US Army Corps of Engineers ®
Omaha District

FINAL

Operable Unit 1 –

ON-POST EXPLOSIVES PLUME

Cornhusker Army Ammunition Plant, Nebraska

Proposed Plan

Submitted:

November 2024

Note to Reader

To assist the reader, when a key technical or administrative term is first introduced in this document, it appears in **bold type**. These specialized terms are listed in the Glossary of Terms in Section 11, and acronyms and abbreviations used in this document are listed in Section 12. Figures are provided at the end after the text.

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1.0 Introduction

The **U.S. Army Corps of Engineers (USACE)** is requesting public comment on this **Proposed Plan**, which presents the preferred remedial action alternative for the **Operable Unit (OU)** 1 on-post explosives plume at the **Cornhusker Army Ammunition Plant (CHAAP)** near Grand Island, Nebraska. OU1 consists of explosives-contaminated groundwater plumes at CHAAP (i.e., plumes with explosives concentrations exceeding regulatory action levels). **Health Advisory Levels (HALs)** were established for the following **explosives compounds**: **hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), 2,4,6-trinitrotoluene (TNT)**, and **octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)**. The HALs were established as regulatory action levels for CHAAP in the OU1 Interim Action Record of Decision (ROD) (U.S. Army Environmental Center [USAEC] 1994) and the subsequent OU1 ROD Amendment (URS Greiner Woodward-Clyde Federal Services [URSGWCFS] 2001). The HALs are 2 **micrograms per liter (µg/L)** for RDX and TNT and 400 µg/L for HMX.

Contaminants of concern (COCs) are the chemical substances found at the site that pose an unacceptable risk to human health or the environment. These are the substances addressed by cleanup actions at the site. The COCs at CHAAP OU1 are RDX, TNT, and HMX. HMX has not exceeded the HAL during past groundwater monitoring. The current remedy for the OU1 on-post explosive plume is groundwater pump and treatment; however, pump and treatment has been discontinued at the site to monitor the OU1 on-post explosive plume for potential migration near the CHAAP boundary. A **Focused Feasibility Study (FFS)** was developed to screen and perform analysis of remedial alternatives using data collected from a recently completed **Rebound Study** to support the termination of the pump and treatment system. The FFS was conducted according to the **Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)**, applicable CERCLA guidance, and the **National Oil and Hazardous Substances Pollution Contingency Plan (NCP)**. Throughout the FFS process, the **Nebraska Department of Environment and Energy (NDEE)** and **U.S. Environmental Protection Agency (EPA)** provided comments, which were incorporated into the Final FFS issued in April 2023. Select information from the Final FFS is presented in this Proposed Plan.

PUBLIC COMMENT PERIOD

16 February 2025 to 18 March 2025

The USACE will accept written and oral comments on the Proposed Plan during the public comment period. Written comments should be submitted to:

U.S. Army Corps of Engineers – Omaha District
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PUBLIC MEETING

USACE will hold a public meeting on 05 March 2025 at the CHAAP Army Office, 7502 West 13th Street, Grand Island, NE, at 6:00pm.

ADMINISTRATIVE RECORD

Additional information on the Proposed Plan or any of the supporting documentation is maintained at the CHAAP Administrative Record at the USACE office in Omaha and at the Grand Island Public Library located at 1124 W 2nd Street, Grand Island, Nebraska, telephone (308) 358-5333.

PREFERRED ALTERNATIVE

The preferred remedial alternative for OU1 is Alternative 3 (In-Situ Bioremediation with Groundwater Monitoring and LUCs).

USACE is required under CERCLA Sections 113(k) and 117(a) and NCP Section 300.430(f)(2) under Title 40 of the ***Code of Federal Regulations*** to issue this Proposed Plan and seek public comment and participation. The Proposed Plan is used to solicit public participation regarding actions it proposes to perform under CERCLA and the NCP (EPA 1990). CHAAP is a National Priorities List site, hence requiring regulatory concurrence of the proposed remedy. Therefore, USACE will select the proposed remedy in consultation with EPA and NDEE and document their decision in an OU1 ROD Amendment, which will include a summary of the public comments and responses.

This Proposed Plan summarizes the site background and characteristics, scope and role of the response action, and site risks (Sections 2, 3, 4, and 5), as well as the **remedial action objective (RAO)**, remedial alternatives, and evaluation of alternatives (Sections 6, 7, and 8). These topics are covered in greater detail in the *Focused Feasibility Study Operable Unit 1, Cornhusker Army Ammunition Plant* (**Brice Engineering, LLC [Brice]** 2023).

The public is encouraged to reference this Proposed Plan and related OU1 documents for specific details that may not be included in this Proposed Plan, including the ***Remedial Investigation/Feasibility Study (RI/FS)*** *Report* (ICF Kaiser 1996), which includes the risk assessment. Project-related documents are included in the **Administrative Record** at locations listed on page 1 of this document.

This Proposed Plan is issued by USACE, under authority of EPA for response actions at OU1. EPA and NDEE are support agencies providing regulatory oversight. The public comment period begins 16 February 2025 and ends on 18 Match 2025. USACE will consider the public's oral and written comments and prepare responses following the public comment period. The **Preferred Alternative** may be modified, or a different alternative may be selected based on new information or public comment.

2.0 Site Background

CHAAP is located on an 11,936-acre tract approximately 2 miles west of Grand Island, Nebraska (Figure 1). The area surrounding CHAAP is primarily rural and agricultural. The city of Grand Island, with a population of approximately 50,000, lies directly east of the plant.

CHAAP was constructed and became fully operational in 1942 as a U.S. government-owned, contractor-operated facility. During the period from September 1945 to February 1950, the plant was declared surplus, then placed in standby status under the control of the Ordnance Corps, U.S. Army. Use of the buildings was primarily for grain storage, except for the Nitrate Area, which was used to manufacture fertilizer until April 1948. In April 1950, CHAAP again became an active installation with the rehabilitation of **Load Line (LL)** 1 and applicable operations for the production of 3.5-inch high explosive rockets. The plant was laid away in 1974 but maintained in a high state of readiness until January 1989 when the plant was declared in excess.

CHAAP includes five former load lines, LL1 through LL5. Other former sites include the Administration Base Housing Area, two Magazine Areas, the Fuze Line, storage and dock facilities, Shop Area, Nitrate Area, CHAAP-05 Open Burning/Open Detonation Burning Grounds, Abandoned Burning Area, Sanitary Landfill, and Pistol Range Burning Grounds/Decant Station Area. Additional detail and information on each of these CHAAP sites is presented in the FFS (Brice 2023).

Currently, activities at CHAAP are limited to groundwater remediation at the **Groundwater Treatment Facility (GWTF)**; leasing property for agriculture; leasing buildings for storage and limited manufacturing; wildlife management; and minor maintenance of the grounds, roads, and leased facilities. The majority of CHAAP property has been transferred to the public over the past 10 to 15 years.

From 1987 to 1988, the U.S. Army completed an incineration project designed to excavate and treat soil beneath the unlined leach pits and cesspools at the CHAAP load lines to remove soil sources of explosives contamination. The project reduced the explosives contamination at these source areas; however, explosives concentrations exceeding the action levels remain below the water table and may represent continuous source areas until source area **remedial actions** (e.g., explosives-contaminated soil removals and subsurface injections [described below]) are completed.

Annual groundwater monitoring of the OU1 on-post explosives plume was initiated in 1994 and includes measuring of sitewide water levels and sampling of monitoring wells throughout the OU1 on-post explosives plumes. Results of the groundwater monitoring efforts are presented in annual reports and presented at annual stakeholder and public meetings.

Other various sampling efforts were completed between 1991 and 1994 and were summarized in the RI/FS Report (ICF Kaiser 1996). This report indicated that unacceptable levels of adverse non-carcinogenic effects associated with explosives in groundwater may occur. As a result, the OU1 Interim ROD was signed in 1994 and selected groundwater extraction and treatment as the remedy for the OU1 on-post groundwater explosive plume. The OU1

ROD Amendment was subsequently signed in 2000 and revised the remedy to include optimized groundwater extraction rates and an additional **extraction well (EW)**.

The GWTF with seven EWs was constructed in Summer 1998, and full-time operation began in December 1998. The GWTF treated groundwater for explosives using **granular activated carbon** absorption technology for treatment, then discharged the treated water to the two on-post drainage canals leading to Silver Creek. Pumping to the GWTF at three EWs was discontinued in 2000 due to non-detection of **explosive compounds**; however, pumping at the four remaining EWs continued. In 2009, pumping was discontinued at EW-4, EW-5, and EW-6 to allow source treatment via subsurface injection, and the pumping rate at EW7 was increased to maintain hydraulic control. Based on subsequent monitoring and modeling, EW7 pumping and GWTF operations ceased in October 2019. The system was placed in "standby" status to accommodate an OU1 rebound study and additional injections (see below).

Between 2000 and 2005, thermal decomposition, demolition, decontamination of property, facilities, equipment, and soil were performed at LL1, LL2, LL3, and LL4 to reduce remaining explosives hazards and prepare for reuse. Additionally, explosives-contaminated soil investigations and soil excavations at LL1, LL2, and LL3 were completed in 2006 and at LL4 in 2007. These excavations addressed explosives-contaminated surface soil and subsurface soil at previously identified source areas. Soil with explosives concentrations greater than the CHAAP industrial risk soil remediation levels was excavated and disposed of at an approved offsite disposal facility. Since completion of the soil excavation project, groundwater is considered the only potentially contaminated medium.

The OU1 Remedial Action-Operations subsurface injection project is a previous voluntary action (not part of the current OU1 remedy for the on-post explosive plume), that was implemented to determine if the remediation of groundwater at CHAAP could be expedited through the use of subsurface injection of amendments. The subsurface injection project began in Spring 2007 and was performed through 2016; and again in 2019 and 2020. The purpose is to enhance **anaerobic in situ bioremediation** processes and **cometabolically** degrade RDX and TNT at the primary source areas near EW1, EW4, EW5, and EW6; and residual concentrations near EW7 (in 2019 and 2020). In the first 3 years of completing subsurface injections, contaminant mass was reduced over 90% in the treatment zones. Implementation of the subsurface injection project also resulted in the shutdown of three EWs (EW4, EW5, and EW6) in the first 5 years. Recent injections completed in 2019 and 2020 have significantly reduced contaminant mass near EW7 and reduced RDX concentrations to less than the HAL of 2 µg/L. Groundwater contaminant fate and transport modeling has shown that the site remediation timeframe has been significantly reduced as a result of the subsurface injections. Results of the subsurface injection activities are presented in annual reports and presented at annual stakeholder and public meetings.

Based on previous statistical analysis and historical numerical groundwater modeling simulations, an OU1 Rebound Study (Brice-AECOM 2022a) was initiated in 2018 to temporarily discontinue pumping at EW7 and monitor groundwater near the former facility boundary. Concurrent with the OU1 Rebound Study, subsurface injections were completed in 2019 and 2020 to accelerate remedial timeframes. Based on the OU1 Rebound Study results, it was recommended to discontinue the OU1 Rebound Study, continue annual groundwater monitoring at OU1, and proceed with an FFS. Results of the OU1 Rebound Study activities were presented in the quarterly OU1 Rebound Study reports and were presented at annual stakeholder and public meetings.

3.0 Site Characteristics

As discussed in the OU1 Interim Action ROD (USAEC 1994) and the subsequent OU1 ROD Amendment (URSGWCFS 2001), explosive wastes and residues may have been released into groundwater from past site activities including munitions loading, assembly, and packing operations and may be significant contributors to human health risks. Based on current sampling results from the Final *2022 Annual Groundwater Monitoring and Report* (Brice-AECOM 2022b), analytes identified in the OU1 on-post explosive plume are:

- RDX (HAL = 2 µg/L, maximum concentration = 37 µg/L)
- TNT (HAL = 2 µg/L, maximum concentration = 39 µg/L)
- 1,3-dinitrobenzene (HAL = N/A, maximum concentration = 8.1 µg/L)
- 2,4-dinitrotoluene (HAL = N/A, maximum concentration = 0.85 µg/L)

- HMX (HAL = 400 µg/L, maximum concentration = 19 µg/L)
- 1,3,5-trinitrobenzene (HAL = N/A, maximum concentration = 22 µg/L)
- 2-amino-4,6-dinitrotoluene (2-Am-DNT) (HAL = N/A, maximum concentration = 45 µg/L)
- 4-amino-2,6-dinitrotoluene (4-Am-DNT) (HAL = N/A, maximum concentration = 47 µg/L)
- mono-nitroso-RDX (MNX) (HAL = N/A, maximum concentration = 0.65 µg/L)

Only RDX, TNT, and HMX are COCs, as they have been detected in the OU1 on-post explosives plume at concentrations greater than $1x10^{-6}$ risk levels. The other analytes listed above (degradation products) have not been detected at concentrations greater than $1x10^{-6}$ risk levels and will continue to be monitored under the annual groundwater monitoring program.

The current OU1 on-post area of the explosives plume (shown on Figure 2) is comprised of the above analytes exceeding HALs at concentrations between 2 µg/L and 39 µg/L. The current horizontal extent of the OU1 explosive plume includes six small, isolated plumes at LL1 and LL2 and a larger plume to the east of LL1 that expands approximately 1,500 feet from just west of LL1 to EW7 to approximately 1,500 feet east of the on-post boundary (North 60th Road). The OU1 explosives plume is approximately 800 feet at its widest. The vertical extent of the OU1 explosives plume expands from just below the water table, at approximately 20 feet below ground surface (bgs) to approximately 50 feet bgs. Long-term monitoring and direct push monitoring shows the current OU1 explosives plume to be shrinking or stable (not migrating) with concentrations declining or staying relatively the same. The most recent estimates in the Final *2022 Annual Groundwater Monitoring and Report* (Brice-AECOM 2022b) indicate the volume of explosives mass remaining in the OU1 plume at CHAAP is approximately 18.75 pounds.

4.0 Scope and Role of Response Action

The OU1 explosives plume is being managed under CERCLA at CHAAP and is the result of past explosives waste disposal practices. The Preferred Alternative (**In-Situ Bioremediation with Groundwater Monitoring and Land Use Controls [LUCs]**) addresses the medium of concern (groundwater) as identified in previous investigations and would be the final remedial action for the COCs identified. The elements of groundwater monitoring would include annual monitoring of the OU1 explosives plume to evaluate attenuation of explosives contamination using the existing monitoring well network. Monitoring would include collecting groundwater elevations, groundwater quality screening data, and groundwater samples for laboratory analysis of explosives and groundwater quality parameters.

In-situ bioremediation would be implemented by completing subsurface injections in the upgradient areas of the plume to inhibit increasing explosives concentrations or explosives plume migration further into the off-post area. Subsurface injections will also be used to reduce the overall site remediation timeframes and move the site one step closer to site closeout.

The Preferred Alternative would also include implementation of LUCs to ensure the existing LUCs continue to restrict access to groundwater contaminated with COCs at concentrations greater than cleanup goals.

5.0 Summary of Site Risks

It is the lead agency's current judgment 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 human health or welfare from actual or threatened releases of hazardous substances into the environment.

The RI/FS Report (ICF Kaiser 1996) included a risk assessment to estimate current and future risks to human health and the environment from exposures to contaminated groundwater. Although the levels of explosives in on-post groundwater were elevated, there are many uncertainties in predicting the risk estimates, including the assumption that residents would actually consume on-post explosives impacted groundwater on a regular basis.

Estimated risks for carcinogens (potentially cancer-causing chemicals) were compared to the NCP acceptable range (i.e., the target risk range of one in a million to one in ten thousand [$1x10^{-6}$ to $1x10^{-4}$] for human health protection at Superfund sites). Chemicals with completed pathways that exceed a risk of $1x10^{-6}$ usually warrant remedial action

under **Applicable or Relevant and Appropriate Requirements (ARARs)**. ARARs for this action are listed in Appendix A of the FFS.

Non-carcinogenic chemical concentrations were compared to a hazard quotient of 1.0. Chemicals that are present in concentrations that exceed a hazard quotient of 1.0 usually warrant remedial action.

Since completion of the soil excavation project, during which all soil exceeding the CHAAP industrial risk soil remediation levels were removed from the site, groundwater is considered the only potentially contaminated medium. No risks are associated with soil at the site.

The following sections summarize the estimation of groundwater risks presented in the 1996 RI/FS.

5.1 Estimated Groundwater Risks

For ingestion of explosives-contaminated groundwater, the risk estimates indicated excess lifetime cancer risks greater than the $1x10^{-6}$ risk level. In addition, it was determined that unacceptable levels of adverse non-carcinogenic effects associated with explosives in groundwater may occur. This exposure pathway for the on-post area was eliminated because CHAAP implemented deed restrictions in the early 2000s prohibiting drinking water supply wells on excessed property (property formerly owned by the government and part of CHAAP) in the vicinity of the plume. As part of the 2001 ROD Amendment (URSGWCFS 2001) the City of Grand Island "Overlay Zone" was established for potentially impacted off-post areas, which designates an institutional control area where it is prohibited to drill drinking water supply wells. Annually, the City of Grand Island Building Department is provided georeferenced computer-aided drafting files and a copy of the off-site map containing the most recent off-post concentration levels. Additionally, as local drilling controls, the Central Platte Natural Resources District (CPNRD) put into effect, on January 5, 2016, a suspension on the drilling of new wells and the issuance of permits to construct new wells for groundwater use in fully and over appropriated areas in Grand Island and surrounding areas. This suspension is for the installation of all wells including municipal, industrial, and irrigation wells and is still in effect. CPNRD's Groundwater Quantity Management Plan (CPNRD 2022) provides current rules and regulations for transfers, variances and offsets, and exemptions for groundwater use in fully and over appropriated areas, which includes 6 to 8 miles along the Platte River throughout the CPNRD and the CHAAP plume area. The CPNRD suspension of new well installation includes, but is not specific to, the CHAAP plume area.

Although the OU1 Rebound Study and annual groundwater monitoring events completed since October 2019 have proven that the explosives concentrations continue to decline and the explosives plume is stable and not migrating, a change in site conditions or restrictions may create potential for future offsite explosives plume migration, which could impact existing downgradient private drinking water wells and receptors.

- Future cancer risk estimates associated with the future ingestion of crops irrigated with on-post groundwater were at the low end of the $1x10^{-6}$ risk range, and the non-carcinogenic hazard indexes were less than 1.0. These low risk estimates demonstrate, based on the assumptions made in the risk assessment, that there are no unacceptable cancer risks and no unacceptable adverse health effects from exposure to explosives in vegetables that have been irrigated with CHAAP groundwater.
- There are no estimated risks to ecological receptors because on-post groundwater is inaccessible to ecological receptors at CHAAP.
- Risks associated with other organic and inorganic chemicals in groundwater were estimated to be at acceptable levels.

The COCs exceeding the HALs within the plume have been identified as RDX and TNT. The most recent data shows that on-post concentrations of RDX and TNT above HALs range from 2 µg/L – 37 µg/L and 2 µg/L – 39 µg/L, respectively. Until the COCs are reduced to concentrations below HALs and drinking water limits, it is assumed that the deed restriction will remain in place and no development will be possible at the property due to the potential risks.

6.0 Remedial Action Objective

Pursuant to NCP Section 300.430(e)(2)(i), RAOs are established to assist in the development of alternatives. RAO(s) specify the COCs and media; exposure pathways and receptors; and preliminary **cleanup goals**. The OU1 ROD (USAEC 1994) and the subsequent OU1 ROD Amendment (URSGWCFS 2001) established RAOs for explosives in groundwater at CHAAP and have been revised for the new proposed remedy.

Applicable or Relevant and Appropriate Requirements (ARARs):
A state and/or federal environmental regulation that is applicable to, or relevant and appropriate for, a particular chemical, action, or location.

To-Be-Considered (TBC):
Non-promulgated materials such as advisories or guidance that are not legally binding but can be used when ARARs are not sufficient.

The COCs in groundwater for OU1 include explosives compounds RDX, TNT, and HMX. These compounds were selected for the OU1 COCs because of their historical use, frequency of occurrence, magnitude of detected concentrations, and potential adverse health effects.

HALs for the explosive compounds RDX, HMX, and TNT were established as cleanup goals for CHAAP in the OU1 ROD (USAEC 1994) and the subsequent OU1 ROD Amendment (URSGWCFS 2001) and remain unchanged. HMX has never been detected at concentrations greater than the HAL.

OU1 HALs:

- 2 µg/L for RDX and TNT
- 400 µg/L for HMX

The RAO established for OU1 is based on existing site knowledge, potential site risks, and current and future potential human health risks at the site. ARARs and **To-Be-Considered (TBC)** criteria were identified in developing the RAOs. Achievement of this RAO will allow regulatory site closure with unrestricted site use potential. Furthermore, these RAOs will eliminate human health risks at OU1. The RAOs for CHAAP groundwater are:

- Protect human health and the environment
- Clean up explosives-contaminated groundwater to less than HALs of 2 µg/L for RDX and TNT and 400 µg/L for HMX

7.0 Summary of Alternatives

The FFS developed three remedial action alternatives for OU1, which are designed to satisfy the RAOs.

7.1 Alternative 1: No Action

Alternative 1 assumes that no remedial action would be implemented. This alternative is required by the NCP and serves as a baseline against which other alternatives are compared.

Under No Action, contaminants would not reduce in concentration, and risks to potential human receptors from exposure to groundwater would remain for an indefinite period.

7.2 Alternative 2: Monitored Natural Attenuation with Land Use Controls

Alternative 2 is a non-treatment method consisting of monitored natural attenuation (MNA) with LUCs. The plume would be monitored annually for attenuation of explosives contamination using the monitoring well network (Figure 3) comprised of 76 monitoring wells. Monitoring would include collecting groundwater elevations, MNA screening data (including field water quality measurements [pH, temperature, dissolved oxygen, oxidation reduction potential, conductivity, turbidity, and ferrous iron]), and groundwater samples for laboratory analysis of explosives (including primary and secondary explosives breakdown products) and MNA parameters (alkalinity, carbon dioxide, dissolved organic carbon, methane, nitrate/nitrite, ammonia, sulfate, sulfide, and total organic carbon) at the monitoring wells. The remediation timeframe for the plume without active treatment is estimated to be approximately 8 years based

on groundwater modeling, and it is assumed that groundwater monitoring would occur over the full amount of time. The monitoring well network would be sampled annually for an additional 10 years (18 years total) to verify contaminant rebound was not occurring. It is expected that the number of monitoring wells that require sampling and the frequency of the sampling would decrease as the plume recedes. The monitoring well network would be optimized annually using a multiple lines-of-evidence approach similar to the Modified Cost Effective Sampling method described in the Monitoring and Remediation Optimization System (MAROS) User's Manual.

LUCs would continue to restrict access to groundwater contaminated with COCs at concentrations greater than cleanup goals.

7.3 Alternative 3: In-Situ Bioremediation with Groundwater Monitoring and Land Use Controls

Alternative 3 continues treatment of COCs in groundwater with subsurface injections, in-situ bioremediation, groundwater monitoring, and LUCs. The areas with remaining residual concentrations that pose a threat of potential off-post migration would be treated by injecting a combination of blackstrap molasses mixed with whey, hydrolyzed vegetable oil, and corn steep into the subsurface to enhance anaerobic in-situ bioremediation processes and cometabolically biodegrade the explosives in the plume. This injection fluid serves as a source of organic carbon for indigenous bacteria to consume, which produce enzymes that create the anaerobic environment allowing for anaerobic degradation of explosives in groundwater. These naturally occurring processes would reduce concentrations of COCs in groundwater within and outside of the treatment area once injections are completed. After injections are complete, groundwater monitoring would be implemented for the entirety of the plume at the monitoring wells as described in Alternative 2. Under these conditions, the remediation timeframe for the explosives plume is estimated to be approximately 6 years based on groundwater modeling and site sampling after previous injection events.

The monitoring well network would be sampled annually for an additional 10 years (16 years total) for detection of COCs and groundwater quality parameters to verify contaminant rebound was not occurring and that the aquifer has been fully restored. It is expected that the number of monitoring wells that require sampling and the frequency of the sampling would decrease as the plume recedes. The monitoring well network would be optimized annually using a multiple lines-of-evidence approach similar to the Modified Cost Effective Sampling method described in the MAROS User's Manual. Successful implementation will be demonstrated by an ongoing reduction in concentration of COCs and eventual reduction below HALs. In the event that RAOs are not met under this alternative option, discussions will be held between stakeholders to identify the appropriateness of additional injections and/or alternative methods.

LUCs would continue to restrict access to groundwater contaminated with COCs at concentrations greater than cleanup goals.

8.0 Evaluation of Alternatives

Nine criteria are used to evaluate the remediation alternatives individually and against each other to select a remedy in accordance with CERCLA. The nine criteria are divided into three categories: threshold, balancing, and modifying. Threshold criteria must be met to be eligible for selection as a remedial action. Balancing criteria weigh the tradeoffs between alternatives, allowing low ratings on one balancing criterion to be compensated by a high rating on another. Modifying criteria may be considered to the extent of currently available information but can be fully considered only after public review of the Proposed Plan. The evaluation of remedial alternatives and relative rankings presented in this Proposed Plan is based on the information provided in the OU1 on-post explosives plume FFS.

CERCLA Nine Evaluation Criteria

	Threshold Criteria
1	**Overall Protection of Human Health and the Environment.** Will the alternative adequately protect human health and the environment against unacceptable risk?

2	**Compliance with ARARs.** Does the alternative attain all federal and state laws and regulations that are either "applicable" or "relevant and appropriate" to the circumstances found at a particular site or provide grounds to invoke a waiver? Does the alternative attain compliance with any TBCs that have been identified when ARARs are not sufficiently protective?
	Balancing Criteria
3	**Long-Term Effectiveness and Permanence.** Does the alternative maintain protection of human health and the environment over time?
4	**Reduction in Toxicity, Mobility, or Volume through Treatment.** Will the alternative use treatment to reduce the toxicity, reduce the volume of the contaminants, or reduce their ability to migrate?
5	**Short-Term Effectiveness (Impact on Community).** What risks would implementing the alternative have on the community, workers, and environment; and how long until the RAO is achieved?
6	**Implementability.** Can the alternative be practically and successfully implemented, considering any technical and administrative issues that may need to be addressed?
7	**Cost.** What is the cost to design, build, and implement the remedy?
	Modifying Criteria
8	**State Acceptance.** Does NDEE accept, oppose, or have comments on the alternative?
9	**Community Acceptance.** Does the community accept, oppose, or have comments on the alternative? (Evaluated after public comment period.)

8.1 Overall Protection of Human Health and the Environment

Alternative 1: No Action would not provide any protection and would not mitigate the potential unacceptable risks to human health and the environment as outlined in the risk assessment.

Alternative 2: MNA with LUCs would limit exposure pathways through the use of LUCs and provide monitoring as an early warning if the plume were to migrate.

Alternative 3: In-Situ Bioremediation with Groundwater Monitoring and LUCs would reduce risk and support restoration of groundwater with the subsurface injections in addition to providing the same protections as Alternative 2. The explosives are not expected to have a negative impact on the ecosystem because the groundwater is inaccessible to ecological receptors.

8.2 Compliance with Applicable or Relevant and Appropriate Requirements

Alternative 1: Compliance with ARARs is not applicable for No Action as CERCLA Section 121, "Cleanup Standards" applies only to remedial actions that EPA determines should be taken under CERCLA Sections 104 and 106 authority.

Alternatives 2 and 3: These alternatives would be expected to meet ARARs upon completion of the remedial action, and waivers would not be required.

8.3 Long-Term Effectiveness and Permanence

Alternative 1: No Action would not provide long-term protection of human health and the environment and would leave a residual risk. Risks to potential future residents would remain indefinitely.

Alternatives 2 and 3: Both MNA with LUCs and MNA with LUCs and Subsurface Injections are field proven at CHAAP and would provide a long-term and permanent remedy that would achieve the cleanup goals. The magnitude of the natural attenuation processes would be governed by the prevailing site conditions and the nature of the compounds. Residual contamination will pose no unacceptable human health or environmental risk.

8.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 1: No Action would not lead to a reduction of the **toxicity, mobility, or volume (TMV)** of contaminants.

Alternative 2: MNA with LUCs would reduce the TMV of COCs in groundwater over time through naturally occurring processes and would not generate a waste stream. This alternative does not include active treatment.

Alternative 3: In-Situ Bioremediation with Groundwater Monitoring and LUCs would reduce the TMV of COCs in groundwater. The hot spots would be treated with injections to enhance anaerobic in situ bioremediation processes and cometabolically biodegrade the explosives in the plume. Modeling indicates there would be continued reduction of the plume.

8.5 Short-Term Effectiveness

Alternative 1: No Action would not result in short-term impacts because no remedial action would be implemented.

Alternatives 2 and 3: The remediation timeframe is estimated to be 18 years for Alternative 2 and 16 years for Alternative 3. Since the plume is away from residential areas, potential short-term impact on the community is low for both Alternatives 2 and 3. Since the plume is located in plowed agricultural fields, potential short-term impacts on the environment is low for Alternatives 2 and 3. Site workers would need to take proper safety precautions during monitoring and/or subsurface injection activities.

8.6 Implementability

Alternative 1: No Action is technically and administratively feasible because there is nothing to implement.

Alternative 2: MNA with LUCs is technically feasible because it would require monitoring the plume for natural attenuation using the existing monitoring well network. MNA is unlikely to negatively affect natural resources and would require limited **operation and maintenance (O&M)**. MNA is field proven at CHAAP, sampling and analysis are easily implemented, and personnel, equipment, and materials are readily available. MNA with LUCs is also administratively feasible because existing deed restrictions, the Hall County Zoning Plan (JEO 2004), and well drilling records are easily accessible to verify LUCs continue to restrict access to groundwater contaminated with COCs at concentrations greater than cleanup goals.

Alternative 3: In-Situ Bioremediation with Groundwater Monitoring and LUCs is technically feasible using conventional and available equipment for subsurface injections and the existing monitoring well network for in-situ bioremediation and groundwater monitoring. In-situ bioremediation and groundwater monitoring is unlikely to affect natural resources and would require limited O&M. In-situ bioremediation is field proven at CHAAP, sampling and analysis are easily implemented, subsurface injections are easily implemented, and personnel, equipment, and materials are readily available. In-situ bioremediation with groundwater monitoring and LUCs is also administratively feasible because the required subsurface injection permits can be easily obtained and existing deed restrictions, the Hall County Zoning Plan, and well drilling records are easily accessible to verify LUCs continue to restrict access to groundwater contaminated with COCs at concentrations greater than cleanup goals.

Alternative 1 is considered the easiest of the three alternatives to implement because there is nothing to implement. However, because the monitoring well network is already in place, Alternatives 2 and 3 would be implemented easily with some coordination with the landowners.

8.7 Cost

The estimated total costs for each alternative are as follows:

- **Alternative 1:** $0 No capital, O&M, or periodic costs
- **Alternative 2:** $8,735,185 Associated with monitoring and LUCs
- **Alternative 3:** $10,668,544 Associated with in-situ bioremediation, groundwater monitoring and LUCs

8.8 Regulatory Acceptance

Alternatives 1, 2, and 3 were presented in the EPA- and NDEE-approved FFS (Brice 2023). USACE will select the proposed remedy in consultation with EPA and NDEE and document their decision in an OU1 ROD Amendment.

8.9 Community Acceptance

This criterion will be evaluated through the public comment and response period for the Proposed Plan. Community acceptance will be evaluated once public comments on the Proposed Plan have been received.

9.0 Preferred Alternative

The preferred remedial alternative for OU1 is Alternative 3 (**In-Situ Bioremediation with Groundwater Monitoring and LUCs**). Alternative 3 continues treatment of COCs in groundwater with in-situ bioremediation to satisfy ARARs and TBCs would achieve the RAOs.

Based on the information currently available, USACE (the lead agency) believes the Preferred Alternative meets the threshold criteria and provides the best balance of tradeoffs with respect to the balancing and modifying criteria. USACE expects the Preferred Alternative to satisfy the following applicable statutory requirements of CERCLA Section 121(b): (1) be protective of human health and the environment, (2) comply with ARARs (or justify a waiver), (3) be cost effective, (4) be easily implementable, (5) provide short-term effectiveness and restrict access to explosives-contaminated groundwater at concentrations greater than cleanup goals, (6) use permanent solutions and proven alternative treatment technologies (subsurface injections) to reduce the potential for offsite plume migration, (7) satisfy the preference for treatment as a principal element and provide significant reduction of TMV of explosives in groundwater over just MNA and LUCs, (8) have NDEE acceptance, and (9) have community acceptance.

The preferred alternative is chosen based on historic evidence that it will reduce COCs below HALs and that restoration of the site will occur at an accelerated rate compared with Alternative 2, which includes no active remediation and relies solely on MNA and groundwater monitoring. Achieving site restoration at an accelerated rate will reduce the overall life-cycle costs. A ROD Amendment will be prepared prior to implementation of the preferred alternative. The ROD Amendment is necessary for the remedy to advance from the presently-approved pump-and-treat system to the proposed in-situ bioremediation with groundwater monitoring and LUCs.

The efficacy of this treatment option would be amenable to the public since the aquifer restoration will occur more quickly to meet the public health initiatives outlined in the Hall County Zoning Plan, as well as allow for the lifting of deed restrictions which will open up the property to future development and contribute to prosperity in the area. The activities will essentially replicate those which have already occurred onsite and have already met approval at the state and federal levels. Evidence from those prior activities, provided in the Rebound Study, supports in-situ bioremediation as a feasible method to produce tangible results that achieve site closure in a reduced amount of time.

10.0 Community Participation

A public comment period is provided for this Proposed Plan. Public comments on this document are encouraged and will be evaluated to assess the community's acceptance of the Preferred Alternative and will be documented in the responsiveness summary included in a new amendment to the 2001 ROD Amendment and 1994 Interim ROD. USACE will hold a public meeting on 05 March 2025 at the CHAAP Army Office, 7502 West 13th Street, Grand Island, NE, at 6:00pm. USACE, EPA, and NDEE encourage the public to gain a more comprehensive understanding of the site history and environmental investigations that have been conducted at the site. Refer to page 1 for more information on accessing the Administrative Record files.

The public comment period begins 16 February 2025 and ends 18 March 2025. Public comments should be sent during the public comment period to Bobbi Jo Trout, USACE Project Manager, in order to be considered.

U.S. Army Corps of Engineers-Omaha District
Attn: Ms. Bobbi Jo Trout – Remedial Project Manager CENWO-PM-HB
1616 Capital Drive
Omaha, NE 68102-4901
Phone: (402) 995-2738
E-mail: bobbi.j.trout@usace.army.mil

11.0 References

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12.0 Glossary of Terms

Administrative Record: The Administrative Record consists of the documents (including studies, plans, and reports) used in the decision-making process and to document the remedial process.

Anaerobic In Situ Bioremediation: The process of introducing physical, chemical, or biological change to the aquifer to create conditions necessary for microorganisms to transform contaminants of concern to innocuous byproducts.

Applicable or Relevant and Appropriate Requirement (ARAR): These substantive requirements of state and federal statutes regulate specific environmental contaminants, locations, or remedial actions to ensure protection of human health and the environment.

Cleanup Goals: Target concentrations for contaminants in the affected environmental media (groundwater for OU1) that are estimated to result in protection of human health.

Cometabolically: Cometabolic bioremediation occurs when an enzyme or cofactor, produced by a microbe to catalyze the degradation of its metabolic substrate, is also capable of degrading target compounds. Cometabolic bioremediation is designed to target COCs by stimulating or augmenting this biological process.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): A federal law (42 United States Code Section 9601) passed in 1980 that established programs to identify hazardous waste sites, ensure cleanup when necessary, evaluate damages to natural resources, and create claims procedures for parties who clean up the sites. Commonly known as "Superfund," CERCLA was amended in 1986 by the Superfund Amendments and Reauthorization Act.

Contaminant of Concern (COC): COCs are the chemical substances found at the site that pose an unacceptable risk to human health or the environment. These are the substances addressed by cleanup actions at the site.

Explosive Compounds: An explosive is any chemical compound or mechanical mixture that, when subjected to heat, impact, friction, detonation, or other suitable initiation, undergoes rapid chemical change, evolving large volumes of highly heated gases—typically nitrogen or carbon dioxide—that exert pressure on the surrounding medium. CHAAP explosives compounds include hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), 2,4,6-trinitrotoluene (TNT), and octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX).

Focused Feasibility Study (FFS): The process of developing and evaluating remedial action alternatives.

Granular activated carbon: A porous adsorption media with extremely high ternal surface area useful for the removal of taste- and odor-producing compounds, natural organic matter, volatile organic compounds, synthetic organic compounds and disinfection byproduct precursors.

Land Use Controls (LUCs): Consist of non-engineered instruments, such as administrative and legal controls or engineered and physical barriers, such as fences and security guards. LUCs help to minimize the potential for exposure to contamination and/or protect the integrity of a response action and are typically designed to work by limiting land and/or resource use by providing information that helps modify or guide human behavior at a site.

Monitored Natural Attenuation (MNA): A strategy that relies on natural processes to decrease concentrations of contaminants in soil and groundwater, monitored by collection of soil and/or groundwater samples to analyze for the presence of contaminants and other site characteristics.

National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR 300): These federal regulations define the implementation requirements of CERCLA. The NCP provides the organizational structure and procedures for addressing federal Superfund sites.

Nebraska Department of Environment and Energy (NDEE): The lead state agency responsible for overseeing the cleanup efforts at CHAAP.

Operable Unit (OU): A distinct part of an entire cleanup action. An OU may be established based on a particular type of contamination, contaminated media (for example, soil, groundwater), source of contamination, or geographical location.

Preferred Alternative: The alternative proposed by the lead agency (in this case USACE) that best meets the cleanup objectives.

Proposed Plan: A document prepared by the lead agency (in this case USACE) and made available to the public to inform the public about alternatives considered to remediate a contaminated site. This document also describes the Preferred Alternative(s) for site remediation.

Rebound Study: A study to test previous statistical analysis and historical numerical groundwater modeling simulations. The objective of a Rebound Study is to establish a sufficient data set to determine whether groundwater extraction is no longer needed, groundwater extraction should be resumed, or alternative actions should be taken.

Record of Decision (ROD): USACE uses the term “Record of Decision” for the documentation of remedial response decisions. Concurrence on the ROD by EPA and NDEE is sought, and USACE approves the documentation.

ROD Amendment: Based on knowledge gained from implementation of the selected remedy, a ROD Amendment specifies changes to the assumptions regarding the work procedures employed to implement the selected remedy and additional requirements.

Remedial Action: An action taken to eliminate, reduce, or control hazards posed by a site.

Remedial Action Objective (RAO): An RAO is the site condition to be achieved following completion of the remedial action with respect to site-specific COCs and maximum residual concentrations in the impacted environmental media.

Remedial Investigation (RI): Investigation to characterize the nature and extent of contamination and to assess the current and future risks to human health and the environment.

Subsurface Injection: Emplacing fluids in a permeable underground aquifer by gravity flow or under pressure through an injection well.

To-Be-Considered (TBC): Non-promulgated materials such as advisories or guidance that are not legally binding but can be used when ARARs are not sufficient.

Toxicity, Mobility, or Volume (TMV): Within the CERCLA framework, the ability of the Preferred Alternative to reduce toxicity (the quality of being toxic or poisonous), mobility (the ability to move or be moved freely or easily), or volume (quantity) of the specified contamination is evaluated.

Treatment: A term to describe a remedial process that reduces the TMV of contaminated media (groundwater at OU1).

U.S. Environmental Protection Agency (EPA): The federal agency responsible for overseeing the cleanup efforts at CHAAP.

13.0 List of Acronyms and Abbreviations

µg/L	micrograms per liter
ARAR	Applicable or Relevant and Appropriate Requirement
bgs	below ground surface
Brice	Brice Engineering, LLC
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHAAP	Cornhusker Army Ammunition Plant
COC	contaminant of concern
EPA	U.S. Environmental Protection Agency
EW	extraction well
FFS	Focused Feasibility Study
GWTF	Groundwater Treatment Facility
HAL	Health Advisory Level
HMX	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
LL	Load Line
LUC	land use control
MAROS	Monitoring and Remediation Optimization System
MNA	monitored natural attenuation
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NDEE	Nebraska Department of Environment and Energy
O&M	operation and maintenance
OU	Operable Unit
RAO	remedial action objective
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
TBC	To-Be-Considered
TMV	toxicity, mobility, or volume
TNT	2,4,6-trinitrotoluene
URSGWCFS	URS Greiner Woodward-Clyde Federal Services
USACE	U.S. Army Corps of Engineers
USAEC	U.S. Army Environmental Center

Figure 1 CHAAP Location Map

Figure 2 Site Layout

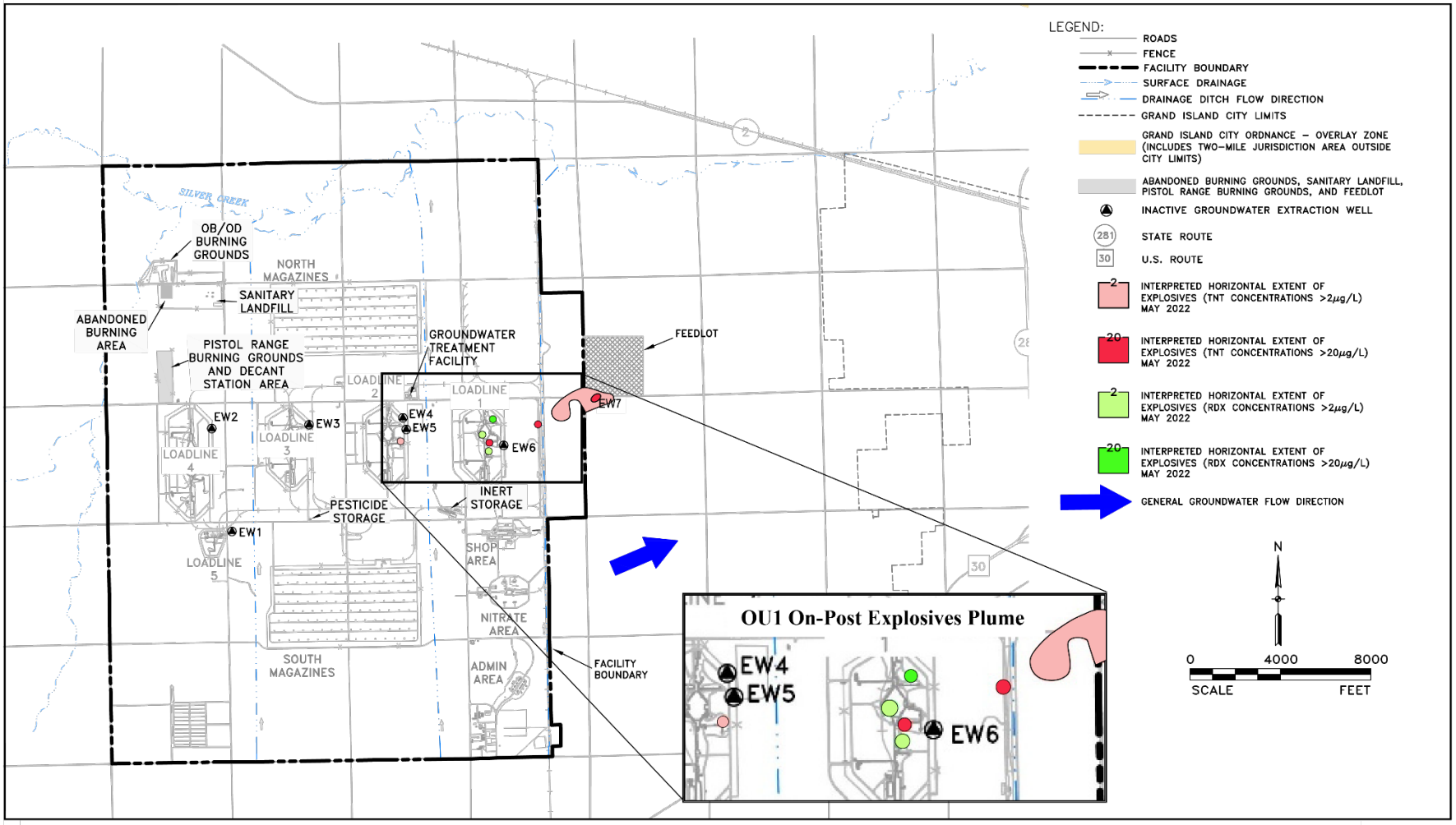

Figure 3 OU1 On-Post Monitoring Well Network and May 2022 Explosives Plume