part of the RD to determine the perchlorate concentrations and evaluate any potential impact to the groundwater.

Alternative 1 – No Action. As required by the NCP, the no action alternative provides a comparative baseline against which the action alternatives can be evaluated. Under this alternative, the groundwater would be left "as is" without implementing any additional containment, removal, treatment, or other mitigating actions. No other actions would be implemented to prevent potential human exposure to contaminated groundwater or to demonstrate that nearby surface water bodies are protected from groundwater impacts.

Estimated Capital Present Worth Cost: $0

Estimated Operation and Maintenance (O&M) Present Worth Cost: $0

Estimated Duration: -

Estimated Total Present Worth Cost: $0

Alternative 2 – Excavation and Off-site Disposal for Soil; MNA and LUCs for Groundwater

Alternative 2 would include excavation of the contaminated soil from LHAAP-17. MNA in both the shallow and intermediate zones would ensure that groundwater contamination remains localized and degrades over time. It is estimated to take approximately 120 years for TCE to attenuate to MCLs. Perchlorate is estimated to attenuate within this time frame, or approximately 15 years. Groundwater monitoring would continue until cleanup levels are met. LUCs would be implemented to prevent exposure to the contaminated groundwater until cleanup levels are achieved.

Estimated Capital Present Worth Cost: $1,440,000

Estimated O&M Present Worth Cost: $460,000

Cost Estimate Duration: 30 years

Estimated Total Present Worth Cost: $1,900,000

Alternative 3 – Excavation and Off-site Disposal of Soil; In Situ Bioremediation; MNA and LUCs for Groundwater

As with Alternative 2, contaminated soil would be removed. Groundwater contamination would be reduced in the groundwater via in situ bioremediation in the shallow zone. It is expected the in situ bioremediation would primarily reduce the perchlorate concentrations. This would make conditions favorable for MNA of TCE. MNA would be implemented in the shallow zone (after in situ bioremediation) and in the intermediate zone. The in situ bioremediation is expected to reduce the TCE concentration to its MCL in less than 120 years and perchlorate in less than 15 years. LUCS would be implemented to prevent exposure to the contaminated groundwater until cleanup levels are achieved.

Estimated Capital Present Worth Cost: $2,030,000

Estimated O&M Present Worth Cost: $590,000

Estimated Duration: 30 years

Cost Estimate Total Present Worth Cost: $2,620,000

Alternative 4 – Excavation and Off-site Disposal of Soil; Groundwater extraction; MNA and LUCs for Groundwater

As with Alternatives 2 and 3, contaminated soil would be removed. Groundwater contamination would be reduced throughout the shallow zone groundwater contaminant plume via groundwater extraction until perchlorate levels are reduced to 20,000 µg/L to make conditions favorable for MNA of TCE. If the trigger value of 20,000 µg/L of perchlorate has not been reached by the end of the estimated 1.5-year pumping period, pumping may cease, pending lead agency and regulatory approval to initiate a contingency action of in situ bioremediation followed by MNA (see Alternative 3 description for basic elements). If perchlorate levels are successfully reduced to 20,000 µg/L or below after the estimated 1.5-year pumping period, then two years of MNA sampling will be implemented. If MNA is not shown to be supported after 2 years of sampling, a contingency remedy of in situ bioremediation will be initiated. As in Alternatives 2 and 3, this alternative utilizes MNA to treat the intermediate zone. Perchlorate is expected to attenuate to its cleanup level in 15 years without

pumping. The pump and treat step is expected to actively reduce the perchlorate concentrations, thus making conditions more favorable for TCE attenuation. TCE should attenuate to MCLs in less time than 120 years. Additionally, 1,2-DCA is estimated to attenuate to its MCL in 10 years. Similar to Alternative 3, LUCs would be implemented to prevent exposure to the contaminated groundwater until cleanup levels are achieved.

Estimated Capital Present Worth Cost: $1,570,000

Estimated O&M Present Worth Cost: $520,000

Estimated Duration: 30 years

Cost Estimate Total Present Worth Cost: $2,090,000

EVALUATION OF ALTERNATIVES

Nine criteria identified in the NCP, §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 section profiles the relative performance of each alternative against the nine criteria, noting how it compares to the other alternatives under consideration. The nine evaluation criteria are discussed below. The "Detailed Analysis of Alternatives" can be found in the FS for LHAAP-17 (Shaw, 2010).

1. Overall Protection of Human Health and the Environment

The four alternatives provide varying levels of human health protection. Alternative 1, no action, does not achieve the RAOs and provides the least protection of all the alternatives; it provides no reduction in risks to human health or the environment because no measures would be implemented to eliminate the pathway for human exposure to soil or to the groundwater contamination and potential groundwater impacts to Harrison Bayou would not be addressed. Additionally, the soil pathway for ecological receptors would not be addressed.

Alternatives 2, 3, and 4 all satisfy the RAOs for LHAAP-17. They would remove the contaminated soil, restore the groundwater to cleanup levels and provide access and use restrictions for residual contamination. Alternatives 2, 3, and 4 would rely on LUCs to prevent access to the groundwater until cleanup levels are achieved by MNA. Alternatives 3 and 4 provide a level of overall protection similar to Alternative 2, but achieve cleanup levels for the shallow groundwater zone in a shorter time.

2. Compliance with ARARs

Alternative 1 does not comply with chemical-specific ARARs because no remedial action or measures would be implemented. Alternatives 2, 3, and 4 do comply with all chemical-specific ARARs for soil because the contaminated soil above the chemical-specific ARAR will be removed, and all chemical-specific groundwater ARARs because they will return the contaminated groundwater at LHAAP-17 to its potential beneficial use wherever practicable, in compliance with Safe Drinking Water Act MCLs as relevant and appropriate.

Location-specific and action-specific ARARs would not apply to Alternative 1 since no remedial activities would be conducted. Alternatives 2, 3, and 4 would comply with all location-specific and action-specific ARARs.

3. Long-Term Effectiveness and Permanence

Alternative 1 would be the least effective and permanent in the long term because no contaminant removal or treatment would take place and no measures would be implemented to control exposure risks posed by contaminated site soil and groundwater.

Alternative 2 would provide a moderate degree of long-term effectiveness by removing the source soils and providing restoration of the groundwater by MNA. LUCs would be required for groundwater for the protection of human health exposure.

Alternatives 3 and 4 would also provide a moderate degree of long-term effectiveness by removing the source soils and provide better long-term effectiveness by achieving cleanup levels in the shallow zone in a shorter time as compared to Alternative 2. Alternatives 3 and 4 would significantly reduce initial groundwater contaminant concentrations and thereafter rely on MNA and LUCs until the cleanup levels are achieved.

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

Alternative 1 does not employ treatment and would not result in a reduction of toxicity, mobility, or volume of contaminants.

Natural attenuation and in situ bioremediation or pumping/treatment coupled with excavation would permanently reduce the mass and concentration of contaminants and, therefore, the toxicity, mobility, and volume of the contaminants. MNA is a passive remedial action and in situ bioremediation is an active treatment process.

Alternatives 2, 3, and 4 would generate daughter products that may temporarily increase toxicity or mobility of the contaminant plume, with in situ bioremediation working in a shorter time frame and pumping and treatment working to reduce concentrations initially. The alternatives include monitoring so TCE daughter products would be quantified, documented and evaluated. Daughter product concentrations would be reduced under these alternatives to levels below their cleanup levels to return groundwater to its potential beneficial use as drinking water wherever practicable.

For Alternative 3, achievement of cleanup levels in groundwater would be expedited by implementing in situ bioremediation in areas of highest contaminant concentrations. Monitoring for contaminants would be performed to assess the effectiveness of the treatment. It is also anticipated that COCs would remain in the plume outside the treated areas and continue to attenuate to cleanup levels over time.

Achievement of cleanup goals would also be expedited for Alternative 4 by implementing pumping and treatment of the contaminated groundwater to reduce perchlorate concentrations throughout the plume.

The soil excavation in Alternatives 2, 3, and 4 would reduce mobility because perchlorate would be removed from the site and placed in a permitted disposal facility. Toxicity and volume would not be reduced by the excavation portion of the alternatives as the form and quantity of the perchlorate would not be altered.

5. Short-Term Effectiveness

Alternative 1 would not involve any remedial measures; therefore, no short-term risk to workers, the community or

the environment would exist. The activities associated with Alternatives 2, 3, and 4 would be protective to the surrounding community from short-term risks except for minimal potential short-term risks during transport (possible accident when soil is transported off site) of perchlorate and explosive contaminated soil.

Alternatives 2, 3, and 4 would involve potential short-term risks to workers associated with exposure to contaminated groundwater from monitoring and/or operation of drilling/construction equipment.

Alternative 3 would have short-term risks to remediation workers associated with exposure while performing in situ bioremediation activities, including handling of additives/materials.

Alternatives 2, 3, and 4 include LUCs as elements of their remedies and would provide almost immediate protection from the contaminated groundwater by prohibiting installation of potable water wells through relatively quick LUC implementation. The time period to achieve groundwater cleanup levels is the most significant difference between Alternative 1 versus Alternatives 2, 3, and 4. Alternatives 3 and 4 are expected to take less time to achieve RAOs.

Alternative 4 would have short-term risks to the workers associated with exposure during increased operations at the LHAAP groundwater treatment system, which include chemical handling (caustic acids) and operation of a high-temperature catalytic oxidizer. The implementation of Alternatives 3 and 4 would require more time than Alternative 2.

6. Implementability

Under Alternative 1, no remedial action would be taken. Therefore, no difficulties or uncertainties would be associated with its implementation. For Alternatives 2, 3, and 4, soil excavation would require extensive coordination between excavation, sampling, transportation and disposal. For groundwater, Alternatives 3 and 4 are technically implementable, although less so than Alternative 2 because of the uncertainties associated with hydrogeologic conditions. Those conditions may impact the ability of in situ bioremediation or groundwater extraction to lower perchlorate concentrations quickly to levels that would be more amenable to MNA of TCE.

Alternative 3 would involve the use of in situ bioremediation, which requires specialized expertise to design and construct the in situ bioremediation treatment elements. A groundwater treatment system currently exists at the LHAAP and is easily accessible to the site; therefore, groundwater extraction for Alternative 4 technically would be readily implementable.

Administratively, all of the alternatives are implementable.

7. Cost

Cost estimates are used in the CERCLA FS process to eliminate those remedial alternatives that would be significantly more expensive than competing alternatives without offering commensurate increases in performance or overall protection of human health or the environment. The cost estimates developed are preliminary estimates with an intended accuracy range of +50 to –30 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 estimates include capital costs (including fixed-price remedial construction) and long-term O&M costs (post-remediation). Overall present worth costs are developed for each alternative assuming a discount rate of 2.8 percent. The duration used for the estimates is a 30-year period.

The progression of present worth costs from the least expensive alternative to the most expensive alternative is as follows: Alternative 1, Alternative 2, Alternative 4, and Alternative 3. No costs are associated with Alternative 1 because no remedial activities would be conducted.

Alternative 2 has the lowest present worth and capital costs of the active remedial alternatives as no active remediation of groundwater would be implemented.

Alternative 3 has the highest present worth and capital costs primarily due to the activities associated with the injection phase of in situ bioremediation. The presence of the existing groundwater treatment system at LHAAP greatly reduces the costs associated with groundwater extraction in Alternative 4.

8. State/Support Agency Acceptance

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

9. Community Acceptance

Community acceptance of the preferred alternative will be evaluated after the public comment period ends and will be described in the record of decision (ROD) for the site.

SUMMARY OF THE PREFERRED ALTERNATIVE

Alternative 4 (excavation and off-site disposal of soil; groundwater extraction, MNA, and LUCs for groundwater) is the preferred alternative for LHAAP-17 and is consistent with the intended future use of the site as a national wildlife refuge. This alternative would satisfy the RAOs for the site through the following:

- Contaminated soil removal with off-site disposal to protect the hypothetical future maintenance worker and ecological receptors and eliminate the soil-to-groundwater pathway
- Extraction and treatment of groundwater until the trigger level of 20,000 µg/L of perchlorate is reached in order to expedite MNA
- MNA to assure protection of human health and the environment by documenting that the contaminated groundwater remains localized with minimal migration and that contaminate concentrations are being reduced to MCLs
- LUCs that would ensure protection of human health by preventing exposure to groundwater until cleanup levels are met.

If the 20,000 µg/L of perchlorate level is not reached after approximately 1.5 years, a contingency remedy, such as in situ bioremediation described in Alternative 3 may be implemented to reduce the perchlorate levels more quickly so the conditions become amenable for TCE to attenuate naturally. The monitoring and reporting associated with MNA would continue until the cleanup levels are achieved.

By extracting contaminated groundwater, Alternative 4 intends to lower the highest concentrations of perchlorate in groundwater to levels more amenable to natural attenuation. The extracted contaminated groundwater would be conveyed to the existing on-site groundwater treatment plant for treatment. The groundwater plume is contaminated with both perchlorate and TCE, and high concentrations of perchlorate tend to inhibit degradation of the TCE, so removal of much of the perchlorate by extraction is expected to accelerate the TCE degradation by MNA. The performance of natural attenuation would be evaluated after two years of monitoring using data from the eight quarters and from the historical sampling events of the prior ten years. The performance objectives for groundwater remediation will be included in the RD. If it is found that the performance objectives are not met, a contingency remedy such as in situ bioremediation (see Alternative 3 description for basic elements) would be implemented. The decision regarding use of the contingency remedy to address the groundwater contamination would be considered after two years of MNA and would be implemented, if required, after approval of the RD.

The selected alternative offers a high degree of long-term effectiveness, can be easily and immediately implemented, and costs less than the other most comparable alternative, Alternative 3.

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) criteria 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. No source materials constituting principle threats will be addressed within the scope of this action.

The Army intends to present details of the soil excavation plan, groundwater extraction plan, LUCs implementation plan, groundwater monitoring plan, and MNA remedy implementation in the RD for LHAAP-17.

The remedy selected in the ROD may change from the preferred 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. Five-Year Reviews will be performed to document that the remedy remains protective of human health and the environment.

COMMUNITY PARTICIPATION

The U.S. Army, USEPA, and TCEQ provide information regarding LHAAP-17 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 Proposed Plan.

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

PRIMARY REFERENCE DOCUMENTS FOR LHAAP-17

Jacobs Engineering Group Inc. (Jacobs), 2001, *Final Remedial Investigation Report for the Group 2 Sites Remedial Investigation (Sites 12, 17, 18/24, 29, and 32) at the Longhorn Army Ammunition Plant, Karnack, Texas,* April.

Jacobs, 2002, *Baseline Human Health and Screening Ecological Risk Assessment for the Group 2 Sites (Sites 12, 17, 18/24, 29, 32, 49, Harrison Bayou and Caddo Lake), Longhorn Army Ammunition Plant, Karnack, Texas,* February.

Planteco Environmental Consultants, LLC (PEC), 2004, *Draft Final In Situ Bioremediation of Perchlorate Contaminated Soils and Groundwater at Site-17 (Burning Ground No. 2), Longhorn Army Ammunition Plant, Karnack, Texas,* March.

Plexus Scientific Corporation (Plexus), 2005, *Final Environmental Site Assessment, Phase I and II Report, Production Areas, Longhorn Army Ammunition Plant, Karnack, Texas, Columbia, Maryland,* February.

Shaw Environmental, Inc. (Shaw), 2007a, *Final Data Gaps Investigation Report, Longhorn Army Ammunition Plant, Karnack, Texas,* April.

Shaw, 2007b, *Installation-Wide Baseline Ecological Risk Assessment, Longhorn Army Ammunition Plant, Karnack, Texas, Volume I: Step 3 Report*, Houston, Texas, November.

Shaw, 2010, *Final Feasibility Study, LHAAP-17, Burning Ground No. 2/Flashing Area, Group 2, Longhorn Army Ammunition Plant, Karnack, Texas,* Houston, Texas, April.

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

Texas Commission on Environmental Quality (TCEQ), 2006, Updated Examples of Standard No. 2, Appendix II, Medium-Specific Concentrations, March 21, 2006.

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.

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

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

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.

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.

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.

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

Hazard Index — 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.

Maximum Contaminant Level (MCL) — The maximum contaminant level 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.

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 — The actual construction or implementation phase of a Superfund site cleanup that follows remedial design.

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.

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.

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	chemical of concern
DCA	dichloroethane
DCE	dichloroethene
DNT	dinitrotoluene
ECOP	environmental condition of property
EcoPRG	ecological preliminary remediation goal
FFA	Federal Facility Agreement
FS	feasibility study
ft	feet
GW-Ind	groundwater MSC for industrial use
GWP-Ind	soil MSC for industrial use based on groundwater protection
HI	hazard index
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
MSC	medium-specific concentration
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
O&M	operation and maintenance
RAO	remedial action objective
RD	remedial design
RI	remedial investigation
ROD	record of decision
TAC	Texas Administrative Code
TCDD	tetrachlorodibenzo-p-dioxin
TCE	trichloroethene
TCEQ	Texas Commission on Environmental Quality
TEQ	toxicity equivalent quotient
TNT	trinitrotoluene
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VC	vinyl chloride
VOC	volatile organic compound

USE THIS SPACE TO WRITE YOUR COMMENTS

Your input on the Proposed Plan for LHAAP-17 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 July 10, 2010. 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.zeiler@us.army.mil