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CORNHUSKER ARMY AMMUNITION PLANT

Record of Decision for Institutional Controls Operable Unit Four

FINAL DOCUMENT

August 1999

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

Larry V. Gulledge 14 Feb 2000
Larry V. Gulledge Date
Deputy to Commander
U.S. Army Industrial Operations Command

FOR: Thomas K. Hogan February 18, 2000
Michael Sanderson Date
Director, Superfund Division
U.S. Environmental Protection Agency, Region VII

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Michael Sanderson
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OU4 ROD Cornhusker AAP

remedy - Institutional control to prevent residential development

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13. ABSTRACT (*Maximum 200 words*)

This Record of Decision summarizes evidence provided in the Feasibility Study for Operable Unit Three (OU3) and Operable Unit Four (OU4) to support the recommendation for deed restriction to prevent residential use for areas of concern designated as OU4 (i.e., Load Lines 1-5 and the Gravel and Clay Pits). The document is intended for public distribution to describe the preferred alternative for OU4.

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LIST OF ACRONYMS AND ABBREVIATIONS

2,4,6-TNT 2,4,6-trinitrotoluene
AOC ....Area of Concern
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
GOCO ....government-owned, contractor-operated
gpd ....gallons per day
HEAST ....Health Effects Assessment Summary Tables
HHRA......................human health risk assessment
HI.............................hazard index
ICF ....ICF Technology, Inc.
IEUBK ....Integrated Exposure Uptake/Biokinetic
IRA ....interim soil removal action
IRIP ....Installation Restoration Incineration Program
IRIS ....Integrated Risk Information System
Mason & Hanger.....Mason & Hanger-Silas Mason Company
NCP.........................National Oil and Hazardous Substances Pollution Contingency Plan
NDEQ......................Nebraska Department of Environmental Quality
NEWWCP ....Non-Explosive Wastewater Cesspool
OU...........................operable unit
PAH.........................polycyclic aromatic hydrocarbon
PEEWC...................Previously Excavated Explosive Wastewater Cesspool
RAO ....Remedial Action Objective
RI.............................Remedial Investigation
RI/FS.......................Remedial Investigation/Feasibility Study
ROD ....Record of Decision
SARA ....Superfund Amendments and Reauthorization Act of 1986
SCD.........................Site Characterization Document
TAL ....Target Analyte List
TBC.........................To-Be-Considered
TOC ....total organic carbon
TRV.........................Toxicity Reference Value
USACE....................U.S. Army Corps of Engineers
USAEC....................U.S. Army Environmental Center
USATHAMA ............U.S. Army Toxic and Hazardous Materials Agency
USEPA....................U.S. Environmental Protection Agency
UST ....underground storage tank

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 AND BASIS OF PURPOSE

This Record of Decision (ROD) document presents the selected remedial action for the Areas of Concern (AOCs) designated as OU4 (i.e., Unsaturated Zone at Load Lines 1-5, and Gravel and Clay Pits) located at the CHAAP in Grand Island, Nebraska. The remedial action is chosen 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 with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The information supporting the decisions on the selected remedy 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

Actual or threatened releases of hazardous substances from the AOCs designated as OU4 (i.e., Unsaturated Zone at Load Lines 1-5, and Gravel and Clay Pits), if not addressed by implementing the response actions selected in this ROD, are not expected to present an imminent and substantial endangerment to public health, welfare, or the environment.

1.4 DESCRIPTION OF THE SELECTED REMEDY: DEED RESTRICTION TO PREVENT RESIDENTIAL USE

The selected remedy for OU4 is institutional controls (i.e., deed restriction to prevent residential use). It should be noted that cleanup criteria were not driven by ecological risk because the areas that comprise OU4 have poor quality habitat due to past and present uses and/or abundance of manmade structures making extensive use by terrestrial receptors unlikely.

1.5 DECLARATION STATEMENT

The current and realistic future land use at OU4 is industrial and agricultural. Extensive sampling during the 1995 Remedial Investigation (RI) indicated that previous soil removal actions (i.e., Installation Restoration Incineration Program [1987-1990] and the Interim Soil Removal Action in 1994) have successfully removed explosives-contamination from the Unsaturated Zone at the Load Lines. Contamination at the Gravel and Clay Pits is below cleanup levels that are protective of human health under non-residential conditions. Therefore, the selected remedy for OU4, deed restrictions to prevent residential use, is sufficient to meet the Remedial Action Objectives (RAOs) for OU4.

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

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

2.0 DECISION SUMMARY, HISTORY, AND ENFORCEMENT ACTIVITIES

2.1 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 micrograve! 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 on standby and has not been reactivated to date.

CHAAP 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. Site-specific operational history at the OU4 AOCs is discussed in Section 2.4.

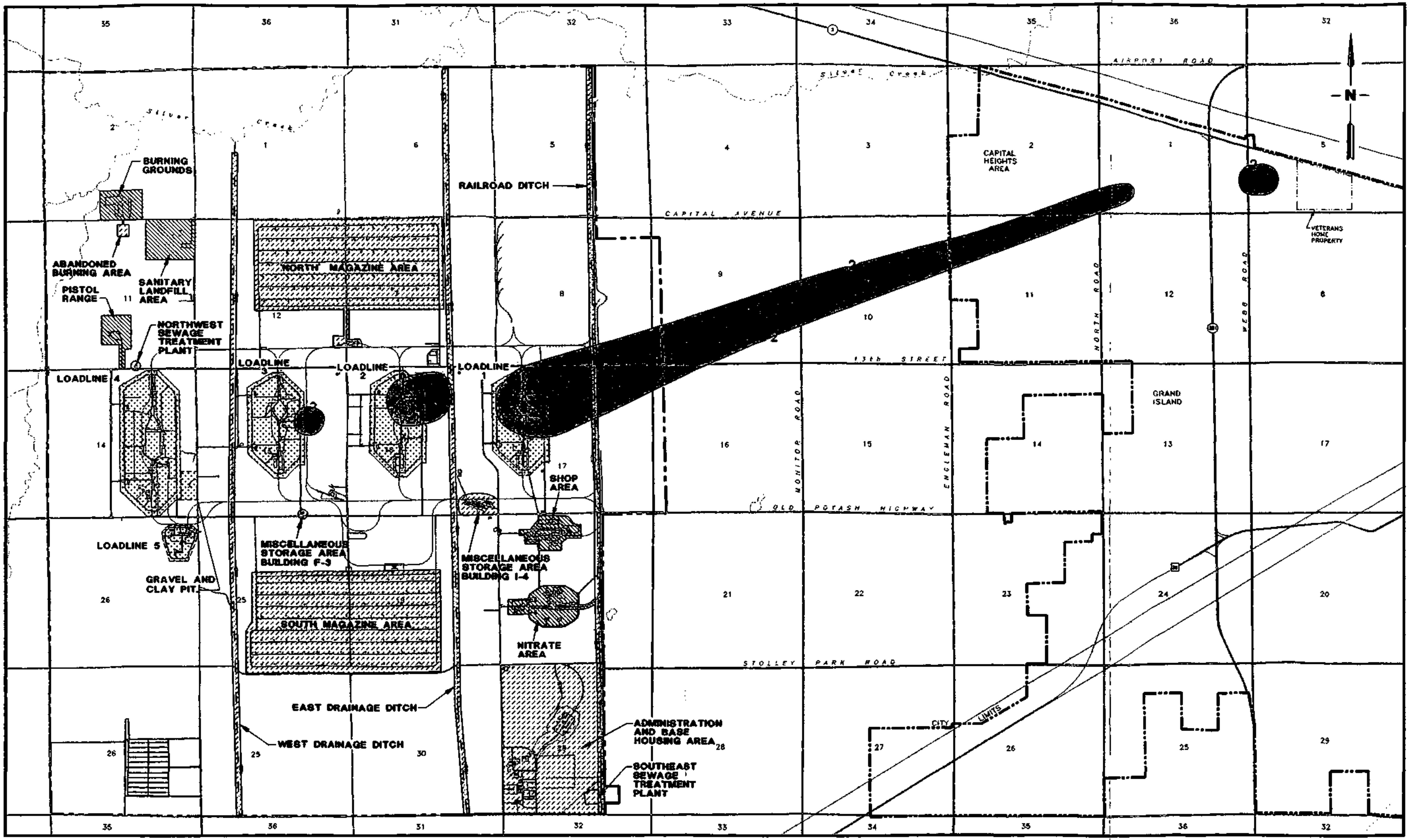
Based on the findings of the 1996 RI, CHAAP was divided into five operable units (OUs) based on current and anticipated land use and the nature and extent of remedial action required for protecting human health under non-residential conditions, as shown in **Exhibit 2-1**.

OU1 consists of the explosives plume beneath the Load Lines and extends past the facility boundary. An interim ROD has been completed for OU1 (USAEC, 1994). A pump and treat system is currently treating explosives-contaminated groundwater. 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.

OU2 consists of the AOCs that were expected to have no or low contamination. These include: The Administration and Base Housing Areas; Abandoned Burning Area; Drainage Ditches; Magazine Areas; Miscellaneous Storage Areas; and Sewage Treatment Plants. A ROD has been completed for OU2 (1998).

OU3 includes the Nitrate Area, Shop Area, Sanitary Landfill, and Pistol Range. These AOCs were addressed through a Feasibility Study. Remedial action is required at these sites. The final remedies for OU3 AOCs are presented in the ROD for OU3.

OU4 consists of the Unsaturated Zone for Load Lines 1-5 and the Gravel and Clay Pits. Because of the fluctuations of the water table, the Unsaturated Zone, for the purposes of this ROD, is defined from 0-6 feet (ft) below ground surface (bgs).



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 OU2
- AREAS OF CONCERN DESIGNATED AS OU3
- AREAS OF CONCERN DESIGNATED AS OU4
- 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 group

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

EXHIBIT 2-1
OPERABLE UNIT DESIGNATIONS AT CHAAP

FILE: RS-NEW-B PLOTTED: 4-28-99

OU5 consists of the Burning Grounds. The Burning Grounds was designated as OU3 in the Feasibility Study. However, due to UXO concerns, this AOC has been removed from OU3 and redesignated as OU5.

This ROD addresses the AOCs designated as OU4 (Unsaturated Zone for Load Lines 1-5 and Gravel and Clay Pits).

2.2 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.

2.3 ENVIRONMENTAL INVESTIGATIONS AND REMEDIAL ACTIONS

Numerous environmental studies had been conducted at CHAAP and in the surrounding area to assess and delineate environmental contamination in soils and groundwater. Provided below are the major environmental investigations and remedial actions that led to the development and selection of the preferred remedial alternative for the AOCs designated as OU4.

2.3.1 Environmental Studies at CHAAP

The following sections summarize environmental investigations and studies conducted at CHAAP since 1980 that focus on environmental contamination at AOCs designated as OU4.

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.

The Installation Assessment concluded that potential exists for groundwater contamination and migration from the Load Line cesspools and leaching pits. The report recommended that a survey to assess the extent of contamination migration via groundwater be initiated by USATHAMA (1980).

Production Records Review, 1980

Following the Installation Assessment, USATHAMA conducted Production Review Records to determine past disposal activities and sites, and to quantify the materials disposed at each location.

This records review involved a site visit to study the layout of the facility. The report described various stages of munitions production from which explosives production wastes resulted, including: 1) the screening area where 2,4,6-TNT flakes were unloaded and sifted for uniform; 2) the melting and mixing facility where the various components were mixed and poured into the munitions; 3) the remelt and refill facility where heated copper rods were inserted into the filled munitions to fill all voids; and 4) the cart washing area where carts used on the load line were cleaned.

In an attempt to quantify the materials disposed at each location, USATHAMA reviewed the CHAAP production information for the operational periods during World War II, and the Korean and Vietnam conflicts. USATHAMA concluded that the largest amounts of waste were discharged to the ground at Load Lines 1 and 2, and that Load Line 3 was the least used production facility. Based on limited data and assumptions from other ammunition plant studies, USATHAMA estimated volumes of dissolved wastes discharged to the ground during each of the periods of operation.

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.

In the Gravel and Clay Pits, debris, trenches, and ground staining were noted along with two liquid filled pits.

Preliminary Contamination Survey, August 1982

Mason & Hanger contracted Envirodyne Engineers Inc. (EEI) to conduct 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. Wells were installed around the Load Lines.

Results from sampling and analysis of the 33 monitoring wells and soil from 15 leaching pits/cesspools indicated that some of the leaching pits and cesspools were highly contaminated with explosives (especially 2,4,6-TNT and RDX) resulting in contamination of the shallow aquifer. The explosive contamination was found to have migrated at least to the installation boundary. The highest levels of explosives were found in wells downgradient (northeast) of Load Line 1. Some soil samples showed increasing contaminant concentrations with depth, while others showed concentrations decreasing with depth. EEI concluded that contaminants migrated offsite, based on contamination seen in one well located at the eastern boundary of the facility. They concluded Load Lines 1, 2, and 3 were the major sources of groundwater contamination at CHAAP.

EEI recommended deeper soil sampling in the leaching pits and cesspools to define the vertical extent of contaminant migration and to determine whether these sites continue to be a source of groundwater contamination.

Groundwater Sampling and Analysis, September 1986 through June 1991

Sampling and analysis of groundwater for explosive contamination continued from September 1986 through June 1991. In addition to the sampling conducted by EEI in March 1986, Mason & Hanger sampled 45 wells for explosive compounds in September 1986. Only one round of groundwater sampling occurred in 1987; in April, 39 wells were sampled for explosive compounds. Explosives analysis were conducted on 42 wells in January, 46 wells in July, and 115 wells in November 1988. HMX, 13 DNB, and NB were added to the list of contaminants analyzed for in November 1988. During the only sampling of 1986, 119 wells were sampled for explosive compounds. ICF Technology, Inc. (ICF) sampled 117 wells, 13 on-post and 104 off-post, for explosive compounds in April 1990. ICF sampled 113 wells, 13 on-post and 100 off-post, for explosives in October 1990. Of the 162 domestic, irrigation and monitoring wells sampled for explosives from May through July 1991, 133 were located off post, 29 were located on post.

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 OU4 were investigated to determine the potential extent of environmental contamination.

The 1991 EA field investigation included:

- Groundwater sampling from new and existing monitoring wells;
- Surface soil sampling at the Load Line buildings, previously unsampled earthen impoundments, and the Gravel and Clay Pits;
- Spot spray tests on building surfaces for explosives contamination;
- Sampling interior paint for lead; and
- An asbestos survey of all buildings and related structures.

The results of the 1991 EA were subsequently used to supplement the 1998 ROD and have been used in the 1996 RI.

Site Characterization Document 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 Remedial Investigation. Due to the significance of data gaps, the risk assessment was removed from the document and the RI was reissued as a Site Characterization Document (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.

Record of Decision on the Interim Remedial Action OU1 1994

Pursuant to the 1994 OU1 and 1993 SCD investigations, an interim remedial action, conducted under CERCLA, was initiated. Using information contained in the 1993 SCD, a Focused Feasibility Study was prepared that evaluated various options for groundwater extraction and treatment and a three dimensional groundwater flow model was developed as an aid to evaluating efforts of the various groundwater extraction options. A preferred option was presented to the public that included extraction wells near the CHAAP Load Lines to minimize the effects of additional sources and off-post extraction wells to prevent further migration of the explosives plume. A ROD for this action was signed on November 11, 1994.

Remedial Investigation 1996

The objective of the RI was to address 1994 SCD data gaps identified by USEPA and NDEQ such that the RI, including a risk assessment, could be performed and a Feasibility Study could be completed.

Previous data collected as a part of the 1991 EA, 1993 SCD, 1994 OU1 sampling effort, and the 1994 U.S. Army Corps of Engineers (USACE) Soil Removal Action and the 1995 Site Investigation were used to determine the nature and extent of contamination and the potential impact to human health, environment, and building surfaces.

OU4 was evaluated as part of a feasibility study conducted in 1996. The feasibility study identified institutional controls involving deed restrictions for non-residential use as the preferred alternative for OU4.

2.3.2 Remedial Actions at CHAAP

Installation Restoration Incineration Program 1987-1990

Fifty eight impoundments (cesspools and leach pits) were identified as containing contaminated soil as a result of munitions manufacturing at CHAAP. The Installation Restoration Incineration Program (IRIP) was an on-site CERCLA removal action, implemented to remove contamination at these sites. Incineration of contaminated soil began on August 23, 1997.

As excavation of contaminated soil progressed, it was determined that original estimates of contaminated soil volume were low, and that additional soils should be incinerated. In addition, some of the ash left after incineration had to be reincinerated to meet ash discharge criteria. The reincineration extended beyond the scheduled completion date of the incineration program. The total amount of contaminated soil and ash incinerated during the IRIP was 44,722 tons. Incineration, decontamination and demobilization were completed by August 8, 1988. Ash from the incineration was placed into trenches northeast of Load Line 2 and south of the North Magazine Area. Ash disposal trenches were approximately 15 ft wide, 6 ft deep, and varying lengths. After the level of the compacted ash within a trench was brought up to grade, a 2-ft cap of topsoil was applied. The site was then fertilized and seeded. Excavations were filled to within 2 ft of existing grade at each site and covered with 2 ft of rich black loam. Sites were then brought to final grade and fertilized and seeded.

Interim Soil Removal Action 1994

A USACE interim soil removal action (IRA) was performed in November-December 1994 at 23 sites at OU4 AOCs at CHAAP. Based on 1993 SCD data, USAEC identified 25 sites, which included 22 sites in the Load Line areas and 1 site each at the Gravel and Clay Pits for an IRA.

USACE performed this removal action in November and December 1994, removing approximately 5,000 tons of explosives contaminated soils based on action levels of 5 μg/g for 2,4,6-TNT and/or RDX in soils. Approximately 1 ft of contaminated soil was removed from each of IRA Sites 1-24. At IRA site 25 (Gravel and Clay Pits), where previous soil samples showed 2,4,6-TNT (4.7 μg/g) at 10.5 ft bgs in GRAVSB002, soil removal was conducted to a depth of 11 ft.

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 2,4,6-TNT and/or RDX in soils. Based on these screening results, 15 of the excavations were identified as requiring additional excavation to meet the previously established (i.e., 1987-1988 incineration project) action levels. Additional soil screening samples were collected from shallow, hand-augered borings to estimate the vertical extent of residual contamination at these sites. Soil samples were collected at 6-inch increments until results below action levels were obtained.

Based on the site screening results, a second phase of soil removal was completed in December 1994 which involved the removal of an additional one foot of soil from portions of IRA sites 3, 4, 5, 6, 7, 8, 10, 11, 14, 15, 17, 18, and 22. IRA sites 3, 4, 5, 6, and 7 were located at Load Line 1; IRA sites 8, 10, and 11 were located at Load Line 2; IRA sites 14 and 15 were located at Load Line 3; and IRA sites 17, 18, and 22 were located at Load Line 4. 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.

The following documents provide details of the site investigations and assessments of cleanup action(s) for the areas listed under OU4:

- USATHAMA, 1980. Installation Assessment of Cornhusker Army Ammunition Plant, Report 155. March 1980.
- USATHAMA, 1986. Installation Restoration Program, Cornhusker Army Ammunition Plant, Site Characterization Document, Report AMXTH-IR-86086. Prepared by U.S. Army Toxic and Hazardous Materials Agency, Aberdeen Proving Ground, Maryland.
- USAEC, 1996. Remedial Investigation for Cornhusker Army Ammunition Plant, Grand Island, Nebraska. Prepared by USAEC.
- USACE, Omaha District, 1998. Feasibility Study for Cornhusker Army Ammunition Plant Operable Unit Three and Operable Unit Four.

2.4 OU 4 OPERATIONAL HISTORY

2.4.1 Load Lines 1-5

The Load Lines were the munition production areas at CHAAP, which were in operation intermittently between 1942 and 1973. Operations produced bombs, shells, boosters, supplementary charges, projectiles, and microgravel mini-mines. The principal explosives used were 2,4,6-TNT, RDX, and, to a lesser extent, HMX. The principal explosive used for munitions production at Load Lines 2, 3, and 4 was 2,4,6-TNT, whereas RDX was the primary explosive used at Load Lines 1 and 5. Lead azide and Freon 113 were also used in the production of microgravel mini-mines at Load Line 5. Other chemical materials used to support munitions production included paints, grease, oil, and solvents.

Major operations conducted at Load Lines 1 through 4 included screening; melting and mixing; rod and pellet manufacturing; remelting; and refilling. Air-borne explosive material generated during production was removed from the buildings by ventilation systems equipped with Schneible wet scrubbers. The water from the Schneible units was run through setting tanks and recycled through the scrubber. Wastewater from this process was disposed via interior building drains connected to concrete pits containing canvas-like filter bags, known as sack sumps, that were designed to filter out solid explosives particles. The filtered wastewater was discharged via open concrete channels into earthen impoundments referred to as explosive wastewater cesspools. These impoundments had brick or masonry-lined side walls but were open at the bottom, allowing wastewater to infiltrate directly into the Alluvial Aquifer. Water that did not infiltrate the bottom of the impoundment was routed through an overflow pipe into a leaching pit.

The limited filtering effectiveness of the sack sumps allowed some solid particles containing explosives to flow into the earthen impoundments. The residue was periodically scrapped from the bottom of the earthen impoundments and leaching pits and ignited at the Burning Grounds, which is located in the northwest section of CHAAP. Wastewater was also generated from periodic washing of machinery, interior-building surfaces, and carts used for transporting the munitions through the LAP process areas. This washwater was also discharged to the sack sumps, explosive wastewater cesspools, and leaching pits (**USATHAMA, 1980**).

The quantity and composition of wastewater generated at CHAAP have been estimated from production records. Limited data were available from the World War II era. The average volume of wastewater generated at CHAAP from all the operations is estimated to have been 7,000 gallons per day (gpd) per load line. Other estimates as high as 9,000 to 28,000 gpd per load line have been documented by Patterson *et al.* (**1986**). Summarizing from the Production Records Review (**USATHAMA, 1980**), the largest amounts of wastewater discharged to the ground originated from Load Lines 1 and 2. Load Line 3 was the least used production facility.

2.4.2 Gravel and Clay Pits

Based on historical aerial photographs and previous investigation results, the Gravel and Clay Pits have been subdivided into eight areas of potential concern. These are, from north to south: the Lumber-Filled Excavation; the Tree Surrounded Impoundment; the Low-Lying Area; the Northeast Depression; the Excavation South of the Low-Lying Area; the Stained Area; the Debris Pile; and the Clay Pit.

Lumber-Filled Excavation: This area is located in the northwest corner of the Gravel and Clay Pit. Used construction material was disposed of in the excavation, including randomly piled, 2-inch by 4-inch lumber, which appeared to have been originally painted yellow. A mound of dirt immediately north of the excavation appeared to have been derived from the excavation.

Tree Surrounded Impoundment: The Tree-Surrounded Impoundment extends south from the Lumber-Filled Excavation to a Load Line 4 drainage ditch. This excavation appears to be an impoundment for surface runoff from the eastern side of Load Line 4, which is channeled via a road culvert from Load Line 4 into the west side of this impoundment. An overflow ditch flows east from the Tree Surrounded Impoundment and transports runoff into the Low-Lying Area. Aerial photographs indicate a denuded area with possible dumping activity in 1969 (**USEPA, 1991**). From 1978 until present, photographs show progressive tree growth over the area around the impoundment.

Low-Lying Area: A large low-lying area occupies a large part of the northern half of the Gravel and Clay Pits. This area appears to receive excess surface water from the Tree Surrounded Impoundment via an overflow ditch. The 1951 aerial photograph indicates an excavation in this area at that time (**EPIC, 1982**). Fill material is present at the surface in the eastern half of the area and consists mostly of what appears to be inert construction debris including asphalt, corrugated pipe, and concrete fence pilings.

Northeast Depression: A small (20 ft x 40 ft) depression, possibly related to excavation, was noted in the northeastern part of the area.

IRA Site 25: IRA Site 25 is located in the west-central part of the Gravel and Clay Pit. Soils from this area (IRA Site 25) were removed as part of the 1994 USACE interim soil removal action

(USACE, 1993a and 1993c). Contaminated soils were excavated to a depth of 11 ft bgs and disposed of off-site in November-December 1994. The excavation was then filled with clean fill.

Excavation South of the Low-Lying Area: Another excavated disposal area was observed south of the Low-Lying Area. This trench was partially filled at the southern end by what appeared to be construction material, including concrete and asphalt debris.

Debris Pile: The Debris Pile is located in the southwest portion of the Gravel and Clay Pits. Aerial photographs from 1978, 1988, and 1991 show a dirt access road from Ninth Avenue terminating at this location and some ground scarring **(USEPA, 1991)**. The Debris Pile currently measures approximately 30 ft x 50 ft in area. In the 1993 SCD investigation, asphalt and concrete rubble were observed, with some of the rubble having oil residue. In the summer of 1995, it consisted of a 10-ft high pile of brush and tree debris. Presently, the debris pile covers the same area and varies in height from 1-6 ft. The pile consists of brush and tree debris with a small quantity of concrete rubble and an occasional roofing shingle.

Clay Pit: The largest excavation in the area is the Clay Pit barrow area, which is located at the southern edge of the Area. This site is now a low area covered with natural vegetation. A shallow, vegetated depression is present which measures approximately 100 ft x 250 ft and may have been the old barrow trench from which clay was excavated. In a 1978 aerial photograph, this area shows ground features consistent with open dumping and/or landfilling activities **(USEPA, 1991)**. It was reported in the 1980 Installation Assessment that the clay pit had been used for the disposal of construction material along with crankcase oil, battery cables, and trash **(USATHAMA, 1980)**.

2.5 HIGHLIGHTS OF COMMUNITY PARTICIPATION

The Proposed Plan for OU3 and OU4 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 CHAAP on April 28, 1999, to inform the public about the preferred remedial alternatives for OU3 and OU4. 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.

3.0 SUMMARY OF SITE RISKS

3.1 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. Chemicals of potential concern (COPCs) were identified for each site evaluated in the RI. However, risks associated with soil exposure to humans under an industrial use scenario 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 Load Line 1 was quantitatively evaluated in the HHRA. Even though not all sites were quantitatively evaluated, COPCs were selected for all AOCs. Provided below is a summary of the COPC 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 (TAL) 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 of the 1996 RI.

- 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 non-carcinogenic 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 COPC. If an inorganic accounted for more than 0.1% of the risk, but was within background levels, 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.

3.2 SOIL COPCs

COPCs for the AOCs designated as OU4 (Unsaturated Zone for Load Lines 1-5 and Gravel and Clay Pit) are presented in **Table 3-1** through **Table 3-6**.

Table 3-1. COPCs at Load Line 1

Surface Soil (0 - 2 ft bgs)	Subsurface Soil (>2 ft bgs)
Explosives	**Explosives**
3,5 Dinitroaniline	1,3-Dinitrobenzene
2-Amino-4,6-Dinitrotoluene	2-Amino-4,6-Dinitrotoluene
4-Amino-2,6-Dinitrotoluene	4-Amino-2,6-Dinitrotoluene
2,4-Dinitrotoluene	2,4-Dinitrotoluene
RDX	2,6-Dinitrotoluene
1,3,5-Trinitrobenzene	RDX
2,4,6-Trinitrotoluene	1,3,5-Trinitrobenzene
	2,4,6-Trinitrotoluene
Inorganics	
Lead	**Organics**
Silver	Benzene
	Chloroform
	1,1-Dichloroethylene
	1,2,3-Trichloropropane

Table 3-1, Continued. COPCs at Load Line 1	
Surface Soil (0 - 2 ft bgs)	**Subsurface Soil (>2 ft bgs)**
	Inorganics Aluminum Barium Chromium Copper Iron Manganese Silver Vanadium

Table 3-2. COPCs at Load Line 2	
Surface Soil (0 - 2 ft bgs)	**Subsurface Soil (>2 ft bgs)**
Explosives 2-Amino-4,6-Dinitrotoluene 4-Amino-2,6-Dinitrotoluene 1,3,5-Trinitrobenzene 2,4,6-Trinitrotoluene **Inorganics** Mercury Silver	**Explosives** 1,3-Dinitrobenzene 2-Amino-4,6-Dinitrotoluene 2,4-Dinitrotoluene 2,6-Dinitrotoluene RDX 1,3,5-Trinitrobenzene 2,4,6-Trinitrotoluene **Inorganics** Aluminum Barium Chromium Copper Iron Manganese Silver Vanadium

Table 3-3. COPCs at Load Line 3	
Surface Soil (0 - 2 ft bgs)	**Subsurface Soil (>2 ft bgs)**
Explosives 2-Amino-4,6-Dinitrotoluene 4-Amino-2,6-Dinitrotoluene 2,4,6-Trinitrotoluene **Inorganics** Lead Mercury Silver	**Explosives** 2-Amino-4,6-Dinitrotoluene 2,6-Dinitrotoluene 1,3,5-Trinitrobenzene 2,4,6-Trinitrotoluene **Organics** Chloroform **Inorganics** Aluminum Barium Chromium Copper Iron Manganese Silver Vanadium

Table 3-4: COPCs at Load Line 4	
Surface Soil (0 - 2 ft bgs)	**Subsurface Soil (>2 ft bgs)**
Explosives 3,5-Dinitroaniline 2-Amino-4,6-Dinitrotoluene 4-Amino-2,6-Dinitrotoluene 2,4-Dinitrotoluene 2,6-Dinitrotoluene RDX 2,4,6-Trinitrotoluene **Inorganics** Mercury Silver	**Explosives** 3,5-Dinitroaniline 2-Amino-4,6-Dinitrotoluene RDX 1,3,5-Trinitrobenzene 2,4,6-Trinitrotoluene **Inorganics** Aluminum Barium Chromium Copper Iron Manganese Vanadium

Table 3-5: COPCs at Load Line 5	
Surface Soil (0 - 2 ft bgs)	**Subsurface Soil (>2 ft bgs)**
Explosives 2,4,6-Trinitrotoluene **Inorganics** Arsenic Cadmium Lead Silver	**Inorganics** Aluminum Barium Chromium Iron Manganese Vanadium

Table 3-6: COPCs at the Gravel and Clay Pits	
Surface Soil	**Subsurface Soil**
Explosives 4-amino-2,6-Dinitrotoluene **PAHs** Benzo[a]anthracene Benzo[a]pyrene Benzo[b]fluoranthene Benzo[k]fluoranthene Chrysene Dibenz[a,h]anthracene Indeno[1,2,3-c,d]pyrene **Inorganics** Mercury Thallium	**PAHs** Benzo[a]anthracene Benzo[a]pyrene Benzo[b]fluoranthene Benzo[k]fluoranthene Chrysene Dibenz[a,h]anthracene Indeno[1,2,3-c,d]pyrene **Other Organics** DDT **Inorganics** Aluminum Barium Chromium Copper Iron Manganese Vanadium

3.3 LOAD LINE HHRA RESULTS

Quantitative risks were not calculated for all AOCs at CHAAP. **Table 3-7** presents the exposure pathways evaluated in the HHRA.

Table 3-7. 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.

The HHRA concluded that for Load Line 1 excess lifetime cancer risks in surface and subsurface soil for current and future land use scenarios were within the NCP $1x10^{-6}$ to $1x10^{-4}$ risk range. Hazard indices (HIs) were less than 1 for non-carcinogens.

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. The results triggered the need for RAOs for lead which is discussed in Section 4.

3.4 ECOLOGICAL RISKS

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.

Results of the ERA indicate that exposures that derive from constituent concentrations in soil exceed the Toxicity Reference Values (TRVs) (i.e., guidelines that represent levels that are protective of terrestrial plants, earthworms, deer mouse, deer and American robin). Therefore, there is potential for adverse effects to individual plants and earthworms. However, risks associated with exposures to chemicals in surface soils at OU4 should be considered an overestimation because the areas that specifically comprise OU4 are generally considered to have poor quality habitat due to past and present uses (i.e., industrial operations) and abundance of manmade structures. As a result of the poor quality habitat, extensive use of these areas by terrestrial receptors is not expected.

4.0 REMEDIAL ACTION OBJECTIVES

4.1 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 most contaminated site in OU4 (i.e., Load Line 1). From a comparative analysis, the Army indicated that risks associated with other, less contaminated sites in OU4 should be lower than those at Load Line 1. However, 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 goals will ensure the protection of both agricultural and industrial workers.

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.

4.1.1 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 1×10^{-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 effects is as follows:

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

where:

C_s	=	chemical concentration in soil (mg/kg),
TR	=	target excess individual lifetime cancer risk (1×10^{-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 ($[mg/kg\text{-}day]^{-1}$).

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

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

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.

Table 4-1 presents the cleanup levels for COPCs at the OU 4 AOCs.

Table 4-1. Cleanup Levels for Soil COPCs (µg/g) at the OU4 AOCs

COPC	Load Line 1	Load Line 2	Load Line 3	Load Line 4	Load Line 5	Gravel and Clay Pits
1,1-Dichloroethylene	10	N/A	N/A	N/A	N/A	N/A
1,2,3,-Trichloropropane	1	N/A	N/A	N/A	N/A	N/A
1,3,5-Trinitrobenzene	102	102	102	102	N/A	N/A
1,3-Dinitrobenzene	204	204	N/A	N/A	N/A	N/A
2,4,6-Trinitrotoluene	191	191	191	191	191	N/A
2,4-Dinitrotoluene	8.42	8.42	N/A	8.42	N/A	N/A
2,6-Dinitrotoluene	8.42	8.42	8.42	8.42	N/A	N/A
2-Amino-4,6-dinitrotoluene	123	123	123	123	N/A	123
2-Amino-2,6-dinitrotoluene	123	123	123	123	N/A	N/A
Aluminum	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000
Arsenic	N/A	N/A	N/A	N/A	6.67	N/A
Barium	143,080	143,080	143,080	143,080	143,080	143,080
Benzene	197	N/A	N/A	N/A	N/A	N/A
Benzo(a)anthracene	N/A	N/A	N/A	N/A	N/A	33
Benzo(a)pyrene	N/A	N/A	N/A	N/A	N/A	33
Benzo(b)fluoranthene	N/A	N/A	N/A	N/A	N/A	33
Benzo(k)fluoranthene	N/A	N/A	N/A	N/A	N/A	33
Cadmium	N/A	N/A	N/A	N/A	2,044	N/A
Chloroform	938	N/A	938	N/A	N/A	N/A
Chromium	10,220	10,220	10,220	10,220	10,220	10,220
Chrysene	N/A	N/A	N/A	N/A	N/A	784
Copper	75,628	75,628	75,628	75,628	N/A	75,628
DDT	N/A	N/A	N/A	N/A	N/A	17
Dibenz(a,h)anthracene	N/A	N/A	N/A	N/A	N/A	33
Inden(1,2,3-c,d)pyrene	N/A	N/A	N/A	N/A	N/A	33
Iron	613,200	613,200	613,200	613,200	613,200	613,200
Isophorone	N/A	N/A	6024	N/A	N/A	N/A
Lead*	400	N/A	400	N/A	400	N/A
Manganese	49,056	49,056	49,056	49,056	49,056	49,056
Mercury	2.86	2.86	2.86	2.86	N/A	613
RDX	52	52	N/A	52	N/A	N/A
Silver	10,220	10,220	10,220	10,220	10,220	N/A
Thallium	N/A	N/A	N/A	N/A	N/A	164
Vanadium	14,308	14,308	14,308	14,308	14,308	14,308

N/A = Chemical was not selected as a COPC at this AOC.
*Cleanup levels for lead and PAHs are numerical values provided by the NDEQ.

4.2 NATURALLY OCCURRING COPCs

One constituent (arsenic) selected as a soil COPC in the HHRA is considered a naturally occurring chemical at CHAAP. Arsenic was selected as a COPC at Load Line 5. 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 4-2**, arsenic detected in surface soils was below the upper limit of regional background levels. Therefore, arsenic was not addressed in the Feasibility Study.

Table 4-2. 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	$1x10^{-6}$ Risk-Based Cleanup Level	$1x10^{-5}$ Risk-Based Cleanup Level	$1x10^{-4}$ Risk-Based Cleanup Level
Arsenic	6.67 µg/g	4.58 µg/g	12 µg/g	3.82 µg/g	38.2 µg/g	382 µg/g

5.0 REMEDIAL INVESTIGATION FINDINGS AT OU4

5.1 LOAD LINE 1

Provided below is a summary of the nature and distribution of COPC contamination at Load Line 1. **Exhibit 5-1** presents sampling locations at Load Line 1. Locations where COPCs were detected above the calculated non-residential (i.e., industrial and agricultural) risk-based cleanup levels are presented on **Exhibit 5-2**.

Non-Explosive Wastewater Cesspools (NEWWCPs): To assess the NEWWCPs as potential sources of contamination, soil samples were collected from sump bottoms as part of the 1993 SCD. Based on these results, soil borings were completed on the downgradient edges of cesspools L1P06, L1P25, and L1P29 as part of the 1995 RI. Because all of the 1993 data were collected from below 6 ft bgs, only 1995 data are evaluated. Review of the 1995 data revealed that no COPCs exceeded the non-residential risk-based cleanup levels.

Areas Adjacent to Explosives Production, Handling or Storage: As previously summarized in the RI report, soil contamination by explosives and metals was detected in areas adjacent to Load Line 1 production buildings. To address the areas adjacent to production buildings, five areas of soil (IRA Sites 3, 4, 5, 6, and 7) were removed during the 1994 IRA. At IRA Site 4, 2,4,6-TNT (1,400 µg/g) exceeded the calculated risk-based industrial cleanup level (191 µg/g) in one sample. However, this sample was collected from a suspect reddish soil horizon directly beneath a sidewalk concrete slab.

Previously Excavated Explosive Wastewater Cesspools (PEEWCs): Soil borings were completed at the three PEEWCs which showed the highest explosives concentrations in 1994 mini well groundwater samples to assess the potential presence and vertical extent of explosives-contaminated soils remaining at the sites. The concentrations of other explosives in unsaturated soil samples were below USEPA Region III Residential RBCs and calculated risk-based industrial cleanup levels. Thus, the 1987 – 1988 excavation and incineration remedial action was effective in removing highly contaminated soils present in the center of the former sumps.

Load Line 1 Building Interior (Subsurface): Two soil borings were drilled through the foundation at Building 1L-10 to a total depth of 12 ft bgs, and three subsurface soil samples were collected from each soil boring. Samples were analyzed for explosives and TAL inorganics. In addition, samples from one soil boring were also analyzed for total organic carbon (TOC). No COPCs exceeded the non-residential risk-based cleanup levels.

5.2 LOAD LINE 2

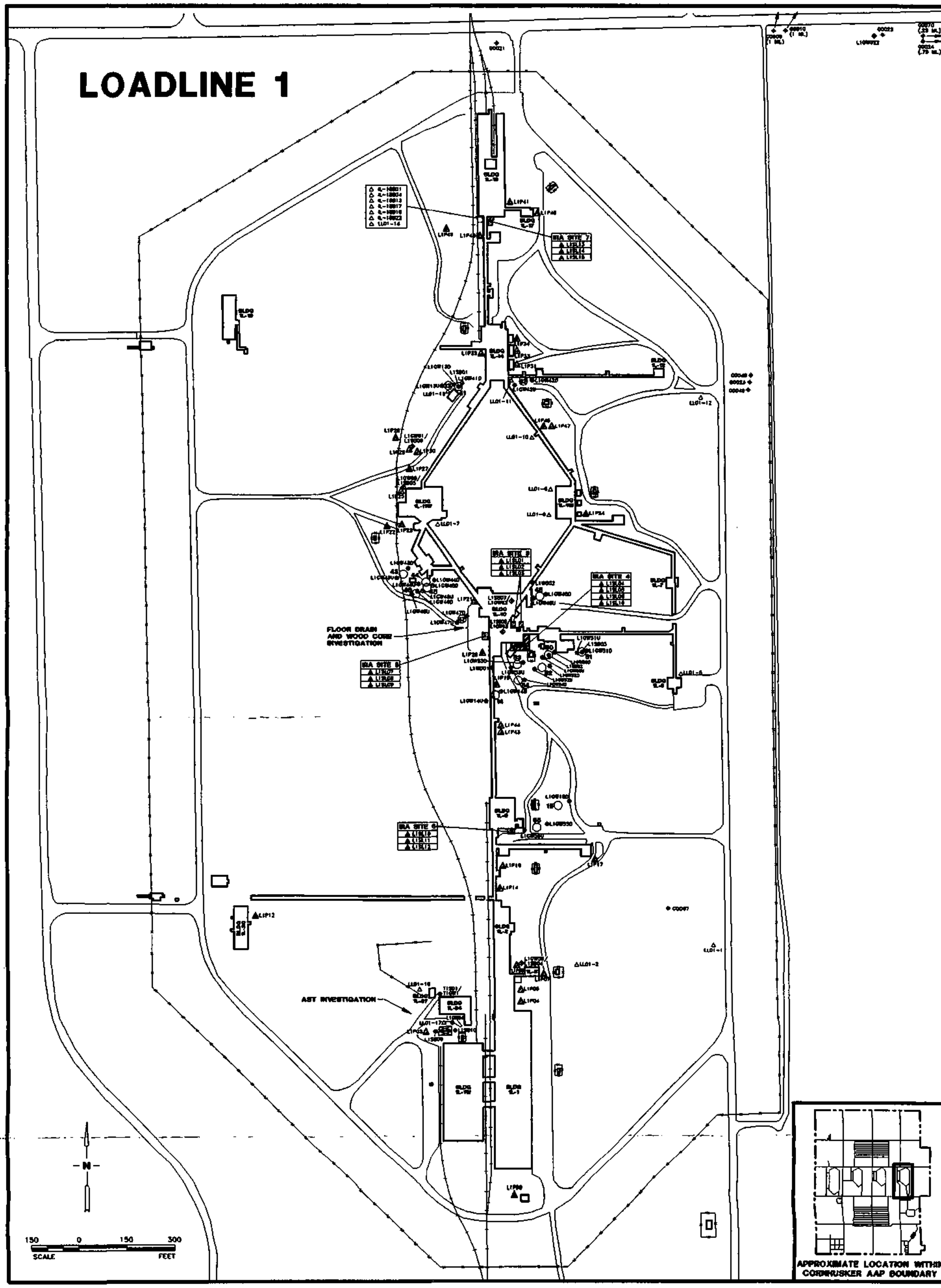
A summary of the nature and distribution of COPC contamination at Load Line 2 is presented below. **Exhibit 5-3** presents sampling locations at Load Line 2.

PEEWCs: Soil borings were completed at PEEWCs Nos. 31, 32, 36, and 37 to assess the potential presence and vertical extent of explosives-contaminated soils remaining at the sites. No COPCs were detected above the non-residential risk-based cleanup levels.

NEWWCPs: As part of the 1993 SCD, 14 soil samples were collected from the bottom of the NEWWCPs. Low levels of 2,4,6-TNT, various inorganics, and VOCs were detected. Based on the results of the 1993 SCD, two soil borings were drilled and samples were collected from depth intervals of 0-2 ft bgs, 5-7 ft bgs, and 10-12 ft bgs. All contaminants were below the non-residential risk-based cleanup levels.

Areas Adjacent to Explosives Production, Handling, or Storage: As previously summarized in the 1993 SCD, soil contamination by explosives and select metals was detected in areas adjacent to Load Line 2 production buildings. To address the areas adjacent to production buildings, six areas of soil (IRA Sites 8, 9 10, 11, 12, and 13) were delineated and removed during the 1994 IRA. No COPCs were detected above the non-residential risk-based cleanup levels.

Load Line 2 Building Interior (Subsurface): Two soil borings were drilled through the foundation at Building 2L-10 to a total depth of 12 ft bgs, and three subsurface soil samples were collected



LEGEND:

- BUILDING AND CORRIDOR
- RAILROAD TRACKS
- ROAD
- FENCE
- AST
- NON-EXPLOSIVE WASTEWATER CESSPOOL
- 1994 USACE SOIL REMOVAL SITE
- PREVIOUSLY EXCAVATED EXPLOSIVE WASTEWATER CESSPOOL/LEACHPIT

SAMPLE LEGEND:

SAMPLING EVENTS

- 4" MONITORING WELL
- 4" MONITORING WELL WITH SUBSURFACE SOIL SAMPLING
- MINIWELL
- MINIWELL WITH SUBSURFACE SOIL SAMPLING
- SURFACE SOIL
- SOIL BORING
- SURFACE WATER/SEDIMENT
- BUILDING SAMPLE

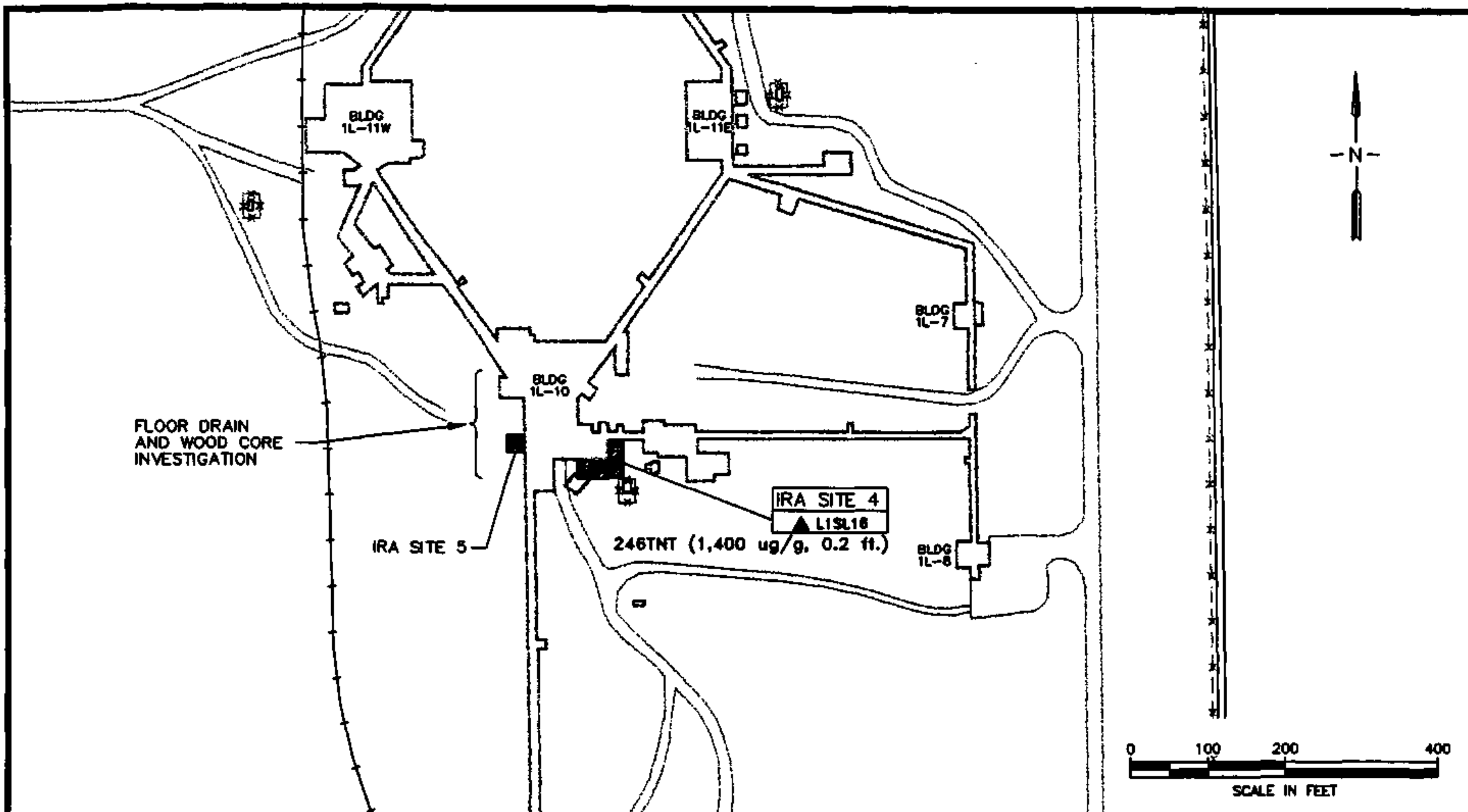
U.S. Army Corps of Engineers
Omaho District

the group

CORNHUSKER AAP
ACAD FILE: RI-L1SMP-B
27 APR 1999

EXHIBIT 5-1

SAMPLE LOCATIONS LOAD LINE 1



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SAMPLE LEGEND:

- ▲ SURFACE SOIL
- ● SOIL BORING

LEGEND:

- BUILDING AND CORRIDOR
- RAILROAD TRACKS
- ROAD
- FENCE
- 1994 USACE SOIL REMOVAL SITE

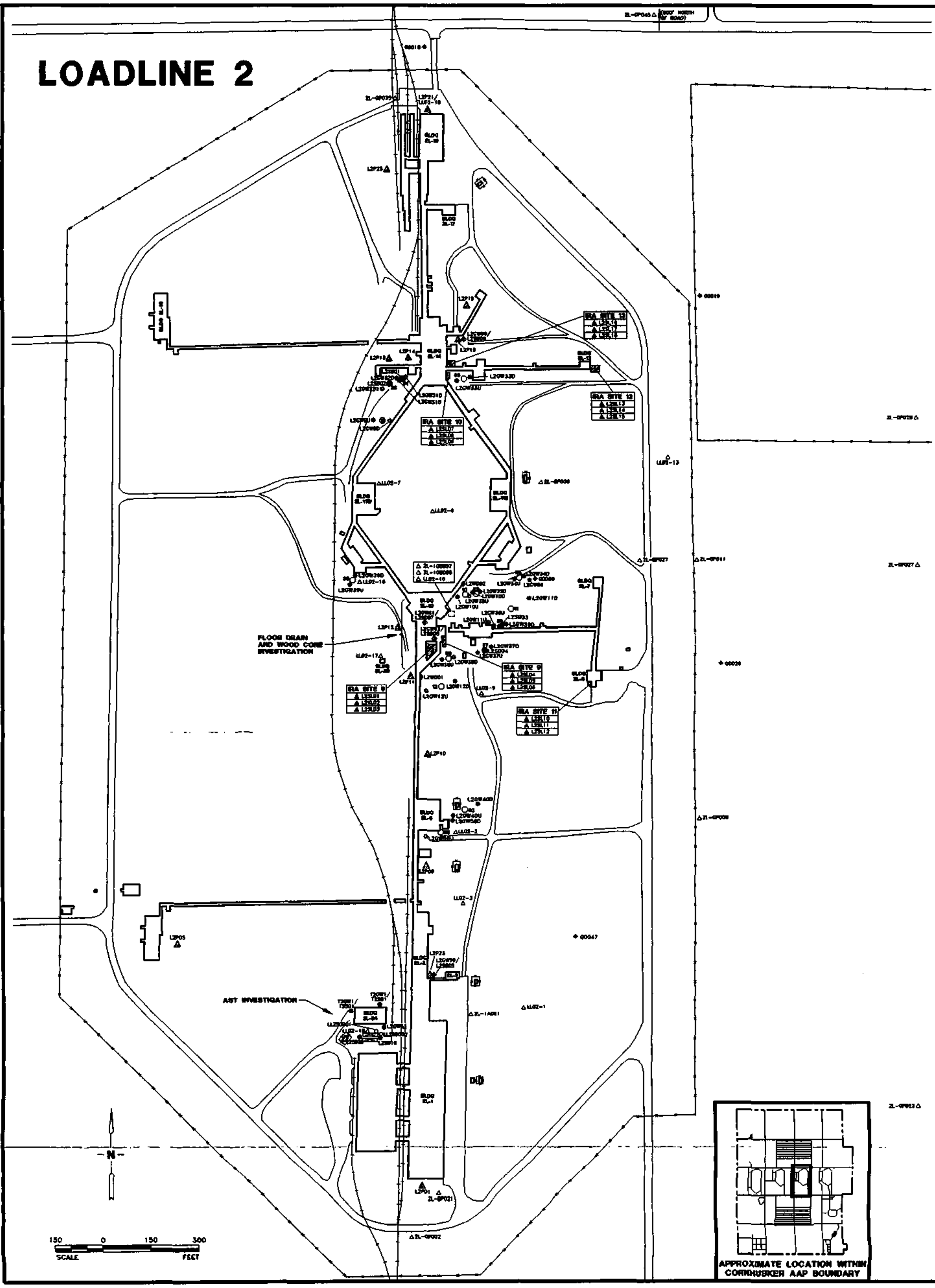
NOTE:
SOIL DETECTIONS EXPRESSED IN ug/g (RED)

U.S. Army Corps of Engineers
Omaha District

the i group

CORNHUSKER AAP
ACAD FILE: FS8
20 APR 1999

EXHIBIT 5-2
LOADLINE 1
LOCATION OF COPC DETECTED ABOVE CLEANUP LEVEL



LEGEND:

- BUILDING AND CORRIDOR
- RAILROAD TRACKS
- ROAD
- FENCE
- AST
- NON-EXPLOSIVE WASTEWATER CESSPOOL
- 1994 USACE SOIL REMOVAL SITE
- PREVIOUSLY EXCAVATED EXPLOSIVE WASTEWATER CESSPOOL/LEACHPIT

SAMPLE LEGEND:

SAMPLING EVENTS

- 4" MONITORING WELL
- 4" MONITORING WELL WITH SUBSURFACE SOIL SAMPLING
- MINIWELL
- MINIWELL WITH SUBSURFACE SOIL SAMPLING
- SURFACE SOIL
- SOIL BORING
- SURFACE WATER/SEDIMENT
- BUILDING SAMPLE (WOOD)

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ACAD FILE: RI-L2SMP-B
27 APR 1999

EXHIBIT 5-3

SAMPLE LOCATIONS
LOAD LINE 2

from each soil boring. Samples were analyzed for explosives and TAL inorganics. In addition, samples from one soil boring were also analyzed for TOC. No COPCs exceeded the risk-based cleanup levels.

5.3 LOAD LINE 3

Provided below is a summary of the nature and distribution of COPC contamination at Load Line 3. **Exhibit 5-4** presents sampling locations at Load Line 3.

PEEWCs: Soil borings were completed at two PEEWCs to assess the potential presence and vertical extent of explosives-contaminated soils remaining at the sites. Explosives were not detected in samples from either soil boring. Thus, the 1987 – 1988 excavation and incineration remedial action was effective in removing highly contaminated soils present in the center of the former sumps.

Areas Adjacent to Explosives Production, Handling, or Storage: As previously summarized in the 1993 SCD, soil contamination by explosives and select metals was evident in areas adjacent to Load Line 3 production buildings. To address the areas adjacent to production buildings, three areas of soil (IRA Sites 14, 15, and 16) were delineated and removed during the 1994 IRA. No COPCs were detected above the risk-based cleanup levels.

Load Line 3 Building Interior (Subsurface): Two soil borings were drilled through the foundation at Building 3L-10 to a total depth of 12 ft bgs, and three subsurface soil samples were collected from each soil boring. Samples were analyzed for explosives and TAL inorganics. In addition, samples from one soil boring were also analyzed for TOC. No COPCs exceeded the risk-based cleanup levels.

5.4 LOAD LINE 4

Provided below is a summary of the nature and distribution of COPC contamination at Load Line 4. **Exhibit 5-5** presents sampling locations at Load Line 4.

PEEWCs: Soil borings were completed at the four PEEWCs that showed the highest explosives concentrations in 1994 mini-well groundwater samples to assess the potential presence and vertical extent of explosives contaminated soils remaining at the former impoundments. Explosives were not detected above calculated risk-based cleanup levels. Thus, the 1987-1998 excavation and incineration remedial action was effective in removing highly contaminated soils in the center of the former sumps.

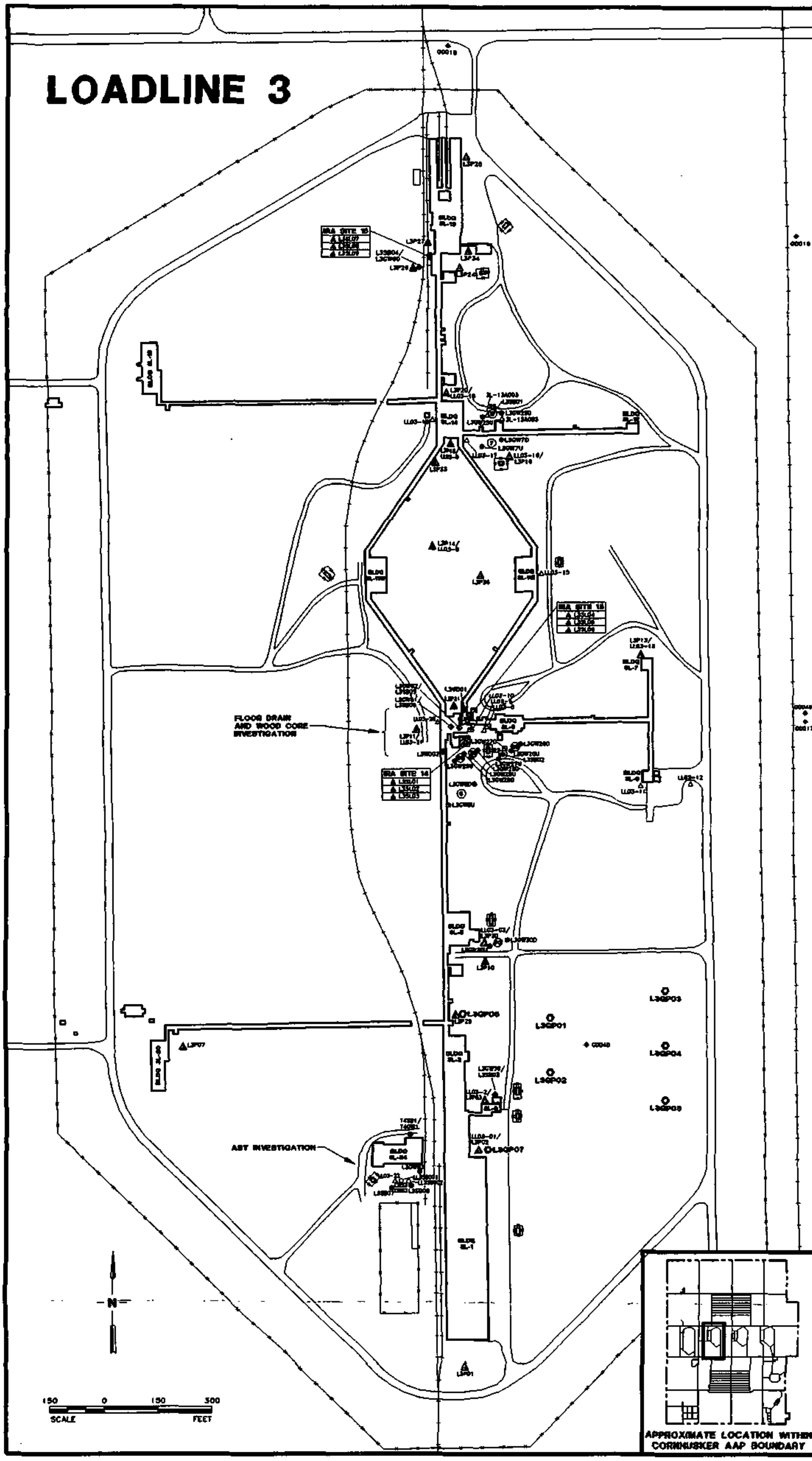
Areas Adjacent to Explosives Production, Handling or Storage: As previously summarized in the 1993 SCD, soil contamination by explosives and select metals was evident in areas adjacent to the Load Line 4 production buildings. To address the areas adjacent to production buildings, five areas of soil (IRA Sites 17 to 22) were delineated and removed during the 1994 IRA. No COPCs were detected above the risk-based cleanup levels.

Load Line 4 Building Interior (Subsurface): Two soil borings were drilled through the foundation at Building 4L-10 to a total depth of 12 ft bgs, and three subsurface soil samples were collected from each soil boring. Samples were analyzed for explosives and TAL inorganics. In addition, samples from one soil boring were also analyzed for TOC. No COPCs exceeded the risk-based cleanup levels.

5.5 LOAD LINE 5

Provided below is a summary of the nature and distribution of COPC contamination at Load Line 5. **Exhibit 5-6** presents sampling locations at Load Line 5.

PEEWCs: In 1995, a soil boring was completed at PEEWC No. 6 to assess the potential presence and vertical extent of explosives contaminated soils remaining at the sites. Explosives were not detected in soil boring samples. Thus, the 1987-1988 incineration remedial action was effective in removing highly contaminated soils present in the center of the former sump PEEWC No. 6.



LEGEND:

- BUILDING AND CORRIDOR
- RAILROAD TRACKS
- ROAD
- FENCE
- AST
- NON-EXPLOSIVE WASTEWATER CESSPOOL
- 1994 USACE SOIL REMOVAL SITE
- PREVIOUSLY EXCAVATED EXPLOSIVE WASTEWATER CESSPOOL/LEACHPIT

SAMPLE LEGEND:

SAMPLING EVENTS

- 4" MONITORING WELL
- 4" MONITORING WELL WITH SUBSURFACE SOIL SAMPLING
- MINIWELL
- MINIWELL WITH SUBSURFACE SOIL SAMPLING
- SURFACE SOIL
- SOIL BORING
- SURFACE WATER/SEDIMENT
- BUILDING SAMPLE

1998 ADDENDUM SAMPLING EVENT:

- SHALLOW (15-18' BGS INTERVAL) GEOPROBE GROUNDWATER SCREENING POINT

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Omaha District

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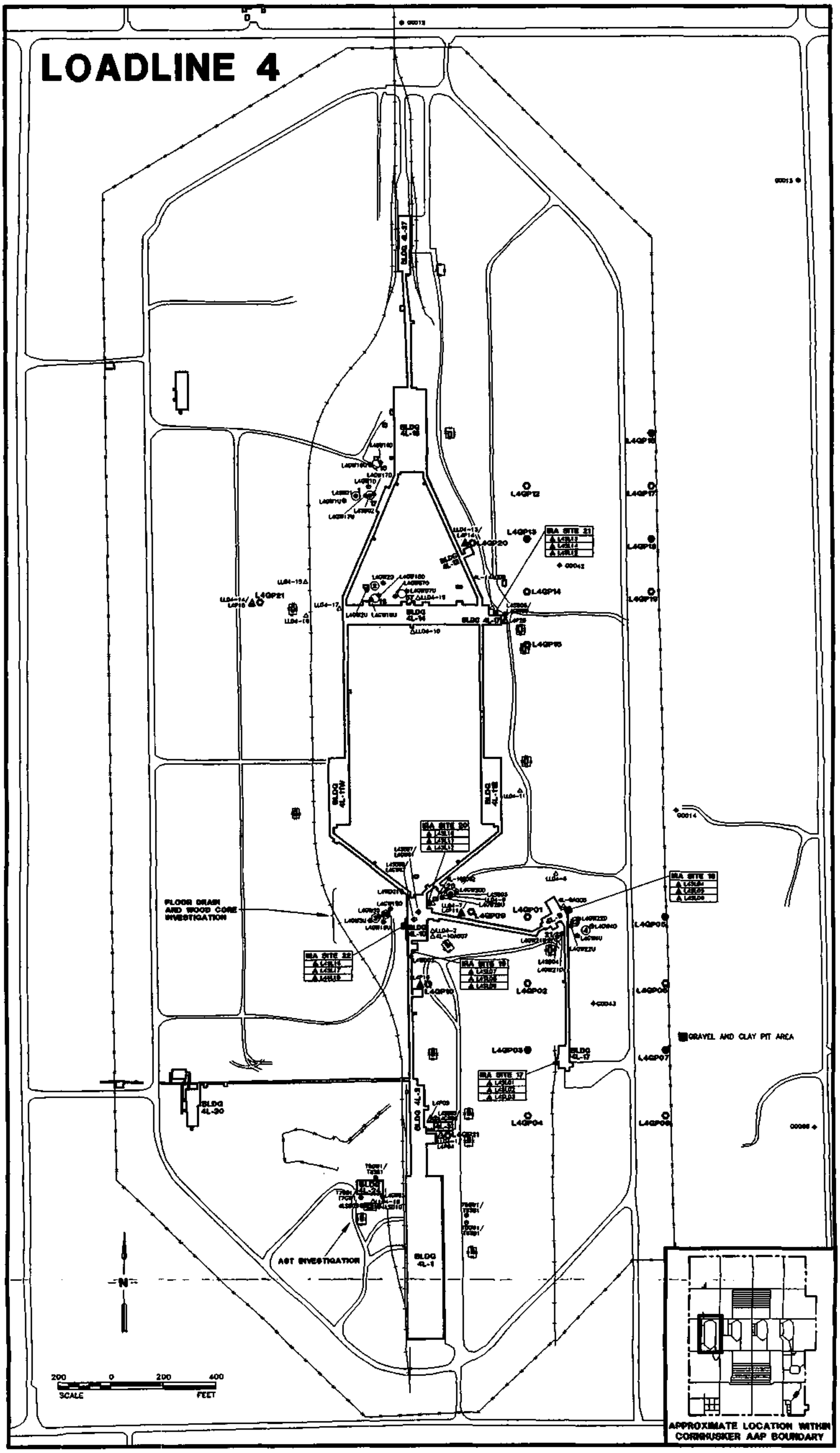
ACAD FILE: RI-L3SMP-B
27 APR 1999

EXHIBIT 5-4

SAMPLE LOCATIONS LOAD LINE 3



LEGEND:

- BUILDING AND CORRIDOR
- RAILROAD TRACKS
- ROAD
- FENCE
- AST
- NON-EXPLOSIVE WASTEWATER CESSPOOL
- 1994 USACE SOIL REMOVAL SITE
- PREVIOUSLY EXCAVATED EXPLOSIVE WASTEWATER CESSPOOL/LEACHPIT

SAMPLE LEGEND:

SAMPLING EVENTS

PRE-1998	1998	
◆	●	4" MONITORING WELL
■	●	4" MONITORING WELL WITH SUBSURFACE SOIL SAMPLING
●	■	MINIWELL
●	◆	MINIWELL WITH SUBSURFACE SOIL SAMPLING
△	▲	SURFACE SOIL
○	●	SOIL BORING
☆	★	SURFACE WATER/SEDIMENT
◇	◆	BUILDING SAMPLE

1999 ADDENDUM SAMPLING EVENT:

- SHALLOW (15–17' BGS INTERVAL) GEOPROBE GROUNDWATER SCREENING POINT
- DEEP (50–52' BGS INTERVAL) GEOPROBE GROUNDWATER SCREENING POINT

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Omaha District

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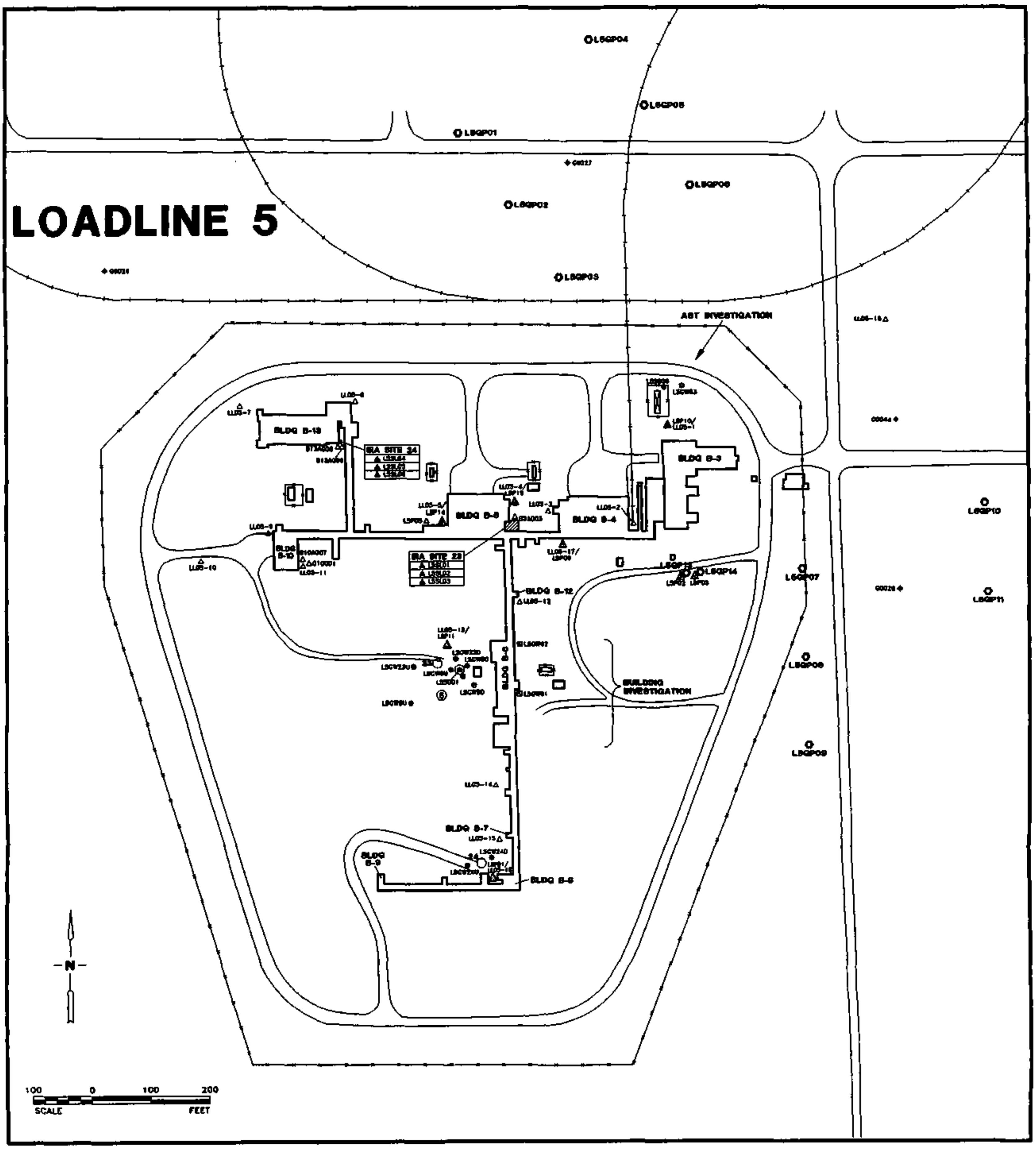
ACAD FILE: RI-L4SND-B
20 APR 1999

EXHIBIT 5-5

SAMPLE LOCATIONS
LOAD LINE 4



LEGEND:

- BUILDING AND CORRIDOR
- RAILROAD TRACKS
- ROAD
- FENCE
- AST
- NON-EXPLOSIVE WASTEWATER CESSPOOL
- 1994 USACE SOIL REMOVAL SITE
- PREVIOUSLY EXCAVATED EXPLOSIVE WASTEWATER CESSPOOL/LEACHPIT

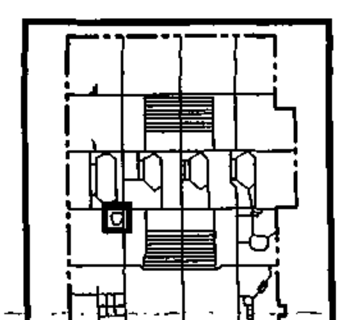
SAMPLE LEGEND:

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
- SURFACE WATER/SEDIMENT
- BUILDING SAMPLE

1996 ADDENDUM SAMPLING EVENT:

- SHALLOW (WATER TABLE INTERVAL) GEOPROBE GROUNDWATER SCREENING POINT



APPROXIMATE LOCATION WITHIN CORNHUSKER AAP BOUNDARY

U.S. Army Corps of Engineers Omaha District	
the group	EXHIBIT 5-6
CORNHUSKER AAP ACAD FILE: RI-L5SMP-8 01 SEP 1996	SAMPLE LOCATIONS LOAD LINE 5

Areas Adjacent to Explosives Production, Handling, or Storage: During 1990 and 1992, several soil samples were collected from areas adjacent to Load Line 5 buildings. Areas that contained high levels of explosives were removed during the 1994 IRA. No COPCs were detected above the risk-based cleanup levels in confirmation samples collected from the IRA sites.

Non-Explosive Wastewater Cesspools: As part of the 1993 SCD, seven soil samples were collected from the bottoms of NEWWCP Numbers L5P01, L5P02, L5P03, L5P05, L5P10, L5P11, and L5P14 and screened for cadmium, chromium, lead, and 2,4,6-TNT. Cadmium, chromium, lead, and 2,4,6-TNT were not detected in any of the screening samples. Seven confirmation samples were collected from bottoms of NEWWCPs and analyzed for TAL inorganics. No COPCs were detected above the risk-based cleanup levels.

5.6 GRAVEL AND CLAY PITS

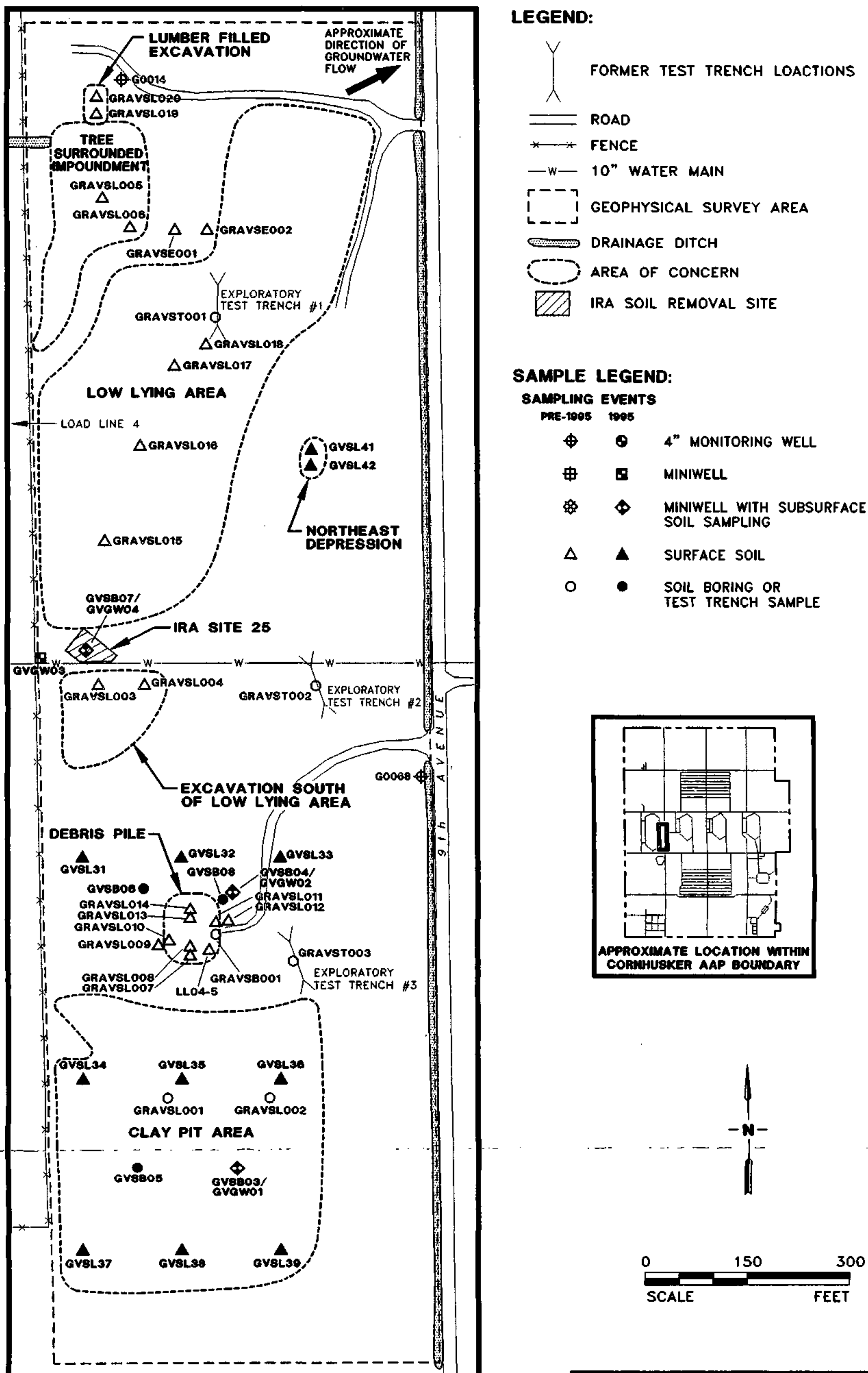
As shown in **Exhibit 5-7**, extensive soil sampling was conducted at the Gravel and Clay Pits. Groundwater was not impacted by activities at the Gravel and Clay Pits. Eight areas within the site were considered AOCs including: Clay Pit Area; Excavation South of the Low-Lying Area; Low-Lying Area; Northeast Depression; IRA Site 25; Tree Surrounded Impoundment; Lumber-Filled Excavation; and Debris Pile. PAHs were detected. However, they were below the NDEQ guidance cleanup level of 33 µg/g. All other COPCs were detected below the residential risk-based cleanup levels.

5.7 CONCLUSIONS

Analytical data indicates that no contaminants exceed the non-residential risk-based cleanup levels in surface soil in the Unsaturated Zone at Load Line 1. The majority of explosives were discharged directly to the Saturated Zone through explosive wastewater cesspools. Areas that contained soil contamination in the Unsaturated Zone were excavated during the 1994 IRA. With the exception of one detection of 2,4,6-TNT at IRA Site 4, COPCs detected at Load Line 1 were all below the calculated risk-based cleanup levels based on non-residential use (i.e., industrial and agricultural), and in most cases below USEPA Region III Residential RBCs. Therefore, the selected remedy, deed restrictions to prevent residential use, is considered sufficient to meet the RAOs for OU4.

Analytical data indicates that no contaminants exceed the non-residential risk-based cleanup levels in surface soil at Load Lines 2-5. The majority of explosives COPCs were discharged directly to the Saturated Zone through explosive wastewater cesspools. Because COPC concentrations are all below the calculated risk-based cleanup levels based on non-residential use (i.e., industrial and agricultural), and in most cases below USEPA Region III Residential RBCs, remedial action for the Unsaturated Soil Zone (0-6 ft bgs) is not required.

Analytical data indicates that no contaminants exceed the non-residential risk-based cleanup levels in surface soil at the Gravel and Clay Pits area. Because PAHs are below the NDEQ cleanup levels and all other COPC concentrations are all below the calculated risk-based cleanup levels based on non-residential use (i.e., industrial and agricultural), the selected remedy, deed restrictions to prevent residential use, is considered sufficient to meet the RAOs for OU4.



U.S. Army Corps of Engineers
Omaha District

the group

CORNHUSKER AAP
ACAD FILE: RI-GRAVP
27 APR 1999

EXHIBIT 5-7

SAMPLE LOCATIONS GRAVEL & CLAY PIT

6.0 DESCRIPTION OF SELECTED REMEDY

The preferred alternative to protect human health, welfare, and the environment at the OU4 AOCs (i.e., deed restriction to prevent residential use) is a form of institutional controls. This decision is based upon findings of the RI which indicate that explosives contamination in the Unsaturated Zone at OU4 is below concentrations posing unacceptable risk to human health under non-residential conditions.

7.0 EXPLANATION OF SIGNIFICANT CHANGES

The Proposed Plan presents the selected remedy (i.e., deed restriction to prevent residential use) as a preferred alternative. No significant changes have been made.

8.0 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 comments, concerns, and questions about the AOCs at OU4 and the Army's responses to these concerns. The public comment period extended from April 21, 1999 to May 21, 1999.

CHAAP has 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.

9.0 OVERVIEW

This ROD presents the preferred remedial alternative to meet the RAOs which are to protect human health under non-residential conditions, including industrial and agricultural use. The preferred remedial alternative, deed restriction to prevent residential use, is expected to be sufficient to meet the RAOs.

The absence of explosives in the Unsaturated Zone of the loadlines is primarily due to the removal action events (i.e., 1987-1988 incineration and 1994 interim removal action) by the USACE. Approximately 20,300 cubic yards of explosives-contaminated soils were excavated from 56 impoundments and incinerated during 1987-1988 remedial activities (IT, 1989). Samples collected after the 1987-1988 remedial action were from other impoundments. USACE performed soil removal actions on an additional 22 area sites in 1994. Results from the 1996 RI indicate that up to a depth of 6 ft bgs soil at OU4 has a negligible amount of contamination. Only one sample, out of the 272 collected, contained any contaminants above their cleanup levels. This sample, collected beneath a concrete sidewalk, contained 2,4,6-trinitrotoluene (2,4,6-TNT) above its respective cleanup level.

10.0 REFERENCES

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