EPA/ROD/R07-00/105
2000

EPA Superfund
Record of Decision:

CORNHUSKER ARMY AMMUNITION PLANT
EPA ID: NE2213820234
OU 03
HALL COUNTY, NE
12/14/1999

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VII
901 NORTH 5TH STREET
KANSAS CITY, KANSAS 66101

January 20, 2000

Ms. Angie Wright
U.S. Environmental Protection Agency
Superfund Docket (5202G)
401 M Street SW
Washington, DC 20460

Dear Ms. Wright:

Enclosed is the Record of Decision for Cornhusker Army Ammunition Plant, Operable Unit 3, Grand Island, Nebraska.

Please let me know if you have any questions. I may be reached at (913) 551-7659.

Sincerely,

Evelyn VanGoethem
Superfund Division

Enclosure

US Army Corps of Engineers
Omaha District

Delivery Order No. DA01
Total Environmental Program Support
Contract Number DAAA15-91-D-0014

CORNHUSKER ARMY AMMUNITION PLANT

Record of Decision for Remedial Action Operable Unit Three

FINAL DOCUMENT

October 1999

THIS DOCUMENT IS INTENDED TO COMPLY WITH THE NATIONAL ENVIRONMENTAL POLICY ACT OF 1969

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (*Leave blank*)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	October 1999	Record of Decision (1999)

4. TITLE AND SUBTITLE

Cornhusker Army Ammunition Plant, Record of Decision for Remedial Action Operable Unit Three (OU3), Final Document

5. FUNDING NUMBERS

U.S. Department of the Army
Contract No.
DAAA15-91-D-0014

Delivery Order 0014

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TEPS14-14

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U.S. Army Corps of Engineers – Omaha District
Attn: CENWO-ED-EA/Mr. Alvin Kam
Omaha, NE 68102-4978

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

See DoDD 5230.24 "Distribution Statements on Technical Documents."

12b. DISTRIBUTION CODE

13. ABSTRACT (*Maximum 200 words*)

This Record of Decision provides the preferred remedial alternatives for areas of concern designated as Operable Unit Three (OU3) (i.e., the Nitrate Area, Pistol Range, Shop Area, and the Sanitary Landfill). The preferred alternative for the Shop Area is Excavation, Off-site Disposal of Lead-contaminated Soils, and Monitoring for Natural Attenuation of Chlorinated Organics in groundwater. The preferred alternative for the Sanitary Landfill is Excavation and Off-site Disposal of RDX-contaminated soil. The preferred alternative for the Pistol Range is Excavation and Off-site Disposal of Lead- and RDX-contaminated soil. The preferred alternative for the Nitrate Area is Excavation and Off-site Disposal of Lead-contaminated soil. All alternatives include a deed restriction to prevent residential use.

14. SUBJECT TERMS

Preferred Alternatives, Excavation, Natural Attenuation, Chlorinated Organics, Explosives, RDX, Lead, Deed Restriction

15. NUMBER OF PAGES

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	None

RECORD OF DECISION FOR REMEDIAL ACTION
OPERABLE UNIT 3
CORNHUSKER ARMY AMMUNITION PLANT, NEBRASKA

FINAL DOCUMENT

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OCTOBER 1999

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LIST OF ACRONYMS AND ABBREVIATIONS

AOC . . . . . Area of Concern
ARAR . . . . . applicable or relevant and appropriate requirement
AST . . . . . aboveground storage tank
bgs . . . . . below ground surface
CERCLA . . . . . Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CHAAP . . . . . Cornhusker Army Ammunition Plant
CLP . . . . . Contract Laboratory Program
COPC . . . . . chemical of potential concern
EA . . . . . Excessing Assessment
EEI . . . . . Envirodyne Engineers, Inc.
EPIC . . . . . Environmental Photographic Interpretation Center
ERA . . . . . ecological risk assessment
FFA . . . . . Federal Facility Agreement
ft . . . . . foot/feet
GAC . . . . . granular activated carbon
GOCO . . . . . government-owned, contractor-operated
gpm . . . . . gallons per minute
HEAST . . . . . Health Effects Assessment Summary Tables
HHRA . . . . . human health risk assessment
HI . . . . . hazard index
IEUBK . . . . . Integrated Exposure Uptake/Biokinetic
IRA . . . . . interim soil removal action
IRIS . . . . . Integrated Risk Information System
Mason & Hanger . . . . . Mason & Hanger-Silas Mason Company
MCL . . . . . Maximum Contaminant Level
NCP . . . . . National Oil and Hazardous Substances Pollution Contingency Plan
NDEQ . . . . . Nebraska Department of Environmental Quality
NPDES . . . . . National Pollutant Discharge Elimination System
O&M . . . . . operation and maintenance
OU . . . . . operable unit
OU1 . . . . . Operable Unit One
OU2 . . . . . Operable Unit Two
OU3 . . . . . Operable Unit Three
OU4 . . . . . Operable Unit Four
OU5 . . . . . Operable Unit Five
PAH . . . . . polycyclic aromatic hydrocarbon
PUC . . . . . Potential Unit of Contamination
PVC . . . . . polyvinyl chloride
RAO . . . . . remedial action objective
RCRA . . . . . Resource Conservation and Recovery Act
RI/FS . . . . . Remedial Investigation/Feasibility Study
ROD . . . . . Record of Decision
SARA . . . . . Superfund Amendments and Reauthorization Act of 1986
SCD . . . . . Site Characterization Document
SOP . . . . . Standard Operating Procedure
TBC . . . . . To-Be-Considered
TCL . . . . . Target Compound List
TCLP . . . . . Toxicity Characteristic Leaching Procedure
TRV . . . . . Toxicity Reference Value
USACE . . . . . U.S. Army Corps of Engineers
USAEC . . . . . U.S. Army Environmental Center
USAEHA . . . . . U.S. Army Environmental Hygiene Agency
USATHAMA . . . . . U.S. Army Toxic and Hazardous Materials Agency

USEPA . . . . . U.S. Environmental Protection Agency
UST . . . . . underground storage tank
UXO . . . . . unexploded ordnance
VOC . . . . . volatile organic compound
XRF . . . . . x-ray fluorescence

1.0 DECLARATION OF THE RECORD OF DECISION

1.1 SITE NAME AND LOCATION

Cornhusker Army Ammunition Plant (CHAAP), Grand Island, Nebraska.

1.2 STATEMENT OF BASIS AND PURPOSE

This Record of Decision (ROD) document presents the selected remedial action(s) for Operable Unit Three (OU3) comprising of the Nitrate Area, Pistol Range, Sanitary Landfill, and Shop Area, located at the CHAAP in Grand Island, Nebraska. The remedial action was selected in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable, with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The information supporting the decisions on the selected remedies is contained in the Administrative Record.

The U.S. Environmental Protection Agency (USEPA) and the Nebraska Department of Environmental Quality (NDEQ) concur with the selected remedy.

1.3 ASSESSMENT OF THE SITE

The response actions selected in this ROD for the Areas of Concern (AOCs) designated as OU3 (i.e., Nitrate Area, Pistol Range, Sanitary Landfill, and the Shop Area), are necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

1.4 DESCRIPTION OF THE SELECTED REMEDY

This ROD has been developed for OU3, which includes the Nitrate Area, Pistol Range, Sanitary Landfill, and the Shop Area. The cleanup levels for OU3 were developed based on protection of industrial workers. The following preferred remedies for each AOC provide protection to humans under non-residential conditions.

Nitrate Area:

The alternative that has been selected as the preferred remedy for protecting human health under non-residential conditions at the Nitrate Area consists of excavation, off-site disposal of lead contaminated soil, and deed restriction to prevent residential use.

Pistol Range:

The alternative that has been selected as the preferred remedy for protecting human health under non-residential conditions at the Pistol Range consists of excavation, off-site disposal of RDX- and lead-contaminated soil, and deed restriction to prevent residential use.

Sanitary Landfill:

The alternative that has been selected as the preferred remedy for protecting human health under non-residential conditions at the Sanitary Landfill consists of excavation, off-site disposal of RDX contaminated soil, and deed restriction to prevent residential use.

Shop Area:

The alternative that has been selected as the preferred remedy for protecting human health under non-residential conditions at the Shop Area consists of the following:

- Excavation, off-site disposal of lead-contaminated soil, and deed restriction to prevent residential use.
- Long-term monitoring for natural attenuation of chlorinated organic compounds in groundwater and deed restriction to prevent groundwater use.

The deed restrictions will include proprietary institutional controls restricting the future use of the property such as easements or restrictive covenants that are legally enforceable against subsequent

property owners and instituted, depending on state law, by conveyance or contract. The U.S. Army will be responsible for implementing and maintaining the effectiveness of institutional controls.

1.5 STATUTORY DETERMINATIONS

The selected remedies are protective of human health and the environment, comply with Federal and state requirements that are applicable or relevant and appropriate to the remedial action, are cost-effective, and utilize permanent solutions to the maximum extent practicable.

The remedies in this OU do not satisfy the statutory preference for treatment (other than any treatment used as part of off-site disposal) as a principal element of the remedy due to the limited extent of soil contamination identified at the AOCs designated as OU3.

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining onsite above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

1.6 ROD DATA CERTIFICATION CHECK LIST

The following information is included in this ROD. Additional information can be found in the Administrative Record file for this site.

- Chemicals of potential concern (COPCs) (Section 4)
- Baseline risk represented by the COPCs (Section 4)
- Cleanup levels established for COPCs and the basis for these levels (Section 5)
- How source materials constituting principal threats are addressed (Sections 6, 7, 8, and 9)
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and ROD (Section 4)
- Potential land and groundwater use that will be available at the site as a result of the Selected Remedies (Sections 6, 7, 8, and 9)
- Estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected (Sections 6, 7, 8, and 9)
- Key factors that led to selecting the remedies (Section 6, 7, 8, and 9)

Larry V. Gulledge 29 Oct 99

Larry V. Gulledge
Deputy to the Commander
U.S. Army Industrial Operations Command

Date

12-14-99

Dennis Grams
Regional Administrator
U.S. Environmental Protection Agency, Region VII

Date

2.0 DECISION SUMMARY

2.1 SITE NAME, LOCATION, AND DESCRIPTION

Cornhusker Army Ammunition Plant is located on an 11,936-acre (19 square miles) tract approximately two miles west of Grand Island, Nebraska, in north-central Hall County.

The land around CHAAP is intensely cultivated and row crops, such as corn and alfalfa, have replaced most of the original prairie grass and other vegetation. Most of the land between CHAAP and Grand Island is used for farming, predominately for hay and/or pasture, dryland crops, and irrigated corn, alfalfa, and soybeans.

A large portion of CHAAP is inactive; however, much of the land and buildings are leased to various individuals and local concerns. Approximately 10,774 acres (17 square miles) is leased out for general agricultural use as follows: 82% cropland, 15% wildlife habitat and protection areas, and 3% grazing. The majority of the cropland acreage is irrigated. Eighty-eight magazines and 25 other buildings are leased out as general storage space.

CHAAP has been divided into five operable units (OUs) **(Exhibit 2-1)** based on land use and the extent of remedial action required for protecting human health and the environment.

Operable Unit One (OU1) is comprised of the explosives-contaminated groundwater plume, which originates from the Load Line Buildings 1-5. An interim ROD has been completed for OU1 and a pump-and-treat system is currently on-line. The pump-and-treat system consists of six extraction wells with a total estimated groundwater extraction rate of approximately 700 gallons per minute, sand filters, and a carbon adsorption system.

The Administration and Base Housing Areas, Abandoned Burning Area, Drainage Ditches, Magazine Areas, Miscellaneous Storage Areas, and Sewage Treatment Plants comprise Operable Unit Two (OU2). A ROD for no further remedial action has been completed for OU2 (1998).

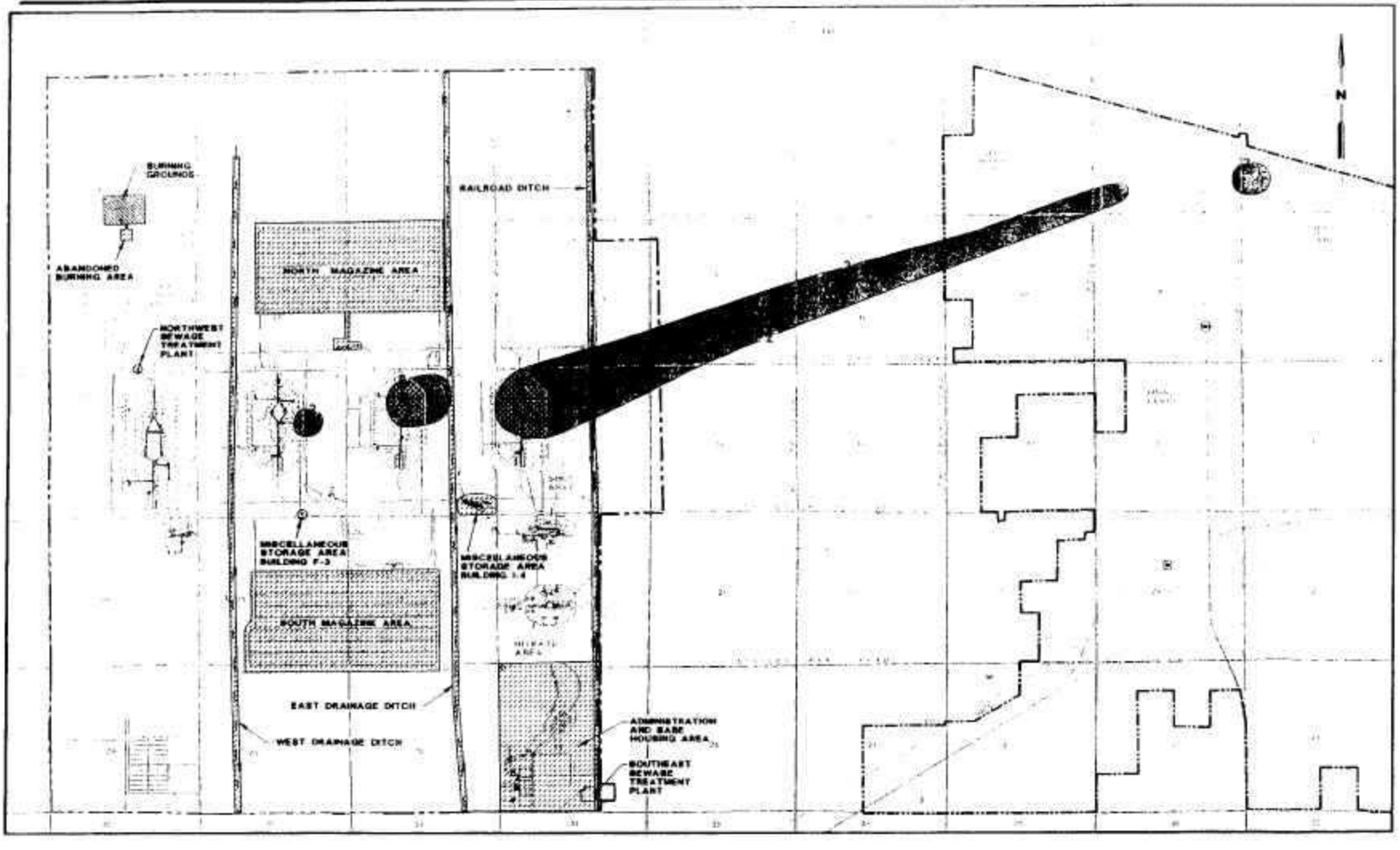
Operable Unit Four (OU4) is comprised of the Gravel and Clay Pits and the unsaturated zone (0-6 feet [ft] below ground surface [bgs]) of Load Lines 1-5. Operable Unit Five (OU5) consists of the Burning Grounds. The Burning Grounds was designated as OU3 in the Feasibility Study. However, because the Army does not want to continue restrictions on the property due to unexploded ordnance (UXO), the AOC has been removed from OU3 and redesignated as OU5. A ROD will be completed for the Burning Grounds.

This ROD has been prepared for OU3, which includes the Nitrate Area, Pistol Range, Sanitary Landfill, and Shop Area.

The Nitrate Area is located in the southeast part of the installation, between the Shop Area and the Administration Area. The Nitrate Area has historically been used to produce crystalline nitrate for bomb production and ammonium nitrate for fertilizer. Cornhusker Railroad Services is a railcar refurbishing operation that has leased and operated much of the Nitrate Area since 1979. The leased areas include Building N-17, the railcar loading area, adjacent open storage areas, and rail sidings throughout CHAAP.

The Pistol Range is located near the western boundary of CHAAP. The site covers approximately 30 acres and currently contains a large earthen backstop berm. A small-arms firing range is located on the south side of the berm, and is surrounded by cultivated fields. This area has historically been used as a small arms training area for state and local police authorities. During the 1968-1969 time period, portions of the Pistol Range were also used for the destruction and burning of wastes from Load Line 5. Local law enforcement personnel currently use the Pistol Range for small-arms practice/training. The adjacent fields are leased out for dry crop cultivation.

The Sanitary Landfill is located in the northwest section of the installation, southeast of the Burning Grounds, and southwest of the intersection of Ninth Avenue and Tenth Street. It encompasses an area of approximately 55 acres. The Sanitary Landfill includes the Sanitary Waste Disposal, Capped Landfill, Burning Cages Metals Disposal, Flammable Liquids Disposal, Fuse Destruction, Interim Removal Site 2, and the Explosives Parking Areas.



2

LEGEND

AREAS OF CONCERN DESIGNATED AS OU1 (OUTLINE OF AREA WHERE RDX IS DETECTED IN ALLUVIAL AQUIFER MONITORING WELLS)

AREAS OF CONCERN DESIGNATED AS OU1

AREAS OF CONCERN DESIGNATED AS OU2

AREAS OF CONCERN DESIGNATED AS OU3

AREAS OF CONCERN DESIGNATED AS OU5

FACILITY BOUNDARY

GRAND ISLAND CITY LIMITS

DRAINAGE DITCH FLOW DIRECTION

SURFACE DRAINAGE

STATE ROUTE

U.S. ROUTE

ROADS

RAILROAD TRACKS

0 1750 3500 7000

SCALE IN FEET

U.S. ARMY CORPS OF ENGINEERS
OMAHA DISTRICT

the Ogroup

CORNHUSKER AAP
FILE: RS-NEW-8
20 JANUARY 1998

EXHIBIT 2-1
OPERABLE UNIT
DESIGNATIONS
AT CHAAP

The Shop Area, located in the east-central area of the facility, immediately south of Load Line 1, covers an area of about 3,000,000 ft^2 and includes 28 buildings and sheds. The Shop Area consists of the installation laundry and a settling basin for laundry wastewater; maintenance facilities for vehicles, equipment and other operations; rail loading and unloading areas; and open storage areas.

3.0 HISTORY AND ENFORCEMENT ACTIVITIES

3.1 FACILITY HISTORY

The CHAAP was constructed and fully operational in 1942. The CHAAP was a U.S. government-owned, contractor-operated (GOCO) facility, which produced artillery shells, mines, bombs, and rockets for World War II, Korean, and Vietnam conflicts. The plant was operated intermittently for 30 years; the most-recent operations ending in 1973.

Quaker Oats Ordnance Corporation, a subsidiary of the Quaker Oats Company that produced bombs, shells, boosters, and supplementary charges, operated the plant from 1942 through 1945. The plant was on standby status for munitions production from 1945 through 1950. During the standby period, many of the buildings were also used for grain storage.

The plant was reactivated in 1950 to produce artillery shells and rockets to support the Korean conflict. These operations were directed by Mason & Hanger-Silas Mason Company (Mason & Hanger) until 1957 when the plant was again placed on standby status **(USATHAMA, 1980)**. In 1963, a total of 809 acres from three parcels of land situated in the northeast, northwest, and southeast corners of the facility were sold to the State of Nebraska for use as wildlife management areas.

The plant was reactivated from 1965 through 1973 for the production of bombs, projectiles, and micrograval mini-mines used in the Vietnam conflict. Mason & Hanger was retained as the operator during this period of operation **(USATHAMA, 1980)**. In 1973, operations ceased; the plant was again placed an standby and has not been reactivated to date. The State Game Commission gave thirty acres of the Sand Pit Area to the State of Nebraska in 1977 for use. Activities at CHAAP are currently limited to maintenance operations, leasing of property for agriculture, leasing of buildings for storage and industrial operations, and wildlife management. Site-specific operational history at the four sites designated as OU3 is discussed in Sections 6, 7, 8, and 9.

3.2 ENFORCEMENT ACTIVITIES

A Federal Facility Agreement (FFA) was signed between the U.S. Army, USEPA, and the State of Nebraska (effective September 4, 1990) to set terms for the Remedial Investigation/Feasibility Study (RI/FS) effort. The FFA provided the terms, listed documents to be generated, and established target dates for delivery of reports. This ROD is being conducted in accordance with the terms outlined in the FFA.

3.3 ENVIRONMENTAL INVESTIGATIONS AND REMEDIAL ACTIONS

Several environmental studies have been conducted at CHAAP and in the surrounding area to assess and delineate contamination. Provided below are the major environmental investigations and remedial actions that led to the development and selection of preferred remedial alternatives for the AOCs designated as OU3.

3.3.1 Environmental Studies at CHAAP

The following sections summarize environmental investigations and studies conducted at CHAAP since 1980 that determined the nature and extent of contamination at AOCs designated as OU3.

Installation Assessment of CHAAP, March 1980

As a part of the U.S. Army's Installation Restoration Program, U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) conducted an installation assessment of the CHAAP. The objective of this study was to assess the environmental quality of CHAAP with regard to the use, storage, treatment, and disposal of toxic and hazardous materials, and to define any conditions that may adversely affect health and welfare, or result in environmental degradation.

Environmental Photographic Interpretation, March 1982 and September 1991

USEPA, the Army, and the Environmental Photographic Interpretation Center (EPIC) provided imagery analysis for the USATHAMA Installation Assessment Project. The task included a detailed historical analysis of the CHAAP to identify possible areas of past use, storage, treatment and disposal of potentially hazardous materials.

A more comprehensive analysis of aerial photographs was issued by EPIC in September 1991 and includes historical photographs dating from 1938 to 1991. Similar to the 1982 EPIC Report, the 1991 report included a detailed historical analysis of CHAAP to identify possible areas of past use, storage, treatment, and disposal of potentially toxic and hazardous materials.

The studies noted trenched areas, liquids, ground scars, ground staining, and drainage passing through potentially contaminated areas at the Sanitary Landfill. In the Shop Area, drainage ditches passing through ground-stained loading areas were noted. Within the Nitrate Area, abundant ground staining and open storage, including possible drummed materials, were evident.

Preliminary Contamination Survey, August 1982

Mason & Hanger contracted Envirodyne Engineers, Inc. (EEI) to conduct a preliminary contamination survey of CHAAP. As a part of this survey, 33 groundwater monitoring wells were installed to assess the water table configuration, estimate groundwater flow velocities, and serve as a groundwater sampling network. These wells were installed around the Nitrate Area and Burning Grounds.

Excessing Assessment 1991

From 1989 through 1991, USATHAMA conducted an Excessing Assessment (EA) to determine the existence of or potential for environmental contamination and to assess human health and environmental risks associated with excessing the installation.

All of the AOCs designated as OU3 with respect to potential environmental contamination were investigated. The 1991 EA field investigation included:

- Geophysical surveys at the Sanitary Landfill and the Pistol Range;
- Installation of new monitoring wells at the Sanitary Landfill;
- Groundwater sampling using new and existing monitoring wells;
- Surface soil sampling at the Sanitary Landfill and Pistol Range; and
- Soil borings at the Sanitary Landfill and Pistol Range.

The results of the 1991 EA were subsequently used to supplement the 1996 RI.

Site Characterization Document (SCD) 1993

The task was initiated by the U.S. Army Environmental Center (USAEC) as a RI/FS to gather information sufficient to support an informed risk management decision and defining the nature and extent of contamination. Following review of the Draft RI by USEPA Region VII and NDEQ, data gaps and concerns were identified which required significant additional site investigation in order to fully characterize the nature and extent of contamination and complete a RI. Due to the significance of data gaps, the risk assessment was removed from the document and the RI was reissued as a SCD.

The study areas investigated included previously identified on-post AOCs and the area east of CHAAP that has been impacted by contaminants from the facility. The field program included sampling and analysis of soil, groundwater, and surface water. As agreed upon by USEPA and NDEQ, the results of the 1993 SCD have been used where applicable to support the preparation of the 1996 RI.

Remedial Investigation 1996

The 1996 RI addressed 1994 SCD data gaps identified by USEPA and NDEQ. A streamlined risk assessment was also prepared. Previous data collected as a part of the 1991 EA, 1994 SCD, 1994 OU1 sampling effort, and the 1994 U.S. Army Corps of Engineers (USACE) Soil Removal Action were used along with data collected in 1995 to determine the nature and extent of contamination, and determine the potential impact to human health and the environment and building surfaces.

3.3.2 Remedial Actions at CHAAP

Interim Soil Removal Action 1994

A USACE interim soil removal action (IRA) was performed in November-December 1994 at 25 sites at CHAAP. Based on 1993 SCD data, USAEC identified 25 sites, including the Sanitary Landfill (IRA Site No. 2). USACE performed this removal action in November and December of 1994, removing approximately 5,000 tons of explosives-contaminated soils based on action levels of 5 µg/g for 246-TNT and or RDX in soils. Approximately one foot of contaminated soil was removed from each of IRA Sites 1-24. At IRA site 25, soil removal was conducted to a depth of 11 ft. At the Sanitary Landfill (IRA Site No. 2), approximately 20 tons (13.4 cy) of soil were removed.

Following the initial excavation of the 25 areas in November 1994, screening level colorimetric and immunoassay soil samples were collected from each excavation to assess the concentrations of 246-TNT and/or RDX in soils. Based on these screening results, 15 of the excavations (excluding the Sanitary Landfill) were identified as requiring additional excavation to meet the previously established (i.e., 1987-1988 incineration project) action levels.

Following excavation, waste classification sampling of the removed soils was conducted and all soil was removed offsite to the Highway 36 Land Development Company located near Deer Trail, Colorado. With the exception of IRA Site 25, the excavations were not backfilled to allow for 1995 RI confirmation sampling.

3.4 HIGHLIGHTS OF COMMUNITY PARTICIPATION

The Proposed Plan for OU3 was released to the public on April 21, 1999, at the information repositories listed below:

- CHAAP, 102 North 60th Street, Grand Island, NE 68802
- Grand Island Public Library, 211 North Washington Street, Grand Island, NE 68802 Phone: (308) 381-5333

The notice of availability of these documents was published on April 19, 1999, in the Grand Island Independent. A public comment period was held from April 21, 1999 through May 21, 1999. A public meeting was held at the community room of Grand Island City Hall on April 28, 1999, to inform the public about the preferred remedial alternative for the Nitrate Area and to seek public comments. At this meeting, representatives from the U.S. Army, USEPA, and NDEQ were present to answer questions about the site and remedial alternatives under consideration.

4.0 SUMMARY OF SITE RISKS

4.1 HUMAN HEALTH RISKS

A human health risk assessment (HHRA) was performed during the 1996 RI to evaluate the potential human health effects associated with chemical contamination from past operations at CHAAP. COPCs were identified for each site evaluated in the RI. However, risks associated with soil exposure to humans were evaluated at areas assumed to be the three most contaminated areas at CHAAP (i.e., Burning Grounds, Pistol Range, and Load Line 1).

Only the Pistol Range was quantitatively evaluated in the risk assessment. Groundwater, however, was evaluated on a site-wide basis. Even though not all sites were quantitatively evaluated, COPCs were selected for all AOCs. Provided below is a summary of the selection process.

The first step of the COPC selection process was to summarize analytical data, which were analyzed according to USEPA's Contract Laboratory Program (CLP) procedures. The following steps, which are in accordance with USEPA (1989) guidance, were used to summarize the analytical data of the HHRA:

- Data from the four sampling phases (the 1991 EA, the 1993 SCD, the 1994 OU1 Sampling Effort, and the 1995 RI) were summarized by environmental medium (i.e., surface soil, subsurface soil, sediment, surface water, and groundwater). In some cases, data were further grouped within an environmental medium by location (e.g., surface soil data were grouped by source area). Because many of the monitoring wells were sampled one or more times, only the most recent round of chemical data from each re-sampled well was included in the HHRA.

- Sampling data collected during the 1995 RI was compared to blank (laboratory, field, and trip) concentration data. If the detected concentration in a site-related sample was less than 10 times (for common laboratory contaminants), or five times (for all other compounds) the concentration in the corresponding blank sample, the sample was qualified with a B and was treated as a non-detect in the HHRA.

- Data that were rejected by the laboratory were not used in the HHRA.

- Certain analytes appeared on the target analyte list of more than one analytical method. In those cases, data from the method specified by the CHAAP USAEC Quality Assurance Project Plan were used in the HHRA.

- Data from duplicate samples (samples collected from the same sample location at the same time) were averaged together and treated as one result. If a chemical was detected in only one of the two duplicate samples, the detected value was averaged with one-half the quantitation limit of the non-detect sample, and the result was counted as one detect sample.

- Mean chemical concentrations for a given medium were calculated by averaging the detected concentrations with one-half the sample quantitation limit of the non-detects. One-half the sample quantitation limit is typically used in the HHRA when averaging non-detect concentrations because the actual value can be between zero and a value just below the sample quantitation limit.

- Due to the fact that there are varying chemical- and sample-specific quantitation limits, even within one medium, the sample quantitation limit for each non-detected sample was compared to the maximum detected concentration for that chemical within the same grouping to determine if the sample quantitation limit would be included in calculating the mean concentration (see previous bullet). If the sample quantitation limit for a non-detect was two or more times higher than the maximum detected concentration, then that sample result was not included in the calculation of the mean for that chemical. This procedure was performed to prevent the mean from being artificially influenced by the high sample quantification limits. As a result of this procedure, several high sample quantitation limits were identified in the data sets and were excluded from the calculation of mean concentrations. It should be noted

that treatment of high non-detects in the HHRA (i.e., that non-detects that are greater than two times the detection limit are eliminated from the data set) differs slightly from the methodology presented in USEPA (1989), where it is stated the high non-detect should be excluded from the data set if it causes the exposure concentration to exceed the maximum detected concentration for the particular sample set. The uncertainty associated with this procedure is discussed in the Uncertainty Section.

- Frequency and detection was calculated as the number of samples in which the chemical was detected over the total number of samples collected for the particular grouping. The frequency and detection was determined after averaging duplicate samples collected from the same sample location.

Based on the review of the summarized data, chemicals were selected for further evaluation using the following methodology:

- In accordance with discussions between USEPA Region VII, NDEQ, and USAEC, a concentration-toxicity screening was conducted for all non-carcinogenic chemicals in each sampled medium (all detected carcinogenic chemicals were retained for evaluation, in accordance with USEPA Region VII protocols). The maximum concentration of each noncarcinogenic chemical detected in a medium was multiplied by the inverse of its respective non-carcinogenic toxicity criterion to determine a concentration toxicity ratio for the particular chemical. Once all concentration-toxicity ratios were calculated, they were summed, and each individual ration was divided by the sum of all ratios. The chemicals that accounted for greater than 0.1% of the relative site-wide risk were then selected as COPCs. If an inorganic accounted for more than 0.1% of the risk, but was within background levels (as determined in the comparison outlined in the following bullet), it was not selected as a COPC. The concentration toxicity screening for each medium is presented in the 1996 RI (Appendix A).

- Standard statistical procedures were used to compare site data with site-specific background data. These procedures included the parametric one-way Analysis of Variance (parametric ANOVA) or the non-parametric one-way Wilcoxon rank-sum test. The parametric ANOVA is generally considered the preferred test for these comparisons, but the use of the parametric ANOVA requires that the data fit a normal or log normal distribution and that the groups to be compared have equal variances. In addition, the parametric ANOVA test does not perform well if a moderate number of observations in a data set are non-detects, and USEPA recommends that the parametric ANOVA should not be used if greater than 15% of the observations are non-detects.

4.1.1 Soil COPCs

COPCs for the specific sites under OU3 are presented in **Tables 4-1** and **4-2** for surface and subsurface soils.

Table 4-1. COPCs in Surface Soil for Human Receptors at the CHAAP OU3 Areas

Nitrate Area	Pistol Range	Sanitary Landfill	Shop Area
Benzo(a)anthracene	RDX	2-Amino-4,6-dinitrotoluene	1,3,5-Trinitrobenzene
Benzo(a)pyrene	Benzo(a)anthracene	4-Amino-2,6-dinitrotoluene	2,4,6-Trinitrotoluene
Benzo(b)fluoranthene	Benzo(a)pyrene	2,4-Dinitrotoluene	Benzo(a)anthracene
Benzo(k)fluoranthene	Benzo(b)fluoranthene	2,6-Dinitrotoluene	Benzo(a)pyrene
Chrysene	Benzo(k)fluoranthene	Nitrobenzene	Benzo(b)fluoranthene
Dibenz(a,h)anthracene	Chrysene	RDX	Benzo(k)fluoranthene
Bis(2-Ethylhexyl)phthalate	Dibenz(a,h)anthracene	2,4,6-Trinitrotoluene	Alpha-Chlordane
Indeno(1,2,3-cd)pyrene	Indeno(1,2,3-c,d)pyrene	Aluminum	Gamma-Chlordane
Isophorone	Arsenic	Arsenic	DDT
n-Nitrosodiphenylamine	Beryllium	Copper	bls(2-Ethylhexyl)phthalate
PCB 1260	Lead	Iron	Indeno(1,2,3-c,d)pyrene
Chromium	Mercury	Lead	Isophorone
Lead	Silver	Mercury	PCB 1254
Mercury		Silver	PCB 1260
Silver		Vanadium	Cadmium

Table 4-1. COPCs in Surface Soil for Human Receptors at the CHAAP OU3 Areas			
Nitrate Area	**Pistol Range**	**Sanitary Landfill**	**Shop Area**
			Chromium
			Lead
			Mercury
			Silver

Table 4-2. COPCs in Sub-surface Soil for Human Receptors at the CHAAP OU3 Areas			
Nitrate Area	**Pistol Range**	**Sanitary Landfill**	**Shop Area**
Bis(2-Ethylhexyl)phthalate	1,3-Dinitrobenzene	2-Amino-4,6-dinitrotoluene	1,3,5-Trinitrobenzene
Aluminum	RDX	RDX	Benzo(a)pyrene
Barium	Benzo(a)antracene	2,4,6-Trinitrotolene	Benzo(b)fluoranthene
Chromium	Benzo(a)pyrene	Benzo(a)pyrene	alpha-Chlordane
Copper	Benzo(b)antracene	Benzo(b)fluoranthene	gamma-Chlordane
Iron	Benzo(k)antracene	Bis(2-Ethylhexyl)phthalate	DDT
Manganese	Chrysene	Indeno(1,2,3-c,d)pyrene	Heptachlor
Vanadium	Dibenz(a,h)anthracene	Aluminum	Indeno(1,2,3-c,d)pyrene
	bis(2-Ethylhexyl)phthalate	Barium	Aluminum
	Hexachlorobenzene	Chromium	Barium
	Indeno(1,2,3-cd)pyrene	Copper	Chromium
	Aluminum	Iron	Copper
	Arsenic	Manganese	Iron
	Barium	Vanadium	Manganese
	Chromium		Vanadium
	Copper		
	Iron		
	Manganese		
	Silver		
	Vanadium		

4.1.2 Groundwater

Table 4-3 presents COPCs in groundwater at OU3.

Table 4-3. Chemicals of Potential Concern in Groundwater at CHAAP
3,5-Dinitroaniline
2-Amino-4,6-dinitrotoluene
4-Amino-2,6-dinitrotoluene
2,4-Dinitrotoluene
2,6-Ditrotoluene
RDX
1,3,5-Trinitrobenzene
2,4,6-Trinitrotoluene
Acrylonitrile
Benzene
Benzo(a)anthracene
Chrysene
1,2-Dichloroethane
bis(2-Ethylhexyl)phthalate
Indeno(1,2,3-c,d)pyrene
Methylene chloride
1,1,2-Trichloroethane
Trichloroethylene
1,2,3-Trichloropropane
1,1,2-Trifluoro-1,2-dichloroethane
Antimony
Beryllium

Quantitative risk calculations for soil contaminants were not made for all AOCs at CHAAP. The Pistol Range is the only AOC designated as OU3 for which a risk assessment was quantitatively performed. **Table 4-4** presents the exposure pathways evaluated in the HHRA.

Table 4-4. Exposure Pathways Evaluated in the HHRA

Environmental Media	Current Land Use	Future Land Use
Surface Soil	Incidental ingestion by trespasser. Dermal contact of chemicals by trespasser.	Incidental ingestion by trespasser. Dermal contact of chemicals by Agricultural Resident.
Subsurface Soil	N/A	Incidental ingestion by excavation worker. Dermal contact of chemicals ingestion by excavation worker. Inhalation of airborne particulate matter by excavation worker.
Groundwater	Ingestion of groundwater of on-post groundwater from an irrigation well by farmer. Ingestion of off-post groundwater by a resident. Dermal absorption of chemicals in off-post groundwater by a resident while bathing. Ingestion of crops that have been irrigated with off-post groundwater by a resident.	Ingestion of groundwater by an agricultural resident. Inhalation of VOCs in groundwater by an agricultural resident wile showering. Dermal absorption of chemcials in groundwater by an agricultural resident while bathing. Ingestion of crops that have been irrigated with groundwater.

Provided below is the summary of risks for the Pistol Range, the only OU3 AOC quantitatively evaluated in the HHRA.

Surface Soil: Excess lifetime cancer risks associated with exposures to surface soil (i.e., incidental ingestion and dermal absorption) by trespassers under current land-use conditions at the Pistol Range were below the $1x10^{-6}$ risk level. The hazard index (HI) was less than one for these pathways, indicating that adverse non-carcinogenic effects would not likely to occur to trespassers. Excess lifetime cancer risks for agricultural child and adult residents under future land-use conditions due to contact with surface soil were above $1 x10^{-6}$; however, they were equal to or below $1 x10^{-5}$. HIs were less than one, indicating that non-carcinogenic effects would not likely occur.

Subsurface Soil: Excess lifetime cancer risks associated with exposures to subsurface soil (i.e., incidental ingestion, dermal absorption, and inhalation) by excavation workers under future land-use conditions at the Pistol Range were equal to or below the $1 x10^{-6}$ risk level. The HI was less than one for these pathways, indicating that adverse non-carcinogenic effects would not likely to occur to excavation workers.

Lead: For the evaluation of lead, the Integrated Exposure Uptake/Biokinetic (IEUBK) model was used. The IEUBK model combines measured site lead concentrations in soil and groundwater with model intake parameters for each background source of lead exposure (i.e., food) to provide a total estimate of lead exposure. Risk is characterized by the probability of exceeding the blood lead level of concern (10 µg/dL). Hypothetical exposures in young children ingesting soil from three sites (i.e., Pistol Range, Load Line 1, and the Burning Grounds) was the exposure scenario used for running the model. Results of the model predicted that the soil lead concentrations (arithmetic mean surface soil exposure point concentration of 5,900 µg/g) at the Pistol Range are likely to have an adverse effect on the exposed child resident.

Groundwater: Groundwater was evaluated on a site-wide basis. The results of the HHRA indicated that for groundwater, only the explosives plume (addressed in the OU1 interim ROD) was associated with an excess lifetime cancer risk above the $1x10^{-4}$ risk level for future agricultural residents drinking and dermally absorbing COPCs in groundwater. Noncarcinogenic adverse effects associated with COPCs in groundwater (OU1 only) could be possible for future agricultural residents if groundwater ingestion and dermal exposure to COPCs were to occur under the conditions assumed in the HHRA.

4.2 ECOLOGICAL RISK

An ecological risk assessment (ERA) was performed to assess the potential for adverse effects to ecological receptors resulting from exposure to site-related chemicals detected in surface soil, surface water, and sediment at CHAAP. The receptor species and/or groups that were selected for quantitative evaluation at CHAAP include terrestrial plants, earthworms, aquatic life, deer mouse, deer, and the American robin.

4.2.1 Nitrate Area

Results of the ERA indicate that exposures that derive from constituent concentrations in soil exceed Toxicity Reference Values (TRVs) (i.e., guidelines that represent levels that are protective to receptors). Therefore, there is potential for adverse effects to occur to individual plants from chromium, lead, and zinc. Adverse effects to individual plants from exposure to lead and zinc are possible; however, adverse effects to populations are unlikely given the concentrations detected. However, population effects are possible from exposures to chromium. Chromium was the only COPC that has the potential to cause adverse effects to individual earthworms. Risks to other groups/receptors are minimal at the Nitrate Area.

Risks associated with exposures to chemicals in surface soil at the Nitrate Area should be considered an overestimation because the Nitrate Area is generally considered to have poor quality habitat due to past and present uses (i.e., industrial operations) and/or abundance of manmade structures. As a result of the poor quality habitat, extensive use of these areas by terrestrial receptors is unlikely, and therefore, ecological risk is not a driver for remedial action.

4.2.2 Pistol Range

Results of the ERA indicate that exposures that derive from constituent concentrations in soil exceed TRVs. There is a limited potential for adverse effects to individual plants and earthworms from lead at the Pistol Range.

Risks associated with exposures to chemicals in surface soil at Pistol Range, particularly the shooting range berm, should be considered an overestimation. This statement is supported by the fact that terrestrial receptors would more likely occur in areas adjacent to the Pistol Range, such as cropland or shelterbelt areas, where the habitat quality is better, food is more plentiful, and chemical contamination may be minimal or nonexistent. Due to these reasons, ecological risk is not a driver for remedial action.

4.2.3 Sanitary Landfill

Results of the ERA indicate that exposures that derive from constituent concentrations in soil exceed TRVs. Therefore, there is potential for adverse effects to occur to individual plants and earthworms from these compounds. Risks to other groups/receptors are minimal at the Sanitary Landfill.

Risks associated with exposures to chemicals in surface soil at the Sanitary Landfill should be considered an overestimation because the Sanitary Landfill is generally considered to have poor quality habitat due to past and present uses (i.e., industrial operations). As a result of the poor quality habitat, extensive use of these areas by terrestrial receptors is not expected.

4.2.4 Shop Area

Results of the ERA indicate that exposures that derive from constituent concentrations in soil exceed TRVs. Risks to other groups/receptors are minimal at the Shop Area.

Risks associated with exposures to chemicals in surface soil at the Shop Area should be considered an overestimation because the Shop Area is generally considered to have poor quality habitat due to past and present uses (i.e., industrial operations) and/or abundance of manmade structures. As a result of the poor quality habitat, extensive use of these areas by terrestrial receptors is not expected.

5.0 REMEDIAL ACTION OBJECTIVES

5.1 REMEDIAL ACTION OBJECTIVES FOR SOIL

Results of the HHRA indicate that potential risks associated with exposure to chemicals at CHAAP were within acceptable range for carcinogens and below the HI trigger value of 1.0 for noncarcinogens for the worst contaminated site in OU3 (i.e., Pistol Range). However, from a comparative analysis, the Army indicated that risks associated with other, less contaminated sites should be lower than those at the Pistol Range. Because a risk assessment was not performed for each site, the Army, EPA and NDEQ agreed to develop cleanup levels using industrial exposure scenarios combined with a health-protective target risk of 10^{-6} for carcinogens and a HI of one for noncarcinogens. When completed, remedial activities achieving these risk-based cleanup objectives (Remedial Action Objectives [RAOs]) will ensure the protection of both agricultural and industrial workers. It should be noted that for lead and polycyclic hydrocarbons, numerical standards provided by NDEQ were used to achieve RAOs.

For lead, the results of the IEUBK model show that adverse effects are possible from exposure of lead to children (incidental ingestion). The potential adverse effect triggered the need for RAOs for lead. The NDEQ, To-Be-Considered (TBC) guidance of 400 mg/kg is considered to be protective of human health under non-residential conditions.

Polycyclic aromatic hydrocarbons (PAHs) were also identified as soil COPCs at several AOCs at OU3. The risk-based cleanup levels calculated were far below the numerical cleanup level typical of sites in Nebraska. With concurrence from USEPA, the NDEQ guidance of 33 mg/kg is considered protective of non-residential use.

5.1.1 Methodology for Calculating COPC Cleanup Levels

Because the HHRA did not quantitatively evaluate each site, the Army proposed RAOs that would be protective of residents/workers involved with agricultural, light industrial, and other non-residential activities. Cleanup levels for COPCs were calculated using industrial exposure values and a conservative $1x10^{-6}$ target excess individual lifetime cancer risk. Cleanup levels for noncarcinogens were based on a target hazard quotient of 1.

The equation used to calculate worker cleanup levels for chemicals exhibiting carcinogenic

$$C_s = \frac{TR * BW * AT_c * DAYS}{IR * EF * ED * CF} * \frac{1}{CSF_O}$$

effects is as follows:
where:

C_s = chemical concentration in soil (mg/kg),
TR = target excess individual lifetime cancer risk ($1 x10^{-6}$),
BW = body weight (70 kg),
AT_c = averaging time for carcinogenic effects (70 years),
DAYS = conversion factor (365 days/year),
IR = soil ingestion rate (50 mg/day),
EF = exposure frequency (250 days/year),
ED = exposure duration (25 years),
CF = conversion factor ($kg/10^{-6}$ mg), and
SF_o = oral cancer slope factor ($[mg/kg-day]^{-1}$).

The equation used to calculate worker cleanup levels for chemicals exhibiting non-carcinogenic effects is:

$$C_s = \frac{THQ * BW * AT_{nc} * DAYS}{IR * EF * ED * CF} * \frac{1}{CSF_O}$$

where:

C_s = chemical concentration in soil (mg/kg),
THQ = target hazard quotient (1),
BW = body weight (70 kg),
At_{nc} = averaging time for non-carcinogenic effects (25 years),
DAYS = conversion factor (365 days/year),
IR = soil ingestion rate (50 mg/day),
EF = exposure frequency (250 days/year),
ED = exposure duration (25 years),
CF = conversion factor ($kg/10^{-6}$ mg), and
RfD_o = oral reference dose (mg/kg-day).

The toxicity criteria (i.e., cancer slope factors and non-cancer reference doses) were obtained from the Integrated Risk Information System (IRIS) or Health Effects Assessment Summary Tables (HEAST). Exposure parameters for workers that were obtained from USEPA (1991) included the body weight, averaging time, soil ingestion rate, exposure frequency, and exposure duration.

Tables 5-1 through **5-4** present cleanup levels for COPCs at OU3 AOCs.

Table 5-1. Cleanup Levels for Soil COPCs (µg/g) at the Nitrate Area

Chemical	Calculated Industrial Risk-Based (µg/g)*
Aluminum	1,000,000
Barium	143,080
Benzo(a)anthracene	33[1]
Benzo(a)pyrene	33[1]
Benzo(b)fluoranthene	33[1]
Benzo(k)fluoranthene	33[1]
Bis (2-ethylhexyl)phthalate	409
Chromium	10,220
Chrysene	784
Copper	75,628
Dibenz(a,h)anthracene	33[1]
Indeno(1,2,3-c,d)pyrene	33
Iron	613,200
Isophorone	6,024
Lead	400[2]
Manganese	49,056
Mercury	613
n-Nitrosodiphenylamine	1,022
PCB 1260	3
Silver	10,220
Vanadium	14,308

* - For carcinogens, concentrations are associated with a risk of 1×10^{-6}
[1] - Cleanup level for PAHs is NDEQ TBC Guidance
[2] - Cleanup level for lead is NDEQ TBC Guidance

Table 5-2. Cleanup Levels for Soil COPCs (µg/g) at the Pistol Range

Chemical	Calculated Industrial Risk-Based levels (µg/g)*
Aluminum	1,000,000
Arsenic	See Section 5.3
Barium	143,080
Beryllium	See Section 5.3
Benzo(a)anthracene	33[1]
Benzo(a)pyrene	33[1]
Benzo(b)fluoranthene	33[1]
Benzo(k)fluoranthene	33[1]
Bis(2-ethylhexyl)phthalate	409
Chromium	10,220

Table 5-2. Cleanup Levels for Soil COPCs (µg/g) at the Pistol Range	
Chemical	**Calculated Industrial Risk-Based Levels (µg/g)***
Chrysene	784
Copper	75,628
Dibenz(a,h)anthracene	33[1]
1,3-Dinitrobenzene	204
Hexachlorobenzene	4
Indeno(1,2,3-c,d)pyrene	33
Iron	613,200
Lead	400[2]
Manganese	49,056
Mercury	613
RDX	52
Silver	10,220
Vanadium	14,308

* - For carcinogens, concentrations are associated with a risk of 1 x 10^{-6}
[1] - Cleanup level for PAHs is NDEQ TBC Guidance
[2] - Cleanup level for lead is NDEQ TBC Guidance

Table 5-3. Cleanup Levels for Soil COPCs (µg/g) at the Sanitary Landfill	
Chemical	**Calculated Industrial Risk-Based (µg/g)***
Aluminum	1,000,000
2-Amino-4,6-dinitrotoluene	123
4-Amino-2,6-dinitrotoluene	123
Arsenic	See Section 5.3
Barium	143,080
Benzo(k)pyrene	33[1]
Benzo(b)flouranthene	33[1]
Bis (2-ethylhexyl)phthlalate	409
Chromium	10,220
Copper	75,628
2,4-Dinitrotoluene	8.42
2-6-Dinitrotoluene	8.42
Indeno(1,2,3-c,d)pyrene)	33
Iron	613,200
Lead	400[2]
Manganese	49,056
Mercury	613
Nitrobenzene	1,022
RDX	520
Silver	10,220
2,4,6-Trinitrotoluene	191
Vanadium	14,308

* - For carcinogens, concentrations are associated with a risk of 1x10^{-6}
[1] - Cleanup level for PAHs is NDEQ TBC Guidance
[2] - Cleanup level for lead is NDEQ TBC Guidance

Table 5-4. Cleanup Levels for Soil COPCs (µg/g) at the Shop Area	
Chemical	**Calculated Industrial Risk-Based Levels (µg/g(***
Aluminum	1,000,000
Barium	143,080
Benzo(a)anthracene	33[1]
Benzo(a)pyrene	33[1]
Benzo(b)fluoranthene	33[1]
Benzo(k)fluoranthene	33[1]
Bis(2-ethylhexyl)phthalate	409
Cadmium	2,044
alpha-Chlordane	4.4
gamma-Chlordane	4.4

Table 5-4. Cleanup Levels for Soil COPCs (µg/g) at the Shop Area	
Chemical	**Calculated Industrial Risk-Based Levels (µg/g(***
Chromium	10,220
Copper	75,628
DDT	17
Heptachlor	1
Indeno(1,2,3-c,d)pyrene	33
Iron	613,200
Isophorone	6,024
Lead	400[2]
Manganese	49,056
Mercury	613
PCB 1254	3
PCB 1260	3
Silver	10,220
1,3,5-Trinitrobenzene	102
2,4,6-Trinitrotoluene	191
Vandium	14,308

* - For carcinogens, concentrations are associated with a risk of $1x10^{-6}$
1 - Cleanup level for PAHs is NDEQ TBC Guidance
2 - Cleanup Level for Lead is NDEQ TBC Guidance

5.2 REMEDIAL ACTION OBJECTIVES FOR GROUNDWATER

The RAO for groundwater was to achieve standards required for the groundwater classification at CHAAP. The groundwater at CHAAP has been classified by the state as GA, which is for public drinking water supply. Also, groundwater at CHAAP is considered Class 1, representing a current source of drinking water of varying value (**USATHAMA, 1992**). Maximum Contaminant Levels (MCLs), which are the National Primary Drinking Water Standards (40 CFR Part 141), are considered to be chemical-specific applicable or relevant and appropriate requirements (ARARs) for groundwater at CHAAP. If there were no MCLs available for COPCs for groundwater at CHAAP, cleanup levels were calculated based on risk from exposure to industrial workers. Furthermore, the State of Nebraska has established numeric water quality standards for groundwater under the Nebraska Administrative Code, Title 118, Groundwater Quality Standards and Use Classification, revised effective September 3, 1991.

5.2.1 Groundwater Cleanup Levels

If COPCs did not have an applicable MCL, risk-based groundwater cleanup levels were calculated. The equation used to calculate worker groundwater cleanup levels for chemicals exhibiting carcinogenic effects is as follows:

$$C_{gw} = \frac{TR * BW * AT_c * DAYS * CF}{IR * ED * CF} * \frac{1}{CSF_O}$$

where:

C_{gw} = chemical concentration in groundwater (pg/L),
TR = target excess individual lifetime cancer risk ($1x10^{-6}$),
BW = body weight (70 kg),
AT_c = averaging time for carcinogenic effects (70 years),
DAYS = conversion factor (365 days/year),
CF = conversion factor (10^3 µg/mg),
IR = groundwater ingestion rate (1 L/day),
EF = exposure frequency (250 days/year),
ED = exposure duration (25 years), and
SF_o = oral cancer slope factor ([mg/kg-day]$^{-1}$).

The equation used to calculate worker groundwater cleanup levels for chemicals exhibiting non-carcinogenic effects is:

$$C_s = \frac{THQ * BW * AT_{nc} * DAYS * CF}{IR * EF * ED} * RfD_o$$

where:

C_{gw} = Chemical concentration in groundwater (µg/L),
THQ = target hazard quotient (1),
BW = body weight (70 kg),
AT_{nc} = averaging time for non-carcinogenic effects (25 years),
DAYS = conversion factor (365 days/year),
CF = conversion factor (10^3 µg/mg),
IR = groundwater ingestion rate (1 L/day),
EF = exposure frequency (250 days/year),
ED = exposure duration (25 years), and
RfD_o = oral reference dose (mg/kg-day).

The target risk and hazard quotient was assumed to be a level of $1x10^{-6}$ for carcinogens and a level of 1.0 for non-carcinogens. The toxicity criteria (i.e., cancer slope factors and non-cancer reference doses) were obtained from IRIS or HEAST. Exposure parameters for workers that were obtained from USEPA (1991) included the body weight, averaging time, water ingestion rate, exposure frequency, and exposure duration.

Table 5-5 presents Cleanup Levels for Groundwater COPCs at CHAAP.

Table 5-5 Cleanup Levels for Groundwater COPCs (µg/L) at CHAAP

Chemical	Federal Maximum Containment Levels (µg/L)	Calculated Industrial Risk-Based Levels (µg/L)	Nebraska Groundwater Standards (µg/L)
2-Amino-4,6-Dinitrotoluene	--	6.1	--
4-Amino-2,6-Dinitrotoluene	--	6.1	--
Antimony[a]	6	--	--
Acrylonitrile	--	0.53	--
Benz[a]anthracene	0.1	--	--
Benzene	5	--	5
Beryllium	4	--	--
Chrysene	0.2	--	--
2,4-Dinitrotoluene	--	0.42	--
2,6-Dinitrotoluene	--	0.42	--
1,2-Dichloroethane	5	--	5
Bis (2-Ethylhexyl) phthalate	6[b]	--	--
HMX	--	5,110	--
Indeno (1,2,3-c,d)pyrene	0.4	--	--
Methyl chloride (dichloromethane)	5[b]	38	--
Nitrobenzene	--	51	--
2-Nitrotoluene	--	1,022	--
3-Nitrotoluene	--	1,022	--
4-Nitrotoluene	--	1,022	--
RDX	--	2.6	--
1,3,5-Trinitrobenzene	--	5.1	--
2,4,6-Trinitrotoluene	--	9.5	--
1,1,2-Trichloroethane	5	--	--

Table 5-5 Cleanup Levels for Groundwater COPCs (µg/L) at CHAAP			
Chemical	**Federal Maximum Containment Levels (µg/L)**	**Calculated Industrial Risk-Based Levels (µg/L)**	**Nebraska Groundwater Standards (µg/L)**
Trichloroethene	5	--	5
1,2,3-Trichloropropane	--	0.041	--
Tetryl	--	1,022	--
1,3-Dinitribenzene	--	10	--

-- = Standard not developed for this chemical.
[a] See Section 5.3.
[b] Common laboratory contaminants.

5.3 NATURALLY OCCURRING COPCS

5.3.1 Soil

Two constituents selected as soil COPCs in the HHRA are considered naturally occurring chemicals at CHAAP. They are arsenic and beryllium.

5.3.1.1 Arsenic

Arsenic, a naturally occurring chemical at CHAAP, was selected as a COPC at the Pistol Range. In order to place the detected concentrations into perspective, the concentrations were compared with facility-specific and regional (Central Nebraska) background levels (Dragun and Chiasson, 1991) for determining whether remediation of arsenic-contaminated soil would be warranted. As shown in **Table 5-6**, arsenic exceeded carcinogenic cleanup levels based on target excess cancer risk of $1x10^{-6}$.

Table 5-6. Comparison of Various Concentrations of Arsenic with Risk-Based Cleanup Levels						
Chemical	**Maximum Concentration Detected**	**Facility-Specific Upper Limit of Background**	**Regional Upper Limit of Background**	**1×10^{-6} Risk-Based Cleanup Level**	**1×10^{-5} Risk-Based Cleanup Level**	**1×10^{-4} Risk-Based Cleanup Level**
Arsenic	27.0 µg/g	4.58 µg/g	12 µg/g	3.82 µg/g	38.2 µg/g	382 µg/g

Because arsenic is found in naturally high concentrations regionally and because the maximum arsenic concentration (i.e., 27.0 µg/g) correlates with a risk of 7.07×10^{-6}, no remedial alternatives were proposed in the FS to address arsenic concentrations in soil.

5.3.1.2 Beryllium

Beryllium, classified as a carcinogen, was detected in surface soils at concentrations greater than the target risk level of $1X10^{-6}$ but below the target risk level of $1x10^{-5}$ under the light industrial use scenario. It should be noted that beryllium appears to be a naturally occurring element in Nebraska soils. The upper limit of facility-specific background exceeds concentrations that correlate with a target risk level of $1X10^{-6}$. **Table 5-7** presents risks associated with exposure to maximum concentrations detected in facility-specific background, maximum concentrations detected at the Pistol Range, and concentrations that correlate with target excess individual lifetime cancer risk levels of $1X10^{-4}$, $1x10^{-5}$, and $1x10^{-6}$.

Table 5-7. Comparison of Beryllium Concentrations and Calculated Risk Based Cleanup Levels		
Sampling Location	**Concentration (µg/g)**	**Risk**
Maximum Concentration detected at Pistol Range (Test Trench PRST07, 2 ft bgs)	4.08	5.43×10^{-6}
Upper Limit of Facility-specific background (surface soil)	1.52	2.06×10^{-6}
Calculated Risk Based Cleanup Level	1.33	1×10^{-6}
Calculated Risk Based Cleanup Level	13.3	1×10^{-5}
Calculated Risk Based Cleanup Level	133	1×10^{-4}

Based on the maximum risk (i.e., 4.08 µg/g) which correlates with a risk of 5.43×10^{-6}, no remedial alternatives were proposed in the FS to address beryllium concentrations in soil.

5.3.2 Groundwater

5.3.2.1 Antimony

The chemical-specific ARAR for antimony is the Federal MCL of 6 µg/L. However, the facility-specific background exceeds the Federal MCL by tenfold (62.4 µg/L). The highest concentration (72.6 µg/L) is slightly above the facility-specific background. Based on high concentrations in background which far exceed the Federal MCL, remedial alternatives to address antimony were not proposed in the FS.

6.0 NITRATE AREA

6.1 OPERATIONAL HISTORY

The Nitrate Area was constructed in 1942 as part of the original facility (**USAEC, 1996**). During World War II, the area was converted for the production of nitrate crystals from nitrate liquor and was known as the Ammonium Nitrate Plant. The crystalline nitrate was used in bomb production. In 1946, the plant was again modified to produce ammonium nitrate fertilizer. Fertilizer production ceased in 1948 and the Nitrate Area facilities were placed on standby status.

In 1968, Building N-2 was modified and converted to provide a mine test facility in support of operations at Load Line 5 (**Mason & Hanger, 1982**). Testing operations began on May 27, 1968, and stopped sometime before mine production ceased near the end of the Vietnam conflict.

Building N-17, the Railcar Loading Area, and adjacent open storage areas have been leased to CRS since 1979 for railroad car rebuilding, repair, and refurbishing. Railcars are currently staged throughout CHAAP on unused rail sidings awaiting repair or refurbishment.

Major areas of environmental concern associated with the Nitrate Area that were investigated include: Building N-17; Railroad Loading Area; Crystallization Buildings (N-5, N-17, N-9, N-13, and N-15); Chemical Analysis Laboratory; Sanitary Leachfield; Drum Storage Area; Marsh and Pond Areas; and Drainage Ditches.

6.2 FINDINGS OF THE REMEDIAL INVESTIGATION

The sampling program at the Nitrate Area included: surface soil and sediment sampling for the 1991 EA; surface and subsurface soil sampling, groundwater sampling, and limited surface water and sediment sampling for the 1993 SCD; and surface and subsurface soil and groundwater sampling for the 1996 RI. **Exhibit 6-1** presents sampling locations of past site investigations for soil and groundwater, respectively. **Exhibit 6-2** displays the locations where COPCs were detected in soil above nonresidential cleanup levels.

6.2.1 Groundwater Sampling Results

Sampling results from the two perimeter wells (G0030 and G0032) indicated that operations at the Nitrate Area had not impacted groundwater.

6.2.2 Soil Sampling Results

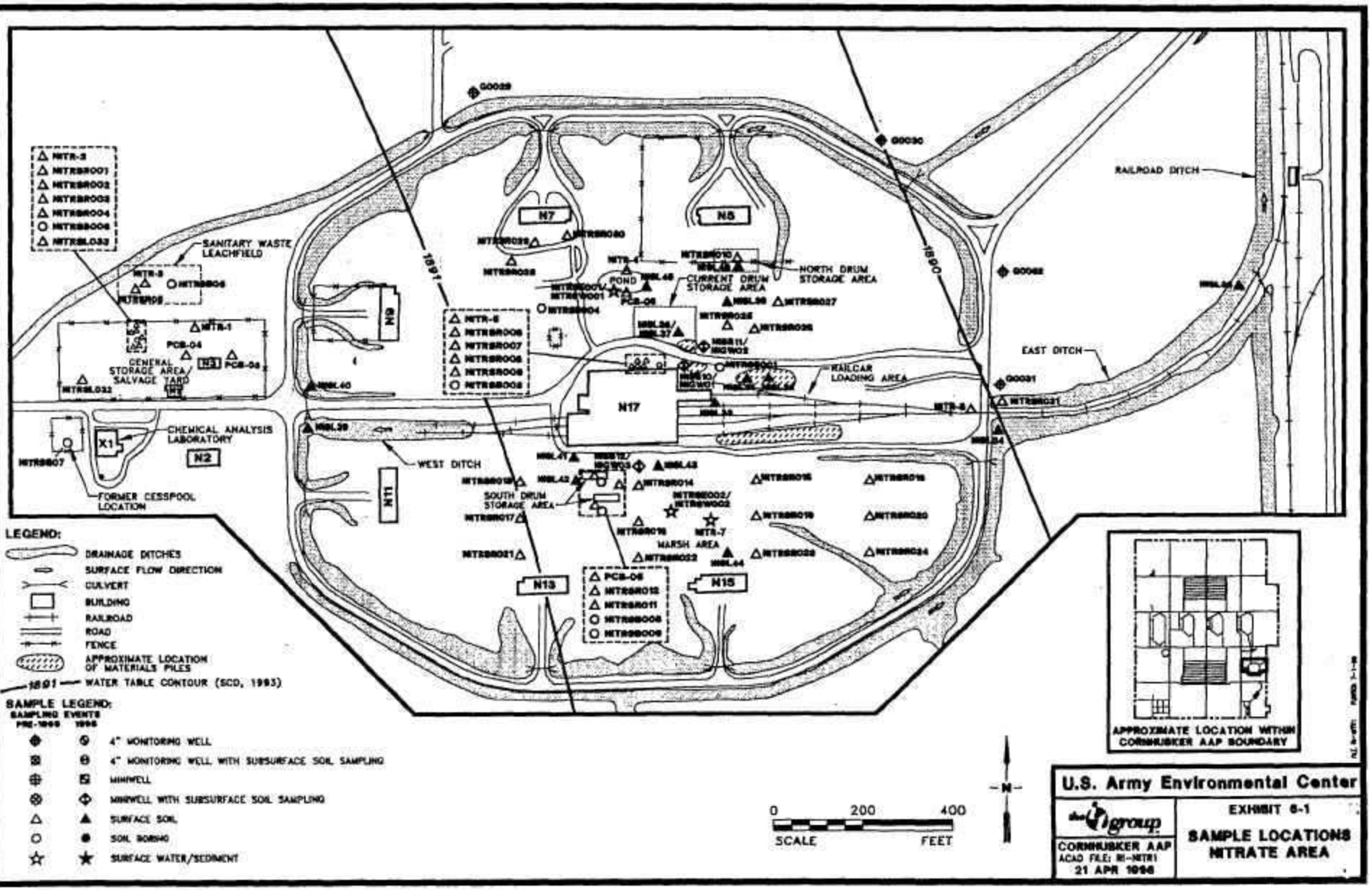
General Storage Area/Salvage Yard: The General Storage Area/Salvage Yard at the Nitrate Area contains lead above the level considered protective of human health under non-residential conditions. The General Storage Area is located within a fenced area which surrounds Buildings N-1 and N-3. This area was used as a salvage yard for storing unwanted equipment, excess machinery, and other items including lead batteries, transformers, and old fuel storage tanks (**Rupp, 1991**). One surface soil sample, NITRSR003, contained lead (4,600 µg/g); however, no other COPCs were detected above the calculated non-residential risk-based cleanup levels. Lead contamination in soil appears to be confined to the surface soil. Lead was not detected in groundwater samples, indicating that lead has likely formed a carbonate mineral phase which is characteristic of the behavior of lead in nonacidic environments.

6.3 DESCRIPTION OF ALTERNATIVES

Based on the findings of the 1996 RI, a FS was prepared in 1998 (**USACE, 1998a**) to address the lead contamination present at the Nitrate Area. Provided below are the remedial alternatives presented in the FS.

6.3.1 Alternative One: No Action for the Nitrate Area

Description: Under this alternative, no actions will be taken to address contamination at the site. The No Action alternative is intended to serve as a baseline with which to compare the risk reduction effectiveness of other potential alternatives. The risks that were calculated in the HHRA are based on the scenario presented by this alternative (i.e., no active reduction of present or future potential risks).



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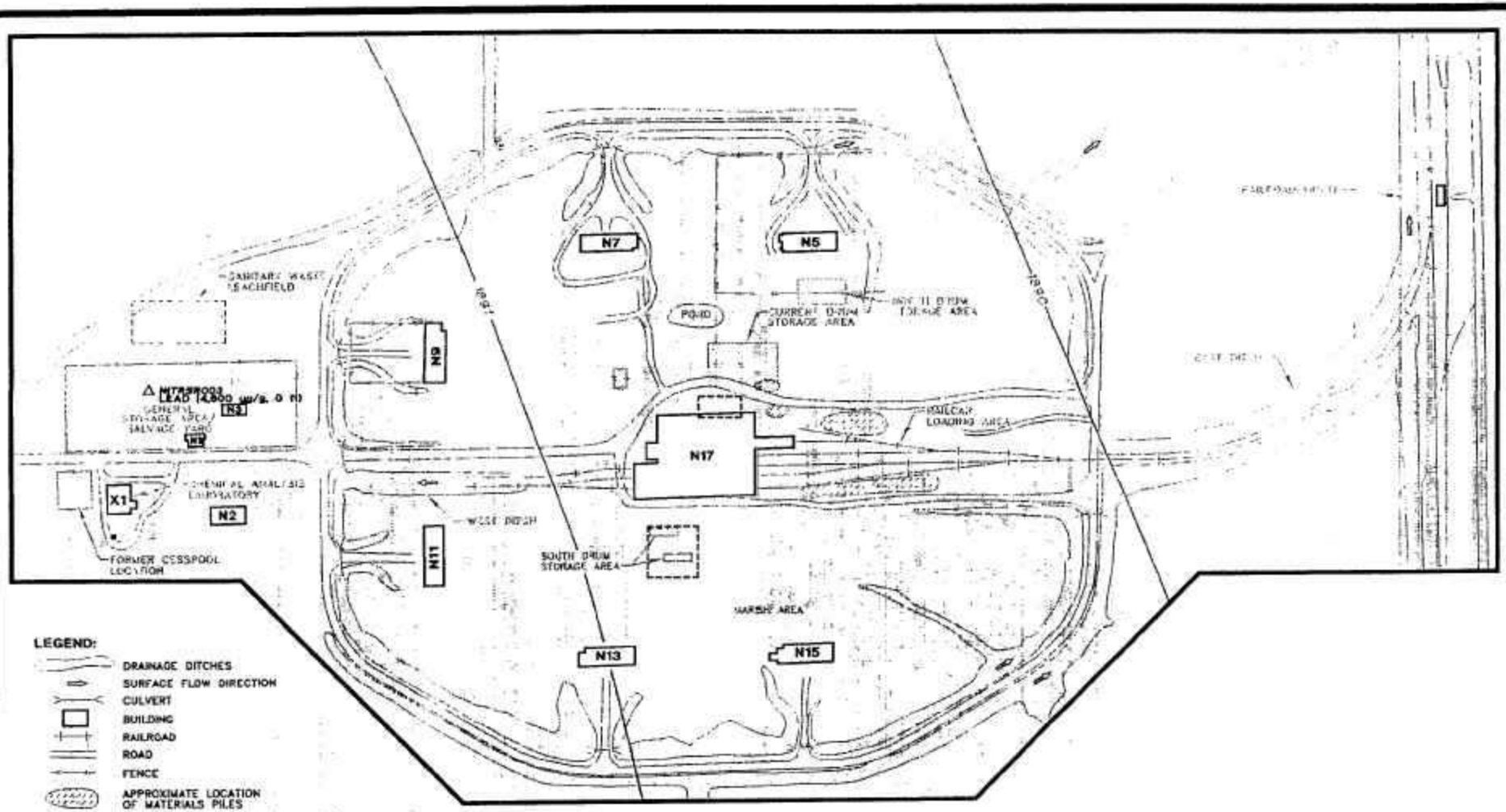
ACAD FILE: 96-NITR1
21 APR 1998

EXHIBIT 6-1

SAMPLE LOCATIONS NITRATE AREA



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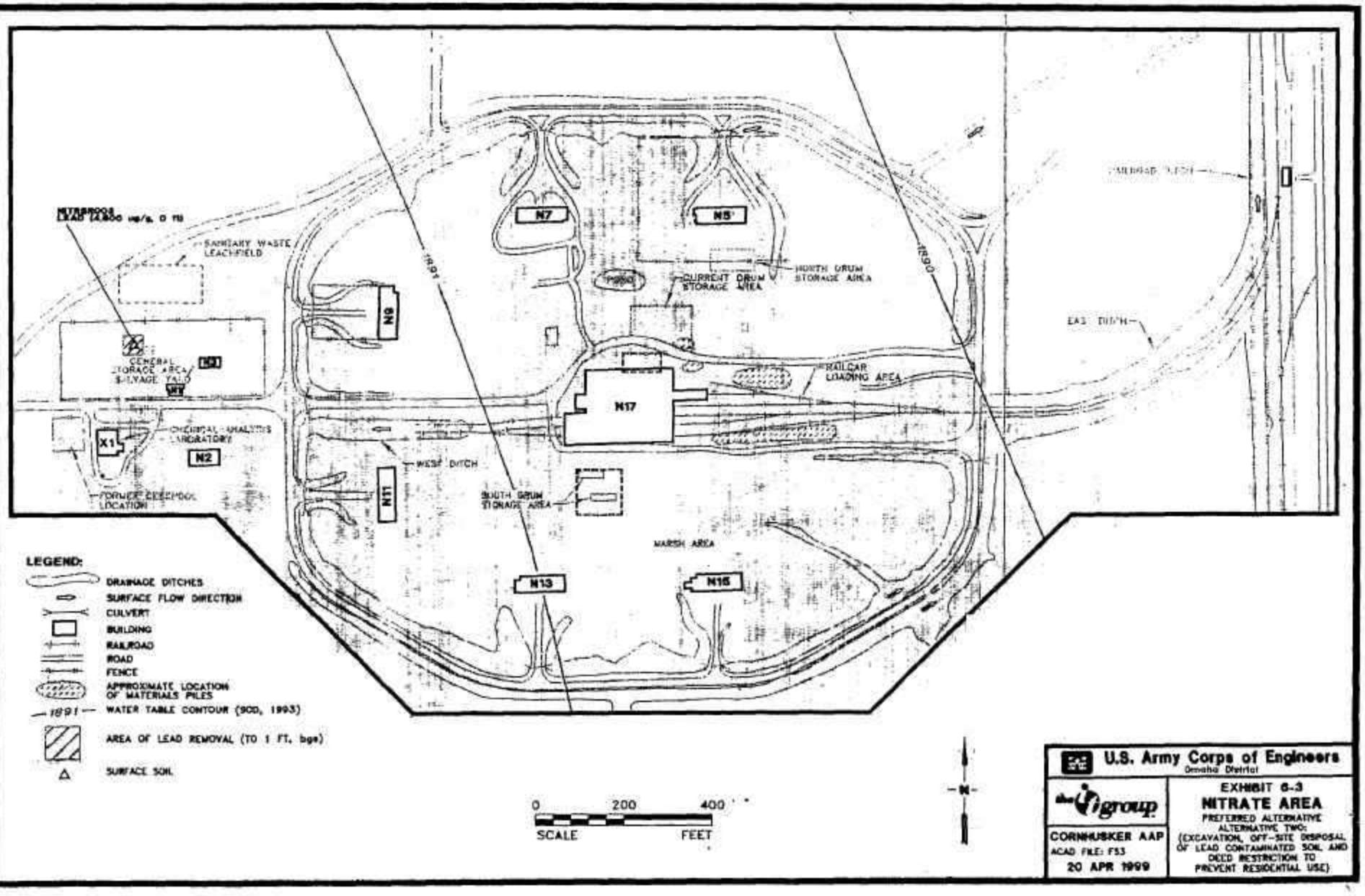
ACAD FILE: F51
20 APR 1999

EXHIBIT 5-2
NITRATE AREA

LOCATION OF COPC DETECTED ABOVE CLEANUP LEVEL


SANITARY WASTE LEACHFIELD
GENERAL STORAGE AREA & SALVAGE YARD
CHEMICAL ANALYSIS LABORATORY
FORMER CESSPOOL LOCATION
WEST DITCH
SOUTH DRUM STORAGE AREA
CURRENT DRUM STORAGE AREA
NORTH DRUM STORAGE AREA
RAILCAR LOADING AREA
MARSH AREA
EAST DITCH
N1
N2
N5
N7
N9
N11
N13
N15
N17
X1
1891
1890
LEGEND:
DRAINAGE DITCHES
SURFACE FLOW DIRECTION
CULVERT
BUILDING
RAILROAD
ROAD
FENCE
APPROXIMATE LOCATION OF MATERIALS PILES
WATER TABLE CONTOUR (90D, 1993)
AREA OF LEAD REMOVAL (TO 1 FT. bgs)
SURFACE SOIL
0
200
400
SCALE
FEET
N
U.S. Army Corps of Engineers
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CORNHUSKER AAP
ACAD FILE: F53
20 APR 1999
EXHIBIT 6-3
NITRATE AREA
PREFERRED ALTERNATIVE
ALTERNATIVE TWO:
(EXCAVATION, OFF-SITE DISPOSAL OF LEAD CONTAMINATED SOIL AND DEED RESTRICTION TO PREVENT RESIDENTIAL USE)

Overall Protection of Human Health and the Environment: The No Action alternative does not decrease the potential risks to humans or the environment in any way, as no remedial activities will be implemented at the site under this alternative.

Compliance with ARARs: The chemical-specific cleanup TBC guidance of 400 µg/g for lead established by the NDEQ will not be met by this alternative. Location- and action-specific ARARs are not considered because no remedial activities will be implemented at the site.

Long-term Effectiveness and Permanence: Over the long-term, this alternative will not be effective. No actions are taken to provide permanent human health and environmental protection.

Reduction of Toxicity, Mobility, or Volume Through Treatment: Because there are no remedial activities implemented at the site, there will be no reduction of toxicity, mobility, or volume through treatment.

Short-term Effectiveness: There is no short-term effectiveness associated with the No Action alternative because no additional remedial activities will be implemented at the site.

Implementability: There are no implementability concerns associated with the No Action alternative because no further remediation activities will be conducted at the site.

Cost: The net present worth for 30 years at 5% interest for this alternative is estimated to be $37,240, the cost of producing the Five-Year Evaluation Report required while the site is listed on the NPL.

6.3.2 Alternative Two: Excavation, Off-Site Disposal of Lead-Contaminated Soil for the Nitrate Area, and Deed Restriction to Prevent Residential Use

Description: Alternative Two is a source removal action. Lead-contaminated soil at the General Storage/Salvage Yard would be excavated to levels below the NDEQ cleanup guidance (400 mg/Kg) and transported to an off-site disposal facility. Based on site investigation sampling results, an area of 10 ft by 10 ft to a depth of one foot would be excavated. The estimated amount of soils to be excavated based on available analytical data is 4 yd^3 (6 tons). The excavated areas would be backfilled with clean soil and graded. Implementation of this alternative prevents exposure pathways via surface to workers. Based on existing data, the lead-contaminated soil may be hazardous under Resource Conservation and Recovery Act (RCRA) regulations. Therefore, the soil, if determined to be RCRA-hazardous, will be disposed at a RCRA Subtitle C Landfill that can accept waste from a CERCLA site.

This alternative also includes implementation of deed restrictions to prevent residential use. The deed restrictions will include proprietary institutional controls restricting the future use of the property such as easements or restrictive covenants that are legally enforceable against subsequent property owners and instituted, depending on state law, by conveyance or contract. The U.S. Army will be responsible for implementing and maintaining the effectiveness of the institutional controls.

Overall Protection of Human Health and the Environment: Because all lead-contamination is removed to below the cleanup level, this alternative provides protection of human health under non-residential conditions.

Compliance with ARARs: NDEQ TBC guidance for lead will be met by this alternative. Action-specific and location-specific ARARs for soil excavation and disposal will be addressed in the Remedial Design for this alternative.

Long-term Effectiveness and Permanence: Lead will be removed to below 400 mg/Kg; therefore, there is no long-term risk associated with lead assuming conditions remain non-residential.

Reduction of Toxicity, Mobility, or Volume Through Treatment: Toxicity, mobility, and volume will be reduced for the soil medium since the contaminated soil will be removed and disposed at an off-site disposal facility.

Short-term Effectiveness: There will be minimal impacts to the community during implementation of this alternative. Fugitive dust generated during excavation will be controlled using a water spray, if necessary. Workers involved with the waste excavation and processing activities could be exposed to risks associated with dermal contact with contaminated soil along with some risks from breathing dust and vapors. However, the emissions levels will be low, and workers will be protected by use of appropriate personal protection equipment.

Implementability: Equipment and materials for implementing this alternative are readily available.

Cost: The net present worth of costs for 30 years at 5% interest for this alternative is estimated to be $132,176, the cost of excavation of lead-contaminated soil and conducting five-year site reviews.

6.4 SUMMARY OF ANALYSIS FOR THE NITRATE AREA ALTERNATIVES

As required by CERCLA, the remedial alternatives described above were evaluated using nine criteria specified by USEPA. This section summarizes the relative performance of each of the alternatives with respect to the nine CERCLA evaluation criteria. **Table 6-1** provides a comparative analysis of the remedial action alternatives for the Nitrate Area.

6.4.1 Protection of Human Health and the Environment

At the Nitrate Area, lead was detected at concentrations greater than the NDEQ Cleanup Guidance. Alternative One will not meet this criterion because no actions are taken to eliminate, reduce, or control exposure pathways. Alternative One does not achieve the threshold criterion of protection of human health and the environment.

Alternative Two provides protection of human health and the environment by eliminating the surface soil exposure pathway as well as mitigating migration of lead into groundwater (sources are removed).

6.4.2 Compliance with ARARs

Compliance with ARARs is a threshold criterion that must be met by the proposed remedial action. Alternative One does not meet the chemical-specific TBC guidance because lead levels remain in soil. There are no location-specific or action-specific ARARs associated with Alternative One. Alternative Two, however, meets the chemical-specific TBC guidance because lead is removed. The actions taken for Alternative Two can be performed in compliance with the action- and location-specific ARARs as identified in **Table 6-3**.

Table 6-1. Comparative Analysis of Remedial Action Alternatives – Nitrate Area

NCP Criteria	Alternative 1 No Action	Alternative 2 Excavation, Off-Site Disposal of Lead-Contaminated Soil, and Deed Restrictions to Prevent Residential Use
1. OVERALL PROTECTIVENESS		
Direct Contact/Soil Ingestion	No significant reduction in risk. Contaminant levels remain in soil	All contamination above levels causing risk will be removed.
2. COMPLIANCE WITH ARARS/TBC GUIDANCE		
Chemical-Specific ARARS	There are no chemical-specific ARARs.	See Alternative 1
Location-Specific ARARs	There are no location-specific ARARs.	Should meet all location-specific ARARs.
Action-Specific ARARs	There are no action-specific ARARs.	Should meet all action-specific ARARs
TBC Guidance	Does not meet protection of industrial worker cleanup levels.	Reduces lead levels in soil below cleanup levels.
3. LONG-TERM EFFECTIVENESS AND PERMANENCE		
Magnitude of Residual Risk (Direct Contact/Soil Ingestion)	Source has not been removed. Existing risk will remain.	Risk is minimized since source is removed.
Adequacy and Reliability of Controls	No controls over remaining contamination. No reliability.	Reliability of soil removal high, since all lead above remedial goals will be removed from the site.
Need for 5-Year Review	Yes.	Yes.

Table 6-1. Comparative Analysis of Remedial Action Alternatives – Nitrate Area

NCP Criteria	Alternative 1 No Action	Alternative 2 Excavation, Off-Site Disposal of Lead-Contaminated Soil, and Deed Restrictions to Prevent Residential Use
4. REDUCTION IN TOXICITY, MOBILITY, AND VOLUME THROUGH TREATMENT		
Treatment Process Used	None.	Stabilization at off-site disposal facility mat be required.
Amount Destroyed or Treated	None.	None.
Reduction of Toxicity, Mobility, or Volume	None.	No reduction in toxicity or mobility, but volume of contaminated soil is reduced.
Irreversible Treatment	None.	None.
Type and Quantity of Residuals Remaining after Treatment	N/A	No detectable residuals remain above cleanup level of 400 µg/g.
Statutory Preference for Treatment	Does not satisfy.	Does not satisfy.
5. SHORT-TERM EFFECTIVENESS		
Community Protection	Risk to community not increased by remedy implementation.	Temporary increase in dust production during excavation.
Worker Protection	No significant risk to workers.	Protection required against dermal contact and inhalation of contaminated dust during excavation activities.
Environmental Impacts	Continued impact from existing conditions.	No environmental impacts from remedial action.
Time until Action is Complete	Not Applicable.	Six months.
6. IMPLEMENTABILITY		
Ability to Obtain Approvals and Coordinate with other Agencies	No approval necessary.	Yes.
Availability of Services and Capacities	No services or capacities necessary.	Services or capacities are readily available.
Availability of Equipment, Specialists, and Materials.	None required.	Equipment, specialists, and materials are readily available.
Availability of Technologies.	None required.	Excavation and disposal technologies readily available.
7. COST		
Capital Cost	$0	$71,381
O&M Cost	$28,000	$28,000
Present Worth Cost	$37,240	$132,176

6.4.3 Long-term Effectiveness and Permanence

Alternative One does not provide long-term effectiveness and permanence. This alternative does not provide sufficient, effective protection of groundwater and potential exposure to humans from exposure to contaminated soils. Alternative Two provides long-term prevention of exposures to contaminated surface soil and migration of lead into groundwater because all sources are removed.

Reviews at least every five years, as required, would be necessary to evaluate the effectiveness of any of these alternatives because hazardous substances would remain onsite in concentrations above health-based levels.

6.4.4 Reduction of Toxicity, Mobility or Volume through Treatment

Alternative One does not provide reduction of toxicity, mobility, or volume of the contaminants. Alternative Two provides reduction of toxicity, mobility, and volume because all lead-contaminated soils are removed to below the cleanup level protective of human health under non-residential conditions.

6.4.5 Short-term Effectiveness

Short-term effectiveness is not applicable to Alternative One. For Alternative Two, the use of proper dust suppressant measures will control windblown emissions of contaminated dust to protect the CRS personnel and on-site workers. Proper personal protective equipment would be required for site workers. Measures to protect the environment are not expected for implementing Alternative Two.

The length of time required to implement and complete the remedial alternatives are as follows: Alternative One is a "No Action" altemative, therefore, no time is required; Alternative Two would require six months to implement.

6.4.6 Implementability

Alternative One, a no further action alternative, is the most easily implemented because it entails no remedial action. However, Alternative Two is also easy to implement because it uses readily available equipment and materials. Alternative Two involves the excavation of lead-contaminated soil and sampling. The excavation (approximately 1 ft bgs) would not require shoring or dewatering.

6.4.7 Cost

Total capital costs, annual operation and maintenance (O&M) costs, and present worth (discount rate of 5%) for each alternative is presented in **Table 6-2**. The progression of total present worth from least expensive to most expensive alternative is Alternative One and Alternative Two. **Table 6-2** provides a detailed cost estimate for Alternative Two at the Nitrate Area.

6.5 SELECTED REMEDY

The selected remedy to address soil contamination at the Nitrate Area is Alternative – Two Excavation, Off-Site Disposal of Lead-Contaminated Soil, and Deed Restriction to Prevent Residential Use (**Exhibit 6-3**). Alternative Two is the preferred alternative because it provides the best balance of features that offer overall protection to human health and the environment. Excavation of contaminated soils will mitigate risks to human health. Furthermore, this action is easy to implement and involves minimal risks to site workers. The deed restrictions will include proprietary institutional controls such as easements or restrictive covenants that are legally enforceable against subsequent property owners and instituted, depending on state law, by conveyance or contract. The U.S. Army will be responsible for implementing and maintaining the effectiveness of the institutional controls. **Table 6-2** presents the detailed cost estimate and **Tables 6-3**, **6-4** and **6-5** present ARARs/TBC guidance applicable to the preferred alternative.

6.6 EXPLANATION OF SIGNIFICANT CHANGES

The Proposed Plan presents the selected remedy as the preferred alternative. No significant changes have been made.

Table 6-2 Cost Estimate for Preferred Alternative for Excavation, Off-Site Disposal of Lead-Contaminated Soil, and Deed Restriction to Prevent Residential Use

Remedial Action	Units	No.	Unit Price	Cost
Capital				
Work Plan	Report	1	$17,250.00	$17,250.00
Pre-Construction Meeting	Meeting	1	$6,960.00	$6,960.00
Site Mobilization/Setup	Site	1	$7,000.00	$7,000.00
Contaminated Soil Removal (Excavation)	Site	1	$5,978.00	$5,978.00
Waste Characterization	Site	1	$2,560.00	$2,560.00
Waste Disposal and Transportation				
Soil Transportation (Rolloff)	Ton	5.6	$265.00	$1,484.00
IDW	55-Gal Drum	2	$130.00	$260.00
Disposal Arrangements	Site	1	$677.00	$677.00
Labor	Site	1	$6,127.00	$6,127.00
Post Excavation Sampling				
Total Lead	Sample	5	$35.00	$175.00
XRF Screening	Week	1	$2,000.00	$2,000.00
Labor	Day	1	$650.00	$650.00
Site Restoration				
Backfilling With Clean Soil	CY	2.50	$15.00	$37.50
Top Soil	CY	2.50	$30.00	$75.00
Grading And Seeding	SY	11.0	$2.00	$22.00
Demobilization	Site	1	$6,000.00	$6,000.00
Closure Report	Report	1	$9,125.00	$9,125.00
Deed Restriction	Each	1	$5,000.00	$5,000.00
			Subtotal Capital Cost	$71,381.00
O & M Cost				
5-Year Site Review (30-Year Period)	Each	1	$10,000.00	$10,000.00
Present Worth 5-Year Site Reviews (30-Year Period @ 5%)				$28,000.00
			Subtotal O & M Cost	$28,000.00
Subtotal Cost of Alternative				$99,381.00
Contingency (@ 25%)				$24,845.00
Project Management (@ 8%)				$7,950.00
Total Cost Alternative				$132,176.00

Table 6-3. Action-Specific ARARs for Preferred Alternative for Excavation, Off-Site Disposal of Lead-Contaminated Soil, and Deed Restriction to Prevent Residential Use

Type of Action	Regulation/Citation	Applicable/Relevant/ Appropriate
Excavation	Regulations to processing machines and equipment (NDEC Title 129 Chapter 4)	Relevant
	Dust generation during construction activities (NDEC Title 129 Chapter 17)	Relevant
	Disposal or decontamination of equipment, structures, etc. (40 CFR 264.114)	Applicable
	On-Site health and safety for personnel during remedial actions (29 CFR 1910)	Applicable
Closure and Post-Closure	Clean Closure (40 CFR 264.111)	Applicable
	Closure with Waste in Place (40 CFR 264.228)	Applicable
	Post-Closure Care (40 CFR 264.117)	Applicable
Disposal of Soil	Hazardous Waste Determination (40 CFR 261)	Applicable
	Standards for generators (40 CFR 262)	Applicable
	Standards for transporters (40 CFR 263; NDEC Title 128 Ch 3 and Ch 17; and 49 CFR 171)	Applicable
	LDRS and Treatment Standards (40 CFR 268)	Applicable

Table 6-4. Location-Specific ARARs for Preferred Alternative for Excavation, Off-Site Disposal of Lead-Contaminated Soil, and Deed Restriction to Prevent Residential Use

Regulation/Citation	Applicable/Relevant/ Appropriate
Executive Order 11988 (Floodplain Management) Evaluate potential effects of actions, avoid impacts to the extent possible (40 CFR 6, Appendix A)	Relevant
Presence of those species listed in the Endangered Species Act (16 USC 1351 et seq.), the Fish and Wildlife Coordination Act (16 USC 661 et seq.), 40 CFR 6.302(h), 50 CFR 402, CWA 404, and 40 CFR 231.10(b), and RSN 37-430 to -438 as being rare, threatened or endangered.	Relevant
Presence of farmlands as defined under 7 CFR 658.4 and 658.5 and the Farmland Protection Relevant Policy Act (7 USC 4201 et seq.)	Relevant

Table 6-5. Chemical-Specific ARARs for Preferred Alternative for Excavation, Off-Site Disposal of Lead-Contaminated Soil, and Deed Restriction to Prevent Residential Use

Constituent	Regulation	Concentration
Lead	NDEQ TBC Guidance. Protective of Human Health under non-residential conditions.	400 mg/Kg

7.0 PISTOL RANGE

7.1 OPERATIONAL HISTORY

The Pistol Range was the site of a destruction area for all the scrap and rejected explosives generated by the Load Line 5 Aerial Mine Program. Based on review of correspondence in Mason & Hanger files, the site appears to have been active from April 1968 until the spring of 1969. CHAAP Standard Operating Procedure (SOP) 612 for the "Pistol Range Demolition Area" (**Mason & Hanger, 1988**) provides operational guidelines for the following operations:

- Static ejection of mines from canisters;
- Burning of RDX and desensitized lead azide;
- Detonation of canisters;
- Detonation of mines;
- Disposal of RDX-contaminated material;
- Burning of XM45E1 mines;
- Detonation of bulk lead azide; and
- Disposal of explosives-contaminated freon.

Based on aerial photographs and historical documents, the following four potential AOCs were identified in the Pistol Range Area: the Burning Pit Area; the Storage Pad; the Firing Range/Backstop Berm/Static Election Test Site; and the Decanting Station and Leaching Pit Area. The Burning Pit Area is the AOC at the Pistol Range that contains contamination above levels considered protective of human health under non-residential conditions.

The Burning Pit Area, located in the northern portion of the Pistol Range study area, was used for explosives demolition. According to a Mason & Hanger engineering drawing, burning and demolition operations took place north of the small arms fire backstop berm in a series of eight burning pits (Test Trenches: PRST07, PRST08, PRST09, PRST10, PSRGST002, PSRGST003, PSRGST004, and PSRGST006) that were 4 ft deep, 2-4 ft in width, and ranged from 8-40 ft in length (**Mason & Hanger, 1969**). Desensitized lead azide, microgravel mini-mines, and explosives-contaminated trash were regularly dumped into burning pits, doused with fuel oil, and ignited. Unexploded mines and bulk explosives scattered over the ground during demolition events were soaked with liquid freon, transported back to the burning pits, and re-ignited. During the 1995 Rl field effort, this area was a flat dry-cultivated field.

7.2 FINDINGS OF THE REMEDIAL INVESTIGATION

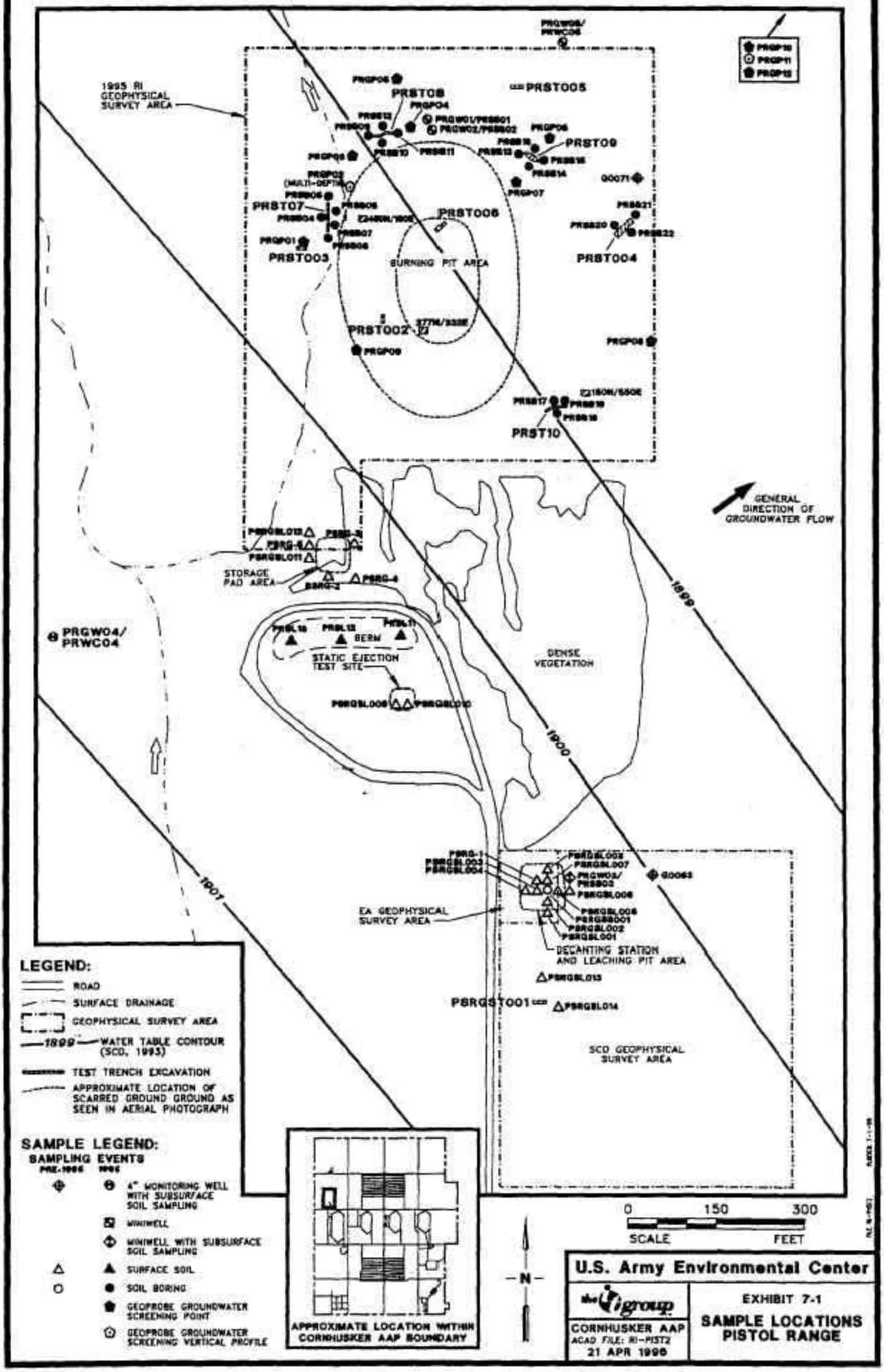
The sampling program at the Pistol Range was as follows: geophysical surveying and surface soil sampling for the 1991 EA; geophysical surveying, surface and subsurface soil sampling, test trench excavating, and groundwater sampling for the 1993 SCD; and geophysical surveying, surface and subsurface soil sampling, test trench excavating, and groundwater sampling for the 1996 Rl. **Exhibit 7-1** presents sampling locations of previous investigations at the Pistol Range. For the sampling program at the Pistol Range, refer to investigative program summary in the 1996 RI. **Exhibit 7-2** displays the locations where COPCs were detected in soil above the non-residential cleanup levels.

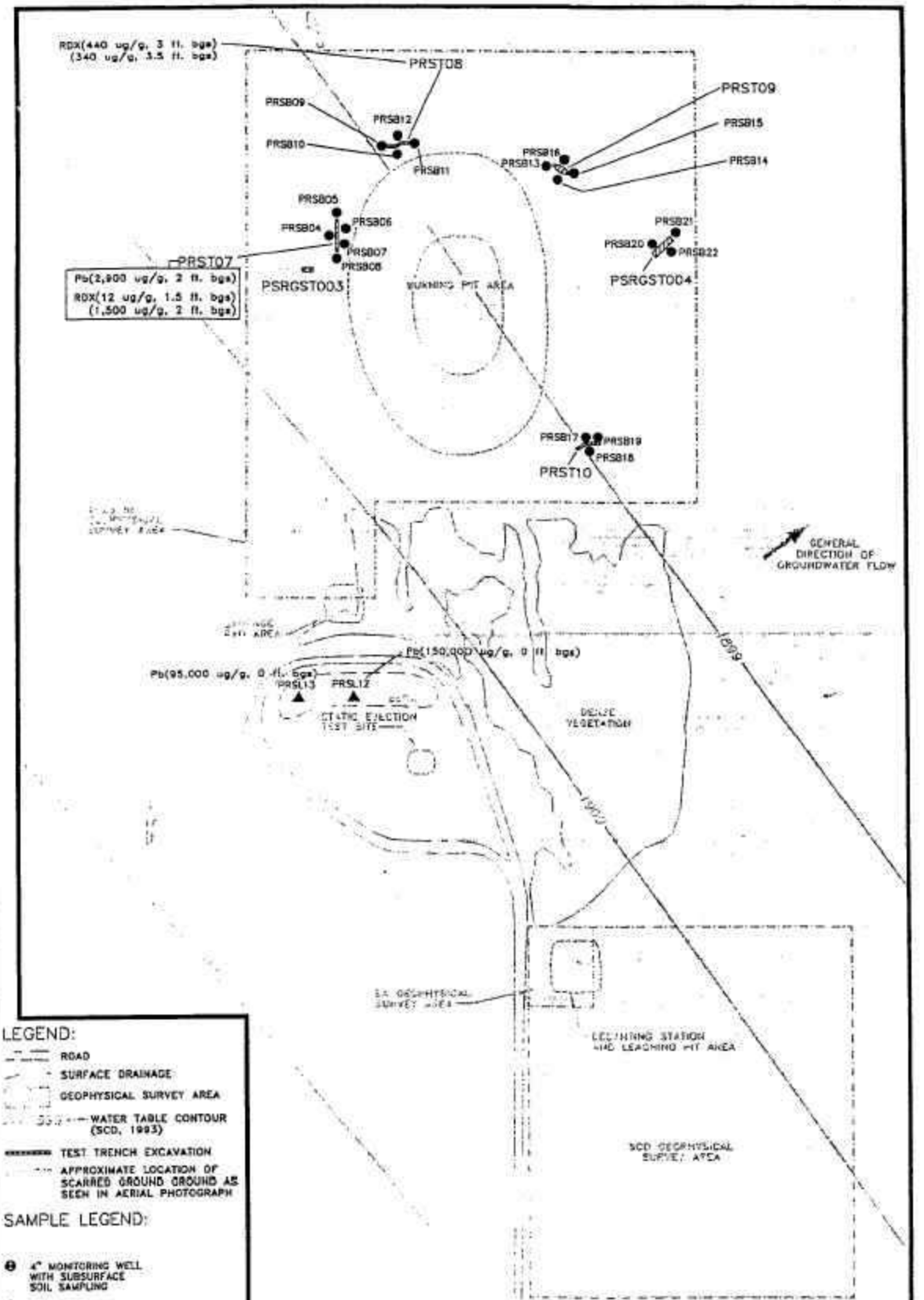
7.2.1 Soil Sampling Results

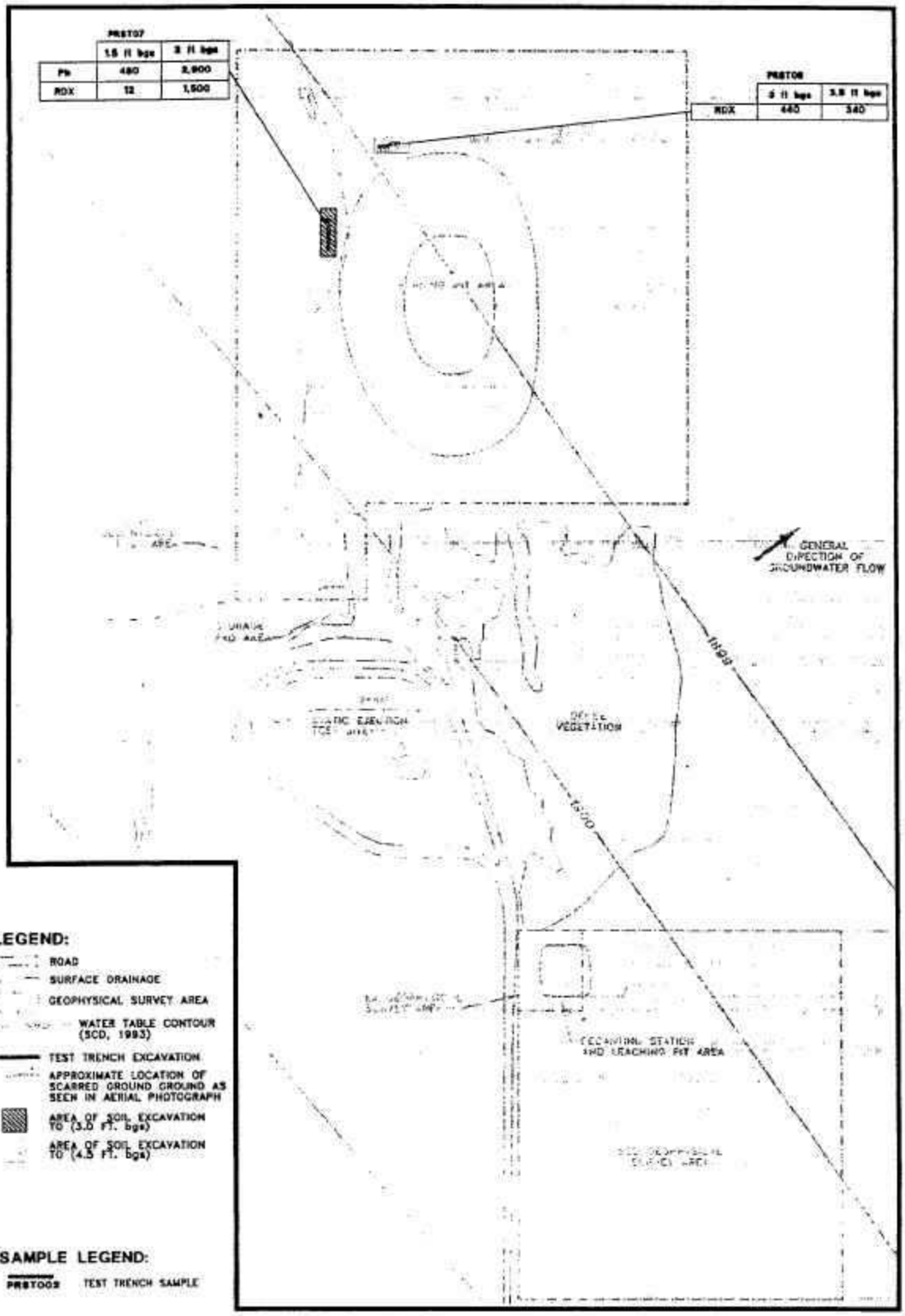
The Test Trenches and Static Ejection Site/Backstop Berm were the only areas within the Pistol Range where contaminants exceeded cleanup levels. Provided below is a summary of COPC contamination at these areas that triggered the need for an alternatives analysis for this AOC.

Test Trenches:

- Test Trench PRST07 **S** Lead (1,700-2,900 µg/g) was detected above the NDEQ TBC Guidance of 400 mg/Kg.


1993 RI GEOPHYSICAL SURVEY AREA
PRST005
PRST008
PRST09
PRST07
PRST006
PRST003
PRST004
PRST002
PRST10
BURNING PIT AREA
STORAGE PAD AREA
STATIC EJECTION TEST SITE
BERM
DENSE VEGETATION
PRGW04/ PRWC04
GENERAL DIRECTION OF GROUNDWATER FLOW
1899
1900
1901
EA GEOPHYSICAL SURVEY AREA
DECANTING STATION AND LEACHING PIT AREA
PSRGST001
SCD GEOPHYSICAL SURVEY AREA
LEGEND:
ROAD
SURFACE DRAINAGE
GEOPHYSICAL SURVEY AREA
1899 WATER TABLE CONTOUR (SCD, 1993)
TEST TRENCH EXCAVATION
APPROXIMATE LOCATION OF SCARRED GROUND GROUND AS SEEN IN AERIAL PHOTOGRAPH
SAMPLE LEGEND:
SAMPLING EVENTS
PRE-1996
1996
4" MONITORING WELL WITH SUBSURFACE SOIL SAMPLING
MINIWELL
MINIWELL WITH SUBSURFACE SOIL SAMPLING
SURFACE SOIL
SOIL BORING
GEOPROBE GROUNDWATER SCREENING POINT
GEOPROBE GROUNDWATER SCREENING VERTICAL PROFILE
APPROXIMATE LOCATION WITHIN CORNHUSKER AAP BOUNDARY
N
0 150 300
SCALE FEET
U.S. Army Environmental Center
the IT group
CORNHUSKER AAP
ACAD FILE: RI-PIST2
21 APR 1998
EXHIBIT 7-1
SAMPLE LOCATIONS
PISTOL RANGE


RDX(440 ug/g, 3 ft. bgs)
(340 ug/g, 3.5 ft. bgs)
PRST08
PRST09
PRSB09
PRSB12
PRSB15
PRSB10
PRSB11
PRSB16
PRSB13
PRSB14
PRSB05
PRSB04
PRSB06
PRSB07
PRSB08
PRST07
Pb(2,900 ug/g, 2 ft. bgs)
RDX(12 ug/g, 1.5 ft. bgs)
(1,500 ug/g, 2 ft. bgs)
PSRGST003
WORKING PIT AREA
PRSB21
PRSB20
PRSB22
PSRGST004
PRSB17
PRSB19
PRSB18
PRST10
GENERAL DIRECTION OF GROUNDWATER FLOW
Pb(150,000 ug/g, 0 ft. bgs)
Pb(95,000 ug/g, 0 ft. bgs)
PRSL13
PRSL12
STATIC EJECTION TEST SITE
DENSE VEGETATION
1999
1993
EM GEOPHYSICAL SURVEY AREA
LEACHING STATION AND LEACHING PIT AREA
SCD GEOPHYSICAL SURVEY AREA
LEGEND:
ROAD
SURFACE DRAINAGE
GEOPHYSICAL SURVEY AREA
WATER TABLE CONTOUR (SCD, 1993)
TEST TRENCH EXCAVATION
APPROXIMATE LOCATION OF SCARRED GROUND AS SEEN IN AERIAL PHOTOGRAPH
SAMPLE LEGEND:
4" MONITORING WELL WITH SUBSURFACE SOIL SAMPLING
SURFACE SOIL
STATIC BERM SITE NOT ADDRESSED BECAUSE SITE WILL CONTINUE TO BE USED AS A FIRING RANGE
SOIL BORING
0
150
300
SCALE
FEET
N
NOTE:
SOIL DETECTIONS EXPRESSED IN RED
U.S. Army Corps of Engineers
Omaha District
the IT group
CORNHUSKER AAP
ACAD FILE: F55
16 APR 1999
EXHIBIT 7-2
PISTOL RANGE
LOCATIONS OF COPCS DETECTED ABOVE CLEANUP LEVELS


PRST07
1.5 ft bgs
3 ft bgs
Pb
480
2,900
RDX
12
1,500
PRST08
3 ft bgs
3.8 ft bgs
RDX
440
340
GENERAL DIRECTION OF GROUNDWATER FLOW
LEGEND:
ROAD
SURFACE DRAINAGE
GEOPHYSICAL SURVEY AREA
WATER TABLE CONTOUR (SCD, 1993)
TEST TRENCH EXCAVATION
APPROXIMATE LOCATION OF SCARRED GROUND GROUND AS SEEN IN AERIAL PHOTOGRAPH
AREA OF SOIL EXCAVATION TO (3.0 Ft. bgs)
AREA OF SOIL EXCAVATION TO (4.5 Ft. bgs)
SAMPLE LEGEND:
PRST003 TEST TRENCH SAMPLE
NOTES:
SOIL DATA IS REPORTED IN µg/g (RED)
0
150
300
SCALE
FEET
N
U.S. Army Corps of Engineers
Omaha District
the Tigroup
CORNHUSKER AAP
ACAD FILE: FS4
20 APR 1999
EXHIBIT 7-3
PISTOL RANGE
PREFERRED ALTERNATIVE, ALTERNATIVE THREE EXCAVATION OF TEST TRENCHES PRST07, AND PRST08, OFFSITE PROPOSAL, AND DEED RESTRICTION TO PREVENT RESIDENTIAL USE

Explosives COPC RDX (12 µg/g at 1.5 ft bgs, 1,500 µg/g at 2 ft bgs) exceeded the calculated non-residentiai risk-based cleanup level.

- Test Trench PRST08 - RDX was detected in subsurface soil samples (3-3.5 ft bgs) in concentrations (340-440 µg/g) that exceed the calculated non-residential risk-based cleanup level.

Static Eiection Test Site/Backstop Berm: Lead (1,400 - 150, 000 µg/g) was detected above the NDEQ TBC Guidance of 400 mg/Kg. The samples were collected from PRSL11, PRSL12, and PRSL13. It should be noted that this area was not addressed in the FS because it is currently being used as a firing range by the local police department.

7.3 DESCRIPTION OF ALTERNATIVES

Based on the findings of the RI, a FS was prepared in 1997 to address lead and RDX contamination at the Pistol Range. Provided below are remedial alternatives for addressing RDX- and lead-contaminated soil at the Burning Pit Area. The assessment consists of evaluating each alternative using the nine criteria listed in the NCP.

7.3.1 Alternative 1: No Action

Description: According to the NCP, the level of treatment achieved must be compared to the required expenditures of time and materials as an integral portion of the remedy selection process. The "No Action" alternative is intended to serve as a baseline with which to compare the risk reduction effectiveness of other potential alternatives.

Overall Protection of Human Health and the Environment: The "No Action" alternative does not decrease the potential risks to humans or the environment in any way, as no remedial activities will be implemented at the site under this alternative. Ingestion or dermal exposure to lead and RDX contamination in soil are potential exposure pathways for workers at the site. Implementation of the "No Action" alternative would not reduce pathways for lead or RDX exposure to humans.

Compliance with ARARs: This alternative does not comply with chemical-specific TBC guidance for RDX and lead. The location-specific and action-specific ARARs are not considered because no remedial activities will be implemented at the site.

Long-term Effectiveness and Permanence: Over the long-term, this alternative will not be effective. No actions are taken to provide permanent human health and environmental protection.

Reduction of Toxicity, Mobility, or Volume Through Treatment: There will be no further remedial activities implemented at the site; subsequently, there will be no further reduction of toxicity, mobility, or volume through treatment.

Short-term Effectiveness: There is no short-term effectiveness associated with the "No Action" alternative because no additional remedial activities will be implemented at the site.

Implementability: There are no implementability concerns associated with the "No Action" alternative because no remediation activities will be conducted at the site.

Cost: Because contaminants are left in place, a site evaluation report must be submitted after five years. The estimated present worth of this alternative is $37,240, the cost of the five-year report.

7.3.2 Alternative 2: Deed Restriction and Groundwater Monitoring

Description: The institutional controls alternative establishes legal and barrier restrictions on the use of land and groundwater as an attempt to reduce the dangers from releases or threatened releases of environmental contaminants. The components of this alternative include:

- Monitoring: Monitoring of groundwater would be initiated and maintained for a period of 30 years. Groundwater would be monitored through a system consisting of three existing wells

and two new wells. The water will be sampled semi-annually and will be analyzed for lead and RDX.

- Deed Restriction: This alternative also includes implementation of deed restrictions to prevent residential use. The deed restrictions will also specifically identify the location and condition of the eight burn pits in accordance with DOD 6055.9-STD Chapter 12. The deed restrictions will include proprietary institutional controls restricting the future use of the property such as easements or restrictive covenants that are legally enforceable against subsequent property owners and instituted, depending on state law, by conveyance or contract. The U.S. Army will be responsible for implementing and maintaining the effectiveness of the institutional controls.

Overall Protection of Human Health and the Environment: Protection of human health from exposure to RDX and lead is achieved by the implementation of site restrictions. However, this alternative does not mitigate migration of contaminants into groundwater. Because groundwater is not protected, this alternative does not comply with this criteria.

Compliance with ARARs: There would be no location-specific or action-specific ARARs associated with this alternative at the site. This alternative does not involve cleanup of RDX- and lead-contaminated soils; therefore, this alternative does not meet chemical-specific TBC guidance.

Long-term Effectiveness and Permanence: No treatment related residuals are generated. All existing waste is left untreated, and the magnitude of risk posed by the site goes unchanged. Therefore, this alternative does not afford long-term protection of human health.

Reduction of Toxicity, Mobility, or Volume through Treatment: This alternative provides no reduction in toxicity, mobility, or volume of the contaminated soil "through treatment."

Short-term Effectiveness: Because no soil will be removed, this alternative creates no additional risks to the community, workers, or the environment due to remedial activities. Installation of wells would not cause risk to workers or the environment.

Implementability : The technical feasibility of implementing Alternative Two is considered to be high because the required activities (monitoring and site control) are easily implemented. Actions to be taken are limited to the addition of warning signs, the prevention of site and groundwater usage to be regulated by the Army, and the implementation of a comprehensive monitoring program.

Cost: The capital cost and annual O&M costs for Alternative Two are approximately $70,000 and $150,000, respectively. The estimated 30-year present worth at a 5% interest rate is $293,880.

7.3.3 Alternative 3: Excavation and Off-site Disposal of Soil from Test Trenches PRST07 and PRST08 and Deed Restriction to Prevent Residential Use

Description: Lead- and RDX-contaminated soil from Test Trench PRST07 and RDX- contaminated soil from Test Trench PRST08 would be removed to cleanup levels. The test trenches are approximately 4 ft by 40 ft in area. Test Trench PRST07 will be excavated to a depth of 3 ft bgs and Test Trench PRST08 will be excavated to a depth of 4.5 ft bgs. Therefore, a volume of 18 yd^3 from PRST07 and 27 yd^3 from PRST08 would be removed. Prior to excavation, soil will be screened for UXO. No shoring or dewatering would be required, as the depth of excavation is less than 5 ft bgs. It should be noted that the pits were delineated and excavated as part of a test trench exercise in 1995. Upon completion of the soil excavation, lead screening using x-ray fluorescence (XRF) in Test Trench PRST07 and RDX screening using immunoassay in Test Trenches PRST07 and PRST08 would be used to determine if excavation of soil to cleanup levels has been completed. If screening data indicate that removal of lead (Test Trench PRST07, only) and RDX to cleanup levels has been accomplished, samples would be collected for confirmational analysis. Samples would be collected and tested to determine if excavated soil is a RCRA-hazardous waste. Please note that the cost estimates are conservative (i.e., disposal costs are for incineration at a RCRA permitted facility). The excavated area would be backfilled with clean soil (approximately 55 yd^3) and reseeded.

This alternative also includes implementation of deed restrictions to prevent residential use. The deed restrictions will also specifically identify the location and condition of the eight burn pits in accordance with DOD 6055.9-STD Chapter 12. The deed restrictions will include proprietary institutional controls restricting the future use of the property such as easements or restrictive covenants that are legally enforceable against subsequent property owners and instituted, depending on state law, by conveyance or contract. The U.S. Army will be responsible for implementing and maintaining the effectiveness of the institutional controls.

Overall Protection of Human Health and the Environment: The removal of lead and RDX contaminated soil to the cleanup levels of 400 µg/g and 52 µg/g, respectively, from the test trenches is protective of human health under non-residential conditions.

Compliance with ARARs:

- Chemical-specific ARARs/TBC guidance: The excavation would meet the chemical-specific TBC guidance for RDX which is the calculated risk-based level and for lead, which is the NDEQ guidance level considered to be protective of human health under non-residential conditions.

- Location-specific ARARs: This alternative is not expected to affect any location-specific ARARS.

- Action-specific ARARs: The proposed remedial design and operation should meet all action-specific ARARs.

Long-term Effectiveness and Permanence: Over the long-term, this alternative would be effective because lead and RDX are removed to levels that are below their respective cleanup levels.

Reduction of Toxicity, Mobility, or Volume through Treatment: Toxicity, mobility, and volume will be reduced for the soil medium since the contaminated soil will be removed and disposed at an off-site disposal facility.

Short-term Effectiveness: If selected as the remedial action, excavation could be implemented in less than six months. This alternative poses minimal risk to the community, workers, or the environment during its implementation. Workers involved with the waste excavation and processing activities could be exposed to risks associated with dermal contact with contaminated soil along with some risks from breathing contaminant dust and vapors. Emission levels, however, will be low, and workers will be protected by use of appropriate personal protective equipment. No endangered species are to be affected during remediation.

Implementability: Equipment and materials for implementing this alternative are readily available.

Cost: Capital and O&M costs associated with this alternative are estimated to be $142,787 and $28,000, respectively. The estimated 30-year present worth at a 5% interest rate is $227,147.

7.4 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES FOR THE PISTOL RANGE

As required by CERCLA, the remedial alternatives described above were evaluated using nine criteria specified by USEPA. This section summarizes the relative performance of each of the alternatives with respect to the nine CERCLA evaluation criteria. **Table 7-1** summarizes the comparative analysis for the three remedial alternatives provided in the FS.

Table 7-1. Comparative Analysis of Remedial Action Alternatives Pistol Range

NCP Criteria	Alternative 1 No Action	Alternative 2 Monitoring of Groundwater and Deed Restriction	Alternative 3 Excavation and Off-Site Disposal of Lead- and RDX-Contaminated Soil and Deed Restriction
1. OVERALL PROTECTIVENESS			
Direct Contact/Soil Ingestion	No significant reduction in risk. Contaminant levels remain in soil.	Deed restrictions limit exposure to contaminated soil; however, contaminants remain in place.	All contamination above levels causing risk will be removed.
2. COMPLIANCE WITH ARARS/TCB GUIDANCE			
Chemical-Specific ARARS	There are no chemical-specific ARARs.	See Alternative 1.	See Alternative 1.
Location-Specific ARARs	There are no location-specific ARARs.	See Alternative 1.	Would meet all location-specific ARARs.
Action-Specific ARARs	There are no action-specific ARARs.	See Alternative 1.	Would meet all action-specific ARARs.
TBC Guidance	Does not meet TBC cleanup levels.	See Alternative 1.	Reduces lead and RDX levels in soil to below cleanup levels.
3. LONG-TERM EFFECTIVENESS AND PERMANENCE			
Magnitude of Residual Risk (Direct Contact/Soil Ingestion)	Source has not been removed. Existing risk will remain.	Source has not been removed. Existing risk will remain.	Risk is eliminated since source is removed.
Adequacy and reliability of Controls	No controls over existing contamination.	Access restrictions reduce some contact with contaminated soil. However, exposure remains.	Reliability of soil removal high, since all RDX and lead above remedial goals will be removed from the site.
Need for 5-Year Review	Yes.	Yes.	Yes.
4. REDUCTION IN TOXICITY, MOBILITY, AND VOLUME THROUGH TREATMENT			
Treatment Process Used	None.	None.	Incineration and stabilization.
Amount Destroyed or Treated	None.	None.	45 yd^3.
Reduction of Toxicity, Mobility, or Volume	None.	None.	Toxicity, mobility, and volume is reduced.
Irreversible Treatment	None.	None.	Incineration is irreversible.
Type and Quantity of Residuals Remaining after Treatment	No residuals remain.	No residuals remain.	RDX would be completely oxidized by incineration. Lead in the residual ash may require stabilization.
Statutory Preference for Treatment	Does not satisfy.	Does not satisfy.	Satisfies.
5. SHORT-TERM EFFECTIVENESS			
Community Protection	Risk to community not increased by remedy implementation.	See Alternative 1.	See Alternative 1.
Worker Protection	No significant risk to workers.	No significant risk to workers.	Protection required against dermal contact and inhalation of contaminated dust during excavation activities.
Environmental Impacts	Continued impact from existing conditions.	Continued impact from existing conditions.	No environmental impacts from remedial action.
Time until Action is Complete	Not applicable.	Until agreement is reached among stakeholders that monitoring is no longer necessary.	Six months.
6. IMPLEMENTABILITY			
Ability to Obtain Approvals and Coordinate with other Agencies	No approval necessary.	Yes.	Yes.
Availability of Services and Capacities	No services or capacities necessary.	Services and capacities are readily available.	See Alternative 2.
Availability of Equipment, Specialists, and Materials.	None required.	Equipment, specialists, and materials are readily available.	See Alternative 2.
Availability of Technologies.	None required.	Yes.	Excavation, disposal, stabilization and incineration technologies readily available.

Table 7-1. Comparative Analysis of Remedial Action Alternatives Pistol Range

NCP Criteria	Alternative 1 No Action	Alternative 2 Monitoring of Groundwater and Deed Restriction	Alternative 3 Excavation and Off-Site Disposal of Lead- and RDX-Contaminated Soil and Deed Restriction
7. COST			
Capital Cost	$0	$70,000	$142,787
O&M Cost	$28,000	$150,962	$28,000
Present Worth Cost	$37,240	$293,880	$227,147

7.4.1 Protection of Human Health and the Environment

Current levels of contamination pose levels of human health risk that may be considered unacceptable. RDX was detected at concentrations greater than the non-residential risk-based cleanup level (52 µg/g). Lead was detected above the NDEQ TBC chemical-specific guidance. Alternative One will not meet this criterion because no actions are taken to eliminate, reduce or control exposure pathways. Alternative One does not achieve the threshold criterion of protection of human health and the environment.

Alternative Two provides some protection from contaminated soil by implementing and maintaining deed restrictions, which would prohibit the use of the test trenches and immediate area for agricultural use. Although the deed restriction will limit dermal and ingestion exposure to contaminants in soil (humans only), it does not prevent further contaminant loading to groundwater; therefore, Alternative Two is not fully protective of human health and the environment.

Alternative Three provides protection of human health and the environment by eliminating the surface soil exposure pathway as well as mitigating migration of RDX and lead into groundwater (sources are removed). Therefore, implementation of this alternative would allow future land use of the Pistol Range area for non-residential purposes. Alternative Three is considered protective of human health because RDX and lead in soil would be removed to concentrations that correlate with the cleanup levels of 52 µg/g and 400 µg/g, respectively.

7.4.2 Compliance with ARARs

Compliance with ARARs is a threshold criterion, which must be met by the proposed remedial action. Alternatives One and Two do not meet the chemical-specific TBC guidance because contaminant levels remain in soil. Alternative Three involves further actions to eliminate exposure to contaminated soil and mitigate migration of contaminants into soil. These actions can be performed in compliance with the action- and location-specific ARARs as identified in **Table 7-2**. This is the only alternative that completely meets chemical-specific TBC guidance.

7.4.3 Long-term Effectiveness and Permanence

Alternatives One and Two do not provide long-term effectiveness and permanence. Neither of these alternatives provides sufficient, effective protection of groundwater. Alternative Three provides long-term prevention of exposures to contaminated soil and migration of contaminants into groundwater because sources are removed.

Reviews at least every five years, as required, would be necessary to evaluate the effectiveness of any of these alternatives because hazardous substances would remain onsite in concentrations above health-based levels.

7.4.4 Reduction of Toxicity, Mobility or Volume through Treatment

Alternatives One and Two do not provide reduction of toxicity, mobility, or volume of the contaminants. Alternative Three provides reduction of toxicity, mobility, and volume because all RDX and lead in the soil are removed to below cleanup levels. If off-site incineration were the off-site disposal option, RDX would be permanently destroyed through treatment. The remaining ash would be stabilized for any inorganics that may be present.

Table 7-2. ARARs and TBC Guidance for Preferred Alternative for Excavation, Off-Site Disposal of RDX- and Lead-Contaminated Soil, and Deed Restriction to Prevent Residential Use
Action-Specific ARARS
Excavation
Regulations to processing machines and equipment (NDEC Title 129 Chapter 4)
Dust generation during construction activities (NDEC Title 129 Chapter 17)
Disposal or decontamination of equipment, structures, etc. (40 CFR 264.114)
On-site health and safety for personnel during remedial actions (29 CFR 1910)
Closure and Post-Closure
Clean Closure (40 CFR 264.111)
Closure with Waste in Place (40 CFR 264.228)
Post-Closure Care (40 CFR 264.117)
Disposal of Soil
Hazardous Waste Determination (40 CFR 261)
Standards for generators (40 CFR 262)
Standards for transporters (40 CFR 263, NDEC Title 128, Ch 3 and Ch 17, and 49 CFR 171)
LDRs and Treatment Standards (40 CFR 268)
Location-Specific ARARs
Presence of those species listed in the Endangered Species Act (16 USC 1351 et seq.), the Fish and Wildlife Coordination Act (16 USC 661 et seq.), 40 CFR 6.302(h), 50 CFR 402, CWA 404, and 40 CFR 231.10(b), and RSN 37-430 to -438 as being rare, threatened or endangered.
Presence of farmlands as defined under 7 CFR 658.4 and 658.5 and the Farmland Protection Policy Act (7 USC 4201 et seg.)
Chemical-Specific TBC Guidance ARARs
Lead: NDEQ TBC Guidance (400 mg/kg) Protective of Human Health Under Non-Residential Conditions
RDX: Calculated Risk-based Cleanup Level (52 mg/kg)

7.4.5 Short-term Effectiveness

Short-term effectiveness is not applicable to Alternative One. Alternative Two provides for short-term protection of workers during implementation. Workers will take appropriate safety measures to perform their functions (e.g., drilling, sampling). For Alternative Three, the use of proper dust suppressant measures will control windblown emissions of contaminated dust to protect the community and on-site workers. Proper personal protective equipment would be required for site workers. Measures to protect the environment are not expected for implementing Alternatives Two and Three.

The length of time required for implementing and completing the remedial alternatives is as follows: Alternative One is a "No Action" alternative; therefore, no time is required; Alternative Two would require less than three months to implement; and Alternative Three will take less than six months to implement.

7.4.6 Implementability

Alternatives One and Two are the most easily implemented. Alternative One is a no further action alternative. Alternative Two involves the installation of monitoring wells and sampling. Alternative Three would also be fairly easy to implement because it uses commonly available equipment and materials. Alternative Three involves excavation and off-site incineration or landfilling of contaminated soils. Excavation to the depths proposed in Alternative Three would be easy to implement. The excavation (approximately 5 ft bgs) would not require shoring or dewatering.

7.4.7 Cost

Total capital and annual costs and present worth (discount rate of 5%) for each alternative are presented in **Table 7-3.** The progression of total present worth from least expensive to most expensive is: Alternative One, Alternative Three, and Alternative Two.

7.5 SELECTED REMEDY

The selected remedy to address the soil contamination at the Pistol Range is Alternative Three - Excavation, Off-Site Disposal of RDX- and Lead-Contaminated Soil, and Deed Restriction to Prevent Residential Use. Alternative Three is the preferred alternative for the Pistol Range because it provides the best balance of features that offer overall protection to human health under non-residential conditions; is easy to implement; and involves minimal risks to site workers. The deed restrictions will also

specifically identify the location and condition of the eight burn pits in accordance with DOD 6055.9-STD Chapter 12. The deed restrictions will include proprietary institutional controls such as easements or restrictive covenants that are legally enforceable against subsequent property owners and instituted, depending on state law, by conveyance or contract. The U.S. Army will be responsible for implementing and maintaining the effectiveness of the institutional controls. **Table 7-2** presents ARARs and TBC guidance for Alternative Three. **Table 7-3** presents a detailed cost estimate for the preferred alternative. **Exhibit 7-3** presents Alternative Three.

Table 7-3. Cost Estimate for Preferred Alternative for Excavation, Off-Site Disposal of RDX- and Lead- Contaminated Soil, and Deed Restriction to Prevent Residential Use

Remedial Action	Units	No.	Unit Price	Cost
Capital				
Work Plan	Report	1	$17,250.00	$17,250.00
Pre-Construction Meeting	Meeting	1	$6,960.00	$6,960.00
Site Mobilization	Site	1	$5,000.00	$5,000.00
Site Setup	Site	1	$2,000.00	$2,000.00
Clearing and Grubbing	Site	1	$800.00	$800.00
Contaminated Soil Removal (Excavation)	Site	1	$11,140.00	$11,140.00
UXO Screening	Site	1	$25,200.00	$25,200.00
Analysis				
Waste Characterization				$2,560.00
Soil Disposal Arrangements				$677.00
Waste Characterization	Site	5	$2,560.00	$2,560.00
Waste Disposal				
Soil Transportation (RDX Contamination)	Ton	68	$515.00	$34,762.00
Decontamination Water	55-Gal Drum	1	$130.00	$130.00
Spent PPE	55-Gal Drum	1	$130.00	$130.00
Disposal Arrangements	Site	1	$677.00	$677.00
Post Excavation Sampling				
Total Lead And RDX	Sample	10	$285.00	$2,850.00
XRF Screening	Week	1	$2,000.00	$2,000.00
Immunoassay (RDX)	Sample	1	$18.00	$18.00
Labor	Day	1	$650.00	$650.00
Site Restoration				
Backfilling With Clean Soil	CY	2.50	$15.00	$37.00
Top Soil	CY	2.50	$30.00	$75.00
Grading And Seeding	SY	11.0	$2.00	$22.00
Demobilization	Site	1	$5,000.00	$5,000.00
Closure Report	Report	1	$9,125.00	$9,125.00
Deed Restriction	Each	1	$5,000.00	$5,000.00
			Subtotal	$142,787.00
O & M Cost				
5-Year Site Review (30-Year Period)	Each	1	$10,000.00	$10,000.00
Present Worth 5-Year Site Reviews (30-Year Period @ 5%)				$28,000.00
			Subtotal O & M Cost	$28,000.00
Subtotal Cost of Alternative				$170,787.00
Contingency (@ 25%)				$42,697.00
Project Management (@ 8%)				$13,663.00
Total Cost Alternative				$227,147.00

7.6 EXPLANATION OF SIGNIFICANT CHANGES

The Proposed Plan presents the selected remedy as the preferred alternative. No significant changes have been made.

8.0 SANITARY LANDFILL

8.1 OPERATIONAL HISTORY

Four Potential Units of Contamination (PUCs) have been identified at the site based on analysis of aerial photographs and historical documents. Below are the AOCs investigated in the RI/FS.

- Disposal Area PUC: includes the Sanitary Waste Disposal Area, the Burning Cage Area, the Capped Landfill Area, the Flammable Liquids Disposal Area, and the Metal Disposal Area.
- Destruction Area PUC: includes the Fuse Destruction Area and the Explosive Parking Area.
- IRA Site 2 PUC.
- Freon-Contaminated Groundwater PUC.

In addition, four ditches at the Sanitary Landfill were sampled for contaminants. Two of the ditches are upgradient. Two of the ditches are adjacent to the explosives parking area.

Use of the Sanitary Landfill area was stopped in 1988. The landfill is currently closed and the area is covered with vegetation.

8.2 FINDINGS OF THE REMEDIAL INVESTIGATION

The sampling program at the Sanitary Landfill was as follows: geophysical survey and surface soil sampling for the 1991 EA; geophysical survey, surface soil sampling, subsurface soil sampling, test trench excavation, and groundwater sampling for the 1993 SCD; and surface soil sampling, subsurface soil sampling, and groundwater screening and sampling for the 1996 RI. **Exhibit 8-1** presents the sampling locations from past investigations at the Sanitary Landfill. For the types of compounds that were analyzed for, refer to the Investigative Program Summary of the 1996 RI. **Exhibit 8-2** displays the locations where COPCs were detected in soil above the calculated non-residential risk-based cleanup levels. Only the Fuse Destruction Area contained contamination considered above levels considered a risk to humans under non-residential conditions. RDX was detected at the northwestern corner of the Fuse Destruction Area at a concentration of 890 µg/g. The detection of RDX above the calculated risk-based cleanup level triggered the need for an alternatives analysis. Provided in Section 8.3 are the summaries of the remedial alternatives presented in the FS.

8.3 REMEDIAL ALTERNATIVES

8.3.1 Alternative 1: No Action.

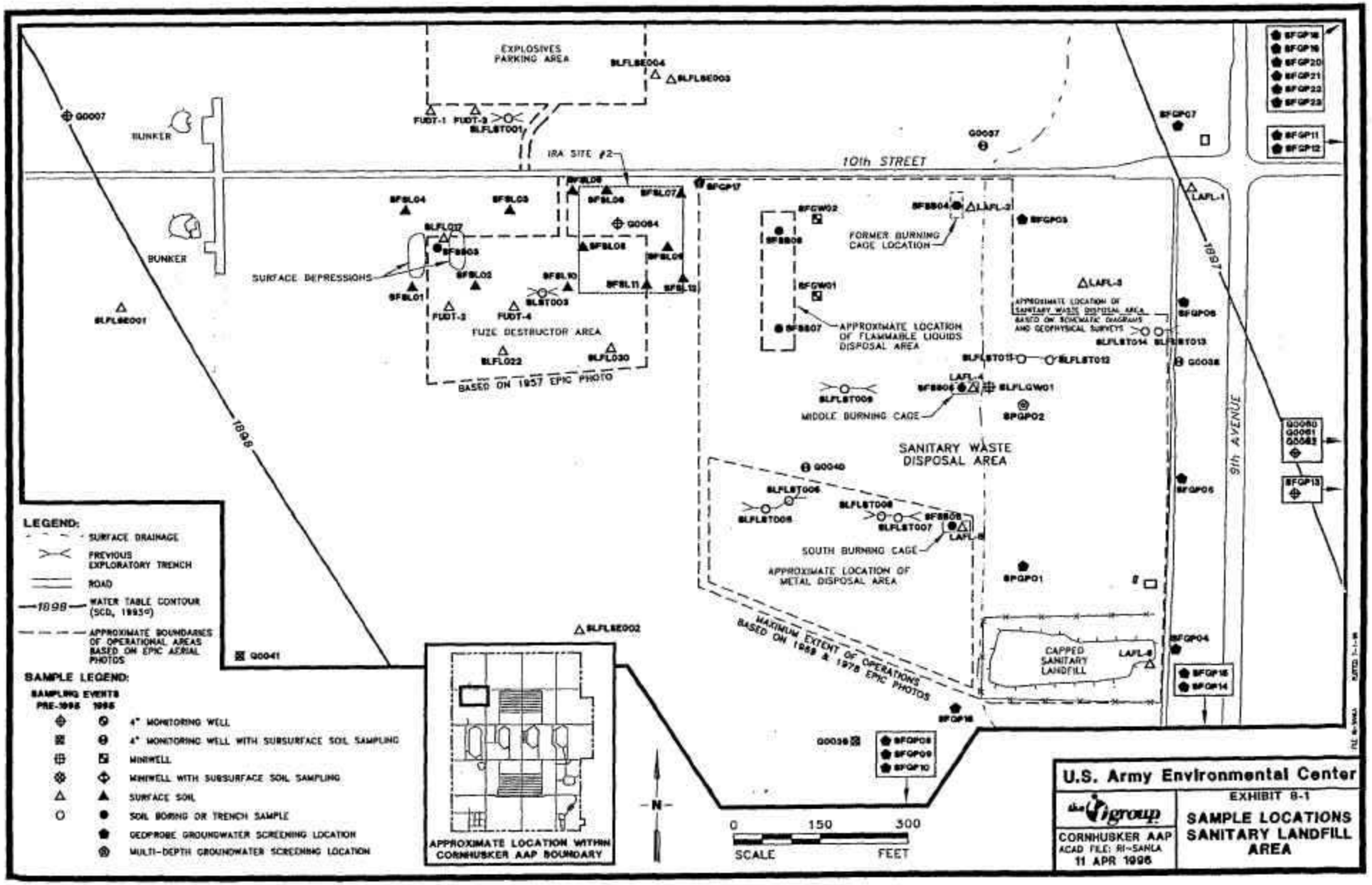
Description: According to the NCP, the level of treatment achieved must be compared to the required expenditures of time and materials as an integral portion of the remedy selection process. The "No Action" alternative is intended to serve as a baseline with which to compare the risk reduction effectiveness of other potential alternatives.

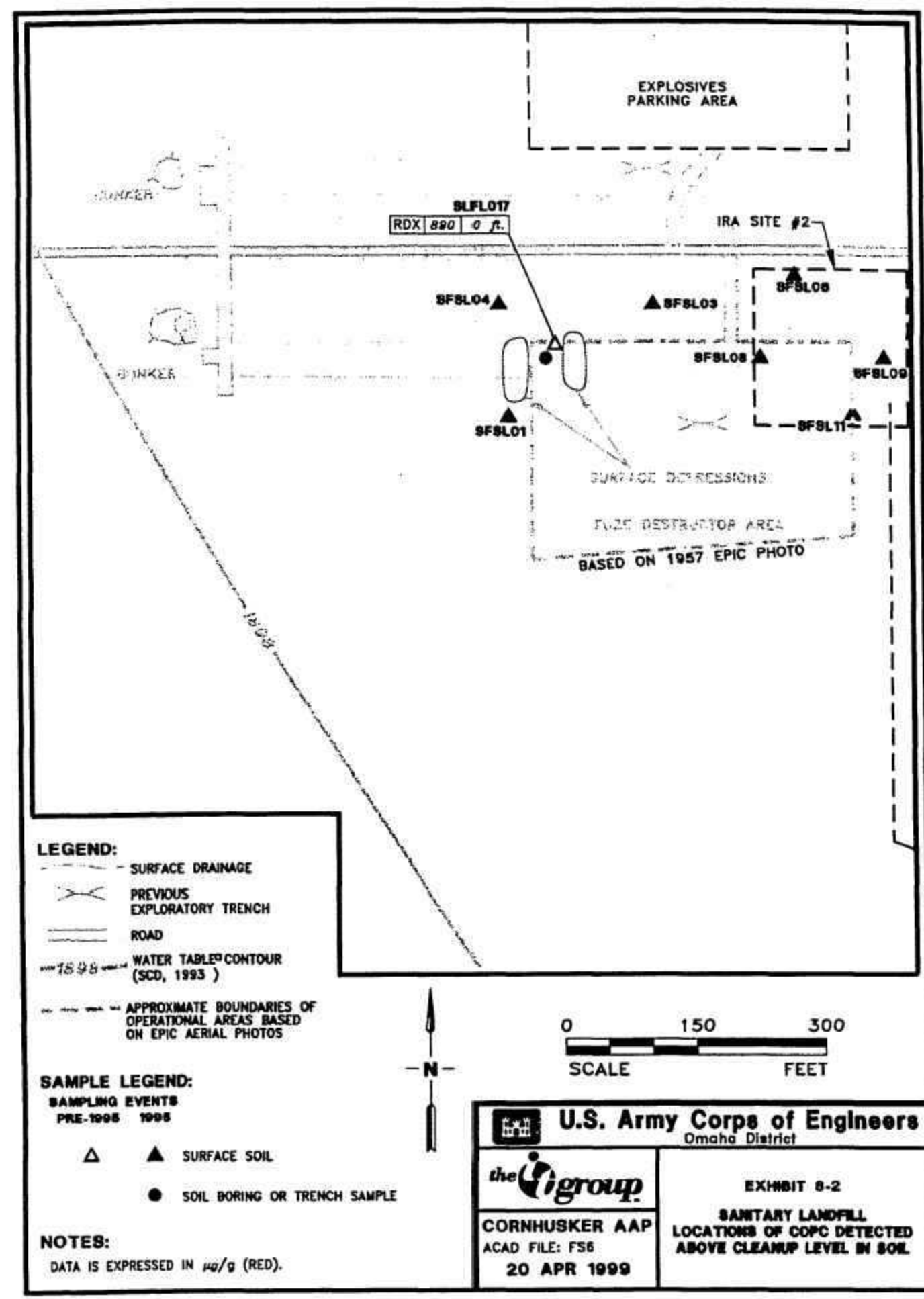
Overall Protection of Human Health and the Environment: The No Action alternative does not decrease the potential risks to humans or the environment in any way, as no remedial activities will be implemented at the site under this alternative. Ingestion or dermal exposures to RDX contamination in surface soil are potential exposure pathways for humans at the site.

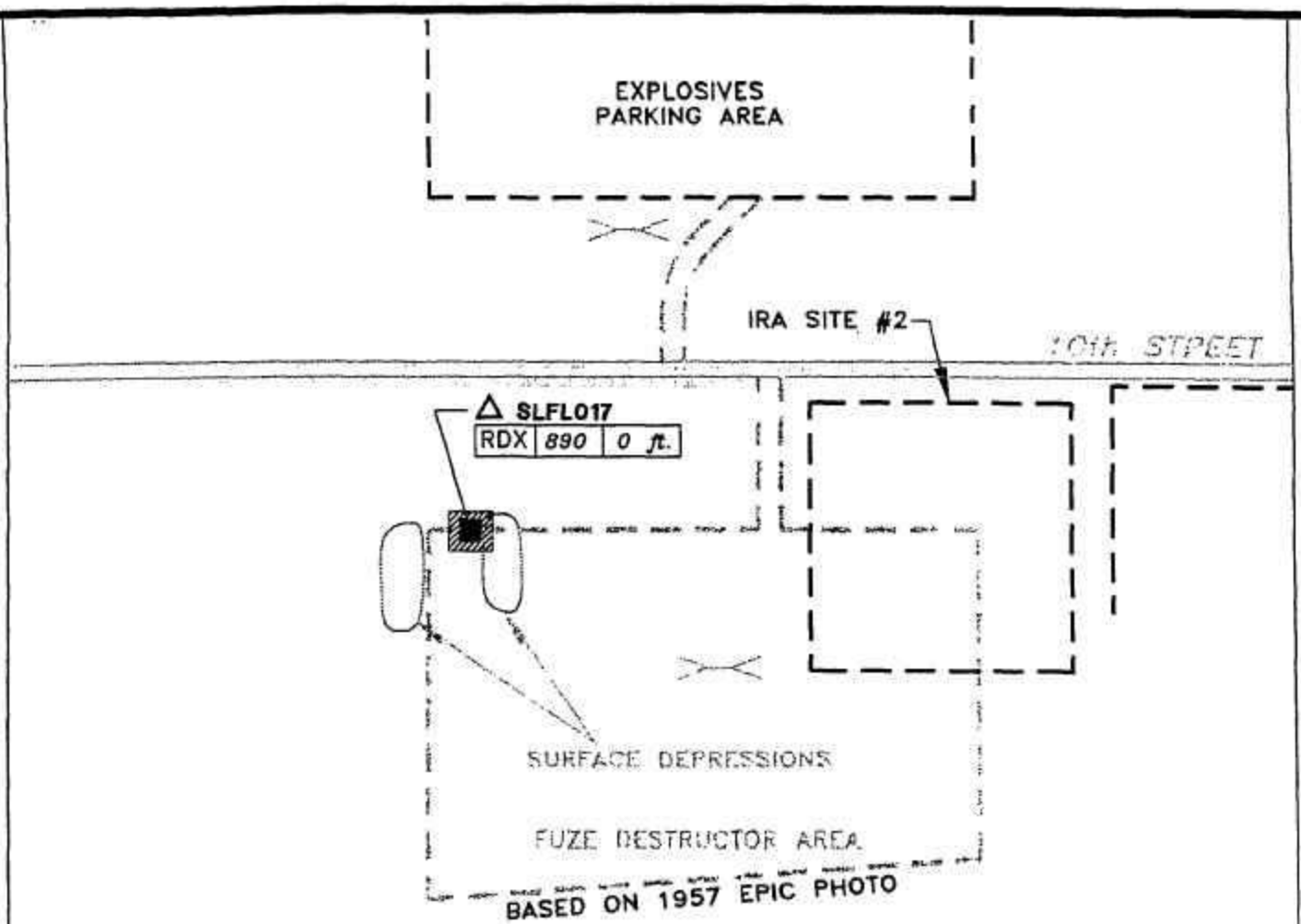
Compliance with ARARs: This alternative does not comply with chemical-specific TBC guidance. Location-specific and action-specific ARARs are not considered because no remedial activities will be implemented at the site.

Long-term Effectiveness and Permanence: Over the long-term, this alternative will not be effective. No actions are taken to provide permanent human health and environmental protection.

Reduction of Toxicity, Mobility, or Volume Through Treatment: There will be no further remedial activities implemented at the site; subsequently, there will be no further reduction of toxicity, mobility, or volume through treatment.


EXPLOSIVES PARKING AREA
SLFLSE004
SLFLSE003
FUDT-1
FUDT-2
SLFLST001
G0007
BUNKER
IRA SITE #2
10th STREET
G0037
BFGP07
BFGP17
BFGP16
BFGP20
BFGP21
BFGP22
BFGP23
BFGP11
BFGP12
BFSL04
BFSL03
BFSL05
BFSL06
BFSL07
G0084
SLFLG017
BFSB03
SURFACE DEPRESSIONS
BFSL01
BFSL02
BFSL10
SLST003
BFSL11
BFSL12
BFSL08
BFSL09
FUDT-3
FUDT-4
FUZE DESTRUCTOR AREA
SLFL022
SLFL030
BASED ON 1957 EPIC PHOTO
BUNKER
SLFLSE001
1898
BFGW02
BFSB04
LAFL-2
BFGP03
FORMER BURNING CAGE LOCATION
BFSB06
BFGW01
BFSB07
APPROXIMATE LOCATION OF FLAMMABLE LIQUIDS DISPOSAL AREA
LAFL-3
APPROXIMATE LOCATION OF SANITARY WASTE DISPOSAL AREA BASED ON SCHEMATIC DIAGRAMS AND GEOPHYSICAL SURVEYS
BFGP05
SLFLST014
SLFLST013
SLFLST011
SLFLST012
G0038
LAFL-1
197
LAFL-4
BFSB05
SLFLGW01
SLFLST009
MIDDLE BURNING CAGE
BFGP02
SANITARY WASTE DISPOSAL AREA
G0040
SLFLST006
SLFLST008
SLFLST007
BFSB08
LAFL-6
SOUTH BURNING CAGE
APPROXIMATE LOCATION OF METAL DISPOSAL AREA
BFGP01
9th AVENUE
G0060
G0061
G0062
BFGP13
BFGP06
MAXIMUM EXTENT OF OPERATIONS BASED ON 1969 & 1978 EPIC PHOTOS
CAPPED SANITARY LANDFILL
LAFL-8
BFGP04
BFGP15
BFGP14
BFGP18
G0041
SLFLSE002
G0039
BFGP08
BFGP09
BFGP10
LEGEND:
SURFACE DRAINAGE
PREVIOUS EXPLORATORY TRENCH
ROAD
1898 WATER TABLE CONTOUR (SCD, 1995a)
APPROXIMATE BOUNDARIES OF OPERATIONAL AREAS BASED ON EPIC AERIAL PHOTOS
SAMPLE LEGEND:
SAMPLING EVENTS
PRE-1995
1995
4" MONITORING WELL
4" MONITORING WELL WITH SUBSURFACE SOIL SAMPLING
MINIWELL
MINIWELL WITH SUBSURFACE SOIL SAMPLING
SURFACE SOIL
SOIL BORING OR TRENCH SAMPLE
GEOPROBE GROUNDWATER SCREENING LOCATION
MULTI-DEPTH GROUNDWATER SCREENING LOCATION
APPROXIMATE LOCATION WITHIN CORNHUSKER AAP BOUNDARY
N
0
150
300
SCALE
FEET
U.S. Army Environmental Center
the Tigroup
CORNHUSKER AAP
ACAD FILE: RI-SANLA
11 APR 1996
EXHIBIT 8-1
SAMPLE LOCATIONS SANITARY LANDFILL AREA


EXPLOSIVES PARKING AREA
BUNKER
SLFL017
RDX 890 0 ft.
IRA SITE #2
SFSL04
SFSL03
SFSL08
SFSL06
SFSL09
SFSL01
SFSL11
BUNKER
SURFACE DEPRESSIONS
FUZE DESTRUCTOR AREA
BASED ON 1957 EPIC PHOTO
1898
LEGEND:
SURFACE DRAINAGE
PREVIOUS EXPLORATORY TRENCH
ROAD
1898 WATER TABLE CONTOUR (SCD, 1993)
APPROXIMATE BOUNDARIES OF OPERATIONAL AREAS BASED ON EPIC AERIAL PHOTOS
SAMPLE LEGEND:
SAMPLING EVENTS
PRE-1995 1995
SURFACE SOIL
SOIL BORING OR TRENCH SAMPLE
NOTES:
DATA IS EXPRESSED IN µg/g (RED).
N
0 150 300
SCALE FEET
U.S. Army Corps of Engineers
Omaha District
the i group
CORNHUSKER AAP
ACAD FILE: FS6
20 APR 1999
EXHIBIT 6-2
SANITARY LANDFILL
LOCATIONS OF COPC DETECTED ABOVE CLEANUP LEVEL IN SOIL



LEGEND:

- SURFACE DRAINAGE
- PREVIOUS EXPLORATORY TRENCH
- ROAD
- APPROXIMATE BOUNDARIES OF OPERATIONAL AREAS BASED ON EPIC AERIAL PHOTOS

SAMPLE LEGEND:

SAMPLING EVENTS

PRE-1995

- △ SURFACE SOIL
- ● SOIL BORING
- PROPOSED SOIL EXCAVATION (15 FT. X 15 FT. X 1 FT.)

NOTE:
DATA IS EXPRESSED IN µg/g (RED).

N

0 120 240

SCALE FEET

U.S. Army Corps of Engineers
Omaha District

the igroup

CORNHUSKER AAP
ACAD FILE: FS2
20 APR 1999

EXHIBIT 8-3
SANITARY LANDFILL PREFERRED ALTERNATIVE THREE
EXCAVATION, OFF-SITE DISPOSAL OF RDX-CONTAMINATED SOIL, DEED RESTRICTION TO PREVENT RESIDENTIAL USE

Short-term Effectiveness: There is no short-term effectiveness associated with the No Action alternative because no additional remedial activities will be implemented at the site.

Implementability: Not applicable.

Cost: Because contaminants are left in place, a site evaluation report must be submitted after five years. The estimated 30-year present worth of this alternative is $37,240, the cost of the 5-year report.

8.3.2 Alternative 2: Groundwater Monitoring and Deed Restriction

Description: This alternative includes semi-annual monitoring of groundwater from two wells, located upgradient and downgradient of the landfill. This alternative also includes implementation of deed restrictions to prevent residential use. The deed restrictions will include proprietary institutional controls restricting the future use of the property such as easements or restrictive covenants that are legally enforceable against subsequent property owners and instituted, depending on state law, by conveyance or contract. The U.S. Army will be responsible for implementing and maintaining the effectiveness of the institutional controls.

Overall Protection of Human Health and the Environment: This alternative does not decrease the potential risks to humans or the environment in any way, as no remedial activities will be implemented at the site under this alternative. The baseline risk assessment indicates that the risks posed by potential exposure pathways are above the acceptable risk range. Therefore, this alternative does not satisfy this criterion.

Compliance with ARARs: The TBC guidance for removing RDX to the risk-based cleanup level would not be met by this alternative.

Long-term Effectiveness and Permanence: Since no remedial actions are taken, this alternative will not provide permanent human health and environmental protection.

Reduction of Toxicity, Mobility, or Volume Through Treatment: There will be no further remedial activities implemented at the site; subsequently, there will be no further reduction of toxicity, mobility, or volume through treatment.

Short-term Effectiveness: There is no short-term effectiveness associated with this alternative, because no additional remedial activities will be implemented at the site.

Implementability: Since this alternative includes only monitoring activities, it is easy to implement.

Cost: The capital cost and annual O&M costs for Alternative Two are approximately $70,000 and $104,650, respectively. The estimated 30-year present worth is $232,285.

8.3.3 Alternative 3: Excavation, Off-Site Disposal of RDX-Contaminated Soil, and Deed Restriction to Prevent Residential Use

Description: RDX-contaminated soil at the northwestern corner of the Fuse Destruction Area would be removed to or below the risk-based cleanup level (52 µg/g). A square area of approximately 225 ft^2 would be excavated from around soil sample SLFL017 to 1 ft bgs. Upon completion of the soil excavation, RDX screening using immunoassay would be used to determine if excavation of soil to the cleanup level has been completed. If screening data indicate that removal of RDX to the cleanup level has been accomplished, samples would be collected for confirmational analysis. The excavated soil would be placed in a 20-ton capacity roll-off. The soil would be transported to a RCRA-permitted incinerator that can accept wastes from a CERCLA site. The excavated areas would be backfilled with clean soil and reseeded. Provided below are the components of the excavation/off-site disposal alternative.

This alternative also includes implementation of deed restrictions to prevent residential use. The deed restrictions will include proprietary institutional controls restricting the future use of the property such as easements or restrictive covenants that are legally enforceable against subsequent property owners and instituted, depending on state law, by conveyance or contract. The U.S. Army will be responsible for implementing and maintaining the effectiveness of the institutional controls.

Overall Protection of Human Health and the Environment: The removal of RDX-contaminated soil to the risk-based cleanup level of 52 µg/g is protective to humans under non-residential conditions.

Compliance with ARARs

- Chemical-specific ARARs/TBC guidance: The alternative would remove RDX to levels below the calculated risk-based cleanup level considered protective of human health under non-residential conditions.
- Location-specific ARARs: This alternative is not expected to affect any location-specific ARARs.
- Action-specific ARARs: The proposed remedial design and operation should meet all requirements presented in **Table 8-2.**

Long-term Effectiveness and Permanence: Over the long-term, excavation of the RDX-contaminated would be effective because the RDX is removed to below the calculated risk-based cleanup level.

Reduction of Toxicity, Mobility, or Volume Through Treatment: Toxicity, mobility, and volume will be reduced for the soil medium since the RDX-contaminated soil will be removed and incinerated at an off-site treatment facility.

Short-term Effectiveness: If selected as the remedial action, excavation could be implemented in less than six months. This alternative poses minimal risk to the community, workers, or the environment during its implementation. Workers involved with the waste excavation and processing activities could be exposed to risks associated with dermal contact with contaminated soil along with some risks from breathing dust and vapors. However, the emission levels will be low, and workers will be protected by use of appropriate personal protective equipment.

Implementability: No permits are required for on-site activities, but the off-site disposal facility must be permitted. The waste shipment must be manifested and transported by a licensed hazardous waste transporter. Equipment and materials for implementing this alternative are readily available.

Cost: The capital and O&M costs for Alternative Three are estimated to be approximately $71,419 and $28,000, respectively. The estimated present worth is $132,228.

8.4 SUMMARY OF COMPARATIVE ANALYSIS OF SANITARY LANDFILL ALTERNATIVES

As required by CERCLA, the remedial alternatives described above were evaluated using nine criteria specified by USEPA. This section summarizes the relative performance of each of the alternatives with respect to the nine CERCLA evaluation criteria. **Table 8-1** summarizes the comparative analysis for the three alternatives provided in the FS.

Table 8-1. Comparative Analysis of Remedial Action Alternatives S Sanitary Landfill

NCP Criteria	Alternative 1 No Action	Alternative 2 Monitoring of Groundwater and Deed Restriction	Alternative 3 Excavation, Off-Site Disposal of RDX- Contaminated Soil, Deed Restriction to Prevent Residential Use
1. OVERALL PROTECTIVENESS			
Direct Contact/Soil Ingestion	No significant reduction in risk. Contaminant levels remain in soil.	Reduces exposure with soil media; however, contaminants remain in soil.	Risk reduced to below acceptable levels for non-residential use.
2. COMPLIANCE WITH ARARS/TBC GUIDANCE			
Chemical-Specific ARARS	There are no chemical-specific ARARs.	See Alternative 1.	See Alternative 1.
Location-Specific ARARs	There are no location-specific ARARs.	See Alternative 1.	Would meet all location-specific ARARs.
Action-Specific ARARS	There are no action-specific ARARs.	See Alternative 1.	Would meet all action-specific ARA S

Table 8-1. Comparative Analysis of Remedial Action Alternatives Sanitary Landfill

NCP Criteria	Alternative 1 No Action	Alternative 2 Monitoring of Groundwater and Deed Restriction	Alternative 3 Excavation, Off-Site Disposal of RDX- Contaminated Soil, Deed Restriction to Prevent Residential Use
TBC Guidance	Does not meet TBC Cleanup levels.	See Alternative 1.	Reduces RDX levels in soil to below cleanup levels.
3. LONG-TERM EFFECTIVENESS AND PERMANENCE			
Magnitude of Residual Risk (Direct Contact/Soil Ingestion)	Existing risk will remain.	See Alternative 1.	Risk is minimized since source is removed.
Adequacy and Reliability of Controls	No controls over remaining contamination. No reliability.	See Alternative 1.	Reliability of soil removal high, since all RDX above remedial goals will be removed from the site.
Need for 5-Year Review	Yes.	Yes.	Yes.
4. REDUCTION IN TOXICITY, MOBILITY, AND VOLUME THROUGH TREATMENT			
Treatment Process Used	None.	None.	Incineration.
Amount Destroyed or Treated	None.	None.	8.3 yd^3.
Reduction of Toxicity, Mobility, or Volume	None.	None.	Toxicity, mobility, and volume are reduced.
Irreversible Treatment	None.	None.	Incineration is irreversible.
Type and Quantity of Residuals Remaining after Treatment	No residuals remain.	No residuals remain.	Incinerated soils remain, but are expected to be nonhazardous. No residual.
Statutory Preference for Treatment	Does not satisfy.	Does not satisfy.	Satisfies.
5. SHORT-TERM EFFECTIVENESS			
Community Protection	Risk to community no increased by remedy implementation.	See Alternative 1.	See Alternative 1.
Worker Protection	No significant risk to workers.	No significant risk to workers.	Protection required against dermal contact and inhalation of contaminated dust during excavation activities.
Environmental Impacts	Continued impact from existing conditions.	Continued impact from existing conditions.	No environmental impacts from remedial action.
Time until Action is Complete	Not applicable.	Until agreement is reached between stakeholders that monitoring is no longer necessary.	Six months.
6. IMPLEMENTABILTY			
Ability to Obtain Approvals and Coordinate with other Agencies	No approval necessary.	See Alternative 1.	Yes.
Availability of Services and Capacities	No services or capacities necessary.	See Alternative 1.	Services available.
Availability of Equipment, Specialists, and Materials.	None required.	See Alternative 1.	Equipment available.
Availability of Technologies.	None required.	None Required.	Excavation, disposal, and incineration technologies readily available.
7. COST			
Capital Cost	$0	$70,000	$71,419
O&M Cost	$28,000	$104,650	$28,000
Present Worth Cost	$37,240	$232,285	$132,228

8.4.1 Protection of Human Health and Environment

Current levels of RDX contamination pose levels of human health risk that may be considered unacceptable. Explosives compound RDX was detected in one location at a concentration greater than the risk-based cleanup level considered protective of human health under non-residential conditions. Alternative One will not meet this criterion because no actions are taken to eliminate, reduce or control

exposure pathways. Alternative One does not achieve the threshold criterion of protection of human health and the environment.

Alternative Two provides some protection from contaminated soil by implementing and maintaining deed restrictions that would prohibit the use of the immediate area for agricultural use. Although the deed restriction will limit dermal and ingestion exposure to contaminants in soil (humans only), it does not prevent further contaminant loading to groundwater; therefore, Alternative Two is not fully protective of human health under non-residential conditions.

Alternative Three provides protection of human health and the environment by eliminating the surface soil exposure pathway as well as mitigating migration of RDX into groundwater (source is removed). Therefore, implementation of this alternative would allow future land use of the Sanitary Landfill area. Alternative Three is considered protective of human health under non-residential conditions because RDX in soil would be removed to below the risk-based cleanup level.

8.4.2 Compliance with ARARs

Compliance with ARARs is a threshold criterion that must be met by the proposed remedial action. Alternatives One and Two do not meet the chemical-specific TBC guidance because RDX levels remain in soil above the risk-based cleanup level. Alternative Three involves further actions to eliminate exposure to contaminated soil and mitigate migration of contaminants into groundwater. These actions can be performed in compliance with the action- and location-specific ARARs. This is the only alternative that completely meets chemical-specific TBC guidance.

8.4.3 Long-term Effectiveness and Permanence

Alternatives One and Two do not provide long-term effectiveness and permanence. Neither of these alternatives provides sufficient, effective protection of groundwater and risk to humans from exposure to contaminated soils. Alternative Three provides long-term prevention of exposures to contaminated surface soil and migration of contaminants into groundwater because sources are removed.

Reviews at least every five years, as required, would be necessary to evaluate the effectiveness of any of these alternatives because hazardous substances would remain onsite in concentrations above health-based levels.

8.4.4 Reduction of Toxicity, Mobility or Volume through Treatment

Alternatives One and Two do not provide reduction of toxicity, mobility, or volume of the contaminants. Alternative Three provides reduction of toxicity, mobility, and volume because all RDX in soil is removed to a level lower than the risk-based cleanup level. As the RDX contaminated soil would be disposed of by off-site incineration, RDX would be permanently destroyed through treatment.

8.4.5 Short-term Effectiveness

Short-term effectiveness is not applicable to Alternative One. Alternative Two provides for short-term protection of workers during implementation. Workers will take appropriate safety measures to perform their functions (e.g., drilling, sampling). For Alternative Three, the use of proper dust suppressant measures will control windblown emissions of contaminated dust to protect the community and on-site workers. Proper personal protective equipment would be required for site workers. Because of the location of the Sanitary Landfill, short-term effectiveness to the public is not applicable for Alternatives Two and Three. Measures to protect the environment are not expected for implementing Alternatives Two and Three.

8.4.6 Implementability

Alternatives One and Two are the most easily implemented. Alternative One is a no further action alternative. Alternative Two involves the installation of monitoring wells and sampling. Alternative Three would also be fairly easy to implement because it uses commonly available equipment and materials. Alternative Three involves excavation and off-site incineration of contaminated soils.

The length of time required to implement and complete the remedial alternatives are as follows: Alternative One is a "No Action" alternative, therefore, no time is required; Alternative Two would require less than three months to implement; and Alternative Three could be implemented in six months.

8.4.7 Cost

Total capital and annual costs and present worth (discount rate of 5%) for each alternative are presented in **Table 8-1**. The progression of total present worth from least expensive to most expensive alternative is: Alternative One, Alternative Three, and Alternative Two.

8.5 SELECTED REMEDY

The selected remedy is Excavation, Off-Site Disposal of RDX-Contaminated Soil, and Deed Restriction to Prevent Residential Use – Alternative Three (**Exhibit 8-3**). This is the preferred alternative for the Sanitary Landfill because it provides the best balance of features that offer overall protection to human health and the environment. Excavation of contaminated soils will remove risk to human health under non-residential conditions. The deed restrictions will include proprietary institutional controls such as easements or restrictive covenants that are legally enforceable against subsequent property owners and instituted, depending on state law, by conveyance or contract. The U.S. Army will be responsible for implementing and maintaining the effectiveness of the institutional controls. In addition, this action is easy to implement, involves minimal risks to site workers, and should comply with all action- and location-specific ARARs during implementation. **Table 8-2** presents ARARs and TBC guidance for Alternative Three. **Table 8-3** provides a detailed cost estimate for Alternative Three.

Table 8-2. ARARs and TBC Guidance for Alternative 3
Action-Specific ARARs
Excavation
Regulations to processing machines and equipment (NDEC Title 129 Chapter 4)
Dust generation during construction activities (NDEC Title 129 Chapter 17)
Disposal or decontamination of equipment, structures, etc. (40 CFR 264.114)
On-site health and safety for personnel during remedial actions (29 CFR 1910)
Closure and Post-Closure
Clean Closure (40 CFR 264.111)
Closure with Waste in Place (40 CFR 264.228)
Post-Closure Care (40 CFR 264.117)
Disposal of Soil
Hazardous Waste Determination (40 CFR 261)
Standards for generators (40 CFR 262)
Standards for transporters (40 CFR 263, NDEC Title 128, Ch 3 and Ch 17), and 49 CFR 171
LDRS and Treatment Standards (40 CFR 268)
Location-Specific ARARs
Presence of those species listed in the Endangered Species Act (16 USC 1351 et seq.), the Fish and Wildlife Coordination Act (16 USC 661 et seq.), 40 CFR 6.302(h), 50 CFR 402, CWA 402, CWA 404, and 40 CFR 231.10(b), and RSN 37-430 to -438 as being rare, threatened or endangered.
Within an area affecting a stream or river and presence of fish or wildlife resources as defined in the Fish and Wildlife Coordination Act (16 USC 661 et seq), and 40 CFR 6.302(g).
Location encompassing an aquatic ecosystem with dependent fish, wildlife, other aquatic life or habitat in the Clean Water Act 404, 40 CFR 230, and 33 CFR 320-330.
Presence of farmlands as defined under 7 CFR 658.4 and 658.5 and the Farmland Protection Policy Act (7 USC 4201 et seq.)
Chemical-Specific TBC Guidance
RDX: 52 µg/g calculated risk-based cleanup level

Table 8-3. Cost Estimate for Alternative 3

Remedial Action	Units	No.	Unit Price	Cost
Capital				
Work Plan	Report	1	$ 17,250.00	$ 17,250.00
Pre-Construction Meeting	Meeting	1	$ 6,960.00	$ 6,960.00
Site Mobilization/Setup	Site	1	$ 8,000.00	$ 8,000.00
Contaminated Soil Removal (Excavation)	Site	1	$ 800.00	$ 800.00
Waste Characterization	Site	1	$ 7,753.00	$ 7,753.00
Waste Disposal And Transportation				
Soil Transportation	Ton	13	$ 515.00	$ 6,437.50
IDW	55-Gal Drum	2	$130.00	$ 260.00
Disposal Arrangements	Site	1	$ 677.00	$ 677.00
Post Excavation Sampling				
Confirmation Samples for RDX	Sample	2	$ 250.00	$ 500.00
Immunoassay (RDX)	Sample	10	$ 18.00	$ 18.00
Labor	Day	1	$ 650.00	$ 650.00
Site Restoration				
Backfilling With Clean Soil	CY	4.8	$ 15.00	$ 72.00
Top Soil	CY	4.8	$ 30.00	$ 144.00
Grading and Seeding	SY	25	$ 2.00	$ 50.00
Demobilization	Site	1	$ 5,000.00	$ 5,000.00
Closure Report	Report	1	$ 9,125.00	$ 9,125.00
Deed Restriction	Each	1	$ 5,000.00	$ 5,000.00
			Subtotal	$ 71,419.00
O&M Cost				
5-Year Site Review 30-Year Period)	Each	1	$ 10,000.00	$ 10,000.00
Present Worth 5-Year Site Reviews (30-Year Period @ 5%)				$ 28,000.00
			Subtotal O&M Cost	$ 28,000.00
Subtotal Cost of Alternative				$ 99,419.00
Contingency (@ 25%)				$ 24,855.00
Project Management (@ 8%)				$ 7,954.00
Total Cost of Alternative				$ 132,228.00

8.6 EXPLANATION OF SIGNIFICANT CHANGES

The Proposed Plan presents the selected remedy as the preferred alternative. No significant changes have been made.

9.0 SHOP AREA

9.1 OPERATIONAL HISTORY

CHAAP contractors, for a variety of base-support functions, have historically used the Shop Area. Buildings in this area include former maintenance shops where vehicles and equipment were repaired and serviced; storage areas for chemicals including petroleum products, paints, anti-freeze and solvents; a railroad car servicing center; and a laundry facility used for cleaning employee garments.

The laundry generated the majority of wastewaters at the Shop Area during periods of ammunition production. According to aerial photographs, leach fields were apparently used in the 1950s for containing and possibly treating wastewaters. An area of ground scarring north of Building SSPS-1, as shown in a 1957 aerial photograph, corresponds to the location of the Shop Area sanitary leachfield (**EPIC, 1982**). A sanitary engineering survey conducted in 1970 at CHAAP by the U.S. Army Environmental Hygiene Agency (USAEHA) (1970) noted that a small quantity of industrial wastewaters from various sources in the Shop Area were processed through the laundry settling basin.

Major areas of environmental concern have been investigated at the Shop Area. These areas include the following: the North Ditch; the Paint Shop; the Paint Spray Shop and Pesticide Mixing Building; the Laundry Settling Basin; the West Ditch; the South Ditch Area; the Former Paint Storage Shed Location; the Sanitary Leachfield Area; and USTs and ASTs. The following sections summarize historical site activities, observations from past site inspections, and current conditions.

Buildings in the Shop Area are currently being leased to various industrial clients and are being used for storage purposes and as office space.

9.2 FINDINGS OF THE REMEDIAL INVESTIGATION

The sampling program at the Shop Area was as follows: geophysical surveying and surface soil sampling during the 1991 EA; geophysical surveying, surface soil sampling, subsurface soil sampling, groundwater sampling, and sediment sampling for the 1993 SCD; and geophysical surveying, surface soil sampling, subsurface soil sampling, and groundwater sampling for the 1995 RI.

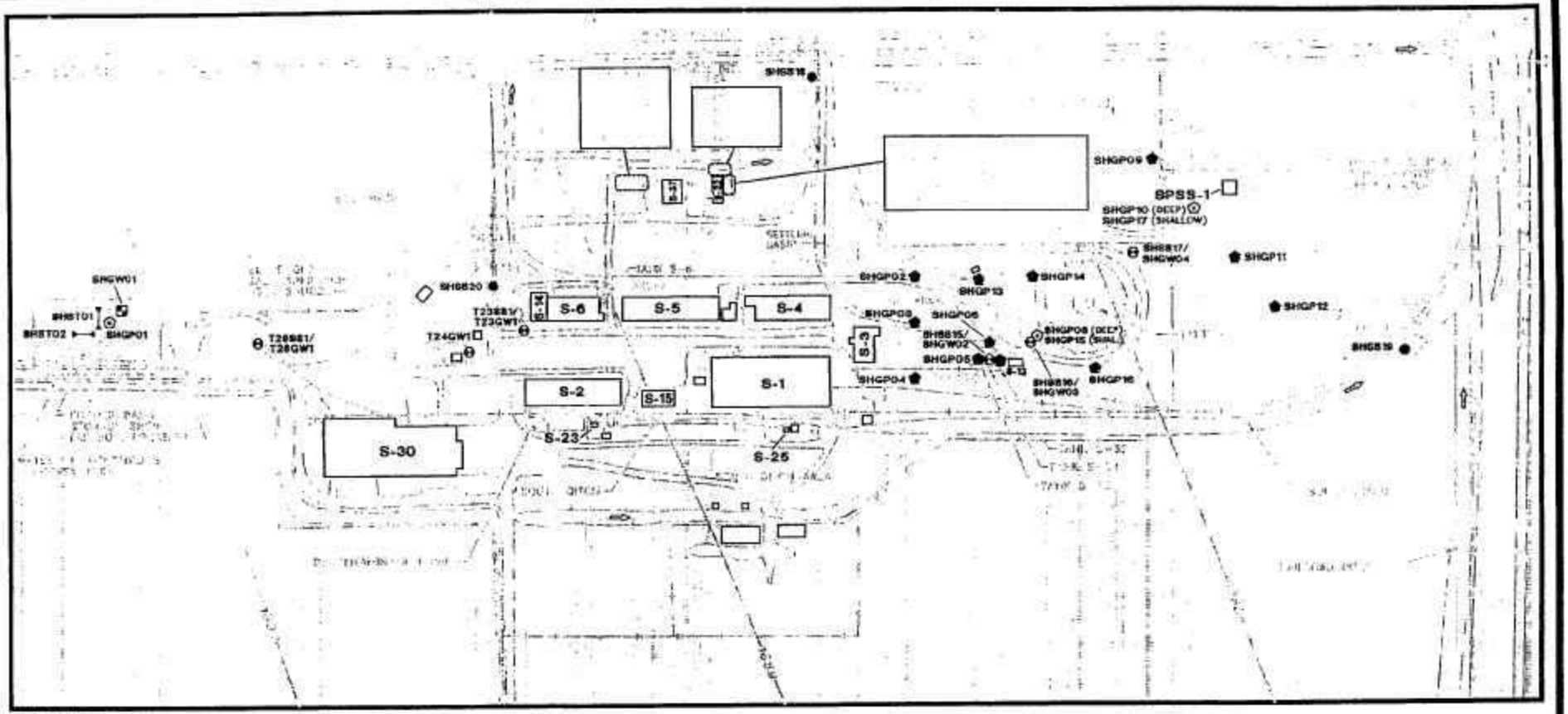
Exhibit 9-1 shows previous soil sampling locations at the Shop Area and locations where lead concentrations exceeded NDEQ TBC guidance. **Exhibit 9-2** shows locations where groundwater COPCs exceeded the non-residential cleanup levels during sampling rounds conducted in 1995, 1996, and 1998.

9.2.1 Groundwater Sampling Results

AST Area: Sampling results from AST monitoring wells indicate that groundwater has been impacted by chlorinated solvents. Five ASTs and five USTs were used at the Shop Area, but have been removed. Tank capacity and contents were compiled from the Mason & Hanger Tank Inventory Reports (**Mason & Hanger, 1982 and 1988**). Tank S-6 was a 1,000-gallon AST located at the East End of Building S-6 (garage). The 1982 tank inventory listed the contents as used oil. Tanks S-32, S-34, and S-35 were located on the east side of the Shop Area. Tank S-32 had a capacity of 10,000-gallons. Tanks S-34 and S-35 each had a capacity of 12,000 gallons. According to the 1988 tank inventory, all three tanks had been used for road oil. Tank S-12, the largest tank at CHAAP, was a 577,500-gallon AST located in the northeast portion of the Shop Area. A 5-ft high secondary containment berm surrounded the tank. The 1988 tank inventory lists the contents as #2 diesel fuel. Provided below are the sampling events that provided characterization of the chlorinated VOCs in groundwater.

- 1995 Sampling Effort: Chlorinated compounds 1,2-DCA (8.3 µg/L) and 1,1,2-TCA (45 µg/L) were detected in samples collected during the 1995 field effort from monitoring well SHGWO3. Samples from monitoring well SHWG02 had a detection of 1,1,2-TCA at 56 µg/L. Each of these detections exceeds their respective Federal MCLs.

- 1996 Sampling Effort: The 1996 RI follow-on sampling effort was designated to identify the source areas for the 1,1,2-TCA and 1,2-DCA contamination detected during 1995 field effort in monitoring wells SHGW02, SHGW03, and SHGW04, as well as to characterize the horizontal and vertical extent of contamination. Chlorinated solvent 1,1,2-TCA was detected



LEGEND:

- GEOPHYSICS SURVEY AREA
- DRAINAGE DITCHES
- SURFACE FLOW DIRECTION
- CULVERT
- TEST TRENCH
- BUILDING
- RAILROAD
- ROAD
- FENCE
- AST
- WATER TABLE CONTOUR

SAMPLE LEGEND:

SAMPLING EVENTS
PRE-1995 1995/1996

- 4" MONITORING WELL
- 4" MONITORING WELL WITH SUBSURFACE SOIL SAMPLING
- MINIWELL
- MINIWELL WITH SUBSURFACE SOIL SAMPLING
- SURFACE SOIL
- SOIL BORING
- GEOPROBE GROUNDWATER SAMPLE POINT
- GEOPROBE GROUNDWATER SAMPLE POINT VERTICAL PROFILE
- LOCATION WHERE LEAD TBC WAS EXCEEDED

N

APPROXIMATE LOCATION WITHIN CORNHUSKER AAP BOUNDARY

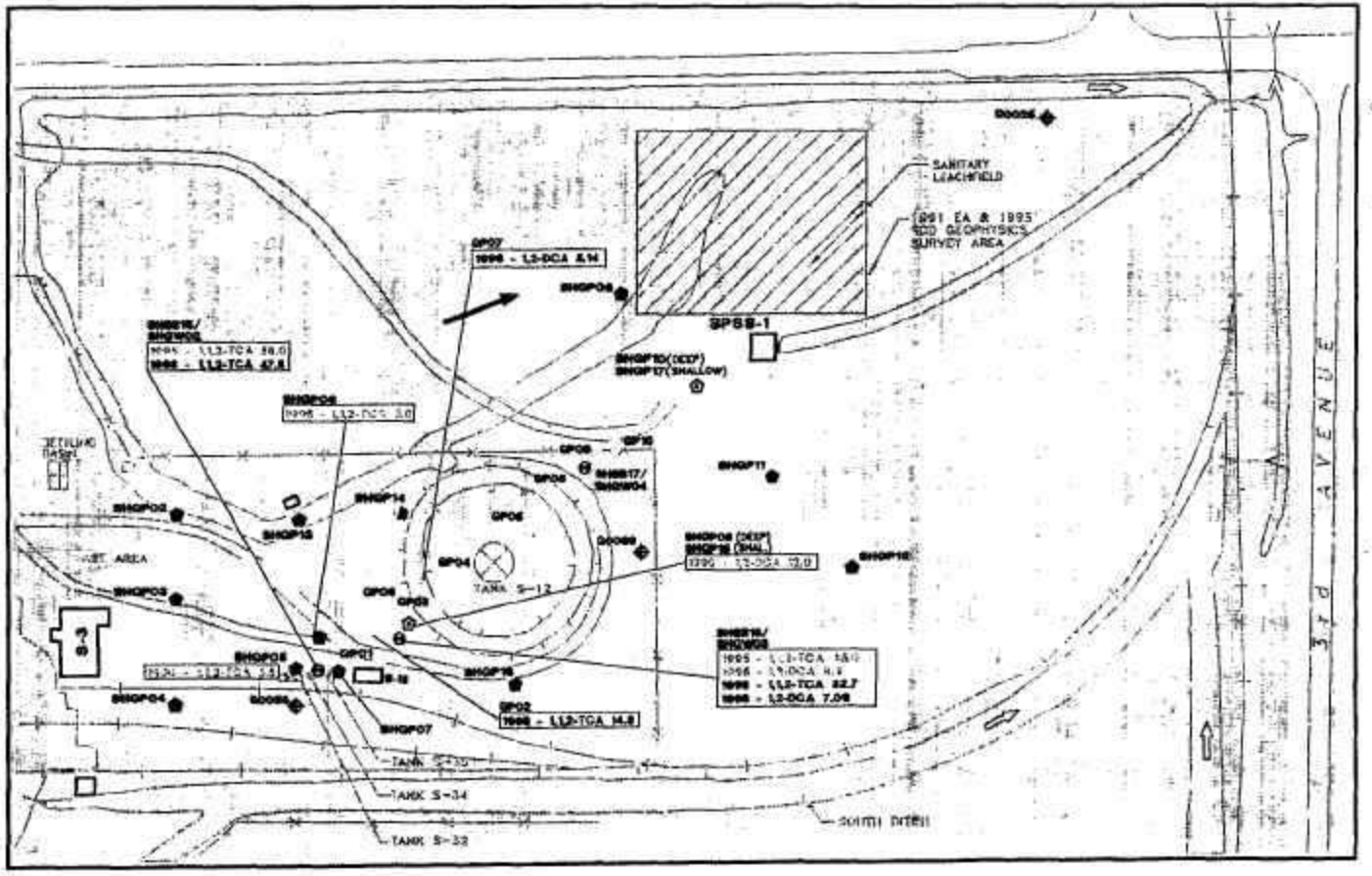
0 200 400
SCALE FEET

U.S. Army Environmental Center

the Tigroup

CORNHUSKER AAP
ACAD FILE: 96-SHOP1
01 SEP 1996

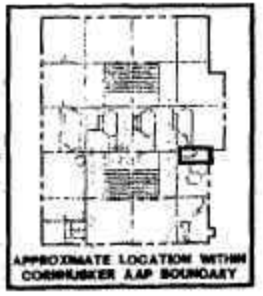
EXHIBIT 9-1
SAMPLE LOCATIONS AT SHOP AREA AND LOCATIONS WHERE LEAD TBC WAS EXCEEDED



LEGEND:

- GEOPHYSICS SURVEY AREA
- DRAINAGE DITCHES
- GROUNDWATER FLOW DIRECTION
- SURFACE FLOW DIRECTION
- CULVERT
- BUILDING
- RAILROAD
- ROAD
- FENCE
- AST
- TCA Trichloroethane
- DCA Dichloroethane

NOTE: ALL CONCENTRATIONS IN ug/L



SAMPLE LEGEND:

SAMPLING POINTS

1992	POST-1992	
⊕	⊕	4" MONITORING WELL
⊠	⊖	4" MONITORING WELL WITH SUBSURFACE SOIL SAMPLING
	●	GEOPROBE GROUNDWATER SAMPLE POINT
	⊙	GEOPROBE GROUNDWATER SAMPLE POINT VERTICAL PROFILE

NOTE:

1998 DATA ARE IN RED

CONCENTRATIONS IN **BOLD** ARE ABOVE FEDERAL MCLs

0 100 200
SCALE FEET

N

US Army Corps of Engineers
Omaha District

the IT group

CORNHUSKER AAP
ACAD FILE: SHOP-AREA-3
SEPT-14-1998

EXHIBIT 9-2
SHOP AREA LOCATIONS WHERE GROUNDWATER COPC'S EXCEEDED CLEANUP LEVELS, 1995, 1996, AND 1998

in Geoprobe ™ groundwater screening point SHGP05, which is located immediately downgradient of AST S-32 at 6.6 µg/L. The detection is far below the concentration of 45 µg/L detected in 1995; however, it still exceeds the Federal MCL (5 µg/L). 1,2-DCA (12 µg/L) was detected in Geoprobe ™ point SHGP15, which is located between monitoring well SHGW03 and the AST S-12 berm. This detection exceeds the Federal MCL (5 µg/L).

- 1998 Groundwater Sampling Results: During the 1998 groundwater sampling event, five monitoring wells and ten Geoprobe™ points were sampled for chlorinated solvents. Concentrations exceeding the Federal MCLs were found in the following wells and Geoprobe ™ sample points: SHGW02 (1,1,2-TCA 47.8 µg/L), SHGW03 (1,1,2-TCA 32.7 µg/L and 1,2-DCA 7.09), GP02 (1,1,2-TCA 14.8 µg/L), and GP07 (1,2-DCA 5.14 µg/L). **Exhibit 9-2** presents the detections of chlorinated solvents during the 1998 sampling round in groundwater. (It should be noted that detections above Federal MCLs are denoted in bold on this exhibit.)

Conclusion: The chlorinated VOC plume is apparently decreasing in concentration based on results of analytical data from 1995, 1996, and 1998 sampling rounds (**USACE, 1998b**). Natural attenuation via anaerobic biodegradation rather than hydrodynamic dispersion appears to be responsible for the decreasing concentrations. The maximum concentrations of 1,1,2-TCA detected was 56.0 µg/L in 1995 in well SHGW02. In 1998, results show a 15% decrease in 1,1,2-TCA. A similar trend can be seen for 1,2-DCA. Further evidence of breakdown is indicated by the detection of vinyl chloride in two locations; however, it should be noted both concentrations were well below the Federal MCL. The results of the 1996 sampling round indicate that the concentrations of 112- TCA and 1,2-DCA are slightly higher than Federal MCLs. Data from the 1998 sampling round indicate that natural attenuation processes continue to be operative at the Shop Area. This is evidenced by a continued decrease in concentrations of 1,1,2-TCA and 1,2-DCA, which for the most part fall below Federal MCLs. Vinyl chloride was detected only once in 1996, where as in 1998 it was detected in two different sampling locations. This provides further evidence that breakdown of 1,1,2-TCA and PCE has occurred between the 1996 and 1998 sampling rounds. Hydrogenolysis of 1,1,2-TCA appears to be the primary biodegradation pathway (evidenced by the detections of 1,2-DCA). However, subsequent breakdown of 1,2-DCA to chloroethane cannot be confirmed because it was not part of the target analyte list for the 1996 or the 1998 sampling rounds.

The results of the 1998 sampling round support the proposed preferred alternative of long-term monitoring of VOCs and their breakdown products in groundwater. The results of 1998 sampling event further support the conclusions predicted by the numerical fate and transport model performed in 1997, which suggests that cleanup may occur through natural attenuation within fifteen years.

9.2.2 Building S-22, Building S-37, and Laundry Settling Basin Sampling Results

Building S-22: Building S-22 is the former Paint Shop. Lead was detected in several samples collected in the vicinity of Building S-22. Four samples, SHOPSR009 (2,400 µg/g), SHOP-8 (570 µg/g), SHOPSR008 (990 µg/g), and SHOPSR010 (1,500 µg/g) exceeded the NDEQ TBC guidance for lead (400 µg/g) (**Exhibit 9-1**).

9.3 CONTAMINANT FATE AND TRANSPORT

Based on monitoring well and Geoprobe™ Sampling results, it has been determined that groundwater in the vicinity of the AST area has been contaminated with chlorinated solvents. Concentrations of 1,1,2-TCA and 1,2-DCA have been detected in samples collected during the 1995, 1996, and 1998 sampling efforts. None of the soil samples collected in the AST area of the Shop Area contained detections of chlorinated organic solvents. This data indicates that the unsaturated zone in this area is no longer a source of contamination to the saturated zone.

In 1995, wells SHGW02, SHGW03 and SHGW04 were installed and sampled. The chlorinated solvent detections for this sampling event suggest a narrow elongated plume extending to the northeast, in the general direction of groundwater flow. 1,1,2-TCA was detected at the highest concentration (56 µg/L) at the upgradient end of the plume (Well SHGW02), and occurs at decreased concentration (45

µg/L) about 90 ft downgradient in SHGW03. 1,2-DCA also occurs in Well SHGW03 at a concentration of 8.3 µg/L. At the distal end of the plume (Well SHGW04; roughly 350 ft downgradient from SHGW02) 1,1,2-TCA was not detected, and the concentration of 1,2-DCA was relatively low (0.68 µg/L). The chlorinated solvent compound distribution is indicative of breakdown of 1,1,2-TCA to 1,2-DCA.

To further characterize the extent of the chlorinated solvent plume, an additional round of sampling was performed in the AST area in August 1996. The three wells sampled in 1995 were resampled and 17 Geoprobe™ groundwater samples were collected. There were no detections of chlorinated solvents upgradient (SHGP02 and SHGP04) or downgradient (SHGP09 through SHGP12) of the solvent plume encountered during the 1995 sampling round, indicating that the plume is apparently immobile, and limited to roughly a 100 ft by 350 ft area. There were no detections of 1,1,2-TCA or 1,2-DCA in 1996 in any of the three wells sampled in 1995. However, 1,1,2-TCA was detected in two of the Geoprobe™ points proximal to SHGW02 (in SHGP05 at 6.6 µg/L; in SHGP06 at 5.0 µg/L). 1,2-DCA (12 µg/L) and vinyl chloride (10.0 µg/L) were detected in the shallow Geoprobe™ groundwater sample SHGP08 (about 120 ft downgradient from Geoprobe™ point SHGP05). The only chlorinated solvents detected at the distal end of the plume in 1996 were far below Federal MCLs. The results of the 1996 groundwater sampling round show a significant reduction in the concentration of 1,1,2-TCA and provide further evidence of the breakdown of 1,1,2-TCA to 1,2-DCA. The breakdown of 1,2-DCA occurs either by hydrogenolysis to chloroethane or vinyl chloride. 1,1,2-TCA can also breakdown to vinyl chloride via dehalogenation. Vinyl chloride was detected in one Geoprobe™ sample in 1996; however, it was detected in SHGW03 and in Geoprobe™ sample in 1998. Furthermore, 1,2-DCA was also detected in these samples which suggests that natural attenuation via hydrogenolysis or dehalogenation is occurring.

9.4 REMEDIAL ALTERNATIVES

The findings of the 1996 RI triggered the requirement for an alternatives analysis for lead contamination in soil in the vicinity of Building S-22 and for chlorinated VOCs in groundwater in the vicinity of the AST area. The Alternatives Analysis was prepared as part of the 1998 FS (**USACE, 1998a**).

The purpose of this detailed evaluation of alternatives is to provide performance and cost data that can be utilized to evaluate further remedial action at the Shop Area. The remedial alternatives are being evaluated as a means of reducing human health risks to within the range of acceptable risks.

9.4.1 Alternative 1: No Action

Description: According to the NCP, the level of treatment achieved must be compared to the required expenditures of time and materials as an integral portion of the remedy selection process. The "No Action" alternative is intended to serve as a baseline by which to compare the risk reduction effectiveness of other potential alternatives.

Overall Protection of Human Health and the Environment: The "No Action" alternative does not decrease the potential risks to humans or the environment in any way, because no remedial activities will be implemented at the site under this alternative. Ingestion or dermal exposure to lead contamination in surface soil are potential exposure pathways for workers at the site. Groundwater is unlikely to reach potential off-site receptors. However, the "No Action" alternative does not include a monitoring system to determine if further remedial action is necessary.

Compliance with ARARs: This alternative does not comply with chemical-specific TBC guidance for lead as the concentration of lead is above the cleanup level protective of industrial workers. This alternative also does not comply with chemical-specific ARARs regarding COPCs detected in groundwater. Chlorinated compounds 1,1,2-TCA and 1,2-DCA are present in concentrations that exceed the Federal MCLs. Location-specific and action-specific ARARs are not considered because no remedial activities will be implemented at the site.

Long-term Effectiveness and Permanence: In the long-term, this alternative will not be effective. No actions will be taken to provide permanent human health and environmental protection.

Reduction of Toxicity, Mobility, or Volume Through Treatment: There will be no further remedial activities implemented at the site; subsequently, there will be no further reduction of toxicity, mobility, or volume through treatment.

Short-term Effectiveness: Short-term effectiveness does not apply to the "No Action" alternative because no additional remedial activities will be implemented at the site.

Implementability: There are no implementability concerns associated with the "No Action" alternative because no remediation activities will be conducted at the site.

Cost: There are no capital costs associated with this alternative. However, an evaluation report will be submitted every five years for a 30-year period at a total present worth cost of $37,240.

9.4.2 Alternative 2: Soil Excavation, Long-term Monitoring for Natural Attenuation of Chlorinated Organic Compounds in Groundwater, and Deed Restriction

Description: This alternative consists of monitoring the natural attenuation of an identified chlorinated volatile organic compound (VOC) plume at the Shop Area and excavation and off-site disposal of lead-contaminated soil (see **Exhibit 9-3**).

- Excavation of Lead-Contaminated Soil: Lead-contaminated soil at the North Ditch Area would be removed to the NDEQ cleanup level. An area of approximately 50 ft by 10 ft to a depth of one foot would be excavated (the volume is approximately 18.5 yd^3). The excavation effort could be completed with conventional construction equipment (e.g., wheeled front-end loader) in one day. Upon completion of the soil excavation, lead screening using XRF would be used to determine if excavation of soil to the cleanup level has been completed. If screening data indicates that removal of lead to the cleanup level has been accomplished, five samples would be collected for confirmational analysis. The excavated soil would be placed in two 20-ton capacity roll-offs. Prior to the excavation, two samples would be collected and tested to determine if the soil is a RCRA-hazardous waste. If the soil fails the Toxicity Characteristic Leaching Procedure (TCLP) for lead, the soil is considered a hazardous waste and would be disposed of RCRA Subtitle C Landfill that can accept wastes from a CERCLA site. The excavated area would be backfilled with clean soil (approximately 21.3 yd^3) and reseeded.

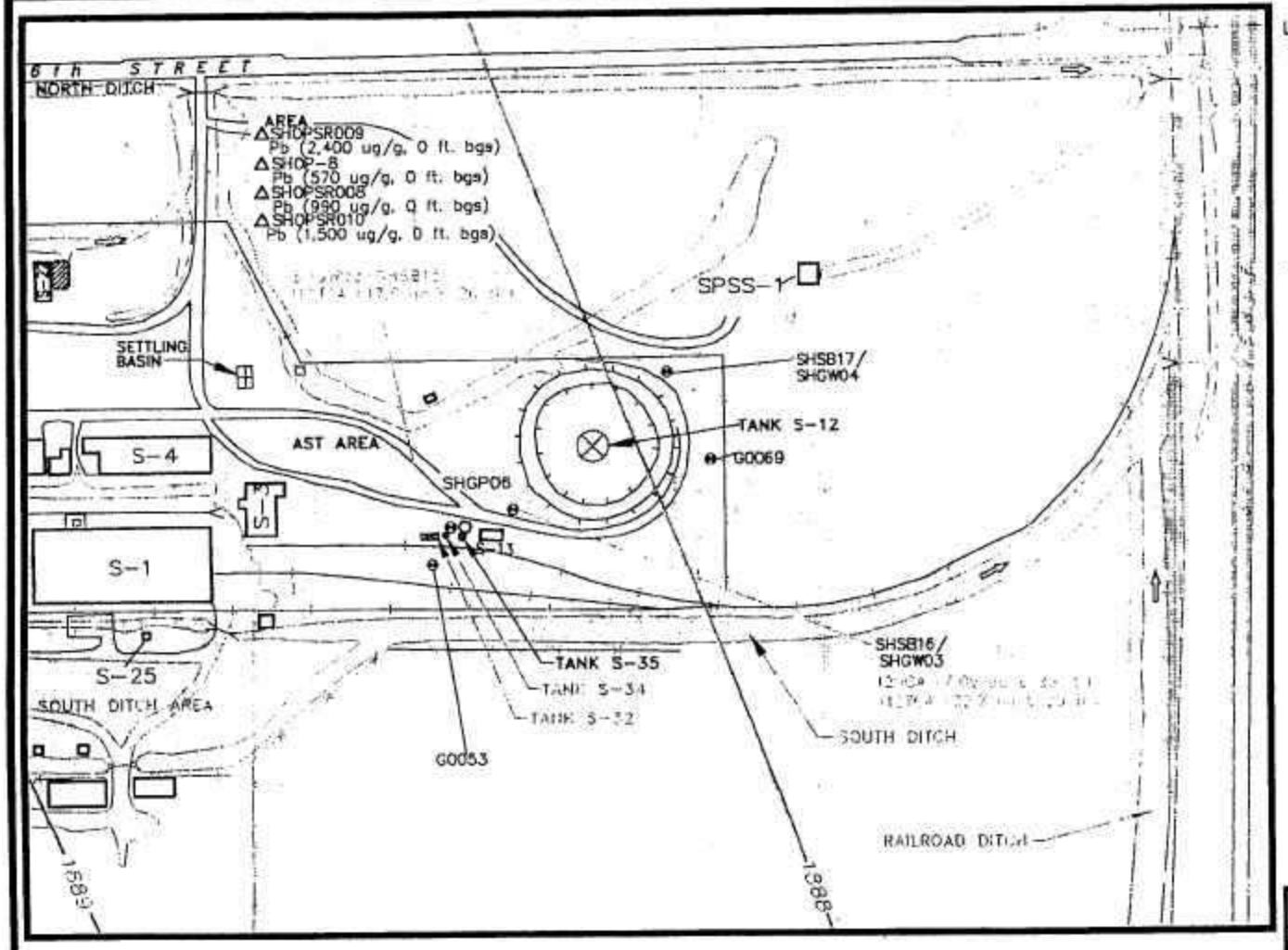
- Monitoring for Natural Attenuation of the Chlorinated VOC Plume: Alternative Two would involve the monitoring of groundwater upgradient and downgradient of the Shop Area chlorinated VOC plume as well as the removal and off-site disposal of lead contaminated soil from the North Ditch Area, northeast of Building S-22. The monitoring well locations and area of soil excavation are displayed in **Exhibit 9-3**. Groundwater upgradient and downgradient would be screened for the TCL VOC List (chlorinated organics), dissolved oxygen, redox potential, and ethane/ethene. Samples from four wells will be collected and analyzed on an annual basis.

- This alternative also includes implementation of deed restrictions to prevent residential use. The deed restrictions will include proprietary institutional controls restricting the future use of the property such as easements or restrictive covenants that are legally enforceable against subsequent property owners and instituted, depending on state law, by conveyance or contract. The U.S. Army will be responsible for implementing and maintaining the effectiveness of the institutional controls.

Overall Protection of Human Health and the Environment:

- Excavation of Lead-Contaminated Soil: The removal of lead contaminated soil to the NDEQ cleanup level of 400 µg/g is protective of humans under non-residential conditions.

- Monitoring for Natural Attenuation of Chlorinated VOC Plume: Natural attenuation could be considered protective of human heath and the environment. Based on future use of the groundwater, exposure to humans is unlikely. Field sampling analytical results and results of the BIOF&T-2D fate and transport model suggest that the chlorinated solvent plume is shrinking and, therefore, will not migrate off-site.

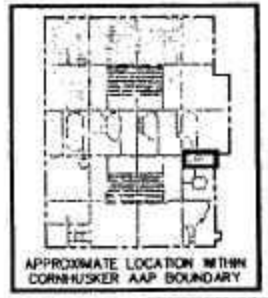


LEGEND:

- DRAINAGE DITCHES
- SURFACE FLOW DIRECTION
- CULVERT
- TEST TRENCH
- BUILDING
- RAILROAD
- ROAD
- FENCE
- AST
- AREAL EXTENT OF CHLORINATED ORGANIC SOLVENT CONTAMINATION OF GROUNDWATER
- WATER TABLE CONTOUR
- PROPOSED SOIL EXCAVATION (15 FT. X 15 FT. X 1 FT.)

SAMPLE LEGEND:

- EXISTING 4" MONITORING WELL
- EXISTING 4" MONITORING WELL TO BE SAMPLED FOR LONG TERM MONITORING
- PROPOSED 4" MONITORING WELL TO BE SAMPLED FOR LONG TERM MONITORING
- SURFACE SOIL
- SOIL BORING



N

0 200 400
SCALE FEET

NOTE:
1393 GROUNDWATER SAMPLING DETECTIONS EXPRESSED IN ug/l (WET)
SOIL DETECTIONS EXPRESSED IN ug/g (RED)

U.S. ARMY CORPS OF ENGINEERS
OMAHA DISTRICT

the IT group

CORNHUSKER AAP
ACAD FILE: FSSHAT4A
15 JAN 1997

EXHIBIT 9-3
SHOP AREA
PREFERRED ALTERNATIVE
ALTERNATIVE TWO:
(EXCAVATION, OFFSITE DISPOSAL OF LEAD CONTAMINATED SOIL AND MONITORING FOR NATURAL ATTENUATION OF THE CHLORINATED VOC PLUME)

Compliance with ARARs:

- Excavation of Lead-Contaminated Soil:

  Chemical-specific TBC guidance: The lead-contaminated soil excavation portion of this alternative would meet the chemical-specific TBC guidance for lead.

  Location-specific ARARs: The lead-contaminated soil excavation portion of this alternative is not expected to affect any location-specific ARARs.

  Action-specific ARARs: The proposed remedial design and operation should meet action-specific ARARs.

- Monitoring for Natural Attenuation of the Chlorinated VOC Plume:

  Chemical-specific ARARs: The Federal MCLs for 1,1,2-TCA and 1,2-DCA are likely to be met by this alternative.

  Location-specific ARARs: Location-specific ARARs would not be affected by this alternative.

  Action-specific ARARs: Action-specific ARARs are not considered because no remedial activities will be implemented at the site for addressing groundwater.

Long-term Effectiveness and Permanence:

- Excavation of Lead Contaminated Soil: In the long-term, the lead-contaminated soil excavation portion of this alternative would be effective because the lead would be removed to a level that is below the cleanup level protective of industrial workers.

- Monitoring for Natural Attenuation of the Chlorinated VOC Plume: Natural attenuation may be occurring in groundwater. This will be determined by long-term monitoring.

Reduction of Toxicity, Mobility, or Volume Through Treatment:

- Excavation of Lead-Contaminated Soil: Volume will be reduced since the lead-contaminated soil will be removed and disposed at a off-site disposal facility. Toxicity and mobility will not be reduced since no treatment is involved.

- Monitoring for Natural Attenuation of the Chlorinated VOC Plume: For groundwater, toxicity, mobility and volume may be reduced through the natural attenuation process.

Short-term Effectiveness:

- Excavation of Lead-Contaminated Soil: This alternative poses minimal risk to the community, workers, and the environment during its implementation. The remote location on a military facility would minimize unauthorized public access to the site. Workers involved with the excavation activities could be exposed to risks including dermal contact with contaminated soil and breathing contaminant dust and vapors. The emission levels, however, will be low, and workers will be protected by use of appropriate personal protective equipment. No protected species are to be affected during remediation.

- Monitoring for Natural Attenuation of the Chlorinated VOC Plume: Because no remediation is involved, no risk to the human health and the environment is expected.

Implementability

- Excavation of Lead-Contaminated Soil: Equipment and materials for implementing this alternative are readily available. If selected as the remedial action, excavation could be implemented in less than six months.

- Monitoring for Natural Attenuation of the Chlorinated VOC Plume: The only actions necessary for implementing this alternative are installation of a monitoring well and the performance of sampling and laboratory analyses. Equipment and services for performing these actions are readily available. Installation of the proposed monitoring well could be implemented in less than one month. Based on the BIOF&T-2D model, 1,1,2-TCA and 1,2-

DCA should reduce to concentrations below their respective Federal MCLs in 15 years (CHAAP OU3 and OU4 FS - Appendix E).

Cost: The estimated capital cost and annual O&M costs are $48,621 and $108,250, respectively. The net present worth of costs for 30 years at 5% interest for this alternative is estimated to be $232,169.

9.4.3 Alternative 3: Soil Excavation, Liquid-Phase Carbon Adsorption, and Deed Restriction

Description: This alternative includes treating the groundwater with granular activated carbon (GAC) and performing semi-annual monitoring. This alternative also includes the excavation and disposal of lead-contaminated soil as described in Alternative Two.

GAC treatment is a physical process that uses GAC to remove a wide variety of contaminants by adsorbing them from liquid. It was estimated that the system would need to be operated for no more than 10 years to reduce VOC concentrations to Federal MCLs (see CHAAP OU3 and OU4 FS - Appendix E).

A capture zone analysis for the pump and treat alternative was performed using the numerical model FLOWPATH (refer to CHAAP OU3 and OU4 FS - Appendix E). Results of the model suggest that a 30-gallon per minute (gpm) extraction rate will be sufficient to capture the chlorinated solvent plume.

The liquid phase GAC system proposed for the Shop Area is a 30-gpm liquid system utilizing six 10-gpm-carbon canisters connected in series and parallel. One 4-inch diameter extraction well with a 30-gpm, 1.5 Hp submersible pump would be used to extract the groundwater into the carbon adsorption unit. Based on vendor estimates, for every 1,000 gallons of water, approximately 0.69 pounds of GAC would be used in removing 1,1,2-TCA and 1,2-DCA to below their respective Federal MCLs. It is estimated that three canisters would have to be exchanged every 21 days. Filters would be used before the system to remove iron and manganese from the water to prevent clogging of the GAC units. Based on conversations with vendors, the filters would need to be changed every month.

The proposed discharge location is the railroad ditch, which is also used as the discharge location for the OU1 groundwater treatment system. The piping used would be 2-inch diameter polyvinyl chloride, (PVC) pipe. The piping (to be encased in a dual pipe casing) would be laid underneath of the railroad track to be discharged directly to the railroad ditch. A National Pollutant Discharge Elimination System (NPDES) permit will be required. It should be noted that no off-gas treatment system will be required because of the low concentrations present in groundwater. This alternative proposes the annual monitoring of the chlorinated organic compound plume. In addition, influent and effluent to the Carbon adsorption system would be monitored on a daily basis for Target Compound List (TCL) VOCs (chlorinated organics only).

This alternative also includes implementation of deed restrictions to prevent residential use. The deed restrictions will include proprietary institutional controls restricting the future use of the property such as easements or restrictive covenants that are legally enforceable against subsequent property owners and instituted, depending on state law, by conveyance or contract. The U.S. Army will be responsible for implementing and maintaining the effectiveness of the institutional controls.

Overall Protection of Human Health and the Environment: This alternative will reduce the concentrations of 1,1,2-TCA and 1,2-DCA to below Federal MCLs and, therefore, would provide protection to human health and environment.

Compliance with ARARS:

Chemical-specific ARARs: The Federal MCLs for 1,1,2-TCA and 1,2-DCA are to be met by this alternative.

Location-specific ARARs: Location-specific ARARs would not be affected by this alternative.

Action-specific ARARs: ARARs that must be addressed in evaluating the GAC process and off-site disposal of spent carbon. The proposed remedial design and operation would meet all action-specific ARAR requirements.

Long-term Effectiveness and Permanence: Implementation of this alternative will essentially eliminate the long-term risk associated with VOC-contaminated groundwater. No long-term residual risk will be associated with the treated groundwater by the liquid-phase carbon adsorption system. The need for replacement of mechanical components, such as extraction pumps, will be minimal through execution of proper maintenance activities.

Reduction of Toxicity, Mobility, or Volume Through Treatment: The GAC system will effectively reduce the mobility and volume of the contaminants in the extracted groundwater. Toxicity will not be reduced, but contaminants will be concentrated in the GAC. The spent carbon generated from the carbon adsorption unit will be shipped to the carbon supplier for off-site regeneration. The adsorbed organics will be thermally decomposed to non-toxic compounds (such as carbon dioxide) during the regeneration process.

Short-term Effectiveness: Community risk associated with implementation of this alternative will be low because the spent carbon will be shipped off-site for regeneration. Environmental impacts resulting from installation and operation of this alternative will be minimal.

Implementability: Installation of the groundwater extraction system and construction of the treatment facility are relatively simple and established procedures. The use of the carbon adsorption unit to remove organic contaminants in groundwater is proven and reliable. All the technologies required to implement this alternative will be readily available. Administrative efforts in obtaining Federal and State permits will be required for the discharge of treated water to the railroad ditch. The design, construction, and operation of this system could be implemented in one year. Based on computer modeling, the length of time required for 1,1,2-TCA and 1,2-DCA to meet Federal MCLs is 10 years (see CHAAP OU3 and OU4 FS - Appendix E).

Cost: The estimated capital cost and annual O&M costs are estimated to be $353,000 and $432,000, respectively. The net present worth of costs for 10 years at 5% interest for this alternative is estimated to be $3.7 Million.

9.4.4 Alternative 4: Soil Excavation, Air Stripping, and Deed Restriction

Description: This alternative includes treating the groundwater by extracting and pumping it through a stacked tray air stripper and performing semi-annual monitoring of groundwater. This alternative also includes the excavation and disposal of lead-contaminated soil as described in Alternative Two.

Air stripping involves the mass transfer of volatile contaminants from water to air. This process is conducted in a packed tower. The typical packed tower air stripper includes a spray nozzle at the top of the tower to distribute contaminated water over the packing in the column, a fan to force air countercurrent to the water flow, and a sump at the bottom of the tower to collect decontaminated water. This water will be discharged into the railroad ditch, upon obtaining the necessary NPDES permit. Based on calculations presented in the FS, it was determined that the system will need to be in operation for no more than 10 years to reduce contaminant concentrations to below Federal MCLs.

A capture zone analysis for the pump and treat alternative was performed using the numerical model FLOWPATH. Results of the model suggest that a 30-gpm extraction rate will be sufficient to capture the chlorinated solvent plume. A detailed discussion of the FLOWPATH model is presented in CHAAP OU3 and OU4 FS - Appendix E.

The air stripping system proposed for the Shop Area is a five-tray, gravity-drain configuration model. One 4-inch diameter extraction well with a 30-gpm, 1/3 Hp submersible pump would be used to extract the groundwater and pump it into the air stripper. Filters would be used before the system to remove iron and manganese from the water to prevent clogging of the air stripper. Based on conversations with vendors, the filters would need to be changed every month.

The proposed discharge location is the railroad ditch, which is also used as the discharge location for the OU1 groundwater treatment system. The piping used would be 2-inch diameter PVC pipe. Effluent samples would be collected monthly and analyzed for chlorinated VOCs. A 30,000 gallon effluent tank would be installed for use in case of an emergency. A 30-gpm, 1/3 Hp pump would be used to move the treated water from the holding tanks to the railroad drainage ditch. A NPDES permit will be required. It should be noted that no off-gas treatment system will be required because of the low concentrations of VOCs present in groundwater.

This alternative proposes the annual monitoring of the chlorinated organic compound plume. In addition, influent and effluent to the carbon adsorption system would be monitored on a daily basis for TCL VOCs (chlorinated organics only).

This alternative also includes implementation of deed restrictions to prevent residential use. The deed restrictions will include proprietary institutional controls restricting the future use of the property such as easements or restrictive covenants that are legally enforceable against subsequent property owners and instituted, depending on state law, by conveyance or contract. The U.S. Army will be responsible for implementing and maintaining the effectiveness of the institutional controls.

Overall Protection of Human Health and the Environment: This alternative will reduce the concentrations of 1,1,2-TCA and 1,2-DCA to below Federal MCLs and, therefore, would provide protection to human health and environment.

Compliance with ARARs:

Chemical-specific ARARs: The Federal MCLs for 1,1,2-TCA and 1,2-DCA are to be met by this alternative.

Location-specific ARARs: Location-specific ARARs would not be affected by this alternative.

Action-specific ARARs: The proposed remedial design and operation should meet all Action-specific ARAR requirements.

Long-term Effectiveness and Permanence: Implementation of this alternative will essentially eliminate the long-term risk associated with VOC-contaminated groundwater. No long-term residual risk will be associated with the groundwater treated by the air stripping system. The need for replacement of mechanical components, such as extraction pumps, will be minimal through execution of proper maintenance activities.

Reduction of Toxicity, Mobility, or Volume Through Treatment: The air stripping system will effectively reduce the mobility and volume of the contaminants in the extracted groundwater. Toxicity will not be reduced, but contaminants will be removed from the groundwater in a vapor-phase form.

Short-term Effectiveness: Community risk associated with implementation of this alternative will be low because the amount of vapor emissions from this system will be far below Nebraska air pollution control regulations. Environmental impacts resulting from installation and operation of this alternative will be minimal.

Implementability: Installation of the groundwater extraction system and construction of the treatment facility are relatively simple, established procedures. The use of the air stripping unit to remove organic contaminants in groundwater is proven and reliable. All the technologies required to implement this alternative will be readily available. Administrative efforts in obtaining Federal and State permits will be required for the discharge of treated water to the railroad ditch. The design, construction, and operation of this system could be implemented in six months. Based on calculations, the length of time required for 1,1,2-TCA and 1,2-DCA to meet Federal MCLs is 10 years (refer to CHAAP OU3 and OU4 FS - Appendix E).

Cost: The present worth cost at five percent interest is approximately $2.8 Million. The capital and O&M costs are to be $362,000 and $323,000, respectively.

9.5 SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES FOR THE SHOP AREA

As required by CERCLA, the remedial alternatives described above were evaluated using nine criteria specified by USEPA. **Table 9-1** summarizes a comparative analysis of the four remedial alternatives presented in the CHAAP OU3 and OU4 FS.

Table 9-1. Comparative Analysis of Remedial Action Alternatives –Shop Area

NCP Criteria	Alternative 1 No Action	Alternative 2 Soil Excavation, Monitoring and Natural Attenuation of Groundwater, and Deed Restriction	Alternative 3 Soil Excavation, Liquid-Phase Carbon Adsorption, and Deed Restriction	Alternative 4 Soil Excavation, Air Stripping, and Deed Restriction
1. OVERALL PROTECTIVENESS				
Direct Contact/Soil Ingestion	No significant reduction in risk. Contaminant levels remain in soil.	All contamination above levels causing risk would be removed	See Alternative 2.	See Alternative 2.
2. COMPLIANCE WITH ARARS/TBC GUIDANCE				
Chemical-Specific ARARs	Chemical-Specific ARARs and TBC guidance would not be met.	Would meet all chemical-specific ARARs.	See Alternative 2.	See Alternative 2.
Location-Specific ARARs	There are no location-specific ARARs.	Would meet all location-specific ARARs	See Alternative 2.	See Alternative 2.
Action-Specific ARARs	There are no action-specific ARARs.	Would meet all action-specific ARARs	See Alternative 2.	See Alternative 2.
TBC Guidance for Lead	Does not meet protection of industrial worker cleanup levels.	Would meet TBC guidance.	See Alternative 2.	See Alternative 2.
3. LONG-TERM EFFECTIVENESS AND PERMANENCE				
Magnitude of Residual Risk (Direct Contact/Soil Ingestion)	Source has not been removed. Existing risk will remain.	Risk is eliminated since source is removed.	Risk is minimized since source is removed.	Risk is minimized since source is removed.
Adequacy and Reliability of Controls	No controls over remaining contamination. No reliability.	Reliability of soil removal high, since all contaminants above remedial goals will be removed from the site. Data analysis and modeling indicate that natural attenuation is occurring at this site.	Reliability of soil removal high, since all contaminants above remedial goals will be removed from the site. Carbon adsorption is an effective technology for remediating VOCs in groundwater.	Reliability of soil removal high, since all contaminants above remedial goals will be removed from the site. Air stripping is an effective technology for remediating VOCs in groundwater.
Need for 5-Year Review	Review would be required.	A 5-year review will be required until groundwater cleanup objectives are reached. A closure report will be prepared when cleanup objectives are reached. 5-year reviews will also be conducted as part of the Deed Restrictions.	See Alternative 2.	See Alternative 2.

Table 9-1. Comparative Analysis of Remedial Action Alternatives – Shop Area

NCP Criteria	Alternative 1 No Action	Alternative 2 Soil Excavation, Monitoring and Natural Attenuation of Groundwater, and Deed Restriction	Alternative 3 Soil Excavation, Liquid-Phase Carbon Adsorption, and Deed Restriction	Alternative 4 Soil Excavation, Air Stripping, and Deed Restriction
4. REDUCTION IN TOXICITY, MOBILITY, AND VOLUME THROUGH TREATMENT				
Treatment Process Used	None.	Excavation and off-site disposal for soil.	Excavation and off-site disposal for soil. Carbon adsorption is used to separate contaminants from groundwater.	Excavation and off-site disposal for soil. Air stripping is used to separate contaminants from groundwater.
Amount Destroyed or Treated	None.	Soil: 18.5 yd^3 Groundwater: 864,000 gallons	See Alternative 2.	See Alternative 2.
Reduction of Toxicity, Mobility, or Volume	None.	In soil, no reduction in toxicity or mobility, but volume of contaminated soil is reduced. TMV is reduced for groundwater through the natural attenuation process.	In soil, no reduction in toxicity or mobility, but volume of contaminated soil is reduced. Mobility and volume in groundwater are reduced because chlorinated VOCs are removed to levels lower than Federal MCLs. Toxicity is not reduced because no treatment is used.	See Alternative 2.
Irreversible Treatment	None.	The natural attentuation process is irreversible.	None.	None.
Type and Quantity of Residuals Remaining after Treatment	No residuals remain.	No detectable residuals remain above cleanup levels.	Spent carbon will be returned to vendor for treatment.	None.
Statutory Preference for Treatment	Does not satisfy.	Satisfies.	Satisfies.	Satisfies.
5. SHORT-TERM EFFECTIVENESS				
Community Protection	Risk to community not increased by remedy implementation, and contamination not expected to reach community in future.	Temporary increase in dust production during excavation.	Temporary increase in dust production during excavation and remedy implementation.	See Alternative 3.
Worker Protection	No significant risk to workers.	Protection required against dermal contact of contaminants and inhalation of contaminated dust during excavation and monitoring activities.	Protection required against dermal contact of contaminants and inhalation of contaminated dust during excavation monitoring, and system implementation activities.	See Alternative 3.
Environmental Impacts	Continued impact from existing conditions.	No environmental impacts from remedial action.	See Alternative 2.	See Alternative 2.
Time until Action is Complete	Not applicable.	15 years based on remodeling.	10 years, based on modeling.	See Alternative 3.
6. IMPLEMENTABILITY				
Ability to Obtain Approvals and Coordinate with other Agencies	No approval necessary.	Program for natural attenuation will require approval from regulators.	Must obtain a NPDES permit for groundwater discharge.	Must obtain a NPDES permit for groundwater discharge.
Availability of Services and Capacities	No services or capacities necessary.	Service and Capacities readily available.	See Alternative 2.	See Alternative 2.

Table 9-1. Comparative Analysis of Remedial Action Alternatives – Shop Area

NCP Criteria	Alternative 1 No Action	Alternative 2 Soil Excavation, Monitoring and Natural Attenuation of Groundwater, and Deed Restriction	Alternative 3 Soil Excavation, Liquid-Phase Carbon Adsorption, and Deed Restriction	Alternative 4 Soil Excavation, Air Stripping, and Deed Restriction
Availability of Equipment, Specialists, and Materials	None required.	Equipment, specialists, and material readily available.	See Alternative 2.	See Alternative 2.
Availability of Technologies.	None required.	Readily available.	See Alternative 2.	See Alternative 2.
7. Cost				
Capital Cost	$0	$48,621	$353,000	$362,000
O&M Cost	$28,000	$108,250	$432,000	$323,000
Present Worth Cost[1]	$37,240	$232,169	$3.7 Million	$2.8 Million

[1] - 15 year present worth used for Alternative Two, 10-year present worth used for Alternatives Three and Four. Costs of five-year reviews are based on a 30-year period.

9.5.1 Protection of Human Health and Environment

COPCs, lead in soil and chlorinated VOCs (e.g., 1,1,2-TCA and 1,2-DCA) in groundwater, were detected at concentrations greater than the cleanup level. Alternative One will not meet this criterion because no actions are taken to eliminate, reduce, or control exposure pathways. Alternative One does not achieve the threshold criterion of protection of human health and the environment.

Alternative Two provides protection of human health and the environment by eliminating the surface soil exposure pathway as well as mitigating migration of lead into groundwater (sources are removed). Therefore, implementation of this alternative would allow future land use for non-residential conditions. Alternative Two is likely to reduce contaminants in groundwater to below groundwater cleanup levels (i.e., Federal MCLs), but will take longer to do so than Alternatives Three and Four.

Alternatives Three and Four provide protection of human health under non-residential conditions by eliminating the surface soil exposure pathway as well as mitigating migration of lead into groundwater (sources are removed). Therefore, implementation of these alternatives would allow future non-residential land use of the Shop Area. Alternatives Three and Four reduce contaminants in groundwater to below Federal MCLs, thereby, allowing unrestricted use of groundwater.

9.5.2 Compliance with ARARs

Compliance with ARARs is a threshold criterion that must be met by the proposed remedial action. Alternative One does not meet the chemical-specific TBC guidance because lead remains in soil. Alternatives Two, Three, and Four involve further actions to eliminate exposure to contaminated soil and mitigate migration of lead into groundwater. These alternatives also reduce VOCs in groundwater to levels that meet chemical-specific ARARs.

9.5.3 Long-term Effectiveness and Permanence

Alternative One does not provide long-term effectiveness and permanence. This alternative does not provide sufficient, effective protection of groundwater and potential exposure to humans from exposure to contaminated soils and groundwater. Alternatives Two, Three, and Four provide long-term prevention of exposures to lead-contaminated surface soil and migration of lead from soils into groundwater because sources are removed. Alternatives Two, Three, and Four will provide long-term protection and permanence. However, Alternative Two will take longer to achieve permanence.

Reviews at least every five years, as required, would be necessary to evaluate the effectiveness of any of these alternatives because hazardous substances would remain onsite in concentrations above health-based levels.

9.5.4 Reduction of Toxicity, Mobility or Volume through Treatment

Alternative One does not provide reduction of toxicity, mobility, or volume of the contaminants. Alternatives Two, Three, and Four provide reduction of volume for soil because all lead is removed to levels lower than the cleanup level protective of industrial workers. Alternative Two provides reduction of toxicity, mobility, and volume of contaminants in groundwater because chlorinated VOCs are reduced to levels lower than Federal MCLs. Alternatives Three and Four provide reduction of mobility and volume because chlorinated VOCs in the groundwater are removed to levels lower than Federal MCLs. Toxicity is not reduced for Alternatives Three and Four because no treatment is used.

9.5.5 Short-term Effectiveness

Short-term effectiveness is not applicable to Alternative One. Alternatives Two, Three, and Four require the use of proper dust suppressant measures to control windblown emissions of potentially contaminated dust to protect the community and on-site workers. Proper personal protective equipment would be required for site workers. Workers will take appropriate safety measures to perform their functions (e.g., drilling, sampling, installation of groundwater treatment alternatives). Measures to protect the environment are not expected for implementing these alternatives.

Alternative One takes the shortest time to implement because no action is involved. Alternative Two should be implemented in less than six months because it only involves the installation of a monitoring well and excavation of soil. Alternatives Three and Four will take one year to implement to allow for design, construction, and permitting of the pump and treat systems.

9.5.6 Implementability

Alternatives One and Two are the most easily implemented. Alternative One is a no further action alternative. Alternative Two involves the installation of a monitoring well, sampling, and excavation. Pump and treat systems proposed in Alternatives Three and Four would also be fairly easy to implement because they use developed commercial technologies. Alternatives Two, Three, and Four involve excavation and landfilling of contaminated soils. Excavations to the depths proposed indicate that these alternatives would be easy to implement. The excavation (approximately 1 ft bgs) would not require shoring or dewatering.

9.5.7 Cost

Total capital and annual costs and present worth (discount rate of 5%) for each alternative are presented in **Table 9-1**.

9.6 SELECTED REMEDY

The selected remedy for the Shop Area is Alternative Two – Soil Excavation and Long-term Monitoring for Natural Attenuation of Groundwater (**Exhibit 9-3**). Alternative Two is the preferred alternative because it provides the best balance of features that offer overall protection to human health and the environment; is easy to implement; it quickly and permanently reduces the toxicity, mobility, and volume of lead-contaminated soil; it meets all ARARs and TBC guidance; is cost-effective; and involves monitoring of chlorinated organic compound concentrations in groundwater until they are reduced to below MCLs. Excavation of contaminated soils will remove risk to human and ecological receptors for the site. In addition, this action is easy to implement and involves minimal risks to site workers. The deed restrictions will include proprietary institutional controls such as easements or restrictive covenants that are legally enforceable against subsequent property owners and instituted, depending on state law, by conveyance or contract. The. U.S. Army will be responsible for implementing and maintaining the effectiveness of the institutional controls. **Table 9-2** presents ARARs and TBC Guidance for Alternative 2. **Table 9-3** provides a detailed cost estimate for Alternative 2.

Table 9-2. ARARs and TBC Guidance for Alternative 2
Action-Specific ARARs
Excavation
Regulations to processing machines and equipment (NDEC Title 129 Chapter 4)
Dust generation during construction activities (NDEC Title 129 Chapter 17)
Disposal or decontamination of equipment, structures, etc. (40 CFR 264.114)
On-Site health and safety for personnel during remedial actions (29 CFR 1910)
Closure
Clean Closure (40 CFR 264.111)
Disposal of Soil
Hazardous Waste Determination (40 CFR 261)
Standards for generators (40 CFR 262)
Standards for transporters (40 CFR 263; NDEC Title 128, Ch 3 and Ch 17; and 49 CFR 171)
LDRS and Treatment Standards (40 CFR 6, Appendix A)
Location-Specific ARARs
Executive Order 11988 (Floodplain Management) Evaluate potential effects of actions, avoid impacts to the extent possible (40 CFR 6, Appendix A)
Presence of wetlands as defined in Executive Order 11990 Section 7(c) 40 CFR 6, Appendix A, Section 4(j), Clean Water Act 404, and 33 CFR 328.3(b)
Presence of those species listed in the Endangered Species Act (16 USC 1351 et seq), the Fish and Wildlife coordination Act (16 USC 661 et seq), 40 CFR 6.302(h), 50 CFR 402, CWA 404, and 40 CFR 231.10(b), and RSN 37-430 to -438 as being rare, threatened or endangered.
Presence of farmlands as defined under 7 CFR 658.4 and 658.5 and the Farmland Protection Policy Act (7 USC 4201 et seq)
Chemical-Specific ARARs/TBC Guidance
Lead: NDEQ Cleanup Level Protective of Non-residential Conditions
TCE and PCE: Federal MCLs

Table 9-3. Cost Estimate for Alternative 2				
Remedial Action	**Units**	**No.**	**Unit Price**	**Cost**
Capital				
Groundwater Monitoring				
New Monitoring Wells	Well	1	$2,500.00	$2,500.00
Excavation				
Excavation (Backhoe, Loader)	Day	1	$480.00	$480.00
Confirmatory Sampling/Analyses				
On-site Screening:				
XRF Screening (Lead)	Day	1	$1,350.00	$1,350.00
Confirmation Sampling:				
Lead (Total)	Sample	3	$18.00	$54.00
Full TCLP	Sample	1	$1,412.00	$1,412.00
Transportation for Disposal	Truck	1	$2,300.00	$2,300.00
Off-Site Disposal (Landfill)	Tons	15	$350.00	$5,250.00
Backfill with Clean Soil	CY	15	$15.00	$225.00
Grading and Seeding	SY	25	$2.00	$50.00
5-Year Evaluation Report[1]	Site	1	$30,000.00	$30,000.00
Deed Restriction	Each	1	$5,000.00	$5,000.00
		Subtotal		$48,621.00
Annual O&M Cost				
Groundwater Monitoring				
Groundwater Analysis	Sample	10	$300.00	$3,000.00
Sampling Labor, Preparation and Reporting	Hours	160	$30.00	$4,800.00
Present Worth Groundwater Monitoring (15-Year Period @ 5%)				$80,250.00
Other O&M Cost				
5-Year Site Review (30-Year Period)	Each	1	$10,000.00	$10,000.00
Present Worth 5-Year Site Reviews (30-Year Period @ 5%)				$28,000.00
Subtotal O&M Cost				$108,250.00
Subtotal Cost of Alternative				$156,871.00
Contingency (@ 25%)				$39,218.00
Engineering and Design (@ 15%)				$23,530.00
Project Management (@ 8%)				$12,550.00
Total Cost of Alternative				$232,169.00

[1]Need for additional evaluation will be determined after initial 5-year review.

9.7 EXPLANATION OF SIGNIFICANT CHANGES

The Proposed Plan presents the selected remedy as the preferred alternative. No significant changes have been made.

10.0 RESPONSIVENESS SUMMARY

The final component of the ROD is the Responsiveness Summary. The purpose of the Responsiveness Summary is to provide a summary of the public's comments, concerns, and questions about OU3 and the Army's responses to these concerns. The public comment period extended from April 21, 1999 to May 1, 1999.

The following is a summary of events that have progressed on the public meeting activities for OU3 sites:

- CHAAP held a public meeting on April 28, 1999, to formerly present the Proposed Plan and to answer questions and receive comments. No comments were submitted by the public at the meeting or during the public comment period (i.e., April 21, 1999 through May 21, 1999).

10.1 OVERVIEW

This Record of Decision presents the preferred remedial alternatives to meet the RAOs which are to protect human health under non-residential conditions, including industrial and agricultural use. **Table 10-1** presents the AOCs, corresponding chemicals of concern, affected RAO (numerical standard), and the preferred remedial alternative. EPA and NDEQ concur with the selected remedies.

Table 10-1. Summary of Preferred Remedial Alternatives for OU3

Area of Concern	COPC	Affected Media	RAO	Preferred Remedial Alternative
Nitrate Area	Lead	Soil	400 µg/g (NDEQ TBC Guidance)	Title: Excavation, Off-Site Disposal of Lead-Contaminated Soil, and Deed Restriction to Prevent Residential Use Cost: $132,176 Implementation Time: Less than six months
Pistol Range	Lead RDX	Soil	Lead - 400 µg/g (NDEQ TBC Guidance) RDX - 52 µg/g (Risk-Based)	Title: Excavation, Off-Site Disposal of RDX-and Lead-Contaminated Soil, and Deed Restriction to Prevent Residential Use Cost: $227,147 Implementation Time: Less than six months
Sanitary Landfill	RDX	Soil	52 µg/g (Risk-Based)	Title: Excavation, Off-Site Disposal of RDX-Contaminated Soil, and Deed Restriction to Prevent Residential Use Cost: $132,228 Implementation Time: Less than six months
Shop Area	Soil - Lead Groundwater - 1,1,2,-TCA, 1,2-DCA	Soil and Groundwater	Lead - 400 µg/g (NDEQ TBC Guidance) 1,1,2-TCA - 5 µg/L 1,2-DCA - 5 µg/L (Federal MCL)	Title: Soil Excavation, Long-term Monitoring for Natural Attenuation of Groundwater, and Deed Restriction to Prevent Residential Use Cost: $232,169 Implementation Time: Soil - less than six months; Groundwater - 15 years

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