FINAL

Focused Feasibility Study
for the
Remediation of Soils at Load Lines 1 through 4
at the
Ravenna Army Ammunition Plant
Ravenna, Ohio

Contract Number DACA45-03-D-0026
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Prepared for:

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FINAL
Ravenna Army Ammunition Plant
Load Lines 1 through 4
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List of Acronyms

AOC	Area of Concern
ARARs	Applicable or Relevant and Appropriate Requirements
BHHRA	Baseline human health risk assessment
BMPs	Best Management Practices
BRACO	Base Realignment and Closure Office
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CNS	Central Nervous System
COCs	Chemicals of Concern
COEC	Chemicals of Ecological Concern
COPECs	Chemicals of potential ecological concern
COPCs	Chemicals of potential concern
CWA	Clean Water Act
DERR	Division of Emergency and Remedial Response
DLA	Defense Logistics Agency
DNT	dinitrotoluene
ESV	Ecological Screening Value
EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
EU	Exposure Unit
FFS	Focused Feasibility Study
FR	Federal Register
GDCS	Generic Direct Contact Soil Standards
GOCO	Government Owned Contractor Operated
HAP	Hazardous Air Pollutants
HHRA	Human Health Risk Assessment
HMX	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HTRW	Hazardous Toxic and Radioactive Waste
HQ	Hazard Quotient
HVAC	Heating Ventilation and Air Conditioning
ICP	Inductively Coupled Plasma
IRIP	Interim Remedy in Place
IRP	Installation Restoration Program
JMC	Joint Munitions Command
Kd	Soil Water Partitioning Coefficient
LDR	Land Disposal Restriction
LL #	Load Line 1, 2, 3, or 4
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MEC	Munitions and Explosives of Concern
MKM	MKM Engineers, Inc.
MOA	Memorandum of Agreement
NCP	National Contingency Plan
NGB	National Guard Bureau
NPL	National Priorities List
OHARNG	Ohio Army National Guard
Ohio EPA	Ohio Environmental Protection Agency

List of Acronyms (continued)

O&M	Operation and maintenance
OSHA	Occupational Safety and Health Administration
PBC	Performance Based Contract
PCBs	Polychlorinated biphenyls
POTW	Publicly Owned Treatment Works
PPE	Personal protective equipment
PRG	Preliminary Remediation Goal
RAB	Restoration Advisory Board
RAOs	Remedial Action Objectives
RBC	Risk Based Concentration
RCRA	Resource Conservation and Recovery Act
RDX	Cyclotrimethylenetrinitramine or hexahydro-1,3,5-trinitro-1,3,5-triazine
RGO	Remedial Goal Option
RI	Remedial Investigation
ROD	Record of Decision
RVAAP	Ravenna Army Ammunition Plant
SAIC	Science Applications International Corporation
SAP	Sampling and Analysis Plan
SBHHRA	Supplemental Baseline Human Health Risk Assessment
SDS	Soil and Dry Sediments
SHHRA	Screening human health risk assessment
SRC	Site-related contaminant
SVOCs	Semivolatile organic compounds
SWP3	Storm Water Pollution Plan
TC	Toxicity Characteristic
TCLP	Toxicity Characteristic Leaching Procedure
TNT	Trinitrotoluene
TSCA	Toxic Substances Control Act
TU	Temporary Unit
UHC	Underlying Hazardous Constituent
USACE	United States Army Corps of Engineers
U.S.C.	United States Code
US EPA	United States Environmental Protection Agency
UTS	Universal Treatment Standard
VOCs	Volatile organic compounds
WBG	Winklepeck Burning Grounds
WWTU	Waste Water Treatment Unit
XRF	X-ray fluorescence

EXECUTIVE SUMMARY

Introduction

Two phases of remedial investigation (RI) have been completed for Load Lines 1 through 4 (LLs 1-4) resulting in an adequate characterization of the extent and magnitude of contamination, human health risks, and ecological risks. These investigations conclude with the recommendation to move forward with a focused feasibility study (FFS). This document presents FFS specific to the stated land use agreed to by the Army. Detailed discussion of the Ravenna Army Ammunition Plant (RVAAP) and LLs 1-4 operation histories, and results of the RI phases of activity, may be found in the Phase I and II RI Reports (SAIC, 2004; Shaw, 2004a, b, c).

This FFS addresses the environmental issues pertaining to surface and subsurface soil and dry sediment at Load Lines 1 through 4 (LLs 1-4) at the Ravenna Army Ammunition Plant (RVAAP) in Ravenna, Ohio only as stated in the Scope of Work listed in the contract between the Louisville Army Corps of Engineers (USACE) and Shaw Environmental (Shaw) dated September 25, 2003. Remediation of surface and subsurface soil and dry sediments is intended to lead to an Interim Remedy In Place (IRIP). Work performed under this contract is based on attaining an interim regulatory closure for soils and dry sediments in LLs 1-4 for a future land use of mounted training, no digging. The closure is considered "interim" because further investigation and remedial activities are expected to be completed by the Army under a separate contract to address soil and sediment conditions under existing floor slabs and within sewer lines in LLs 1-4. Work pertaining to the sewers and slabs has been specifically excluded from this Performance Based Contract (PBC). This FFS includes an evaluation of human health risks associated with a National Guard Trainee receptor and development of remedial goal options (RGOs) for identified chemicals of concern (COCs). It has been determined that ecological RGOs are not necessary, reasons for which are presented in this report. Alternatives for remediation of hazardous and toxic waste contamination above RGOs are presented and evaluated, along with applicable and relevant or appropriate requirements (ARARs) that would govern the action.

Human Health Risk Assessment and RGO Development

The following steps were used to generate conclusions regarding human health risks and hazards associated with contaminated surface and subsurface soils and dry sediments at LLs 1-4:

- identification of chemicals of potential concern (COPCs),
- calculation of risks and hazards,
- identification of COCs,
- calculation of RGOs; and
- evaluation of RGOs in comparison to applicable U.S. Environmental Protection Agency (US EPA) Region 9 Preliminary Remediation Goals (PRGs).

Exposure to shallow surface soil and sediment was evaluated for six receptor scenarios: National Guard Fire/Dust Suppression Worker, National Guard Trainee, National Guard Security Guard/Maintenance Worker, recreational Hunter/Trapper/Fisher, and Resident Farmer (adult and child). Exposure to deep surface soil was also evaluated for the National Guard Trainee. Based on the Army specified future land use, the National Guard mounted training (no digging) was used as the primary receptor in the Supplemental Baseline Human Health Risk Assessment (SBHHRA) (Shaw, 2004d). This scenario assumes the following for a National Guard Trainee:

- On-site up to 24 hours per day for 24 days per year for a total exposure frequency of 39 days per year for 25 years;
- Mounted training with no digging (i.e., training on vehicles only resulting in potential maneuver damage up to 4 feet below ground surface); and,
- Exposure via incidental ingestion, dermal contact and inhalation of vapors and fugitive dust.

In support of a FFS, and based on the Army specified future land use scenario of National Guard mounted training (no digging), the following is a summary of the human health risk assessment (HHRA).

- 31 COPCs were identified in surface soil at LLs 1-4.
- Risk-based RGOs were calculated assuming a 10^{-5} target excess individual lifetime cancer risk for carcinogens and an acceptable target hazard index of 1 for non-carcinogens consistent with Ohio Environmental Protection Agency (Ohio EPA) guidance.
- Risk-based RGOs were estimated for 14 COCs in soil and sediment in LLs 1-4 for the National Guard Trainee receptor.
- No RGO was established for lead, however a provisional RGO value of 1,995 mg/kg was proposed.
- The risk-based RGO for manganese in surface and subsurface soil is below the established, naturally occurring background concentrations. The Army and Ohio EPA have agreed that the Region 9 PRG concentration of manganese in surface soil of 1,800 mg/kg would be used as the RGO for this project. The established facility-wide background manganese concentration of 3,030 mg/kg for subsurface soils will be applied as the RGO for subsurface soils.

Summary of Ecological Risk and RGO Development

Multiple soil contaminants of ecological concern with large hazard quotients (HQs) were identified for multiple ecological receptors at each of the load lines in the Level III baseline ecological risk assessments. These HQs are perceived to have a high degree of uncertainty and are considered conservative. However, quantitative RGOs for soil are not needed for ecological receptors at LLs 1-4. Remedial activities will reduce the overall concentration of many contaminants and will have the effect of lowering the HQs. Habitat alteration may be extensive, resulting in vegetation removal (simpler or missing habitat), shorter food chains (simpler ecosystem), and lower exposure (fewer organisms). Given that the remedial activities and proposed future use of the four load lines will significantly alter previously established ecological conditions at RVAAP, it was decided that ecological RGOs would not be practical for consideration for work associated with this FFS. (Shaw, 2004e)

Remedial Alternatives

The following general response actions were considered:

- No action,
- Institutional controls,
- Containment,
- Excavation,
- Treatment, and
- Disposal actions.

Treatment options included physical (separation), chemical (chemical oxidation), biological (composting) and thermal (incineration) treatment technologies. Composting was eliminated due to the inability to treat metals and PCBs, and is further discussed in Section 4.4.7. The technologies/process options screened under each general response action were selected for their ability to remove or reduce COC concentrations in soil to meet RGOs. RVAAP-specific considerations included the future land use of National Guard mounted training (no digging), residual structures that may be in place at the implementation of the interim remedy, and the shallow depth to bedrock in many areas of the load lines.

Technologies retained under the general response actions were combined into the following alternatives for detailed analysis.

- Alternative SDS1: No Action.
    - For this alternative, no action would be taken to reduce the hazards present in the AOCs to potential human and ecological receptors. There would be no reduction in toxicity, mobility, or volume of the contaminated media. Accessibility to contaminants by

workers and the public would not be prevented. Consideration of the no action alternative is required under the National Contingency Plan for baseline comparison with other alternatives.

- Alternative SDS2: Excavation with Capping
    - The contaminated soils exceeding RGOs would be excavated and consolidated under a cap. Removal of soils with contaminants above RGOs would reduce human and ecological exposure risk, although the integrity of the cap will require long-term maintenance. Consolidation of excavated soil under one cap maximizes cost-effectiveness. Land Use Controls are necessary to maintain the integrity of the cap resulting in restricted land use for National Guard mounted training (no digging) with no vehicular access to capped area(s).
- Alternative SDS3: Excavation with Off-Site Disposal
    - The contaminated soils exceeding RGOs would be excavated and disposed of off-site at a permitted facility. Removal of soils with contaminants above RGOs would reduce human and ecological exposure risk. Conducting excavation and off-site disposal within LLs 1-4 in one mobilization effort maximizes cost-effectiveness. Land Use Controls would be necessary to prevent land use other than for National Guard mounted training (no digging).

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1.0 INTRODUCTION

This report documents the focused feasibility study (FFS) at Load Lines 1 through 4 (LLs 1-4) at the Ravenna Army Ammunitions Plant (RVAAP), Ravenna, Ohio (Figure 1-1 and 1-2). The FFS was conducted under the United States Department of Defense Installation Restoration Program by Shaw Environmental, Inc. (Shaw), under contract number DACA45-03-D-0026, Task Order 0001, with the United States Army Corps of Engineers (USACE), Louisville District. This document investigates the remedial alternatives for surface and subsurface soil and dry sediment at LLs 1-4 to achieve an Interim Remedy in Place (IRIP). The objectives of this contract are to remediate soils and dry sediments to obtain an IRIP for LLs 1-4 for the future planned land use of National Guard Trainee mounted training (no digging). As part of this contract, the building slabs and sediment in the sewers will remain in place, and therefore, this FFS and resulting interim remedy does not address soils beneath the slabs or sediment in the sewers. Soils underneath the slabs and sediment in the sewers would need to be addressed if the slabs were removed or the stated land use changes. This contract also does not address groundwater, deep soils, surface water or wet sediments.

The FFS was conducted in compliance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 following work plans reviewed and commented on by the Ohio Environmental Protection Agency (Ohio EPA). This FFS was prepared in accordance with United States Environmental Protection Agency (US EPA) guidance document, "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final," (US EPA, 1988). In addition, Ohio EPA guidance was reviewed during development of this report, specifically, "Generic Statement of Work, Remedial Investigation/Feasibility Study, State Version," (Ohio EPA, 1999).

1.1 Purpose and Organization of Report

Two phases of remedial investigation (RI) have been completed for LLs 1-4 resulting in an adequate characterization of the extent and magnitude of contamination, human health risks, and ecological risks. The investigation concluded with the recommendation to move forward with a feasibility study. Detailed discussion of the RVAAP and LLs 1-4 operational history and results of the RI phases of activity may be found in the Phase I and II RI Reports (Science Applications International Corporation (SAIC), 2004; Shaw, 2004a, b, c).

As part of this FFS for LLs 1-4, data acquired in the Phase I and II RIs were screened against human health remedial goal options (RGOs) and considered during the screening and evaluation of remedial alternatives in the FFS to determining the areas and volumes of soils exceeding applicable RGOs. Additional data collected in November 2004 to address perceived data gaps are included in Section 2.4.

The report consists of Sections 1.0 through 7.0, and supporting appendices (A through E). Section 1.0 describes the purpose, objectives, and organization of this report; provides a description and history of LLs 1-4; and describes the environmental setting at RVAAP and LLs 1-4, including the geology, hydrogeology, climate, and ecological resources. Section 2.0 describes the generation of RGOs for the defined land use and the ecological and human health risks. Section 3.0 presents the applicable or relevant and appropriate requirements (ARARs) pertinent to the defined land use, the evaluated alternatives, and the resulting remedial actions. Section 4.0 defines the range of general response actions applicable to LLs 1-4. Section 5.0 identifies and evaluates the proposed remedial alternatives that were retained. Section 6.0 provides the summary of results of the FFS. Section 7.0 provides a list of referenced documents used to support this FFS.

1.2 Background Information

This section describes the background of the RVAAP facility and the history of the specific areas of concern (AOCs).

1.2.1 Site Description

RVAAP is a government-owned, contractor-operated (GOCO) facility. It is jointly operated by the United States Army Base Realignment and Closure Office (BRACO) and the National Guard Bureau (NGB). The BRACO controls environmental AOCs and bulk explosives storage areas. Materials formerly stored in the bulk explosives storage areas have been removed. The Ohio Army National Guard (OHARNG) controls non-AOC areas for training purposes.

RVAAP is located in northeastern Ohio within east-central Portage County and southwestern Trumbull County, approximately 37 km (23 miles) east of the city of Akron, 4.8 km (3 miles) east-northeast of the city of Ravenna, and approximately 1.6 km (1 mile) northwest of the town of Newton Falls (see Figure 1-1). The installation consists of 8,668.3 hectares (21,419 acres) contained in a 17.7 km (11 mile)-long, 5.6 km (3.5 mile)-wide tract, bounded by State Route 5, the Michael J. Kirwan Reservoir, and the CSX System Railroad on the south; Garretsville and Berry roads on the west; and the CONRAIL Railroad on the north. Additional and less populous communities surrounding the installation include: Windham to the north; Garrettsville 9.6 km (6 miles) to the northwest; Charlestown to the southwest; and Wayland 4.8 km (3 miles) to the southeast.

The 2000 Census lists the total populations of Portage and Trumbull counties as 152,061 and 225,116, respectively. Population centers closest to RVAAP are Ravenna, with a population of 11,771, and Newton Falls, with a population of 5,002.

The RVAAP facility is located in a rural area and is not close to any major industrial or developed areas. Approximately 55 percent of Portage County, in which the majority of the RVAAP is located, consists of either woodland or farm acreage. The Michael J. Kirwan Reservoir (also known as West Branch Reservoir) is the closest major recreational area and is located adjacent to the western half of RVAAP south of State Route 5.

1.2.2 Site History

Industrial operations at RVAAP primarily consisted of 12 munitions assembly facilities referred to as “load lines.” LLs 1-4 were used to melt and load trinitrotoluene (TNT) and Composition B into large-caliber shells. LL 5 through LL 11 were used to manufacture fuzes, primers, and boosters. Potential contaminants in these load lines include, but are not limited to, lead compounds, mercury compounds, and explosives. LL 12 was used to produce ammonium nitrate for explosives and fertilizers prior to its use as a weapons demilitarization facility.

The operations of the primary load lines produced explosive dust, spills, and vapors that collected on the floors and walls of each building. Periodically the floors and walls would be cleaned with water and steam. The liquid, containing TNT and Composition B, was known as “pink water” for its characteristic color.

RVAAP used several areas for burning, demolition, and testing of ordnance and explosives. These burning grounds and demolition areas consist of large parcels of open space or abandoned quarries. Potential contaminants at these AOCs include, but are not necessarily limited to, explosives, propellants, metals, waste oils, and sanitary waste.

RVAAP has been inactive since 1992. The only activities still being carried out from the wartime era are the infrequent demolition of unexploded ordnance found at the installation. The Army is also overseeing the reclamation of railroad tracks, telephone lines, and steel for reuse or recycling. The Army has completed the demolition of buildings at LL 1 and LL 12 and has begun the demolition of excess buildings at LLs 2-4, which includes the removal of friable asbestos. The demolition of buildings at LL 1 did not include slab removal.

Until May 1999, about 1,010 hectares (2,497 acres) of land and some existing facilities at RVAAP were used by the OHARNG for training purposes. NGB serves an administrative function as the property holder who issues an operating license to OHARNG. Training and related activities that took place included field operations and bivouac training, convoy training, equipment maintenance, and storage of heavy equipment. In a Memorandum of Agreement (MOA) dated December 1998, 6,544 hectares (16,164 acres) of land at RVAAP was transferred from the Joint Munitions Command (JMC) to the NGB, effective May 1999, for expanded training missions. On May 13, 2002, an additional 3,774 acres of land was transferred from RVAAP to the NGB via an amendment to the MOA. Approximately, 1,481 acres of property remain under the control of BRACO; this acreage includes AOCs and active mission areas. As AOCs are remediated, transfer of remaining acreage from BRACO to the NGB will be conducted. The OHARNG has prepared a comprehensive Environmental Assessment and an Integrated Natural Resources Management Plan, which will address future uses of the property. These uses include two live-fire rifle ranges, hand grenade practice and qualification ranges, a light demolition range, and two armored vehicle maneuver areas. Additional field support and cantonment facilities will be constructed to support future training. The Ohio Air National Guard and the United States Air Force Reserve plan to partner with the OHARNG in construction of a 1,219-m (4,000-ft) unpaved tactical runway.

The Army intends to complete the required CERCLA remedy selection process and attain regulatory closure status for LLs 1-4 so that these areas can be turned over to the OHARNG for training activities. LLs 1-4 are located along the southeastern side of the RVAAP as shown in Figure 1-2. This FFS will focus specifically on LLs 1-4.

The intent of the work under this FFS is to attain an interim regulatory closure for soils and dry sediments in LLs 1-4. The focus of this FFS is primarily on contaminated surface and subsurface soils (to a depth of approximately 4 feet deep) and dry sediment in the LLs 1-4 area, although it may be necessary to address soils at a greater depth. The remediation of groundwater, surface water and saturated sediments located beneath surface and standing water are not included in this FFS. Thus, 'dry sediment' for the purposes of this FFS includes sediment located in existing drainage containment structures, dry sediment located proximate to discharge structures (headwalls, outfalls), and sediments located within conveyance ditches and swales that do not have significant water flow on a continuous basis. Remediation activities associated with this FFS are limited to areas within the fenced boundaries of LLs 1-4.

Load Line 1

LL 1 was historically the most productive of the load lines. The RI report for LL 1 (SAIC, 2004) was accepted by Ohio EPA in March 2004. A Supplemental Baseline Human Health Risk Assessment (SBHHRA) for LL 1 Alternative Receptors Report (Shaw, 2004d) was issued in May 2003 and finalized in July 2004 to address alternative NGB receptors in the LL 1 area.

LL 1 (RVAAP-08) is located in the southeastern portion of RVAAP (Figure 1-2). It covers approximately 150 acres. It began operation in 1941 and was used until 1971. A detailed site map of LL 1 is presented in Figure 1-3. During World War II (1941 through 1945) and the Korean War (1951 through 1957), LL 1 was used to melt and load TNT and Composition B explosives into large-caliber shells. Composition B is a mixture of TNT and cyclotrimethylenetrinitramine (RDX). Cadmium was applied to various components of the shells to deter rust. The operation on the load line produced explosive dust, spills, and vapors that collected on the floors and walls of several buildings. These residues were periodically washed from walls and floors with water and steam. As patterns of contamination indicate, during building wash down, pink water or loose explosive flakes, chips, or dust may have been swept out of doorways onto the ground. The majority of the wastewater, known as pink water, was collected in concrete sumps located throughout the load line area. The pink water was then pumped to a sawdust filtration unit for clarification and removal of nitro-compounds prior to discharge. Sawdust filtration units consisted of a set of three parallel 3- × 9.1- × 0.9-m (10- × 30- × 3-ft) concrete settling tanks and a set of three 1.5- × 4.6- × 0.9-m (5- × 15- × 3-ft) filter blocks in the bottom of the filtration tanks. Sawdust from the filtration unit near Building CA-6A was disposed of at Winklepeck Burning Grounds (WBG).

Various industrial operations associated with the munitions loading process were also conducted during the operation of LL 1. These operations included painting, drilling and boostering; munitions truck and equipment maintenance; and paint, oil, solvent, and equipment storage. The load lines were rehabilitated in 1951 to remove and replace soils contaminated with accumulated explosives and to remove and replace waste water lines, particularly at Buildings CB-4 and CB-4A. However, many contaminated storm drain lines remained in each load line after 1951 (USATHAMA, 1978).

During 1961–1967, LL 1 was the site of munitions rehabilitation activities. These activities primarily involved the dismantling, replacing of components, and repainting of mines. Much of this work was conducted in Buildings CB-13 and CB-14. Additionally, demilitarization of primers occurred in the southeastern area of Building CB-13, which may have contributed to propellant contamination.

LL 1 was the subject of a Phase I RI in 1996 (USACE, 1998). The results of this investigation are summarized in Section 1.2.3.

Most LL 1 buildings were demolished and removed between 1999 and 2000. All buildings with residual explosive dust were washed down, and the freestanding equipment was removed from the buildings before the load line was declared inactive in 1971. Salvaging contractors removed telephone lines and major rail spurs across the AOC from 1996 to 1998. Similarly, the overhead steam lines have been removed for metal recycling following the removal of friable asbestos. Inside the buildings, removal of friable asbestos shielding began in 1997, as did removal of the steel piping, trim, overhead lighting (with polychlorinated biphenyl (PCB) ballasts), and some structural steel. All salvage/scrap operations have been overseen by the JMC. Transite (asbestos and concrete) siding and roofing, and any remaining recyclable steel, were removed as part of the demolition work. There was concern that removing the transite panels would introduce new contamination to the soil around the buildings. To minimize the spread of potential contaminants, the following measures were taken during the demolition work:

- vacuuming and sweeping all dust and debris before transite removal/demolition, during removal activities as significant quantities of dust and debris accumulated, and at the completion of demolition activities;
- disposing of dust and debris according to all applicable state, federal, and local laws, rules, and regulations;
- removing loose paint on all surfaces; and
- removing structural steel members with high levels of paint-related contamination by mechanical cutting where feasible, with minimal use of cutting torches.

Salvage and demolition activities at LL 1 were complete as of June 2000. All buildings (except for CB-13 and CB-801) have been demolished, and the debris either has been removed from the site or, if inert, placed in “clean, hard fill” areas at the locations of the former change houses (CB-12, CB-8, CB-22, and CB-23). Floor slabs of the demolished buildings and all below-grade infrastructure remain in place.

Several manholes or other storm/sanitary sewer access points were filled in or obstructed during the demolition process.

Load Line 2

LL 2 is located in the southeastern portion of RVAAP (Figure 1-2) and encompasses approximately 212 acres (Figure 1-4). It was used to melt and load TNT and Composition B into large-caliber shells and bombs. The line operated during World War II, from 1951 to 1957, and again from 1969 to 1971. During its operational history, LL 2 produced about 10 million munitions.

During operations, bulk TNT in granular form was offloaded at Buildings DA-6 and DA-6A for screening and preparation. Bulk RDX and octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) were received in chunk or nugget form and were manually examined to remove any foreign material. Following preparation, bulk explosive was manually transported in wheeled carriers through a covered walkway to the melt-pour buildings (DA-4 and DA-4A) for processing and loading into shells. Bulk explosive was manually introduced to steam-jacketed melting kettles located on the third floor of the buildings and piped to loading bays on the first floor. The primary charge was loaded into the shells and they were staged in finishing/cooling bays also located on the first floors of the melt-pour buildings. Funnel removal, manual topping of the primary charge, and face off operations were conducted in these areas. Upon completion of primary charge loading, shells were transported to Building DB-10 for drilling operations for booster charges or other preparation steps depending on the type of munition. Drilling operations utilized vacuum equipment to contain explosive dust, which was piped to exterior dust collection units located along the north side of Building DB-10. Radiography equipment used to provide quality assurance (QA) of the primary charge was located in Building DB-26. Buildings DB-13A, -13B, and -13C housed packaging and shipping operations. Shell preparation operations, including cleaning and painting, were contained in Building DB-3. Bulk explosive carrier washout activities were conducted in Building DB-25; effluent was directed to an above-grade concrete settling tank immediately south of the building, which discharged to an unlined drainage ditch.

In a 1950s phase of construction, two large cyclic-heating buildings (DB-27 and DB-27A), associated heating, ventilation, and air conditioning (HVAC) facilities (DB-27B), and new shipping facility (DB-27C) were constructed along the north end of the load line. Loaded shells were placed in the cyclic-heating buildings and subjected to alternating heating and cooling cycles to re-crystallize the primary charge; thus increasing its density and explosive force.

Other ancillary facilities include the following:

- Buildings DB-8, DB-8A, and DB-22 - change houses, offices, and cafeteria facilities;
- Building DB-802 - receiving, inert storage, shell preparation;
- Building DC-1 - load line steam plant and power house;
- Buildings DA-28 and DB-29 - elevator machine houses; and
- Physical plant service buildings (DA-5, DA-7, DA-21, DB-2, DB-9/9A, DB-11, DB-19, and DB-20).

When the facility was at full capacity, LL 2 generated approximately 3,192,000 liters (L) (842,700 gallons (gal)) of pink water per month (Jacobs, 1989) from washdown and steam decontamination of equipment. As patterns of contamination indicate, during building wash down, pink water or loose explosive flakes, chips, or dust may have been swept out of doorways onto the ground. Pink water generated from the munitions-assembly operations was collected in concrete sumps located throughout the load line, which were connected to settling tanks. After settling, the water was pumped by low-pressure steam ejectors into two tanks, approximately 26,200 L (6,900 gal) in volume for cooling. When the water cooled to 80°F, it was pumped through an overhead pipe to a sawdust filtration unit. The sawdust filtration unit consisted of a set of three parallel 3- × 9.1- × 0.9-m (10- × 30- × 3-ft) concrete settling tanks and a set of three 1.5- × 4.6- × 0.9-m (5- × 15- × 3-ft) concrete filtration tanks with vitreous clay filter tiles in the bottom of each tank. The contaminated sawdust used in the filtration tanks and the settled sludge were periodically removed and destroyed at WBG. The effluent from the sawdust filtration units was discharged to Kelly's Pond, a triangular, unlined earthen settling impoundment, which is approximately 0.8 ha (2 acres) in size and from 1.8 to 2.4 m (6 to 8 ft) deep. The discharge from the impoundment was channeled to a surface stream that immediately exits the installation south of the load line and, ultimately, empties into the West Branch of the Mahoning River.

In addition, chromic acid was used in Building DB-802 in shell-preparation processes. Chromic acid was stored in an above-grade tank on concrete pedestals located along the eastern side of the building. Some effluents containing chromic acid were reportedly discharged from Building DB-802 into the large central drainage ditch that, ultimately, discharges to Kelly's Pond (USACE, 1998).

Demilitarization Operations
Munitions-demilitarization activities (debanding and TNT washout) were conducted during the late 1940s and cartridge reclamation work was performed from 1951 to 1957. TNT washout equipment was located in Building DB-4A. Approximately 1.8 million kg (4 million lbs) of TNT was salvaged during demilitarization activities.

Demolition Activities
Demolition activities at LL 2 to date (1999 to present) have included removal of asbestos siding and roofing material from most structures. Production equipment has been removed from the major buildings. Piping and overhead conveyor systems have been removed from the extensive walkways connecting the major production buildings. Steel structural framework and concrete structures and buildings remain in place. A very small portion of the floor slabs remains at Building FF-19.

Load Line 3
Production Operations
LL 3 is located in the southeastern portion of RVAAP (Figure 1-2) and consists of approximately 167 acres (Figure 1-5). It was used to melt and load Composition B into large-caliber shells and bombs. The line operated during World War II, from 1951 to 1957, and again from 1969 to 1971. During its operation history, LL 3 produced about 6.5 million munitions.

During operations, bulk TNT in granular form was offloaded at Buildings EA-6 and EA-6A for screening and preparation. Bulk RDX and HMX were received in chunk or nugget form and were manually examined to remove any foreign material. Following preparation, bulk explosive was manually transported in wheeled carriers via a covered walkway to the melt-pour buildings (EA-4 and EA-4A) for processing and loading into shells. Bulk explosive was manually introduced to steam-jacketed melting kettles located on the third floor of the buildings and piped to loading bays on the first floor. The primary charge was loaded into the shells and they were staged in finishing/cooling bays, also located on the first floors of the melt-pour buildings. Funnel removal, manual topping of the primary charge, and face off operations were conducted in these areas. Upon completion of primary charge loading, shells were transported to Building EB-10 for drilling operations for booster charges or other preparation steps depending on the type of munition. Drilling operations utilized vacuum equipment to contain explosive dust, which was piped to exterior dust collection units located along the north side of Building EB-10. Radiography equipment used to provide QA of the primary charge was located in Building EB-10A. Buildings EB-13A, -13B, and -13C housed packaging and shipping operations. Shell receiving and preparation operations, including cleaning and painting, were contained in Building EB-3. Bulk explosive carrier washout activities were conducted in Building EB-25; effluent was directed to an above-grade concrete settling tank immediately south the building, which discharged to an unlined drainage ditch. As patterns of contamination indicate, during building wash down, pink water or loose explosive flakes, chips, or dust may have been swept out of doorways onto the ground.

Other ancillary facilities include the following:

- Buildings EB-8, EB-8A, and EB-22 – change houses, offices, and cafeteria facilities;
- Building EB-803 – receiving and inert storage;
- Buildings EA-28 and EA-28A – elevator machine houses; and
- Physical plant service buildings (EA-5, EA-7, EA-21, EB-2, EB-9/9A, EB-11, EB-19, and EB-20).

Demilitarization Operations
Demilitarization activities were conducted between 1951 and 1957. Separate from the demilitarization activities, beginning in the early 1950's the Defense Logistics Agency (DLA) conducted a strategic materials storage mission at LL 3. One hundred above-grade storage tanks (Tank Nos. 1401 through 1500), having a capacity of 500 barrels (21,000 gal), were constructed to store strategic materials. Tank Nos. 1401 through 1476 were used to store silica carbide. The remainder were used to store various other strategic solid materials. Approximately 228,000 munitions were processed during demilitarization work.

Demolition Activities
By the late 1970's all but 20 tanks had been removed; those remaining were used to store antimony, asbestos, and magnesium silicate (talc). All DLA storage tanks are now empty; the remaining materials were removed in 2000.

<u>Load Line 4</u>
Production Operations
LL 4 is located in the south central portion of the RVAAP (Figure 1-2) and consists of approximately 125 acres (Figure 1-6). It was used to melt and load TNT into large-caliber shells, bombs, and antitank mines. The line operated briefly during World War II and again from 1951 to 1957. During its operational history, LL 4 produced about 1.2 million munitions. Bulk TNT was offloaded at Building G-16, transported to G-11 for screening, and then to Buildings G-10 or G-15 for additional preparation steps. Following preparation, bulk explosives were transported via a covered walkway to the melt-pour building (G-8) for processing and loading into shells. Once the primary TNT charge was loaded into the shells, they were transported to Buildings G-12 and G-12A for cooling. Funnel removal, face off operations, and drilling operations for booster charges or other preparation steps depending on the type of munitions were conducted in Building G-13. Explosives dust collection units were located just north of Building G-13. Radiography equipment used to provide quality assurance of the primary charge was located in Building G-13A. Buildings G-18, G-19, and G-19A housed packing and shipping operations and Building G-9 was used as a magazine and empty transport cart storage.

Ancillary facilities include the following:

- Buildings G-6 and G-6A - change house and cafeteria facilities;
- Buildings G-1, G-1A, G-2, and G-3 - inert material receiving and warehousing operations;
- Building G-4 - steam plant and power house;
- Building G-5 - office areas; and
- Buildings G-2, G-7, G-14, and G-17 - physical plant service buildings.

When the facility was at full capacity, LL 4 generated approximately 3,390,000 L (895,000 gal) of pink water per month (Jacobs, 1989) from washdown and steam decontamination of equipment. As patterns of contamination indicate, during building wash down, pink water or loose explosive flakes, chips, or dust may have been swept out of doorways onto the ground. Pink water generated from these operations was collected in concrete sumps and pumped via an overhead 6-in. diameter cast iron flume to a settling basin and sawdust filtration unit located southwest of Building G-8. The settling basin consisted of a 9.1- × 9.1- × 0.9-m (10- × 30- × 3-ft) concrete basin divided into three compartments separated by baffles. The sawdust filtration unit consisted of a concrete tank comprised of three compartments measuring about 1.5 × 4.6 × 0.9 m (5 × 15 × 3 ft). The bottom of the compartments was lined with vitreous clay filter tiles; each compartment was separated by baffles. Effluent from the filtration unit was discharged to an unlined drainage ditch that flows into a 0.8-ha (2 acre) settling pond within LL 4. The pond discharges to a surface stream that exits RVAAP south of the load line.

Solid wastes generated at LL 4 during full capacity operations included approximately 11,930 kg (26,305 lbs) per month of explosives-contaminated sawdust and settling sludges, which were periodically removed from the filtration tank and settling basin, along with contaminated combustible wastes (paper, cardboard) and explosives dust. These materials were transported to the WBG and destroyed by thermal treatment.

Demolition Activities
No significant demolition activities have occurred at LL 4. Rail lines within the AOC have been removed as part of facility-wide reclamation efforts.

1.2.3 Nature and Extent of Contamination

The evaluation of the nature and extent of contamination is presented in the RI reports for LLs 1-4 (SAIC, 2004; Shaw 2004a, b, c). The following sections summarize the findings of the Phase I and II sampling efforts. Additional data was obtained during the November 2004 soil sampling event which are summarized in Section 2.3.

1.2.3.1 Load Line 1

A Phase I RI was performed for LL 1 to confirm whether contamination was present at the AOC and to determine the nature of the chemicals of potential concern (COPCs). The Phase I RI relevant to this FFS included sampling and analysis of surface soils, ditch sediment, and sediment from Criggy's and Charlie's Ponds (Figure 1-7(1) and Figure 1-7(2)). The Phase I RI indicated that elevated concentrations of explosives, inorganics, and organics occur in soils in the central portion of the complex. Contaminants were prevalent around the doorways, drains, and vacuum pumps associated with the melt/pour buildings (Buildings CB-4 and CB-4A) and near the main concrete settling tank adjacent to monitoring well LL1mw-063. During Phase I RI field activities, residual propellant pellets were found on the ground beside Buildings CB-13, CB-13B, and CB-14.

Aluminum, arsenic, barium, cadmium, chromium, iron, lead, manganese, magnesium, mercury, selenium, and zinc were all detected in soils at concentrations above their respective background criteria. Maximum concentrations of inorganics in soils were higher at LL 1 than at any of the remaining high-priority AOCs investigated, but occurrences of high concentrations of metals did not coincide with high concentrations of explosives. Trace levels of heptachlor and two semivolatile organic compounds (SVOCs) (2,4-dimethylphenol and diethyl phthalate) were detected on one occasion. Inorganic constituents included cyanide, arsenic, barium, beryllium, cobalt, copper, manganese, mercury, nickel, and zinc, in addition to major geochemical elements (aluminum, calcium, iron, magnesium, potassium, and sodium).

Four sediment samples in drainage ditches contained detectable concentrations of explosives. Samples from a concrete settling tank near Building CB-13 contained the highest concentrations of explosives. Metals were concentrated near Building CB-3A and the ditch along Outlet D just upstream at former Track 23. PCBs were identified in the southern third of the load line and were associated with Building CB-3A and the drainage ditch along Outlet D.

The Phase I sampling locations were biased in that they were based on observations of staining or loaded at the ends of effluent pipes or along drainages. Subsequent to the Phase I RI, the LL 1 buildings (except CB-13 and CB-801) were demolished and removed, leaving the floor slabs and most below-grade infrastructure in place. The railroad tracks and timbers were also removed, but the slag cinders in the railroad beds remained. Hence, several Phase I locations were re-sampled in Phase II to assess whether demolition and removal operations had altered occurrences of soil and sediment contamination as documented in the Phase I RI.

The Phase II RI surface and subsurface soil sample locations were chosen to investigate specific buildings and surrounding areas, based on which the data was aggregated. For surface soils and subsurface soils, the geographic area of LL 1 (see Figure 1-7(1) and Figure 1-7(2)) was separated into eight aggregates consisting of buildings, the perimeter area and the railroad track bed. The soils aggregate areas include:

- Buildings CB-3/CB-801;
- Buildings CB-4/4A and CA-6/6A;
- Buildings CB-13/CB-10;
- Buildings CB-14, CB-17 and CA-15;
- Area around the base of the former Water Tower;
- Former Change Houses (CB-12, -23, -8, -22);
- Railroad track bed and
- Perimeter area

Sediment locations were grouped according to drainage features and the areas drained for the Phase II RI. The five sediment aggregates include:

- Outlets D, E and F and Criggy's Pond;
- Outlet C and Charlie's Pond;
- Outlets A and B;
- North area channel; and
- Off-AOC

The Phase II sampling results are applicable to two large areas of LL 1 AOC: the main process area, consisting of the former process buildings, and the remaining perimeter (non-production) area of the AOC.

Surface Soil

In the main process area, the contaminant suite in the surface soil consists of explosives and propellants (2,4,6-TNT and nitrocellulose), several metals and some organic compounds (PAHs, one PCB and one volatile organic compound (VOC)). Explosives are primarily in the immediate vicinity of the building pads with the highest levels in the soils surrounding the pad of Building CB-4A. Organic compounds are more ubiquitous throughout the process area. The results of surface soil samples collected in the area outside of the process areas (generally 50 to 100 feet away from buildings, walkways, railroads and other man-made structures) indicate that metals (with the exception of manganese) were only slightly elevated above background with no explosives or propellants detected.

Subsurface Soil

Where residual metals contamination is present, the levels of contamination are generally lower in subsurface soils than in the surface soils. Explosives were consistently detected in the melt-pour area, although scattered detections occurred in other areas.

Sediment

In sediment, the highest concentration of explosives and propellants were measured in ditch sediment samples near Building CB-13 and CB-13B. Explosives migration along drainages for extensive distances is not indicated. PCBs detections were isolated, and widespread transport of PCBs via eroded soil is not indicated.

1.2.3.2 Load Line 2

Evaluation of data collected during the Phase I and II RIs shows that historical operations have resulted in contamination of surface and subsurface soil, primarily in the vicinity of former operations buildings, and in some drainage ditches near source areas (Figure 1-8(1) through Figure 1-8(3)).

Surface Soil

Aggregates containing the former process buildings (Explosives Handling Areas, Preparation and Receiving Areas, and Packaging and Shipping Areas) exhibited the greater number and concentrations of site-related contaminants (SRCs) than the outlying aggregates (Change Houses, North Ditches, and Perimeter Area). Explosives were detected in all aggregates except the Change Houses. 2,4,6-TNT was the most frequently detected explosive and it occurred at the highest concentrations. The most commonly detected inorganics above background include arsenic, lead, and manganese. SVOCs, primarily PAHs, were widespread at low, estimated concentrations; only sporadic samples contained this class of compounds at concentrations greater than 1 mg/kg. Arochlor-1254 was the most commonly detected PCB compound. Low levels of VOCs (primarily acetone and toluene) were detected. Almost all stations with higher concentrations and/or a number of SVOCs, PCBs/pesticides, and VOCs occurred in the immediate vicinity of the process buildings, or along the railroad tracks connecting the process areas to one another.

Subsurface Soil

Contamination in the subsurface soil at LL 2 varied considerably by aggregate. Explosives were confined to the Explosives Handling Areas and Perimeter Areas Aggregates, and were not detected in the subsurface in other aggregates. Inorganic SRCs were slightly more widespread in the subsurface, occurring in four of the six subsurface soil aggregates. The most commonly detected metals were antimony, arsenic, cadmium, lead, and zinc. Most results for metals were near or only slightly above the background criteria. The extent and magnitude of SRCs in subsurface soil corresponded with elevated levels observed in samples collected from the overlying surface soil interval. Propellants and pesticides were not detected in any subsurface soil sample at LL 2.

Sediment

Kelly's Pond and Exit Drainages Aggregate

- Three explosive compounds (2,4,6-TNT, 2,4-dinitrotoluene (DNT), and 4-amino-2,6-DNT) were detected at low concentrations in sediments from the Kelly's Pond and Exit Drainages Aggregate.

- Inorganic SRCs occur in sediments from the Kelly's Pond and Exit Drainages Aggregate. Concentrations are typically low, occurring at or slightly above the background criteria.

- Two pesticides and numerous SVOCs (primarily PAHs) were detected in sediment samples from the Kelly's Pond and Exit Drainages Aggregate. Most detected values were clustered at stations LLs-182 and LL2sd/sw-053(p), at concentrations less than 1 mg/kg.

- PCBs and VOCs were not detected in sediment in the Kelly's Pond and Exit Drainages Aggregate. Trace quantities of carbon disulfide were detected in one surface water sample.

North Ponds Aggregate

- No explosives were identified in the sediment sample from the North Ponds Aggregate; nitrocellulose was detected at a low, estimated concentration.

- Inorganic SRCs occurring in sediment in the North Ponds Aggregate include lead, nickel, and cadmium. All detected concentrations were low (1 to 2 mg/kg for lead and nickel, and less than 1 mg/kg for cadmium) and were estimated values.

- Organic constituents, other than nitrocellulose, were not detected in sediment.

1.2.3.3 Load Line 3

Evaluation of data collected during the Phase I and Phase II RIs show that historical operations have resulted in contamination of surface and subsurface soil, primarily in the vicinity of the former operations buildings, and in some drainage ditches near source areas (Figure 1-9(1) through Figure 1-9(3)).

Surface Soil

Aggregates containing the former process buildings (Explosive Handling Areas, Preparation and Receiving Areas, and Packaging and Shipping Areas) exhibited greater numbers and concentrations of SRCs than the outlying aggregates (Change Houses, West Ditches, and Perimeter Area). Explosives were detected in all aggregates with the exception of Change Houses and the DLA Storage Tanks Aggregates, with 2,4,6-TNT being the most pervasive constituent across LL 3. Inorganic constituents were consistently identified in all surface soil aggregates. Those constituents directly related to process operations such as cadmium, chromium, lead, nickel, and zinc were found to exceed the established background criteria with the highest frequency. SVOC compounds (primarily PAHs), VOCs, and pesticides, were detected throughout the surface soils; however, concentrations were generally low and appeared as localized detects, typically located near the process buildings or railroad tracks. PCBs (specifically PCB-1254) were widely reported with localized elevated concentrations in the vicinity of Buildings EB-4, EB-11, EB-803, EB-6A, and EB-8A.

Subsurface Soils

Subsurface soils within the Change Houses Aggregate, Packaging and Shipping Areas Aggregate, West Ditches Aggregate, and the DLA Storage Tanks Aggregate were not characterized during the Phase II RI. However, the DLA area has been specifically excluded from the SOW of the PBC. It is being handled by the Army under a separate contract so it is not included in this FFS. Based on field explosive analysis, further evaluation of the subsurface soils as they pertain to explosives in the Preparation and Receiving Aggregate was not performed. Evaluation of subsurface soils for SVOCs, VOCs, and pesticides were also not performed. PCBs were exclusively evaluated within the subsurface soils of the Explosives Handling Areas Aggregate.

Explosive compounds were identified in the subsurface soils within the Explosives Handling Areas Aggregate and the Perimeter Area Aggregate. As in the surface soils, 2,4,6-TNT was the most pervasive explosive constituent detected. In samples analyzed near Buildings EA-6, EA-21, and EA-5, 2,4,6-TNT concentrations in the subsurface exceeded the detected concentrations in the corresponding surface samples. Due to the adsorptive properties of the explosive compounds, the inconsistencies may be attributed to reworking of the surface soils with the Explosives Handling Areas and Perimeter Area Aggregates.

Several organic constituents were identified in the subsurface soils within LL 3. Primary accumulation areas for inorganic SRCs were in the immediate vicinity of former process buildings within each aggregate characterized. Within the limited number of subsurface soil samples collected, the distribution of inorganic constituents appears widespread throughout the load line; however, concentrations generally appear lower than identified in the surface interval.

The organic subsurface soils investigation at the LL 3 consisted only of PCB analysis within the Explosives Handling Areas Aggregate. The peak concentration of PCB-1254 was identified in the subsurface soils on the west side of Building EB-4. In this area, the subsurface soil concentration was 35 times higher than the corresponding surface soil sample.

Sediment
Within the sediments of the Cobb's Pond Tributary Aggregate, explosive and inorganic compounds were identified. Explosive concentrations were generally low with limited distribution, while inorganic constituents experienced a wider distribution throughout the tributary. PCB-1254 was identified as a single occurrence within the sediments of the Cobb's Pond Tributary.

1.2.3.4 <u>Load Line 4</u>
Based on evaluation of data collected during the Phase I and II RIs, the extent and magnitude of contamination at LL 4 appears to be much less than compared to the other major melt-pour lines at RVAAP (LLs 1-3). A brief summary of nature and extent of contamination within each of the environmental media characterized is outlined below.

Surface Soil
Explosive and explosive compounds present in surface soil at LL 4 are relatively few in number, concentrations are comparatively low relative to LLs 1-3, and are limited in extent to the immediate proximity of source areas (Figure 1-10(1) and Figure 1-10(2)). Pervasive inorganic SRCs in surface soil include inorganic constituents such as barium, cadmium, chromium, copper, lead, thallium, and zinc. SVOCs, such as fluoranthene and pyrene, were also present in one or more samples from each of the aggregates comprising LL 4. Other metals and SVOC were detected in LL 4, but were not pervasive throughout the entire AOC. The VOCs detected in surface soil samples from LL 4 include acetone, benzene, chloroform, dimethylbenzene, and toluene. In addition, PCBs-1254 and -1260 and some pesticides were detected sporadically.

Subsurface Soil
Based on the evaluation of the occurrence and distribution of contaminants in the limited number of subsurface soil samples that were able to be collected at LL 4, the following observations were made.

- No explosives or propellants were detected in the subsurface soil at LL 4.
- The metals detected at concentrations exceeding their respective background concentration most frequently include barium, beryllium, cadmium, lead, and zinc. Metals above background are most prevalent in subsurface soil in the vicinity of Building G-1A in the Preparation and Receiving Areas Aggregate and Building G-9 in the Explosives Handling Areas Aggregate.
- Subsurface soil from LL 4 was not analyzed for VOCs or SVOCs; therefore, no direct observations regarding the presence or distribution of these contaminants can be made. If any organic compounds are present in the subsurface soil, it is reasonable to expect that the occurrence and distribution would generally coincide with the distribution seen in the overlying surface soil.
- Subsurface soil from LL 4 was not analyzed for pesticides. As with VOCs and SVOCs, it can be expected that if pesticides are present in the subsurface soil, their distribution would be similar to the distribution of pesticides seen in surface soil at LL 4.

Sediment

- Explosive compounds were detected in sediment samples, although at concentrations less than 1 mg/kg. Explosives were not detected in associated water samples.
- Cadmium is a pervasive SRC in sediment, occurring in sediment within all three viable habitat aggregates at LL 4, although all detected concentrations were 1 mg/kg (estimated) or less. The number and concentrations of inorganics are greatest in sediment within the settling pond. However, for inorganics with established background concentrations, the maximum concentrations for all detected constituents were only between 2 and 3 times the established background criteria.

- Pesticide and PCB contaminants are generally absent within sediment; one PCB compound was detected at concentrations of less than 0.5 mg/kg. Pesticides and SVOCs were not detected in sediment.
- VOCs were only sporadically detected at low concentrations in sediment.

1.2.3.5 Summary

Available process knowledge and investigation results suggest that the primary COPCs are those shown in Table 1-1.

Table 1-1. COPCs at LLs 1-4

Chemical Group	COPC*	Rationale
Explosives	TNT	Primary munitions explosive
	DNT	Primary munitions explosive
	RDX	Primary munitions explosive
	HMX	Primary munitions explosive
	Trinitrobenzene	Associated with primary explosives
	Dinitrobenzene	Associated with primary explosives
	Nitrobenzene	Associated with primary explosives
	Nitrotoluene	Associated with primary explosives
Propellants	Nitroglycerine	Associated with primary explosives
	Nitroguanidine	Associated with primary explosives
	Nitrocellulose	Associated with primary explosives
Metals	Arsenic	Previously detected
	Aluminum	Munitions booster cups, slag
	Antimony	Previously detected
	Barium	Previously detected
	Cadmium	Previously detected
	Chromium	Common to munitions processing, previously detected
	Chromium, hexavalent	Associated with Chromic acid use
	Copper	Common to munitions processing
	Lead	Common to munitions processing, previously detected
	Manganese	Previously detected
	Mercury	Previously detected
	Selenium	Previously detected
	Silver	Common to munitions processing
	Thallium	Previously detected
	Zinc	Previously detected
VOCs	—	Associated with industrial processes
SVOCs	Benzo(a)anthracene	Associated with industrial processes
	Benzo(a)pyrene	Associated with industrial processes
	Benzo(b)fluoranthene	Associated with industrial processes
	Dibenz(a,h)anthracene	Associated with industrial processes
PCBs	Arochlor-1254	Associated with industrial processes
Pesticides	—	Associated with industrial processes, previously detected

*Not all compounds were detected at all load lines.

1.2.4 Contaminant Fate and Transport

Fate and transport modeling was conducted to asses the impact of COPCs detected in soil and dry sediment on underlying groundwater. Although remediation of groundwater is not included in the Scope of Work for this contract, the impact of the soils and dry sediments to groundwater was considered in the Remedial Investigation and subsequent development of RGOs. Fate and transport modeling was used to simulate the vertical transport of contaminants from source areas to groundwater and horizontal transport with the groundwater system to receptor locations. A detailed description of the model and resulting analysis are described in Section 5.0 of the RIs for LLs 1-4 (SAIC, 2004; Shaw 2004a, b, c). A summary of this analysis, as presented in Section 8.2 of the LL 1 RI and Section 8.1.2 of the LLs 2-4 RIs, is presented in this section. The discussion in this section focuses on soil and dry sediment as source areas and does not include contaminant fate and transport in groundwater or surface water. Remedial actions associated with this FFS are focused on removing impacted materials that exceed established clean-up criteria for contaminants (Section 2.1.5). The removal of contaminant mass as a result of the remedial action will reduce leachability to groundwater and surface water. Results of groundwater monitoring indicate no impact to groundwater detected in samples collected from monitoring wells located outside of the source areas.

The vadose zone contaminant transport model program SESOIL was used to predict the maximum concentration of leachate in the soil profile beneath the source areas (i.e., ground surface to upper level of saturated soil zone). The expected release mechanism and migration pathway for COPCs in soil at LL 1 is through the infiltration of precipitation. Water infiltrating through contaminated surface and subsurface soils may leach contaminants into the groundwater. The factors that affect the leaching rate include a contaminant's solubility, soil-water partitioning coefficient (K_d) and the amount of infiltration. Insoluble compounds will precipitate out of solution in the subsurface or remain in their insoluble forms with little leaching. For the contaminants detected at LL 1, sorption process and K_d will have the greatest effect on leaching. Prior to reaching the groundwater, contaminants will experience attenuation mechanisms of retardation, degradation and fixation on soil.

The following primary conclusions can be drawn from this analysis for each of the load lines:

LL 1:
Modeling indicates some of the explosives compounds are expected to leach from the contaminated surface soils into the groundwater with predicted concentrations exceeding the groundwater RGOs in the source areas. Metal, PCB, and PAH contaminants within the LL 1 subsurface soils are not expected to leach to groundwater beneath the sources within the modeled time frame of 1,000 years.

LL 2:
The SESOIL modeling results indicate that antimony, arsenic, cadmium, chromium, mercury, and RDX may leach from surface soil to groundwater with concentrations beneath the source area above groundwater Maximum Contaminant Levels (MCLs). The timeframe for the metals constituents to reach peak concentrations in groundwater beneath the source ranged from 149 to 647 years. The projected timeframe for RDX to achieve peak concentrations is 3 years, suggesting that such leaching has already occurred. The leaching modeling is conservative and migration of these constituents may be attenuated because of moderate to high retardation factors for these constituents. However, the presence of antimony, arsenic, 2,4-DNT, and RDX in groundwater within the Explosives Handling Areas Aggregate indicates leaching processes are ongoing near the source areas.

LL 3:
The SESOIL modeling results indicate that RDX may leach from surface soil to groundwater with concentrations beneath the source area exceeding its groundwater MCL or Risk Based Concentration (RBC). The predicted time for peak groundwater concentration for RDX was 12 years, which based on site history, may have already occurred. RDX was identified in groundwater at a concentration lower than the predicted value. The leaching model is conservative and migration of these constituents may be attenuated because of moderate to high retardation factors for these constituents.

LL 4:
The SESOIL modeling results indicate that chromium, selenium, and RDX may leach from surface soil to groundwater with concentrations beneath the source area above groundwater MCLs or RBCs. The timeframe for RDX to exceed its criteria is 6 years, suggesting that such leaching has already occurred. The timeframes for chromium and selenium are 411 and 119 years, respectively, suggesting that concentrations may increase in the future. None of these constituents were detected in groundwater at LL 4. The leaching modeling is conservative and migration of these constituents may be attenuated because of moderate to high retardation factors for these constituents.

Contaminant fate and transport modeling for LLs 1-4 was based on conservative assumptions and specific information and data from each load line. Further information regarding groundwater quality related to RVAAP is presented in the RIs for LLs 1-4 (SAIC, 2004; Shaw 2004a, b, c) and numerous facility-wide groundwater sampling reports included in the project information repository.

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2.0 RISK ASSESSMENT

The baseline human health risk assessment (BHHRA) or screening human health risk assessments (SHHRAs) and ecological risk assessments (ERAs) performed for LLs 1-4 AOCs at RVAAP are available in the following documents:

- *Phase II Remedial Investigation Report for Load Line 1 at the Ravenna Army Ammunition Plant, Ravenna, Ohio* (SAIC, 2004), SHHRA in Section 6 and ERA in Section 7;
- *Phase II Remedial Investigation Report for Load Line 2 at the Ravenna Army Ammunition Plant, Ravenna, Ohio* (Shaw, 2004a), SHHRA in Section 6 and ERA in Section 7;
- *Phase II Remedial Investigation Report for Load Line 3 at the Ravenna Army Ammunition Plant, Ravenna, Ohio* (Shaw, 2004b), SHHRA in Section 6 and ERA in Section 7;
- *Phase II Remedial Investigation Report for Load Line 4 at the Ravenna Army Ammunition Plant, Ravenna, Ohio* (Shaw, 2004c), SHHRA in Section 6 and ERA in Section 7;
- *Supplemental Baseline Human Health Risk Assessment for Load Line 1 Alternative Receptors at the Ravenna Army Ammunition Plant, Ravenna, Ohio* (Shaw, 2004d); and
- *Proposed Remedial Goal Options for Soil at Load Lines 1, 2, 3, and 4 at the Ravenna Army Ammunition Plant, Ravenna, Ohio* (Shaw, 2004e).

The risk assessments included in these reports document a variety of potential human and ecological receptor populations that may exceed unacceptable risk levels and identify the COCs and chemicals of potential ecological concern (COPECs) that could contribute to potential risks from exposure to contaminated media within LLs 1-4. These risk assessments also document the calculation of risk-based RGOs for human receptors for all media (i.e., soil, surface water, sediment, and groundwater), all COCs, and all receptor populations evaluated in the RIs for LLs 1-4. Each assessment was performed using the following steps:

- Identification of COPCs,
- Calculation of risks and hazards,
- Identification of COCs,
- Calculation of RGOs, and
- Evaluation of RGOs in comparison to applicable US EPA Region 9 Preliminary Remediation Goals (PRGs).

COPCs are summarized in Table 1-1 in the previous section. As previously stated, this FFS does not address remediation of surface water or groundwater media. The potential risks from COC-impacted surface soil and sediment are summarized in the following sub-sections. The discussion on sediment does not differentiate the risks associated with dry versus wet sediment. However, this FFS is concerned only with the remediation of dry sediment.

As previously described, the load lines were divided into aggregate areas based on historical use and geographic proximity. For the risk assessment, these aggregates are referred to as exposure units (EUs).

2.1 Human Health Risk Assessment and Development of RGOs

The BHHRA is presented in the Phase II RI reports for each load line (SAIC, 2004; Shaw 2004a, b, c). The SBHHRA (Shaw, 2004d) is a supplement to the BHHRA in the RI for LL 1 (SAIC, 2004) and was developed to reflect land use decisions made by the Ohio Army National Guard. Based on the Army specified future land use, the National Guard mounted training (no digging) was used as the primary receptor in the Supplemental Baseline Human Health Risk Assessment (SBHHRA) (Shaw, 2004d). This scenario assumes the following for a National Guard Trainee:

- On-site up to 24 hours per day for 24 days per year for a total exposure frequency of 39 days per year for 25 years;

- Mounted training with no digging (i.e., training on vehicles only resulting in potential maneuver damage up to 4 feet below ground surface); and,
- Exposure via incidental ingestion, dermal contact and inhalation of vapors and fugitive dust.

The exposure assumptions used in evaluating the human health risks incorporated the presence of the facility-perimeter fencing to restrict general access to the facility for all but the Residential receptor scenario. Fencing is also currently in place around the individual load lines; however, exposure assumptions incorporated human access to these AOCs. Therefore, for the remedial alternatives evaluated in this FFS, the individual load line fencing can be removed without changing the risk analysis and exposure assumptions. The facility-wide perimeter fencing, however, should remain in place. As will be discussed in Section 4.0 with the introduction of remedial alternatives, this is consistent with the planned future land use of National Guard mounted training (no digging). The human health risk assessments are summarized in this section for the four load lines.

2.1.1 Load Line 1

This section summarizes the findings of the SBHHRA (Shaw, 2004d).

2.1.1.1 Sediment

Potential human health risks/hazards were evaluated for exposure to COPCs in sediment at three EUs. Direct contact (i.e., ingestion, dermal contact, and inhalation) with sediment was evaluated for the National Guard Trainee and Fire/Dust Suppression Worker, recreational Hunter/Trapper/Fisher, and Resident Subsistence Farmer. Indirect contact (i.e., ingestion of food) was evaluated for the recreational Hunter/Trapper/Fisher and Resident Subsistence Farmer.

Outlet C and Charlie's Pond EU

Arsenic and manganese are identified as COCs in sediment for National Guard Trainee use of the Outlet C and Charlie's Pond EU. No sediment COCs are identified for the National Guard Fire/Dust Suppression Worker and Hunter/Trapper/Fisher at this EU. Arsenic, PCB 1254, and benzo(*a*)pyrene are identified as COCs in sediment for residential use at this EU. Benzo(*a*)pyrene, PCB-1254, and arsenic are COCs for waterfowl ingestion by the Hunter/Trapper/Fisher at Outlet C and Charlie's Pond. Arsenic is a COC in sediment for fish ingestion by the Resident Subsistence Farmer at this EU.

Outlets A and B EU

Various PAHs [benzo(*a*)pyrene, benzo(*b*)fluoranthene, and dibenz(*a,h*)anthracene], arsenic, and cadmium are identified as COCs in sediment at the Outlets A and B EU for the National Guard receptors. Benzo(*a*)pyrene is the only COC identified at the Outlets A and B EU for Recreational use. Arsenic; 2,4-DNT; PCB-1254; and several PAHs [benz(*a*)anthracene, benzo(*a*)pyrene, benzo(*b*)fluoranthene, dibenz(*a,h*)anthracene, and indeno(1,2,3-*cd*)pyrene] are identified as COCs for the Resident Subsistence Farmer at this EU. Indirect contact was not evaluated at this EU. Lead was identified as a COPC in sediment at this EU.

Outlets D, E, and F, and Criggy's Pond EU

Arsenic and manganese are identified as COCs for the National Guard Trainee at the Outlets D, E, and F, and Criggy's Pond EU. No sediment COCs are identified for the National Guard Fire/Dust Suppression Worker and Hunter/Trapper/Fisher at this EU. Antimony, arsenic, and manganese are identified as COCs for residential use at this EU. Arsenic and antimony are COCs for waterfowl ingestion by the Hunter/Trapper/Fisher at this EU. Arsenic is a COC in sediment for fish ingestion by the Resident Subsistence Farmer at this EU. Lead was identified as a COPC in sediment at this EU.

2.1.1.2 Soil

Potential human health risks/hazards were evaluated for exposure to COPCs in soil at seven EUs. Direct contact (i.e., ingestion, dermal contact, and inhalation) with shallow surface soil was evaluated for the

National Guard Security Guard/Maintenance Worker and Fire/Dust Suppression Worker, recreational Hunter/Trapper/Fisher, and Resident Subsistence Farmer. Direct contact with deep surface soil was evaluated for the National Guard Trainee. Direct contact with subsurface soil and indirect contact (i.e., ingestion of food) were evaluated for the Resident Subsistence Farmer.

Two metals (arsenic and manganese), two explosives (TNT and RDX), five PAHs [benz(*a*)anthracene, benzo(*a*)pyrene, benzo(*b*)fluoranthene, dibenz(*a,h*)anthracene, and indeno(1,2,3-*cd*)pyrene], and PCB-1254 were identified as COCs for the National Guard receptors at several EUs. Only the Water Tower EU had no COCs for these receptors. Two COCs [benzo(*a*)pyrene at Buildings CB-3 and -801 and PCB-1254 at Buildings CB-4/4A and CA-6/6A] were identified for the recreational receptors.

Two metals (arsenic and antimony), four explosives (TNT; 2,4-DNT; 2,6-DNT; and RDX), five PAHs [benz(*a*)anthracene, benzo(*a*)pyrene, benzo(*b*)fluoranthene, dibenz(*a,h*)anthracene, and indeno(1,2,3-*cd*)pyrene], dieldrin, and PCB-1254 were identified as COCs for direct exposure by the Resident Subsistence Farmer at several EUs. Only the Water Tower EU had no COCs for these receptors. Additional metals, explosives, PAHs, and pesticides were identified for indirect exposure to surface soil via ingestion of vegetables, beef, and dairy products by the Resident Subsistence Farmer.

Two explosives (2,4,6-TNT and RDX) were identified as COCs in subsurface soil for the Resident Subsistence Farmer at Buildings CB-4/4A and CA-6/6A. Antimony is the only subsurface soil COC identified at Buildings CB-13 and -10.

2.1.2 Load Line 2

This section summarizes the findings of the Phase II RI for LL 2 (Shaw, 2004a).

2.1.2.1 <u>Sediment</u>

Exposure to sediment was evaluated for five receptor scenarios: National Guard Fire/Dust Suppression Worker, National Guard Trainee, Hunter/Trapper/Fisher, and Resident Farmer (adult and child). Three PAHs were identified as sediment COCs for the Resident Farmer (adult and child) scenario only: benzo(*a*)pyrene, benzo(*b*)fluoranthene, and dibenz(*a,h*)anthracene.

Ratios of EPCs to RGOs provide an indication of the estimated cancer risks. Estimated cancer risks for sediment risks would be less than 10^{-6} for the two National Guard receptors and the Hunter/Trapper/Fisher, but between 10^{-6} and 10^{-5} for the resident farmer scenarios.

2.1.2.2 <u>Soil</u>

Soil was evaluated at six EUs. Direct contact (ingestion, dermal contact, inhalation) with surface and subsurface soils was evaluated for six receptors: National Guard Security Guard/Maintenance Worker (shallow surface soil), National Guard Fire/Dust Suppression Worker (shallow surface soil), National Guard Trainee (deep surface soil), Hunter/Trapper/Fisher (shallow surface soil), and Resident Farmer (adult and child) (shallow surface soil and subsurface soil). The following summarizes the resulting COCs in soil at LL 2.

- Eighteen LL 2 COCs were identified for shallow surface soil, including 7 metals (aluminum, antimony, arsenic, cadmium, copper, manganese, and thallium), 3 explosives (2,4,6-TNT; 2,4-DNT; and RDX), 1 pesticide (dieldrin), 2 PCBs (PCB-1254 and PCB-1260), and 5 PAHs [benz(*a*)anthracene, benzo(*a*)pyrene, benzo(*b*)fluoranthene, dibenz(*a,h*)anthracene, and indeno(*1,2,3-cd*)pyrene]. The number of shallow surface soil COCs varied for each receptor, with only 1 COC for the Fire/Dust Suppression Worker and Hunter/Trapper/Fisher; 12 COCs for the Security Guard/Maintenance Worker, 13 COCs for the Resident Farmer Adult, and 18 COCs for the Resident Farmer Child. The number of shallow surface soil COCs identified for each EU also varied: 15 for the Preparation and Receiving Areas Aggregate, 14 for the Explosives Handling Areas

Aggregate, 7 for both the Packaging and Shipping Areas and the Perimeter Area Aggregates, 1 for the North Ditches Aggregate, and none for the Change Houses Aggregate.

Ratios of EPCs to RGOs provide an indication of estimated cancer risks. All estimated risks for shallow surface soil COCs would be less than 10^{-6} for the Fire/Dust Suppression Worker and Hunter/Trapper/Fisher. For the Security Guard/Maintenance Worker, most COCs would produce a cancer risk at or slightly above 10^{-6}, with the following exceptions, where the estimated cancer risk would be slightly larger than 10^{-5}: 2,4,6-TNT in the Explosives Handling Areas and the Perimeter Area Aggregates; RDX in the Explosives Handling Areas Aggregate; PCB-1254 in the Preparation and Receiving Areas Aggregate; and benzo(*a*)pyrene in the Explosives Handling Areas and the Preparation and Receiving Areas Aggregates. For the resident farmer scenarios, estimated cancer risks would exceed 10^{-5} for several shallow surface soil COCs, including: arsenic in the Explosives Handling Areas, Preparation and Receiving Areas, Packaging and Shipping Areas, and Perimeter Area Aggregates; 2,4,6-TNT in the Explosives Handling Areas and Perimeter Area Aggregates; RDX in the Explosives Handling Areas Aggregate; PCB-1254 in the Preparation and Receiving Areas Aggregate; and benzo(*a*)pyrene and dibenz(*a,h*)anthracene, both in the Explosives Handling Areas and Preparation and Receiving Areas Aggregates.

- Nine LL 2 COCs were identified for the National Guard Trainee exposed to deep surface soil, including five metals (aluminum, antimony, arsenic, hexavalent chromium, and manganese), two explosives (2,4,6-TNT and RDX), one PCB (PCB-1254), and one PAH [benzo(*a*)pyrene]. The number of deep surface soil COCs identified for each EU varied: six for both the Explosives Handling Areas and Preparation and Receiving Areas Aggregates, five for the Perimeter Area Aggregate, three for the Packaging and Shipping Areas Aggregate, and none for the Change Houses and North Ditches Aggregates.

  Ratios of EPCs to RGOs indicate that estimated cancer risks would be at or slightly above 10^{-6} for most deep surface soil COCs. One deep surface soil COC (hexavalent chromium in the Perimeter Area Aggregate) would result in cancer risk to the National Guard Trainee of slightly larger than 10^{-5}.

- Six LL 2 COCs were identified for the Resident Farmer (adult and child) exposed to subsurface soil, including three metals (aluminum, antimony, and arsenic), two explosives (2,4,6-TNT and 2,4-DNT), and one PCB (PCB-1260). The number of subsurface soil COCs identified for each EU included: five for the Explosives Handling Areas Aggregate, three for the Perimeter Area Aggregate, two for the Packaging and Shipping Areas Aggregate, and none for the Preparation and Receiving Areas Aggregate.

  Ratios of Exposure Point Concentrations (EPCs) to RGOs provide an indication of the estimated cancer risks. Estimated risks that would be greater than 10^{-5} for the resident farmer include arsenic (at the Explosives Handling Areas and Packaging and Shipping Areas Aggregates), as well as 2,4,6-TNT (at the Explosives Handling Areas and Perimeter Area Aggregates).

2.1.3 Load Line 3

This section summarizes the findings of the Phase II RI for LL 3 (Shaw, 2004b).

2.1.3.1 <u>Sediment</u>

Exposure to sediment was evaluated for five receptor scenarios: National Guard Fire/Dust Suppression Worker, National Guard Trainee, Hunter/Trapper/Fisher, and Resident Farmer (adult and child). Three chemicals were identified as sediment COCs for the Resident Farmer scenario only: antimony, PCB-1254, and benzo(*a*)pyrene. For the sediment COCs, ratios of EPCs to RGOs indicate that estimated cancer risks would be less than 10^{-6} for the two National Guard receptors, as well as for the

Hunter/Trapper/Fisher; estimated cancer risks would be at or slightly above 10^{-6} for the residential farmer scenarios.

2.1.3.2 Soil

Surface soil was evaluated at seven EUs; subsurface soil was evaluated at three EUs. Direct contact (ingestion, dermal contact, and inhalation) with surface and subsurface soils was evaluated for six receptors: National Guard Security Guard/Maintenance Worker (shallow surface soil), National Guard Fire/Dust Suppression Worker (shallow surface soil), National Guard Trainee (deep surface soil), Hunter/Trapper/Fisher (shallow surface soil), and Resident Farmer (adult and child) (shallow surface soil and subsurface soil). The following summarizes the resulting COCs in soil at LL 3.

- Twenty-one LL 3 COCs were identified for shallow surface soil, including 7 metals (aluminum, antimony, arsenic, barium, cadmium, manganese, and thallium), 4 explosives (1,3-DNB; 2,4,6-TNT; 2,4-DNT; and RDX), 2 PCBs (PCB-1254 and PCB-1260), 3 pesticides (4,4'-DDE; dieldrin; and heptachlor), and 5 PAHs [benz(*a*)anthracene, benzo(*a*)pyrene, benzo(*b*)fluoranthene, dibenz(*a,h*)anthracene, and indeno(1,2,3-*cd*)pyrene]. The number of shallow surface soil COCs varied for each receptor, with 2 COCs for the Hunter/Trapper/Fisher; 3 COCs for the Fire/Dust Suppression Worker, 13 COCs for the Security Guard/Maintenance Worker, 17 COCs for the Resident Farmer Adult, and 21 COCs for the Resident Farmer Child. The number of shallow surface soil COCs identified for each EU also varied: 3 for both the DLA Storage Tanks and Change Houses Aggregates, 8 for the Preparation and Receiving Areas Aggregate, 10 for the Packaging and Shipping Areas Aggregate, 11 for both the Perimeter Area and West Ditches Aggregates, and 16 for the Explosives Handling Areas Aggregate.

  Ratios of EPCs to RGOs provide an indication of estimated cancer risks. Most COCs have EPCs that would produce cancer risks of less than 10^{-5}; a handful of COCs would produce risks in excess of 10^{-5} for receptors other than the resident farmer: PCB-1254 in six of the seven aggregates (all except the DLA Storage Tanks Aggregate; estimated risk for PCB-1254 would exceed 10^{-4} for the Security Guard/Maintenance Worker in the in the Explosives Handling Areas and Packaging and Shipping Areas Aggregates); 2,4,6-TNT in the Explosives Handling Areas and Packaging and Shipping Areas Aggregates; and benzo(*a*)pyrene in the Explosives Handling Areas and West Ditches Aggregates. Estimated risks for several COCs would exceed the 10^{-5} risk level for the resident farmer scenarios, including arsenic; 2,4,6-TNT ($>10^{-4}$ in the Explosives Handling Areas Aggregate); 2,4-DNT; PCB-1254 ($>10^{-4}$ in the Explosives Handling Areas, Packaging and Shipping Areas, and Perimeter Area Aggregates); and benzo(*a*)pyrene, benzo(*b*)fluoranthene, and dibenz(*a,h*)anthracene.

- Eight LL 3 COCs were identified for the National Guard Trainee exposed to deep surface soil, including five metals (aluminum, arsenic, barium, cadmium, and manganese), one explosive (2,4,6-TNT), one PCB (PCB-1254), and one PAH [benzo(*a*)pyrene]. The number of deep surface soil COCs identified for each EU varied: two for the DLA Storage Tanks Aggregate, three for both the Change Houses and Preparation and Receiving Areas Aggregates, four for the West Ditches Aggregate, five for the Perimeter Area Aggregate, six for the Explosives Handling Areas Aggregate, and seven for the Packaging and Shipping Areas Aggregate.

  Ratios of EPCs to RGOs indicate that estimated cancer risks would be at or slightly above 10^{-6} for most deep surface soil COCs; two COCs would result in estimated cancer risk to the National Guard Trainee of slightly larger than 10^{-5} at the Explosives Handling Areas Aggregate (2,4,6-TNT and PCB-1254), the Packaging and Shipping Areas Aggregate (PCB-1254), and the Perimeter Area Aggregate (PCB-1254).

- Five LL 3 COCs were identified for the Resident Farmer (adult and child) exposed to subsurface soil, including two metals (arsenic and cadmium), two explosives (2,4,6-TNT and RDX), and one PCB (PCB-1254). The number of subsurface soil COCs identified for each EU included four for the Perimeter Area Aggregate, three for the Explosives Handling Areas Aggregate, and one for the Preparation and Receiving Areas Aggregate.

  Ratios of EPCs to RGOs provide an indication of estimated cancer risks. Estimated risks that would be greater than 10^{-5} for the resident farmer include arsenic and PCB-1254 ($>10^{-4}$) at the Explosives Handling Areas Aggregate, arsenic and 2,4,6-TNT at the Perimeter Area Aggregate, and arsenic at the Preparation and Receiving Areas Aggregate.

2.1.4 Load Line 4

This section summarizes the findings of the Phase II RI for LL 4 (Shaw, 2004c)

2.1.4.1 Sediment

Exposure to sediment was evaluated for five receptor scenarios: National Guard Fire/Dust Suppression Worker, National Guard Trainee, Hunter/Trapper/Fisher, and Resident Farmer (adult and child). The following summarizes the resulting COCs in sediment at LL 4.

Aluminum was the only COC identified for the National Guard Trainee exposed to sediment; this COC and thallium were also identified for the On-Site Residential Farmer Child. Both COCs were identified for the Main Stream Segment Downstream of Perimeter Road Bridge and the Settling Pond Aggregate; no sediment COCs were identified for the Main Stream Segment Upstream of Perimeter Road Bridge or Exit Drainage Aggregates. Aluminum and thallium are both non-carcinogenic chemicals.

2.1.4.2 Soil

Surface soil was evaluated at six EUs; subsurface soil was evaluated at four EUs. Direct contact (ingestion, dermal contact, and inhalation) with surface and subsurface soils was evaluated for six receptors: National Guard Security Guard/Maintenance Worker (shallow surface soil), National Guard Fire/Dust Suppression Worker (shallow surface soil), National Guard Trainee (deep surface soil), Hunter/Trapper/Fisher (shallow surface soil), and Resident Farmer (adult and child) (shallow surface soil and subsurface soil). The following summarizes the resulting COCs in soil at LL 4.

- Eleven LL 4 COCs were identified for shallow surface soil, including 4 metals (aluminum, arsenic, manganese, and thallium), 2 PCBs (PCB-1254 and PCB-1260), and 5 PAHs [benz(*a*)anthracene, benzo(*a*)pyrene, benzo(*b*)fluoranthene, dibenz(*a,h*)anthracene, and indeno(1,2,3-*cd*)pyrene]. The number of shallow surface soil COCs varied for each receptor: none for the Fire/Dust Suppression Worker and Hunter/Trapper/Fisher; six COCs for the Security Guard/Maintenance Worker; eight COCs for the Resident Farmer Adult; and nine COCs for the Resident Farmer Child. The number of shallow surface soil COCs identified for each EU also varied: 2 for both the Melt-Pour Drainage Ditches and Perimeter Area Aggregates; 4 for both the Packaging and Shipping Areas and the Change Houses Aggregates; 5 for the Preparation and Receiving Areas Aggregate; and 11 for the Explosives Handling Areas Aggregate.

  Ratios of EPCs to RGOs provide an indication of estimated cancer risks. All estimated risks for shallow surface soil COCs would be less than 10^{-6} for the Fire/Dust Suppression Worker and Hunter/Trapper/Fisher. For the Security Guard/Maintenance Worker, most COCs would produce a cancer risk at or slightly above 10^{-6}, with one exception: the estimated cancer risk would be slightly larger than 10^{-5} for PCB-1254 in the Preparation and Receiving Areas Aggregate. For the resident farmer scenarios, estimated cancer risks would exceed 10^{-5} for several shallow surface soil COCs, including: arsenic in the Explosives Handling Areas, Preparation and Receiving Areas, and Melt-

Pour Drainage Ditches Aggregates; PCB-1254 in the Preparation and Receiving Areas Aggregate; PCB-1260 in the Explosives Handling Areas Aggregate; and benzo(*a*)pyrene in the Explosives Handling Areas Aggregate.

- Four LL 4 COCs were identified for the National Guard Trainee exposed to deep surface soil, including three metals (aluminum, arsenic, and manganese), and one PCB (PCB-1254). The number of deep surface soil COCs identified for each EU varied: none for the Change Houses Aggregate; one for the Melt-Pour Drainage Ditches, Packaging and Shipping Areas, and Perimeter Area Aggregates; three for the Explosives Handling Areas Aggregate; and four for the Preparation and Receiving Areas Aggregate.

  Ratios of EPCs to RGOs indicate that estimated cancer risks would be below 10^{-6} for most deep surface soil COCs; two COCs would result in estimated cancer risk to the National Guard Trainee of slightly larger than 10^{-6} at the Explosives Handling Areas Aggregate (arsenic); at the Preparation and Receiving Areas Aggregate (arsenic and PCB-1254); and at the Melt-Pour Drainage Ditches Aggregate (arsenic).

- Two metals were identified as LL 4 subsurface soil COCs for the resident farmer scenarios: aluminum and manganese. The COCs were identified for the Preparation and Receiving Areas Aggregate only; no subsurface soil COCs were identified for the Explosives Handling Areas, Packaging and Shipping Areas, or Perimeter Area Aggregates. Aluminum and manganese are both non-carcinogenic chemicals.

2.1.5 Development of RGOs

RGOs are medium-specific goals that the remedial actions are expected to accomplish to protect human health and the environment. They guide the formulation and evaluation of remedial alternatives. RGOs have been developed to reflect the anticipated future land use for LLs 1-4 of the RVAAP in accordance with US EPA land use policy (US EPA, 1995).

The intended future land use for LLs 1-4 is for National Guard mounted training (no digging). Based on this intended future land use, risk-based RGOs for the National Guard Trainee are the primary risk-based RGOs applicable to LLs 1-4 soil at RVAAP (Shaw, 2004e). COCs for soil for the National Guard Trainee receptor are summarized in Table 2-1.

Table 2-1. COCs in Soil for National Guard Trainee at LLs 1-4[a]

Chemical	COC[b]			
	LL 1	LL 2	LL 3	LL 4
Inorganics				
Aluminum		X	X	X
Antimony		X		
Arsenic	X	X	X	X
Barium			X	
Cadmium			X	
Chromium, hexavalent		X		
Manganese	X	X	X	X
Explosives				
2,4,6-TNT	X	X	X	
RDX	X	X		
PCBs				
Aroclor-1254	X	X	X	X
SVOCs				
Benz(a)anthracene	X			
Benzo(a)pyrene	X	X	X	
Benzo(b)fluoranthene	X			
Dibenz(a,h)anthracene	X			

[a] Deep (0 to 4 feet below ground surface) surface soil is used for National Guard Trainee.
[b] COCs are those contaminants that have an Incremental Lifetime Cancer Risk (ILCR) greater than 10^{-6} an/or a Hazard Index (HI) greater than 1 for a given land use scenario.
X – Chemical is a COC for at least one soil aggregate at this load line.

Risk-based RGOs were calculated assuming a combined exposure through ingestion, inhalation of vapors and fugitive dust, and dermal contact with soil. For chemicals having both a cancer and non-cancer endpoint, risk-based RGOs were calculated for both cancer risk and non-cancer hazard, and the lower of the two values is used as the final risk-based RGO. Risk-based RGOs were calculated assuming a 10^{-5} target excess individual lifetime cancer risk (TR) for carcinogens and an acceptable target hazard index (THI) of 1 for non-carcinogens consistent with Ohio EPA guidance. The following is a summary of the target risk from the RGO document (Shaw, 2004e):

- LL 1 – Nine COCs were identified in soil for the National Guard Trainee: seven carcinogens and two non-carcinogens. Of the seven carcinogens, one (arsenic) is a class A carcinogen associated with lung tumors; four PAHs [benz(a)anthracene (stomach tumors), benzo(a)pyrene (larynx/stomach tumors), benzo(b)fluoranthene (tumors), and dibenz(a,h)anthracene (immunodepressive effects)] are class B2 carcinogens that might have some similarities in target organs (mostly stomach or undefined tumors); Aroclor-1254 is also a class B2 carcinogen, but with potential effects to the liver; RDX is a class C carcinogen for liver effects. The two non-carcinogens (manganese and TNT) have differing toxic endpoints (central nervous system (CNS) and liver, respectively).

- LL 2 – Nine COCs were identified in soil for the National Guard Trainee: five carcinogens and four non-carcinogens. Of the five carcinogens, two (arsenic and hexavalent chromium) are class A carcinogens and have similar target organs (lungs or respiratory system); two [Aroclor-1254 and benzo(a)pyrene] are class B2 carcinogens, but with differing target organs (liver and larynx/stomach); and one (RDX) is a class C carcinogen potentially associated with liver cancer. The four non-carcinogens (aluminum; antimony; manganese and 2,4,6-TNT) have differing toxic endpoints (not defined, gastrointestinal/liver/development, CNS and liver, respectively).

- LL 3 – Eight COCs were identified in soil for the National Guard Trainee: three carcinogens and five non-carcinogens. Of the three carcinogens, one (arsenic) is a class A carcinogen with the lungs or respiratory system as the target organ, and two [Aroclor-1254 and benzo(a)pyrene] are class B2 carcinogens, but with differing target organs (liver and larynx/stomach). The five non-carcinogens (aluminum; barium; cadmium; manganese and 2,4,6-TNT) have differing toxic endpoints (not defined, blood, kidney, CNS and liver, respectively).

- LL 4 – Four COCs were identified in soil for the National Guard Trainee: two carcinogens and two non-carcinogens. Of the two carcinogens, one (arsenic) is a class A carcinogen with the lungs or respiratory system as the target organ, and the other one (Aroclor-1254) is a class B2 carcinogen, with a different target organ (liver). The two non-carcinogens (aluminum and manganese) have differing toxic endpoints (not defined and CNS, respectively).

The resulting risk-based RGOs for the National Guard Trainee are presented in Table 2-2.

Table 2-2. Risk-Based RGOs for the National Guard Trainee for Soil at LLs 1-4[a]

COC	Risk-Based RGO (mg/kg)	Background[b] (mg/kg)
Inorganics		
Aluminum	34,942	17,700
Antimony	2,458	0.96
Arsenic	31	15.4
Barium	3,483	88.4
Cadmium	109	NA
Chromium, hexavalent	16	NA
Manganese (surface soils)	351	1,450
Explosives		
2,4,6-TNT	1,646	NA
RDX	838	NA
PCBs		
Aroclor-1254	35	NA
SVOCs		
Benz(a)anthracene	105	NA
Benzo(a)pyrene	10	NA
Benzo(b)fluoranthene	105	NA
Dibenz(a,h)anthracene	10	NA

[a] Deep (0 to 4 feet below ground surface) surface soil is used for National Guard Trainee.
[b] Final facility-wide background values for RVAAP from the *Phase II Remedial Investigation Report for the Winklepeck Burning Grounds at the Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE, 2001). Background values for soil are available for two soil depths: surface (0 to 1 feet below ground surface) and subsurface (1 to 12 feet below ground surface); the minimum value for these two aggregates is reported.
NA – Not available

The proposed risk-based RGO for manganese of 351 mg/kg is below the background and established US EPA Region 9 PRG concentrations. In addition, the US EPA Region 9 PRG for manganese in soils is 1,800 mg/kg. This issue was discussed during a meeting held between the various stakeholders in Dayton, Ohio on May 17, 2004 and in subsequent correspondence between Ohio EPA, the Army and Shaw. RVAAP-specific background for various constituents (including manganese) was established at the RVAAP during the Winklepeck Burning Grounds RI effort. Sampling was conducted at various locations at the facility where there was reasonable certainty that no impact to the location by facility operations would have occurred. Additionally, prior to establishing the background values, all analytical data was carefully screened and evaluated. The Ohio EPA was a part of this process and agreed to the resulting background values. Although the calculated risk-based RGO for manganese is less than the background and PRG values, there is no policy in effect whereby the Ohio EPA has to recommend or compel an entity to clean up to less than background values or those shown to be protective of human health. As a result, the concentration of 1,800 mg/kg of manganese in soil will be used as the clean-up criterion for surface soils under this effort. Where applicable, the RVAAP-specific background concentration of 3,030 mg/kg of manganese for subsurface soils will be used as the project-specific RGO for subsurface soils.

Lead is not a COC for the National Guard Trainee because the exposure frequency for this receptor is close to the biological half-life of lead. Therefore, no risk-based RGO can be calculated, nor is one required. At the request of the Ohio EPA (Ohio EPA, 2004), the National Guard Trainee exposure parameters are used with the preliminary remediation goal (PRG) calculator for the Interim Adult Lead Methodology, along with the most recently recommended values for baseline blood lead concentration and geometric standard deviation from EPA (2002). The resulting provisional RGO (a.k.a. PRG) ranges from 1,995 to 3,663 mg/kg. The estimated Exposure Point Concentration of lead at the water tower Exposure Unit at Load Line 1 exceeds the lower end of this range. However, it must be noted that use of this calculator is not recommended for receptors with less than a constant lead intake over a duration of 90 days, and the annual exposure duration for the National Guard Trainee is only 39 days. The estimated Exposure Point Concentrations of lead at all Exposure Units at LLs 2-4 are below this provisional range. Ohio EPA agreed to a provisional lead RGO of 1,995 mg/kg in the May 17, 2004 meeting mentioned above.

Table 2-3 summarizes the clean-up levels for the remediation of surface and subsurface soils and dry sediments at LLs 1-4. These clean-up levels are based on a future land use of mounted training, no digging with the target receptor being the National Guard Trainee.

Table 2-3. Project Specific Clean-up Criteria for the National Guard Trainee for Soil at LLs 1-4

COC	Clean-up Criterion (mg/kg)
Aluminum	34,942
Antimony	2,458
Arsenic	31
Barium	3,483
Cadmium	109
Chromium, hexavalent	16
Manganese (surface soils)	1,800
Manganese (subsurface soils)	3,030
Lead	1,995
2,4,6-TNT	1,646
RDX	838
Aroclor-1254	35
Benz(a)anthracene	105
Benzo(a)pyrene	10
Benzo(b)fluoranthene	105
Dibenz(a,h)anthracene	10

Risk-based RGOs for residential receptors were also calculated to evaluate whether certain areas of LLs 1-4 could be eligible for unrestricted land use (Shaw, 2004e). However, this FFS focuses on the intended land use for National Guard mounted training (no digging) only. Further evaluation of remedial requirements to attain a closure goal based on unrestricted future use of LLs 1-4 would be covered under a separate contract by the Army if it is determined that a change to the proposed future land use is necessary.

2.2 Ecological Risk Assessment and Development of RGOs

Establishment of Hazard Quotients (HQ) and Chemicals of Environmental Concern (COECs) are presented in the documents listed in Section 2.0. Quantitative RGOs for soil are not needed for ecological receptors at LLs 1-4. The rationale, as presented in the Proposed RGO document (Shaw, 2004e), has the following four elements:

- Ecological risk has been predicted for vegetation and small mammals, as evidenced by relatively high HQs at LL 1; at LLs 2-4, ecological risks are predicted to be smaller than at LL 1 because the exposure and HQs are lower. These HQs are perceived to have a high degree of uncertainty and are considered conservative.

- Mitigations for human health protection will simultaneously protect ecological resources.

- Habitat alteration may be intensive and likely extensive to meet the military land-use mission (mounted training (no digging)).

- No unique ecological resources are found at LLs 1-4, and nearby habitat offers home ranges for wildlife to escape from mounted training (no digging) activities. In addition, no to little off-site (i.e., outside the load lines) contaminant migration has occurred, which means that the nearby habitats offer a safe environment.

Multiple soil COECs with large HQs were identified for multiple ecological receptors at each of the load lines in the Level III baseline ERAs (SAIC, 2002, 2004; Shaw, 2004a, b, c). These HQs are perceived to have a high degree of uncertainty and are considered conservative as they were calculated utilizing maximum detected contaminant concentrations not the lower average values. These COECs are summarized in Table 2-4 from the Proposed RGO document (Shaw, 2004e).

Table 2-4. Overview of Soil COECs Contributing to Ecological Risk at LLs 1-4

Area of Concern	COECs with Highest HQs		Other COECs with HQs>1	
	Chemicals	HQs	Chemicals	HQs
LL 1	Aroclor-1254 and chromium	(110,000 and 626, respectively)	Lead, zinc, and 16 others[a]	1.1 to 53,000
LL 2	Aroclor-1254 and chromium	(69 and 97, respectively)	Antimony, lead and 5 others[a]	1.1 to 49
LL 3	Aroclor-1254 and chromium	(442 and 159, respectively)	Barium, zinc, and 8 others[a]	1 to 69
LL 4	Aroclor-1254 and chromium	(72 and 88, respectively)	Thallium, zinc, and 6 others[a]	1.1 to 45

[a] Aluminum HQs exceeded 1 for various ecological receptors at LLs 1-4, and iron HQs exceeded 1,000 for plants at LLs 1-4; however, their risks were deemed minimal, as described in the ERAs, so they are not included.

Remedial activities will decrease the concentrations of COECs and reduce the number of COECs in soil to which ecological receptors are exposed, thereby reducing ecological risk. In addition, remediation will indirectly affect the potential exposure pathways to COECs through the food web and habitat. National Guard mounted training (no digging) activities will also result in habitat alteration through cleared vegetation, harmed vegetation and soil compaction. Habitat alteration may be extensive and result in soil compaction (damage to ecosystem), vegetation damage and removal (simpler or missing habitat), shorter food chains (simpler ecosystem), and lower exposure (fewer organisms). These impacts will cause potential ecological receptors to seek food and shelter elsewhere, thereby reducing ecological risk. Suitable nearby habitats are available to receive fleeing wildlife.

Given the compelling reasons for lack of ecologically based remediation, ecologically based RGOs are not needed under the implementation of the interim remedy for soils at LLs 1-4. Prior to final closure, it may be necessary to reevaluate the need to develop ecological RGOs for potential receptors at LLs 1-4 depending on changes resulting from remedy implementation and proposed construction activities to support the OHARNG mission.

2.3 Results of November 2004 Data Gap Analysis and Additional Soil Sampling

Additional sampling of soils was conducted at LLs 1-4 to further define the extent of contamination and fill potential data gaps from the RIs (SAIC, 2004; Shaw, 2004a, b, c). Rationale and locations for sampling were provided in the *Final Sampling and Analysis Plan for the Data Gap Analysis and Additional Sampling in Support of the Remediation of Soil at Load Lines 1, 2, 3, and 4 at the Ravenna Army Ammunition Plant, Ravenna, Ohio* dated October 2004 (SAP; Shaw, 2004f). The following sections detail the sampling implementation, results of the sampling and effectiveness of field analysis compared to fixed-base laboratory analysis.

2.3.1 Implementation

Shaw personnel mobilized to the site on November 1, 2004 to mark locations for sampling, clear the areas of munitions and explosives of concern (MEC) and direct the landscaper to clear and grub vegetation.

Shaw sampling personnel and the mobile laboratory mobilized to the site on November 8, 2004 and began sampling activities on November 9, 2004. Field activities were completed on December 6, 2004. Samples were collected in accordance with the SAP (Shaw, 2004f) and field screened for metals, PCBs or explosives depending on the required analysis. The purpose of the field screening was to assess if the concentration of the COC was above the respective Risk-Based RGO listed in Table 2-2. For field screening purposes, the surface soil background concentration of 1,450 mg/kg for manganese (Table 2-2) was used in the evaluation of proposed sampling locations instead of the Risk-Based RGO of 351 mg/kg. In addition, the provisional lead RGO of 1,995 mg/kg was used as an action level for this analysis.

If the field screening result indicated a concentration above the RGO (or Background for manganese), then an additional sample would be taken in the respective horizontal direction (“stepout”), or vertical with depth, and field screened again. A horizontal stepout location was approximately 10 feet, whereas a vertical stepout location was one foot. Once the field screening results indicated a concentration below the RGOs (or Background for manganese), the final sample was sent to the fixed-based laboratory for confirmatory analysis.

Due to number of samples that exceeded the Background concentration for manganese, it was decided that the continuance of stepout sampling would be stopped after the field screening results were below 2,000 mg/kg or after three stepouts, whichever occurred first. Rationale for this limit was that three stepouts in the area confirms that the area is not a random detection, provides enough information as to the magnitude of the impact to soil, indicates that the material may be at a naturally occurring level that will be addressed in possible RGO reevaluations, and if remediation is necessary, data gaps related to extent would be addressed by final confirmation samples.

Comparisons of the field screening results to the fixed-base laboratory results are included in Section 2.3.3.

Through comparison of field data to laboratory manganese data and discussions with NITON, Shaw realized that NITON had recommended the incorrect model X-ray fluorescence spectrometry (XRF) instrument for this application. Appendix A details calibration issues and corrective actions for the field manganese screening. In addition, sampling personnel inadvertently neglected to analyze a high TNT sample for nitrate, and by the time the error was realized, the holding time for the sample had expired. However, the results of the field screening compared to the fixed-base laboratory results for the explosives analysis show good correlation, and, thus, for these samples, it appears that nitrate was not an issue.

2.3.2 Results

The results for the November 2004 soil sampling event are summarized in the tables provided in Appendix B. Table B-1 indicates the status of each of the stepout locations grouped by Original Station Identification (ID) from the RI sampling effort. Pink colored cells indicate that the extent of the COC was not defined, and green colored cells indicate that the extent of the COC was defined to below the RGO concentration. Tables B-2, B-3, and B-4 provide a summary of the field and analytical results and Table B-5 provides the details of the sampling locations (i.e., ID, northing and easting, and depth). An electronic copy of the laboratory data reports is provided in Appendix B.

The following paragraph details the results of each Original Station ID (from RI) extent sampling and is organized by the drawings on which the samples and results are depicted. In the following descriptions, field analysis is indicated by “field” and laboratory analysis is indicated by “laboratory”. Compass directions N, S, E, W are used for North, South, East, and West, respectively, to describe direction of location from the original station location. RGOs and Background refer to the values listed in Table 2-2 as presented in the RGO document (Shaw, 2004e).

2.3.2.1 Load Line 1

The November 2004 soil sampling locations in LL 1 are divided into four sampling areas as shown on Figure 2-1(1). The individual areas are shown with sampling results on Figures 2-1(2) through 2-1(5). The results of this additional sampling in LL 1 are described in this section and organized by Original Station ID.

LL1-068
Samples were collected in the SE direction (Figure 2-1(2)). Samples were collected until the field XRF manganese result was below Background at 20 feet from the original location.

LL1-253
Samples were collected in four directions for the laboratory analysis of hexavalent chromium (Figure 2-1(2)). Results were below the RGO.

LL1-111, LL1-112, LL1-113, LL1-117, LL1-118
Only one sample was collected in the direction specified for each location due to the contiguous location of the samples along the Northeast side of building CB-13B (Figure 2-1(2)). LL1-111 stepout and LL1-113 stepout were below the Background for manganese as determined by the XRF. No confirmation sample was submitted to the laboratory.

LL1-119
Samples were collected in two directions until a manganese concentration below Background was determined by XRF in the field samples (Figure 2-1(2)). The samples submitted to the laboratory for both directions did not confirm the XRF field results that were below Background, (i.e, the fixed-base laboratory results indicated manganese concentrations above Background). No additional samples were collected beyond 30 feet as directed by the screening logic presented above.

LL1-357
Samples were collected at depth and in the NE direction (Figure 2-1(3)). The sample collected at depth was below the TNT RGO. The sample collected in the NE direction exceeded the TNT RGO. The next horizontal stepout location was obstructed, and moved to the ENE direction. The sample results from the ENE direction indicated concentrations of TNT and RDX below the RGOs.

LL1-009
One sample was collected in the NW direction (Figure 2-1(3)). No depth sample was collected due to refusal. A concrete pad is located underneath the residual soils. The NW sample was located on the concrete pad. The field lead result was above the provisional RGO. No further sample was collected in the NW direction due to the presence of a building structure and a 5 to 6-foot increase in height. Also, there was visual evidence of paint chips at the refusal point. The concrete pad is suspected to have been coated or painted.

LL1-158
One sample was collected for field analysis of lead and PCBs (Figure 2-1(3)). The first stepout (LL1-457) was above the RGO for PCBs as determined by field screening. The field screening lead value was below the provisional RGO. The second stepout (LL1-473) sample was below the RGO for PCBs.

LL1-157
Samples were collected at depth and two directions for TNT and RDX (Figure 2-1(3)). Field and laboratory samples were below the RGOs.

LL1-148
Samples were collected at depth and two directions for analysis of PCBs (Figure 2-1(3)). The less than RGO field sample was achieved at the depth interval of 2 to 3 feet. The horizontal stepout samples were below the RGO.

LL1-008
Samples were collected in four directions (Figure 2-1(3)). Field and laboratory samples were below the Background for manganese.

LL1-325
A depth sample was collected for field and laboratory analysis of TNT (Figure 2-1(3)). The field screening result was less than the RGO. The sample was inadvertently not sent to the fixed-base laboratory for analysis.

LL1-397
Samples were collected in four directions for field and laboratory analysis of manganese (Figure 2-1(4)). This area is outside the fenced area of LL 1 near a culvert under the railroad bed. One sample from the southern direction (LL1ss-467) fixed-base laboratory result for manganese exceeded Background at a concentration of 1,740 mg/kg. The other samples were below Background.

LL1-399
Samples were collected in four directions for field and laboratory analysis of manganese (Figure 2-1(4)). This area is outside the fenced area of LL 1 near a culvert under the railroad bed. One sample from the southern direction (LL1ss-463) fixed-base laboratory result for manganese exceeded Background at a concentration of 1,800 mg/kg. The other samples were below Background.

LL1-409
Samples were collected in three directions for field and laboratory analysis of manganese and arsenic (Figure 2-1(4)). One sample from the northernmost location (LL1-445) exceeded Background for manganese. An additional stepout was not collected since the XRF result was less than 2,000 mg/kg. Analytical results from the east and south directions were below the arsenic RGO and manganese Background.

LL1-205
Samples were collected in four directions for manganese (Figure 2-1(4)). The overall area consisted of a similar soil type. After sampling the third stepout with manganese above Background, additional stepouts were not collected. The suspected area of soils containing manganese above Background could be approximately 60 feet by 100 feet based upon visual evidence of similar soil type and color. The area appears to be filled in with coarse material.

LL1sd-060
Samples were collected in four directions for analysis of arsenic (Figure 2-1(5)). The fixed-base laboratory result for the sample collected in the east direction (LL1-452) was above the RGO for arsenic at 43.3 mg/kg.

LL1-288
Samples were collected in four directions for analysis of manganese (Figure 2-1(5)). Stepout samples were below Background.

2.3.2.2 Load Line 2

The November 2004 soil sampling locations in LL 2 are divided into four sampling areas as shown on Figure 2-2(1). The individual areas are shown with sampling results on Figures 2-2(2) through 2-2(5). The results of this additional sampling in LL 2 are described in this section and organized by Original Station ID.

LL2-104
Samples were collected in three directions for field and laboratory analysis of manganese (Figure 2-2(2)). Stepout locations are below Background.

LL2-101
Samples were collected at depth and in three horizontal directions for field and laboratory analysis of manganese (Figure 2-2(2)). Stepout locations were below Background. An additional depth sample (interval) was collected and was below Background.

LL2-086
One sample was collected for analysis of TNT (Figure 2-2(2)). Analytical results indicated concentrations below the RGO.

LL2-094
Samples were collected in two directions for field and laboratory analysis of TNT (Figure 2-2(2)). Results indicated concentrations of TNT are below the RGO.

LL2-232
Samples were collected in two directions for analysis of manganese (Figure 2-2(2)). Stepout locations are below Background. One stepout location was collected at 19 feet rather than 10 feet due to a building demolition pile at the 10 feet location.

LL2ss-032
Samples were collected in four directions for analysis of manganese (Figure 2-2(3)). The laboratory results for the sample collected in the NE direction (LL2ss-286) did not confirm the field results of manganese below 2,000 mg/kg. Therefore, a data gap remains in the NE direction. Since the field analysis of manganese was less than 2,000 mg/kg, no additional stepout samples were collected.

LL2ss-031
Samples were collected in two directions for field and laboratory analysis of manganese (Figure 2-2(3)). The laboratory results for the sample collected in the NW direction (LL2ss-306) did not confirm the field result that indicated a concentration below 2,000 mg/kg. Since the field analysis of manganese was less than 2,000 mg/kg, no additional stepout samples were collected.

LL2-166
There was one sample collected for analysis of lead, manganese and PCBs (Figure 2-2(3)). The sample was field screened for PCBs and submitted to the laboratory prior to field testing for metals. The laboratory was contacted to analyze this sample for lead and manganese. The PCBs, lead, and manganese concentrations are below the RGO, provisional RGO and Background, respectively.

LL2-243
There was one sample collected for analysis of lead (Figure 2-2(3)). The result is below the provisional RGO.

LL2ss-044
Samples were collected at depth and two directions for analysis of TNT (Figure 2-2(3)). The results are below the RGO.

LL2ss-014
Samples were collected at depth and one direction for analysis of RDX (Figure 2-2(3)). The results are below the RGO.

LL2-188
There was one sample collected for the analysis of lead and hexavalent chromium (Figure 2-2(4)). The results are less than the provisional RGO and RGO, respectively.

LL2-178
There was one sample collected for the analysis of lead (Figure 2-2(4)). The result is less than the provisional RGO.

LL2-167
There was one sample collected for analysis of lead, manganese and PCBs (Figure 2-2(4)). The sample was field screened for PCBs and submitted to the laboratory prior to testing for metals in the field. The laboratory was contacted to analyze this sample for lead and manganese. The PCBs, lead and manganese concentrations are below the RGO, provisional RGO and Background, respectively.

2.3.2.3 Load Line 3

The November 2004 soil sampling locations in LL 3 are divided into five sampling areas as shown on Figure 2-3(1). The individual areas are shown with sampling results on Figures 2-3(2) through 2-3(6). The results of this additional sampling in LL 3 are described in this section and organized by Original Station ID.

LL3ss-022
Samples were collected in two directions for analysis of manganese (Figure 2-3(2)). Analytical results from the sample collected in the NW direction (LL3-304) did not confirm the field screening result of manganese below 2,000 mg/kg.

LL3ss-021
Samples were collected in two directions for analysis of manganese (Figure 2-3(2)). Although the field analysis indicated concentrations below 2,000 mg/kg these results were not confirmed with fixed-based laboratory data.

LL3-097
Samples were collected in two directions for analysis of manganese (Figure 2-3(2)). The maximum of three stepouts were collected in the NE direction and concentrations remain above Background. The NW sample field result of 1,020 mg/kg was not confirmed by laboratory analysis which indicated a concentration of 1,930 mg/kg.

LL3ss-034
Samples were collected in two directions for analysis of TNT (Figure 2-3(2)). The results in both directions are below the RGO.

LL3-046(p2)
Samples were collected at depth and in four directions for analysis of manganese (Figure 2-3(2)). The laboratory result in the S direction (LL3ss-253) indicated a manganese concentration of 1,590 mg/kg and

in the west direction (LL3ss-308) of 2,010 mg/kg. Additional stepout samples were not collected since the field analysis result was less than 2,000 mg/kg.

LL3-149
Samples were collected in two directions for analysis of manganese (Figure 2-3(2)). The laboratory analytical result for the stepout location in the SW direction (LL3-299) was above Background at 2,750 mg/kg. The sample collected in the NE direction was below Background.

LL3-077
Samples were collected in two directions for the analysis of manganese, lead and PCBs (Figure 2-3(2)). A data gap remains for the NW direction for manganese and lead. The PCB result was less than the RGO. The sample was sent to the laboratory prior to field analysis for metals. The laboratory results for lead and manganese were below the provisional RGO and Background, respectively.

LL3ss-002
Samples were collected at depth and in two directions for analysis of TNT (Figure 2-3(3)). An additional depth sample was required. The results in two directions are below the RGO. The depth sample from 3 to 4 feet is below the RGO.

LL3-102
Samples were collected in the NE direction for analysis of manganese and PCBs (Figure 2-3(3)). The depth sample was at refusal and therefore no sample was collected. The NE direction was sampled until below PCBs RGO and manganese Background.

LL3-230
Samples were collected in two directions for analysis of TNT (Figure 2-3(4)). Results were below the RGO.

LL3-158
Samples were collected in two directions for analysis of manganese (Figure 2-3(4)). The maximum three stepouts were collected in the E direction ending with sample LL3ss-331 with a laboratory result of 4,490 mg/kg. The northern direction was defined to below Background.

LL3-153
There was one sample collected for analysis of manganese (Figure 2-3(4)). The result is less than Background.

LL3-231
Samples were collected in two directions for analysis of TNT (Figure 2-3(4)). Results were below the RGO.

LL3-150
Samples were collected in three directions for analysis of manganese (Figure 2-3(5)). The results are less than Background.

LL3sd-049(d)
Samples were collected in three directions for analysis of manganese (Figure 2-3(5)). No depth sample was collected due to refusal. Results are less than Background.

LL3-049(p2)
Samples were collected at depth and in two directions for analysis of manganese (Figure 2-3(5)). The field screening result for the depth sample indicates a concentration below Background; however, the laboratory result indicates a concentration slightly above Background at 1,640 mg/kg. Due to the less than Background field screening result, another depth sample was not collected. The extent to the NE was defined. The field screening result for the SW sample (LL3ss-272) was below Background; however, a laboratory sample was not submitted as the sample was inadvertently discarded.

LL3ss-012
Samples were collected at depth and in two directions for analysis of TNT (Figure 2-3(5)). The results in two directions are below the RGO. The result of the depth sample collected from 1.5 to 2.5 feet is below Background.

LL3-173
Samples were collected in four directions for analysis of manganese (Figure 2-3(6)). Analytical results are below Background.

2.3.2.4 Load Line 4

The November 2004 soil sampling locations in LL 4 are divided into two sampling areas as shown on Figure 2-4(1). The individual areas are shown with sampling results on Figures 2-4(2) through 2-4(3). The results of this additional sampling in LL 4 are described in this section and organized by Original Station ID.

LL4-133
Samples were collected at depth and in two directions for analysis of PCBs (Figure 2-4(2)). Results are less than the RGO.

LL4-088
Samples were collected in three directions for analysis of manganese and aluminum (Figure 2-4(2)). Manganese results were below Background. Laboratory results were below the aluminum RGO and manganese Background.

LL4-118
Samples were collected at depth and in two directions for analysis of lead (Figure 2-4(3)). Results were less than the provisional RGO.

LL4-081
Samples were collected at depth and in one direction for analysis of aluminum and manganese (Figure 2-4(3)). The depth samples were composed of crushed bedrock. No soil was encountered and, therefore, no sample was collected. The result for the horizontal stepout was below the aluminum RGO and manganese Background.

LL4-080
Samples were collected at depth and in one direction for analysis of aluminum and manganese (Figure 2-4(3)). The depth samples were composed of crushed bedrock. No soil was encountered and, therefore, no sample was collected. The result for the horizontal stepout was below the aluminum RGO and manganese Background.

2.3.2.5 LLs 1-4 Summary

In summary, there are several discrete locations, typically for manganese, that require further extent delineation. However, it is expected that these areas will be considered for remediation and the results of confirmatory sampling during remediation will dictate where additional soils that require remediation are located.

2.3.3 Comparative Evaluation of Field and Laboratory Analysis for Explosives, PCBs, and Metals

This section includes discussions of field analytical results compared to laboratory analytical results from the November 2004 soil sampling event for TNT and RDX, PCBs, and select metals.

2.3.3.1 Field TNT and RDX Screening Analysis

This section presents a comparison of the TNT and RDX field screening analysis to values determined by the off-site, fixed-base analytical laboratory.

Field sampling and analysis protocol

Samples were collected from surface and subsurface locations in LLs 1-3 (one sample was collected from LL 4 for RDX analysis but was not field screened). TNT and RDX samples were composite samples from three discrete sampling locations positioned in a 3-ft equilateral triangle pattern in the sampling area as proposed in the SAP (Shaw, 2004f).

Field determinations of TNT and RDX in soil samples were performed through implementation of colorimetric analyses using the TNT or RDX Ensys® Soil Test System from SDI, Inc. This test system uses the same method developed by the USACE Cold Regions Research and Engineering Laboratory (Jenkins *et al.*, 1996). This test system provides the materials in pre-measured and pre-packaged form eliminating labor intensive procedures of reagent preparation. The analysis was conducted in accordance with procedures of the RVAAP SOP for explosives analysis in Appendix C of the SAP (Shaw, 2004f).

The procedure for measuring TNT concentrations in soils involves a liquid extraction of the explosives from the soil matrix with acetone and formation of a color complex with sodium sulfite and potassium hydroxide. Absorbance is measured at a wavelength of 540 nanometers. For RDX, glacial acetic acid and zinc powder are added to the extract prepared similarly to the TNT sample extract. When analyzing for both TNT and RDX, the same sample extract is used. A complexing agent (NitriVer3) is added to the sample, and absorbance is measured at 507 nanometers. In both methods, percent absorbance is correlated to concentration. Fixed-base laboratory determinations for TNT and RDX were performed by solvent extraction and analysis by liquid chromatographic techniques (SW846-8330).

Surface and subsurface soil samples were field analyzed with colorimetric methods for TNT and/or RDX. The purpose of the analysis was to help define the extent of soil contamination with respect to the RGOs. The decision made based upon the field test is whether the soil concentration exceeds (fails) or is below (passes) the RGOs. This is a pass/fail test. The working range of the field test is several orders of magnitude below the criteria. The field test working range is 2 to 40 mg/kg for both TNT and RDX. Initially the sample extracts for TNT analysis were diluted such that the working range of the test brackets the RGO (1,646 mg/kg TNT). Performing this dilution step increases the reporting limit by the same factor. A 250x dilution raises the working range to 500 to 10,000 mg/kg. After several sample analyses, the field results indicated that the soil samples had relatively low TNT and/or RDX concentrations. Therefore, the dilution step was eliminated and only used when field results exceeded the working range.

TNT comparison

TNT field screening and laboratory results are presented in Table 2-5. The correct decision was made using the field screen data for all but one sample when determining pass/fail with regard to the RGO. The field result for Sample ID LL1ss-357-1467-SO was less than the RGO. The laboratory result was above the RGO, with a difference of 51% from the field result. The field result for Sample ID LL2ss-304-1261-SO was a suspect positive due to visible interference in the sample extract indicated by the yellow tint.

However, the interference was not significant enough to make an incorrect decision of pass. The correct decision regarding pass/fail was 96.4% accurate.

Figure 2-5 is a plot of TNT field screening data versus laboratory data for positive detects in the field results. Comparison of all positive TNT data where both laboratory and field screening values provided a correlation coefficient of 0.8063 (Figure 2-5). Although it appears that a correlation does not exist, the decisions made in the field using the field test data provided a correct decision 96.4% of the time. The primary reason for the differences between the field result and the laboratory result is the rigorous extraction procedure conducted by the fixed-base laboratory.

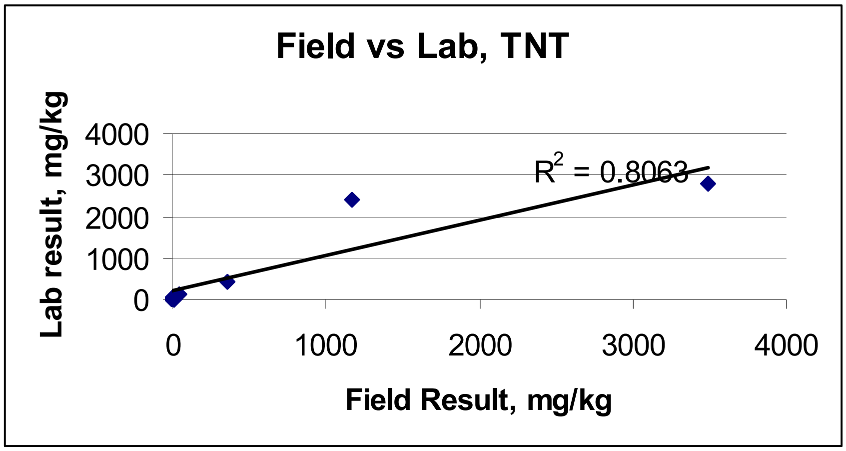
Based on the evaluation of field and fixed-base laboratory results, the field explosives screening method provided a valid representation of the presence or absence of TNT.

Table 2-5. Comparison of Laboratory and Field TNT Results, LLs 1-3 November 2004

Stepout Station ID	Sample ID	Field Result (mg/kg)	Laboratory Result (mg/kg)
LL1ss-157	1463-SO	< 2	9.81
LL1ss-357	1467-SO	1173	2400
LL1ss-470	1455-SO	< 500	2.69
LL1ss-471	1456-SO	< 500	0.80
LL1ss-472	1457-SO	10	5.94
LL1ss-480	1470-SO	355	441
LL2ss-044	1262-SO	< 2	< 0.277
LL2ss-296	1252-SO	< 500	1.58
LL2ss-297	1253-SO	< 500	0.92
LL2ss-298	1255-SO	< 500	< 0.316
LL2ss-299	1256-SO	< 2	< 0.271
LL2ss-303	1260-SO	< 2	< 0.313
LL2ss-304	1261-SO	108*	< 0.271
LL3ss-002	1176-SO	3493	2780
LL3ss-012	1231-SO	< 2	< 0.265
LL3ss-282	1215-SO	< 500	< 0.285
LL3ss-283	1216-SO	< 500	< 0.280
LL3ss-284	1217-SO	< 500	< 0.279
LL3ss-285	1218-SO	< 200	0.42
LL3ss-286	1219-SO	< 2	< 0.323
LL3ss-287	1220-SO	< 2	< 0.315
LL3ss-288	1222-SO	< 2	< 0.267
LL3ss-289	1223-SO	< 2	< 0.279
LL3ss-290	1224-SO	< 500	< 0.283
LL3ss-291	1225-SO	< 2	< 0.265
LL3ss-292	1226-SO	5	1.22
LL3ss-294	1229-SO	42	148
LL3ss-295	1230-SO	5	32

*The color of the extract was yellow and is suspected to interfere with reading at 540 nanometers.

Figure 2-5. TNT Field Test Comparison with Laboratory Test



RDX comparison

RDX field screening and laboratory results are presented in Table 2-6. The correct decision was made using the field screening data for each sample when determining pass/fail with regard to the RDX RGO. The correct decision regarding pass/fail was 100% accurate.

Table 2-6. Comparison of Laboratory and Field RDX Results, LLs 1-3 November 2004

Stepout Station ID	Sample ID	Field Result (mg/kg)	Laboratory Result (mg/kg)
LL1ss-157	1463-SO	< 2	< 1.09
LL1ss-470	1455-SO	6	11.40
LL1ss-357	1467-SO	7	19.30
LL1ss-471	1456-SO	2.1	< 1.26
LL1ss-472	1457-SO	3.0	5.20
LL1ss-480	1470-SO	4	0.42
LL2ss-014	1266-SO	< 2	< 1.11
LL2ss-300	1257-SO	< 2	< 1.15
LL2ss-301	1258-SO	< 2	< 1.25
LL2ss-302	1259-SO	< 2	< 1.16

2.3.3.2 Field PCBs Screening Analysis

This section presents a comparison of the PCBs field screening analysis to values determined by the off-site, fixed-base analytical laboratory.

Field sampling and analysis protocol

Samples were collected from surface and subsurface locations in LLs 1-4. Samples were discrete samples taken from 1-foot intervals in accordance with the SAP (Shaw, 2004f). Field determinations of PCBs in soil samples were performed through implementation of colorimetric analyses using the PCB Ensys® Soil Test System from SDI. This semi-quantitative test system is based on the use of antibodies that bind either PCBs or PCB-conjugates. Known quantities of these antibodies are pre-coated onto a test tube. The PCBs and PCB-conjugates compete for binding sites of the antibodies. Since the amount of PCB-conjugates is also known, a sample that contains a low amount of PCBs will result in a dark blue color because most of the PCB-conjugates are bound to the antibody sites. A high amount of PCBs allows fewer PCB-conjugate molecules to bind with the antibodies yielding a lighter blue color. Color development is inversely proportional to the concentration of PCBs. The determination of PCBs concentration in the sample was determined by reading with a spectrophotometer. The color of the sample is compared to the reference standard provided with the field kit. The reference standard is Arochlor-1254 at 0.5 mg/kg in the extract. In order to determine if the sample is above or below the PCBs RGO of 35 mg/kg in soil, the sample extract is diluted such that the detection level is 35 mg/kg. For this field test, two dilutions were performed to achieve a detection level of 25 mg/kg and 35 mg/kg.

The procedure for measuring PCBs concentration in soils involves a liquid extraction from the soil matrix with methanol and formation of a color complex with substrates. Absorbance is measured at a wavelength set by the manufacturer. Fixed-base laboratory determinations for PCBs were performed by solvent extraction and analysis by liquid chromatographic techniques (SW846-8082).

PCBs Comparison
PCBs field screening and laboratory results are presented in Table 2-7. The correct decision was made using the field screen data for all samples when determining pass/fail with regard to the PCBs RGO. The correct decision regarding pass/fail was 100% accurate.

Table 2-7. Comparison of Laboratory and Field PCBs Results, LLs 1-4 November 2004

Stepout Station ID	Sample ID	Original Station ID	Field Result (mg/kg)	Laboratory Results (mg/kg)
LL1ss-148	1442-SO	LL1-148	< 25	0.8
LL1ss-455	1436-SO	LL1-148	< 25	11.7
LL1ss-456	1437-SO	LL1-148	< 25	3.1
LL1ss-473	1458-SO	LL1-158	< 25	0.03
LL2ss-275	1228-SO	LL2-166	< 25	0.46
LL2ss-276	1229-SO	LL2-167	< 25	0.724
LL3ss-102	1212-SO	LL3-102	> 35	154
LL3ss-246	1174-SO	LL3-077	< 25	6.1
LL3ss-247	1175-SO	LL3-077	< 25	11.5
LL3ss-280	1213-SO	LL3-102	> 35	563
LL3ss-281	1214-SO	LL3-102	> 35	191
LL4ss-133	1187-SO	LL4-133	< 25	0.078
LL4ss-194	1186-SO	LL4-133	< 25	0.13

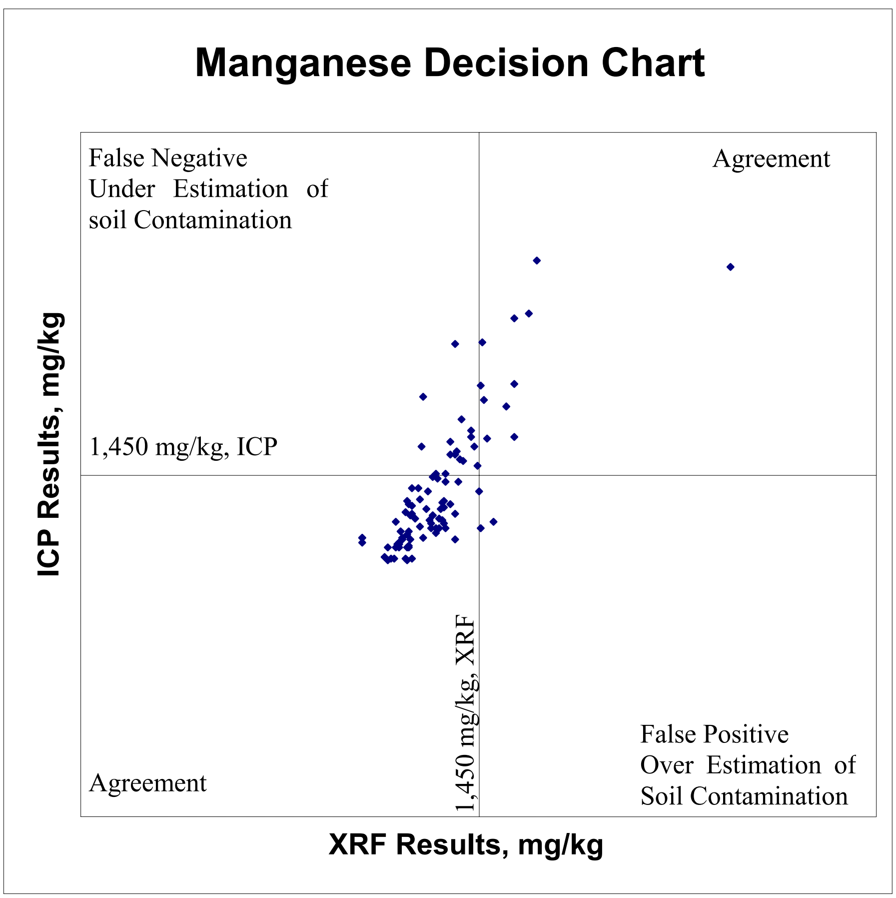
2.3.3.3 Field Metals Analysis by XRF
Ex situ field screening for manganese, arsenic and lead was conducted using a NITON 702 or 702S XRF instrument. A discussion of the XRF instrument performance is included in Appendix A. The same sample contained in XRF sample cups used for the analysis in the field samples, that were less than the action level, was submitted to the fixed-base laboratory for analysis. This procedure eliminates bias from splitting samples. Surface and subsurface soil were hand augered from the center of the sampling location to a depth of 1-foot intervals. Each sample was placed in a stainless-steel bowl and thoroughly homogenized. Aliquots for the *ex situ* XRF were extracted from the homogenized mixture, air dried, screened through a ¼” and #10 mesh sieves and ground.

The XRF measurements were made to see if this technique would produce results comparable to the fixed base laboratory methods. If the XRF and laboratory methods produced comparable results, the more rapid XRF method could be used in the future to help define the extent of contamination, with confirmatory samples sent to a fixed-base laboratory. The field screening samples are directly comparable to the fixed-base laboratory samples because the field screening and fixed-base laboratory samples are the same homogenized source material. Differences between the *ex situ* field XRF and fixed-base laboratory results should primarily reflect differences in the two methods used on the same material.

Manganese *Ex Situ* XRF results compared to ICP laboratory results

The XRF results are compared to the inductively coupled plasma (ICP) results with respect to the accuracy of decision made using the field results. Figure 2-6 is the decision chart in reference to the Background concentration for manganese. The cross marks represent the Background for manganese at 1,450 mg/kg. The upper right quadrant represents an agreement between XRF and ICP results that the sample location is above the action level. Similarly, the lower left quadrant represents an agreement between XRF and ICP that the sample location is below the action level. The other quadrants represent disagreement between the XRF and ICP results. The upper left quadrant indicates a decision to discontinue sampling based upon the field test when the laboratory result indicates the necessity to continue. This is a cautious decision to defining the extent of contamination. The lower right quadrant indicates the decision to continue sampling based upon the field test result when the laboratory result indicates unnecessary sampling. This is an overly conservative decision to define the extent of contamination. There are 92 decision points for manganese. There are 16 decision points that under estimated the definition of contamination. This represents 16.3% False Negatives. There were three decision points that over estimated the definition of contamination. This represents 3.3% False Positives. Of the False Negatives, eleven of the ICP results are less than 2,000 mg/kg, three are between 2,000 and 3,000 mg/kg and one was at 3,350 mg/kg. The False Positives results were 1,460, 1,480 and 1,640 mg/kg.

Figure 2-6. Manganese Decision Chart



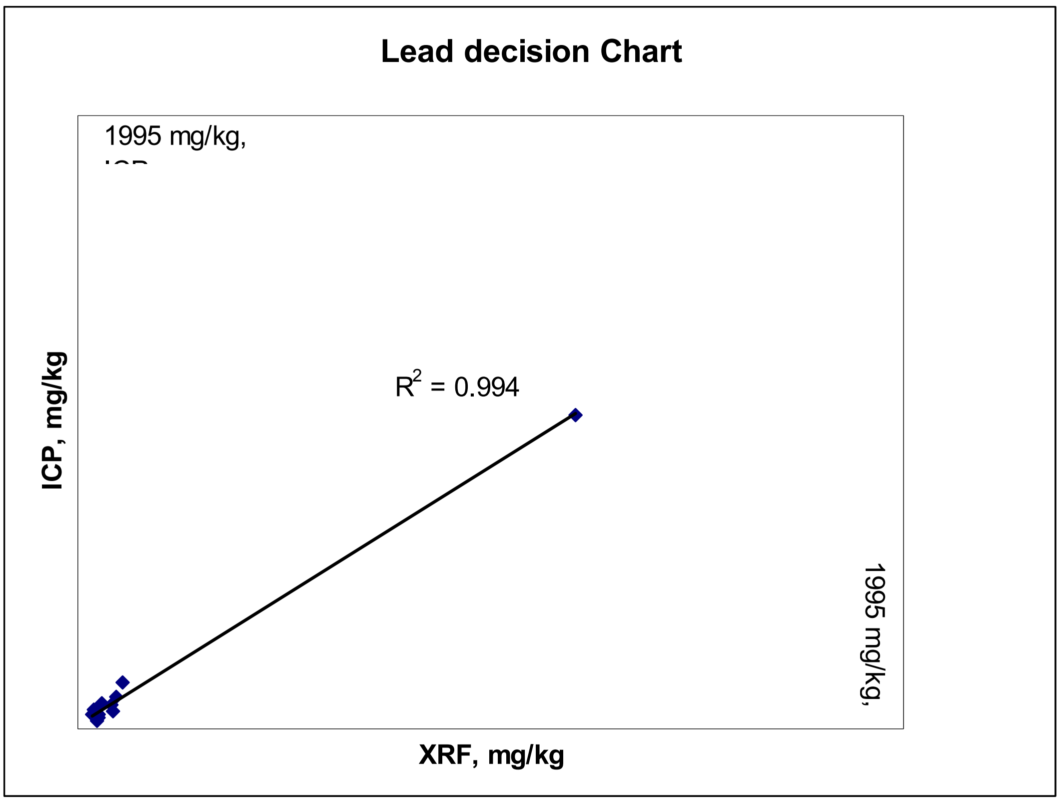
Arsenic *Ex Situ* XRF Results Compared to ICP Laboratory Results

Due to the limited scope of arsenic analysis and the XRF limit of detection there are insufficient data to perform a meaningful data analysis.

Lead *Ex Situ* XRF Results Compared to ICP Laboratory Results

The XRF results are compared to the ICP results with respect to the accuracy of the sampling decision made using the field results. Figure 2-7 is the decision chart in reference to the provisional RGO for lead. Only one quadrant of the decision chart is presented as all data points occur in this region. There were 18 valid data points available for the comparison; however, one data point was discarded as a data outlier. The resulting correlation is apparent with a correlation coefficient of 0.994. A decision determined by XRF analysis can be made with high confidence.

Figure 2-7. Lead Decision Chart



2.4 Estimation of Soil Volume

An estimation of the volume of soil requiring remediation was calculated from the information provided in the RI Reports for LLs 1-4 (SAIC, 2004; Shaw, 2004a, b, c) and the results of the November 2004 soil sampling event (Appendix B). Appendix C contains the soil volume calculations. The total volume of soil and dry sediment to be addressed by the remedial action is estimated to be approximately 14,600 cubic yards. A majority of the soil volume targeted for remediation is due to exceedances of the current RGOs for manganese and arsenic. If manganese and arsenic were excluded from requiring remediation, or their RGOs increased, the soil volume may be reduced. Table 2-8 summarizes soil volumes associated with COC specific RGO exceedances. The total volume represents soil from 108 separate areas within the 654 acres of LLs 1-4 that have COC concentrations in exceedance of the established RGOs. The approximate areas of remediation are shown in plan view in Figures 2-8 through 2-11 for LLs 1-4, respectively.

Table 2-8. Estimated Volume of Soil and Dry Sediment for Remediation

Load Line	Volume Manganese (cy)	Volume Arsenic (cy)	Volume others* (cy)	Total Volume (cy)
LL 1	4,838	795	1,507	7,140
LL 2	757	730	823	2,310
LL 3	2,212	45	1,590	3,847
LL 4	551	1	718	1,270
TOTAL	**8,358**	**1,571**	**4,638**	**14,567**
Clean-up Criterion (mg/kg)	*1,800 (surface) / 3,030 (subsurface)*	*31*	*REFER TO TABLE 2-3*	

* Others include metals other than manganese or arsenic, PCBs, explosives and SVOCs.

The estimated volumes of soil have an assumed margin of error of +/- 20% based on the current RGOs established for the project. Variances to the total volume are expected to occur due to unknown changes in AOC conditions since the collection of the Phase I and II RI and November 2004 investigation data, limited uncertainty as to the actual extent of COC impact to soil at sample locations, soil types and heterogeneity, and changes in regulatory clean-up standards. For cost estimation purposes, a soil volume of 14,600 cubic yards was used to prepare cost estimates for each remedial option identified in Section 6.0.

The soil volume estimates were derived from a review of the analytical results presented in the RI reports for soil and sediment samples and the results of the November 2004 soil sampling effort. The majority of soil samples indicating exceedances of the RGOs (Table 2-2) were collected from the soils surrounding the perimeter of the process and melt pour buildings located in each of the four load lines. Exceedances were detected for explosives, metals (typically manganese), and in some areas, PCBs and SVOCs. Typically, samples exceeded RGOs for both explosives and metals. Analytical data was used to provide both an areal and vertical assessment of COC impact to soils.

The details of the soil volume estimation are presented in Appendix C. Appendix C includes an overview of the volume estimation process, assumptions applied to the soil volume estimate calculations for each cases, and tables that summarize location-specific extents of contamination. In general, the Phase I and Phase II RI and November 2004 data were reviewed for results that indicated a COC concentration at or above the RGOs (summarized in Table 2-2) established for the project. Each of the identified 'target' sampling locations was reviewed in plan view with the surrounding locations to determine an approximate extent of contamination. The range of resulting volumes presented in Table 2-8 are a result of the different base assumptions used in determining that 'extent.' One method is conservative and the other is potentially more realistic given the information about the deposition pattern of contaminants in LLs 1-4. In addition, depending on the remedial action selected, actual soil volumes will be determined in the field during remediation based on targeted sampling and laboratory confirmation results.

3.0 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

CERCLA Section 121 specifies that remedial actions must comply with requirements or standards under federal or more stringent state environmental laws that are "applicable or relevant and appropriate to the hazardous substances or particular circumstances at the site." Inherent in the interpretation of ARARs is the assumption that protection of human health and the environment is ensured. This chapter summarizes potential federal and state chemical-, location-, and action-specific ARARs for the potential remedial actions at Load Lines 1-4 conducted under the Installation Restoration Program (IRP) to address hazardous, toxic, and radioactive waste (HTRW) contamination. The concurrent MEC action at RVAAP is addressed under a separate Army protocol in accordance with its applicable requirements governing MEC removal (e.g., UXO Safety Submittals, etc.). Shaw intends to notify the Army immediately if MEC is detected during remediation, or clearance activities associated with remediation activities, so that MEC issues can be addressed concurrently if feasible.

ARARs include those federal and state regulations that are designed to protect the environment. Applicable requirements are "those clean-up standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility sighting law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site" [40 *Code of Federal Regulations (CFR)* 300.5]. US EPA has stated in the National Contingency Plan (NCP) that applicable requirements are those requirements that would apply if the response action were not taken under CERCLA.

Relevant and appropriate requirements are "those clean-up standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility sighting law that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site such that their use is well suited to the particular site" (40 *CFR* 300.5).

In the absence of federal or state-promulgated regulations, there are many criteria, advisories, guidance values, and proposed standards that are not legally binding but may serve as useful guidance for setting protective clean-up levels. These are not potential ARARs but are to-be-considered guidance [40 *CFR* 300.400(g) (13)].

CERCLA on-site remedial response actions must comply only with the substantive requirements of a regulation [CERCLA Section 121(e)]. US EPA reaffirmed this position in the final NCP [55 *Federal Register (FR)* 8756, March 8, 1990]. Substantive requirements pertain directly to the actions or conditions at a site, while administrative requirements facilitate their implementation. US EPA recognizes that certain administrative requirements (i.e., consultation with state agencies, reporting, etc.) are accomplished through state involvement and public participation. These administrative requirements should also be observed if they are useful in determining clean-up standards at the site (55 *FR* 8757).

Although on-site remedial actions at National Priorities List (NPL) sites must comply only with the substantive requirements of federal or state environmental regulations, the Ohio Revised Code does not provide a similar permit waiver for actions conducted under the Ohio EPA Remedial Response Program Policy. The Ohio EPA's Division of Emergency and Remedial Response (DERR) Policy DERR-OO-RR-034 states that, "it has been DERR's policy to require responsible parties to acquire and comply with all necessary permits, including the substantive and administrative requirements."

CERCLA Section 120(a)(4) requires federal facilities not on NPL, such as RVAAP to comply with all state laws concerning removal and remedial action, which are equitably enforced at federal and non-federal facilities [42 *United States Code (USC)* §9620(a)(4)]. CERCLA contains a narrow waiver of sovereign immunity for compliance with state laws regarding removal and remedial actions [42 *U.S.C.* §9620(a)(4)]. The section provides that, "State laws concerning removal and remedial action, including State laws regarding enforcement, shall apply to removal and remedial action at facilities owned or operated by a department, agency, or instrumentality of the United States when such facilities are not included on the [NPL]." This CERCLA statutory mandate differs from the compliance with ARARs mandate under CERCLA Section 120(d)(2)(A) in that the applicable state laws concerning removal or remedial action must be met regardless of the level of risk present at the site. The compliance with ARARs mandate only arises under CERCLA 121 (d)(2)(A) when an on-site remedial action is required due to unacceptable risk. Therefore, regardless of the risk present at the site, the Army will be required to meet the substantive requirements of any state laws and implementing regulations that require corrective action. Remedial activities at RVAAP are being conducted in accordance with the Director's Orders and Findings signed on June 10, 2004.

3.1 Potential Chemical-Specific ARARs

Chemical-specific ARARs are normally health- or risk-based numerical values or methodologies which, when applied to site-specific conditions, result in the establishment of numerical values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment (EP A/540/G-89/006, August 1988). The chemical specific ARARs and requirements for RVAAP are provided in Table D-1 in Appendix D.

3.1.1 Groundwater

Where the beneficial use of the groundwater is as a current or potential source of drinking water, US EPA states a preference for Safe Drinking Water Act of 1974 non-zero MCL goals (MCLGs) and MCLs where they are relevant and appropriate [CERCLA 121 (d)(2)(A), as amended, and 40 *CFR* 300.430(e)(2)(i)(B) and (C)]. Groundwater is not being addressed under the considered alternatives and, therefore, chemical-specific ARARs are not identified for groundwater in this FS.

3.1.2 Surface Water

Section 121 (d)(2) of CERCLA states that every remedial action shall require a level of control which at least attains water quality criteria established under Sections 304 or 303 or the Clean Water Act (CW A). Therefore, surface water quality criteria are ARARs for surface water clean-up. The considered alternatives do not address surface water. Measures will be implemented during construction to prevent settled solids or toxic substances from entering these waters. These measures will assure that the water quality criteria of OAC 3745-1-04 and anti-degradation provisions of OAC 3745-105 are met. These requirements have been included in Table D-1 in Appendix D to indicate that the HTRW actions will be protective of these waters of the state.

3.1.3 Soil

The generic direct contact soil standards (GDCS) of OAC 3745-300-08 are not applicable to Load Lines 1-4 because remediation is not conducted under Ohio's Voluntary Action Program. These standards are not relevant and appropriate because the circumstances specified in OAC 3745-300-08 (B)(1) exist at Load Lines 1-4. Property-specific risk-based standards must be determined in place of or in addition to the GDCS if (1) the exposure pathways or exposure factors for the intended land use are not included in the development of the GDCS for residential, commercial, or industrial scenarios; (2) the COCs at the property are not included in the GDCS; (3) radioactive materials are identified on the property; (4) PCBs subject to Toxic Substances Control Act (TSCA) are identified on the property; or (5) important ecological resources are identified on the property. Property-specific risk-based clean-up standards are applicable to RVAAP because the exposure scenarios for the intended land use are not considered in the development of the GDCS and certain COCs are not included in OAC 3745-300-08 (B)(3).

3.2 Potential Action-Specific ARARs

This section summarizes the potential] action-specific ARARs that may be pertinent to management of the soils resulting from excavation as described in this FFS. Potential action-specific ARARs are identified in Table D-2 in Appendix D.

Remedial actions that involve excavation of soils or capping will require site preparation activities such as clearing of trees, grubbing, and grading of the site. During these activities, measures will need to be implemented to control fugitive dust emissions so that requirements of OAC 3745-07-08 will be met. Control measures typically include the application of water or other dust suppressants during clearing, grubbing, and grading.

Under 40 *CFR* 63, Subpart G air emissions standards have been proposed for site remediation activities at facilities that are major sources of hazardous air pollutants (HAPs) where the facility has implemented maximum achievable control technology for one of the major sources listed under Section 2 of the Clean Air Act of 1970 (CAA). Major sources are facilities that emit more than 10 tons/year for an individual HAP or greater than 25 tons/year of a combination of HAPs. Under the proposed rule, emissions limits are set for process vents, remedial materials management units, and work practices. The proposed rule exempts sites being addressed under CERCLA authority and corrective actions initiated under permits and orders.

Site clearing and grading activities will disturb more than 1 acre of land. As of March 10, 2003, construction activities disturbing more than 1 acre of land are subject to the stormwater National Pollutant Discharge Elimination System permit requirements of 40 *CFR 1*22.26. General permits are issued by authorized states and incorporate the requirements of the EPA's "Core" General Permit for Industrial Activity or the "Core" General Permit for Construction Activities issued by EPA in 1992. The core or baseline permits establish the same terms and conditions for all covered dischargers. State-issued core or baseline permits may also contain requirements in addition to those specified by the federal baseline general permits. Stormwater discharges from construction activities are covered under Ohio EPA's General Permit OHCOOOO02. Coverage under the general permit is obtained by submission of a Notice of Intent to the control authority. Dischargers covered under a general permit are also required to develop and implement a Storm Water Pollution Prevention Plan (SWP3). At a minimum, the SWP3 for construction activities must address the following:

- interim and permanent stabilization practices such as the use of temporary seeding, mulching, geotextiles, vegetative buffer strips, and preservation of existing vegetation;
- a plan for sequencing of disturbances and stabilization activities;
- implementation of storm water diversion structures to divert run-on away from disturbed areas;
- the use of sediment basins, sediment traps, and silt fences;
- the use of stormwater detention structures, retention basins, run-off flow controls, and velocity dissipation devices;
- good housekeeping practices; and
- procedures to minimize off-site tracking of sediments by vehicles.

As indicated previously, the DERR requires responsible parties to obtain all permits that are relevant to the considered action.

Under 40 *CFR* 262.1] (OAC 3745-52-]]), any person who generates a solid waste must determine if that waste is hazardous by evaluation of whether the waste is excluded from Subtitle C regulation, listed under 40 *CFR* 26]; Subpart 0; or exhibits one of the hazardous waste characteristics under 40 *CFR* 261, Subpart C. At load lines 1-4 the first regulatory consideration is whether or not the waste soils contaminated with TNT will carry the EPA waste code K047. Pursuant 40 CFR 261.33, K047 is pink/red water from TNT operations. Initially, it would appear that the soils impacted by the pink water would trigger the code K047. However, the US EPA only intended for this waste to be regulated for its inherent reactive characteristic. Consequently, since the subject remedial soils at RVAAP do not exhibit the reactive characteristic, under the revised mixture and derived from rules (66 Federal Register 27286 5/16/01) they do not have to be managed as a K047 waste. This relief is also referred to the "contained in" policy and has been adopted by the State of Ohio in regulating generators in similar situations.

On May 26, 1998, EPA promulgated a Phase IV land disposal restriction (LDR) rule that established treatment standards for hazardous contaminated soil. Hazardous contaminated soil is defined as soil that contains a listed waste or exhibits a characteristic of a hazardous waste. As indicated above, a portion of the soils may be hazardous contaminated soil. As such, RCRA Subtitle C regulations, such as the LDRs, will be applicable to the extent that the action generates and, subsequently, actively manages (treats, stores, or disposes) these soils.

If the excavated soils exhibit the Toxicity Characteristic (TC), RCRA Subtitle C standards will be potentially applicable for the screening unit. The process reduces the concentrations of the COC, which may be viewed as treatment by Ohio EPA. If screening is considered treatment by Ohio EPA, the unit would be subject to permitting standards for physical, chemical, and biological treatment (40 *CFR* 265 Subpart Q). Alternately, screening of excavated soils could be performed without meeting certain of the above standards if the wastes were managed in a temporary unit (TU). TUs may be used to store or conduct non-thermal treatment on remediation wastes for a period of up to 12 months. Additionally, under 40 *CFR* 268.3 (OAC 3745-270-03), the process must not dilute the waste as means of achieving compliance with the LDR treatment standards. A determination of the applicability of the LDR treatment standards must be made at the point of generation (upon excavation).

It is assumed that any debris separated from the soils would be accumulated on-site in containers for less than 90 days. Containers must be kept closed, constructed of materials that are compatible with the stored waste, and maintained in good condition.

One option for staging of excavated soils is a waste pile. Waste piles that hold hazardous wastes, hazardous debris, or hazardous contaminated soils must have a double-liner system. The bottom liner must be a composite liner with a thickness of at least 3 ft and a hydraulic conductivity of: $<10^{-7}$ m/sec. Waste piles used to store RCRA Subtitle C wastes must also have a leachate collection between the top and bottom liners that is sloped at 1 %. The leachate collection system must have a minimum thickness of 2: 12 in. and a hydraulic conductivity of 10-2 cm/sec. Both the liners and leachate collection system must be constructed from materials that are compatible with the stored waste. The leachate collection system must be designed with sumps or similar collection systems that keep the leachate head at < 12 in. Waste piles must be protected from precipitation, surface water run-on, and wind dispersal. Under DERR policy, this waste pile would require RCRA permitting to receive the excavated soils. Accordingly, Table D-2 in Appendix D summarizes the RCRA-permitting standards of 40 *CFR* 264 Subparts B-G and 40 *CFR* 270 (and their corollary OAC provisions).

As indicated, a portion of the soils within the hot spots may contain listed wastes or exhibit the TC for barium, cadmium, chromium, or lead. Accordingly, the LDRs of 40 *CFR* 268 (OAC 3745-270-40) are potentially applicable to these soils. The LDR program requires hazardous wastes to be treated to meet certain standards prior to land disposal. Under 40 *CFR* 268.2, the term "land disposal" means placement in or on the land and includes".. placement in a landfill, surface impoundment, waste pile, land treatment facility... or concrete vault or bunker intended for disposal purposes." Treatment standards under the LDR program may be either concentration limits for certain constituents in the waste or specified treatment technologies.

A Phase IV LDR rule, promulgated May 26, 1998, revised treatment standards for metal-bearing wastes and established treatment standards for hazardous contaminated soils. Consistent with CERCLA policy, this Phase IV rule indicated that, "LDRs only attach to hazardous waste or hazardous contaminated soil when it is generated and placed into a land disposal unit. Therefore, if contaminated soil is not removed from the land, LDRs can not apply" (63 *FR* 28617). Conversely, if any volume of soil contains a listed waste or exhibits a characteristic at its point of generation (excavation), the LDRs must be met prior to placement of such soil in a land disposal unit. The treatment standards specific to hazardous contaminated soils are codified in 40 *CFR* 268.49 (OAC 3745-270-49) and require the concentrations of all underlying hazardous constituents (UHCs) to be reduced by 90% and capped at 10 times the universal treatment standards (UTSs) of 40 *CFR* 268.48. Therefore, if soils that exhibit the TC or contain listed wastes are excavated, these volumes of soils must meet hazardous contaminated soil treatment standards prior to being placed in a waste pile or prior to being disposed of in a landfill after management in another unit.

Under the recently promulgated Hazardous Waste Identification Rule - Media, US EPA created a new unit for the temporary management of remediation wastes, known as the staging pile. The staging pile is an accumulation of solid, non-flowing remediation wastes that may be used for storage of those wastes for 2 years. Placement of remediation wastes into a staging pile does not trigger LDRs because such units are not considered land disposal units. The potential action-specific ARARs for staging piles are the performance criteria of 40 *CFR* 264.552. These standards require that the staging pile must be designed to prevent, or minimize, releases of hazardous waste or hazardous constituents to the environment;

- the staging pile must be designed to minimize cross-media transfer, as necessary, to protect human health and the environment;
- the staging pile cannot be used for treatment; and
- the 2-year time limitation indicated above.

Specific designation of the unit as a staging pile, and the design and operating specifications to meet these performance standards, are prescribed by the US EPA Regional Director, or authorized state, within an RCRA permit. Potential use of a staging pile is a preferable option to use of a waste pile in management of excavated soil. However, Ohio EPA has proposed adoption of these rules but has not finalized the rulemaking process at this time. Therefore, the provisions for a staging pile are not currently available to RVAAP.

Soils exceeding the RGOs will be transported off-site for disposal. Soils that exceed the alternative treatment standards of 40 *CFR* 268.49 must be treated to meet these alternative LDR standards for soils prior to off-site disposal in a Subtitle C Landfill. Excavation may also result in the generation of limited quantities of hazardous debris (i.e., lead castings). These wastes must be treated to meet the hazardous debris treatment standards of 40 *CFR* 268.45 prior to off-site land disposal.

Based on analytical results for wastewater generated in the RI, it is unlikely that this wastewater would exhibit the TC. If the tank system is used to store the wastewater prior to its conveyance to a Wastewater Treatment Unit (WWTU) or is part of on-site WWTU, the relevant and appropriate requirements are CWA standards. Under 40 *CFR* 264.1, WWTUs are exempt from the 40 *CFR* 264 and 270 standards. If the wastewater is indirect discharged to the Publicly Owned Treatment Works (POTW), it must meet the general and specific prohibitions of the federal pretreatment program and requirements that prohibit slug discharges or discharges resulting in unnatural coloring.

4.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

The NCP (40 *CFR* 300) identifies the objectives of and general procedures for conducting a feasibility study. The NCP states that the primary objective of a feasibility study is to "ensure that appropriate remedial alternatives are developed and evaluated such that relevant information concerning the remedial action options can be presented to a decision maker and an appropriate remedy selected." The development and evaluation of alternatives is based on the complexity of the remedial action under consideration and the impacts being addressed. The goal of the remedy selection process as stated in the NCP is to select remedies that are protective of human health and the environment, that maintain protection over time, and that minimize untreated waste. In developing remedial alternatives, the NCP requires that: 1) remedial action objectives be established, 2) potentially suitable technologies be identified and evaluated, and 3) suitable technologies be assembled into alternative remedial actions. The remedial action objectives must address the COC-impacted media present at the site, and the remedial alternatives developed to address the objective must be protective of human health and the environment.

In October 1988, US EPA issued revised guidance for conducting feasibility studies under CERCLA (EPA/540/G-89/004). The guidance indicates that feasibility studies are generally performed in three phases: the development of alternatives, the screening of alternatives, and the detailed analysis of alternatives.

This section includes the following subsections:

- Section 4.1 establishes the remedial action objectives (RAOs);
- Section 4.2 describes the general response actions for the impacted media at the facility;
- Section 4.3 identifies and then screens technology types and process options

As previously described, the focus of this feasibility study is on the source soils and dry sediment as part of an IRIP. These are considered source control actions and do not include management of migration components.

4.1 Remedial Action Objectives

The remedial action objectives (RAOs) are the RGOs for soil and dry sediment that were established in Section 2.1.5. The estimated impacted soil volume requiring remedial action was estimated in Section 2.3. In addition, remedial alternatives will comply with ARARs defined in Section 3.0.

4.2 General Response Actions

The RAOs and ARARs serve as the basis for the comparison of the remedial alternatives in this FFS. This section presents a range of general response actions incorporating readily available technologies and options applicable to the RAOs for soil and dry sediment at LLs 1-4 for RVAAP. Only qualified technologies/process options that apply to the media (soil and dry sediment) were considered. General response actions developed to meet RAOs for each impacted medium, soil and dry sediment, are summarized in tabular form in Table 4-1. These include no action, institutional controls, containment, treatment or excavation.

Under CERCLA, the no action is used as a baseline for comparison and typically assumes that protective measures are not employed and that monitoring is not performed.

Table 4-1 Development of Technologies

Environmental Media	Remedial Action Objectives	General Response Actions	Remedial Technology Types	Process Options
Soil and Dry Sediment	a) Prevent human exposure through direct or indirect contact (e.g., foodstuffs), ingestion and inhalation with soil exceeding RGOs. b) Comply with ARARs.	No Action		
		Institutional Actions: • Access restrictions	Access Restrictions: • Fencing • Land use controls	
		Containment Actions: • Containment	Containment Technologies: • Capping • Vertical barriers	• Clay cap, asphalt, multi-layer • Slurry wall, sheet piling
		Excavation/Treatment Actions: • Disposal/excavation • *In situ* treatment • *Ex situ* treatment	Removal Technologies: • Excavation	Solids excavation
			Treatment Technologies: • Physical treatment • Chemical treatment • Biological treatment • Thermal treatment	• Solidification/stabilization • Soil flushing/chemical extraction • Soil vapor extraction • Enhanced bioremediation • Composting • Phytoremediation • Incineration

4.3 Identification and Screening of Technologies

This section identifies and screens potential technologies for soil and dry sediments at LLs 1-4 at RVAAP to achieve IRIP.

Potential remedial technologies are identified in Table 4-1 based on the RAOs and General Response Actions for LLs 1-4 of the RVAAP. In accordance with US EPA feasibility study guidance (US EPA, 1988), the technology types are general categories of remedial technologies while process options are specific processes within each technology type. The technology types considered in this step for both soil and dry sediment, as shown in Table 4-1, include no action, institutional controls, containment, removal and treatment.

The remedial technology types and process options are initially screened in Table 4-2 based on technical implementability. Primary factors in this screening step include applicability of processes to AOC COCs, potentially limiting subsurface conditions, generation of residual wastes from treatment and future land use (National Guard mounted training (no digging)). Process options that are screened out from further consideration are highlighted with hatch marks in Table 4-2. Although numerous process options are available for soils, only a limited number of technology types and process options are applicable to LLs 1-4 as a whole. These potentially applicable process options remaining after this screening step include capping, excavation and select *ex situ* treatments.

The screening process was performed using the following steps:

1. If a technology is not consistent with planned future land use (National Guard mounted training, no digging), it is eliminated from further consideration regardless of other criteria.
2. If a technology is a treatment technology and results in the generation of a second waste stream that requires additional handling or treatment, it is eliminated from further consideration regardless of other criteria.
3. If a technology is applicable to limited COCs, it is retained for further consideration for limited applicability provided it meets the other three screening criterion. Retention of these technologies with potential limited applicability is possible due to the variance in COCs in each discrete area within LLs 1-4.
4. If a technology is not suitable due to potentially limiting subsurface conditions in discrete areas, it is retained for further consideration for limited applicability provided it meets the other three screening criterion.

As identified in Table 4-2, the following technologies were eliminated from further consideration:

- Not consistent with future land use: *in situ* treatments (soil vapor extraction, soil flushing, solidification/stabilization, enhanced bioremediation, phytoremediation, radio frequency heating, and steam injection);
- Not a final treatment step: *ex situ* separation, *ex situ* chemical extraction, and *ex situ* soil washing; and
- Applicable to limited COCs AND applicable to limited soils: pyrolysis.

Vertical barriers were also eliminated from further consideration due to the incompatibility between the function of the technology and the nature of the COCs in a soil matrix.

Table 4-2 – Screening of Technologies and Process Options*

Soil General Response Actions	Remedial Technology Types	Process Options	Description	Screening Comments
No Action	None	Not applicable	No action	Required for consideration by NCP
Institutional Controls	Access Restrictions	Fencing	Fencing is currently in place around the entire facility and the individual AOCs; although, not around the discrete areas designated for remediation within LLs 1-4.	Potentially applicable
		Land use restrictions	Future land use restrictions would be required for the facility.	Potentially applicable
Containment	Cap	Clay cap	Compacted clay covered with soil over areas of contamination. Structural barriers needed around cap to prevent vehicular travel on cap.	Potentially applicable;[a] however, may not be acceptable to NGB due to inhibition of future land use in capped areas and ongoing operation and maintenance (O&M).
		Asphalt	Spray application of a layer of asphalt over areas of contamination. Structural barriers needed around cap to prevent vehicular travel on cap.	Potentially applicable;[a] however, may not be acceptable to NGB due to inhibition of future land use in capped areas and ongoing O&M.
		Multi-layer, multi-media cap	Clay and synthetic membrane covered by soil over areas of contamination. Structural barriers needed around cap to prevent vehicular travel on cap.	Potentially applicable;[a] however, may not be acceptable to NGB due to inhibition of future land use in capped areas and ongoing O&M.
	Vertical barriers	Slurry wall	Trench around areas of contamination is filled with a soil (or cement) bentonite slurry	Soil and COCs likely not migrating horizontally, technology not necessary.
		Sheet piling	Vibrating force to advance sheet piles into the ground	Soil and COCs likely not migrating horizontally, technology not necessary.
Removal	Excavation	Solids excavation	Remove contaminated solids from AOC.	Potentially applicable
Disposal Excavation	Disposal Excavation	Off-site disposal	Transport excavated solids off-site for disposal at approved facility.	Potentially applicable
In Situ Treatment	Physical Treatment	Soil vapor extraction (SVE)	Vacuum applied to extraction wells induces movement of gas-phases volatiles to collection for treatment.	Not applicable to inorganic or explosive contaminants found in soils at LLs 1-4. Not consistent with future land use.
	Chemical Treatment	Soil flushing	Inject cosolvent through contaminated area and collected liquid from the subsurface for further treatment.	Not applicable to explosive contaminants found in soils at LLs 1-4. Not feasible because of very shallow depth to bedrock. Not consistent with future land use.

Table 4-2 – Screening of Technologies and Process Options*

Soil General Response Actions	Remedial Technology Types	Process Options	Description	Screening Comments
In Situ Treatment (continued)	Chemical Treatment (continued)	Solidification / stabilization	Add binders to mechanically or chemically interact with the contaminants to limit their solubility or mobility.	Not applicable to explosive contaminants found in soils at LLs 1-4. Does not reduce total metals concentration that is basis for RGO. Not feasible because of discrete target areas. Not consistent with future land use.
	Biological Treatment	Enhanced bioremediation	Circulate water-based nutrients through the soil in place. Indigenous microbes degrade contaminants over time.	Not effective in reducing total metals concentration that is basis for RGOs. No treatment during winter months. Not consistent with future land use.
		Phytoremediation	Introduce plants to remove contaminants from impacted soils through natural biological processes.	Not applicable for explosive contaminants found in soils at LLs 1-4. No treatment during winter months. Not consistent with future land use.
	Thermal Treatment	Radio frequency heating	Use electromagnetic energy from electrodes to heat soils and enhance SVE performance.	Not applicable for inorganic or explosive contaminants found in soils at LLs 1-4. Not consistent with future land use.
		Steam injection	Inject steam below the zone of contamination to release contaminants from soil and migrate upwards to be collected with an SVE system.	Not applicable for inorganic or explosive contaminants found in soils at LLs 1-4. Not consistent with future land use.
Ex Situ Treatment	Physical Treatment	Separation	Magnetic separation (or sieve after stabilizing step) of contaminants from soil. Requires further handling of separated solids.	Not applicable to explosive contaminants found in soils at LLs 1-4. Potential limited applicability. Not a final treatment step.
	Chemical Treatment	Chemical extraction	Uses acid to extract heavy metal contaminants, or cosolvents for other constituents, from soils. Extractant requires further treatment.	Not applicable to explosive contaminants found in soils at LLs 1-4. Potential limited applicability. Not a final treatment step.
		Chemical reduction / oxidation	Apply chemical oxidants to destroy contaminants in the subsurface.	Not applicable to explosive contaminants found in soils at LLs 1-4. Potential limited applicability.
		Soil washing	Mix soils in reactor to detach contaminants from soil. Extractant requires further treatment.	May not be effective in attaining RGOs. Potential limited applicability. Not a final treatment step.

Table 4-2 – Screening of Technologies and Process Options*

Soil General Response Actions	Remedial Technology Types	Process Options	Description	Screening Comments
Ex Situ Treatment (continued)	Chemical Treatment (continued)	Solidification / stabilization	Add binders to mechanically or chemically interact with the contaminants to limit their solubility or mobility.	Not applicable to explosive contaminants found in soils at LLs 1-4. Potential limited applicability. Does not reduce total metals that is basis for RGO.
	Biological Treatment	Composting	Combine contaminated soil with readily degradable carbon sources and bulking agents and nutrients. Indigenous microbes degrade contaminants over time.	Does not reduce total metals that is basis for RGOs. Not applicable to PCBs. Bulking agents effectively dilute soil and increase subsequent treatment volume. Potential limited applicability.
	Thermal Treatment	Incineration	Chemical decomposition induced in organic materials by heat.	Not applicable to inorganic contaminants found in soils at LLs 1-4. Potential limited applicability.
		Pyrolysis	Chemical decomposition induced in organic materials by heat in the absence of oxygen.	Not applicable to inorganics, explosives or PCBs found in soils at LLs 1-4. Area of SVOC-only contamination is too minimal.[b]

*Shaded cells indicate that the remedial technology type and/or process option was eliminated from further evaluation.

[a] There are approximately 108 discrete contaminated areas in LLs 1-4 totaling over 196,000 square feet of soil surface. This estimate of the total surface area for capping does not include any buffer perimeter for the cap to extend beyond the contaminated area, which would increase the square footage. The area of the cap would be substantially reduced if contaminated soil was consolidated prior to capping.

[b] Pyrolysis for PCBs is not a fully established technology at this time. The one area of soil requiring remediation only for SVOC contamination is estimated at approximately 7,644 ft^3 (283 cy). The potential applicability of pyrolysis is therefore too limited and no economies of scale will be recognized in implementation.

4.4 Evaluation of Technologies and Selection of Representative Technologies

The process options that remained after the initial screening step were further evaluated and compared with respect to relative effectiveness, overall implementability and cost. The evaluation of effectiveness focuses on the reliability of the process to meet remediation goals for contaminants and address the volume of impacted media given AOC conditions and the potential impact on human health and the environment during construction and implementation. The implementability evaluation focuses more on the institutional aspects of implementability than the technical and administrative feasibility used in the earlier screening step. The cost evaluation is based on engineering judgment of relative estimates for capital and operation and maintenance (O&M) costs.

The results of this evaluation are summarized in Table 4-3 and each process option is described in more detail below. Process options that are screened out from further consideration are highlighted with hatch marks in Table 4-3.

4.4.1 Institutional Controls

Institutional controls are used in CERCLA remedies to prevent or control exposures of potential receptors to contamination remaining in place at the site "…to assure continued effectiveness of the response action" [40 CFR 300.430 (e)(3)(ii)]. Institutional controls will not be considered as a stand-alone technology but as a general technology used in combination with other alternatives to enforce land use controls during the implementation of, and following, the selected interim remedy. Public access to RVAAP in general, and LLs 1-4, is currently restricted by fencing (facility and individual AOC perimeter fences) and security surveillance. A security fence surrounds the perimeter of the facility. Currently, an eight-foot high chain link fence topped with barbed wire surrounds each of the LLs 1-4. Authorized access to each load line is through a locked gate.

The designated future land use is for National Guard mounted training (no digging). Land use restrictions are effective for protecting human health as long as the implementation is maintained. These would prevent invasive activities (e.g., drilling or digging) in contaminated soils. LLs 1-4 are RVAAP property and controlled by the Army. The following land use controls could be implemented:

- Restricted access prohibiting residential use;
- Restricted access precluding casual access by maintenance of a facility-perimeter fence surrounding RVAAP;
- Use of facility-perimeter fencing and signage around the facility perimeter to regulate intrusive activities and potential exposure to contaminants; and
- Briefings to area users, monitoring of user activities within LLs 1-4, and facility-specific operations plans.

Should future land use change in the near future, the land use controls will need to be reevaluated to determine their protectiveness. This remedial option has a relative low cost and will be maintained for further consideration as part of a remedial alternative. Land use controls are not a preferred remedial option given the future land use and difficulties in maintaining the land use controls. Institutional controls, including deed restrictions for land and groundwater use and facility-perimeter fencing, may be required for interim remedies to prevent unauthorized land use.

4.4.2 Capping

Placing an impermeable barrier (cap) over the impacted area would eliminate infiltration through the contaminated soils. Capped areas could not be disturbed as it would jeopardize the integrity of the cap. The future land use would have to exclude capped areas which would be inconsistent with the agreed upon future land use. This remedy would require Land Use Controls and long term monitoring. A properly maintained cap is effective for preventing direct contact, ingestion or inhalation of contaminated soils, however it is not a permanent remedy. Generally, construction of a cap is easily implementable as it is a well practiced technology and numerous skilled contractors are available. However, due to the distribution of discrete areas of contaminated soil requiring remediation, the soils would need to be excavated and consolidated on-site at one or more locations prior to placement on a liner and capping. However, the construction of a cap within the load lines may limit National Guard training activities by reducing the areas available for training. The cap and liner could be a clay, asphalt or multi-layer, multi-media type. The clay cap is the least expensive of the three options and requires only a source of clay sufficient to cover the area required. An asphalt cap is relatively inexpensive to install but requires continued maintenance. The multi-layer, multi-media cap is the most expensive in terms of capital and maintenance costs. The clay and asphalt cap remedial options will be maintained for further consideration as part of a remedial alternative; however the multi-layer cap remedial option is eliminated at this point due to relative high cost.

4.4.3 Solids Excavation

Excavation actions involve removal of soil using conventional earth-moving equipment such as excavators and loaders. Soil excavation would be used in conjunction with other remedies such as consolidation and capping, ex-situ treatment, and disposal actions. Excavation is suitable for LLs 1-4 because of the proximity of the contaminants to the soil surface, and because the total volume of waste soils that would be generated is expected to be limited and manageable. Excavated soils would be staged temporarily on-site until the follow-on remedies are in place, such as construction of a containment liner for capping or ex-situ treatment, or characterization for disposal. Excavated areas would be brought back to grade with clean fill soil. Removal of the contaminant source by excavation is a permanent remedy for the areas excavated, and when used in conjunction with disposal actions, is an interim remedy for LLs 1-4. This remedial option is consistent with the National Guard mounted training (no digging) land use scenario. The cost of excavation is low and no future maintenance will be required after regrading. This remedial option will be maintained for further consideration as part of an interim remedial alternative for the AOCs.

4.4.4 Off-Site Disposal

Disposal involves permanent disposition of the contaminated soil in a manner that protects human health and the environment. Off-site disposal would involve the transportation of excavated soil to an approved and licensed disposal facility. All excavated materials will be sampled for waste characterization prior to any disposal activities. Wastewater accumulated during equipment decontamination at the AOCs could be disposed of off-site at a treatment, storage, and disposal facility or a POTW, or treated on-site, depending on its characteristics. Because the source contamination would be permanently removed, off-site disposal actions would be consistent with the future land use for National Guard mounted training (no digging) and allow for unrestricted use of the Load Line 1-4 areas for training. Off-site disposal is considered readily implementable in the area of RVAAP due to the proximity of RVAAP to several facilities that accept hazardous materials for disposal. The cost is moderate; however, there are no maintenance costs. This remedial option will be maintained for further consideration as part of an interim remedial alternative.

4.4.5 Chemical Reduction / Oxidation

Chemical oxidation is effective for permanent destruction of SVOCs and reduction in mobility of metals. However, it does not reduce the total metals concentration that is the basis for many of the RGOs. Chemical oxidation for explosives is not a fully established technology at this time. This uncertainty with the remedy can result in excess costs and implementation of additional remedies if the initial remedy does not work or reach RGOs. Chemical oxidation is implementable in excavated soils. Treated soil will require on- or off-site disposal. On-site disposal would require Land Use Controls and Long Term

Monitoring, which is inconsistent with the future land use. The cost for soil handling and hazardous reagents and monitoring is high, although once treated, maintenance costs should be low. This remedial option is eliminated from further consideration as part of a remedial alternative due to the high cost for the initial treatment and then needed additional cost by another technology to address explosives.

4.4.6 Solidification / Stabilization

Stabilization is typically used for metals-containing soil with concentrations exceeding Toxicity Characteristic Leaching Procedure (TCLP) limits (i.e., metals will leach and impact groundwater). Stabilization prevents the metals from leaching to infiltrating water. However, it does not reduce the total metals concentration, and it has not been proven effective for reducing the toxicity, mobility or volume of explosives. Therefore, this process would need to be used in conjunction with another process for explosives or in an area where explosives did not exceed RGOs. In addition, this process is typically not used for metals-containing soils if the soils do not exhibit the characteristic toxicity. Due to inaccessibility of soils located under building overhangs for mixing, the soils would need to be excavated and consolidated on-site prior to treatment. Following stabilization, the treated material needs to be disposed of on- or off-site. On-site disposal would require Land Use Controls and Long Term Monitoring, which is inconsistent with the future land use. The capital cost of stabilization increases as the need for soils handling increases. This remedial option is eliminated from further consideration due to the limited applicability not only to overall COCs but even to the technology target COCs.

4.4.7 Composting

MKM Engineers, Inc (MKM) conducted a bioremediation pilot test in 2000 for explosives contaminated soils (MKM, 2002). The pilot test consisted of both a bench scale and field pilot study. Results of the pilot test indicated that bioremediation, through windrow composting, would be a viable alternative for explosives contaminated soils at RVAAP. Based on the data provided in the report, the concentrations of metals in the soil to be treated were generally below RGOs. However, at LLs 1-4, soils designated for remediation generally exceed RGOs for metals as well as explosives or PCBs. Bioremediation would not reduce the total metals concentrations, that is the basis for many of the RGOs. Due to inaccessibility of soils located under building overhangs for mixing, the soils would need to be excavated and consolidated on-site prior to treatment. The addition of organic material for composting would dilute the remaining metals-containing soils, in violation of Ohio rules OAC 3745-270-03. Ohio EPA would have to agree that the remedy violates the intent of the statute, but is acceptable. Although this issue was addressed in the MKM report, the soil contained primarily only explosives in soil above the RGO, and not metals and PCBs as observed at LLs 1-4. The increased soil volume due to composting amendments would increase the volume of waste to be disposed on or off-site, and may potentially affect the effectiveness of follow-on remedies such as stabilization. On-site disposal would require Land Use Controls and Long Term Monitoring, which is inconsistent with the future land use. The handling and increased volume would increase remediation and monitoring costs. This remedial option is eliminated from further consideration due to the high cost, long treatment time and need for additional treatment for metals and PCBs.

4.4.8 Incineration

Incineration would be effective for permanent destruction of explosives and SVOCs in soil. The residual is ash. However, incineration is not effective for reducing the toxicity, mobility or volume of metals in soils. This *ex situ* process is moderately implementable for LL 1-4 soils. The capital cost is high, however, there are no maintenance costs. This remedial option is eliminated from further consideration due to the high cost for the initial treatment and then needed additional cost by another technology to address metals.

Table 4-3 summarizes the evaluation of process options. Process options that are screened out from further consideration are highlighted with hatch marks in Table 4-3.

Table 4-3 - Evaluation of Process Options*

Soil General Response Actions	Remedial Technology Types	Process Options	Effectiveness	Implementability	Cost
No Action	None	Not applicable	Does not achieve RAOs	Not acceptable to Ohio EPA	None
Institutional Controls	Access Restrictions	Fencing Land use restrictions	Effectiveness depends on continued future implementation. Does not reduce contamination.	Legal requirements and authority.	Negligible cost to install fencing since already in place and minimal cost to maintain. Minimal cost to document land use restrictions.
Containment	Cap	Clay cap	Effective, susceptible to cracking, but has self-healing properties. Requires maintenance and Long Term Monitoring.	Easily implemented. Restrictions on future land use in capped areas (i.e., off-limits to vehicular travel).	Medium capital, low maintenance.
		Asphalt	Effective but susceptible to weathering and cracking. Requires maintenance and Long Term Monitoring.	Easily implemented. Restrictions on future land use in capped areas (i.e., off-limits to vehicular travel).	Medium capital, high maintenance.
		Multi-layer, multi-media cap	Effective, least susceptible to cracking.	Moderate implementability. Restrictions on future land use in capped areas (i.e., off-limits to vehicular travel).	High capital, high maintenance.
Removal	Excavation	Solids excavation	Effective for permanent removal of contaminants. Removed solids require treatment or disposal.	Easily implemented. Land use restricted to National Guard mounted training (no digging).	Low capital, no maintenance.
Disposal Excavation	Disposal Excavation	Off-site disposal	Effective for permanent removal of contaminants.	Easily implemented. Land use restricted to National Guard mounted training (no digging).	Moderate capital, no maintenance.
Ex Situ Treatment	Chemical Treatment	Chemical reduction / oxidation	Not applicable for explosives, effective for permanent destruction of SVOCs, effective for reducing mobility of metals. Requires area for final managed disposal.	Moderate implementability.	Moderate capital, no maintenance.

Table 4-3 - Evaluation of Process Options*

Soil General Response Actions	Remedial Technology Types	Process Options	Effectiveness	Implementability	Cost
		Solidification / stabilization	Not applicable for explosives, effective for permanent destruction of SVOCs, effective for reducing mobility of metals. Does not reduce total metals. Requires area for final managed disposal.	Moderate implementability.	High capital, no maintenance.
Ex Situ Treatment (continued)	Biological Treatment	Composting	Does not reduce total metals, effective for permanent destruction of SVOCs and explosives. Requires area for final managed disposal.	Moderate implementability.	Low capital, low maintenance.
	Thermal Treatment	Incineration	Not applicable for inorganics, effective for permanent destruction of SVOCs and explosives.	Easily implemented.	High capital, no maintenance.

*Shaded cells indicate that the remedial technology type and/or process option was eliminated from further evaluation.

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5.0 DEVELOPMENT AND SCREENING OF ALTERNATIVES

Potential technologies for soil and dry sediment at LLs 1-4 at RVAAP were identified and screened in Section 4.3. The results of the screening process identified a limited number of technologies that are potentially viable for the contaminants and conditions at LLs 1-4. The remaining technologies include the following: no action, institutional controls, containment under a cap, and removal by excavation and off-site disposal. Other technologies that were eliminated in the last step were those that would require to be operated in combination or only in a selected area and the costs would then be prohibitive compared to the single stage processes.

The remedial alternatives for LLs 1-4 of the RVAAP that are described in this section are numbered as shown below. The detailed analysis of each alternative is discussed in Section 6.0.

Medium	FFS Alternative	Description
Soil and Dry Sediment	SDS1	No Action
	SDS2	Excavation and On-Site Capping
	SDS3	Excavation and Off-Site Disposal

SDS - Soil and Dry Sediment

The remedial alternatives for this FFS do not address media other than soil and dry sediment and do not include soil under building slabs or sediment in the sewers. Potential impacts to groundwater and surface water may be identified but are not necessarily considered in the evaluation of the alternatives. As previously stated, the objective of this FFS is to obtain an IRIP for soil and dry sediment at LLs 1-4 and is not intended to evaluate a complete final remedy for AOC closure. The alternatives presented here are for soil and dry sediment source control and do not include management of migration aspects for the COCs.

The following sections provide the detailed descriptions of the alternatives.

5.1 Alternative SDS1: No Action

Consideration of the no action alternative is required under US EPA guidance for removal actions under CERCLA for baseline comparison with other alternatives. Under this alternative, contaminated soil and dry sediment would remain in place. No action would be taken to reduce the hazards present at LLs 1-4 to potential human or ecological receptors. There would be no measured reduction in toxicity, mobility, or volume of the contaminated media. Although SVOCs and explosives may naturally attenuate with time, it is unlikely that metals and PCB concentrations will be reduced through natural attenuation mechanisms such as dilution, dispersion or degradation. The potential exposure risks will remain indefinitely. It should be noted that fencing is currently in place at the facility, both around the facility and around LLs 1-4; however, maintenance of the facility-perimeter or AOC fence is not a component of this alternative.

Although this FFS does not address management of migration remedies for the AOCs, it should be noted that the No Action alternative would not impact implementation of potential future remedial actions. The detailed analysis of the No Action alternative is discussed in Section 6.1.1.

5.2 Alternative SDS2: Excavation and On-Site Capping

This alternative would involve the excavation of contaminated surface and subsurface soil and dry sediment from discrete areas and consolidation in one or more stockpiles. Soils exceeding the TSCA and/or RCRA criteria would be disposed off-site at a licensed facility. The stockpile will be lined and covered with a protective cap to act as a physical barrier against direct contact and prevent infiltration. Surface controls would be necessary to prevent erosion damage, control runoff or other disturbances to the cap. Following excavation of the contaminated surface and subsurface soil and dry sediment and receipt of laboratory confirmatory soil sample results, clean backfill would be placed in excavated areas, and the load line area would be restored to pre-excavation topography. "Clean" backfill consists of on- or off-site soil that has passed the chemical and physical requirements in accordance with the RVAAP facility-wide plans. This alternative would also require the use of institutional controls to prevent access and invasive activities in the capped area and land use controls to prevent use other than National Guard mounted training (no digging). The time to achieve RAOs would be approximately one year.

This alternative includes the following components:

- Excavation of discrete areas of contaminated surface and subsurface soil and dry sediment as defined in Section 2.3;
- Off-site disposal of soils exceeding TSCA and/or RCRA criteria;
- Consolidation of soils in on-site stockpile(s) on an impermeable liner;
- Replacement of excavated material with compacted clean backfill;
- Cap of asphalt pavement or clay over consolidated and graded stockpile;
- Surface water diversion and runoff controls for the cap;
- Regulation of intrusive activities into the cap;
- Maintenance of cap integrity;
- Implementation of land use restrictions for land use other than National Guard mounted training (no digging);
- Installation and maintenance of signage and structural access barriers to prevent vehicular traffic;
- Periodic groundwater monitoring to ensure the remedy does not impact groundwater;
- Maintenance, inspection and repair of building slabs and foundations; and,
- Five year reviews.

The areas to be excavated within LLs 1-4 will be delineated based on available data included in the RI reports and additional field confirmation sampling activities. The volume of soil requiring excavation is estimated for each load line in Section 2.3. Removal work will begin with demarcation of the areas of soil exceeding calculated RGO values for the National Guard mounted training (no digging) land use scenario. The perimeter of the area to be excavated would be delineated with flagging and enclosed with temporary fencing or another barrier to limit access. A sign would be posted at the entrance to each AOC listing the hazards present at the AOC and a telephone number of someone to contact to gain access to the AOC. Excavation will begin in the area of the highest COC concentrations detected and move outward from the assumed source location. This will serve to remove the most grossly impacted soils first to minimize the generation of hazardous wastes. Once the "hot spot" areas are removed, further excavation will be guided by field test kits. Confirmatory samples for laboratory analysis would be taken from the sidewalls and bottom of the completed excavations to verify that the contaminated soil above RGOs was removed. If analysis results indicate that contamination remains in the ground, additional soil would be excavated. Confirmatory samples would be taken from the extended excavation, and the process repeated as necessary until the soil to remain in place meets the RAOs. Building foundations will remain in place during excavation. The excavated areas will be backfilled with clean fill. "Clean" backfill consists of on- or off-site soil that has passed the chemical and physical requirements in accordance with the RVAAP facility-wide plans.

Site preparation would include, as required based on the local site topography, constructing temporary diversion ditches to minimize surface run-on into the excavations, installing silt fence and staked hay bales to minimize transport of soil in run-off, constructing temporary staging area for soils, equipment laydown areas, and establishing decontamination areas at the AOCs. Similar measures would be taken to avoid erosion of contaminated soils or ponding of water in the open excavations. Environmental protection barriers expected to be used in the completion of this alternative include Best Management Practices (BMPs) such as haybales, silt fencing, and polyethylene sheeting and liners for temporary stockpiling of soils. An impermeable liner will be required for the consolidated stockpile prior to capping. Inspection of these barriers will occur regularly during construction to ensure that their intended use has not been compromised during the completion of field activities. The existing concrete slabs and foundations that will remain at the facility after building demolition may be considered environmental protection barriers as they may provide a barrier for infiltration to potentially impacted soils beneath the slabs. Concrete slabs will be inspected on a periodic basis to ensure that no additional cracks caused by soil remediation activities are created. Maintenance to the slabs will be conducted as necessary.

Consolidation of the contaminated soils on-site will be developed at a grade sufficient to support a cap. The grade will aid in directing surface water runoff away from the capped areas. Capping will contain instead of treating contaminated soil and dry sediment, so there are no treatment residuals to manage. However, the cap will require long-term maintenance to maintain the cap integrity indefinitely. The cap will prevent precipitation from infiltrating the contaminated soil thereby limiting natural attenuation of SVOCs and explosives. However, metals and PCBs are not expected to naturally attenuate under a cap and the cap will need to be maintained indefinitely. In addition, the cap will prevent infiltration from potentially leaching explosives from the soil to other media that can reach receptors.

All construction equipment and tools that come into contact with contaminated or potentially contaminated media would be decontaminated prior to being used for AOC restoration activities or being moved out of the controlled area. A temporary decontamination pad capable of collecting wash water including overspray would be assembled, if not currently in existence. Equipment and tools would be thoroughly cleaned with a steam cleaner to remove all visible soil and mud. The decontamination water would be collected in portable polyethylene tanks (polytanks). Soil residue would be placed in temporary storage piles.

The wastewater stored in portable polytanks would be tested for the full suite of constituents (i.e., VOCs, SVOCs, PCBs, pesticides, explosives, propellants and unfiltered TAL metals) prior to making disposal determinations.

The excavated area will be backfilled with clean fill, returned to pre-excavation grade and seeded. “Clean” backfill consists of on- or off-site soil that has passed the chemical and physical requirements in accordance with the RVAAP facility-wide plans.

Although this FFS does not address management of migration remedies for LLs 1-4, it should be noted that excavation and on-site capping would not impact implementation of potential future remedial actions in the load line area. Remedial actions in the area of the cap would be strictly limited. Land use controls will be implemented for the load lines consistent with the land use for National Guard mounted training (no digging). The location for the on-site capped stockpile will be selected such that it will not interfere with future land use, to the extent possible. Structural barriers will be placed around the capped area to prevent vehicular travel.

In addition, the risk of contamination to groundwater and surface water within LLs 1-4 is expected to be minimal during construction due to the implementation of control measures and management procedures. During removal activities, BMPs will be implemented to minimize surface water runoff, dust, and deposition of the excavated material. Such practices include the following:

- Using haybales and silt fence downgradient of the excavation ahead of wetlands;
- Using sprayed water and polyethylene covers to minimize dust generated from excavated materials;
- Washing truck and vehicle tires prior to leaving the load lines to minimize tracking of soils to other areas; and,
- Monitoring dust generation at the excavation and at the perimeter.

For this option, long-term groundwater monitoring would be performed for five years at select existing wells in LLs 1-4 to monitor for potential impacts to groundwater. Groundwater samples will be collected quarterly for the first two years after remedy implementation. The sampling frequency thereafter will be reviewed by the Ohio EPA and will be based on the laboratory results. Groundwater samples will be submitted to an environmental chemistry laboratory for analysis of the full suite of constituents (i.e., VOCs, SVOCs, PCBs, pesticides, explosives, propellants and unfiltered TAL metals). In addition, the concrete slabs and building foundations that remain in place after interim remediation will be inspected periodically to assess their integrity until removed. The remedial action will be subject to a five-year review as part of the CERCLA process to assure that human health and the environment are being protected.

The detailed analysis of the capping alternative is discussed in Section 6.1.2.

5.3 Alternative SDS3: Excavation and Off-Site Disposal

This alternative would involve the excavation of contaminated surface and subsurface soil and dry sediment from discrete areas and permanent disposal in a RCRA-permitted landfill as a non-hazardous, hazardous or TSCA waste, depending on levels and type of contamination. Following excavation of the contaminated surface and subsurface soil and dry sediment and receipt of laboratory confirmatory soil sample results, clean backfill would be placed in excavated areas, and the AOCs would be restored to pre-excavation topography. “Clean” backfill consists of on- or off-site soil that has passed the chemical and physical requirements in accordance with the RVAAP facility-wide plans. This alternative would support the planned future land use (i.e., National Guard mounted training, no digging). The time to achieve RAOs would be approximately six-months.

This alternative includes the following components:

- Excavation of discrete areas of contaminated surface and subsurface soil and dry sediment as defined in Section 2.3;
- Temporary on-site storage via stockpiling and characterization;
- Disposal of excavated soil and dry sediment at a RCRA and/or TSCA permitted landfill;
- Replacement of excavated material with compacted clean backfill;
- Implementation of land use restrictions for land use other than National Guard mounted training (no digging);
- Installation and maintenance of access barriers and signage;
- Periodic groundwater monitoring to ensure the remedy does not impact groundwater;
- Maintenance, inspection and repair of building slabs and foundations; and
- Five year reviews.

The areas to be excavated within LLs 1-4 will be delineated based on available data included in the RI reports and additional field confirmation sampling activities. The volume of soil requiring excavation is estimated for each load line in Section 2.3. Removal work will begin with demarcation of the areas of soil exceeding calculated RGO values for the National Guard mounted training (no digging) land use scenario. The perimeter of the area to be excavated would be delineated with flagging and enclosed with temporary fencing or another barrier to limit access. A sign would be posted at the entrance to each AOC listing the hazards present at the AOC and a telephone number of someone to contact to gain access to the AOC. Excavation will begin in the area of the highest COC concentrations detected and move outward from the assumed source location. This will serve to remove the most grossly impacted soils first to minimize the generation of hazardous wastes. Once the “hot spot” areas are removed, further excavation will be guided by field test kits. Confirmatory samples for laboratory analysis would be taken from the sidewalls and bottom of the completed excavations to verify that the contaminated soil above RGOs was removed. If analysis results indicate that contamination remains in the ground, additional soil would be excavated. Confirmatory samples would be taken from the extended excavation, and the process repeated as necessary until the soil to remain in place meets the RAOs. Building foundations will remain in place during excavation. The excavated areas will be backfilled with clean fill. "Clean" backfill consists of on- or off-site soil that has passed the chemical and physical requirements in accordance with the RVAAP facility-wide plans.

Site preparation would include, as required based on the local site topography, constructing temporary diversion ditches to minimize surface run-on into the excavations, installing silt fence and staked hay bales to minimize transport of soil in run-off, constructing temporary staging areas for soils, equipment laydown areas, and establishing decontamination areas at the AOCs. Similar measures would be taken to avoid erosion of contaminated soils or ponding of water in the open excavations. Environmental protection barriers expected to be used in the completion of this alternative include BMPs such as haybales, silt fencing, and polyethylene sheeting and liners for temporary stockpiling of soils. Inspection of these barriers will occur regularly during construction to ensure that their intended use has not been compromised during the completion of field activities. The existing concrete slabs and foundations that will remain at the facility after building demolition may be considered environmental protection barriers as they may provide a barrier for infiltration to potentially impacted soils beneath the slabs. Concrete slabs will be inspected on a periodic basis to ensure that no additional cracks caused by soil remediation activities are created. Maintenance to the slabs will be conducted as necessary.

Excavated soils will be stored on-site temporarily in stockpiles prior to transporting to disposal facilities. Stockpiles would be staged on top of a polyethylene liner and covered with the same. The cover would be secured to prevent wind damage to the cover and stockpile. Stormwater runoff would be collected for treatment or off-site disposal. The stockpiled soils will be sampled and characterized. Soil removed from small excavations will be stockpiled. Soil from large excavations may be characterized and loaded out directly.

Excavated contaminated soil and dry sediment could require special handling and disposal at a RCRA Subtitle C hazardous waste landfill; however, disposal characterization samples would be analyzed prior to disposal. It is expected that the majority of the soils containing metals do not exceed the TCLP limits, and therefore do not require stabilization prior to off-site shipment. If the soil is determined to be non-hazardous, it could be disposed at a local Subtitle D landfill. It is conservatively assumed that the excavated soil and dry sediment would be hazardous and would be disposed at a hazardous waste RCRA Subtitle C landfill.

Off-site disposal facilities will be selected based on waste characterization data collected from representative stockpiles of removed material. The disposal facilities accepting soils with metals contamination, will also accept soils with explosives, PCBs, SVOCs, and metals contamination, eliminating the need to reduce concentrations prior to shipment through other remedial measures. Several off-site disposal facilities accepting these wastes are located within 200 miles of RVAAP.

Excavation and off-site disposal will remove the contaminants from the AOCs so there will be no treatment residuals. The contaminated soil and dry sediment will be transported to the off-site disposal facilities in a manner that reduces potential risks to human health. Once the soils are excavated, long-term maintenance is not required.

All construction equipment and tools that come into contact with contaminated or potentially contaminated media would be decontaminated prior to being used for AOC restoration activities or being moved out of the controlled area. A temporary decontamination pad capable of collecting wash water including overspray would be assembled, if not currently in existence. Equipment and tools would be thoroughly cleaned with a steam cleaner to remove all visible soil and mud. The decontamination water would be collected in portable polytanks. Soil residue would be placed in temporary storage piles.

The wastewater stored in portable polytanks would be tested for the full suite of constituents (i.e., VOCs, SVOCs, PCBs, pesticides, explosives, propellants and unfiltered TAL metals) prior to making disposal determinations.

The excavated area will be backfilled with clean fill, returned to pre-excavation grade and seeded. "Clean" backfill consists of on- or off-site soil that has passed the chemical and physical requirements in accordance with the RVAAP facility-wide plans.

Although this FFS does not address management of migration remedies for the AOCs, it should be noted that excavation and off-site disposal would not impact implementation of potential future remedial actions in the load line area. Land use controls will be implemented for the load lines consistent with the land use for National Guard mounted training (no digging).

In addition, the risk of contamination to groundwater and surface water within LLs 1-4 is expected to be minimal during construction due to the implementation of control measures and management procedures. During removal activities, BMPs will be implemented to minimize surface water runoff, dust, and deposition of the excavated material. Such practices include the following:

- Using haybales and silt fence downgradient of the excavation ahead of wetlands;
- Using of sprayed water and polyethylene covers to minimize dust generated from excavated materials;
- Washing truck and vehicle tires prior to leaving the load lines to minimize tracking of soils to other areas; and,
- Monitoring dust generation at the excavation and at the perimeter.

For this option, long-term groundwater monitoring will be performed for five years at select existing wells in LLs 1-4 to monitor for potential impacts to groundwater. Groundwater samples will be collected quarterly for the first two years after remedy implementation. The sampling frequency thereafter will be reviewed by the Ohio EPA and will be based on the laboratory results. Groundwater samples will be submitted to an environmental chemistry laboratory for analysis of the full suite of constituents (i.e., VOCs, SVOCs, PCBs, pesticides, explosives, propellants and unfiltered TAL metals). In addition, the concrete slabs and building foundations that remain in place after remediation will be inspected periodically to ensure their integrity has not been compromised allowing infiltration to potentially contaminated soils underneath. The remedial action will be subject to a five-year review as part of the CERCLA process to assure that human health and the environment are being protected.

The detailed analysis of the excavation alternative is discussed in Section 6.1.3.

5.4 Screening of Alternatives

Because only three alternatives are going to be evaluated, this screening step is not necessary. The detailed analysis of alternatives is discussed in Section 6.0.

6.0 DETAILED ANALYSIS OF ALTERNATIVES

The detailed individual analysis evaluates remedial alternatives selected for final consideration. In addition, these alternatives were evaluated individually and then comparatively against the following two CERCLA threshold criteria:

- overall protection of human health and the environment, and
- compliance with ARARs;

and the following five CERCLA balancing criteria:

- long-term effectiveness and permanence;
- reduction of toxicity, mobility or volume through treatment;
- short-term effectiveness;
- implementability; and
- cost.

The two CERCLA modifying criteria (State and community acceptance) will be evaluated after State and public comments on the revised FFS and the Proposed Plan are received. The purpose of this analysis is to provide sufficient information to compare the alternatives, select an appropriate interim remedy for LLs 1-4, and demonstrate its compliance with the CERCLA remedy selection requirements.

Overall Protection of Human Health and the Environment
The NCP requires that the selected remedy adequately protect human health and the environment over the long-term. The overall assessment of protection draws on the assessments conducted under other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs. This evaluation criterion describes the manner in which AOC risks posed through the identified pathways are eliminated, reduced or controlled through treatment, engineering or institutional controls. This evaluation criterion also considers whether the alternative poses any unacceptable short-term or cross-media impacts.

Compliance with ARARs
This criterion is used to determine whether an alternative will meet federal and State ARARs. It identifies the requirements that are applicable or relevant and appropriate to an alternative and describes how the alternative meets action-specific, chemical-specific and location-specific ARARs. If an ARAR is not met, the basis for justifying a waiver will be discussed. The principal ARARs for remediation of soils at LLs 1-4 are presented in Section 3.0 and summarized in Appendix D.

Long-Term Effectiveness and Permanence
This criterion addresses the risk remaining at the AOCs after RAOs are met. Specific evaluation of this criterion focuses on assessing the magnitude of the residual risk, and the adequacy and reliability of controls used to manage remaining waste and treatment residuals over the long-term.

Reduction of Toxicity, Mobility or Volume Through Treatment
This criterion addresses the statutory preference for selecting remedial actions that employ treatment to permanently and significantly reduce toxicity, mobility, or volume of the hazardous substances. Specifically, the factors on which this analysis focuses include the following:

- the treatment processes and what they will treat;
- the amount of hazardous materials treated or destroyed and how the principal threat is addressed;
- the degree of expected reduction in toxicity, mobility or volume;
- the degree to which treatment will be irreversible; and
- the type and quantity of residuals that will remain following treatment.

Short-Term Effectiveness
This criterion addresses the effects of a remedial alternative during the construction and implementation phase, including the protection of the community and workers, potential environmental impacts and mitigative measures, and the time frame to achieve clean-up goals.

Implementability
The implementability criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation. Specifically, evaluation of this criterion considers the following:

- the ability to construct and operate components of the alternatives and potential technical difficulties and unknowns;
- the ease of undertaking additional remedial action;
- the ability to monitor the performance and effectiveness of the remedy and the ability to evaluate the risks of exposure should the monitoring be insufficient to detect a failure of the remedy;
- administrative feasibility (i.e., activities that are necessary to coordinate with other offices and agencies for permits, rights-of-way, etc.); and
- the availability of services, capacities, materials, equipment and specialists.

Cost
Cost estimating procedures are contained in US EPA costing guidance (US EPA, 1987, 2000). The purpose of the cost evaluation is to compare how an alternative's cost impacts the overall "cost-effectiveness" of the alternative over time. These "study estimate" costs are expected to provide an accuracy of +50 percent to -30 percent and were prepared for the AOCs using data available from the RIs (SAIC, 2004; Shaw, 2004a, b, c). They do not include pre-design activity or design development costs. They do not represent construction cost estimates or cost at completion. The individual components of the cost estimates are defined as follows:

- Capital Costs: Capital costs consist of direct (construction) and indirect (non-construction and overhead) costs associated with installation and implementation of remedial alternatives. Direct costs include expenditures for the equipment, labor, and materials necessary to install remedial actions. Indirect costs include expenditures for engineering, financial, administration, and other services that are not part of actual installation activities.
- Annual O&M Costs: Annual O&M costs are post-construction costs necessary to ensure the continued effectiveness of a remedy.
- Present Worth Analysis: A present worth analysis is used to evaluate expenditures that occur over different time periods. This analysis provides a single figure representing the amount of money that, if invested in the base year at a given interest rate, would be sufficient to cover costs associated with the remedial action over its planned life.
- Cost Sensitivity Analysis: A sensitivity analysis assesses the effect that variations in specific assumptions associated with the design, implementation, operation, discount rate, and effective life of an alternative may have on the estimated cost of the alternative.

State Acceptance and Community Acceptance
The final two criteria, State Acceptance and Community Acceptance, are not included in this FFS in accordance with US EPA guidance because these two criteria are typically evaluated by US EPA following a public comment period on a Proposed Plan for the selected remedy and are considered by US EPA in arriving at a record of decision (ROD).

As discussed in Section 1.0, this FFS was performed in accordance with US EPA guidance for conducting a detailed evaluation of alternatives in a CERCLA feasibility study (US EPA, 1988).

6.1 Individual Analysis of Alternatives

The following sections evaluate the remedial alternatives detailed in Section 5.0, using the seven criteria discussed in the preceding section. The alternatives include No Action, Excavation and On-Site Capping, and Excavation with Off-Site Disposal.

6.1.1 Alternative SDS1: No Action

As described in Section 5.1, the No Action alternative does not include any further action. No remedial actions would be undertaken to reduce, contain, or remove contaminated soil and dry sediment. Off-site migration of contaminants would not be mitigated under the No Action alternative. It should be noted that fencing is currently in place around the facility and around LLs 1-4 area to restrict access; however, maintenance of the facility-perimeter or AOC fence is not a component of this alternative.

6.1.1.1 Overall Protection of Human Health and the Environment

The No Action alternative will not actively treat the COC-impacted soil and dry sediment or isolate human or environmental receptors from potential exposure to the COCs. This remedy will not reduce the short-term risk to humans or terrestrial organisms through ingestion, inhalation or contact with exposed COC-impacted soils and dry sediments. This remedy does not involve the natural attenuation of the COCs within an acceptable timeframe and therefore, does not provide long-term protection of human health and the environment. The lack of institutional controls, permanent facility-perimeter or AOC fencing, and continued 24-hour RVAAP security, along with a growing local population,[1] increase the potential risk of exposure to COCs. The National Guard Trainee will not be protected from potential exposure during future land use of mounted training (no digging).

This alternative does not reduce the migration of COCs from impacted soil and dry sediment to potential environmental receptors. However, as described in Section 2.2, impacts to environmental receptors are not included in the evaluation of alternatives.

6.1.1.2 Compliance with ARARs

The principal ARARs for remediation of soils LLs 1-4 are presented in Section 3.0 and summarized in Appendix D. These federally enforceable standards would be protective of a potential National Guard Trainee who could be exposed to the COCs.

The No Action alternative would not comply with chemical-specific ARARs. The concentrations in soil would remain above the RGOs, and although natural attenuation would occur for some COCs, the soil would not be confirmed to have been restored to National Guard Trainee use standards.

6.1.1.3 Long-Term Effectiveness and Permanence

The No Action alternative does not involve active treatment and will not yield treatment residuals or require long-term management. However, in the absence of an active remedy or significant natural attenuation processes, contaminated soils and dry sediments will remain in place at LLs 1-4 and will continue to pose a long-term risk to human health and the environment. In addition, this alternative will not reduce the toxicity, mobility or volume of contamination.

Monitoring data will not be available to assess whether AOC conditions are adequately protective of human health and the environment. The lack of institutional controls, permanent facility-perimeter or AOC fencing, and continued 24-hour RVAAP security, along with a growing local population,[2] increase the potential risk of exposure to COCs.

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[1] Portage and Trumbull counties combined had a 1.8% increase in population from 1990 to 2000. (Ohio State University, 2001)
[2] Ibid.

6.1.1.4 Reduction of Toxicity, Mobility or Volume

This alternative will not involve active treatment, containment, removal or disposal. Because no treatment would be implemented, there would be no reduction in toxicity, mobility, or volume. Due to their recalcitrant nature, the COCs will not naturally attenuate to levels protective of human health and the environment, within an acceptable timeframe. Therefore this alternative will not result in the significant reduction in the mass or volume of the COCs. In the absence of active treatment and degradation processes, the contaminants will continue to be toxic to humans and terrestrial organisms. Under this alternative, the migration of COCs through surface water run-off, dust, and leaching to groundwater, will pose a potential risk to environmental receptors.

6.1.1.5 Short-Term Effectiveness

Because this remedy does not involve active remediation or construction, there would not be a risk of exposure for AOC workers or the surrounding community to COCs. AOC workers will use appropriate personal protective equipment (PPE) to prevent contact with impacted media. The environment will not face additional adverse impact due to construction activities such as erosion, sedimentation or vegetative damage.

In the absence of any active treatment or containment, the No Action alternative will not reduce the risk to humans or terrestrial organisms through ingestion, inhalation or contact with COC-impacted soils or sediments. However, the lack of permanent residents on RVAAP and the low population density on its adjacent properties and existence of the facility and individual AOC perimeter fencing will mitigate the risk of exposure to COCs in the short-term.

6.1.1.6 Implementability

This section is divided into the three following categories: technical feasibility, administrative feasibility and availability of services and materials.

Technical Feasibility

The No Action alternative does not involve active remediation and therefore, technical feasibility is not a consideration. This alternative will not interfere with any planned remedial actions in the future.

Administrative Feasibility

No administrative or regulatory attention from the State agencies involved is required to implement this alternative with the exception that Ohio EPA would have to accept this remedy as the IRIP.

Feasibility of Obtaining Services and Materials

No services, equipment or materials are necessary to implement this alternative.

6.1.1.7 Cost

The No Action alternative will not have a capital or O&M cost.

6.1.1.8 Community Acceptance

This alternative has not yet been formally presented to the public for comment. There is a 30-day public comment period after submittal of the Final Focused Feasibility Study. Responses to the public's comments will be prepared prior to the selection of the remedial action.

6.1.2 Alternative SDS2: Excavation and On-Site Capping

As described in Section 5.2, this Alternative SDS2 includes the following components:

- Excavation of discrete areas of contaminated surface and subsurface soil and dry sediment as defined in Section 2.3;
- Off-site disposal of soils exceeding TSCA and/or RCRA criteria;
- Consolidation of soils in on-site stockpile(s) on an impermeable liner;
- Replacement of excavated material with compacted clean backfill;

- Cap of asphalt pavement or clay over consolidated and graded stockpile;
- Surface water diversion and runoff controls for the cap;
- Regulation of intrusive activities into the cap;
- Maintenance of cap integrity;
- Implementation of land use restrictions for land use other than National Guard mounted training (no digging);
- Installation and maintenance of signage and structural access barriers to prevent vehicular traffic;
- Periodic groundwater monitoring to ensure the remedy does not impact groundwater;
- Maintenance, inspection and repair of building slabs and foundations; and
- Five year reviews.

Removal of contaminated soil and dry sediment and containment of soils under a cap would eliminate the potential contact of receptors at the AOCs, as required under CERCLA. The remedial actions would be undertaken to reduce, contain, or remove contaminated soil. Off-site migration of contaminants would be mitigated under this alternative.

6.1.2.1 Overall Protection of Human Health and the Environment

Consolidation and capping of COC-impacted soils and dry sediments will isolate the source of contamination and protect humans and terrestrial organisms from potential exposure to the COCs, provided the integrity of the cap is maintained. The long-term containment of impacted soils and sediments under caps also prevents the migration of COCs through surface water run-off or dust generation. Capping the most grossly contaminated soil and dry sediment will reduce the mobility of the COCs and protect National Guard Trainee receptors in the long-term. However, this alternative relies on land use controls to eliminate or reduce exposures to other human and ecological receptors associated with unrestricted land use. The institutional controls would be implemented through and by RVAAP in concurrence with Ohio EPA. This alternative would provide protection of human health through new fencing or other structural barriers around capped areas, warning signs, and institutional controls placed on the use of on-site soils.

Removal and cap construction activities pose a short-term risk to human health and the environment. Because of the potential risk of exposure of AOC workers to impacted media during capping activities, they will require OSHA training and use PPE. In addition, the use and maintenance of facility-perimeter fencing and warning signs and structural barriers around the cap will protect humans and terrestrial organisms from potential exposure to COC-impacted media. Facility-perimeter fencing and institutional controls would prevent land use inconsistent with National Guard mounted training (no digging), signs would warn the public and trainees of the institutional controls and potential risks, and structural barriers would prevent vehicular travel on the cap. The potential short-term impact on environmental receptors through surface water run-off, dust and deposition of excavated material can be reduced through the use of BMPs.

6.1.2.2 Compliance with ARARs

The principal ARARs for remediation of soils at LLs 1-4 are presented in Section 3.0 and summarized in Appendix D. These federally enforceable standards would be protective of a potential National Guard Trainee who could be exposed to the COCs.

This alternative would comply with chemical-specific ARARs. Soils with measured concentrations of COC exceeding the RGOs would be removed. Effectiveness of the remedy would be confirmed through confirmatory samples analyzed at a certified analytical laboratory.

6.1.2.3 Long-Term Effectiveness and Permanence

This alternative contains but does not actively treat or destroy the COC-impacted media and therefore, its effectiveness is directly dependent upon maintaining the long-term integrity of the cap and liner and institutional controls. COC-impacted media will remain untreated under the cap and will pose a significant risk to human and environmental receptors if the cap fails. However, off-site disposal of TSCA and RCRA waste and capping the most grossly contaminated soil and dry sediment will reduce the mobility of the COCs and protect National Guard Trainee receptors in the long-term. However, this alternative relies on land use controls to eliminate or reduce exposures to other human and ecological receptors associated with unrestricted land use. Facility-perimeter fencing and warning signs, structural barriers around the capped areas, and land use restrictions will need to remain in place at the load lines for the long-term. The long-term effectiveness of this approach is directly related to the adequacy and reliability of the established land use controls. It is reasonable to expect that with appropriate documentation and procedures, land use controls could be successfully implemented and would be effective in protecting human health and the environment.

6.1.2.4 Reduction of Toxicity, Mobility or Volume

Although this alternative will not destroy the contaminated material, it will significantly reduce the total mass of COCs in soils that may create an exposure hazard at LLs 1-4 by removing impacted soils to a consolidated, capped stockpile. The total volume of soil to be excavated from LLs 1-4 and capped is discussed in Section 2.3. The capping of COC-impacted soils and sediments will not reduce the toxicity or volume of COCs but would instead reduce their long-term mobility through containment. The cap will prevent precipitation from infiltrating the COC-impacted soil and sediment and transporting COCs into groundwater or surface water. However, the effects of this alternative are easily reversible if the cap fails and the COC-impacted media are exposed to environmental agents. Long-term maintenance of the cap and a periodic monitoring will be important components of this alternative.

This alternative will not yield any toxic residuals as soils in exceedance of RGOs will remain under the cap. Additional process residuals that will require handling may include washwater from equipment decontamination, accumulated stormwater, and disposable PPE. The long-term groundwater monitoring program will be designed to ensure protection of potential receptors and identify changes in media impacted by the remedy.

6.1.2.5 Short-Term Effectiveness

It is expected that RAOs will be achieved within one year. Following completion of field remediation activities, implementation of land use controls for the AOC, monitoring, and 5-year reviews would be conducted. Until remediation goals are met and the construction of the asphalt or clay cap is complete, there exists a potential risk of exposure for the community to COCs through ingestion, inhalation and contact with COC-impacted soils and dry sediments. It is expected that there will be a short-term increase in traffic, noise and dust pollution associated with the import and placement of clean fill in the excavated area. The use and maintenance of temporary construction fencing and warning signs during remediation will mitigate the short-term risk to human receptors. Dust controls will be implemented to reduce risk to the community during excavation.

During remedial activities, health risk to AOC workers will arise from potential contact to COC-impacted soils and dry sediments. Air quality could be affected by the release of particulates during soil excavation. Air monitors would be used to measure dust emissions during construction activities. Engineering controls would be implemented to ensure emissions do not exceed levels that could pose a risk to human health. The use of heavy construction equipment and vehicles for excavation poses potential risks of physical injuries. The potential risks to AOC workers will be managed by ensuring OSHA certification and using safe working practices and PPE, consistent with the project health and safety plan.

This alternative will impact the surrounding vegetation and habitat during remedial activities. Excavation activities and siting for the on-site capped stockpile(s) could potentially destroy vegetation and disturb the local wetlands. BMPs will be used to minimize surface water-run off, dust and deposition of excavated material on potential environmental receptors. Surface water diversion and runoff controls constructed as part of the cap could impact the water balance in local wetlands. In addition, the use of facility-perimeter fencing will reduce the risk of contact between terrestrial organisms and COC-impacted soils and dry sediments.

6.1.2.6 Implementability

This section is divided into the three following categories: technical feasibility, administrative feasibility and availability of services and materials.

Technical Feasibility

Excavation is a common remedy used for contaminated soils and sediments and can be completed with little difficulty. Capping is also a common remedy and can be completed with moderate difficulty. While the engineering and construction of the cap are highly implementable, siting a location for a capped stockpile to remain indefinitely on the grounds of RVAAP will require a significant evaluation effort. The technology is reliable in removing soil and dry sediment impacted above RGOs. It may affect the future implementation of any planned future remedial or monitoring events at the stockpile location.

This technology is reliable for containing contaminated soils provided cap integrity is maintained. A visual inspection program will be part of the long-term monitoring and will be effective in evaluating the effectiveness and integrity of the cap. The results of periodic groundwater monitoring will be used to evaluate the effectiveness of the removal action and the integrity of the impermeable liner under the capped stockpile.

Administrative Feasibility

The necessary permits for siting a location for the on-site capped stockpile is moderately difficult. Implementation of this alternative will require restricted access to the load lines through the use of structural barriers around the cap and facility-perimeter fencing and warning signs and will not be consistent with the intent of the specified future land use. It is expected that the necessary documentation to implement institutional controls will be difficult to obtain. Consultation with State and local agencies, and approval of this remedy by Ohio EPA as the IRIP will be required. Construction will occur entirely on RVAAP property.

Feasibility of Obtaining Services and Materials

Numerous vendors and contractors are available to complete the tasks involved in this remedy. The necessary labor and equipment required to delineate the excavation areas, perform the excavation, and construct the liner/cap system are available. Clean fill is available in the volume required to replace the excavated material and restore the original surface grade. “Clean” backfill consists of on- or off-site soil that has passed the chemical and physical requirements in accordance with the RVAAP facility-wide plans. Necessary services, equipment and materials required for sampling during remedial activities and as part of the long-term monitoring program are also readily available.

6.1.2.7 Cost

The cost analysis is presented in Appendix E. Present worth costs use 30 years as a costing period, although the remedy may require monitoring, maintenance, and enforcement beyond this 30-year period.
The total present worth cost for this alternative is estimated at $6,829,608. This estimated cost is comprised of a capital cost of $5,715,552 and a non-discounted O&M cost of $3,148,179.

6.1.2.8 Community Acceptance

This alternative has not yet been formally presented to the public for comment. This is a proposed interim remedy for LLs 1-4 and it is subject to public review and comment. There is a 30-day public comment period after submittal of the Final Focused Feasibility Study. Responses to the public's comments will be prepared prior to the selection of the remedial action.

6.1.3 Alternative SDS3: Excavation and Off-Site Disposal

As described in Section 5.3, Alternative SDS3 consists of the following components:

- Excavation of discrete areas of contaminated surface and subsurface soil and dry sediment as defined in Section 2.3;
- Temporary on-site storage via stockpiling and characterization;
- Disposal of excavated soil and dry sediment at a RCRA and/or TSCA permitted landfill;
- Replacement of excavated material with compacted clean backfill;
- Implementation of land use restrictions for land use other than National Guard mounted training (no digging);
- Installation and maintenance of access barriers and signage;
- Periodic groundwater monitoring to ensure the remedy does not impact groundwater;
- Maintenance, inspection and repair of building slabs and foundations; and
- Five year reviews.

Removal of contaminated soil and dry sediment would eliminate the potential contact of receptors at the AOCs, as required under CERCLA. The remedial actions would be undertaken to reduce, contain, or remove contaminated soil. Off-site migration of contaminants would be mitigated under this alternative.

6.1.3.1 <u>Overall Protection of Human Health and the Environment</u>

Excavation and off-site disposal of COC-impacted surface and subsurface soils and dry sediment provides long-term protection of human health by removing the source of contamination from potential human exposure through ingestion, inhalation or contact. This alternative also eliminates the mobility of COCs from the impacted soils and dry sediments and therefore, protects environmental receptors from potential exposure to COC-impacted media. Removing the most grossly contaminated soil and dry sediment will reduce the toxicity, mobility, and volume of the COCs and protect National Guard Trainee receptors in the long-term. This alternative allows for restricted land use for National Guard Trainee mounted training (no digging). The institutional controls would be implemented through RVAAP in concurrence with Ohio EPA. This alternative would provide protection of human health through facility-perimeter fencing, warning signs, and institutional controls placed on the use of on-site soils.

During removal and disposal activities, there is a potential for exposure of AOC workers to dust, excavated material and other COC-impacted media and they will require OSHA training and use appropriate PPE. The risk to the surrounding community during remedial activities will be mitigated by the low population density on adjacent properties. In addition, the use and maintenance of facility-perimeter fencing and warning signs will protect humans and terrestrial organisms from potential exposure to COC-impacted media. Facility-perimeter fencing and institutional controls would prevent land use inconsistent with National Guard mounted training (no digging) and signs would warn the public and trainees of the institutional controls and potential risks. The potential short-term impact on environmental receptors through surface water run-off, dust and deposition of excavated material can be reduced through the use of BMPs.

6.1.3.2 <u>Compliance with ARARs</u>

The principal ARARs for remediation of soils at LLs 1-4 are presented in Section 3.0 and summarized in Appendix D. These federally enforceable standards would be protective of a potential National Guard Trainee who could be exposed to the COCs.

This alternative would comply with chemical-specific ARARs. The concentrations in soil above RGOs would be removed. The soils would be confirmed to have been restored to National Guard Trainee use standards.

6.1.3.3 Long-Term Effectiveness and Permanence

The excavation and off-site disposal of soils exceeding RGOs will result in a permanent solution for soils for the intended future land use as part of an interim remedy for the AOC, effectively eliminating the source of contamination and yielding no treatment residuals. There is no significant residual risk associated with this alternative for National Guard Trainee receptors at LLs 1-4 once the excavated soils have been disposed of. This alternative allows for restricted land use for National Guard Trainee mounted training (no digging). This remedy will also effectively reduce the volume, toxicity and mobility of the COCs.

Under this alternative, long-term institutional controls including facility-perimeter fencing, warning signs, and land use restrictions will remain in place at the load lines. Groundwater sampling events will be performed as part of the long-term monitoring plan and will be effective in evaluating the remedial action.

6.1.3.4 Reduction of Toxicity, Mobility or Volume

Although this alternative will not treat or destroy the contaminated material, it will significantly reduce the total mass of COCs at LLs 1-4 by removing impacted soils. The total volume of soil to be excavated from LLs 1-4 and disposed of off-site is discussed in Section 2.3. This process permanently reduces the toxicity, mobility and volume of COC-impacted soil and dry sediment at LLs 1-4 by transferring the material to a proper off-site disposal facility. This process is permanent and irreversible for LLs 1-4.

At the off-site disposal facility, the COC-impacted soils and dry sediment will remain untreated and there will be no reduction in their toxicity. However, the long-term mobility of the COCs will be minimized through proper containment of the impacted media.

This alternative will not yield any toxic residuals once the excavated materials have been removed. Process residuals may include washwater from equipment decontamination, accumulated stormwater, and disposable PPE. The long-term groundwater monitoring program will be designed to ensure protection of potential receptors.

6.1.3.5 Short-Term Effectiveness

It is expected that RAOs will be achieved in approximately six months. Following completion of field remediation activities, implementation of land use controls for the AOC, monitoring, and 5-year reviews would be conducted. Until remediation goals are met, there exists a potential risk of exposure for the community to COCs through ingestion, inhalation and contact with COC-impacted soils and dry sediments. It is expected that there will be an increase in traffic, noise and dust pollution associated with the removal and transport of the soils and sediments and the import and placement of clean fill in the excavated areas. The use and maintenance of temporary construction fencing and warning signs during remediation will mitigate the short-term risk to human receptors. Dust controls will be implemented to reduce risk to the community during excavation.

During remedial activities, health risk to AOC workers will arise from potential contact to COC-impacted soils and dry sediments. Air quality could be affected by the release of particulates during soil excavation. Air monitors would be used to measure dust emissions during construction activities. Engineering controls would be implemented to ensure emissions do not exceed levels that could pose a risk to human health. The use of heavy construction equipment and vehicles for excavation and disposal activities poses potential risks of physical injuries. The potential risks to AOC workers will be managed by ensuring OSHA certification and using safe working practices and PPE, consistent with the project health and safety plan.

This alternative will impact the surrounding vegetation and habitat during remedial activities. Excavation activities could potentially destroy vegetation and disturb the local wetlands. BMPs will be used to minimize surface water-run off, dust and deposition of excavated material on potential environmental receptors. In addition, the use of facility-perimeter fencing will reduce the risk of contact between terrestrial organisms and COC-impacted soils and dry sediments.

6.1.3.6 Implementability

This section is divided into the three following categories: technical feasibility, administrative feasibility and availability of services and materials.

Technical Feasibility

Excavation and off-site disposal is a common remedy used for contaminated soils and sediments and can be completed with little difficulty. The technology is reliable in removing soil and dry sediment impacted above RGOs. It will not affect the future implementation of any planned future remedial or monitoring events at the AOCs. The results of periodic groundwater monitoring will be used to evaluate the effectiveness of the interim remedial action.

Administrative Feasibility

Implementation of this alternative will require restricted access to the load lines through the use of facility-perimeter fencing and warning signs. It is expected that the necessary documentation to implement institutional controls will not be difficult to obtain. Off-site disposal of contaminated soils will require coordination with facilities accepting the material to ensure the proper documentation is prepared. Consultation with State and local agencies, and approval of this remedy and disposal facilities from Ohio EPA, will be required.

Feasibility of Obtaining Services and Materials

Numerous vendors and contractors are available to complete the tasks involved in this remedy. The necessary labor and equipment required to delineate the excavation areas and perform the excavation are available. Disposal facilities are available and have the capacity to manage the volume and content of the excavated material that will be generated at the AOCs. Clean fill is available in the volume required to replace the excavated material and restore the original surface grade. “Clean” backfill consists of on- or off-site soil that has passed the chemical and physical requirements in accordance with the RVAAP facility-wide plans. Necessary services, equipment and materials required for sampling during remedial activities and as part of the long-term monitoring program are also readily available.

6.1.3.7 Cost

The cost analysis is presented in Appendix E. The total present worth cost for this alternative is estimated at $5,237,176. This estimated cost is comprised of a capital cost of $5,103,863 and a non-discounted O&M cost of $183,658.

6.1.3.8 Community Acceptance

The basic components of this remedial approach were first presented to the Restoration Advisory Board (RAB) at a meeting on October 15, 2003. The public and representatives from the Ohio EPA were present at the meeting. The minutes of the RAB meetings are maintained on file by MKM Engineers. Although the description of the remedial approach for LLs 1-4 presented at that meeting may not have been as detailed as in this FFS, the feedback is an indicator of potential concerns with the remedial concept. As indicated in the minutes of the RAB meeting held on January 21, 2004, a representative of the Ohio EPA indicated that many questions were asked about the implications of the proposed remedial approach after the October 15, 2003 meeting had ended. However, Shaw has been working with USACE and Ohio EPA since the initial presentation to address questions and reach resolution on the remedial approach.

This is a proposed interim remedy for LLs 1-4 and it is subject to public review and comment. There is a 30-day public comment period after submittal of the Final Focused Feasibility Study. Responses to the public’s comments will be prepared prior to the selection of the remedial action.

6.2 Comparison of Alternatives

In this section, the AOC-wide remedial alternatives described and analyzed in detail in previous sections are evaluated in relation to one another for seven of the nine NCP evaluation criteria, defined in Section 6.1, in accordance with 40CFR 300(e)(9)(ii). State and community acceptance, the other two NCP criteria, are typically assessed in decision documents prepared by US EPA based on public comment received after the RI/FS is completed.

Evaluation Criteria	Remedial Alternatives SDS1 No Action	SDS2 Excavation and On-Site Capping	SDS3 Excavation and Off-Site Disposal
Protective of Human Health and Environment	No	Yes	Yes
Complies with ARARs	No	Yes	Yes
Effective and Permanent	No	Yes	Yes
Reduces Toxicity, Mobility or Volume	No	No	Yes
Short-Term Effectiveness	Unacceptable	Acceptable	Acceptable
Implementable	Yes	Yes	Yes
Cost			
Capital	$0	$5,715,552	$5,103,863
Non-Discounted O&M	$0	$3,148,179	$183,658
Total Present Worth	$0	$6,829,608	$5,237,176
State Acceptance	Unlikely	Unlikely	Likely[a]
Community Acceptance	Unlikely	Likely	Likely

[a] with land use controls to restrict public access, soil use inconsistent with National Guard mounted training (no digging), access to soil under building slabs, and groundwater use.

6.2.1 Overall Protection of Human Health and the Environment

Alternative SDS1 (No Action) will not reduce the short- or long-term risks for human or environmental receptors from potential exposure to the COCs. Alternatives SDS2 (Excavation and On-Site Capping) and SDS3 (Excavation and Off-Site Disposal) provide long-term protection of human health by removing the source of contamination from potential human exposure through ingestion, inhalation or contact. These two alternatives also eliminate the mobility of COCs from the impacted soils and dry sediments and therefore, protect environmental receptors from potential exposure to COC-impacted media. Removing the most grossly contaminated soil and dry sediment will reduce the toxicity, mobility, and volume of the COCs and protect National Guard Trainee receptors in the long-term. While both alternatives result in restricted land use for the National Guard Trainee mounted training (no digging), Alternative SDS2 requires the capped area to be off-limits to vehicular traffic. The institutional controls would be implemented through RVAAP in concurrence with Ohio EPA. These alternatives would provide protection of human health through facility-perimeter fencing and warning signs, institutional controls placed on the use of on-site soils, and structural barriers around the capped areas (Alternative SDS2). Short-term exposure risks will be mitigated through the use of BMPs, OSHA training and the use of appropriate PPE.

6.2.2 Compliance with ARARs

The ARARs are presented in Appendix D. Each alternative, except Alternative SDS1 (No Action), could be designed and implemented to meet respective ARARs.

6.2.3 Long-Term Effectiveness and Permanence

Alternative SDS3 (Excavation and Off-Site Disposal) would afford the highest degree of long-term effectiveness and permanence. Alternative SDS3 would provide for removal of COCs that exceed acceptable risk levels. The alternative would reduce risk to levels in accordance with RAOs and could be implemented in approximately six months.

The long-term effectiveness and permanence of Alternative SDS2 (Excavation and On-Site Capping) would be less reliable because contaminated soil would remain on-site and long-term controls would be necessary to prevent disturbance to the cap. The cap would require about one to two months longer to implement than SDS3 (Excavation and Off-Site Disposal). Long-term maintenance of the cap would be required as long as COCs remain at LLs 1-4 and above acceptable risk levels. Alternative SDS1 (No Action) is neither effective nor permanent in the long-term.

6.2.4 Reduction of Toxicity, Mobility or Volume

None of the remedial alternatives include treatment as a principal element. Although Alternative SDS3 (Excavation and Off-Site Disposal) will permanently reduce the toxicity, mobility and volume of COCs in soil and dry sediment at LLs 1-4, the reduction would not be achieved through treatment. Alternative SDS2 (Excavation and On-Site Capping) would reduce the mobility of COCs by preventing infiltration of precipitation, not through treatment. This alternative does not reduce the toxicity or volume of COCs in the soil and dry sediment at LLs 1-4. Alternative SDS1 (No Action) does not reduce the toxicity, mobility or volume of COCs in soil and dry sediment at LLs 1-4.

6.2.5 Short-Term Effectiveness

Alternative SDS2 (Excavation and On-Site Capping) would have the greatest short-term effectiveness because it would present the least risk to the community by maintaining the majority of contaminated soils on-site. Alternative SDS3 (Excavation with Off-Site Disposal) would require potential exposure controls, but could be effective in the short-term and would be completed in less time than Alternative SDS2. Alternative SDS1 (No Action) is not effective in the short-term.

6.2.6 Implementability

Alternative SDS1 (No Action) would involve no implementability issues. Alternative SDS2 (Excavation and On-Site Capping) would be moderately easy to implement by requiring excavation of several discrete areas, materials handling for consolidation and capping. Alternative SDS3 (Excavation with Off-Site Disposal) would be moderately easy by requiring excavation of several discrete areas and materials handling.

6.2.7 Cost

The cost analysis for the alternatives was presented in Appendix E. Alternative SDS1 (No Action) does not have capital or O&M costs. The capital costs for SDS3 (Excavation with Off-Site Disposal) and Alternative SDS2 (Excavation and On-Site Capping) are similar with some relative savings for Alternative SDS3. However, the O&M costs for Alternative SDS3 are significantly lower (more than half) than those for Alternative SDS2.

6.2.8 Community Acceptance

The minutes of recent RAB meetings indicate that the public audience in attendance did not voice major objections to Alternative SDS3 (Excavation and Off-Site Disposal) when it was first introduced; however, there were numerous follow-up questions about the potential implications of this and bioremediation alternatives. Reasons for not using bioremediation are provided in Section 4.0, specifically Tables 4-2 and 4-3. The other two alternatives in this FFS were not presented at RAB meetings but will be formally presented in CERCLA documents placed in the Administrative Record and at subsequent public meetings.

These are proposed interim remedies for LLs 1-4 and are subject to public review and comment. There is a 30-day public comment period after submittal of the Final Focused Feasibility Study. Responses to the public's comments will be prepared prior to the selection of the remedial action.

6.3 Recommended Interim Remedy

Based on a detailed analysis of the feasible remedial alternatives using the criteria described in the previous sections, the following action to address surface and subsurface soil and dry sediment contamination at LLs 1-4 of the RVAAP is proposed:

Alternative SDS3 – Excavation with Off-Site Disposal.

This alternative was chosen as the preferred alternative for remediation due to its expediency, permanency, consistency with approved future land use, moderate relative cost, feasibility and implementability. However, this recommended interim remedy for LLs 1-4 is a proposal and it is subject to public review and comment.

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Comment Response Table for Draft Final FFS (Final)
Ravenna Load Lines 1-4 FPRI
Ravenna Army Ammunition Plant – Ravenna, OH

Cmt. No.	Comment	Recommendation	Response
CELRL-ED-EE (John Jent Rec'd 11 April 2005)			
1	Page 1-9, line 32; Do not remember consistent detection of 1,2-Dichloroethene.	Please provide justification for this statement.	The sentence was deleted from the text. A review of the LL 1 information in the Phase II RI does not support the statement.
2	Page 1-9, line 35; This sentence is misleading. Sometimes the background levels for subsurface soil are greater than those for surface soil.	Where residual metals contamination is present, the levels of contamination are generally lower in subsurface soils than in the surface soils.	The recommended sentence replaced the previous sentence.
3	Para 1.2.4; Discussion is based solely on conservative modeling. Acknowledge that this discussion focuses on source removal, but the public will be reading these documents and needs to be aware of the large body of field/lab determined information that indicates little if any off-site migration of contamination in the groundwater.	Please also discuss the results of multiple rounds of sampling on the array of multiple groundwater monitoring wells.	The following paragraph was added on Page 1-15 at the end of Section 1.2.4: "Contaminant fate and transport modeling for LLs 1-4 was based on conservative assumptions and specific information and data from each load line. Further information regarding groundwater quality related to RVAAP is presented in the RIs for LLs 1-4 (SAIC, 2004; Shaw 2004a, b, c) and numerous facility-wide groundwater sampling reports included in the project information repository."
4	Tables 2-1 and 2-2; Please add a footnote to the arsenic that states that a study is currently underway to speciate the two valence forms of arsenic; and that there is a possibility that results of that study may remove arsenic from the list of COCs and RGOs. Results should be available by June 2005.		Since the report on arsenic speciation will not be available for use for this project and any changes to the arsenic RGO may result in changes to previously approved documents and subsequent additional review by regulators, references to the arsenic study will not be included in the documents for the LLs 1-4 FPRI. As discussed with Ohio EPA, the Army may be able to use the results of the speciation study on future projects.
5	Table 2-2; Please either add another table that clarifies the clean-up levels, as opposed to the risk-base RGOs, or clarify for manganese and lead the results of the discussion on page 2-10. Again, on quick reading by the public this table would indicate that clean up for manganese is to 351.		A new table (Table 2-3) was added to the text to clearly specify proposed clean-up criteria for COCs.

 Issue date: 9 May 2005

Cmt. No.	Comment	Recommendation	Response
6	Page 2-11, line 9; Please indicate that these HQs were calculated utilizing maximum detected contaminant concentrations, as opposed to average values of contaminant concentrations.		The sentence was changed to read as follows: "These HQs are perceived to have a high degree of uncertainty and are considered conservative as they were calculated utilizing maximum detected contaminant concentrations not the lower average values."
7	Table 2-7; For clarity, please add the clean-up levels of manganese and arsenic, either via footnote or in the headings.		Clean-up criteria for manganese and arsenic were added to Table 2-8 (formerly Table 2-7)
8	Page 4-7, lines 26 and 27; Since the property is being maintained within the Army, please delete the use of deeds, and change to "property management plans, or records of decision".		As agreed to between Ohio EPA and the Army, Shaw revised the first two bullet points in Section 4.4.1 to read as follows: • "Restricted access prohibiting residential use; • "Restricted access precluding casual access by maintenance of a boundary fence surrounding RVAAP;"
9	General; Since the recommended interim remedy is based on excavations of soils and dry sediments above clean-up levels, please provide a general discussion of closure sampling.	Utilize multi-incremental sampling for closure sampling.	Preliminary discussions of confirmatory sampling (i.e., sampling locations) related to the two active remedies are included in Sections 5.2 and 5.3. Further detailed discussions on the type and method of closure sampling will be presented in the Remedial Design documents once a remedy is selected.
AEC (Joann Watson – Rec'd 14 April 2005)			
10	Page 2-2 adequately describes the strategy to address fencing but that level of detail is not present in other discussions of fencing throughout the document. Those lapses beg the question "Which fence is being discussed—the AOC fencing or the installation perimeter fencing?"	Throughout the document, when discussing fencing, be clear as to which fence you are discussing. For example, in Table 4-2, please specify the fencing you are discussing. This comment is applicable to sections 4.4.1 where the text bounces between perimeter fencing and AOC fencing.	The text was revised throughout to clarify between facility-perimeter or individual AOC fencing.

Cmt. No.	Comment	Recommendation	Response
11	Table 4-3: The statement that the cost of fencing is negligible is probably incorrect given the size of the perimeter fence and its importance to your alternative.	Please reconsider the statement and plan on appropriate levels of funding should the fence be required as part of an interim remedy. Note something less than maintenance of the perimeter fence may be proposed (i.e., a fence that surrounds the load lines only may be proposed).	The purpose of the cost column in Table 4-3 is to compare the relative cost of process options. In this case fencing is a relatively low cost option when compared to capping or treatment options. However, the cost entry in the table for fencing and land use restrictions was revised as follows for clarity: "Negligible cost to install fencing since already in place and minimal cost to maintain. Minimal cost to document land use restrictions."
12	Pages 6-4 to 6-5: Facility perimeter fencing maintenance should be added to the component and added to the cost of this alternative.		Although the facility-perimeter fence is part of the proposed remedy and will be referenced in the ROD, maintenance of the fence is performed on a facility-wide basis. Costs associated with the maintenance will, therefore, not be included in the costs associated with the work proposed at LLs 1-4 under the FPRI contract. Costs associated with the maintenance of the facility-perimeter fence will be arranged and coordinated between the Army and NGB outside of Shaw's FPRI contract.
13	Page 6-8, section 6.1.3: Maintenance, inspection and repair of the facility perimeter fence should be included in the components of this alternative.		See response to Comment 12 above.
14	Section 6.1.3.8: Please consider adding text that states this is a **proposal,** subject to public review and comment. We cannot prejudice the public involvement process.		The following sentence was added to the text of "Community Acceptance" in Sections 6.1.2.8, 6.1.3.8, and 6.2.8: "This is a proposed interim remedy for LLs 1-4 and it is subject to public review and comment." Similarly, the following sentence was added to the end of Section 6.3, where the recommended remedy is put forth: "However, this recommended interim remedy for LLs 1-4 is a proposal and it is subject to public review and comment."

Comment Response Table for Draft Final FFS (Final)
Ravenna Load Lines 1-4 FPRI
Ravenna Army Ammunition Plant – Ravenna, OH

Cmt. No.	Comment	Recommendation	Response
	Comments From Ohio EPA (Rec'd 25 April 2005)		
15	On page E-1, lines 21-22, there is an indication that any future groundwater, surface water and submerged sediments will be addressed under their respective facility-wide investigations. Please strike this text from the revised document. The facility-wide effort for surface water and sediment is focused on investigation of the surface water/sediment and overall biological health of the on-installation streams and the groundwater initiative focuses on a more long term installation-wide assessment of the groundwater. Neither initiative looked at any potential future actions or remediation.		The sentence was deleted.
16	Thanks for replacing JMC with BRACO, but there were a couple instances, because it is a historical issue, where it should have remained JMC (see page 1-3, line 12; page 1-4, line 29). Please check. Also, it is my understanding that there is currently another re-organization in progress. Please contact Ravenna Army Ammunition Plant (RVAAP) staff to determine which is the correct agency.		The two identified references to BRACO were changed to read JMC. As of the printing of this document, Shaw believes the text as written reflects the most current organizational structure.
17	Page 1-2, lines 7-9 indicates that the bulk explosives are currently being removed. Please be advised that all the explosives have been removed. (Also applicable to page 1-3, line 2.)		The sentence on Page 1-2 was revised to read as follows: "Materials formerly stored in the bulk explosives storage areas have been removed." The sentence on Page 1-3 was revised to read as follows: "The only activities still being carried out from the wartime era are the infrequent demolition of unexploded ordnance found at the installation."
18	On page 1-2, line 31, change "fuse" to "fuze		The text was revised as requested.

 Issue date: 9 May 2005

Cmt. No.	Comment	Recommendation	Response
19	Although there is no documentation that exists that indicates that pinkwater was swept out of doorways, the fact that we are finding contamination in some of these areas suggests that this may have been one of the practices utilized. Please add text to the revised document to indicate that this may have been the case.		The sentence on Page 1-4 was revised to read as follows: "As patterns of contamination indicate, during building wash down, pink water or loose explosive flakes, chips, or dust may have been swept out of doorways onto the ground." This sentence was also added to similar discussions for LL 2 (Page 1-5), LL 3 (Page 1-7), and LL 4 (Page 1-7).
20	Page 1-11, lines 22-23 (new text) indicates that the Defense Logistics Agency (DLA) area is excluded from the scope of work (SOW) of this performance-based contract (PBC). What is the status of this separate contract? How will this potentially impact upon Ohio Army National Guard (OHARNG) plans for this area?		Shaw has not been involved in the planning for the DLA area. Please contact the Army for that information.
21	On page 1-14 lines 3-4, please revise the text to read that remedial actions associated with this FFS are focused on removing impacted materials that are either above Remedial Goal Options (RGOs) or established background (in the case of manganese).		The sentence was revised to refer to clean-up criteria which are summarized in Table 2-3, a new table compiling the applicable background values and RGOs, in Section 2.1.5. The sentence was revised as follows: "Remedial actions associated with this FFS are focused on removing impacted materials that exceed established clean-up criteria for contaminants (Section 2.1.5)."
22	For wastewater samples, please indicate that the sample for Target Analyte List (TAL) metals is unfiltered.		'Filtered' was replaced with 'unfiltered' TAL metals in the four occurrences of the term within the document.
23	On page 5-4 in section 5.3 and page 6-8 in section 6.1.3, add another bullet that indicates that five year reviews will be conducted. Also, factor these costs into the revised cost estimates.		Five year reviews were included as a line item for the Excavation and Off-Site Disposal Alternative, as requested. The cost estimates (Appendix E) and the costs presented in Section 6.1.3.7 and 6.2 were also revised to reflect the additional cost.

Issue date: 9 May 2005

Cmt. No.	Comment	Recommendation	Response
24	On some of the figures [for example 1-7(1)], it is very difficult to differentiate between the sample points that are designated by a triangle. Please consider using different colors in the revised document for some of the figures.		The symbols for Phase II RI samples (the triangles) were consolidated in Figures 1-7(1) and 1-7(2) such that all Phase II RI sample locations are indicated by the same triangle. A similar revision was made for Figures 1-8(3) and 1-10(1) such that all Phase I RI sample locations are indicated by the same circle.
25	Add verbiage to appendix A that details what occurred after the new NITON instrument was shipped to the installation		The last paragraph on Page 3 of Appendix A was revised to read as follows: "The new model 702S was sent to the site on November 18, 2004. Based on previous discussions with USACE and Ohio EPA personnel, it was agreed that a portion of the samples previously submitted to the laboratory for manganese would be returned to the site for additional sample preparation (longer grinding and homogenization period) and re-screening for manganese using the 702S model. The screened samples would then be re-submitted to the laboratory for Mn analysis so that a correlation between the laboratory results and the field screening results using the 702S model on the same sample could be evaluated. A total of five samples were re-analyzed. Improved correlations between the XRF and laboratory results were noted in using the 702S model. In addition, a direct reading could be determined for the manganese medium calibration check sample by 702S Model whereas a range was observed for the 702 Model. Field and laboratory screening results for the five samples for lead and manganese are presented on Tables A-2 and A-3 below. Correlation results for samples collected from Load Lines 1, 2, 3, and 4 are shown on Table B-2 in Appendix B." Two new tables (Tables A-2 and A-3), showing

Cmt. No.	Comment	Recommendation	Response
			the lead and manganese results from the five samples, were also added at the end of Appendix A.
26	In Appendix B, on Tables B-3 and B-4, please add a footnote that indicates what is meant by a blank cell.		A footnote indicating that blank cells indicated 'not analyzed' was added to Table B-3, as requested. The blank spaces in Table B-4 were filled with 'NA' to match the existing footnote in that table.

Figures

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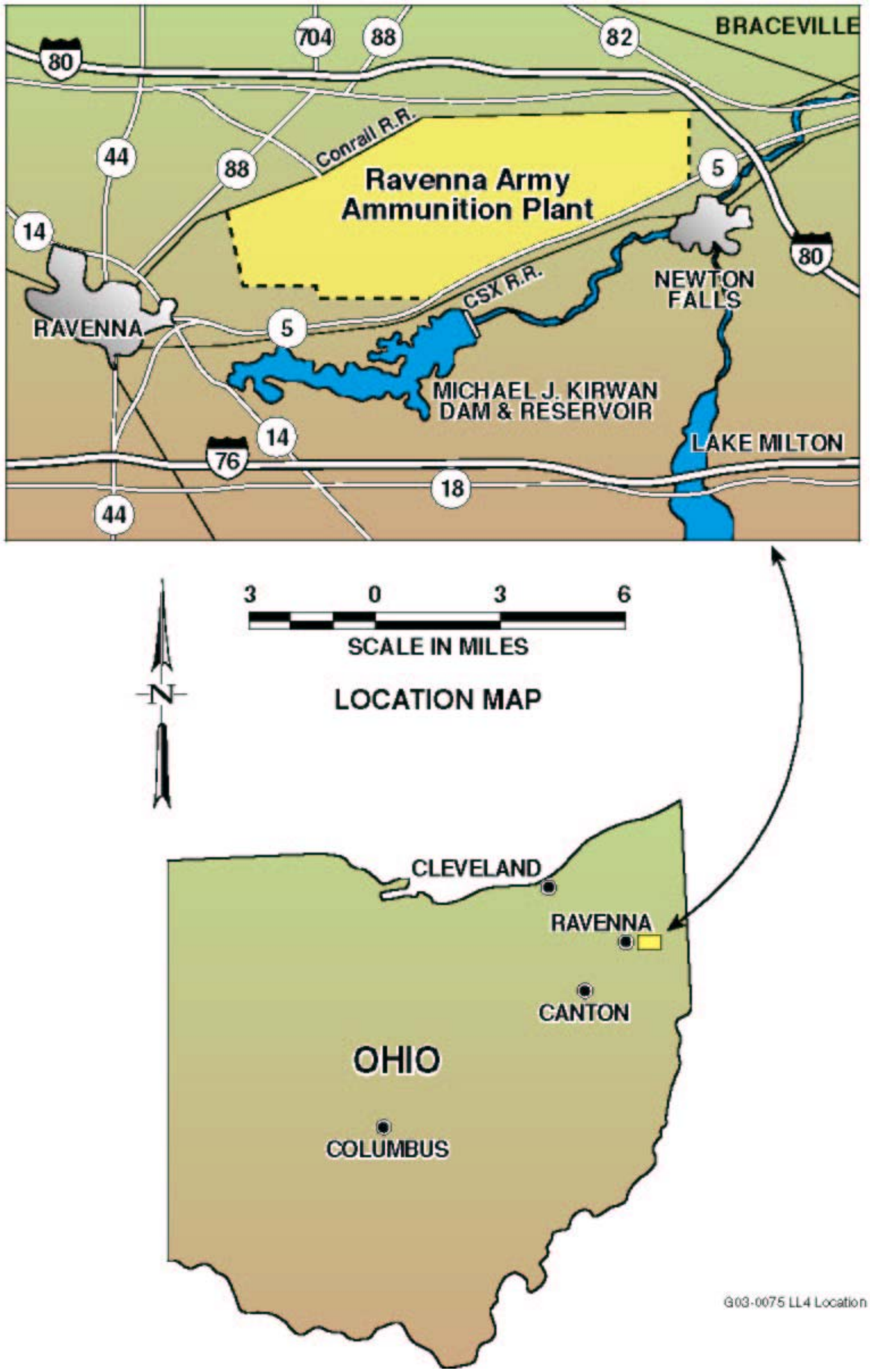

Figure 1-1 – Site Locus Map

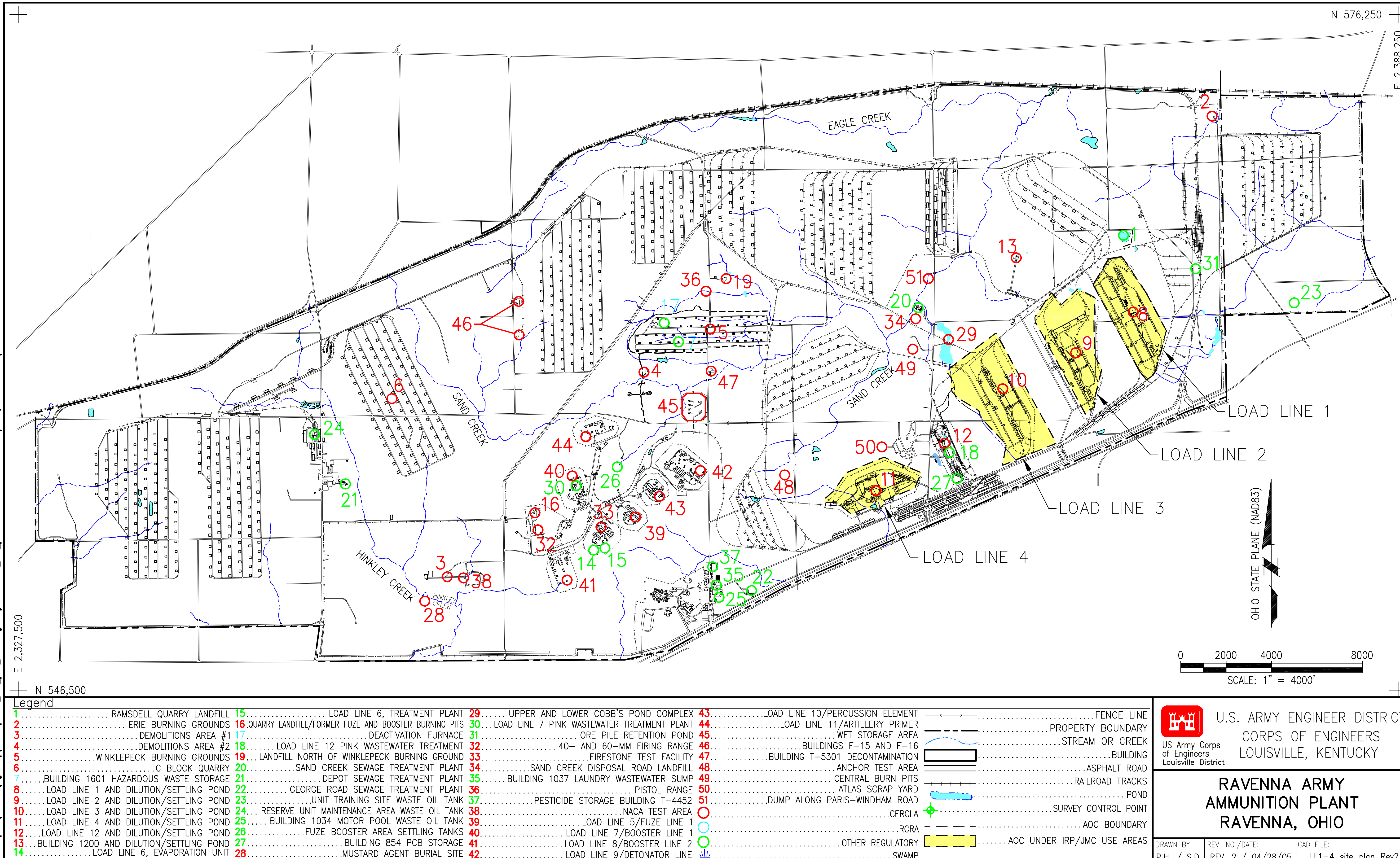

Figure 1-2. RVAAP Facility Map

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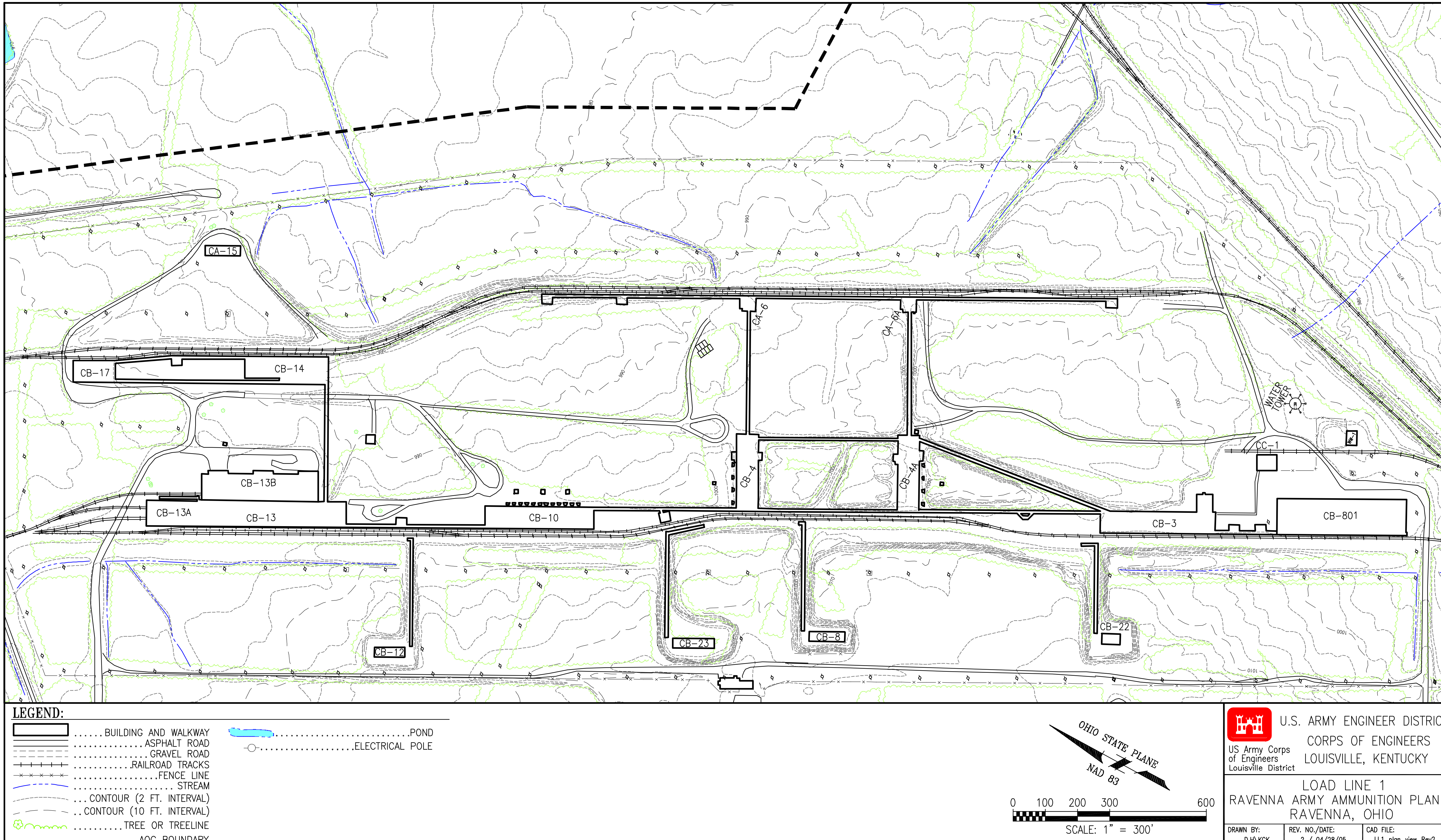

Figure 1-3. Load Line 1 Plan View

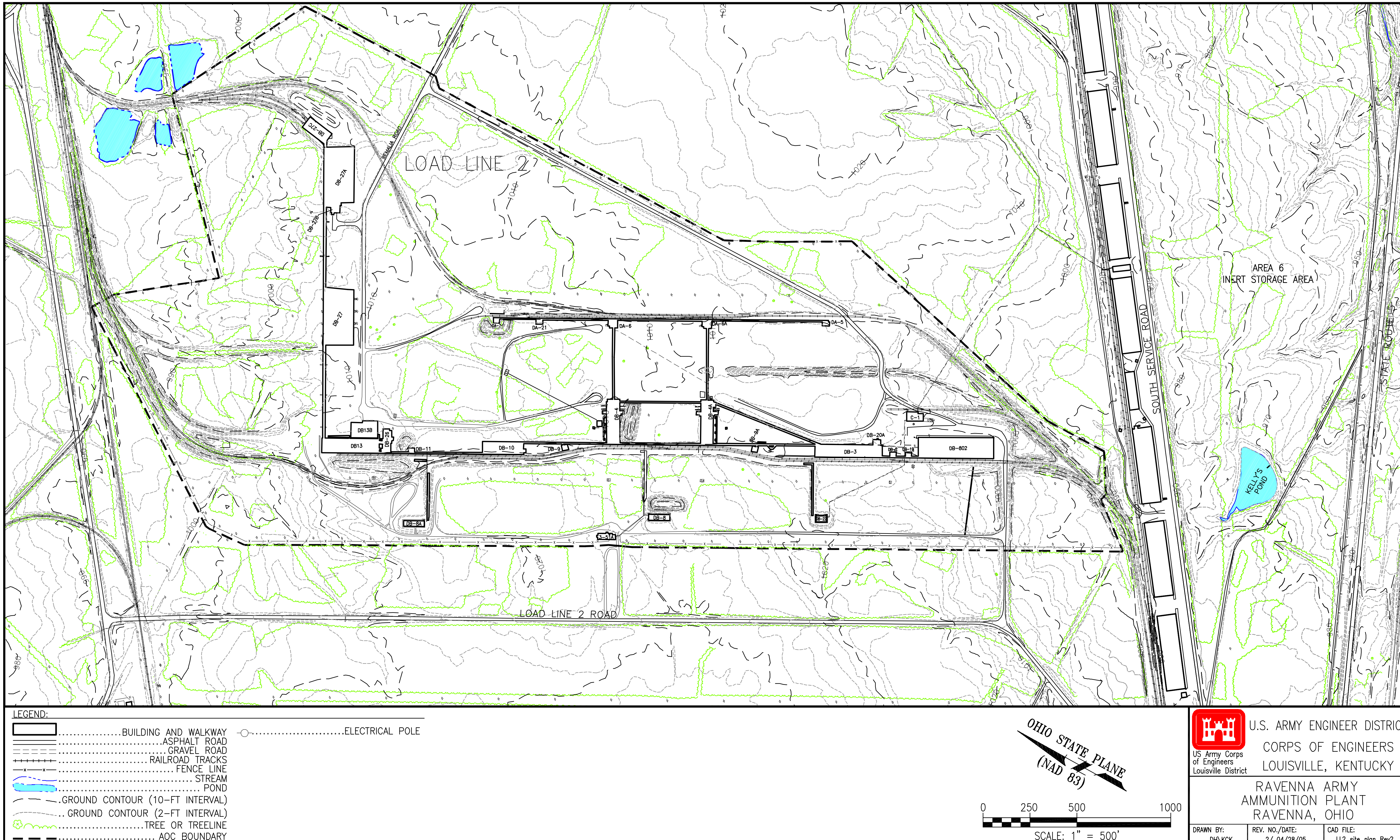

Figure 1-4. Load Line 2 Plan View

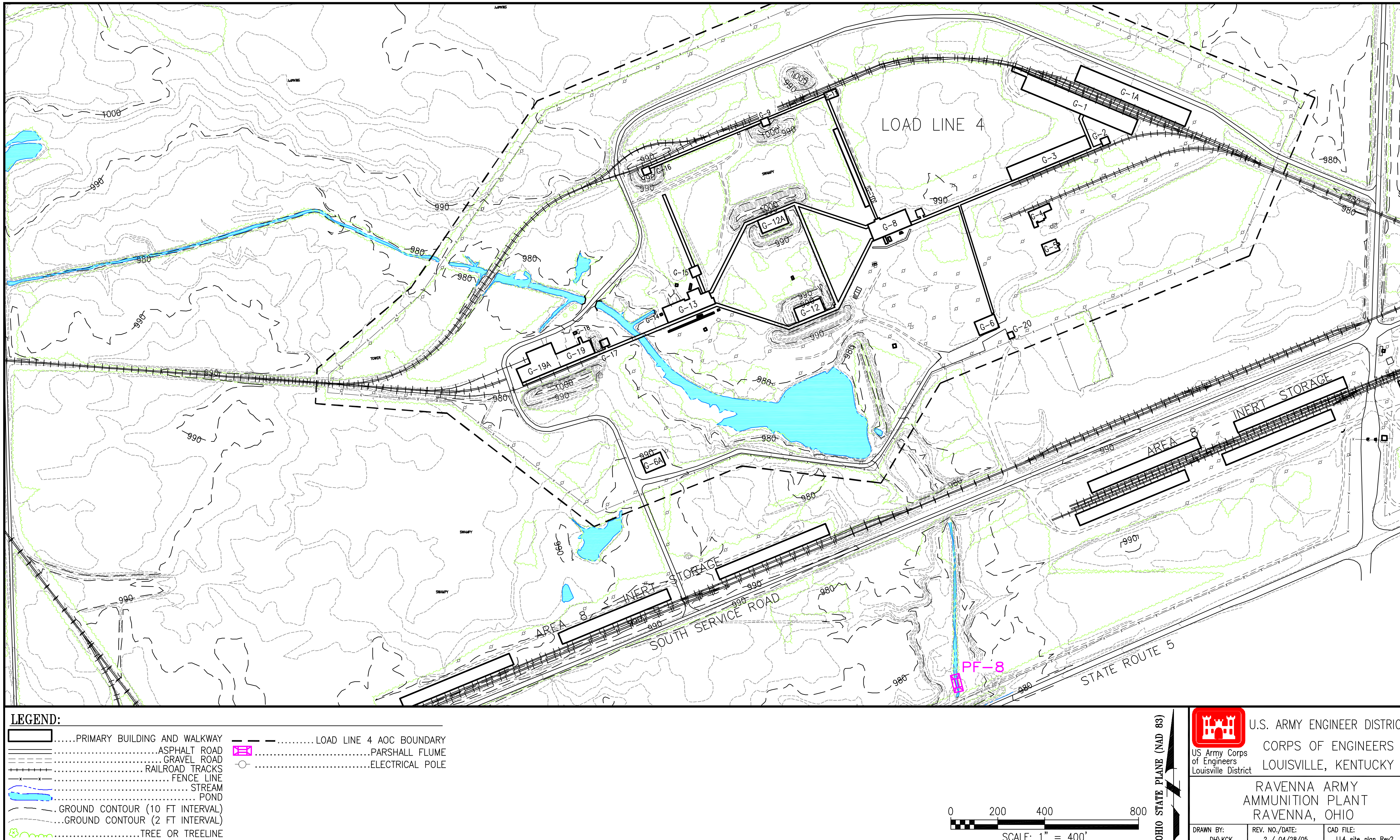

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Figure 1-6. Load Line 4 Plan View

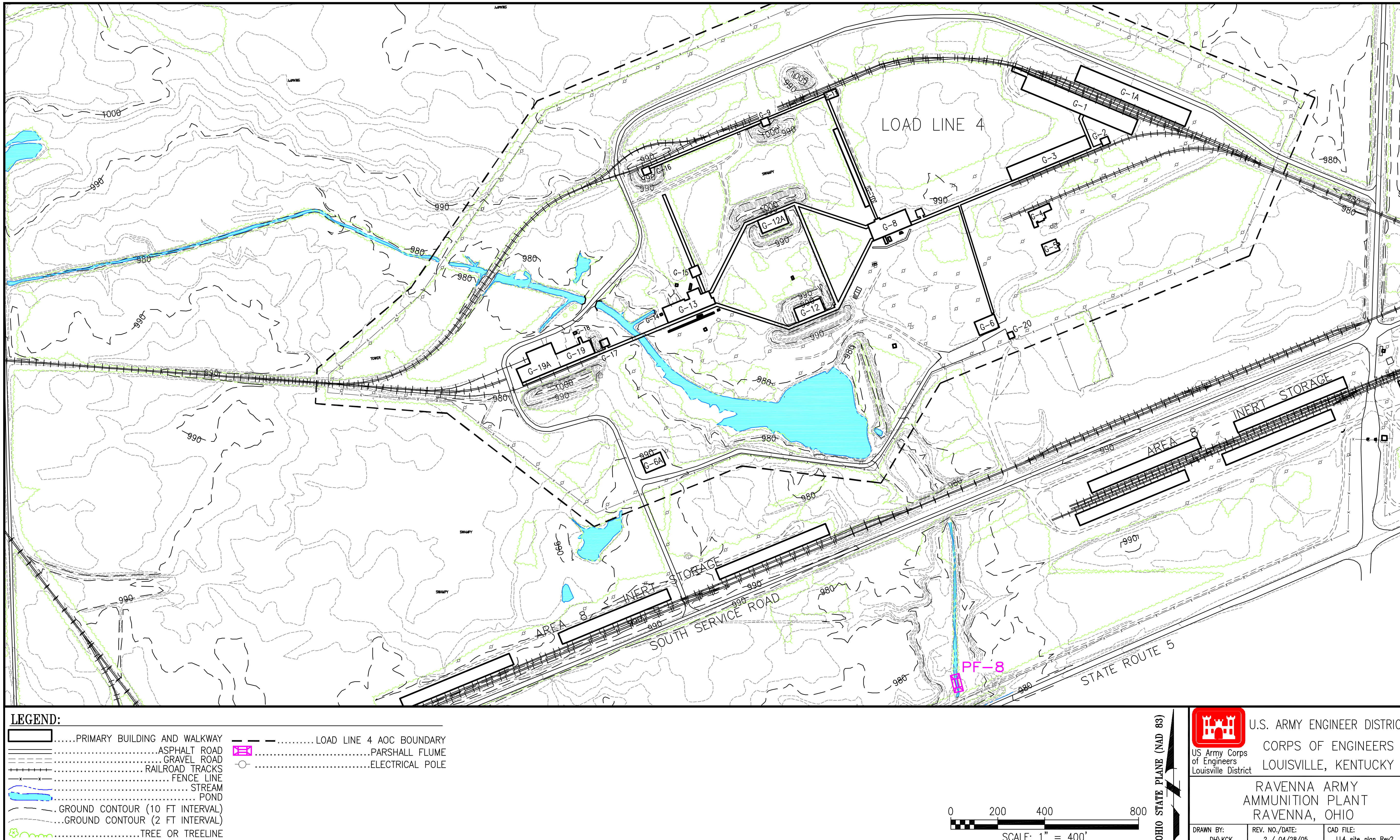

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Figure 1-6. Load Line 4 Plan View

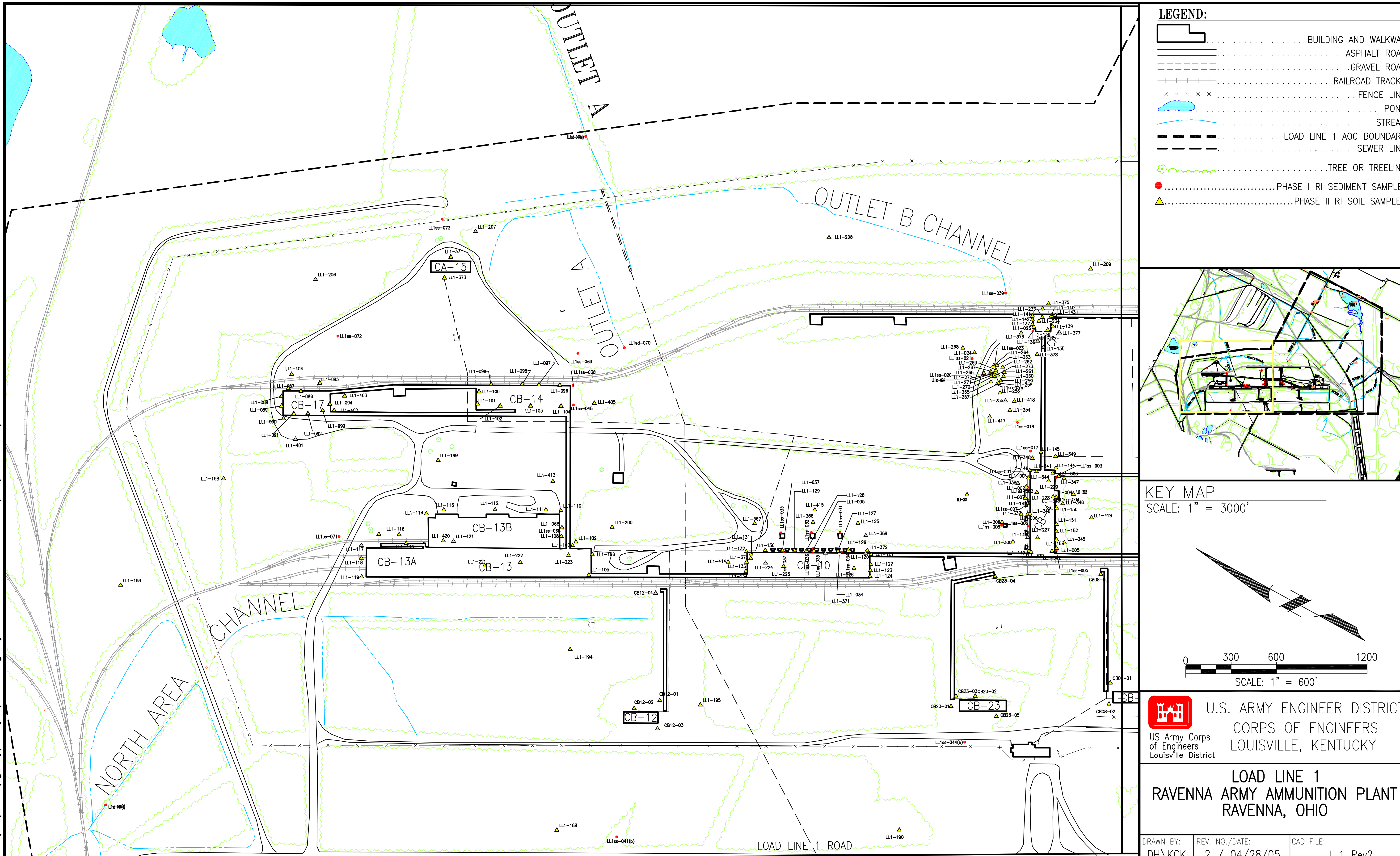

Figure 1-7(1). Load Line 1 Phase I and Phase II RI Surface Soil, Subsurface Soil and Sediment Sampling Locations -Northern Section

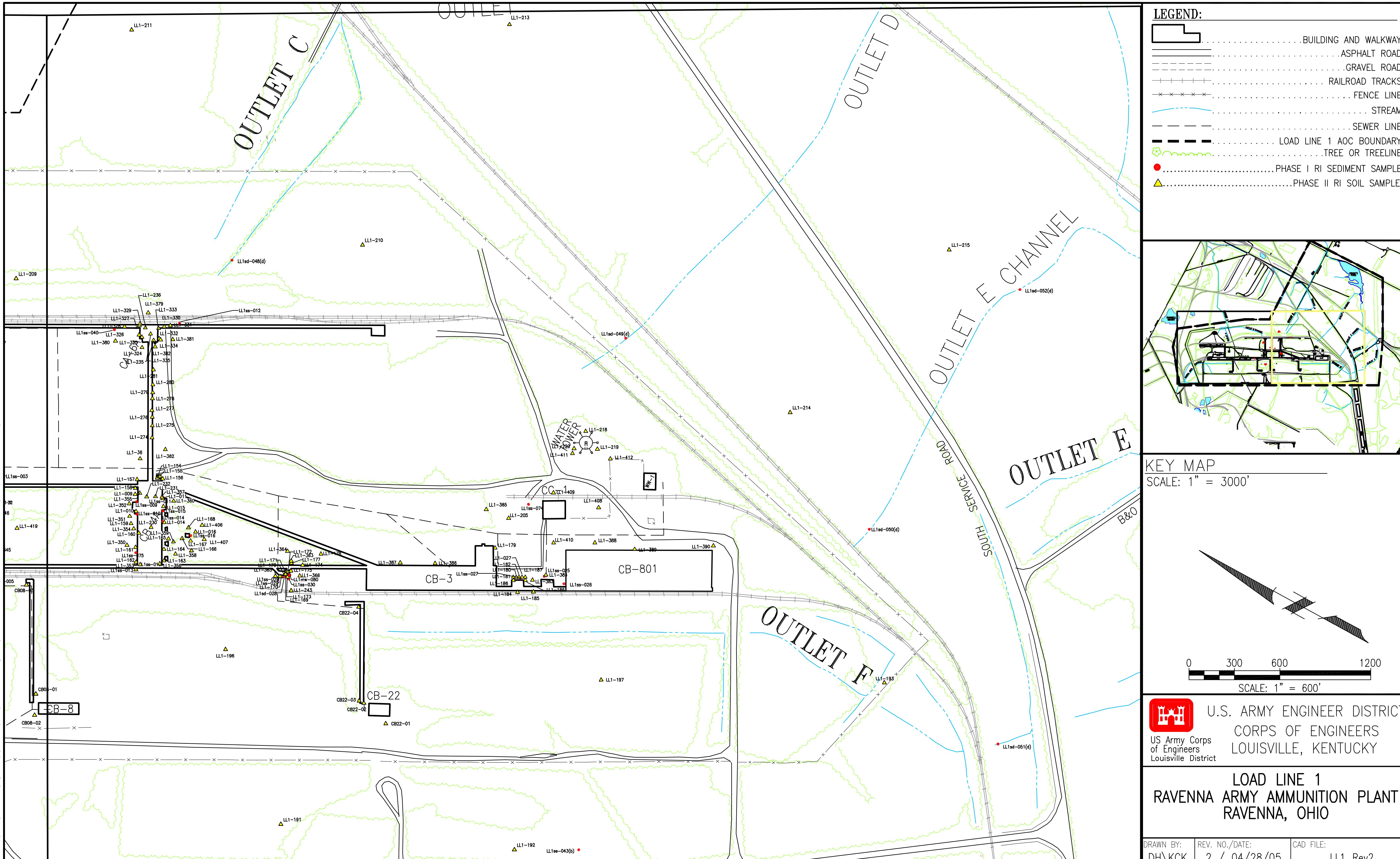

Figure 1-7(2). Load Line 1 Phase I and Phase II RI Surface Soil, Subsurface Soil and Sediment Sampling Locations - Southern Section

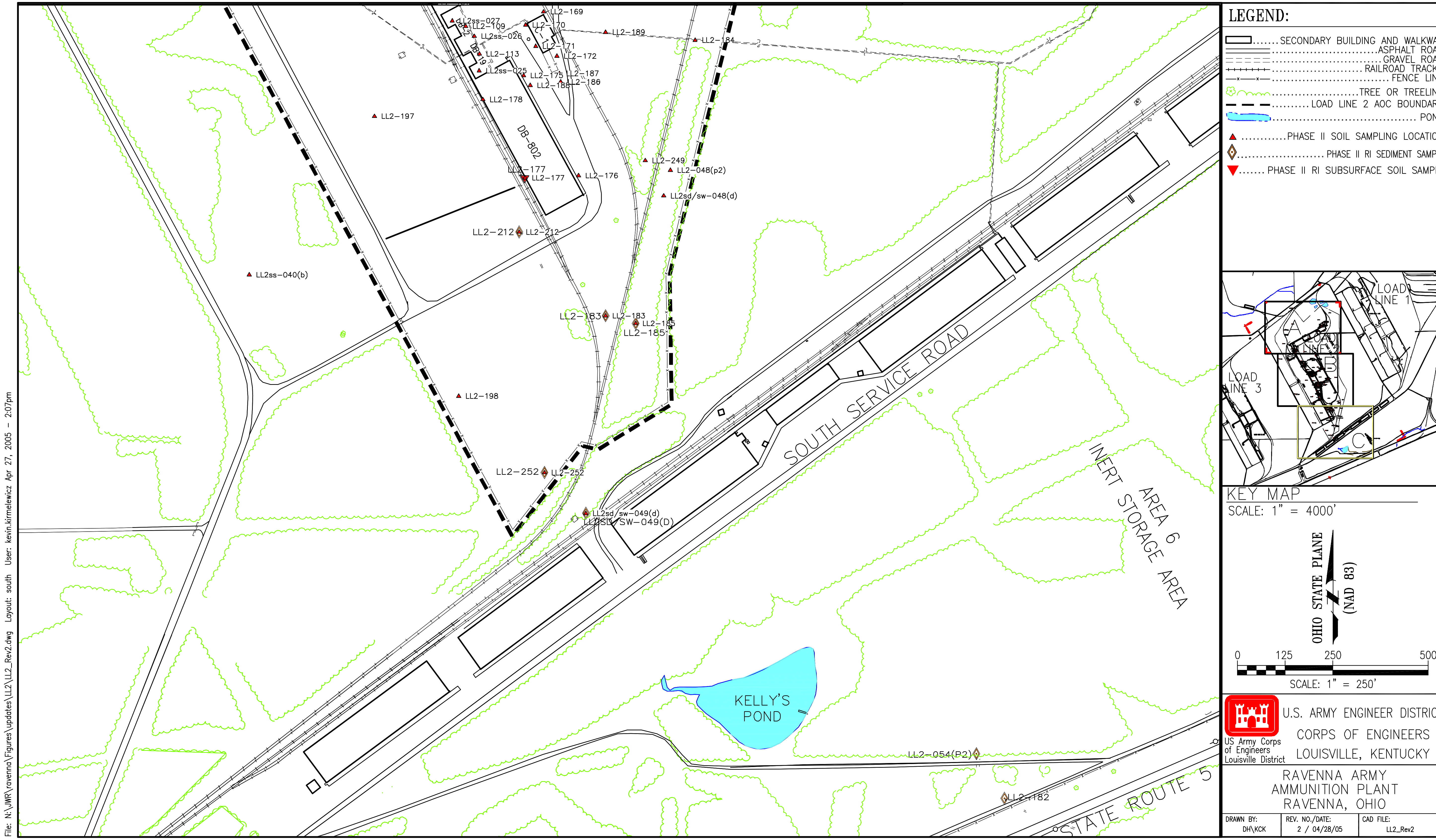

Figure 1-8(1). Load Line 2 Phase I and Phase II RI Surface Soil, Subsurface Soil and Sediment Sampling Locations - Southern Section

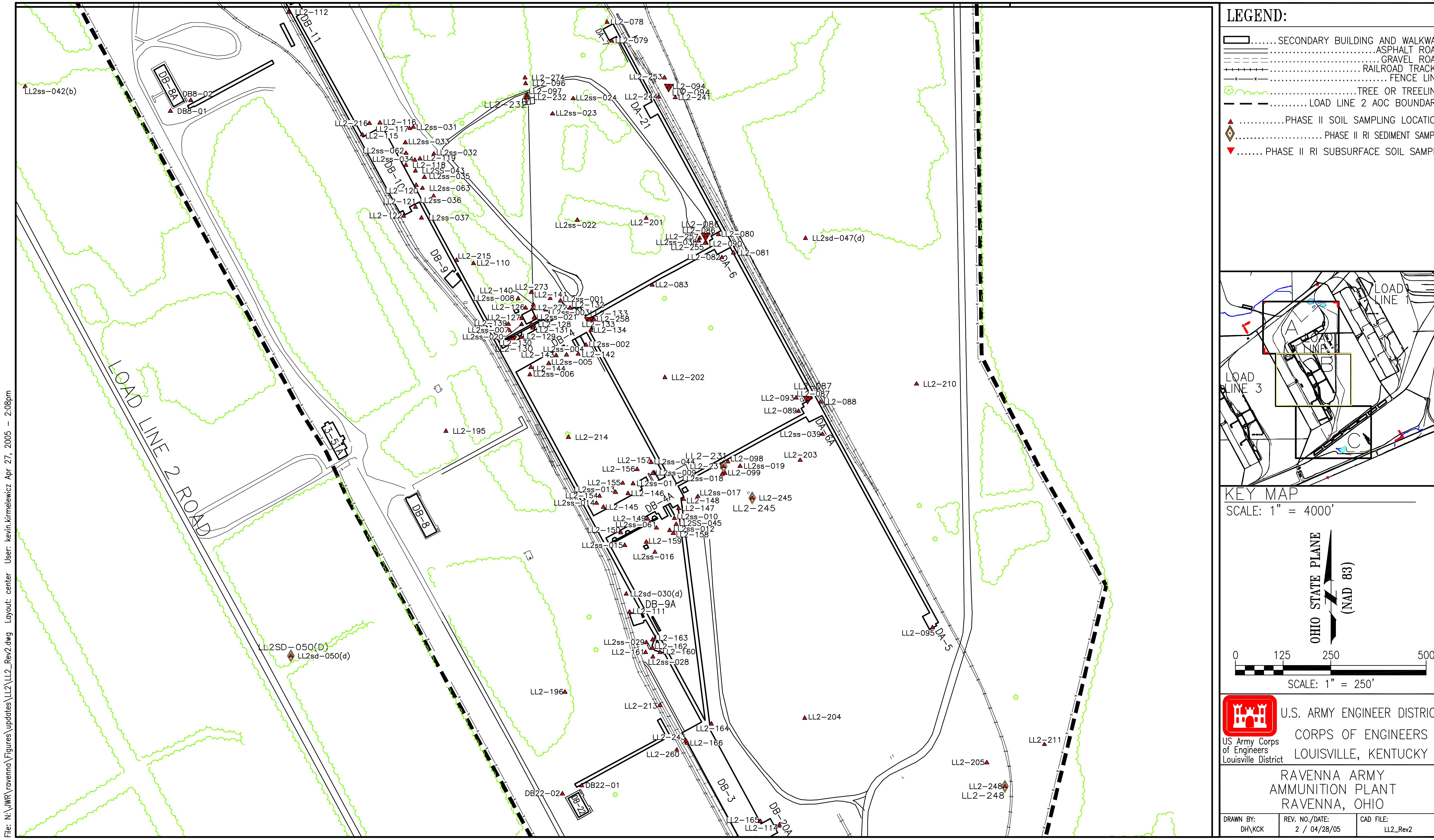

Figure 1-8(2). Load Line 2 Phase I and Phase II RI Surface Soil, Subsurface Soil and Sediment Sampling Locations - Central Section

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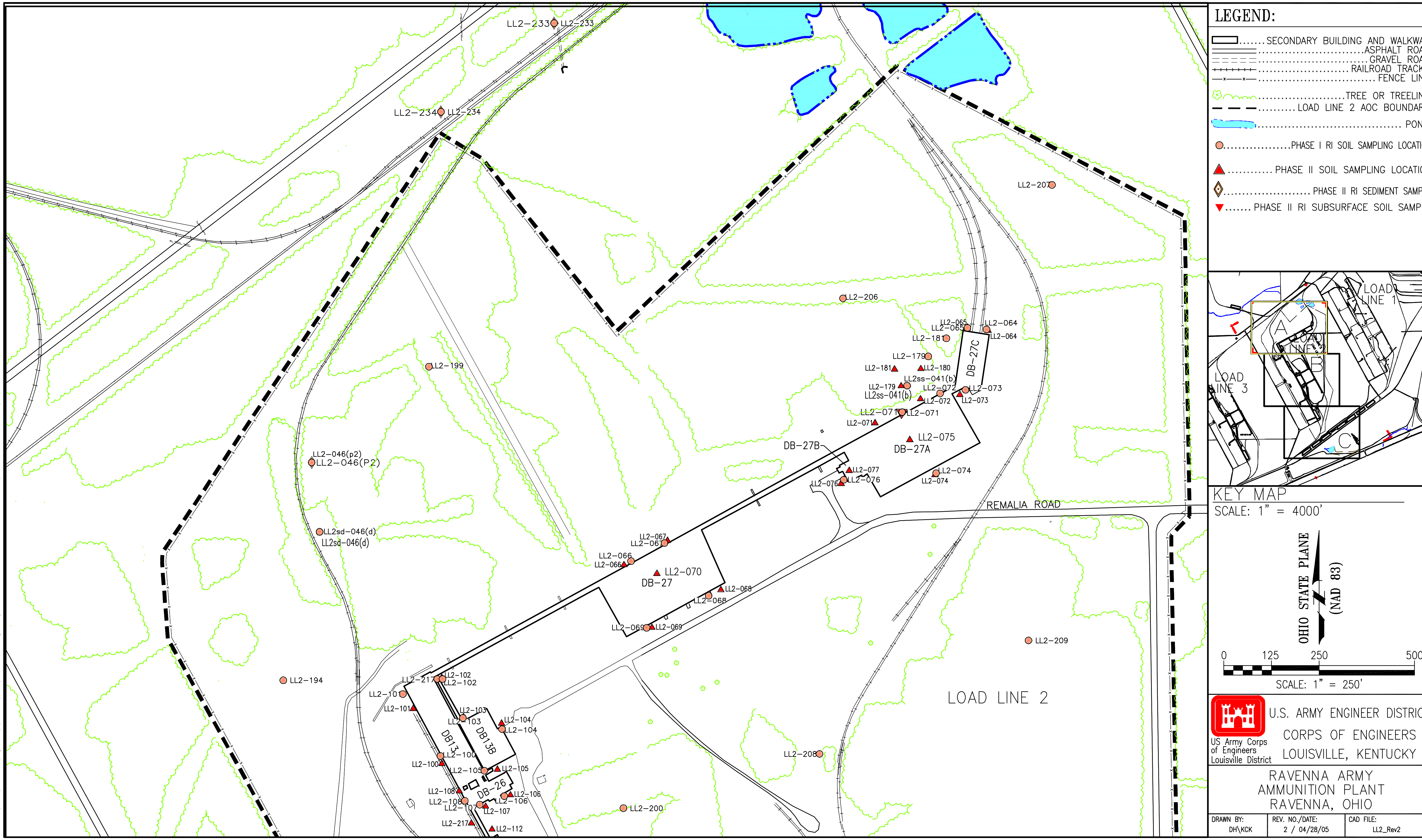

Figure 1-8(3). Load Line 2 Phase I and Phase II RI Surface Soil, Subsurface Soil and Sediment Sampling Locations - Northern Section

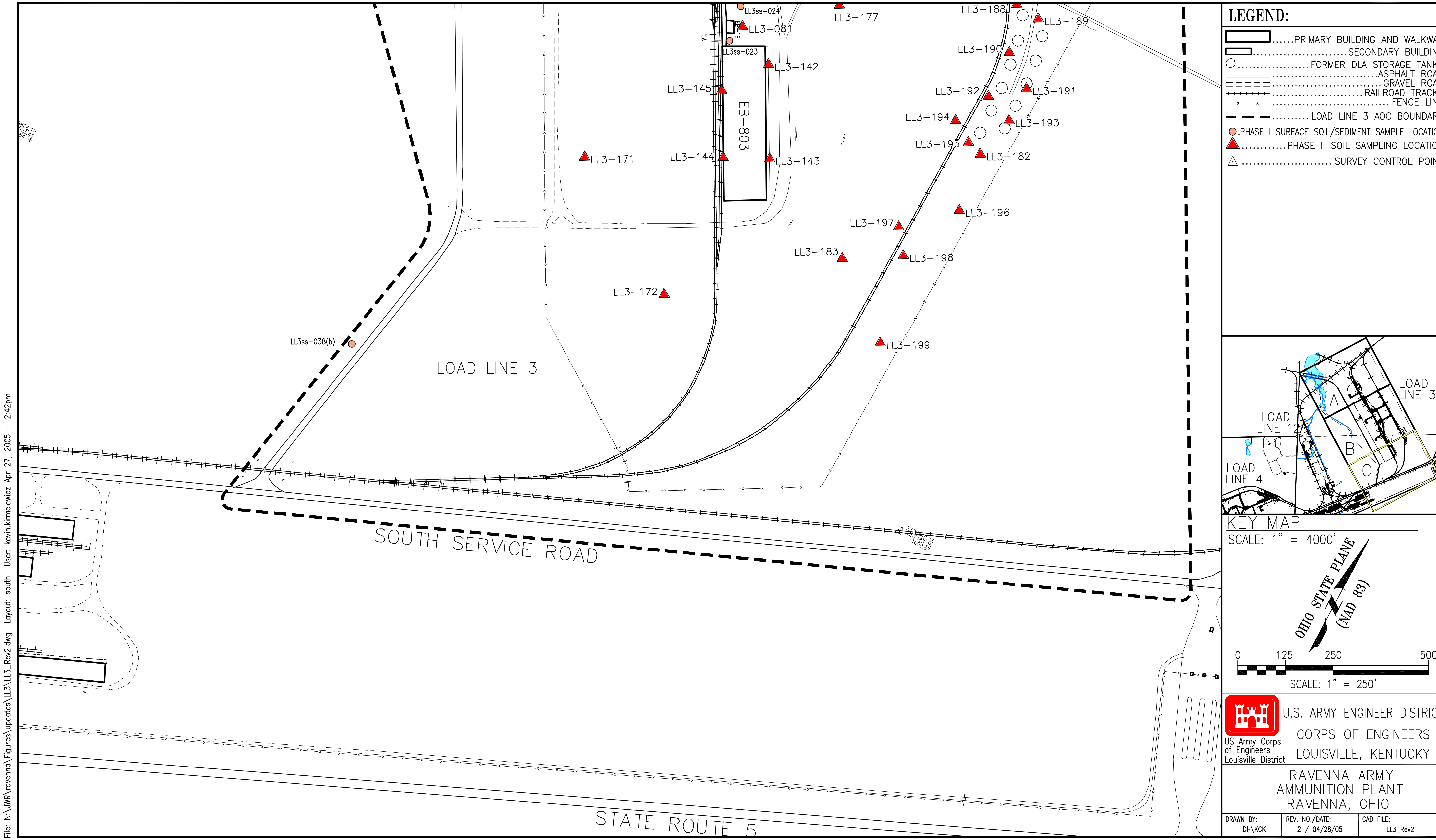

Figure 1-9(1). Load Line 3 Phase I and Phase II RI Surface Soil, Subsurface Soil and Sediment Sampling Locations - Southern Section

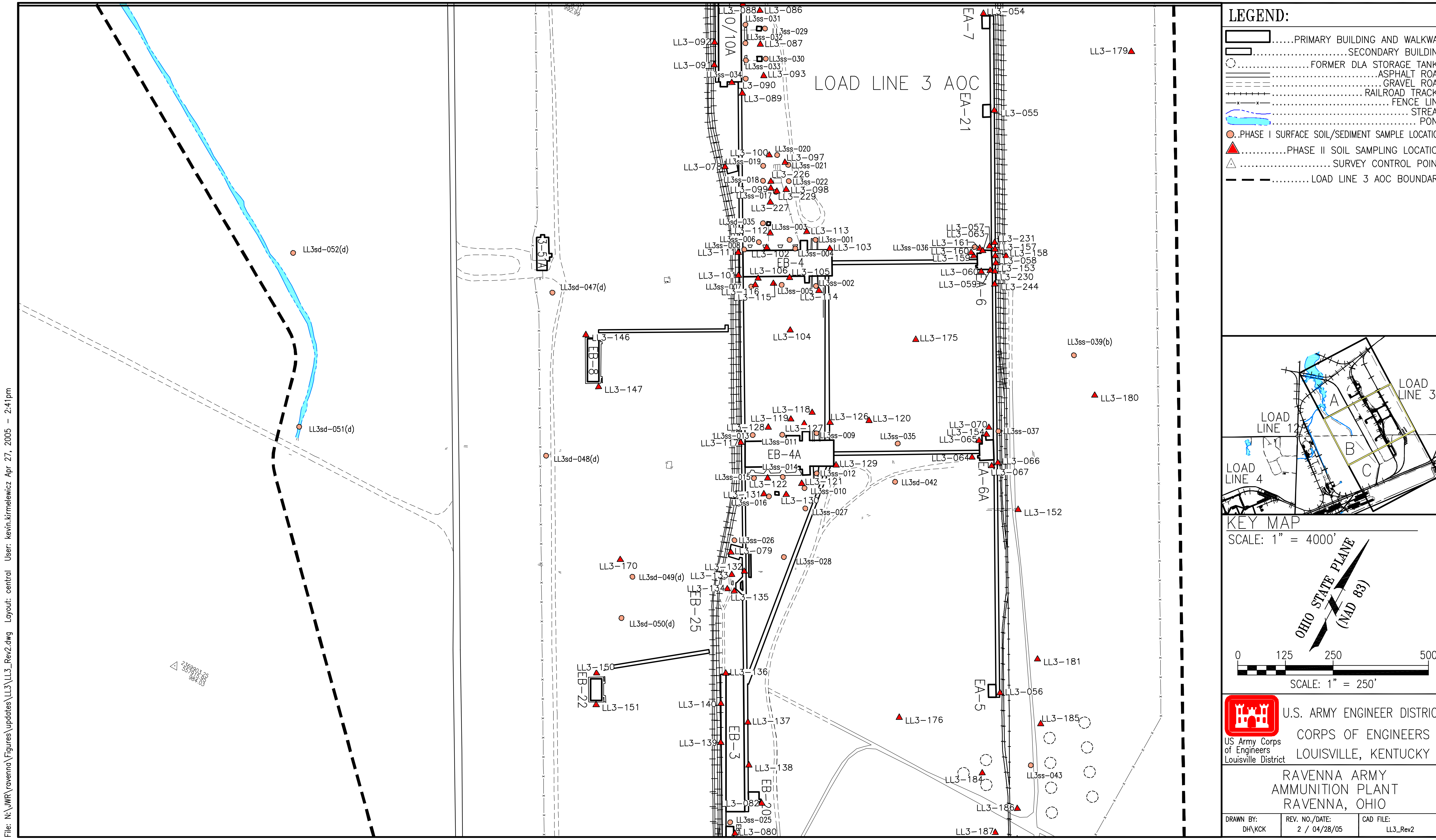

Figure 1-9(2). Load Line 3 Phase I and Phase II RI Surface Soil, Subsurface Soil and Sediment Sampling Locations - Central Section

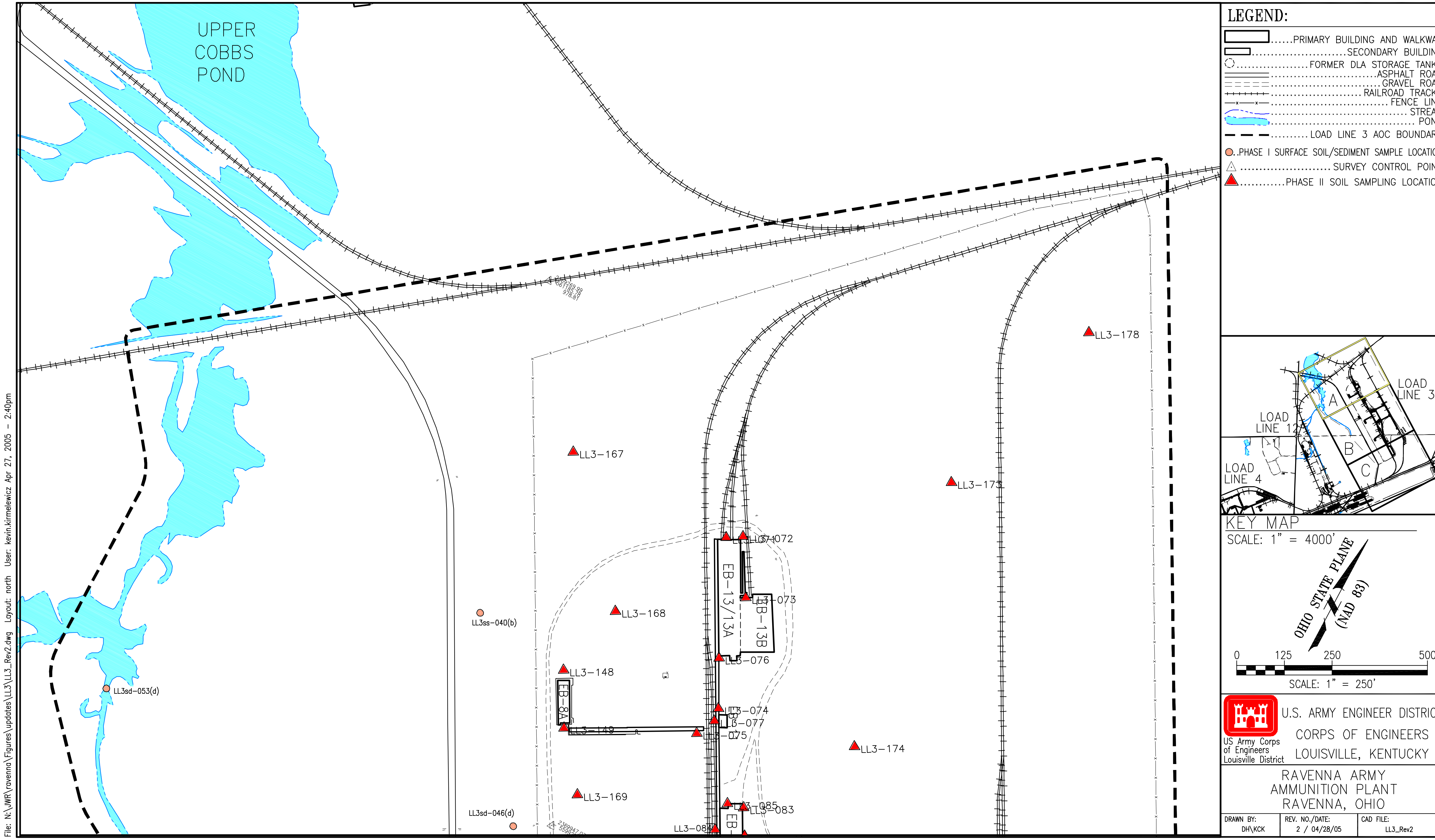

Figure 1-9(3). Load Line 3 Phase I and Phase II RI Surface Soil, Subsurface Soil and Sediment Sampling Locations - Northern Section

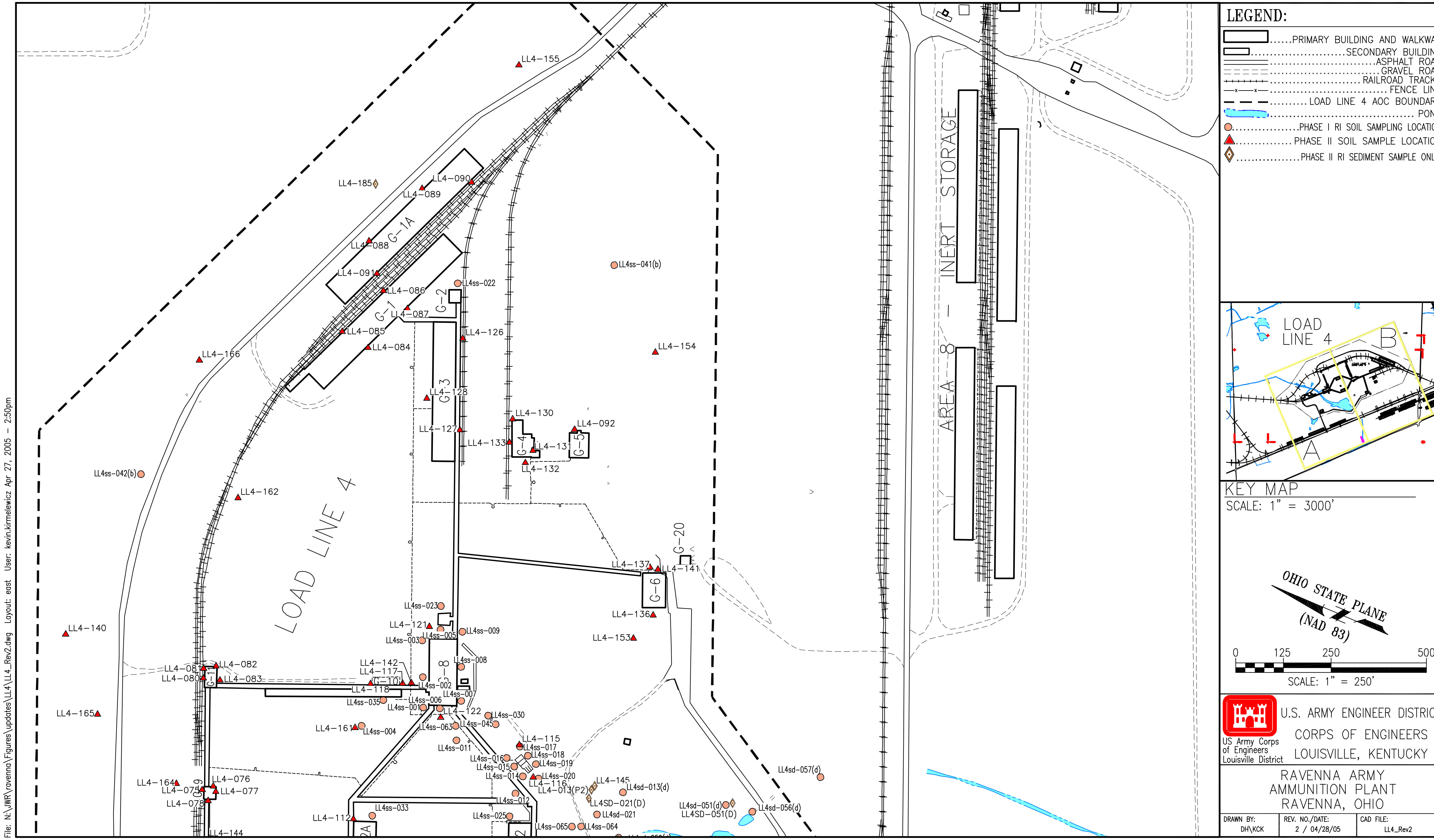

Figure 1-10 (1). Load Line 4 Phase I and Phase II RI Surface Soil, Subsurface Soil and Sediment Sampling Locations - Eastern Section

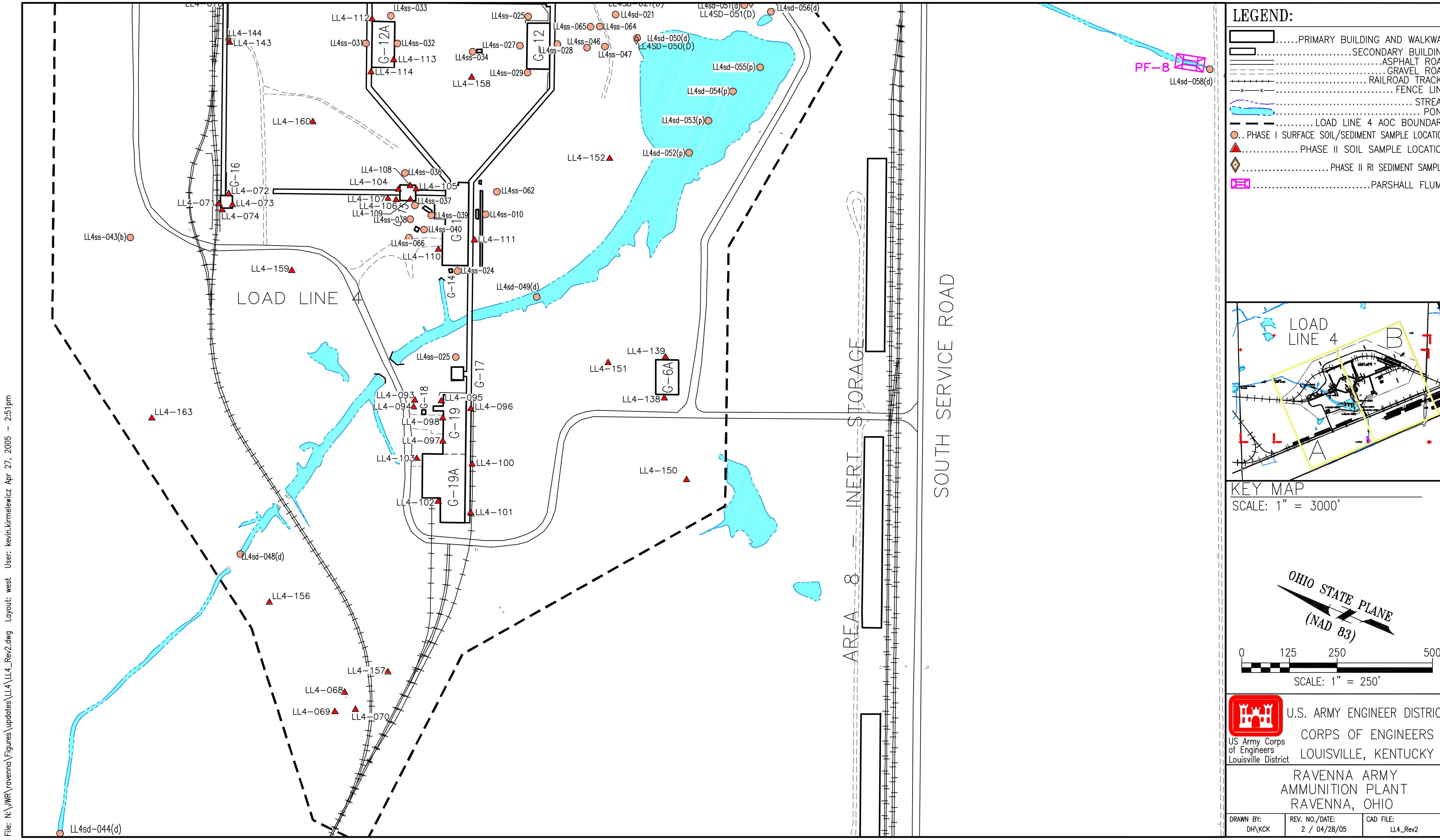

Figure 1-10 (2). Load Line 4 Phase I and Phase II RI Surface Soil, Subsurface Soil and Sediment Sampling Locations - Western Section

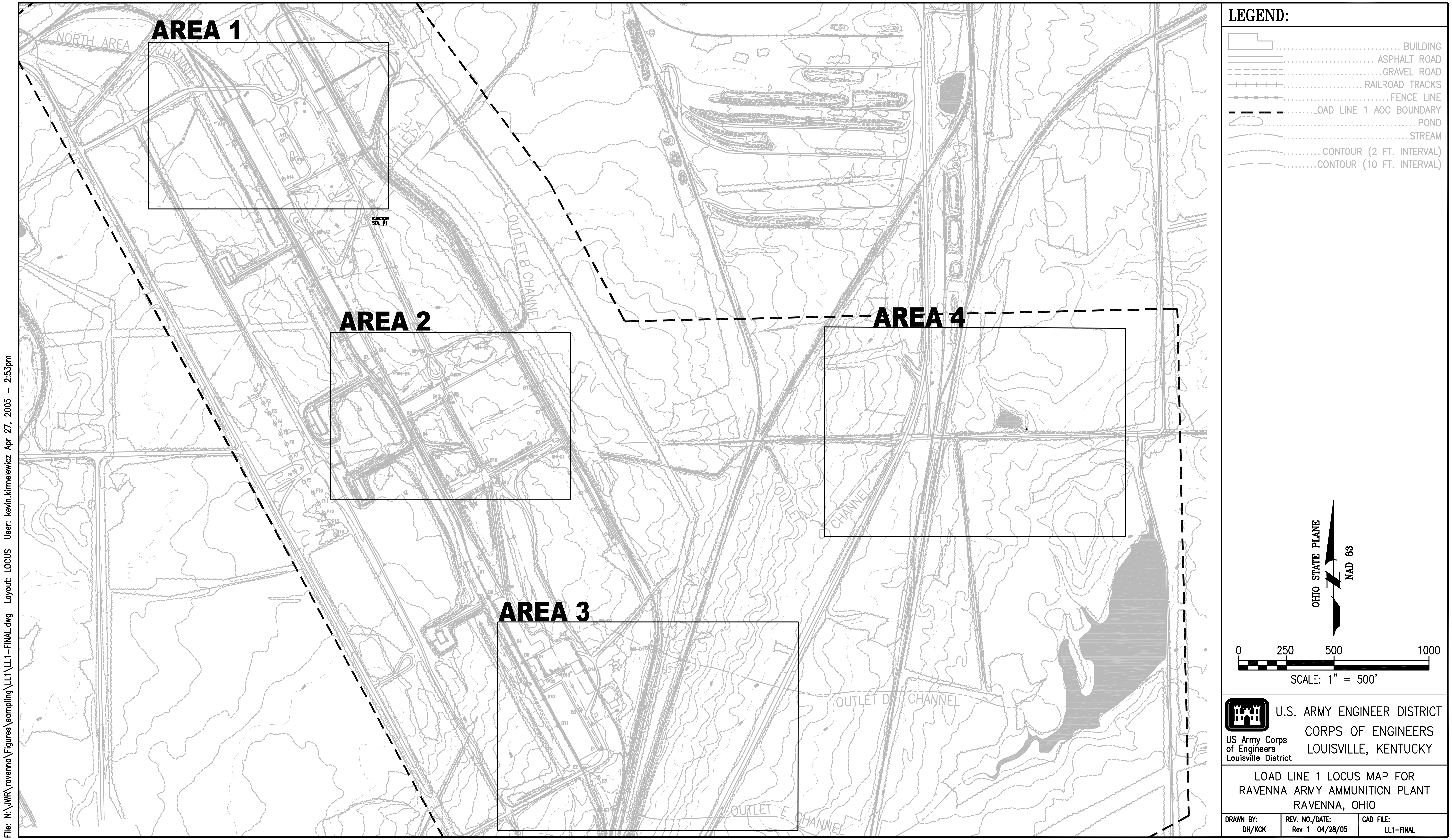

FIGURE 2-1(1) Load Line 1, Locus Map - November 2004 Soil Sampling Locations

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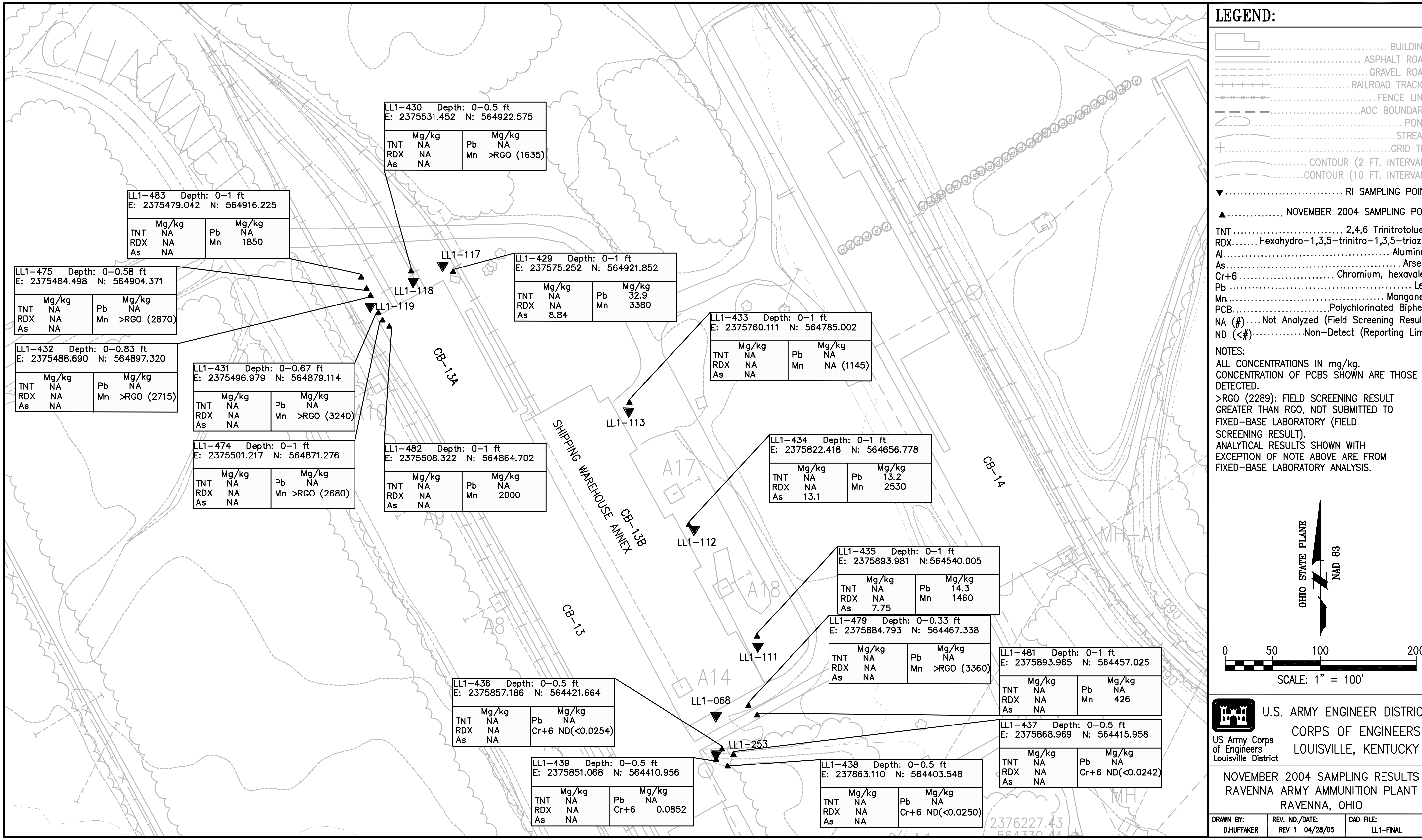

Figure 2-1(2) Load Line 1, Area 1 - November 2004 Soil Sampling Locations

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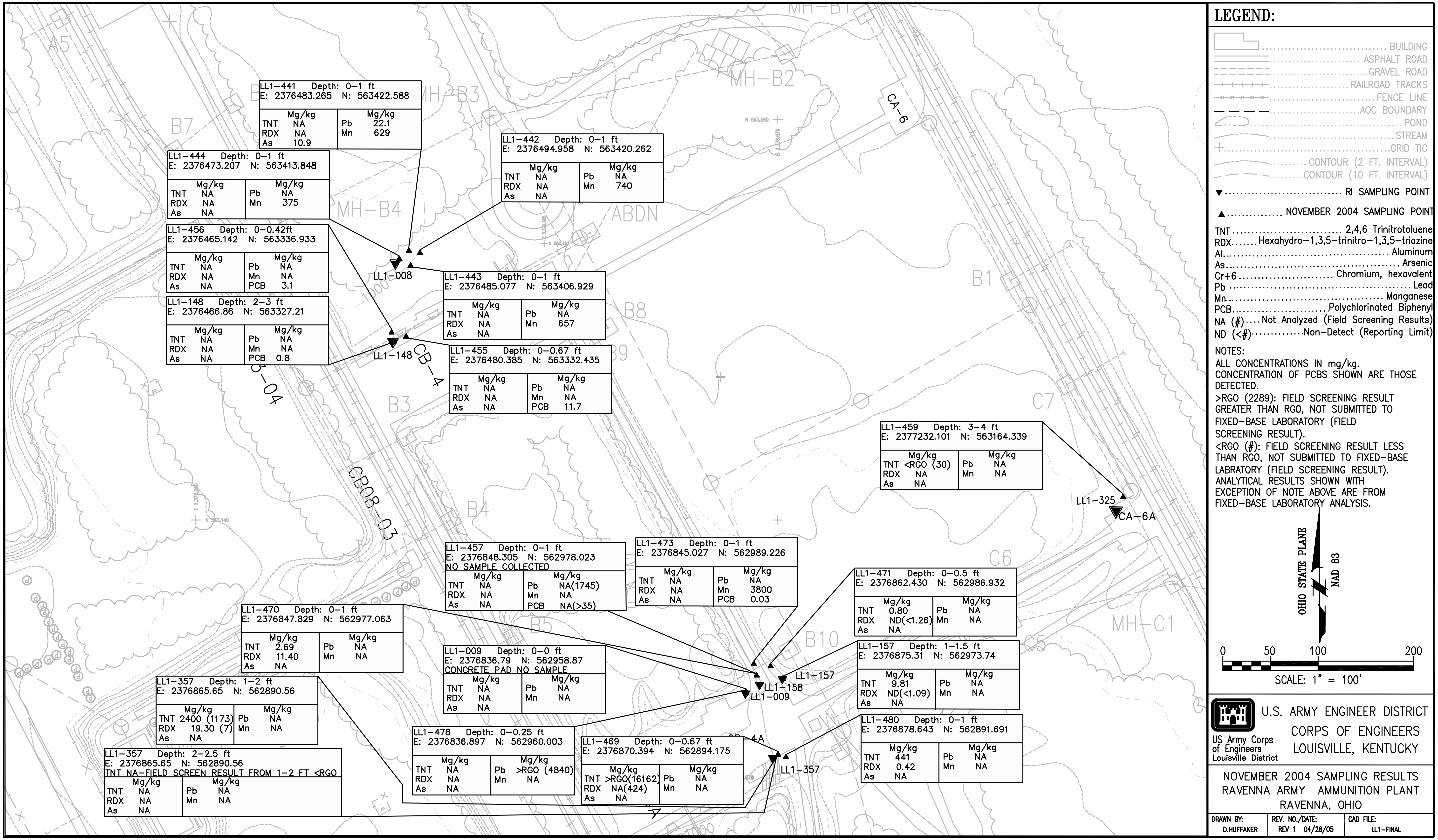

Figure 2-1(3) Load Line1, Area 2 - November 2004 Soil Sampling Locations

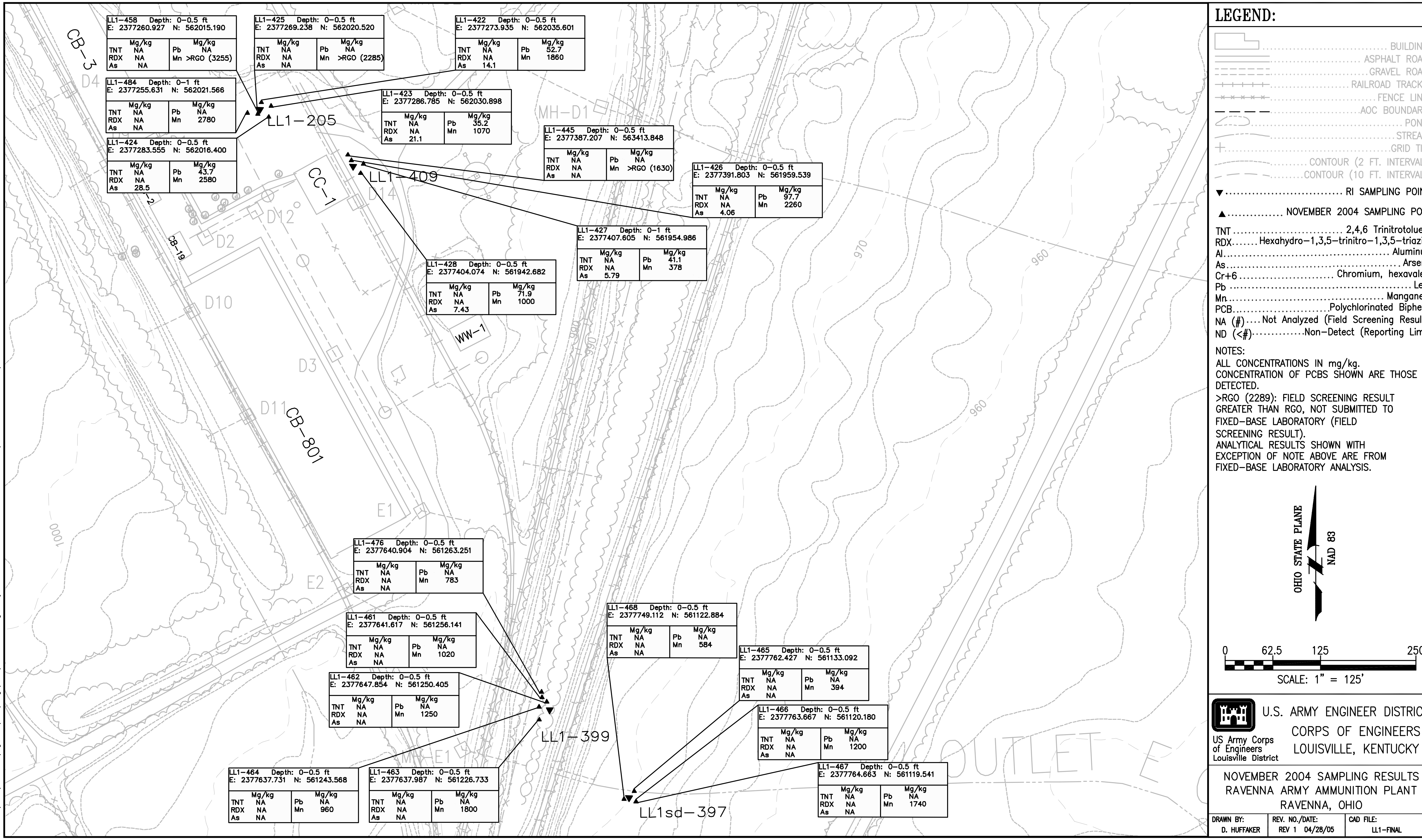

Figure 2-1(4) Load Line 1, Area 3 - November 2004 Soil Sampling Locations

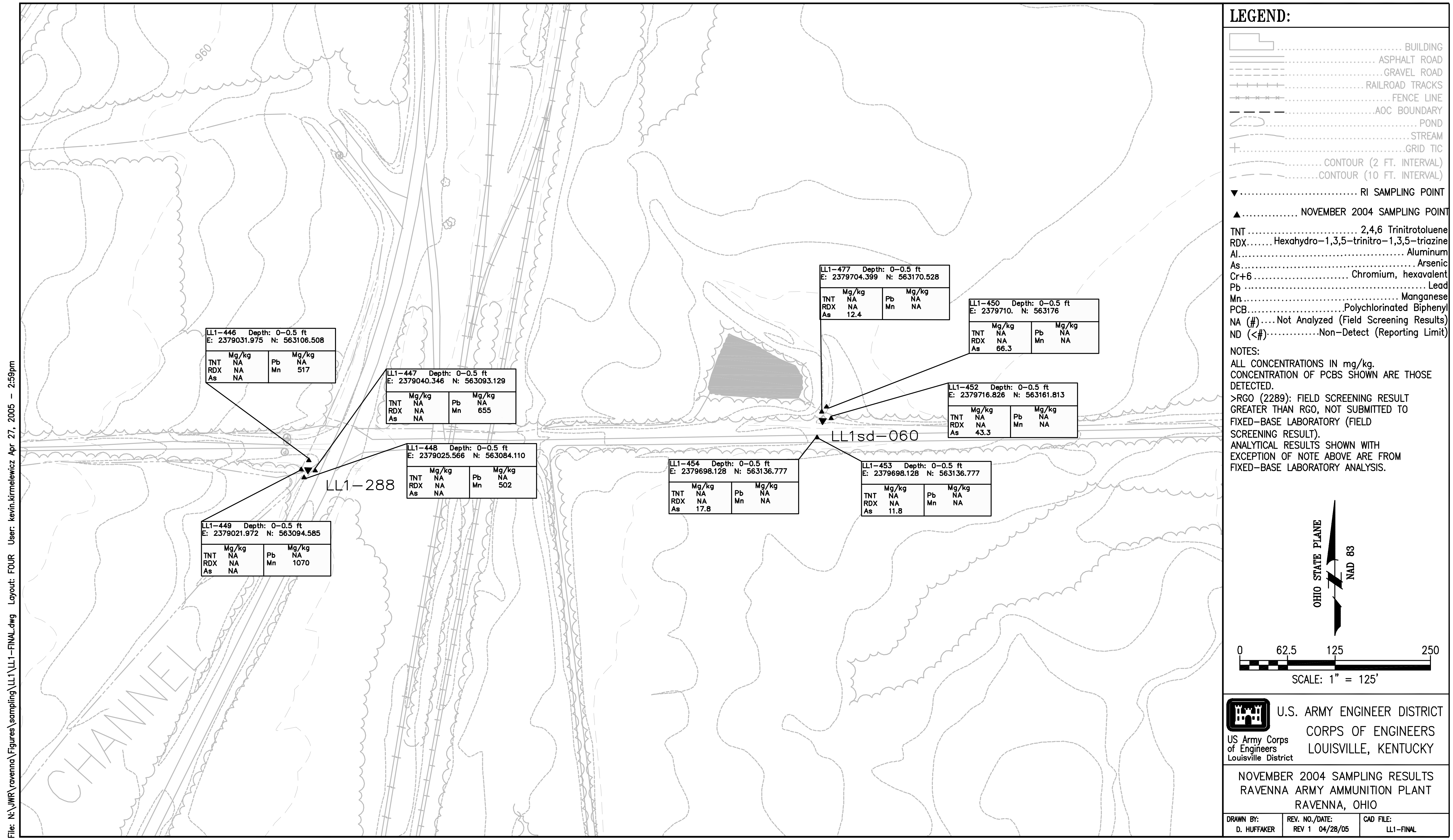

Figure 2-1(5) Load Line 1, Area 4 - November 2004 Soil Sampling Locations

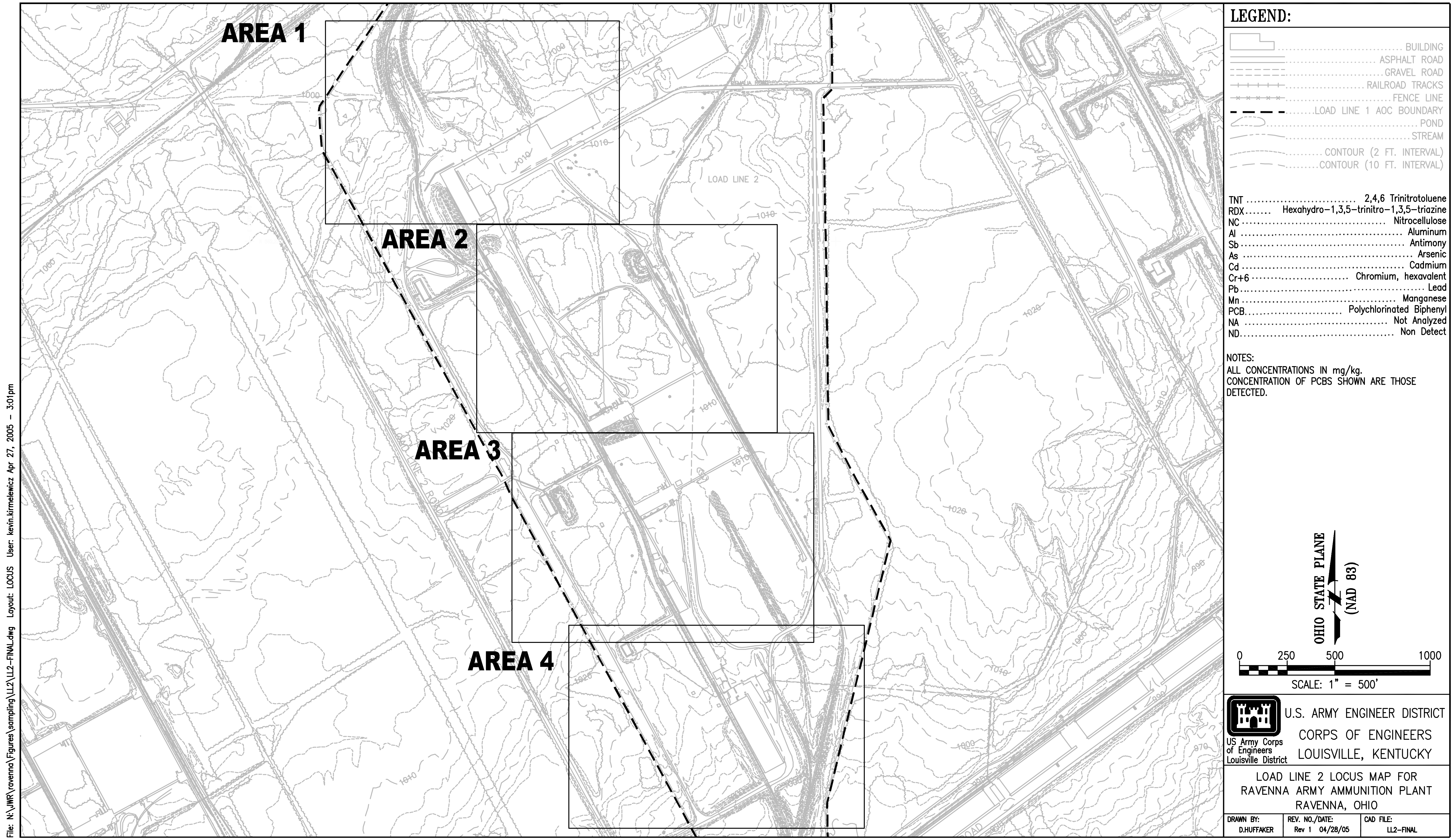

Figure 2-2 (1) Load Line 2, Locus Map - November 2004 Soil Sampling Locations

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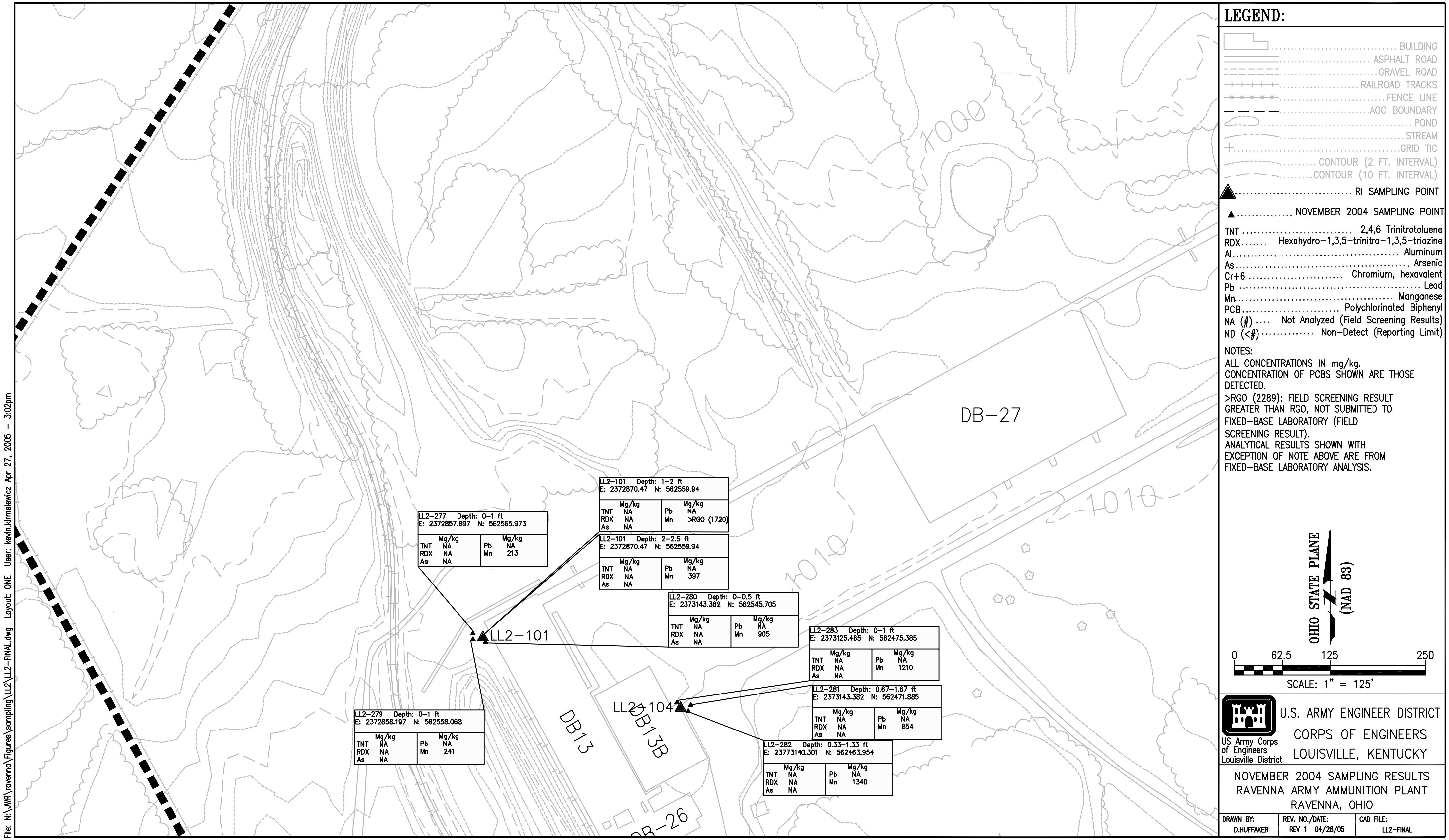

Figure 2-2(2) Load Line 2, Area 1 - November 2004 Soil Sampling Locations

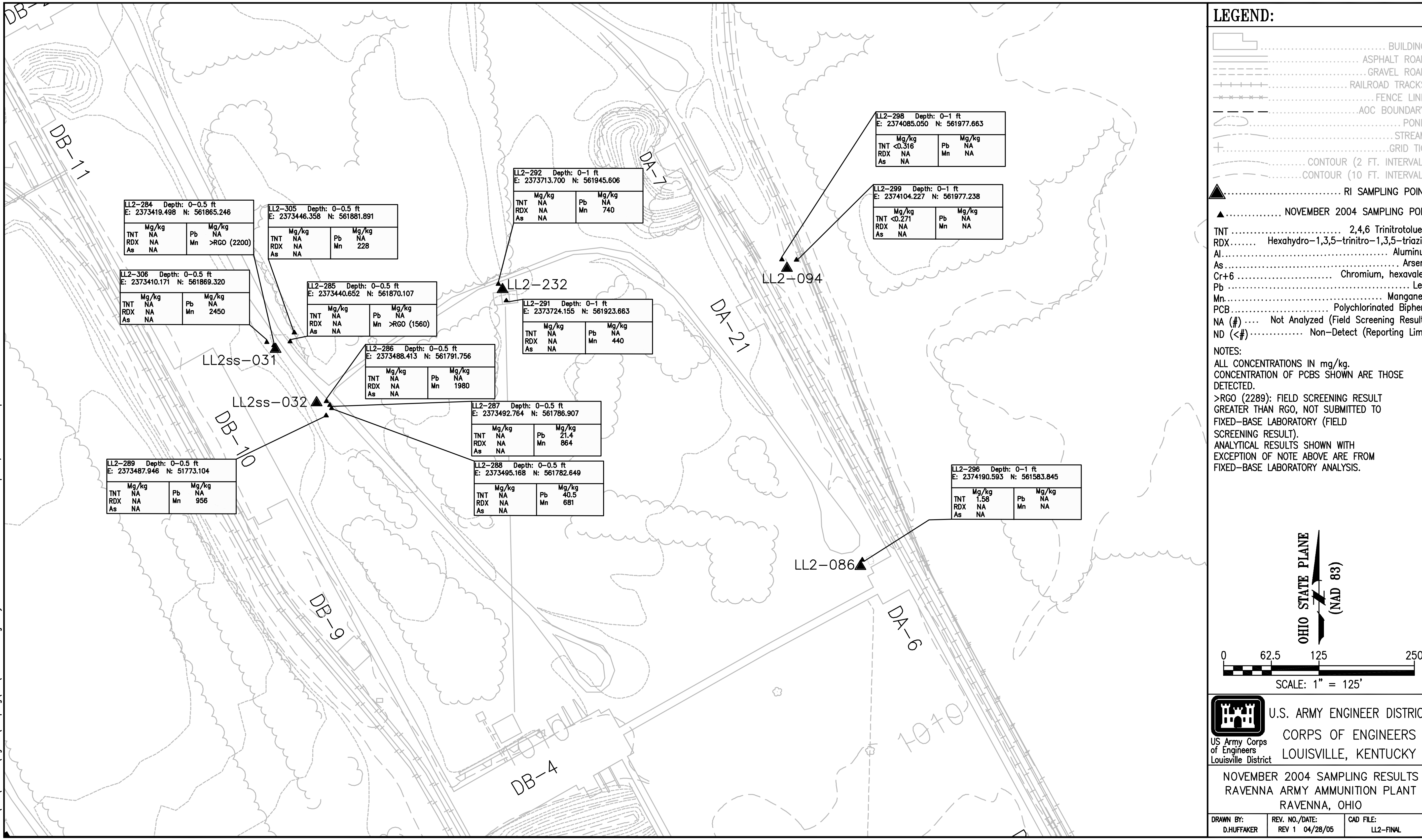

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Figure 2-2(3) Load Line 2, Area 2 - November 2004 Soil Sampling Locations

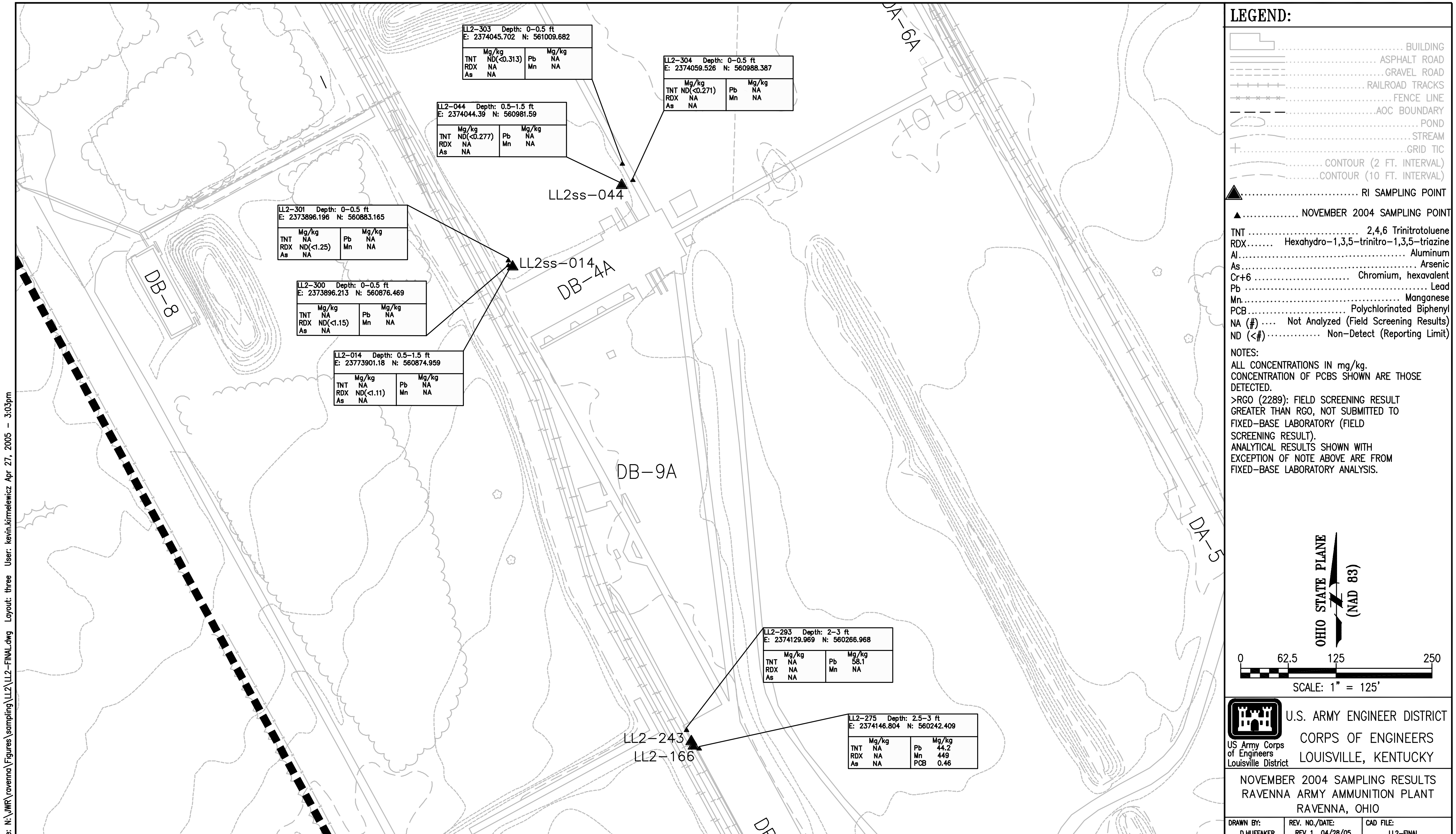

Figure 2-2(4) Load Line 2, Area 3 - November 2004 Soil Sampling Locations

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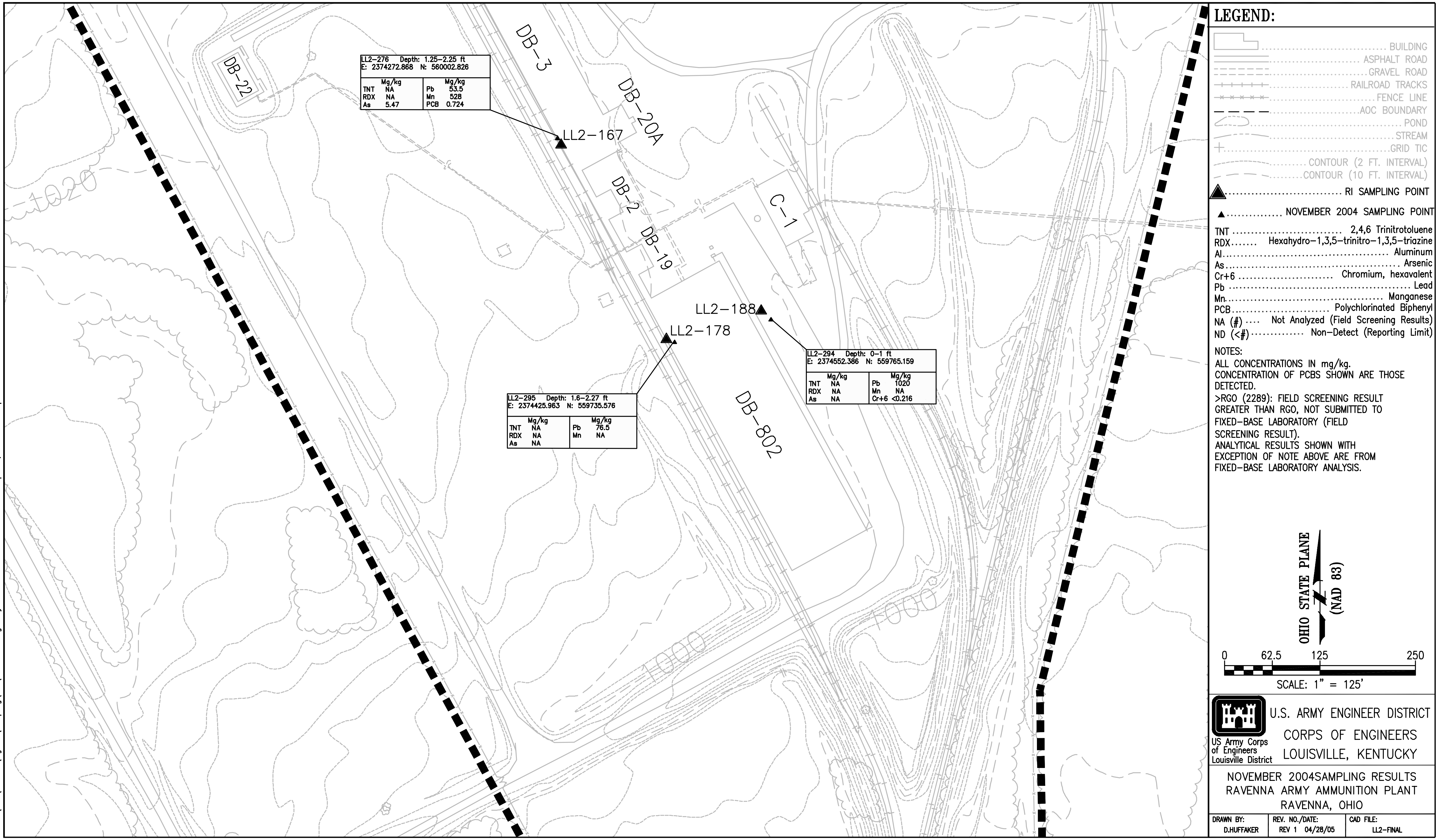

Figure 2-2(5) Load Line 2, Area 4 - November 2004 Soil Sampling Locations

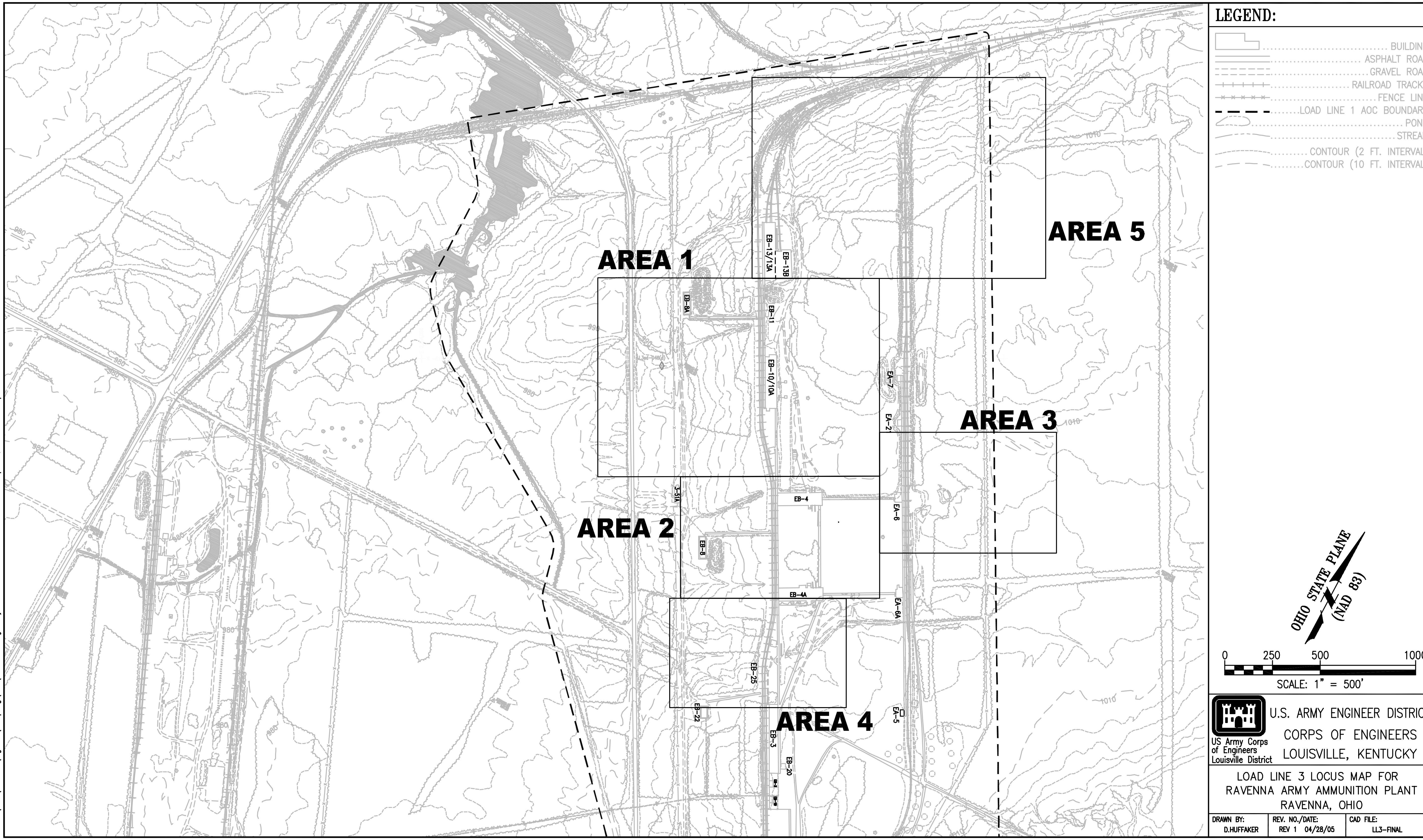

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Figure 2-3(1) Load Line 3, Locus Map - November 2004 Soil Sampling Locations

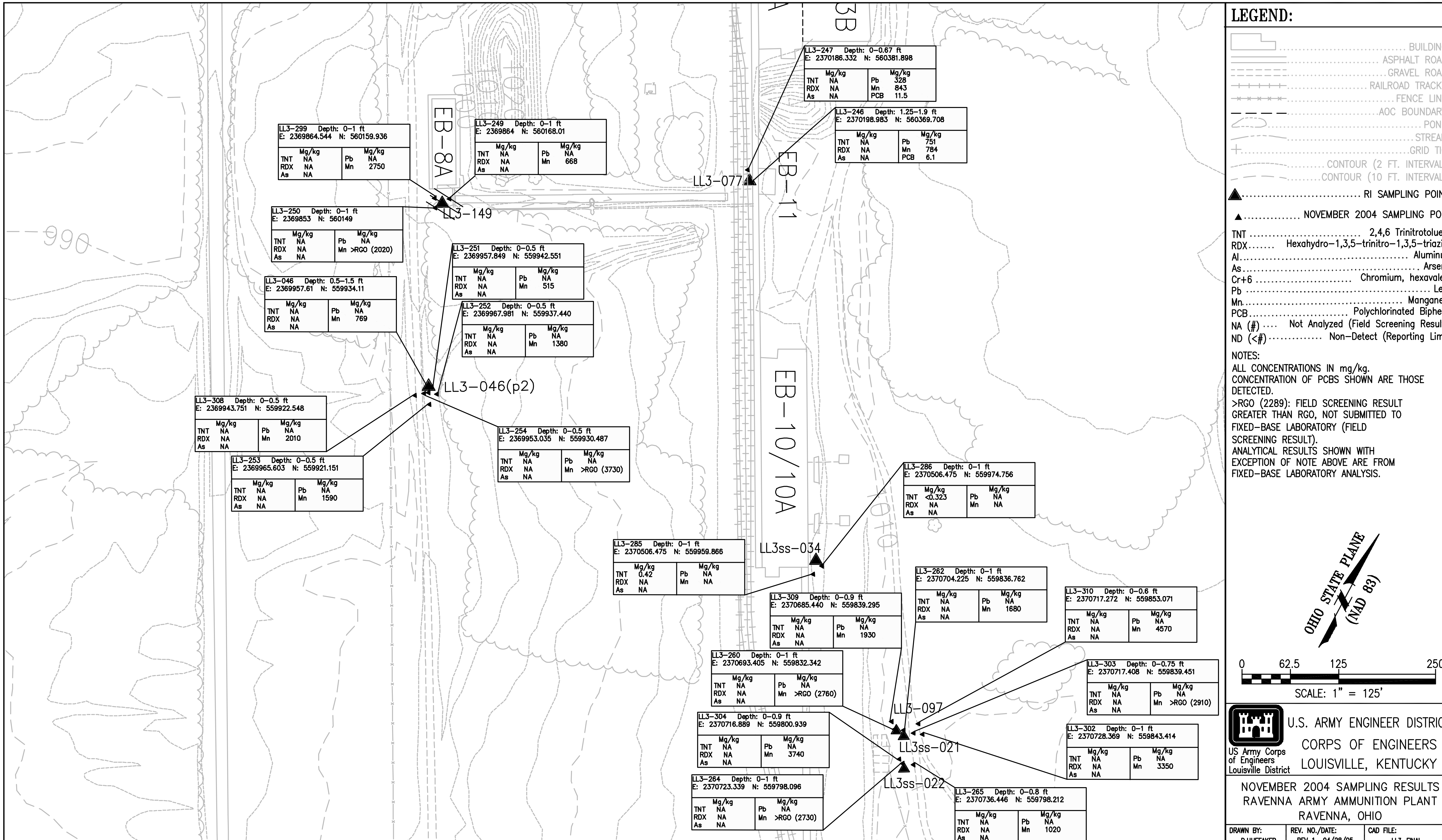

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Figure 2-3(2) Load Line 3, Area 1 - November 2004 Soil Sampling Locations

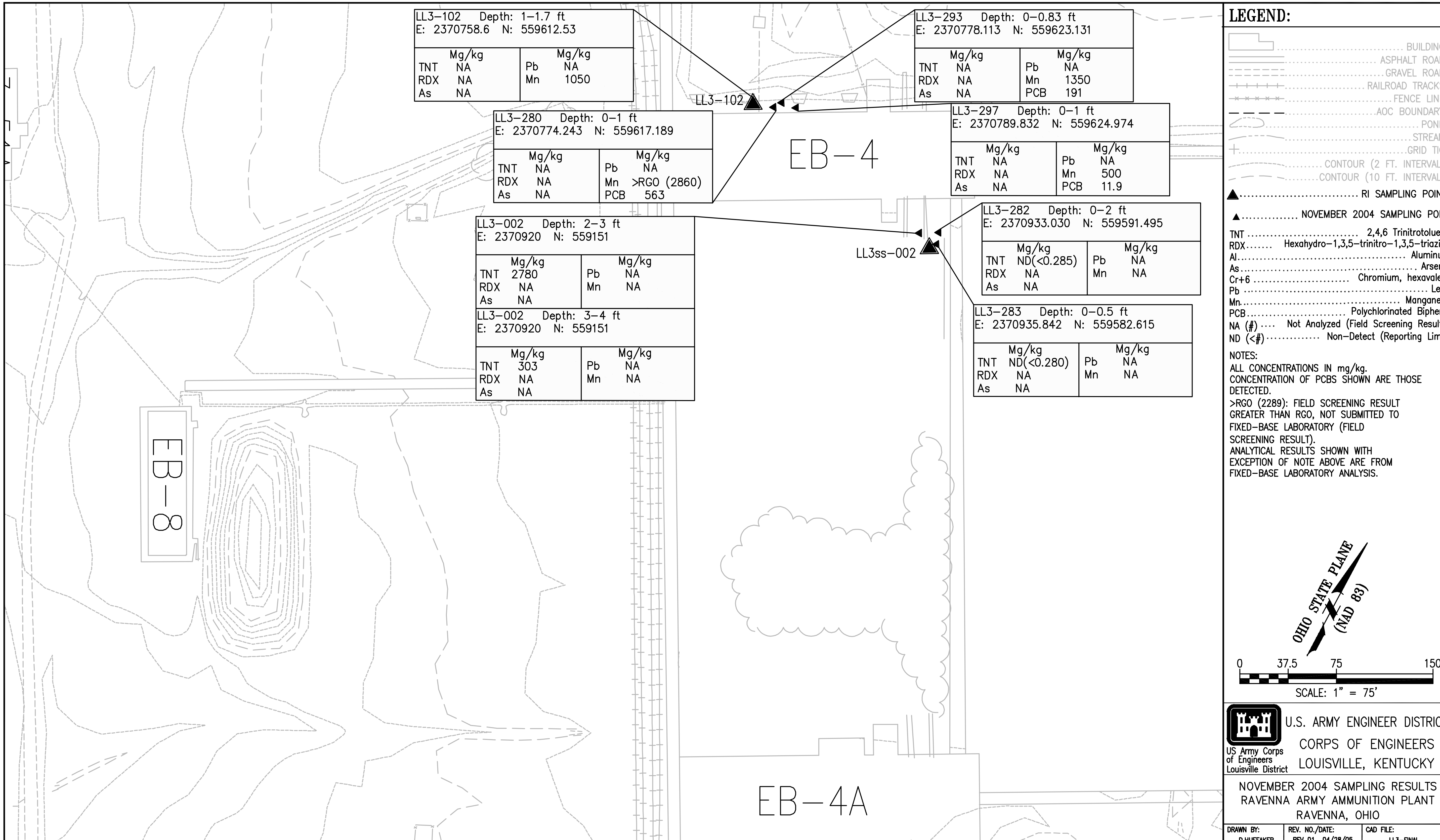

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Figure 2-3(3) Load Line 3, Area 2 - November 2004 Soil Sampling Locations

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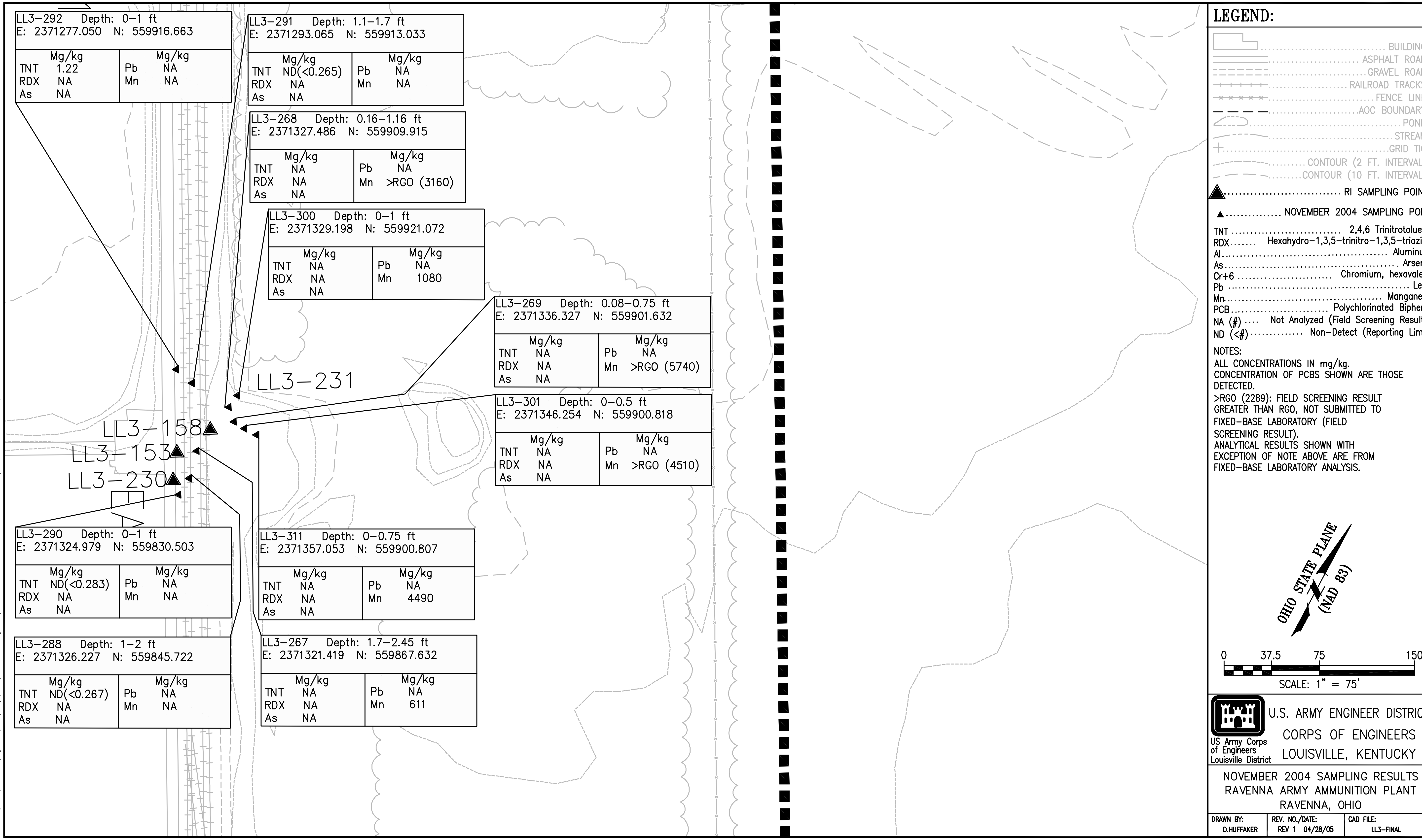

Figure 2-3(4) Load Line 3, Area 3 - November 2004 Soil Sampling Locations

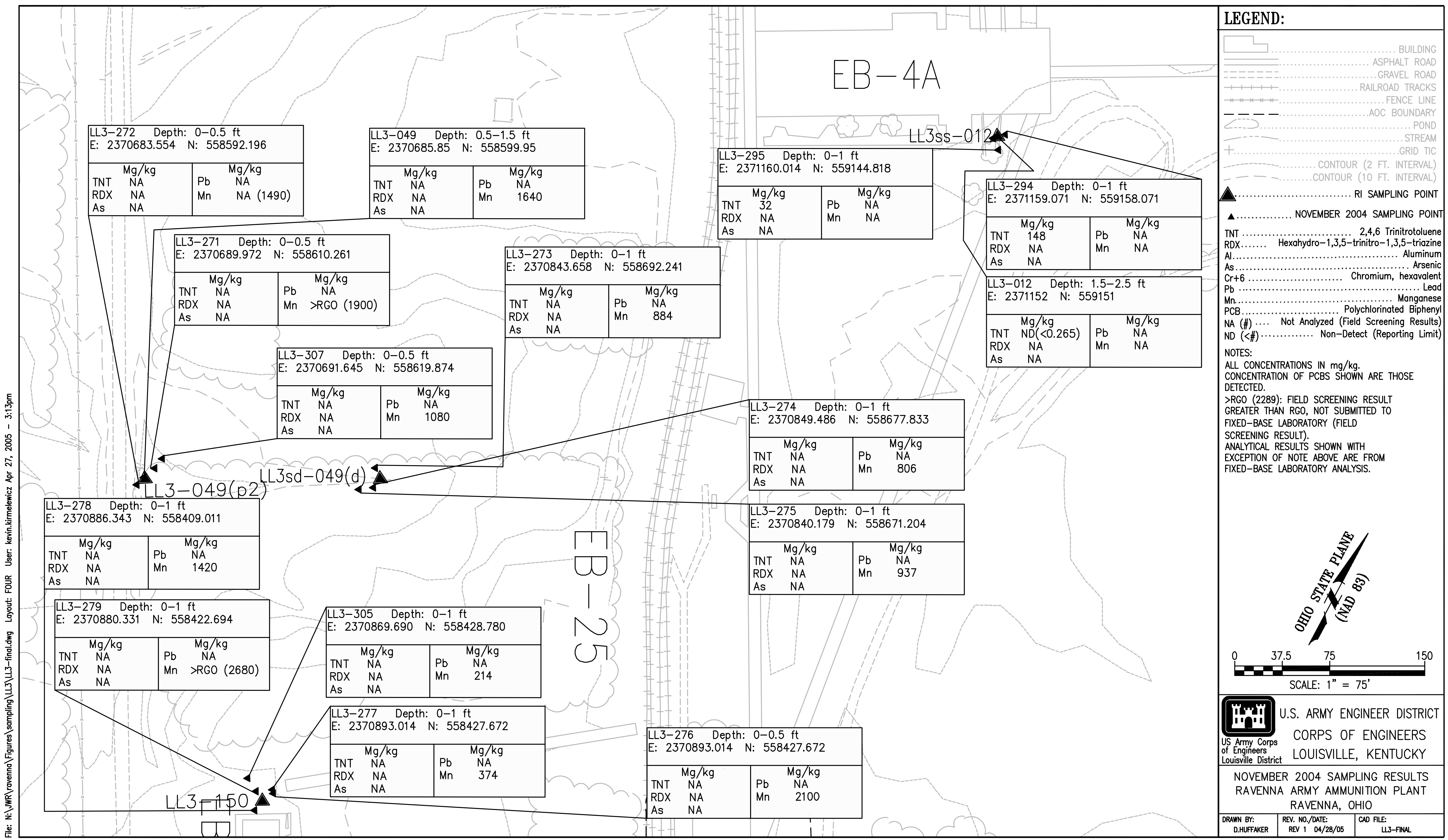

Figure 2-3(5) Load Line 3, Area 4 - November 2004 Soil Sampling Locations

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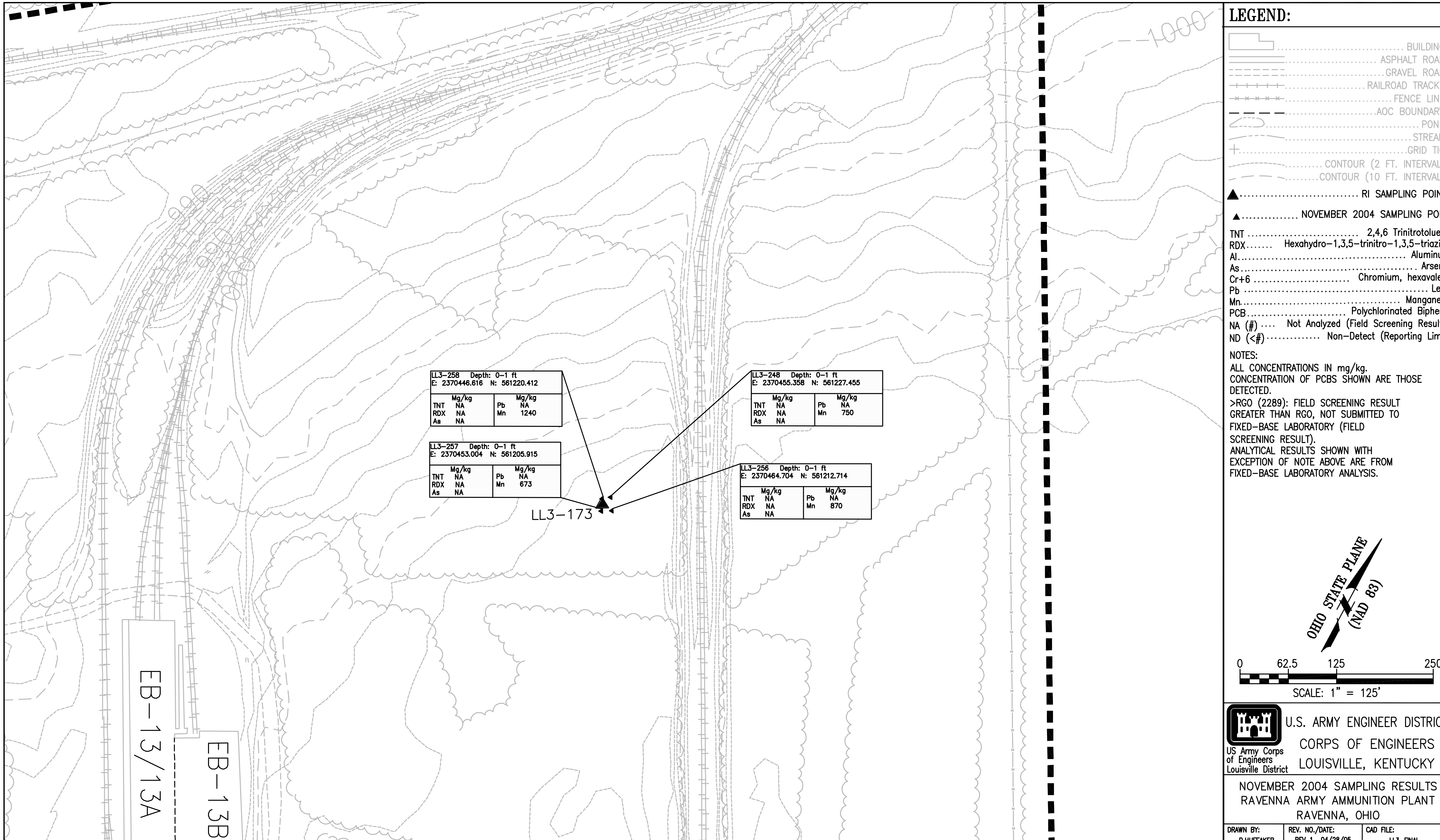
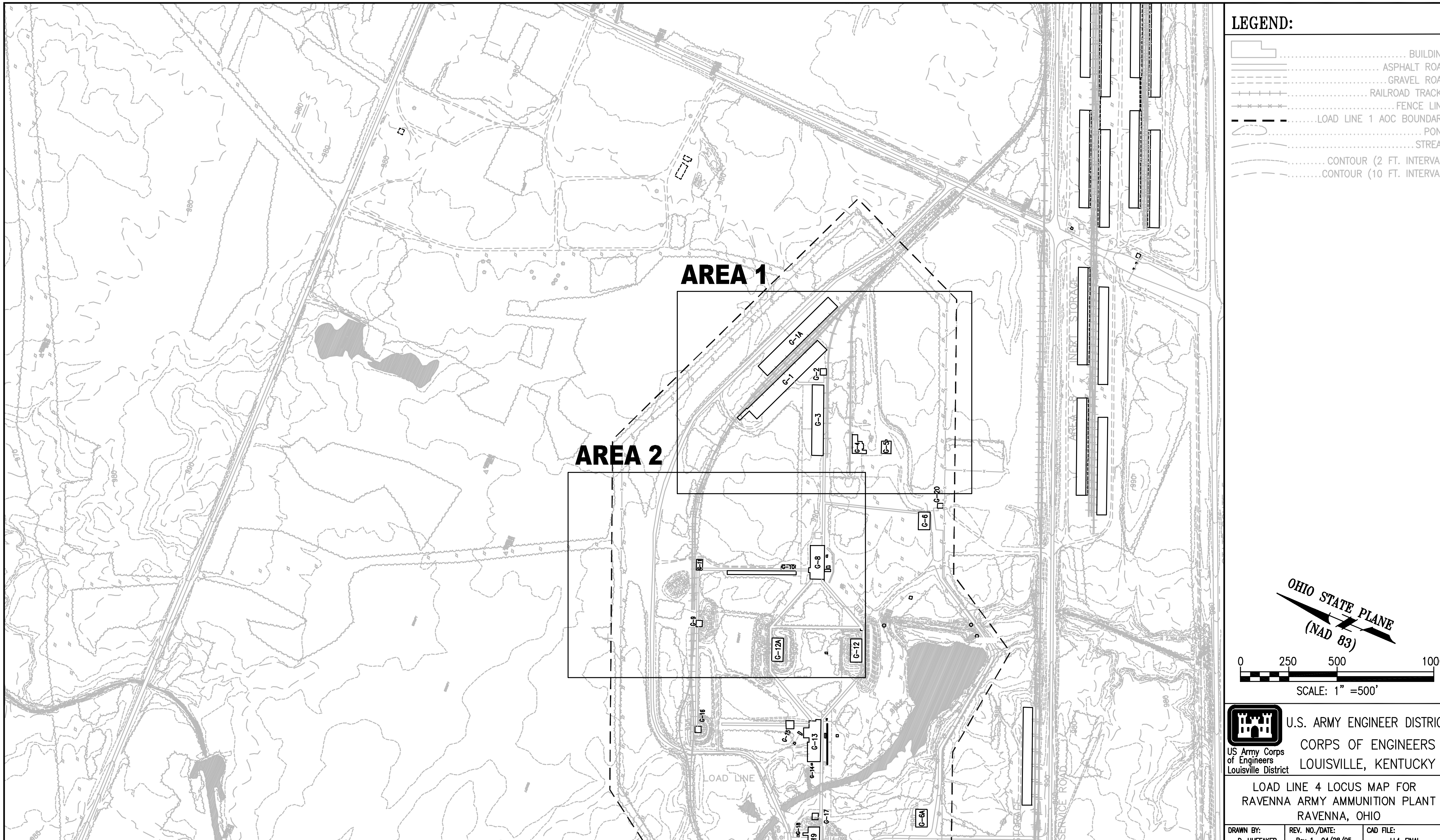


Figure 2-3(6) Load Line 3, Area 5 - November 2004 Soil Sampling Locations



File: N:\JWR\ravenna\Figures\sampling\LL4\LL4-FINAL.dwg Layout: LOCUS User: kevin.kirmelewicz Apr 27, 2005 - 3:15pm

Figure 2-4(1) Load Line 4, Locus Map - November 2004 Soil Sampling Locations

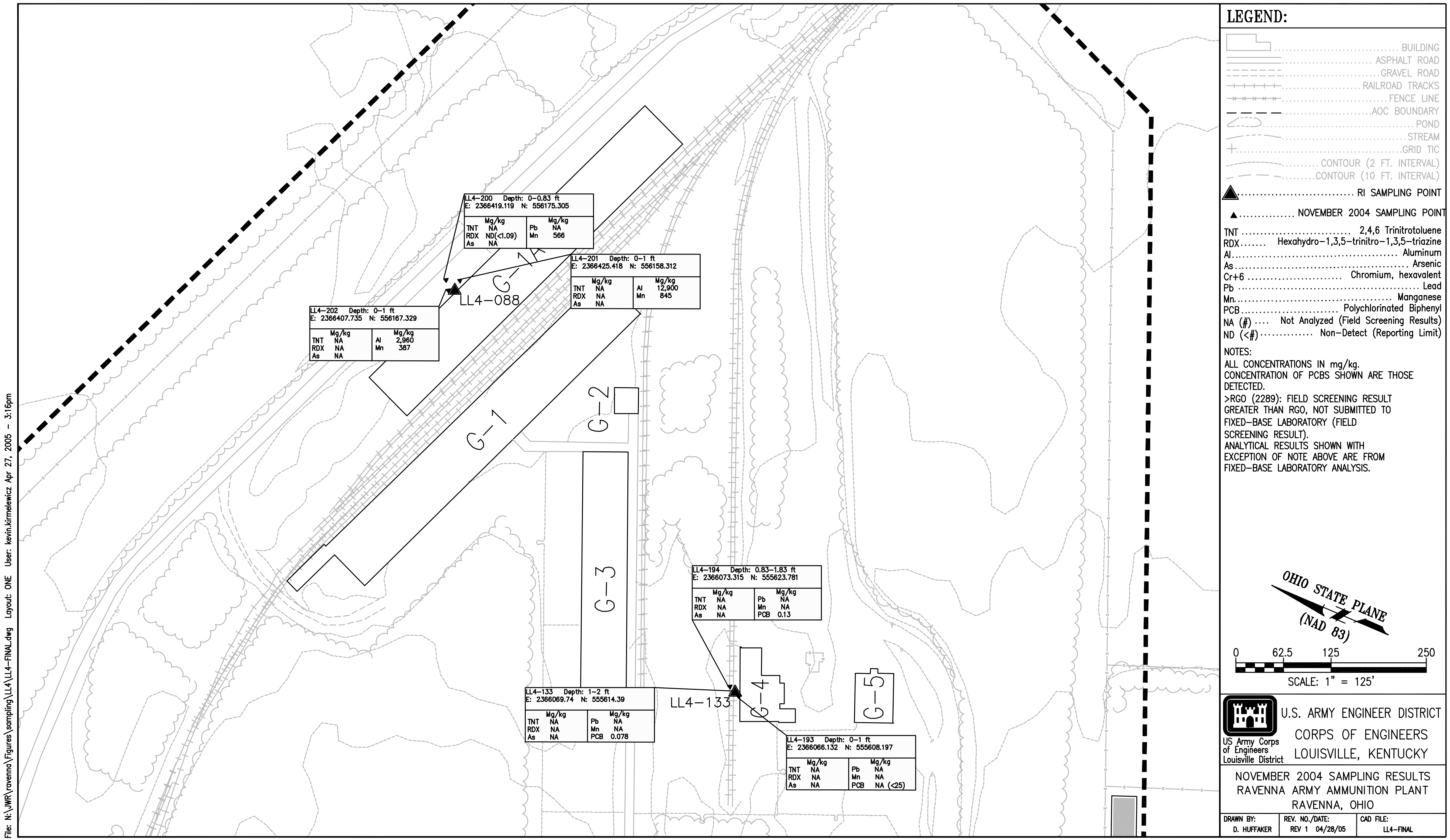


Figure 2-4(2) Load Line 4, Area 1 - November 2004 Soil Sampling Locations

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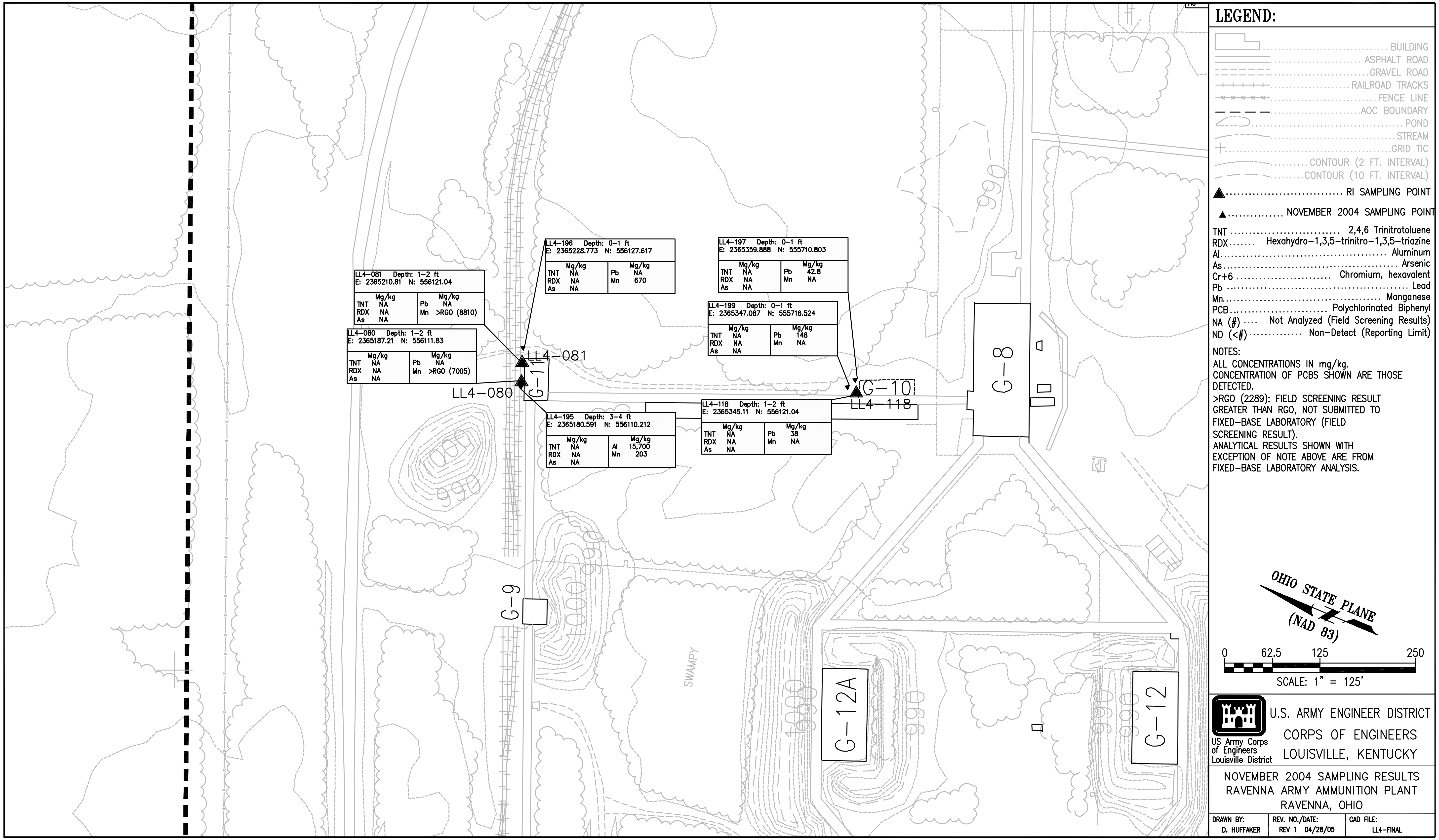

Figure 2-4(3) Load Line 4, Area 2 - November 2004 Soil Sampling Locations

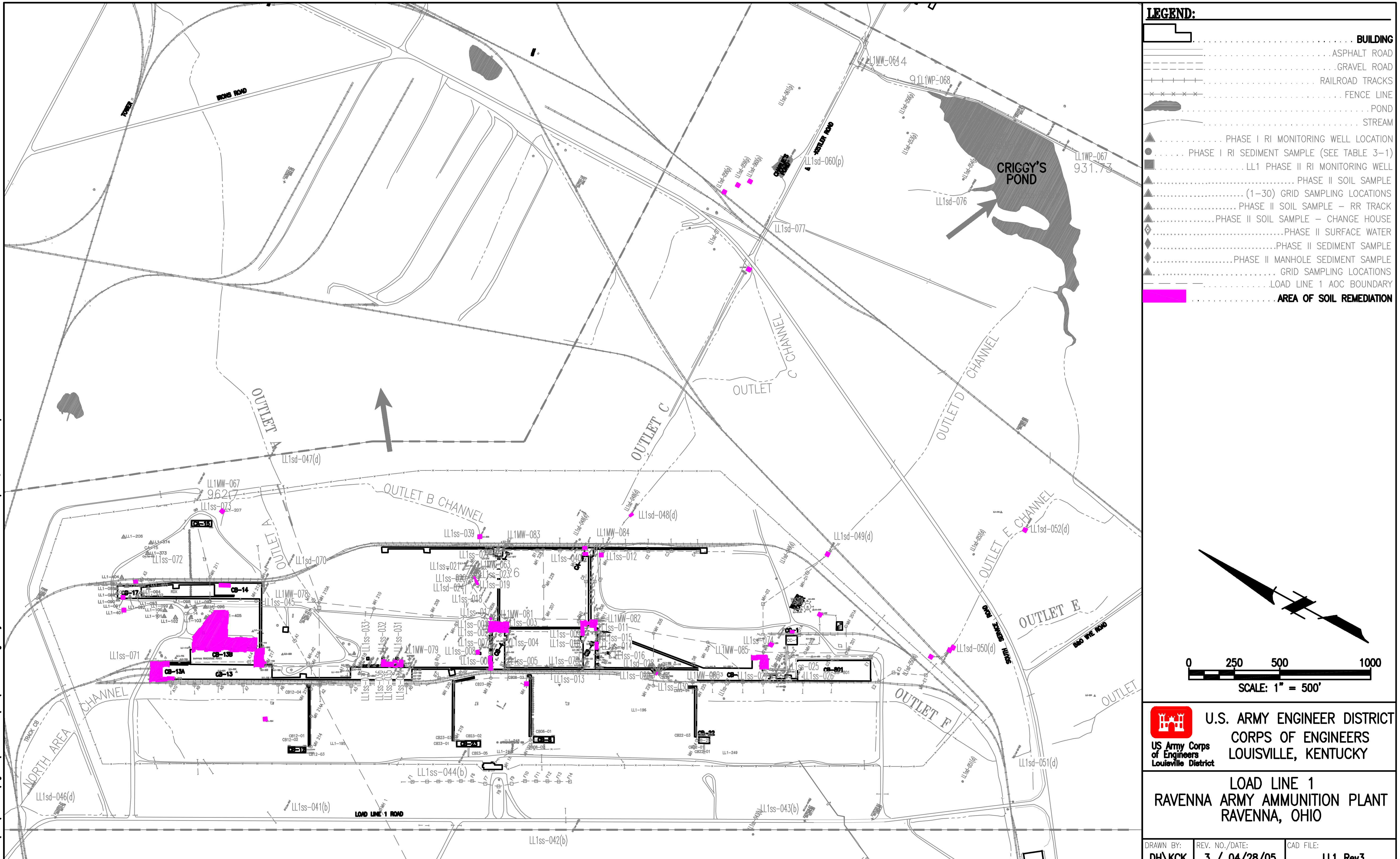

Figure 2-8. Load Line 1 - Approximate Areas of Soil Remediation

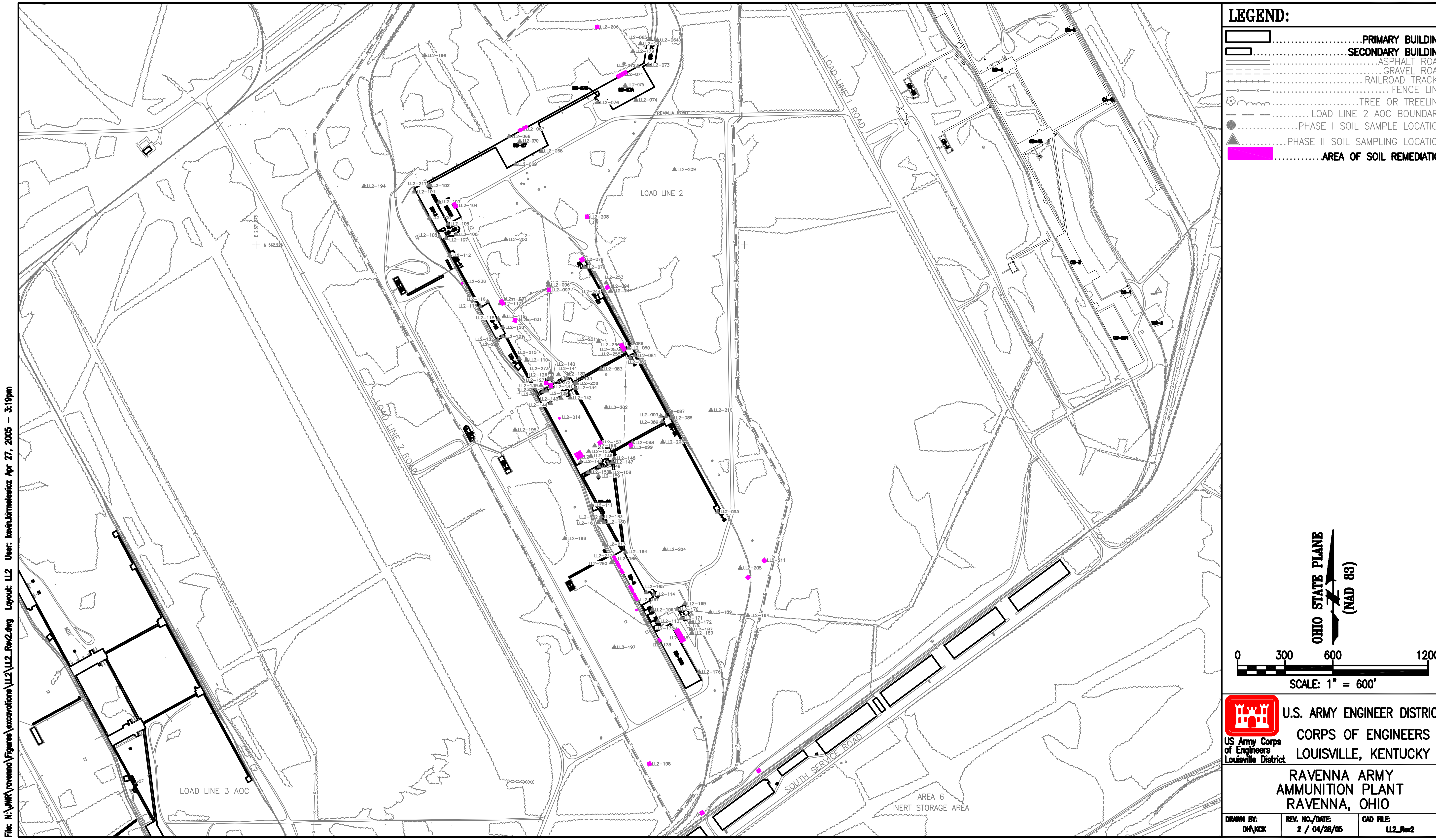

Figure 2-9. Load Line 2 - Approximate Areas of Soil Remediation

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Figure 2-10. Load Line 3 - Approximate Areas of Soil Remediation

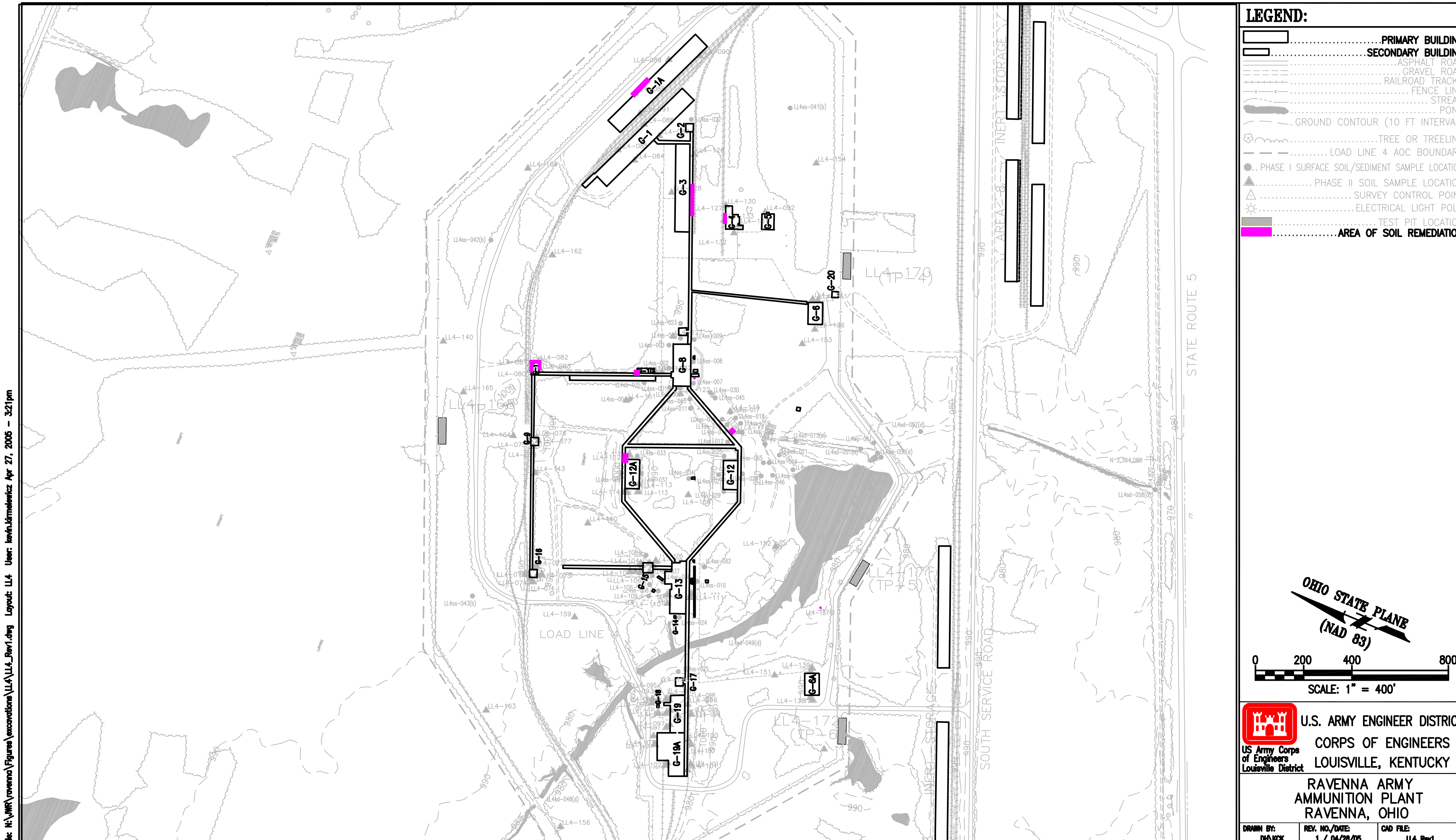

Figure 2-11. Load Line 4 - Approximate Areas of Soil Remediation

Appendix A

Field XRF Instrument Evaluation

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Appendix A
Field X-Ray Fluorescence Instrument Evaluation

The plan calls for analysis of soils using an X-ray Fluorescence (XRF) Spectrometer to analyze metals concentrations in soils for field screening. NITON Corporation (NITON) was selected as the supplier of the XRF instrument since a certification for operation and radiation safety was current for the operator of the instrument. NITON was contacted October 26, 2004. A list of metals was given to the sales representative in order to determine the model required for analysis. The 700 series are multi-element instruments. Multi-element instruments can have one to three sources. The elements required of the project can be monitored with a single source. NITON's sales representative suggested a 702 model instrument. Arrangements were made to get the instrument on-site.

On November 10, 2004 the instrument was operated for the first time. The process used to verify instrument control includes an energy calibration which is automatically performed by the instrument prior to use and the analysis of a NIST certified standards. There are no manual inputs to the instrument to alter how the instrument detects or calculates metals. The Manufacturer's calibration can only be checked against standards. The NIST standards provided with the instrument are Low, Medium and High concentrations of clay that has been certified to have specific levels of several elements. There is also a silicon dioxide blank. The Low standard was not used since the levels of concern were at or above the Medium and High standards. The Blank verifies instrument "cleanliness". The Medium standard is used for determining accuracy of lead and the High Standard is used for determining accuracy of manganese. Although arsenic is a target metal, the level of concern is at or below the instrument detectable level.

The first analysis of the Medium standard yielded results for lead that was acceptable well within 10% of the known value. The manganese result for the medium standard was reported as less than the detection limit after a two minute source time reading. The detection limit for this particular reading was 740 mg/kg, which is approximately half the action level for the site. The high standard was used to determine if manganese is in control. The High standard for manganese was within acceptable range. So, for the determination of instrument control, the Medium standard was used for the evaluation of lead and the High standard was used for the evaluation of both lead and manganese. Arsenic was not anticipated to be a viable method for determining concentration in soil since the detection limit for the instrument was greater than the action level for a two minute source time reading. However, data was collected for arsenic.

The analysis of the High standard on November 11, 2004 yielded a manganese result at 10% above the certified level. The lead level was well within acceptable control limits. The manganese result for the Medium standard, although not used for determining instrument control, provided a result above the known value. Since the level was half the action level and the High standard was within control the elevated result of the Medium standard was noted and analysis continued. The High standard was run two more times during the analysis and the manganese level was near the 10% above the known value. However, lead was well within 10% of the known value. It should be noted that a high result is indicative of increased sensitivity. The increased sensitivity of the instrument provides a conservative value with respect to project action levels.

On November 12, 2004, much of the day dealt with sample preparation and sample packaging. Samples analyzed on November 10, 2004 were submitted to the laboratory for analysis. Five samples were selected for rush analysis to determine the correlation between the analysis by XRF versus the ICP. The results follow:

Sample ID	Analysis by XRF	Analysis by ICP
LL1ss-423-1402-SO	Mn - <560 Pb - 37 As - <23	Mn – 1070 Pb – 35.2 As – 21.1
LL1ss-426-1405-SO	Mn - 1235 (avg) Pb - 89 (avg) As - < 22	Mn – 2260 Pb – 97.7 As – 4.1
LL1ss-429-1409-SO	Mn - 1495 (avg) Pb - 46 (avg) As - <27	Mn – 3380 Pb – 32.9 As – 8.8
LL1ss-434-1414-SO	Mn - 1530 (avg) Pb - 32.5 As - <17	Mn – 2530 Pb – 13.2 As – 13.1
LL1ss-435-1415-SO	Mn - 1041 (avg) Pb - 36.6 As - <25	Mn – 1460 Pb – 14.3 As – 7.8

The manganese values were higher in the results obtained by ICP. Lead values are primarily even and arsenic values are all below the XRF detection limit. There are several factors that cause the wide difference between the manganese ICP result and the XRF result. For purposes of this discussion it should be noted that the sample preparation for ICP analysis is more rigorous and based upon dry weight. The XRF analysis has minimal sample preparation and based upon wet weight. The same soil sample was used for the analysis by XRF and ICP. Also the XRF reports a result associated with a calculated error. The error for manganese can be as much as 100 to 400 mg/kg. The error is calculated by the instrument and factors in the interferences causes by other metals in the sample. So the result of 1,235 mg/kg could be as much as 1,635 mg/kg. The decision making processes used in the field included the use of the error prior to receiving the rush results. With respect to the decision process the correct decision was made for all samples for exceeding the action level of 1,495 mg/kg manganese.

The XRF was operated briefly on November 12, 2004. Again the manganese result of the Medium standard was elevated, but the High standard was at the 10% level above the known standard.

Work continued on November 15, 2004. The High standard was well within control limits for manganese and lead. Manganese was slightly elevated for the Medium standard and lead was well within control limit. The High standard analyzed at the end of the analysis was well within control limits for manganese and lead.

On November 16, 2004, PCB samples were run and limited samples were analyzed by XRF. The High standard was elevated for manganese at 10%. Lead was within control limits. Lead was within control limits for the Medium Standard while manganese was more than double the known value in two consecutive readings. The only difference from the day before was the replacement of the charge battery. The analysis occurred at the end of the day. The same result occurred on November 17, 2004. NITON was contacted to determine what was causing the instrument to suddenly become highly sensitive for manganese but not for lead.

The technical support person for NITON indicated that manganese is a difficult element to analyze due to numerous interferences. Because of these interferences the detection limit is high.

For the 702 Model the manganese detection at a source reading of two minutes is 1,600 mg/kg. This value is above the project action level. The apparent readings, below this value, are considered estimated at best and should be used in conjunction with the error. The error for this analyte is approximately 100 to 400 mg/kg. So a reading of 1,000 mg/kg could be 600 to 1,400 mg/kg. The particular instrument currently in use at the time was a low resolution instrument. The technical support person indicated that a high resolution model 702S is more appropriate for the analysis of manganese. Additionally, NITON indicated that the correlation will be much improved if the samples are ground to a fine powder. The 702S will provide a detection limit of approximately 700 mg/kg at a source time of two minutes. This value is half the project action level and will provide sufficient detection for manganese. Additionally, the improved sample preparation will provide a better correlation between XRF and ICP.

The new model 702S was sent to the site on November 18, 2004. Based on previous discussions with USACE and Ohio EPA personnel, it was agreed that a portion of the samples previously submitted to the laboratory for manganese would be returned to the site for additional sample preparation (longer grinding and homogenization period) and re-screening for manganese using the 702S model. The screened samples would then be re-submitted to the laboratory for manganese analysis so that a correlation between the laboratory results and the field screening results using the 702S model on the same sample could be evaluated. A total of five samples were re-analyzed. Improved correlations between the XRF and laboratory results were noted in using the 702S model. In addition, a direct reading could be determined for the manganese medium calibration check sample by 702S Model whereas a range was observed for the 702 Model. Field and laboratory screening results for the five samples for manganese and lead are presented on Tables A-2 and A-3 below. Correlation results for samples collected from LLs 1-4 are shown on Table B-2 in Appendix B.

Selected samples were re-analyzed with the 702S model XRF from NITON. The table of results comparing field analysis by 702 and 702S and fixed-base lab by ICP are provided in the following tables.

Table A-2. Manganese Field Screening Results

Sample ID	Data Analyzed	Manganese by 702	Manganese by 702S	Manganese by ICP	RPD 702 vs ICP	RPD 702S vs ICP
LL1ss-441-1422	12/1/2005		685	629	11%	9%
	11/11/2005	565				
LL1ss-442-1423	12/1/2005		1010	740	9%	31%
	11/11/2005	806				
LL1ss-443-1424	12/1/2005		922	657	36%	34%
	11/11/2005	949				
LL1ss-444-1425	12/1/2005		567	375	62%	41%
	11/11/2005	711				
LL1ss-461-1446	11/22/2005		572	1020	97%	56%
	11/15/2005	2960				
Soils analyzed by 702 were not ground						
Soils analyzed by 702S were ground						

Table A-3. Lead Field Screening Results

Sample ID	Data Analyzed	Lead by 702	Lead by 702S
LL1ss-441-1422	12/1/2005		25
	11/11/2005	<30	
LL1ss-442-1423	12/1/2005		19.8
	11/11/2005	43	
LL1ss-443-1424	12/1/2005		22.2
	11/11/2005	30	
LL1ss-444-1425	12/1/2005		15.5
	11/11/2005	<32	
LL1ss-461-1446	11/22/2005		21.2
	11/15/2005	51.9	
Soils analyzed by 702 were not ground			
Soils analyzed by 702S were ground			

Appendix B

November 2004 Soil Sampling Data

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TABLE B-1
Status of Extent
November 2004 Sampling Event
Ravenna Army Ammunition Plant, Ravenna, Ohio

Sample ID	Original Station ID	Direction	Distance (ft)	Analyte	XRF Metals (mg/kg)	Kemron Metals (mg/kg)	Ensys TNT/RDX (mg/kg)	Kemron TNT/RDX (mg/kg)	Ensys PCB (mg/kg)	Kemron PCB (mg/kg)	Status
LL1ss-442-1423-SO	LL1-008	E	10	Manganese	1010	740					Defined extent
LL1ss-441-1422-SO	LL1-008	N	10	Manganese	565	629					
LL1ss-443-1424-SO	LL1-008	S	10	Manganese	922	657					
LL1ss-444-1425-SO	LL1-008	W	10	Manganese	567	375					
LL1ss-009-1464-SO	LL1-009	at location	depth	--	No sample collected, concrete						LL1-009 is located on top of a concrete pad 3"-9" below settled soils, paint chips visible
LL1ss-478-1466-SO	LL1-009	NW	8	Lead	4840		Continuing NW goes into concrete structure				Extent limited by physical barrier
LL1ss-479-1469-SO	LL1-068	SE	10	Manganese	3360						Defined extent
LL1ss-481-1471-SO	LL1-068	SE	20	Manganese	448	426					
LL1ss-435-1415-SO	LL1-111	NW	10	Manganese	1041	1460					NW direction not defined
LL1ss-434-1414-SO	LL1-112	NW	10	Manganese	1530	2530	No Stepouts as directed				NW direction not defined
LL1ss-433-1413-SO	LL1-113	NW	10	Manganese	1145						Defined extent
LL1ss-429-1409-SO	LL1-117	SE	10	Manganese	1495	3380	No Stepouts as directed				SE direction not defined
LL1ss-430-1410-SO	LL1-118	NW	10	Manganese	1635		No Stepouts as directed				NW direction not defined
LL1ss-432-1412-SO	LL1-119	NW	10	Manganese	2715						Extent not defined
LL1ss-475-1460-SO	LL1-119	NW	20	Manganese	2870						
LL1ss-483-1473-SO	LL1-119	NW	30	Manganese	1390	1850					
LL1ss-431-1411-SO	LL1-119	SE	10	Manganese	3240						
LL1ss-474-1459-SO	LL1-119	SE	20	Manganese	2680						
LL1ss-482-1472-SO	LL1-119	SE	30	Manganese	1350	2000					
LL1ss-148-1441-SO	LL1-148	at location	depth	PCB					> 35		Defined extent
LL1ss-148-1442-SO	LL1-148	at location	depth	PCB					< 25	0.8	
LL1ss-148-1443-SO	LL1-148	at location	depth	--	Not needed						
LL1ss-455-1436-SO	LL1-148	NE	10	PCB					< 25	11.7	
LL1ss-456-1437-SO	LL1-148	NW	10	PCB					< 25	3.1	
LL1ss-157-1463-SO	LL1-157	at location	depth	RDX			1.25	< 1.09			Defined extent
LL1ss-157-1463-SO	LL1-157	at location	depth	TNT			0.28	9.81			
LL1ss-471-1456-SO	LL1-157	NE	10	RDX			2.10	< 1.26			
LL1ss-471-1456-SO	LL1-157	NE	10	TNT			29.55	0.80			
LL1ss-470-1455-SO	LL1-157	NW	10	RDX			5.67	11.40			
LL1ss-470-1455-SO	LL1-157	NW	10	TNT			66.48	2.69			
LL1ss-457-1438-SO	LL1-158	NW	10	Lead, PCB	1745				> 35		Defined extent
LL1ss-473-1458-SO	LL1-158	NW	20	PCB					< 25	0.03	
LL1ss-423-1402-SO	LL1-205	E	10	Manganese	< 560	1070					Defined extent in E direction
LL1ss-422-1401-SO	LL1-205	N	10	Manganese	744	1860					N, S, W directions not defined
LL1ss-424-1403-SO	LL1-205	S	10	Manganese	761	2580					
LL1ss-425-1404-SO	LL1-205	W	10	Manganese	2285						
LL1ss-458-1439-SO	LL1-205	W	20	Manganese	3255						
LL1ss-484-1474-SO	LL1-205	W	30	Manganese	1900	2780					
LL1ss-437-1417-SO	LL1-253	E	10	Chrom, hex		<0.0242	Hexavalent Chromium				Defined extent
LL1ss-436-1416-SO	LL1-253	N	10	Chrom, hex		<0.0254	Hexavalent Chromium				
LL1ss-438-1418-SO	LL1-253	S	10	Chrom, hex		<0.0250	Hexavalent Chromium				
LL1ss-439-1419-SO	LL1-253	W	9	Chrom, hex		0.0852	Hexavalent Chromium				

TABLE B-1
Status of Extent
November 2004 Sampling Event
Ravenna Army Ammunition Plant, Ravenna, Ohio

Sample ID	Original Station ID	Direction	Distance (ft)	Analyte	XRF Metals (mg/kg)	Kemron Metals (mg/kg)	Ensys TNT/RDX (mg/kg)	Kemron TNT/RDX (mg/kg)	Ensys PCB (mg/kg)	Kemron PCB (mg/kg)	Status
LL1ss-447-1428-SO	LL1-288	E	10	Manganese	1035	655					Defined extent
LL1ss-446-1427-SO	LL1-288	N	10	Manganese	746	517					
LL1ss-448-1429-SO	LL1-288	S	10	Manganese	< 590	502					
LL1ss-449-1430-SO	LL1-288	W	10	Manganese	1024	1070					
LL1ss-459-1440-SO	LL1-325	at location	depth	TNT			29.55				Defined extent
LL1ss-357-1467-SO	LL1-357	at location	depth	RDX			6.52	19.3			Depth not defined for TNT
LL1ss-357-1467-SO	LL1-357	at location	depth	TNT			1173	2400			
LL1ss-480-1470-SO	LL1-357	ENE	10	RDX			3.86	0.42			
LL1ss-480-1470-SO	LL1-357	ENE	10	TNT			354.55	441			
LL1ss-469-1454-SO	LL1-357	NE	10	RDX			424.23				Stepout obstruction, moved to
LL1ss-469-1454-SO	LL1-357	NE	10	TNT			16161.99				LL1ss-480
LL1ss-466-1451-SO	LL1-397	E	10	Manganese	810	1200					S direction not defined
LL1ss-465-1450-SO	LL1-397	N	10	Manganese	556	394					
LL1ss-467-1452-SO	LL1-397	S	10	Manganese	1100	1740					
LL1ss-468-1453-SO	LL1-397	W	10	Manganese	918	584					
LL1ss-462-1447-SO	LL1-399	E	10	Manganese	624	1250					S direction not defined
LL1ss-461-1446-SO	LL1-399	N	10	Manganese	572	1020					
LL1ss-476-1461-SO	LL1-399	N	20	Manganese	988	783					
LL1ss-463-1448-SO	LL1-399	S	10	Manganese	1170	1800					
LL1ss-464-1449-SO	LL1-399	W	10	Manganese	1010	960					
LL1ss-427-1406-SO	LL1-409	E	10	Manganese	< 450	378					N direction not defined
LL1ss-426-1405-SO	LL1-409	N	10	Manganese	1235	2260					
LL1ss-445-1426-SO	LL1-409	N	20	Manganese	1630						
LL1ss-428-1408-SO	LL1-409	S	10	Manganese	614.5	1000					
LL1ss-452-1433-SO	LL1sd-060	E	10	Arsenic	26	43.3					E direction not defined
LL1ss-450-1431-SO	LL1sd-060	N	10	Arsenic	35.5	66.3					
LL1ss-477-1462-SO	LL1sd-060	N	20	Arsenic	15.8	12.4					
LL1ss-453-1434-SO	LL1sd-060	S	10	Arsenic	< 18	11.8					
LL1ss-454-1435-SO	LL1sd-060	W	10	Arsenic	25.2	17.8					
LL2ss-296-1252-SO	LL2-086	N	10	TNT			37.30	1.58			Defined extent
LL2ss-299-1256-SO	LL2-094	E	10	TNT			0.68	< 0.271			Defined extent
LL2ss-298-1255-SO	LL2-094	NW	10	TNT			14.77	< 0.316			
LL2ss-101-1230-SO	LL2-101	at location	depth	Manganese	1720						Defined extent
LL2ss-101-1231-SO	LL2-101	at location	depth	Manganese	577	397					
LL2ss-277-1232-SO	LL2-101	NW	10	Manganese	<390	213					
LL2ss-280-1235-SO	LL2-101	SE	10	Manganese	538	905					
LL2ss-279-1234-SO	LL2-101	W	10	Manganese	< 270	241					
LL2ss-281-1236-SO	LL2-104	NE	10	Manganese	603	854					Defined extent
LL2ss-283-1238-SO	LL2-104	NW	10	Manganese	1460	1210					
LL2ss-282-1237-SO	LL2-104	SE	10	Manganese	1030	1340					
LL2ss-275-1228-SO	LL2-166	SE	10	Manganese		449					
LL2ss-275-1228-SO	LL2-166	SE	10	Lead, PCB		44.2			< 25	0.46	Defined extent
LL2ss-276-1229-SO	LL2-167	NW	10	Arsenic	<29	5.47					
LL2ss-276-1229-SO	LL2-167	NW	10	Manganese		528					
LL2ss-276-1229-SO	LL2-167	NW	10	Lead, PCB		53.5			< 25	0.724	Defined extent

TABLE B-1
Status of Extent
November 2004 Sampling Event
Ravenna Army Ammunition Plant, Ravenna, Ohio

Sample ID	Original Station ID	Direction	Distance (ft)	Analyte	XRF Metals (mg/kg)	Kemron Metals (mg/kg)	Ensys TNT/RDX (mg/kg)	Kemron TNT/RDX (mg/kg)	Ensys PCB (mg/kg)	Kemron PCB (mg/kg)	Status
LL2ss-295-1251-SO	LL2-178	SE	10	Lead	53	76.5					Defined extent
LL2ss-294-1249-SO	LL2-188	SE	10	Lead	1200	1020					
LL2ss-294-1249-SO	LL2-188	SE	10	Chrom, hex		<0.216					Defined extent
LL2ss-291-1246-SO	LL2-232	S	19	Manganese	428	440					Defined extent
LL2ss-292-1247-SO	LL2-232	W	10	Manganese	853	740					
LL2ss-293-1248-SO	LL2-243	NW	10	Lead	32.9	58.1					Defined extent
LL2ss-014-1266-SO	LL2ss-014	at location	depth	RDX			0.85	< 1.11			Defined extent
LL2ss-014-1267-SO	LL2ss-014	at location	depth	--	Not needed						
LL2ss-014-1268-SO	LL2ss-014	at location	depth	--	Not needed						
LL2ss-301-1258-SO	LL2ss-014	NW	10	RDX			1.59	< 1.25			
LL2ss-300-1257-SO	LL2ss-014	W	10	RDX			1.02	< 1.15			
LL2ss-302-1259-SO	LL2ss-014	W	10	RDX			1.81	< 1.16			
LL2ss-285-1240-SO	LL2ss-031	NE	17.5	Manganese	1560						NW direction not defined
LL2ss-305-1262-SO	LL2ss-031	NE	27.5	Manganese	344	228					
LL2ss-284-1239-SO	LL2ss-031	NW	10	Manganese	2200						
LL2ss-306-1263-SO	LL2ss-031	NW	20	Manganese	1800	2450					
LL2ss-287-1242-SO	LL2ss-032	E	10	Manganese	875.5	864					NE direction not defined
LL2ss-286-1241-SO	LL2ss-032	NE	10	Manganese	1560	1980					
LL2ss-289-1244-SO	LL2ss-032	S	10	Manganese	982	956					
LL2ss-288-1243-SO	LL2ss-032	SE	10	Manganese	725.5	681					
LL2ss-044-1262-SO	LL2ss-044	at location	depth	TNT			0.20	< 0.277			Defined extent
LL2ss-044-1263-SO	LL2ss-044	at location	depth	--	Not needed						
LL2ss-044-1264-SO	LL2ss-044	at location	depth	--	Not needed						
LL2ss-044-1265-SO	LL2ss-044	at location	depth	--	Not needed						
LL2ss-304-1261-SO	LL2ss-044	E	16	TNT			108.14	< 0.271			
LL2ss-303-1260-SO	LL2ss-044	N	27	TNT			1.12	< 0.313			
LL3ss-046-1237-SO	LL3-046(p2)	at location	depth	Manganese	1640	769					S and W directions not defined
LL3ss-252-1183-SO	LL3-046(p2)	E	10	Manganese	939	1380					
LL3ss-251-1182-SO	LL3-046(p2)	N	10	Manganese	501	515					
LL3ss-253-1184-SO	LL3-046(p2)	S	10	Manganese	1445	1590					
LL3ss-254-1185-SO	LL3-046(p2)	W	10	Manganese	3730						
LL3ss-259-1190-SO	LL3-046(p2)	W	10	Manganese	3520						
LL3ss-308-1250-SO	LL3-046(p2)	W	20	Manganese	1910	2010					
LL3ss-049-1235-SO	LL3-049(p2)	at location	depth	Manganese	1250	1640					Depth not defined
LL3ss-049-1236-SO	LL3-049(p2)	at location	depth	--	Not needed						
LL3ss-271-1203-SO	LL3-049(p2)	NE	10	Manganese	1900						
LL3ss-307-1249-SO	LL3-049(p2)	NE	20	Manganese	907	1470					
LL3ss-272-1204-SO	LL3-049(p2)	SW	10	Manganese	1490						
LL3ss-247-1175-SO	LL3-077	NW	10	Manganese		843					Defined extent
LL3ss-247-1175-SO	LL3-077	NW	10	Lead, PCB		328			< 25	11.5	
LL3ss-246-1174-SO	LL3-077	SE	10	Manganese	841.5	784					
LL3ss-246-1174-SO	LL3-077	SE	10	Lead, PCB	318	751			< 25	6.1	

TABLE B-1
Status of Extent
November 2004 Sampling Event
Ravenna Army Ammunition Plant, Ravenna, Ohio

Sample ID	Original Station ID	Direction	Distance (ft)	Analyte	XRF Metals (mg/kg)	Kemron Metals (mg/kg)	Ensys TNT/RDX (mg/kg)	Kemron TNT/RDX (mg/kg)	Ensys PCB (mg/kg)	Kemron PCB (mg/kg)	Status
LL3ss-261-1192-SO	LL3-097	NE	10	Manganese	2160						Extent not defined
LL3ss-303-1244-SO	LL3-097	NE	20	Manganese	2910						
LL3ss-310-1252-SO	LL3-097	NE	30	Manganese	2180	4570					
LL3ss-260-1191-SO	LL3-097	NW	10	Manganese	2760						
LL3ss-309-1251-SO	LL3-097	NW	20	Manganese	1090	1930					
LL3ss-102-1212-SO	LL3-102	at location	depth	Manganese, PCB	992	1050			> 35	154	Depth not defined for PCBs
LL3ss-280-1213-SO	LL3-102	NE	10	Manganese, PCB	2860				> 35	563	
LL3ss-293-1227-SO	LL3-102	NE	20	Manganese, PCB	1200	1350			> 35	191	
LL3ss-297-1238-SO	LL3-102	NE	30	Manganese, PCB	1150	500				11.9	
LL3ss-249-1180-SO	LL3-149	NE	9	Manganese	1480	668					SW direction not defined
LL3ss-250-1181-SO	LL3-149	SW	10	Manganese	2020						
LL3ss-299-1239-SO	LL3-149	SW	20	Manganese	1480	2750					
LL3ss-277-1209-SO	LL3-150	NE	10	Manganese	306	374					Defined extent
LL3ss-279-1211-SO	LL3-150	NW	10	Manganese	2680						
LL3ss-305-1246-SO	LL3-150	NW	20	Manganese	609	214					
LL3ss-278-1210-SO	LL3-150	SW	10	Manganese	878	1420					
LL3ss-267-1199-SO	LL3-153	NE	10	Manganese	469	611					Extent not defined with depth
LL3ss-269-1201-SO	LL3-158	E	10	Manganese	5740						E direction not defined
LL3ss-301-1242-SO	LL3-158	E	20	Manganese	4510						
LL3ss-311-1253-SO	LL3-158	E	30	Manganese	4620	4490					
LL3ss-268-1200-SO	LL3-158	N	10	Manganese	3160						
LL3ss-300-1240-SO	LL3-158	N	20	Manganese	716	1080					
LL3ss-256-1187-SO	LL3-173	E	10	Manganese	609	870					Defined extent
LL3ss-248-1179-SO	LL3-173	N	10	Manganese	422	750					
LL3ss-257-1188-SO	LL3-173	S	10	Manganese	862	673					
LL3ss-258-1189-SO	LL3-173	W	10	Manganese	687	1240					
LL3ss-288-1222-SO	LL3-230	NE	10	TNT			0.70	< 0.267			Defined extent
LL3ss-290-1224-SO	LL3-230	SE	10	TNT			14.77	< 0.283			
LL3ss-291-1225-SO	LL3-231	NE	10	TNT			0.82	< 0.265			Defined extent
LL3ss-292-1226-SO	LL3-231	NW	10	TNT			5.20	1.22			
LL3ss-002-1176-SO	LL3ss-002	at location	depth	TNT			3492.83	2780			Defined extent
LL3ss-002-1177-SO	LL3ss-002	at location	depth	TNT				303			
LL3ss-282-1215-SO	LL3ss-002	NE	10	TNT			22.16	< 0.285			
LL3ss-283-1216-SO	LL3ss-002	SE	10	TNT			29.55	< 0.280			
LL3ss-012-1231-SO	LL3ss-012	at location	depth	TNT			0.38	< 0.265			Defined extent
LL3ss-012-1232-SO	LL3ss-012	at location	depth	--	Not needed						
LL3ss-012-1233-SO	LL3ss-012	at location	depth	--	Not needed						
LL3ss-294-1229-SO	LL3ss-012	NE	10	TNT			42.42	148			
LL3ss-295-1230-SO	LL3ss-012	SE	10	TNT			5.24	32			
LL3ss-263-1194-SO	LL3ss-021	NE	10	Manganese	4100						Extent not defined
LL3ss-302-1243-SO	LL3ss-021	NE	20	Manganese	1160	3350					
LL3ss-262-1193-SO	LL3ss-021	NW	10	Manganese	1210	1680					
LL3ss-265-1196-SO	LL3ss-022	NE	10	Manganese	1090	1020					NW direction not defined
LL3ss-264-1195-SO	LL3ss-022	NW	10	Manganese	2730						
LL3ss-304-1245-SO	LL3ss-022	NW	20	Manganese	1900	3740					

TABLE B-1
Status of Extent
November 2004 Sampling Event
Ravenna Army Ammunition Plant, Ravenna, Ohio

Sample ID	Original Station ID	Direction	Distance (ft)	Analyte	XRF Metals (mg/kg)	Kemron Metals (mg/kg)	Ensys TNT/RDX (mg/kg)	Kemron TNT/RDX (mg/kg)	Ensys PCB (mg/kg)	Kemron PCB (mg/kg)	Status
LL3ss-286-1219-SO	LL3ss-034	E	10	TNT			0.60	< 0.323			Defined extent
LL3ss-285-1218-SO	LL3ss-034	S	10	TNT			37.29	0.415			
no sample	LL3sd-049(d)	at location	depth	--	Refusal						Defined extent
LL3ss-273-1205-SO	LL3ss-049(d)	NE	10	Manganese	1150	884					
LL3ss-274-1206-SO	LL3ss-049(d)	SE	10	Manganese	647	806					
LL3ss-275-1207-SO	LL3ss-049(d)	SW	10	Manganese	802	937					
LL4ss-080-1194-SO	LL4-080	at location	depth	Manganese	7005						Depth defined by refusal
LL4ss-080-1195-SO	LL4-080	at location	depth	--	Not Tested - all rock						SW sample below RR slag
LL4ss-080-1996-SO	LL4-080	at location	depth	--	Not Tested - all rock						Extent not defined for Al
LL4ss-195-1200-SO	LL4-080	SW	10	Manganese/Aluminum	310/NA	203/15700					
LL4ss-081-1197-SO	LL4-081	at location	depth	Manganese	8810						Depth defined by refusal
LL4ss-081-1198-SO	LL4-081	at location	depth	--	Not Tested - all rock						Defined extent for Mn
LL4ss-081-1199-SO	LL4-081	at location	depth	--	Not Tested - all rock						Extent not defined for Al
LL4ss-196-1201-SO	LL4-081	NE	10	Manganese	967	670					
LL4ss-200-1206-SO	LL4-088	NE	10	Manganese	562	566					NE direction not defined for Al
LL4ss-202-1209-SO	LL4-088	NW	10	Manganese/Aluminum	407/NA	387/2960					Depth not defined
LL4ss-201-1207-SO	LL4-088	SE	10	Manganese/Aluminum	884/NA	845/12900					
LL4ss-118-1191-SO	LL4-118	at location	depth	Lead	40.8	38					Defined extent
LL4ss-118-1192-SO	LL4-118	at location	depth	Lead	12.4						
LL4ss-118-1193-SO	LL4-118	at location	depth	--	Not needed						
LL4ss-197-1202-SO	LL4-118	NE	10	Lead	29.7	42.8					
LL4ss-199-1205-SO	LL4-118	NW	10	Lead	102.5	148					
LL4ss-133-1187-SO	LL4-133	at location	depth	PCB					< 25	0.078	Defined extent
LL4ss-133-1188-SO	LL4-133	at location	depth	--	Not needed						
LL4ss-133-1189-SO	LL4-133	at location	depth	--	Not needed						
LL4ss-194-1186-SO	LL4-133	NW	10	PCB					< 25	0.13	
LL4ss-193-1185-SO	LL4-133	SW	10	PCB					< 25		

Notes:
(green) Extent defined based on comparison to cutoff criteria
(pink) Extent not defined or refusal
XRF metals - Average of field screening results for metals/various analyses
Kemron - fixed laboratory results
Ensys TNT/RDX - Field screening results for TNT and/or RDX
Ensys PCBs - Field screening results for PCBs
NA - not analyzed

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TABLE B-2
Summary of Field Screening and Laboratory Analysis - Metals
November 2004 Sampling Event
Ravenna Army Ammunition Plant, Ravenna, Ohio

Sample ID	Original Station ID	Analytes	XRF Result 1 (mg/kg)	XRF Result 2 (mg/kg)	XRF Average Result	XRF RPD	Comment	Kemron Result	XRF vs. laboratory RPD	NOTE
LL1ss-009-1464-SO	LL1-009	Lead	Concrete pad - no sample					No sample collected		
LL1ss-422-1401-SO	LL1-205	Manganese	< 590	744	744		Old NITON	1860	21%	
LL1ss-422-1401-SO		Lead						52.7		
LL1ss-422-1401-SO		Arsenic						14.1		
LL1ss-423-1402-SO	LL1-205	Manganese	< 560	< 560	< 560		Old NITON	1070	29%	1
LL1ss-423-1402-SO		Lead						35.2		
LL1ss-423-1402-SO		Arsenic						21.1		
LL1ss-424-1403-SO	LL1-205	Manganese	761	< 450	761		Old NITON	2580	27%	
LL1ss-424-1403-SO		Lead						43.7		
LL1ss-424-1403-SO		Arsenic						28.5		
LL1ss-425-1404-SO	LL1-205	Manganese	2450	2120	2285	14%	Old NITON	Above RGO, not sent to the lab		
LL1ss-426-1405-SO	LL1-409	Manganese	1300	1170	1235	11%	Old NITON	2260	15%	
LL1ss-426-1405-SO		Lead						97.7		
LL1ss-426-1405-SO		Arsenic						4.06		
LL1ss-427-1406-SO	LL1-409	Manganese	< 450	< 450	< 450		Old NITON	378	13%	1
LL1ss-427-1406-SO		Lead						41.1		
LL1ss-427-1406-SO		Arsenic						5.79		
LL1ss-428-1408-SO	LL1-409	Manganese	528	701	614.5	28%	Old NITON	1000	12%	
LL1ss-428-1408-SO		Lead						71.9		
LL1ss-428-1408-SO		Arsenic						7.43		
LL1ss-429-1409-SO	LL1-117	Manganese	1700	1290	1495	27%	Old NITON	3380	19%	
LL1ss-429-1409-SO		Lead						32.9		
LL1ss-429-1409-SO		Arsenic						8.84		
LL1ss-430-1410-SO	LL1-118	Manganese	1810	1460	1635	21%	Old NITON	Above RGO, not sent to the lab		
LL1ss-431-1411-SO	LL1-119	Manganese	3400	3080	3240	10%	Old NITON	Above RGO, not sent to the lab		
LL1ss-432-1412-SO	LL1-119	Manganese	2730	2700	2715	1%	Old NITON	Above RGO, not sent to the lab		
LL1ss-433-1413-SO	LL1-113	Manganese	1210	1080	1145	11%	Old NITON			
LL1ss-434-1414-SO	LL1-112	Manganese	1550	1510	1530	3%	Old NITON	2530	12%	
LL1ss-434-1414-SO		Arsenic						13.1		
LL1ss-434-1414-SO		Lead						13.2		
LL1ss-435-1415-SO	LL1-111	Manganese	1090	991	1040.5	10%	Old NITON	1460	8%	
LL1ss-435-1415-SO		Arsenic						7.75		
LL1ss-435-1415-SO		Lead						14.3		
LL1ss-436-1416-SO	LL1-253	Chromium, Hex						<0.0254		
LL1ss-437-1417-SO	LL1-253	Chromium, Hex						<0.0242		
LL1ss-438-1418-SO	LL1-253	Chromium, Hex						<0.0250		
LL1ss-439-1419-SO	LL1-253	Chromium, Hex						0.0852		
LL1ss-440-1420-SO	LL1-253	Chromium, Hex						0.036		
LL1ss-441-1422-SO	LL1-008	Manganese	685		565		(565) Old NITON	629	3%	

TABLE B-2
Summary of Field Screening and Laboratory Analysis - Metals
November 2004 Sampling Event
Ravenna Army Ammunition Plant, Ravenna, Ohio

Sample ID	Original Station ID	Analytes	XRF Result 1 (mg/kg)	XRF Result 2 (mg/kg)	XRF Average Result	XRF RPD	Comment	Kemron Result	XRF vs. laboratory RPD	NOTE
LL1ss-441-1422-SO		Arsenic						10.9		
LL1ss-441-1422-SO		Lead						22.1		
LL1ss-442-1423-SO	LL1-008	Manganese	1010		1010		(849) Old NITON	740	8%	
LL1ss-443-1424-SO	LL1-008	Manganese	922		922		(942) Old NITON	657	8%	
LL1ss-444-1425-SO	LL1-008	Manganese	567		567		(711) Old NITON	375	10%	
LL1ss-445-1426-SO	LL1-409	Manganese	1620	1640	1630	1%	Old NITON	Above RGO, not sent to the lab		
LL1ss-446-1427-SO	LL1-288	Manganese	768	724	746	6%	Old NITON	517	9%	
LL1ss-447-1428-SO	LL1-288	Manganese	1050	1020	1035	3%	Old NITON	655	11%	
LL1ss-448-1429-SO	LL1-288	Manganese	< 590	< 560	< 590		Old NITON	502	13%	1
LL1ss-449-1430-SO	LL1-288	Manganese	1150	898	1024	25%	Old NITON	1070	1%	
LL1ss-450-1431-SO	LL1sd-060	Arsenic	42.1	28.9	35.5	37%	Old NITON	66.3	15%	
LL1ss-451-1432-SO	LL1sd-060	Arsenic	29.7	32.9	31.3	10%	Old NITON	Above RGO, not sent to the lab		
LL1ss-452-1433-SO	LL1sd-060	Arsenic	26	< 23	26		Old NITON	43.3	12%	
LL1ss-453-1434-SO	LL1sd-060	Arsenic	< 16	< 18	< 18		Old NITON	11.8	1%	1
LL1ss-454-1435-SO	LL1sd-060	Arsenic	25.2		25.2			17.8	9%	
LL1ss-457-1438-SO	LL1-158	Lead	1780	1710	1745	4%	Old NITON	Exceeded PCB, not sent to lab		
LL1ss-458-1439-SO	LL1-205	Manganese	3210	3300	3255	3%	Old NITON	Above RGO, not sent to the lab		
LL1ss-460-1445-SO	LL1-205	Manganese	Duplicate of LL1ss-458-1439, sample disgarded prior to analysis and split to QA/Kemron Labs							
LL1ss-461-1446-SO	LL1-399	Manganese	572		572		(2960/3570) old NITON	1020	14%	
LL1ss-462-1447-SO	LL1-399	Manganese	624		624			1250	17%	
LL1ss-463-1448-SO	LL1-399	Manganese	1170		1170			1800	11%	
LL1ss-464-1449-SO	LL1-399	Manganese	1010		1010			960	1%	
LL1ss-465-1450-SO	LL1-397	Manganese	605	507	556	18%		394	9%	
LL1ss-466-1451-SO	LL1-397	Manganese	810		810			1200	10%	
LL1ss-467-1452-SO	Lab Dup	Manganese	1140	1170	1155	3%	35%	1740	10%	
LL1ss-467-1452-SO	LL1-397	Manganese	1090	1110	1100	2%	Dup RPD	1740	11%	
LL1ss-468-1453-SO	LL1-397	Manganese	918		918			584	11%	
LL1ss-473-1458-SO	LL1-158	Manganese	19.7		19.7			3800	49%	
LL1ss-474-1459-SO	LL1-119	Manganese	2680		2680			Above RGO, not sent to the lab		
LL1ss-475-1460-SO	LL1-119	Manganese	2870		2870			Above RGO, not sent to the lab		
LL1ss-476-1461-SO	LL1-399	Manganese	988		988			783	6%	
LL1ss-477-1462-SO	LL1sd-060	Arsenic	14.3	17.3	15.8	19%		12.4	6%	
LL1ss-478-1466-SO	LL1-009	Lead	4840		4840			Above RGO, not sent to the lab		
LL1ss-479-1469-SO	LL1-068	Manganese	3360		3360			Above RGO, not sent to the lab		
LL1ss-481-1471-SO	LL1-068	Manganese	448		448			426	1%	
LL1ss-482-1472-SO	LL1-119	Manganese	1350		1350			2000	10%	
LL1ss-483-1473-SO	LL1-119	Manganese	1390		1390			1850	7%	
LL1ss-484-1474-SO	LL1-205	Manganese	1900		1900			2780	9%	
LL2ss-101-1230-SO	LL2-101	Manganese	1790	1650	1720	8%	Old NITON	Above RGO, not sent to the lab		

Prepared by PC on 1/7/05
QA/QC by MS on 1/24/05

TABLE B-2
Summary of Field Screening and Laboratory Analysis - Metals
November 2004 Sampling Event
Ravenna Army Ammunition Plant, Ravenna, Ohio

Sample ID	Original Station ID	Analytes	XRF Result 1 (mg/kg)	XRF Result 2 (mg/kg)	XRF Average Result	XRF RPD	Comment	Kemron Result	XRF vs. laboratory RPD	NOTE
LL2ss-101-1231-SO	LL2-101	Manganese	577		577			397	9%	
LL2ss-275-1228-SO	LL2-166	Manganese	Sent to Kemron, PCB, prior to analysis					449		
LL2ss-275-1228-SO	LL2-166	Lead	Sent to Kemron, PCB, prior to analysis					44.2		
LL2ss-276-1229-SO	LL2-167	Manganese	Sent to Kemron, PCB, prior to analysis					528		
LL2ss-276-1229-SO	LL2-167	Lead	Sent to Kemron, PCB, prior to analysis					53.5		
LL2ss-276-1229-SO	LL2-167	Arsenic	< 28	< 29	<29		Old NITON	5.47		
LL2ss-276-1229-SO		Manganese						528		
LL2ss-276-1229-SO		Lead						53.5		
LL2ss-277-1232-SO	LL2-101	Manganese	< 390	< 290	<390		Old NITON	213	2%	1
LL2ss-278-1233-SO	LL2-101	Manganese	< 470	530	530		Old NITON	211	22%	
LL2ss-279-1234-SO	LL2-101	Manganese	< 270	195	< 270		Old NITON	241	14%	1
LL2ss-280-1235-SO	LL2-101	Manganese	538		538			905	13%	
LL2ss-281-1236-SO	LL2-104	Manganese	603		603			854	9%	
LL2ss-282-1237-SO	LL2-104	Manganese	1030		1030			1340	7%	
LL2ss-283-1238-SO	LL2-104	Manganese	1460		1460			1210	5%	
LL2ss-284-1239-SO	LL2ss-031	Manganese	2200		2200		(2010/1760) Old NITON	Above RGO, not sent to the lab		
LL2ss-285-1240-SO	LL2ss-031	Manganese	1560		1560			Above RGO, not sent to the lab		
LL2ss-286-1241-SO	LL2ss-032	Manganese	1560		1560			1980	6%	
LL2ss-287-1242-SO	LL2ss-032	Manganese	913	838	875.5	9%	Old NITON	864	0%	
LL2ss-287-1242-SO		Lead						21.4		
LL2ss-288-1243-SO	LL2ss-032	Manganese	664	787	725.5	17%	Old NITON	681	2%	
LL2ss-288-1243-SO		Lead						40.5		
LL2ss-289-1244-SO	LL2ss-032	Manganese	982		982			956	1%	
LL2ss-290-1245-SO	LL2ss-032	Manganese	504		504			495	0%	
LL2ss-291-1246-SO	LL2-232	Manganese	428		428			440	1%	
LL2ss-292-1247-SO	LL2-232	Manganese	853		853			740	4%	
LL2ss-293-1248-SO	LL2-243	Lead	32.9		32.9			58.1	14%	
LL2ss-294-1249-SO	LL2-188	Lead	1200		1200			1020	4%	
LL2ss-294-1249-SO		Chromium, Hex						<0.216		
LL2ss-295-1251-SO	LL2-178	Lead	53		53			76.5	9%	
LL2ss-305-1262-SO	LL2-031	Manganese	344		344			228	10%	
LL2ss-306-1263-SO	LL2-031	Manganese	1800		1800			2450	8%	
LL3ss-046-1237-SO	LL3-046(p2)	Manganese	1640		1640			769	18%	
LL3ss-049-1235-SO	LL3-049(p2)	Manganese	1250		1250			1640	7%	
LL3ss-049-1236-SO	LL3-049(p2)	Manganese	Not needed							
LL3ss-102-1212-SO	LL3-102	Manganese	992		992			1050	1%	
LL3ss-246-1174-SO	LL3-077	Manganese	927	756	841.5	20%	Old NITON	784	2%	
LL3ss-246-1174-SO	LL3-077	Lead	345	291	318	17%	Old NITON	751	20%	
LL3ss-247-1175-SO	LL3-077	Manganese	Sent to Kemron, PCB, prior to analysis					843		

Prepared by PC on 1/7/05
QA/QC by MS on 1/24/05

TABLE B-2
Summary of Field Screening and Laboratory Analysis - Metals
November 2004 Sampling Event
Ravenna Army Ammunition Plant, Ravenna, Ohio

Sample ID	Original Station ID	Analytes	XRF Result 1 (mg/kg)	XRF Result 2 (mg/kg)	XRF Average Result	XRF RPD	Comment	Kemron Result	XRF vs. laboratory RPD	NOTE
LL3ss-247-1175-SO	LL3-077	Lead	Sent to Kemron, PCB, prior to analysis					328		
LL3ss-248-1179-SO	LL3-173	Manganese	422		422			750	14%	
LL3ss-249-1180-SO	LL3-149	Manganese	1480		1480			668	19%	
LL3ss-250-1181-SO	LL3-149	Manganese	2000	2040	2020	2%		Above RGO, not sent to the lab		
LL3ss-251-1182-SO	LL3-046(p2)	Manganese	501		501			515	1%	
LL3ss-252-1183-SO	LL3-046(p2)	Manganese	939		939			1380	10%	
LL3ss-253-1184-SO	LL3-046(p2)	Manganese	1480	1410	1445	5%		1590	2%	
LL3ss-254-1185-SO	LL3-046(p2)	Manganese	3730		3730			Above RGO, not sent to the lab		
LL3ss-255-1186-SO	LL3-046(p2)	Manganese	952		952			808	4%	
LL3ss-256-1187-SO	LL3-173	Manganese	609		609			870	9%	
LL3ss-257-1188-SO	LL3-173	Manganese	929	795	862	16%		673	6%	
LL3ss-258-1189-SO	LL3-173	Manganese	687		687			1240	14%	
LL3ss-259-1190-SO	LL3-046(p2)	Manganese	3520		3520			Above RGO, not sent to the lab		
LL3ss-260-1191-SO	LL3-097	Manganese	2760		2760			Above RGO, not sent to the lab		
LL3ss-261-1192-SO	LL3-097	Manganese	2160		2160			Above RGO, not sent to the lab		
LL3ss-262-1193-SO	LL3-097	Manganese	1210		1210			1680	8%	
LL3ss-263-1194-SO	LL3-097	Manganese	4100		4100			Above RGO, not sent to the lab		
LL3ss-264-1195-SO	LL3ss-022	Manganese	2730		2730			Above RGO, not sent to the lab		
LL3ss-265-1196-SO	LL3ss-022	Manganese	1070	1110	1090	4%		1020	2%	
LL3ss-266-1197-SO	LL3ss-022	Manganese	3040		3040			Above RGO, not sent to the lab		
LL3ss-267-1199-SO	LL3ss-153	Manganese	469		469			611	7%	
LL3ss-268-1200-SO	LL3ss-158	Manganese	3160		3160			Above RGO, not sent to the lab		
LL3ss-269-1201-SO	LL3ss-158	Manganese	5790	5690	5740	2%		Above RGO, not sent to the lab		
LL3ss-270-1202-SO	LL3ss-158	Manganese	6000		6000			Above RGO, not sent to the lab		
LL3ss-271-1203-SO	LL3ss-049(p2)	Manganese	1900		1900			Above RGO, not sent to the lab		
LL3ss-272-1204-SO	LL3ss-049(p2)	Manganese	1490		1490					
LL3ss-273-1205-SO	LL3ss-049(d)	Manganese	1150		1150			884	7%	
LL3ss-274-1206-SO	LL3ss-049(d)	Manganese	708	586	647	19%		806	5%	
LL3ss-275-1207-SO	LL3ss-049(d)	Manganese	802		802			937	4%	
LL3ss-276-1208-SO	LL3-150	Manganese	1360		1360			2100	11%	
LL3ss-277-1209-SO	LL3-150	Manganese	306		306			374	5%	
LL3ss-278-1210-SO	LL3-150	Manganese	878		878			1420	12%	
LL3ss-279-1211-SO	LL3-150	Manganese	2680		2680			Above RGO, not sent to the lab		
LL3ss-280-1213-SO	LL3-102	Manganese	2860		2860			Above RGO, not sent to the lab		

TABLE B-2
Summary of Field Screening and Laboratory Analysis - Metals
November 2004 Sampling Event
Ravenna Army Ammunition Plant, Ravenna, Ohio

Sample ID	Original Station ID	Analytes	XRF Result 1 (mg/kg)	XRF Result 2 (mg/kg)	XRF Average Result	XRF RPD	Comment	Kemron Result	XRF vs. laboratory RPD	NOTE
LL3ss-281-1214-SO	LL3-102	Manganese	820		820					
LL3ss-293-1227-SO	LL3-102	Manganese	1200		1200			1350	3%	
LL3ss-297-1238-SO	LL3-102	Manganese	1150		1150			500	20%	
LL3ss-299-1239-SO	LL3-149	Manganese	1480		1480			2750	15%	
LL3ss-300-1240-SO	LL3-158	Manganese	716		716			1080	10%	
LL3ss-301-1242-SO	LL3-158	Manganese	4510		4510			Above RGO, not sent to the lab		
LL3ss-302-1243-SO	LL3-021	Manganese	1160		1160			3350	24%	
LL3ss-303-1244-SO	LL3-097	Manganese	2910		2910			Above RGO, not sent to the lab		
LL3ss-304-1245-SO	LL3-022	Manganese	1900		1900			3740	16%	
LL3ss-305-1246-SO	LL3-150	Manganese	609		609			214	24%	
LL3ss-306-1247-SO	LL3-150	Manganese	559		559			205	23%	
LL3ss-307-1249-SO	LL3-049(p2)	Manganese	907		907			1470	12%	
LL3ss-308-1250-SO	LL3-046(p2)	Manganese	2000	1820	1910	9%		2010	1%	
LL3ss-309-1251-SO	LL3-097	Manganese	1090		1090			1930	14%	
LL3ss-310-1252-SO	LL3-097	Manganese	2180		2180		Third stepout	4570	18%	
LL3ss-311-1253-SO	LL3-158	Manganese	4620		4620		Third stepout	4490	1%	
LL4ss-080-1194-SO	LL4-080	Manganese	7170	6840	7005	5%		Above RGO, not sent to the lab		
LL4ss-080-1195-SO	LL4-080	Manganese	Not tested - all rock							
LL4ss-080-1996-SO	LL4-080	Manganese	Not tested - all rock							
LL4ss-081-1197-SO	LL4-081	Manganese	8810		8810		All rock	Above RGO, not sent to the lab		
LL4ss-081-1198-SO	LL4-081	Manganese	Not tested - all rock							
LL4ss-081-1199-SO	LL4-081	Manganese	Not tested - all rock							
LL4ss-118-1191-SO	LL4-118	Lead	40.8		40.8			38	2%	
LL4ss-118-1192-SO	LL4-118	Lead	12.4		12.4					
LL4ss-118-1193-SO	LL4-118	Lead	Not needed							
LL4ss-195-1200-SO	LL4-080	Manganese	343	278	310.5	21%		203	10%	
LL4ss-195-1200-SO		Aluminium						15,700		
LL4ss-196-1201-SO	LL4-081	Manganese	967		967			670	9%	
LL4ss-197-1202-SO	LL4-118	Lead	29.7		29.7			42.8	9%	
LL4ss-198-1203-SO	LL4-118	Lead	43.2		43.2			44.7	1%	
LL4ss-199-1205-SO	LL4-118	Lead	101	104	102.5	3%		148	9%	
LL4ss-200-1206-SO	LL4-088	Manganese	562		562			566	0%	
LL4ss-201-1207-SO	LL4-088	Manganese	884		884			845	1%	
LL4ss-201-1207-SO		Aluminium						12,900		
LL4ss-202-1209-SO	LL4-088	Manganese	407		407			387	1%	
LL4ss-202-1209-SO		Aluminium						2,960		
LL4ss-203-1210-SO	LL4-088	Manganese	495	403	449	20%		463	1%	
LL4ss-203-1210-SO		Aluminium						2,940		

Prepared by PC on 1/7/05
QA/QC by MS on 1/24/05

TABLE B-2
Summary of Field Screening and Laboratory Analysis - Metals
November 2004 Sampling Event
Ravenna Army Ammunition Plant, Ravenna, Ohio

Sample ID	Original Station ID	Analytes	XRF Result 1 (mg/kg)	XRF Result 2 (mg/kg)	XRF Average Result	XRF RPD	Comment	Kemron Result	XRF vs. laboratory RPD	NOTE

Notes:
RPD - Relative Percent Difference
Blank indicates not analyzed
1. RPD calculated by using half of the XRF field detection limit

Prepared by PC on 1/7/05
QA/QC by MS on 1/24/05

TABLE B-3
Summary of Field Screening and Laboratory Analysis - TNT/RDX
November 2004 Sampling Event
Ravenna Army Ammunition Plant, Ravenna, Ohio

Sample ID	Original Station ID	Analyte	Sample Weight (g)	Extraction Volume	Dilution	Result (mg/kg)	Kemron Result (mg/kg)	RPD Field vs. Laboratory
LL1ss-157-1463-SO	LL1-157	TNT	10	50	1	0.28	9.81	47%
LL1ss-157-1463-SO	LL1-157	RDX	10	50	1	1.25	< 1.09	NA
LL1ss-357-1467-SO	LL1-357	TNT	10	50	100	1173	2400	17%
LL1ss-357-1467-SO		TNT	10	50	100	952		
LL1ss-357-1467-SO	LL1-357	RDX	10	50	1	6.52	19.30	25%
LL1ss-357-1468-SO	LL1-357	TNT	Not needed					
LL1ss-357-1468-SO	LL1-357	RDX	Not needed					
LL1ss-459-1440-SO	LL1-325	TNT	10	50	250	30		
LL1ss-469-1454-SO	LL1-357	TNT	10.1	50	250	16762		
LL1ss-469-1454-SO	Re-Run	TNT	10.1	50	2500	16162		
LL1ss-469-1454-SO	LL1-357	RDX	10	50	110	424		
LL1ss-470-1455-SO	LL1-157	TNT	10	50	250	66.48	2.69	46%
LL1ss-470-1455-SO	LL1-157	RDX	10	50	1	5.67	11.40	17%
LL1ss-471-1456-SO	LL1-157	TNT	10	50	250	29.55	0.80	47%
LL1ss-471-1456-SO	LL1-157	RDX	10	50	1	2.10	< 1.26	NA
LL1ss-472-1457-SO	LL1-157	TNT	10	50	1	10	5.94	13%
LL1ss-472-1457-SO		TNT	10	50	10	15		
LL1ss-472-1457-SO	LL1-157	RDX	10	50	1	3.01	5.20	13%
LL1ss-480-1470-SO	LL1-357	TNT	10	50	100	355	441	5%
LL1ss-480-1470-SO	LL1-357	RDX	10	50	1	4	0.42	40%
LL2ss-014-1266-SO	LL2ss-014	RDX	10	50	1	0.9	< 1.11	NA
LL2ss-014-1267-SO	LL2ss-014	RDX	Not needed					
LL2ss-014-1268-SO	LL2ss-014	RDX	Not needed					
LL2ss-044-1262-SO	LL2ss-044	TNT	10	50	1	0	< 0.277	NA
LL2ss-044-1263-SO	LL2ss-044	TNT	Not needed					
LL2ss-044-1264-SO	LL2ss-044	TNT	Not needed					
LL2ss-044-1265-SO	LL2ss-044	TNT						
LL2ss-296-1252-SO	LL2-086	TNT	9.9	50	250	37	1.58	46%
LL2ss-297-1253-SO	LL2-086	TNT	9.9	50	250	22	0.92	46%
LL2ss-298-1255-SO	LL2-094	TNT	10	50	250	15	< 0.316	NA
LL2ss-299-1256-SO	LL2-094	TNT	10	50	1	1	< 0.271	NA
LL2ss-300-1257-SO	LL2ss-014	RDX	10	50	1	1	< 1.15	NA

Prepared by PC on 1/7/05
QA/QC by MS on 1/24/05

TABLE B-3
Summary of Field Screening and Laboratory Analysis - TNT/RDX
November 2004 Sampling Event
Ravenna Army Ammunition Plant, Ravenna, Ohio

Sample ID	Original Station ID	Analyte	Sample Weight (g)	Extraction Volume	Dilution	Result (mg/kg)	Kemron Result (mg/kg)	RPD Field vs. Laboratory
LL2ss-301-1258-SO	LL2ss-014	RDX	10	50	1	1.6	< 1.25	NA
LL2ss-302-1259-SO	LL2ss-014	RDX	10	50	1	1.8	< 1.16	NA
LL2ss-303-1260-SO	LL2ss-044	TNT	10	50	1	1	< 0.313	NA
LL2ss-304-1261-SO	LL2ss-044	TNT	10	50	1	69		
LL2ss-304-1261-SO		TNT	10	50	10	108	< 0.271	NA
LL3ss-002-1176-SO	LL3ss-002	TNT						
LL3ss-002-1176-SO		TNT	10	50	100	3493	2780	6%
LL3ss-002-1177-SO	LL3ss-002	TNT					303	
LL3ss-012-1231-SO	LL3ss-012	TNT	10	50	1	0	< 0.265	
LL3ss-012-1232-SO	LL3ss-012	TNT	Not needed					
LL3ss-012-1233-SO	LL3ss-012	TNT	Not needed					
LL3ss-282-1215-SO	LL3ss-002	TNT	10	50	250	22	< 0.285	
LL3ss-283-1216-SO	LL3ss-002	TNT	10	50	250	30	< 0.280	
LL3ss-284-1217-SO	LL3ss-002	TNT	10	50	250	22	< 0.279	
LL3ss-285-1218-SO	LL3ss-034	TNT						
LL3ss-285-1218-SO		TNT	10	50	100	37	0.42	49%
LL3ss-286-1219-SO	LL3ss-034	TNT	10	50	1	1	< 0.323	
LL3ss-287-1220-SO	LL3ss-034	TNT	10	50	1	1	< 0.315	
LL3ss-288-1222-SO	LL3-230	TNT	10	50	1	1	< 0.267	
LL3ss-289-1223-SO	LL3-230	TNT	10	50	1	1	< 0.279	
LL3ss-290-1224-SO	LL3-230	TNT	10	50	250	15	< 0.283	
LL3ss-291-1225-SO	LL3-231	TNT	10	50	1	1	< 0.265	
LL3ss-292-1226-SO	LL3-231	TNT	10	50	1	5	1.22	31%
LL3ss-294-1229-SO	LL3ss-012	TNT	10	50	1	42		
LL3ss-294-1229-SO		TNT	10	50	2.5	42	148	28%
LL3ss-295-1230-SO	LL3ss-012	TNT	10	50	1	5	32	36%
LL3ss-296-1234-SO	LL3ss-012	TNT	Not needed					
LL4ss-200-1206-SO		RDX					<1.09	

RPD - relative percent difference
NA - not calculated - laboratory result below detection limit
Blank indicates not analyzed.

Prepared by PC on 1/7/05
QA/QC by MS on 1/24/05

TABLE B-4
Summary of Field Screening and Laboratory Analysis - PCBs
November 2004 Sampling Event
Ravenna Army Ammunition Plant, Ravenna, Ohio

Stepout Station ID	Sample ID	Original Station ID		PCB Result (mg/kg)	KEMRON Results (mg/kg)
LL1ss-148	LL1ss-148-1441-SO	LL1-148		> 35	NA
LL1ss-148	LL1ss-148-1442-SO	LL1-148		< 25	0.8
LL1ss-148	LL1ss-148-1443-SO	LL1-148	Not tested, LL1ss-148-1442-SO below 35 ppm		
LL1ss-148	LL1ss-148-1444-SO	LL1-148	Not tested, LL1ss-148-1442-SO below 35 ppm		
LL1ss-455	LL1ss-455-1436-SO	LL1-148		< 25	11.7
LL1ss-456	LL1ss-456-1437-SO	LL1-148		< 25	3.1
LL1ss-457	LL1ss-457-1438-SO	LL1-158		> 35	NA
LL1ss-473	LL1ss-473-1458-SO	LL1-158		< 25	0.03
LL2ss-275	LL2ss-275-1228-SO	LL2-166		< 25	0.46
LL2ss-276	LL2ss-276-1229-SO	LL2-167		< 25	0.724
LL3ss-102	LL3ss-102-1212-SO	LL3-102		> 35	154
LL3ss-246	LL3ss-246-1174-SO	LL3-077		< 25	6.1
LL3ss-247	LL3ss-247-1175-SO	LL3-077		< 25	11.5
LL3ss-280	LL3ss-280-1213-SO	LL3-102		> 35	563
LL3ss-281	LL3ss-281-1214-SO	LL3-102		> 35	NA
LL3ss-293	LL3ss-293-1227-SO	LL3-102		> 35	191
LL3ss-297	LL3ss-297-1238-SO	LL3-102		NA	11.9
LL4ss-133	LL4ss-133-1187-SO	LL4-133		< 25	0.078
LL4ss-133	LL4ss-133-1188-SO	LL4-133	Not tested, LL1ss-133-1187-SO below 25 ppm		
LL4ss-133	LL4ss-133-1189-SO	LL4-133	Not tested, LL1ss-133-1187-SO below 25 ppm		
LL4ss-133	LL4ss-133-1190-SO	LL4-133	Not tested, LL1ss-133-1187-SO below 25 ppm		
LL4ss-193	LL4ss-193-1185-SO	LL4-133		< 25	NA
LL4ss-193	LL4ss-193-1185-SO	Lab Duplicate		< 25	NA
LL4ss-194	LL4ss-194-1186-SO	LL4-133		< 25	0.13

Relative Percent Difference not calculated due to qualitative nature of PCB Screening kit.
NA - Not Analyzed

Prepared by PC on 1/7/05
QA/QC by MS on 1/24/05

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TABLE B-5
Sample Depth Location and Interval
November 2004 Sampling Event
Ravenna Army Ammunition Plan, Ravenna, Ohio

Sample ID	Northing	Easting	CAD Point	Start Depth (ft BGS)	End Depth (ft BGS)	
LL1ss-009-1464-SO	562958.87	2376836.79	1	0	0	
LL1ss-148-1441-SO	563327.21	2376466.86	2	1	2	
LL1ss-148-1442-SO	563327.21	2376466.86	3	2	3	
LL1ss-148-1443-SO	563327.21	2376466.86	4	3	3.5	*
LL1ss-148-1444-SO	563327.21	2376466.86	5	3	3.5	FD
LL1ss-157-1463-SO	562973.74	2376875.31	6	1	1.5	
LL1ss-157-1465-ER	0.00	0.00	7			ER
LL1ss-357-1467-SO	562890.56	2376865.65	8	1	2	
LL1ss-357-1468-SO	562890.56	2376865.65	9	2	2.5	
LL1ss-422-1401-SO	562035.60	2377273.94	10	0	0.5	
LL1ss-423-1402-SO	562030.90	2377286.79	11	0	0.5	
LL1ss-424-1403-SO	562016.40	2377283.56	12	0	0.5	
LL1ss-425-1404-SO	562020.52	2377269.24	13	0	0.5	
LL1ss-426-1405-SO	561959.54	2377391.80	14	0	0.5	
LL1ss-427-1406-SO	561954.99	2377407.61	15	0	1	
LL1ss-427-1407-ER	0.00	0.00	16			ER
LL1ss-428-1408-SO	561942.68	2377404.07	17	0	0.5	
LL1ss-429-1409-SO	564921.85	2375575.25	18	0	1	
LL1ss-430-1410-SO	564922.58	2375531.45	19	0	0.5	
LL1ss-431-1411-SO	564879.11	2375496.98	20	0	0.67	
LL1ss-432-1412-SO	564897.32	2375488.69	21	0	0.83	
LL1ss-433-1413-SO	564785.00	2375760.11	22	0	1	
LL1ss-434-1414-SO	564656.78	2375822.42	23	0	1	
LL1ss-435-1415-SO	564540.01	2375893.98	24	0	1	
LL1ss-436-1416-SO	564421.66	2375857.19	25	0	0.5	
LL1ss-437-1417-SO	564415.96	2375868.97	26	0	0.5	
LL1ss-438-1418-SO	564403.55	2375863.11	27	0	0.5	
LL1ss-439-1419-SO	564410.96	2375851.07	28	0	0.5	*
LL1ss-440-1420-SO	564410.96	2375851.07	29			FD
LL1ss-440-1421-ER	0.00	0.00	30			ER
LL1ss-441-1422-SO	563422.59	2376483.27	31	0	1	
LL1ss-442-1423-SO	563420.26	2376494.96	32	0	1	
LL1ss-443-1424-SO	563406.93	2376485.08	33	0	1	
LL1ss-444-1425-SO	563413.85	2376473.21	34	0	1	
LL1ss-445-1426-SO	561966.91	2377387.25	35	0	0.5	
LL1ss-446-1427-SO	563106.51	2379031.98	36	0	0.5	
LL1ss-447-1428-SO	563093.13	2379040.35	37	0	0.5	
LL1ss-448-1429-SO	563084.11	2379025.57	38	0	0.5	
LL1ss-449-1430-SO	563094.59	2379021.97	39	0	0.5	
LL1ss-450-1431-SO	563176.00	2379710.00	40	0	0.5	*
LL1ss-451-1432-SO	563176.00	2379710.00	40	0	0.5	FD
LL1ss-452-1433-SO	563161.81	2379716.83	42	0	0.5	
LL1ss-453-1434-SO	563136.78	2379698.22	43	0	0.5	
LL1ss-454-1435-SO	563136.78	2379698.22	44	0	0.5	
LL1ss-455-1436-SO	563332.44	2376480.39	45	0	0.67	
LL1ss-456-1437-SO	563336.93	2376465.14	46	0	0.42	
LL1ss-457-1438-SO	562978.02	2376848.31	47	0	1	
LL1ss-458-1439-SO	562015.19	2377260.93	48	0	0.5	*

TABLE B-5
Sample Depth Location and Interval
November 2004 Sampling Event
Ravenna Army Ammunition Plan, Ravenna, Ohio

Sample ID	Northing	Easting	CAD Point	Start Depth (ft BGS)	End Depth (ft BGS)	
LL1ss-459-1440-SO	563164.34	2377232.10	49	3	4	
LL1ss-460-1445-SO	563163.95	2379705.56	50	0	0.5	FD
LL1ss-461-1446-SO	561256.14	2377641.62	51	0	0.5	
LL1ss-462-1447-SO	561250.41	2377647.85	52	0	0.5	
LL1ss-463-1448-SO	561226.73	2377637.99	53	0	0.5	
LL1ss-464-1449-SO	561243.57	2377637.73	54	0	0.5	
LL1ss-465-1450-SO	561133.09	2377762.43	55	0	0.5	
LL1ss-466-1451-SO	561120.18	2377763.67	56	0	0.5	
LL1ss-467-1452-SO	561119.54	2377764.66	57	0	0.5	
LL1ss-468-1453-SO	561122.88	2377749.11	58	0	0.5	
LL1ss-469-1454-SO	562894.18	2376870.39	59	0	0.67	
LL1ss-470-1455-SO	562977.06	2376847.83	60	0	1	*
LL1ss-471-1456-SO	562986.93	2376862.43	61	0	0.5	
LL1ss-472-1457-SO	562977.06	2376847.83	62	0	1	FD
LL1ss-473-1458-SO	562989.23	2376845.03	63	0	1	
LL1ss-474-1459-SO	564871.28	2375501.22	64	0	1	
LL1ss-475-1460-SO	564904.37	2375484.50	65	0	0.58	
LL1ss-476-1461-SO	561263.25	2377640.90	66	0	0.5	
LL1ss-477-1462-SO	563170.53	2379704.40	67	0	0.5	
LL1ss-478-1466-SO	562960.00	2376836.90	68	0	0.25	
LL1ss-479-1469-SO	564467.34	2375884.79	69	0	0.33	
LL1ss-480-1470-SO	562891.69	2376878.64	70	0	1	
LL1ss-481-1471-SO	564457.03	2375893.97	71	0	1	
LL1ss-482-1472-SO	564864.70	2375508.32	72	0	1	
LL1ss-483-1473-SO	564916.23	2375479.04	73	0	1	
LL1ss-484-1474-SO	562021.57	2377255.63	74	0	1	
LL2ss-014-1266-SO	560874.96	2373901.18	75	0.5	1.5	
LL2ss-014-1267-SO	560874.96	2373901.18	76	1.5	2.5	
LL2ss-014-1268-SO	560874.96	2373901.18	77	2.5	3.5	
LL2ss-044-1262-SO	560981.59	2374044.39	78	0.5	1.5	
LL2ss-044-1263-SO	560981.59	2374044.39	79	1.5	2.5	*
LL2ss-044-1264-SO	560981.59	2374044.39	80	2.5	3.5	
LL2ss-044-1265-SO	560981.59	2374044.39	81	1.5	2.5	FD
LL2ss-101-1230-SO	562559.94	2372870.47	82	1	2	
LL2ss-101-1231-SO	562559.94	2372870.47	83	2	2.5	
LL2ss-275-1228-SO	560242.41	2374146.80	84	2.5	3	
LL2ss-276-1229-SO	560002.83	2374272.87	85	1.25	2.25	
LL2ss-277-1232-SO	562565.97	2372857.90	86	0	1	*
LL2ss-278-1233-SO	562565.97	2372857.90	87	0	1	FD
LL2ss-279-1234-SO	562558.07	2372858.20	88	0	1	
LL2ss-280-1235-SO	562554.71	2372874.54	89	0	0.5	
LL2ss-281-1236-SO	562471.89	2373143.38	90	0.67	1.67	
LL2ss-282-1237-SO	562463.95	2373140.30	91	0.33	1.33	
LL2ss-283-1238-SO	562475.39	2373125.47	92	0	1	
LL2ss-284-1239-SO	561865.25	2373419.50	93	0	0.5	
LL2ss-285-1240-SO	561870.11	2373440.65	94	0	0.5	
LL2ss-286-1241-SO	561791.76	2373488.41	95	0	0.5	
LL2ss-287-1242-SO	561786.91	2373492.76	96	0	0.5	

TABLE B-5
Sample Depth Location and Interval
November 2004 Sampling Event
Ravenna Army Ammunition Plan, Ravenna, Ohio

Sample ID	Northing	Easting	CAD Point	Start Depth (ft BGS)	End Depth (ft BGS)	
LL2ss-288-1243-SO	561782.65	2373495.17	97	0	0.5	
LL2ss-289-1244-SO	561773.10	2373487.95	98	0	0.5	*
LL2ss-290-1245-SO	561773.10	2373487.95	99	0	0.5	FD
LL2ss-291-1246-SO	561923.66	2373724.16	100	0	1	
LL2ss-292-1247-SO	561945.61	2373713.70	101	0	1	
LL2ss-293-1248-SO	560266.97	2374129.97	102	2	3	
LL2ss-293-1250-ER	0.00	0.00	103			ER
LL2ss-294-1249-SO	559765.16	2374552.39	104	0	1	
LL2ss-295-1251-SO	559735.58	2374425.96	105	1.6	2.27	
LL2ss-296-1252-SO	561583.85	2374190.59	106	0	1	*
LL2ss-297-1253-SO	561583.85	2374190.59	107	0	1	FD
LL2ss-297-1254-ER	0.00	0.00	108			ER
LL2ss-298-1255-SO	561977.66	2374085.05	109	0	1	
LL2ss-299-1256-SO	561977.24	2374104.23	110	0	1	
LL2ss-300-1257-SO	560876.47	2373896.21	111	0	0.5	*
LL2ss-301-1258-SO	560883.17	2373896.20	112	0	0.5	
LL2ss-302-1259-SO	560876.47	2373896.21	113	0	0.5	FD
LL2ss-303-1260-SO	561009.68	2374045.70	114	0	0.5	
LL2ss-304-1261-SO	560988.39	2374059.53	115	0	0.5	
LL2ss-305-1262-SO	561881.89	2373446.36	116	0	0.5	
LL2ss-306-1263-SO	561869.32	2373410.17	117	0	0.5	
LL3ss-002-1176-SO	559584.00	2370920.00	118	2	3	
LL3ss-002-1177-SO	559584.00	2370920.00	119	3	4	
LL3ss-012-1231-SO	559151.00	2371152.00	120	1.5	2.5	
LL3ss-012-1232-SO	559151.00	2371152.00	121	2.5	3.5	
LL3ss-012-1233-SO	559151.00	2371152.00	122	3.5	4.5	*
LL3ss-046-1237-SO	559934.11	2369957.61	123	0.5	1.5	
LL3ss-049-1235-SO	560170.01	2369855.18	125	0.5	1.5	
LL3ss-049-1236-SO	560170.01	2369855.18	126	1	1.9	
LL3ss-102-1212-SO	559612.53	2370758.60	127	1	1.7	*
LL3ss-246-1174-SO	560369.71	2370198.98	128	1.25	1.9	
LL3ss-247-1175-SO	560381.90	2370186.33	129	0	0.67	
LL3ss-247-1178-ER	0.00	0.00	130			ER
LL3ss-248-1179-SO	561227.46	2370455.36	131	0	1	*
LL3ss-249-1180-SO	2369864.00	560168.00	132	0	1	
LL3ss-250-1181-SO	2369853.00	560149.00	133	0	1	
LL3ss-251-1182-SO	559942.55	2369957.85	134	0	0.5	
LL3ss-252-1183-SO	559937.44	2369967.98	135	0	0.5	
LL3ss-253-1184-SO	559921.15	2369965.60	136	0	0.5	
LL3ss-254-1185-SO	559930.49	2369953.04	137	0	0.5	*
LL3ss-255-1186-SO	561227.46	2370455.36	138	0	1	FD
LL3ss-256-1187-SO	561212.71	2370464.70	139	0	1	
LL3ss-257-1188-SO	561205.92	2370453.00	140	0	1	
LL3ss-258-1189-SO	561220.41	2370446.62	141	0	1	
LL3ss-258-1190-ER	0.00	0.00	142			ER
LL3ss-259-1190-SO	559930.49	2369953.04	143	0	0.5	FD?
LL3ss-260-1191-SO	559832.34	2370693.41	144	0	1	
LL3ss-261-1192-SO	559834.09	2370707.29	145	0	1	

TABLE B-5
Sample Depth Location and Interval
November 2004 Sampling Event
Ravenna Army Ammunition Plan, Ravenna, Ohio

Sample ID	Northing	Easting	CAD Point	Start Depth (ft BGS)	End Depth (ft BGS)	
LL3ss-262-1193-SO	559836.76	2370704.23	146	0	1	
LL3ss-263-1194-SO	559836.13	2370718.94	147	0	1	
LL3ss-264-1195-SO	559798.10	2370723.34	148	0	1	*
LL3ss-265-1196-SO	559803.21	2370736.45	149	0	0.8	
LL3ss-266-1197-SO	559798.10	2370723.34	150	0	1	FD
LL3ss-267-1199-SO	559867.63	2371321.42	151	1.7	2.45	
LL3ss-268-1200-SO	559909.92	2371327.49	152	0.16	1.16	
LL3ss-269-1201-SO	559901.63	2371336.33	153	0.08	0.75	*
LL3ss-270-1202-SO	559901.63	2371336.33	154	0.08	0.75	FD
LL3ss-271-1203-SO	558610.26	2370689.97	155	0	0.5	
LL3ss-272-1204-SO	558592.20	2370683.55	156	0	0.5	
LL3ss-273-1205-SO	558692.24	2370843.66	157	0	1	*
LL3ss-274-1206-SO	558677.83	2370849.49	158	0	1	
LL3ss-275-1207-SO	558671.21	2370840.18	159	0	1	
LL3ss-276-1208-SO	558427.67	2370893.01	160	0	0.5	FD
LL3ss-277-1209-SO	558429.87	2370891.04	161	0	1	
LL3ss-278-1210-SO	558409.01	2370886.34	162	0	1	
LL3ss-279-1211-SO	558422.69	2370880.33	163	0	1	*
LL3ss-280-1213-SO	559617.19	2370774.24	164	0	1	
LL3ss-281-1214-SO	559612.53	2370758.60	165	0	1	FD
LL3ss-282-1215-SO	559591.50	2370933.03	166	0	2	*
LL3ss-283-1216-SO	559582.62	2370935.84	167	0	0.5	
LL3ss-284-1217-SO	559591.50	2370933.03	168	0	2	FD
LL3ss-285-1218-SO	559959.87	2370506.48	169	0	1	
LL3ss-286-1219-SO	559974.76	2370511.47	170	0	1	*
LL3ss-287-1220-SO	559974.76	2370511.47	171	0	1	FD
LL3ss-288-1222-SO	559845.72	2371326.23	172	1	2	*
LL3ss-289-1223-SO	559845.72	2371326.23	173	1	2	FD
LL3ss-290-1224-SO	559830.50	2371324.98	174	0	1	
LL3ss-291-1225-SO	559913.03	2371293.07	175	1.1	1.7	
LL3ss-292-1226-SO	559916.66	2371277.05	176	0	1	
LL3ss-293-1227-SO	559623.13	2370778.11	177	0	0.83	
LL3ss-293-1228-ER	0.00	0.00	178			ER
LL3ss-294-1229-SO	559624.97	2370789.83	179	0	1	
LL3ss-295-1230-SO	559144.82	2371160.01	180	0	1	
LL3ss-296-1234-SO	559151.00	2371152.00	181	3.5	4.5	FD
LL3ss-297-1238-SO	559624.97	2370789.83	182	0	1	
LL3ss-299-1239-SO	560159.94	2369846.54	184	0	1	
LL3ss-300-1240-SO	559921.07	2371329.20	185	0	1	
LL3ss-300-1241-ER	0.00	0.00	186			ER
LL3ss-301-1242-SO	559900.82	2371346.25	187	0	0.5	
LL3ss-302-1243-SO	559843.41	2370728.37	188	0	1	
LL3ss-303-1244-SO	559839.45	2370717.41	189	0	0.75	
LL3ss-304-1245-SO	559800.94	2370716.89	190	0	0.9	
LL3ss-305-1246-SO	558428.78	2370869.69	191	0	1	*
LL3ss-306-1247-SO	558428.78	2370869.69	192	0	1	FD
LL3ss-306-1248-SO	0.00	0.00	193			ER
LL3ss-307-1249-SO	558619.87	2370691.65	194	0	0.5	

TABLE B-5
Sample Depth Location and Interval
November 2004 Sampling Event
Ravenna Army Ammunition Plan, Ravenna, Ohio

Sample ID	Northing	Easting	CAD Point	Start Depth (ft BGS)	End Depth (ft BGS)	
LL3ss-308-1250-SO	559922.55	2369943.75	195	0	0.5	
LL3ss-309-1251-SO	559839.30	2370685.44	196	0	0.9	
LL3ss-310-1252-SO	559853.07	2370717.27	197	0	0.6	
LL3ss-311-1253-SO	559900.81	2371357.05	198	0	0.75	
LL4ss-080-1194-SO	556111.83	2365187.21	199	1	2	
LL4ss-080-1195-SO	556111.83	2365187.21	200	2	3	
LL4ss-080-1996-SO	556111.83	2365187.21	201	3	4	
LL4ss-081-1197-SO	556121.04	2365210.81	202	1	2	
LL4ss-081-1198-SO	556121.04	2365210.81	203	2	3	
LL4ss-081-1199-SO	556121.04	2365210.81	204	3	4	
LL4ss-118-1191-SO	555702.68	2365345.11	205	1	2	
LL4ss-118-1192-SO	555702.68	2365345.11	206	2	3	
LL4ss-118-1193-SO	555702.68	2365345.11	207	3	4	
LL4ss-133-1187-SO	555614.39	2366069.74	208	1	2	
LL4ss-133-1188-SO	555614.39	2366069.74	209	2	3	*
LL4ss-133-1189-SO	555614.39	2366069.74	210	3	4	
LL4ss-133-1190-SO	555614.39	2366069.74	211	2	3	FD
LL4ss-193-1185-SO	555608.20	2366066.13	212	0	1	
LL4ss-194-1186-SO	555623.78	2366073.32	213	0.83	1.83	
LL4ss-195-1200-SO	556110.21	2365180.59	214	3	4	
LL4ss-196-1201-SO	556127.62	2365228.77	215	0	1	
LL4ss-197-1202-SO	555710.80	2365359.89	216	0	1	*
LL4ss-197-1203-SO	0.00	0.00	217			ER
LL4ss-198-1204-SO	555710.80	2365359.89	218	0	1	FD
LL4ss-199-1205-SO	555716.52	2365347.09	219	0	1	
LL4ss-200-1206-SO	556175.31	2366419.12	220	0	0.83	
LL4ss-201-1207-SO	556158.31	2366425.42	221	0	1	
LL4ss-201-1208-ER	0.00	0.00	222			ER
LL4ss-202-1209-SO	556167.33	2366407.74	223	0	1	*
LL4ss-203-1210-SO	556167.33	2366407.74	224	0	1	FD

NOTE : Coords are Ohio State plane NAD '83 feet
FD - Field Duplicate
* - FD collected at this location
ER - Equipment Rinsate

Appendix C

Soil Volume Estimation for Remediation

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Load Line 1
Volume Estimate Summary

REMEDIATION VOLUME FOR INDIVIDUAL CONTAMINANT CATEGORIES

	Volume*	Volume*	Volume*	Volume*	Volume*	Volume*	Volume*	
COC	PCBs	SVOCs	TNT/RDX	Arsenic	Metals, other	Mn	Lead	
Estimate Basis	NGTRGO	NGTRGO	NGTRGO	NGTRGO	NGTRGO	PRG	PRG	
								TOTAL
Melt Pour	2,422	0	9,305	1,478	768	9,542	3,778	
Processing Storage	7,506	7,644	0	0	3,320	91,902	13,236	
Demil	0	0	0	1,260	1,260	16,334	0	
Change Houses	0	0	0	0	0	9,720	0	
Others	0	0	0	19,030	0	6,400	0	
Total (ft^3)	9,928	7,644	9,305	21,768	5,348	133,898	17,014	**204,905**
Total (cy)	368	283	345	806	198	4,959	630	**7,589**

REMEDIATION VOLUME CORRECTED TO REMOVE OVERLAP

	Volume*	Volume*	Volume*	Volume*	Volume*	Volume*	Volume*	
COC	PCBs	SVOCs	TNT/RDX	Arsenic	Metals, other	Mn	Lead	
Estimate Basis	NGTRGO	NGTRGO	NGTRGO	NGTRGO	NGTRGO	PRG	PRG	
								TOTAL
Melt Pour	2,422	0	9,305	1,174	0	9,414	2,235	
Processing Storage	7,506	7,644	0	0	3,320	90,030	8,244	
Demil	0	0	0	1,260	0	15,074	0	
Change Houses	0	0	0	0	0	9,720	0	
Others	0	0	0	19,030	0	6,400	0	
Total (ft^3)	9,928	7,644	9,305	21,464	3,320	130,638	10,479	**192,778**
Total (cy)	368	283	345	795	123	4,838	388	**7,140**

*volumes in units of cubic feet and based on contaminant category only

Load Line 1

COCs		Aluminum	Antimony	Arsenic	Barium	Cadmium	Hex. Chromium	Manganese	Lead	2,4,6-TNT	RDX	PCB-1254	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b) fluoranthene	Dibenzo(a,h) anthracene
		METALS								EXPLOSIVES		PCBs	SVOCs			
PRG (mg/kg)		17,700	0.96	15.4	88.4	NA	NA	1,800	1,995	NA	NA	NA	NA	NA	NA	NA
RGO Resident (mg/kg)[1]		**77,540**	**31**	**5.7**	**5,285**	**72**		**3,316**		**32**	**47**	**1.2**	**5.9**	**0.59**	**5.9**	**0.59**
RGO NGT (mg/kg)[1]		34,942	2,458	31	3,483	109	16	351		1,646	838	35	105	10	105	10
Melt-Pour Complex[2]																
CB-4	LL1ss-002			**77**												
CB-4	LL1ss-003									5800						
CB-4	LL1-144		1.1U	**5.7**				2,250	143	**87**	5U					
CB-4	LL1-001		1.1	5.5				2,330	179	**470**	29	**8.9**	1.1	**1**	1.4	1.6U
CB-4	LL1-148		1.3U	**10.5**				415	350			**1,100**				
CB-4	LL1-008		1.2U	**13.7**				**3,500**	25.7							
CB-4	LL1-340		0.7	**7.4**				1,830	402	**990**	100U					
CB-4 sewer	LL1-295		2.9U	**39**				1,020	306			**2.1**				
CB-4A	LL1ss-009								3,610							
CB-4A	LL1-009		6.1U	**14.3**				450	7,130							
CB-4A	LL1-158		1.1U	**4.9**				140	2,450			**73**				
CB-4A	LL1-014		1.1U	**9.2**				425	2,070							
CB-4A	LL1-357		1.1U	**7.5**				631	117	**4,800**	**1,200**					
CB-4A	LL1-155		0.69	**7.3**				1,960	213							
CB-4A	LL1-157		1.3U	**8.6**				555	726	**4,800**	**2,300**					
CB-4A perimeter	LL1sd-028			**43.3**					2,220			**44**				
CA-6 perimeter	LL1ss-039									10,000						
CA-6	LL1-258		1.3U	**14.9**				2,220	20.7							
CA-6	LL1ss-019	47,600		**41.2**				2,030								
CA-6A	LL1-325		1.2U	**12.4**				437	95.3	**4,500**	300U					
CA-6A	LL1-327	46,100	1.2U	**55.6**				1,630	222							
CA-6A	LL1-381		1.2U	**11.3**				2,020	22.8							
CA-6A perimeter	LL1sd-048(d)							1,860								

		ESTIMATED REMEDIATION VOLUME FOR PCBs				ESTIMATED REMEDIATION VOLUME FOR EXPLOSIVES				ESTIMATED REMEDIATION VOLUME FOR ARSENIC				ESTIMATED REMEDIATION VOLUME FOR METALS (excluding As, Mn and Pb)				ESTIMATED REMEDIATION VOLUME FOR MANGANESE				ESTIMATED REMEDIATION VOLUME FOR LEAD			
		Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)	Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)	Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)	Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)	Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)	Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)
CB-4	LL1ss-002									21	9	2	378												
CB-4	LL1ss-003					34	14	2	952																
CB-4	LL1-144																	30	29	2	1,740				
CB-4	LL1-001																	24	17	2	816				
CB-4	LL1-148	20	11	2	440																				
CB-4	LL1-008																	10	10	2	200				
CB-4	LL1-340																	31	13	2	806				
CB-4 sewer	LL1-295									5	5	1	28												
CB-4A	LL1ss-009																					14	6	2	168
CB-4A	LL1-009																					21	20	2	819
CB-4A	LL1-158	30	21	2	1,260																	21	30	2	1,239
CB-4A	LL1-014																					39	16	2	1,248
CB-4A	LL1-357					10	14	2	280																
CB-4A	LL1-155																	37	12	2	888				
CB-4A	LL1-157					33	33	2	2,178																
CB-4A perimeter	LL1sd-028	19	19	2	722					19	8	2	304									19	8	2	304
CA-6 perimeter	LL1ss-039					75	30	2	4,500																
CA-6	LL1-258																	28	9	2	504				
CA-6	LL1ss-019									16	4	2	128	16	4	2	128	16	4	2	128				
CA-6A	LL1-325					31	15	3	1,395																
CA-6A	LL1-327									16	20	2	640	16	20	2	640								
CA-6A	LL1-381																	35	32	2	2,240				
CA-6A perimeter	LL1sd-048(d)																	37	30	2	2,220				
TOTAL					2,422				9,305				1,478				768				9,542				3,778
TOTAL CORRECTED FOR OVERLAP					2,422				9,305				1,174				0				9,414				2,235

Notes:

[1] - RGOs from Proposed RGO document (Shaw, 2004) approved by OhioEPA in July 2004.

[2] - Reported highest concentration of sample or field duplicate, where applicable. Reported highest concentration of surface or subsurface sample, where applicable.

Shaded concentration values exceed the RGO for the National Guard Trainee (NGT). Although dimension values are estimated, shaded dimension values indicate less well defined limits.

NO ADDITIONAL REMEDIATION REQUIRED FOR SVOCs.

Load Line 1

COCs		METALS								EXPLOSIVES		PCBs	SVOCs			
		Aluminum	Antimony	Arsenic	Barium	Cadmium	Hex. Chromium	Manganese	Lead	2,4,6-TNT	RDX	PCB-1254	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b) fluoranthene	Dibenzo(a,h) anthracene
PRG (mg/kg)		17,700	0.96	15.4	88.4	NA	NA	1,800	1,995	NA	NA	NA	NA	NA	NA	NA
RGO Resident (mg/kg)[1]		**77,540**	**31**	**5.7**	**5,285**	**72**		**3,316**		**32**	**47**	**1.2**	**5.9**	**0.59**	**5.9**	**0.59**
RGO NGT (mg/kg)[1]		34,942	2,458	31	3,483	109	16	351		1,646	838	35	105	10	105	10
Processing and Storage Area[2]																
CB-10	LL1ss-036							2,140	8,510			**40**				
CB-10	LL1ss-034								3,370							
CB-13	LL1-253						25									
CB-13B	LL1-068		1.2	8.8				2,170	24.4							
CB-13B	LL1-111		1.9	4.5				2,530	224							
CB-13B	LL1-112		0.76	**5.8**				2,610	248							
CB-13B	LL1-113		1.2U	3.1				3,080	38.1							
A+B	LL1-252		1.4U	**11.5**				1,840	1,140							
CB-13A	LL1-117		1.1U	4.0				**3,650**	10.4							
CB-13A	LL1-118		1.1U	4.1				**3,340**	11.2							
CB-13A	LL1-119		2.2U	**6.1**				2,640	14.2							
CB-3	LL1-179		1.2U	5.3				712	47.1				**14**	**13**	**15**	**1.7**
CB-3	LL1-205		1.4	**8.0**				**4,070**	38.5							
CC-1	LL1-409		1.1U	**6.7**				**3,350**	97.7				1	**1.3**	2.5	0.32
Water Tower	LL1-412		1.9	**14.0**				687	2,510							
CB-801 perimeter	LL1sd-049(d)		2,460						2,160							

		ESTIMATED REMEDIATION VOLUME FOR PCBs				ESTIMATED REMEDIATION VOLUME FOR SVOCs				ESTIMATED REMEDIATION VOLUME FOR ARSENIC				ESTIMATED REMEDIATION VOLUME FOR METALS (excluding As, Mn and Pb)				ESTIMATED REMEDIATION VOLUME FOR MANGANESE				ESTIMATED REMEDIATION VOLUME FOR LEAD			
		Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)	Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)	Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)	Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)	Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)	Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)
CB-10	LL1ss-036	27	139	2	7,506													36	26	2	1,872	36	26	2	1,872
CB-10	LL1ss-034																					31	30	2	1,860
CB-13	LL1-253													10	10	2	200								
CB-13B	LL1-068																	35	83	2	5,810				
CB-13B	LL1-111																	52	94	2	9,776				
CB-13B	LL1-112																	142	70	2	19,880				
CB-13B	LL1-113																	119	82	2	19,516				
A+B	LL1-252																	38	119	2	9,044				
CB-13A	LL1-117																	78	20	2	3,120				
CB-13A	LL1-118																	36	77	2	5,544				
CB-13A	LL1-119																	169	20	2	6,760				
CB-3	LL1-179					91	42	2	7,644																
CB-3	LL1-205																	50	103	2	10,300				
CC-1	LL1-409																	20	7	2	280				
Water Tower	LL1-412																					38	84	2	6,384
CB-801 perimeter	LL1sd-049(d)													52	30	2	3,120					52	30	2	3,120
TOTAL					7,506				7,644				0				3,320				91,902				13,236
TOTAL CORRECTED FOR OVERLAP					7,506				7,644				0				3,320				90,030				8,244

Notes:
[1] - RGOs from Proposed RGO document (Shaw, 2004) approved by OhioEPA in July 2004.
[2] - Reported highest concentration of sample or field duplicate, where applicable. Reported highest concentration of surface or subsurface sample, where applicable.
Shaded concentration values exceed the RGO for the National Guard Trainee (NGT). Although dimension values are estimated, shaded dimension values indicate less well defined limits.
NO ADDITIONAL REMEDIATION REQUIRED FOR EXPLOSIVES.

Load Line 1		METALS								EXPLOSIVES		PCBs	SVOCs					ESTIMATED REMEDIATION VOLUME FOR ARSENIC				ESTIMATED REMEDIATION VOLUME FOR METALS (excluding As, Mn and Pb)				ESTIMATED REMEDIATION VOLUME FOR MANGANESE			
COCs		Aluminum	Antimony	Arsenic	Barium	Cadmium	Hex. Chromium	Manganese	Lead	2,4,6-TNT	RDX	PCB-1254	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b) fluoranthene	Dibenzo(a,h) anthracene		Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)	Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)	Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)
PRG (mg/kg)		17,700	0.96	15.4	88.4	NA	NA	1,800	1,995	NA	NA	NA	NA	NA	NA	NA													
RGO Resident (mg/kg)[1]		**77,540**	**31**	**5.7**	**5,285**	**72**		**3,316**		**32**	**47**	**1.2**	**5.9**	**0.59**	**5.9**	**0.59**													
RGO NGT (mg/kg)[1]		34,942	2,458	31	3,483	109	16	351		1,646	838	35	105	10	105	10													
Demilitarization Processing[2]																													
CB-14	LL1-099		0.63	**15.5**				**3,400**	25.3	4.5	34															60	18	2	2,160
CB-17	LL1-092		1.2U	**10**				2,360	99.5																	41	21	2	1,722
CB-17	LL1-401		1.1U	**8.2**				1,830	16.4																	30	50	2	3,000
CB-17	LL1-095	**97,300**	9U	**112**				**4,700**	186									30	21	2	1,260	30	21	2	1,260	30	21	2	1,260
CA-5	LL1-207							2,340																		64	64	2	8,192
TOTAL																					1,260				1,260				16,334
TOTAL CORRECTED FOR OVERLAP																					1,260				0				15,074

Notes:

[1] - RGOs from Proposed RGO document (Shaw, 2004) approved by OhioEPA in July 2004.

[2] - Reported highest concentration of sample or field duplicate, where applicable. Reported highest concentration of surface or subsurface sample, where applicable.

Shaded concentration values exceed the RGO for the National Guard Trainee (NGT). Although dimension values are estimated, shaded dimension values indicate less well defined limits.

NO ADDITIONAL REMEDIATION REQUIRED FOR PCBs, SVOCs, EXPLOSIVES, OR LEAD.

Load Line 1	METALS								EXPLOSIVES		PCBs	SVOCs					ESTIMATED REMEDIATION VOLUME FOR MANGANESE			
COCs	Aluminum	Antimony	Arsenic	Barium	Cadmium	Hex. Chromium	Manganese	Lead	2,4,6-TNT	RDX	PCB-1254	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b) fluoranthene	Dibenzo(a,h) anthracene		Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)
PRG (mg/kg)	17,700	0.96	15.4	88.4	NA	NA	1,800	1,995	NA	NA	NA	NA	NA	NA	NA					
RGO Resident (mg/kg)[1]	**77,540**	**31**	**5.7**	**5,285**	**72**		**3,316**		**32**	**47**	**1.2**	**5.9**	**0.59**	**5.9**	**0.59**					
RGO NGT (mg/kg)[1]	34,942	2,458	31	3,483	109	16	351		1,646	838	35	105	10	105	10					
Change Houses[2]																				
CB-12 LL1-194							2,070										30	30	2	1,800
CB-8 CB08-03		1.2U	2.5				2,040	31.4									30	132	2	7,920
TOTAL																				9,720
TOTAL CORRECTED FOR OVERLAP																				9,720

Notes:

[1] - RGOs from Proposed RGO document (Shaw, 2004) approved by OhioEPA in July 2004.

[2] - Reported highest concentration of sample or field duplicate, where applicable. Reported highest concentration of surface or subsurface sample, where applicable.

Shaded concentration values exceed the RGO for the National Guard Trainee (NGT). Although dimension values are estimated, shaded dimension values indicate less well defined limits.

NO ADDITIONAL REMEDIATION REQUIRED FOR PCBs, SVOCs, EXPLOSIVES, OR METALS (EXCLUDING MANGANESE).

Load Line 1		METALS								EXPLOSIVES		PCBs	SVOCs				ESTIMATED REMEDIATION VOLUME FOR ARSENIC				ESTIMATED REMEDIATION VOLUME FOR MANGANESE			
	COCs	Aluminum	Antimony	Arsenic	Barium	Cadmium	Hex. Chromium	Manganese	Lead	2,4,6-TNT	RDX	PCB-1254	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b) fluoranthene	Dibenzo(a,h) anthracene	Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)	Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)
	PRG (mg/kg)	17,700	0.96	15.4	88.4	NA	NA	1,800	1,995	NA	NA	NA	NA	NA	NA	NA								
	RGO Resident (mg/kg)[1]	**77,540**	**31**	**5.7**	**5,285**	**72**		**3,316**		**32**	**47**	**1.2**	**5.9**	**0.59**	**5.9**	**0.59**								
	RGO NGT (mg/kg)[1]	34,942	2,458	31	3,483	109	16	351		1,646	838	35	105	10	105	10								
Sediment Samples[2]																								
C/Charlie's	LL1sd-058(p)			**67.1**													73	73	2	10,658				
C/Charlie's	LL1sd-059(p)			**54.7**													56	56	2	6,272				
C/Charlie's	LL1-060		1.7U	**50.5**				322	24.9								10	15	2	300				
Off-AOC	LL1-320		2.8U	**37.9**				441	25								30	30	2	1,800				
C/Charlie's	LL1-288		2U	**12.4**				2,350	20.5												10	10	2	200
Perimeter/Miscellaneous																								
perimeter, southernmost	LL1-215							2,130													30	30	2	1,800
perimeter, southernmost	LL1sd-052(d)							1,850													30	30	2	1,800
DEF/Criggy	LL1-400		1.4U	**16**				1,800	42.4												30	30	2	1,800
DEF/Criggy	LL1-397		2	**21**				2,750	127												10	10	2	200
DEF/Criggy	LL1-399		1.7U	**18.2**				**3,380**	30.8												30	10	2	600
																TOTAL				19,030				6,400
																TOTAL CORRECTED FOR OVERLAP				19,030				6,400

Notes:

[1] - RGOs from Proposed RGO document (Shaw, 2004) approved by OhioEPA in July 2004.

[2] - Reported highest concentration of sample or field duplicate, where applicable. Reported highest concentration of surface or subsurface sample, where applicable.

Shaded concentration values exceed the RGO for the National Guard Trainee (NGT). Although dimension values are estimated, shaded dimension values indicate less well defined limits.

NO ADDITIONAL REMEDIATION REQUIRED FOR PCBs, SVOCs, EXPLOSIVES, OR LEAD.

Load Line 2
Volume Estimate Summary

REMEDIATION VOLUME FOR INDIVIDUAL CONTAMINANT CATEGORIES

	Volume*	Volume*	Volume*	Volume*	Volume*	Volume*	Volume*	
COC	PCBs	SVOCs	TNT/RDX	Arsenic	Metals, other	Mn	Lead	
Estimate Basis	NGTRGO	NGTRGO	NGTRGO	NGTRGO	NGTRGO	PRG	PRG	**TOTAL**
Total (ft^3)	8,638	28	7,074	24,465	12,633	25,227	26,286	**104,349**
Total (cy)	320	1	262	906	468	934	974	**3,865**

REMEDIATION VOLUME CORRECTED TO REMOVE OVERLAP

	Volume*	Volume*	Volume*	Volume*	Volume*	Volume*	Volume*	
COC	PCBs	SVOCs	TNT/RDX	Arsenic	Metals, other	Mn	Lead	
Estimate Basis	NGTRGO	NGTRGO	NGTRGO	NGTRGO	NGTRGO	PRG	PRG	**TOTAL**
Total (ft^3)	8,638	0	7,074	19,704	2,348	20,439	4,168	**62,369**
Total (cy)	320	0	262	730	87	757	154	**2,310**

*volumes in units of cubic feet and based on contaminant category only

Load Line 2

Location	Sample ID	Aluminum	Antimony	Arsenic	Barium	Cadmium	Hex. Chromium	Manganese	Lead	2,4,6-TNT	RDX	Arochlor 1254	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b) fluoranthene	Dibenzo(a,h) anthracene
		METALS								EXPLOSIVES		PCBs	SVOCs			
	COCs	Aluminum	Antimony	Arsenic	Barium	Cadmium	Hex. Chromium	Manganese	Lead	2,4,6-TNT	RDX	Arochlor 1254	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b) fluoranthene	Dibenzo(a,h) anthracene
	PRG (mg/kg)	17,700	0.96	15.4	88.4	NA	NA	1,800	1,995	NA	NA	NA	NA	NA	NA	NA
	RGO Resident (mg/kg)[1]	**77,540**	**31**	**5.7**	**5,285**	**72**		**3,316**		**32**	**47**	**1.2**	**5.9**	**0.59**	**5.9**	**0.59**
	RGO NGT (mg/kg)[1]	34,942	2,458	31	3,483	109	16	351		1,646	838	35	105	10	105	10
Explosives Handling Area[2]																
DB-4 sump	LL2-227			**60.8**	**17500**	**187**		1,870	23,300			**3200**				
DB-4 sump	LL2-228											**170**				
DB-4A	LL2ss-014			**8.7**				754	881	**470**	9,800					
DB-4A	LL2ss-044									**12,000**	20					
DB-4A	LL2-231		0.79U	**31.5**				308	20.6							
DB-4A sump	LL2-229								2,240			**1500**				
DB-4A sump	LL2-230			**37.1**				2,010	3,080			**570**		**23**		
DB-10	LL2-232		3.1U	**9.2**				**4,990**	**431**							
DB-10	LL2ss-032			**6.2**				**4,240**	46.1							
DB-10	LL2ss-031		0.33	4.4				3,310	81							
DB-10, ballast slag	LL2-216	35,200						**5,370**								
DB-10 sewer	LL2-236		1.3U	**6.7**				2,620	148			**3.7**				
DA-6	LL2-086		1.2U	**22.1**					14.7	17,000	3.5U					
Preparation and Receiving Area																
DB-3	LL2-243		**664**	**13.4**				374	2,610			**4.6**				
DB-3	LL2-166		2	**18**				1,770	2,510			**36**	1.5	**1.9**	2.5	0.27
DB-3	LL2-167		**192**	**38.8**				2,280	2,320			**59**				
DB-3 sewer	LL2-250		**8,910**	**36.2**				568	23,700							
DA-5 perimeter	LL2-211		1.1U	**11**				1,920	20.7							
DA-5 perimeter	LL2-248		**8,120**	**36.5**				473	24,800			**5.7**				
DB-802	LL2-188		7.1	**30**			81.9	1,400	6,930			0.22				
DB-802	LL2-178		0.84	**14.2**				635	2,190							
DB-802 sewer	LL2-251		**845**	**8.7**				374	5,280			**4.3**				
Packaging and Shipping Areas																
DB-27	LL2-067		1.3U	**74.4**				681	17.7							
DB-27A	LL2-071		1.3U	**49.1**				307	9.6							
DB-27C perimeter	LL2-206		1.3U	**13.1**				2,910	27.6							
DB-13	LL2-101		0.68	**7.5**				**7,460**	64.3							
DB-13B	LL2-104		1.2	**8.9**				3,070	**535**			**9.5**				
Perimeter Area																
DA-21	LL2-094									**3,600**	3.6	1.1				
DA-7	LL2-078		1.3U	**6.3**				2,180	36.8			**1.4**				
DA-7 perimeter	LL2-208		1.2U	**8.6**				2,760	18.0							
South Svc. Rd.	LL2-198		1.2U	**12.5**				2,100	20.7							
South Svc. Rd. sump	LL2-259							**5,840**								
South Svc. Rd.	LL2sd/sw-049(d)		21.3	**28.8**				1,860	150	NA	6.8					
Sumps																
DB-4/4A sump	LL2-214							**7,500**								

Location	Sample ID	ESTIMATED REMEDIATION VOLUME FOR PCBs				ESTIMATED REMEDIATION VOLUME FOR SVOCs				ESTIMATED REMEDIATION VOLUME FOR EXPLOSIVES				ESTIMATED REMEDIATION VOLUME FOR ARSENIC				ESTIMATED REMEDIATION VOLUME FOR METALS (excluding As, Mn and Pb)				ESTIMATED REMEDIATION VOLUME FOR MANGANESE				ESTIMATED REMEDIATION VOLUME FOR LEAD			
		Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)	Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)	Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)	Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)	Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)	Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)	Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)
Explosives Handling Area[2]																													
DB-4 sump	LL2-227	5	5	1	28									5	5	1	28	5	5	1	28	5	5	1	28	5	5	1	28
DB-4 sump	LL2-228	5	5	1	28																								
DB-4A	LL2ss-014									34	33	2	2,244																
DB-4A	LL2ss-044									39	19	2	1,482																
DB-4A	LL2-231													18	36	2	1,296												
DB-4A sump	LL2-229	5	5	1	28																					5	5	1	28
DB-4A sump	LL2-230	5	5	1	28	5	5	1	28					5	5	1	28					5	5	1	28	5	5	1	28
DB-10	LL2-232																					8	45	2	720				
DB-10	LL2ss-032																					49	25	2	2,450				
DB-10	LL2ss-031																					11	79	2	1,738				
DB-10, ballast slag	LL2-216																	5	5	1	28	5	5	1	28				
DB-10 sewer	LL2-236																					5	5	1	28				
DA-6	LL2-086									41	27	2	2,214																
Preparation and Receiving Area																													
DB-3	LL2-243																									18	13	2	468
DB-3	LL2-166	147	13	2	3,822																					147	13	2	3,822
DB-3	LL2-167	181	13	2	4,706									181	13	2	4,706					181	13	2	4,706	181	13	2	4,706
DB-3 sewer	LL2-250													5	5	1	28	5	5	1	28					5	5	1	28
DA-5 perimeter	LL2-211																					30	93	2	5,580				
DA-5 perimeter	LL2-248													93	55	2	10,230	93	55	2	10,230					93	60	2	11,160
DB-802	LL2-188																	20	58	2	2,320					20	58	2	2,320
DB-802	LL2-178																									153	12	2	3,672
DB-802 sewer	LL2-251																									5	5	1	28
Packaging and Shipping Areas																													
DB-27	LL2-067													65	19	2	2,470												
DB-27A	LL2-071													71	40	2	5,680												
DB-27C perimeter	LL2-206																					30	30	2	1,800				
DB-13	LL2-101																					10	26	2	520				
DB-13B	LL2-104																					29	10	2	580				
Perimeter Area																													
DA-21	LL2-094									27	21	2	1,134																
DA-7	LL2-078																					28	28	2	1,568				
DA-7 perimeter	LL2-208																					30	30	2	1,800				
South Svc. Rd.	LL2-198																					30	30	2	1,800				
South Svc. Rd. sump	LL2-259																					5	5	1	28				
South Svc. Rd.	LL2sd/sw-049(d)																					30	30	2	1,800				
Sumps																													
DB-4/4A sump	LL2-214																					5	5	1	28				
TOTAL					8,638				28				7,074				24,465				12,633				25,227				26,286
TOTAL CORRECTED FOR OVERLAP					8,638				0				7,074				19,704				2,348				20,439				4,168

Notes:
[1] - RGOs from Proposed RGO document (Shaw, 2004) approved by OhioEPA in July 2004.
[2] - Reported highest concentration of sample or field duplicate, where applicable. Reported highest concentration of surface or subsurface sample, where applicable.
Shaded concentration values exceed the RGO for the National Guard Trainee (NGT). Although dimension values are estimated, shaded dimension values indicate less well defined limits.

Load Line 3
Volume Estimate Summary

REMEDIATION VOLUME FOR INDIVIDUAL CONTAMINANT CATEGORIES

	Volume*	Volume*	Volume*	Volume*	Volume*	Volume*	Volume*	
COC	PCBs	SVOCs	TNT/RDX	Arsenic	Metals, other	Mn	Lead	
Estimate Basis	NGTRGO	NGTRGO	NGTRGO	NGTRGO	NGTRGO	PRG	PRG	
								TOTAL
Total (ft^3)	28,674	600	12,160	3,628	966	62,766	5,265	**114,058**
Total (cy)	1,062	22	450	134	36	2,325	195	**4,224**

REMEDIATION VOLUME CORRECTED TO REMOVE OVERLAP

	Volume*	Volume*	Volume*	Volume*	Volume*	Volume*	Volume*	
COC	PCBs	SVOCs	TNT/RDX	Arsenic	Metals, other	Mn	Lead	
Estimate Basis	NGTRGO	NGTRGO	NGTRGO	NGTRGO	NGTRGO	PRG	PRG	
								TOTAL
Total (ft^3)	26,154	0	12,160	1,216	966	59,712	3,658	**103,865**
Total (cy)	969	0	450	45	36	2,212	135	**3,847**

*volumes in units of cubic feet and based on contaminant category only

Load Line 3		METALS								EXPLOSIVES		PCBs	SVOCs			
	COCs	Aluminum	Antimony	Arsenic	Barium	Cadmium	Hex. Chromium	Manganese	Lead	2,4,6-TNT	RDX	Arochlor 1254	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b) fluoranthene	Dibenzo(a,h) anthracene
	PRG (mg/kg)	17,700	0.96	15.4	88.4	NA	NA	1,800	1,995	NA	NA	NA	NA	NA	NA	NA
	RGO Resident (mg/kg)[1]	**77,540**	**31**	**5.7**	**5,285**	**72**		**3,316**		**32**	**47**	**1.2**	**5.9**	**0.59**	**5.9**	**0.59**
	RGO NGT (mg/kg)[1]	34,942	2,458	31	3,483	109	16	351		1,646	838	35	105	10	105	10
Explosive Handling Area[2]																
EA-6	LL3-160	35,200	1.2U	1.8U				**3,500**	3.6							
EA-6	LL3-058		4	**8.8**				2,300	1,590			**160**	**29**	**23**	**29**	**4.1**
EA-6	LL3-153		1.1U	**11.7**				2,970	66.8			**10**				
EA-6	LL3-158		1.1U	**7.6**				1,960	16.6							
EA-6	LL3-245		1.1U	**15.5**				2,140	33.4							
EA-6	LL3-231									**3,600**	25U					
EA-6	LL3-157									**4,200**	0.5U					
EA-6	LL3-230									**2,400**	25U					
EB-4	LL3-102		**164**	**34**				2,700	1,350			**1,100**				
EB-4	LL3-111		2.8	4.5				2,890	201			**35**				
EB-4	LL3-103											**38**				
EB-4	LL3-106		1.6U	**23.5**				518	405			**100**				
EB-4 ditch	LL3-219		**177**	**20.7**				213	873			**36**				
EB-4 Sump	LL3-210		5.6	**27.5**				907	4,710	**380**	**350**	110				
EB-4	LL3ss-002									**5,660**	5U	**21**				
EB-4	LL3-097		0.97	**8**				2,650	22.3							
EB-4	LL3ss-021		NR	**12.8**				2,300	21.2							
EB-4	LL3ss-022		NR	**9.6**				**4,800**	20.6							
EB-4	LL3-099		1.2U	**31.4**				455	16.6							
EB-4A Sump	LL3-211		6.2	37				2,110	788							
EB-4A	LL3ss-012									5,500						
EB-4A	LL3ss-013		NR	**12.6**				520	2,620							
EB-4A	LL3-128											**44**				
EB-4A / EB-25	LL3-221		1.2	**14.2**				2,380	19.1							
EB-10 / 10A	LL3ss-034									**390,000**	5,000U					
EB-10 / 10A	LL3-086		1.1U	**11**				1,810	18.8							
Preparation and Receiving Area																
EB-803 sewer	LL3-223		**756**	**13.8**					3,930							
Packaging and Receiving Area																
EB-11	LL3-077		**166**	**22.8**				**3,260**	8,950	**820**	NR	91				
Change Houses																
EB-8A	LL3-149		NR	NR				2,040	177							
EB-8A ditch	LL3-046(p2)		1.2U	**16.5**				2,620	18.5							
EB-22	LL3-150		NR	NR				2,440	28.9							
EB-22 ditch	LL3sd/sw-049(d)		NR	**18**				2,310	24.1							
EB-22 ditch	LL3-049(p2)		2.1U	**16.6**				**4,620**	31.9				5.3	**4.5**	**6.5**	**0.67**
Perimeter and Tank Storage Areas																
EA-21	LL3-055		1.2U	**24.2**				1,610	2,500			110				
EB-13	LL3-173		1.3U	**13.8**				1,910	26							
EA-5 south	LL3-186		17.3	**13**				1,870	22							
EA-5 south	LL3-193		1.8	**8.8**				1,980	22.4							
EA-5 south	LL3-196		1.1U	**7.4**				2,510	12.9							

Location	Sample	ESTIMATED REMEDIATION VOLUME FOR PCBs				ESTIMATED REMEDIATION VOLUME FOR SVOCs				ESTIMATED REMEDIATION VOLUME FOR EXPLOSIVES				ESTIMATED REMEDIATION VOLUME FOR ARSENIC				ESTIMATED REMEDIATION VOLUME FOR METALS (excluding As, Mn and Pb)				ESTIMATED REMEDIATION VOLUME FOR MANGANESE				ESTIMATED REMEDIATION VOLUME FOR LEAD			
		Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)	Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)	Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)	Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)	Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)	Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)	Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)
Explosive Handling Area[2]																													
EA-6	LL3-160																	23	21	2	966	23	21	2	966				
EA-6	LL3-058	18	15	2	540	20	15	2	600													23	18	2	828				
EA-6	LL3-153																					23	20	2	920				
EA-6	LL3-158																					45	30	2	2,700				
EA-6	LL3-245																					31	30	2	1,860				
EA-6	LL3-231									14	20	2	560																
EA-6	LL3-157									18	20	2	720																
EA-6	LL3-230									16	20	2	640																
EB-4	LL3-102	89	31	2	5,518									67	18	2	2,412					45	18	2	1,620				
EB-4	LL3-111	30	22	3	1,980																	45	22	3	2,970				
EB-4	LL3-103	98	20	2	3,920																								
EB-4	LL3-106	81	22	2	3,564																								
EB-4 ditch	LL3-219	70	30	2	4,200																								
EB-4 Sump	LL3-210	5	5	1	28																					5	5	1	28
EB-4	LL3ss-002									40	50	3	6,000																
EB-4	LL3-097																					75	40	2	6,000				
EB-4	LL3ss-021																					68	28	2	3,808				
EB-4	LL3ss-022																					28	34	2	1,904				
EB-4	LL3-099													22	27	2	1,188												
EB-4A Sump	LL3-211													5	5	1	28					5	5	1	28				
EB-4A	LL3ss-012									31	50	2	3,100																
EB-4A	LL3ss-013																									55	33	2	3,630
EB-4A	LL3-128	54	68	2	7,344																								
EB-4A / EB-25	LL3-221																					33	27	2	1,782				
EB-10 / 10A	LL3ss-034									19	30	2	1,140																
EB-10 / 10A	LL3-086																					64	38	2	4,864				
Preparation and Receiving Area																													
EB-803 sewer	LL3-223																									5	5	1	28
Packaging and Receiving Area																													
EB-11	LL3-077	10	22	2	440																	10	22	2	440	10	22	2	440
Change Houses																													
EB-8A	LL3-149																					34	40	2	2,720				
EB-8A ditch	LL3-046(p2)																					10	40	2	800				
EB-22	LL3-150																					10	33	2	660				
EB-22 ditch	LL3sd/sw-049(d)																					10	33	2	660				
EB-22 ditch	LL3-049(p2)																					20	36	2	1,440				
Perimeter and Tank Storage Areas																													
EA-21	LL3-055	30	19	2	1,140																					30	19	2	1,140
EB-13	LL3-173																					10	10	2	200				
EA-5 south	LL3-186																					103	32	2	6,592				
EA-5 south	LL3-193																					104	53	2	11,024				
EA-5 south	LL3-196																					133	30	2	7,980				
TOTAL					28,674				600				12,160				3,628				966				62,766				5,265
TOTAL CORRECTED FOR OVERLAP					26,154				0				12,160				1,216				966				59,712				3,658

Notes:

[1] - RGOs from Proposed RGO document (Shaw, 2004) approved by OhioEPA in July 2004.

[2] - Reported highest concentration of sample or field duplicate, where applicable. Reported highest concentration of surface or subsurface sample, where applicable.

Shaded concentration values exceed the RGO for the National Guard Trainee (NGT). Although dimension values are estimated, shaded dimension values indicate less well defined limits.

Load Line 4
Volume Estimate Summary

REMEDIATION VOLUME FOR INDIVIDUAL CONTAMINANT CATEGORIES

COC	Volume* PCBs	Volume* SVOCs	Volume* TNT/RDX	Volume* Arsenic	Volume* Metals, other	Volume* Mn	Volume* Lead	
Estimate Basis	NGTRGO	NGTRGO	NGTRGO	NGTRGO	NGTRGO	PRG	PRG	**TOTAL**
Total (ft^3)	798	0	28	55	17,458	32,153	1,150	**51,640**
Total (cy)	30	0	1	2	647	1,191	43	**1,913**

REMEDIATION VOLUME CORRECTED TO REMOVE OVERLAP

COC	Volume* PCBs	Volume* SVOCs	Volume* TNT/RDX	Volume* Arsenic	Volume* Metals, other	Volume* Mn	Volume* Lead	
Estimate Basis	NGTRGO	NGTRGO	NGTRGO	NGTRGO	NGTRGO	PRG	PRG	**MIN**
Total (ft^3)	798	0	0	28	17,458	14,880	1,122	**34,285**
Total (cy)	30	0	0	1	647	551	42	**1,270**

*volumes in units of cubic feet and based on contaminant category only

Load Line 4

	COCs	METALS								EXPLOSIVES		PCBs	SVOCs			
		Aluminum	Antimony	Arsenic	Barium	Cadmium	Hex. Chromium	Manganese	Lead	2,4,6-TNT	RDX	Arochlor 1254	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b) fluoranthene	Dibenzo(a,h) anthracene
	PRG (mg/kg)	17,700	0.96	15.4	88.4	NA	NA	1,800	1,995	NA	NA	NA	NA	NA	NA	NA
	RGO Resident (mg/kg)[1]	**77,540**	**31**	**5.7**	**5,285**	**72**		**3,316**		**32**	**47**	**1.2**	**5.9**	**0.59**	**5.9**	**0.59**
	RGO NGT (mg/kg)[1]	34,942	2,458	31	3,483	109	16	351		1,646	838	35	105	10	105	10
Melt-Pour Building[2]																
G-8 sewer	LL4-175		21.2	**40**				2,490	5,020	**310**	**2,100**	**260**				
G-8	LL4ss-014							2,830								
G-10	LL4-118								5,790							
Handling and Prep																
G-11	LL4-080	37,400						**6,730**								
G-11	LL4-081	38,800						**7,320**								
G-11	LL4-082							2,150								
Processing (G-12, 12A, 13 13A)																
G-12A	LL4-112							**4,560**								
Packaging and Shipping Area (G-18, 19, 19A)																
G-19	LL4-095			NR				1,870	501							
G-19 sewer	LL4-186			**26.6**				**30,500**	251							
Steam Plant and Powerhouse (G-4)																
G-4	LL4-133											**48**				
Inert Handling (G-1, 1A, 2, 3)																
G-1A	LL4-088	36,700						**4,660**								
G-3	LL4-127							1,830				**5.7**				
Storm Sewer																
pond	LL4-187			**157**				**4,410**	27				3.2	**3.5**	5.5	0.51

		ESTIMATED REMEDIATION VOLUME FOR PCBs				ESTIMATED REMEDIATION VOLUME FOR EXPLOSIVES				ESTIMATED REMEDIATION VOLUME FOR ARSENIC				ESTIMATED REMEDIATION VOLUME FOR METALS (excluding As, Mn and Pb)				ESTIMATED REMEDIATION VOLUME FOR MANGANESE				ESTIMATED REMEDIATION VOLUME FOR LEAD			
		Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)	Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)	Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)	Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)	Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)	Length (ft)	Width (ft)	Depth (ft)	Total Volume (ft^3)
Melt-Pour Building[2]																									
G-8 sewer	LL4-175	5	5	1	28	5	5	1	28	5	5	1	28					5	5	1	28	5	5	1	28
G-8	LL4ss-014																	53	31	2	3,286				
G-10	LL4-118																					17	33	2	1,122
Handling and Prep																									
G-11	LL4-080													28	11	2	616	28	11	2	616				
G-11	LL4-081													28	12	2	672	18	12	2	432				
G-11	LL4-082																	58	25	2	2,900				
Processing (G-12, 12A, 13 13A)																									
G-12A	LL4-112																	25	40	2	2,000				
Packaging and Shipping Area (G-18, 19, 19A)																									
G-19	LL4-095																	44	42	2	3,696				
G-19 sewer	LL4-186																	5	5	1	28				
Steam Plant and Powerhouse (G-4)																									
G-4	LL4-133	35	11	2	770																				
Inert Handling (G-1, 1A, 2, 3)																									
G-1A	LL4-088													98	55	3	16,170	98	55	3	16,170				
G-3	LL4-127																	135	11	2	2,970				
Storm Sewer																									
pond	LL4-187									5	5	1	28					5	5	1	28				
TOTAL					798				28				55				17,458				32,153				1,150
TOTAL CORRECTED FOR OVERLAP					798				0				28				17,458				14,880				1,122

Notes:
[1] - RGOs from Proposed RGO document (Shaw, 2004) approved by OhioEPA in July 2004.
[2] - Reported highest concentration of sample or field duplicate, where applicable. Reported highest concentration of surface or subsurface sample, where applicable.
Shaded concentration values exceed the RGO for the National Guard Trainee (NGT). Although dimension values are estimated, shaded dimension values indicate less well defined limits.
NO ADDITIONAL REMEDIATION REQUIRED FOR SVOCs.

Appendix D

Applicable or Relevant and Appropriate Requirements

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Table D-1

Potential Chemical-Specific ARARs and TBC Guidance for Remediation of Soils at LLs 1-4

Action	Requirements	Prerequisite	Citation(s)
Surface and Sub-Surface Soils	The GDCS may apply to any property except for certain circumstances specified in OAC 3745-300-08(B)(1). See below.	The GDCS are not applicable to excavation of soils at LLs 1-4 because remediation is not conducted under the VAP. The GDCS are not relevant and appropriate because the circumstances listed under OAC 3745-300-08(B)(1) apply.	OAC 3745-300-08(B)(1)
	Property-specific risk-based standards must be determined in place of or in addition to GDCS if (1) the exposure pathways or exposure factors for the intended land use are not included in the development of GDCS for residential, commercial, or industrial scenarios considered for the GDCS; (2) the chemicals of concern at the property are not included in the GDCS; (3) radioactive materials are identified on the property; (4) PCBs subject to TSCA are identified on the property; or (5) important ecological resources on the property are impacted.	Property-specific risk-based clean-up standards are applicable to LLs 1-4 because the exposure scenarios for the intended land use are not considered in the development of the GDCS. Property-specific risk-based clean up standards are developed in accordance with CERCLA methodology.	OAC 3745-300-09(B)(2)
Surface Waters and Wetlands	All waters of the state shall be free of suspended solids, floating debris, oil, scum, or toxic substances from human activity that create a nuisance, cause degradation, or adversely affect aquatic life. There may be no degradation of water quality that results in violation of the applicable water quality criteria or the impairment of existing uses. Wetlands-designated uses shall be maintained and protected such that degradation through direct, indirect, or cumulative impacts do not result in wetland use or function.	Applicable to activities at LLs 1-4 that may impact waters of the state (connected drainageways) or wetlands, including isolated wetlands. Applicable to any CWA 401 certification, any non-point source of pollution that adds a regulated pollutant or any state-isolated wetland permit application. The applicant of subject activities must submit documentation, as required under OAC 3745-1-5(B)(3). Submittal and review requirements do not apply to discharge to limited quality waters and discharges with less than 65 mg/L of total suspended solids.	OAC 3745-1-04 OAC 3745-1-5(B)(1) and (2) OAC 3745-1-5(D) OAC 3745-1-54

ARARs = Applicable or relevant and appropriate requirements.
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980.
CWA = Clean Water Act.
GDCS = Generic direct contact soils standard.
LLs 1-4 = Load Lines 1 through 4.
mg/L = milligrams per Liter.
OAC = Ohio Administrative Code.
PCBs = Polychlorinated biphenyls.
TBC = To be considered.
TSCA = Toxic Substances Control Act of 1976.
VAP = Voluntary Action Program.

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Table D-2

Potential Action-Specific ARARs and TBC Guidance for Remediation of Soils at LLs 1-4

Action	Requirements	Prerequisite	Citation(s)
General Construction Standards-Site Preparation and Excavation			
Activities Resulting in the Emission of Particulate Matter, Dusts, Fumes, Gas, Mists, Smoke, etc. From a Hazardous Waste Facility	No owner/operator of a hazardous waste facility shall cause or allow the emission of any particulate matter, dusts, gas, fumes, mists, smoke, vapor, or odorous substances that interferes with the enjoyment of life or property by persons living or working in the vicinity of the facility. Any such action is considered a public nuisance.	Applicable to soil excavation activities at LLs 1-4	ORC 3734.02(I) OAC 3745-15-07(A)
Activities Causing Fugitive Dust Emissions	Persons engaged in construction activities shall take reasonable precautions to prevent particulate matter from becoming airborne; reasonable precautions include, but are not limited to, the following: • the use of water or chemicals for control of dust during construction operations or clearing of land; and • the application of asphalt, oil, water, or suitable chemicals on dirt roads, materials stockpiles, and other surfaces, which can create airborne dusts. No person shall cause, or allow, fugitive dust to be emitted in such a manner that visible emissions are produced beyond the property line.	Applicable to fugitive emissions from demolition of existing buildings or structures, construction operations, grading of roads, or the clearing of land. Applicable to pre-construction clearing activities and excavation activities.	OAC 3745-17-08(B)
Construction Activities Causing Storm Water Runoff (e.g., clearing, grading, and excavation)	Construction activities disturbing more than 1 acre must develop and implement a storm water pollution prevention plan incorporating best management practices (including sediment and erosion controls, vegetative controls, and structural controls) in accordance with the requirements of the Ohio EPA General Permit for Construction Activities (Permit ORC 000002). An NOI shall be submitted 21 days prior to initiation of the construction activity.	Applicable to stormwater discharges from land disturbances from a construction activity involving more than 1 acre. NOI must be submitted pursuant to DERR-OO-RR-034, which indicates that no permit exemption equivalent to CERCLA Section 121(e) is available for non-NPL sites.	40 *CFR* 122.26 OAC 3745-38-06

Table D-2

Potential Action-Specific ARARs and TBC Guidance for Remediation of Soils at LLs 1-4

Action	Requirements	Prerequisite	Citation(s)
Removal of Contaminated Soils			
Removal or Remediation of Hazardous-contaminated Soils	The GDCS may apply to any property except for certain circumstances specified in OAC 3745-300-08(B)(1). Property-specific risk-based standards must be determined in place of or in addition to the GDCS if: (l) the exposure pathways or exposure factors for the intended land use are not included in the development of the GDCS for residential, commercial, or industrial scenarios; (2) the chemicals of concern at the property are not included in the GDCS; (3) radioactive materials are identified on the property; (4) PCBs subject to TSCA are identified on the property; or (5) important ecological resources are identified on the property.	The GDCS are not applicable to at LLs 1-4 because the action is not under the VAP. The GDCS are not re1evant and appropriate because the exposure scenarios for the intended land use are not considered in the development of the GDCS and certain chemicals of concern are not included in OAC 3745-300-08(B)(3). Property-specific risk-based clean-up standards will be developed in accordance with CERCLA methodology.	OAC 3745-300-08(B)(1) OAC 3745-300-09(B)(2)
	No person shall engage in filling, grading, excavating, drilling, or mining on land where a hazardous waste or solid waste facility was operated without prior authorization from the director of the Ohio EPA.	Not applicable to HTRW excavation activities at LLs 1-4. MEC activities are covered under the Administrative Orders and are therefore exempt from OAC 3745-27-13. See OAC 3745-27.13(C).	ORC 3734.02(H) OAC 3745-27-13(C)
Waste Generation, Characterization, Segregation, and Storage-Excavated Soils and Buried Wastes, Sludge, Surface Features, Debris, and Secondary Wastes			
Generation and Characterization of Solid Waste *(all primary and secondary wastes)*	The generator must determine if the material is a solid waste, as defined in 40 *CFR* 261.2 and 40 *CFR* 261.4(a). if the material is a solid waste, the generator must determine if the solid waste is a hazardous waste by:	Applicable to generation of a solid waste as defined in 40 *CFR* 261.2 and that is not excluded under 40 *CFR* 261.4(a).	40 *CFR* 262.11(a)(b)(c) OAC 3745-52-11(A)(B)(C)(D)
	• determining if the waste is listed under 40 *CFR* Part 261; or • determining if the waste exhibits characteristics by using prescribed testing methods or applying generator knowledge based on information regarding material or processes used; and • determining if the waste is excluded under 40 *CFR* Parts 261, 262, 266, 268, and 273	Applicable to the generation and characterization of hazardous-contaminated soil and hazardous debris resulting from excavation. Process history indicates that soils were contaminated with K046 pink/red water from TNT operations. Applicable to the generation and characterization of hazardous-contaminated soil and hazardous debris resulting from excavation. Site data indicate that soils contain metals at concentrations that exceed 20 times the TC limit and may exhibit the characteristics D008. Applicable to generation of decontamination wastewater.	40 *CFR* 262.11(a)(b)(c) OAC 3745-52-11(A)(B)(C)(D) 40 *CFR* 262.II(a)(b)(c) OAC 3745-52-11(A)(B)(C)(D)
	The generator must determine if the waste is restricted from land disposal under 40 *CFR* 268 *et seq.* by testing in accordance with prescribed methods or use of generator knowledge of waste.	Applicable to the generation and characterization of hazardous-contaminated soil and hazardous debris resulting from excavation. Applicable to generation of decontamination wastewater.	40 *CFR* 268.7 OAC 3745-270-07

Table D-2

Potential Action-Specific ARARs and TBC Guidance for Remediation of Soils at LLs 1-4

Action	Requirements	Prerequisite	Citation(s)
	The generator must determine each EPA Hazardous Waste Number (Waste Code) to determine the applicable treatment standards under 40 CFR 268.40, Subpart D.	Applicable to the generation and characterization of hazardous-contaminated soil and hazardous debris resulting from excavation. Applicable to generation of decontamination wastewater.	40 *CFR* 268.9(a) OAC 3745-270-07 OAC 3745-270-09
	The generator must determine the underlying hazardous constituents [as defined in 40 *CFR* 268.2(i)] in the waste.	Applicable to the generation and characterization of RCRA characteristic hazardous waste (except D00I non-wastewaters treated by combustion, recovery of organics, or polymerization. See 268.42, Table I) and to hazardous-contaminated soils for their subsequent storage, treatment, or disposal.	40 *CFR* 268.9(a) OAC 3745-270-09
Accumulation of Hazardous Debris from Excavation and Screening. It is Assumed that any Debris Resulting from Excavation and Screening will be Accumulated for < 90 Days	A generator may accumulate for up to 90 days or conduct treatment of hazardous wastes in containers without an Ohio EPA permit. Generators that accumulate for 90 days or conduct on-site treatment of hazardous waste in containers must comply with the personnel training, preparedness and prevention requirements, and contingency plan requirements of 40 *CFR* 265.16; 40 *CFR* 265, Subpart C; and 40 *CFR* 265, Subpart D, respectively.	Applicable to 90-day accumulation of debris from excavation and screening if such debris contains listed wastes or exhibits a characteristic.	40 *CFR* 262.34(a)(4) OAC 3745-52-34(A)(4)
	Containers must be marked with the date upon which period of accumulation began and with the words "Hazardous Waste."	Applicable to 90-day accumulation of debris from excavation and screening if such debris contains listed wastes or exhibits a characteristic.	40 *CFR* 262.34 (a)(2)(3) OAC 3745-52-34 (A)(2)(3)
	Containers holding hazardous wastes must be kept closed except to add or remove wastes and must not be managed in a manner that would cause them to leak.	Applicable to 90-day accumulation of debris from excavation and screening if such debris contains listed wastes or exhibits a characteristic.	40 *CFR* 264.171 40 *CFR* 264.172 40 *CFR* 264.173 40 *CFR* 264.176 40 *CFR* 264.17 OAC 3745-52-34(A)(1)
	Containers of hazardous waste must be maintained in good condition and comparable with the waste stored therein. Containers holding ignitable or reactive wastes must be separated from potential ignition sources and located 50 ft from the property boundary.		
Storage of Hazardous-contaminated Soil in a Waste Pile	Submission of Parts A and B of the RCRA Permit Application is required for owners/operators of any Hazardous Waste Management Unit. Specific submission requirements are provided at 40 *CFR* 270.13 and 270.14.	Applicable to storage of soils from excavation if the soils are hazardous per the toxicity characteristic. Not ARAR if the soils do not contain a hazardous waste. There is no state equivalent to the permit exemption provided by CERCLA Section 121(e). It is the DERR's policy to require responsible parties to acquire and comply with all permits required by the action (unless permit exception is provided for by the orders).	40 *CFR* 270.13 40 *CFR* 270.14 40 *CFR* 270.18 OAC 3745-50-44 OAC 3745-50-44(C)(4)

Table D-2

Potential Action-Specific ARARs and TBC Guidance for Remediation of Soils at LLs 1-4

Action	Requirements	Prerequisite	Citation(s)
	Owners/operators of hazardous waste management facilities must comply with the General Facility Standards of 40 *CFR* 264, Subpart B concerning waste analysis, site security, inspection/maintenance, personnel training, special precautions for management of ignitable or reactive wastes, and locations standards.	Applicable to storage of soils from excavation if the soils are hazardous per the toxicity characteristic. Not ARAR if the soils do not contain a hazardous waste. There is no state equivalent to the permit exemption provided by CERCLA Section 121(e). It is the DERR's policy to require responsible parties to acquire and comply with all permits required by the action (unless permit exception is provided for by the orders).	40 *CFR* 264.13 to 40 *CFR* 264.18 OAC 3745-54-13 to OAC 3745-54-18
	Owners/operators of hazardous waste management facilities must comply with the Preparedness Standards of 40 *CFR* 264, Subpart C concerning alarms, communication systems, notification of local authorities, testing and maintenance of spill control and emergency response equipment, and aisle space.	Applicable to storage of soils from excavation if the soils are hazardous per the toxicity characteristic. Not ARAR if the soils do not contain a hazardous waste. There is no state equivalent to the permit exemption provided by CERCLA Section 121 (e). It is the DERR's policy to require responsible parties to acquire and comply with all permits required by the action (unless permit exception is provided for by the orders).	40 CFR 264.31 to 40 CFR 264.38 OAC 3745-54-31 to OAC 3745-54-37
	Owners/operators of hazardous waste management facilities must comply with the Preparedness Standards of 40 *CFR* 264, Subpart D concerning development of a written contingency plan that designates the emergency coordinator, describes emergency and evacuation procedures, and identifies the emergency equipment to be maintained. Copies of the plan must be submitted to local authorities that would respond in the event of an emergency.	Applicable to storage of soils from excavation if the soils contain listed wastes K044 through K047 or exhibit the TC. Not ARAR if the soils do not contain a hazardous waste. There is no state equivalent to the permit exemption provided by CERCLA Section 121(e). It is the DERR's policy to require responsible parties to acquire and comply with all permits required by the action (unless permit exception is provided for by the orders).	40 *CFR* 264.50 to 40 *CFR* 264.56 OAC 3745-54-52 to OAC 3745-54-56
	Owners/operators of hazardous waste management facilities must comply with the Recordkeeping Standards of 40 *CFR* 264, Subpart E concerning maintenance of the operating record, manifest files, contingency plan, and closure plan.	Applicable to storage of soils from excavation if the soils are hazardous per the toxicity characteristic. Not ARAR if the soils do not contain a hazardous waste. There is no state equivalent to the permit exemption provided by CERCLA Section 121(e). It is the DERR's policy to require responsible parties to acquire and comply with all permits required by the action (unless permit exception is provided for by the orders).	40 *CFR* 264.70 to 40 *CFR* 264.77 OAC 3745-54- 73 to OAC 3745-54-77
	Owners/Operators of waste piles must implement a groundwater monitoring program in accordance with 40 *CFR* 264, Subpart F unless the unit is an engineered structure that does not receive liquid wastes or wastes containing free liquids and is designed to exclude precipitation and run-on/run-off. The unit must also have inner and outer layers of containment. Waste piles that are inside or under a structure that prevents wind dispersal and protects the pile from contact with precipitation or run-on are exempt from groundwater monitoring.	Applicable to storage of soils from excavation if the soils are hazardous per the toxicity characteristic. The provisions for groundwater monitoring are not considered relevant and appropriate to the operation of the waste piles if the soils do not contain hazardous wastes due to the limited nature of the action. There is no state equivalent to the permit exemption provided by CERCLA Section 121(e). It is the DERR's policy to require responsible parties to acquire and comply with all permits required by the action (unless permit exception is provided for by the orders).	40 *CFR* 264.90 to 40 *CFR* 264.100 OAC 3745-54-90 to OAC 3745-54-99 OAC 3745-55-01

Table D-2

Potential Action-Specific ARARs and TBC Guidance for Remediation of Soils at LLs 1-4

Action	Requirements	Prerequisite	Citation(s)
	Upon closure of a hazardous waste management unit the owner/operator must comply with the general closure performance standard.	Closure must be conducted in a manner that minimizes the need for further maintenance and controls, minimizes, or eliminates, to the extent necessary to protect human health and the environment post-closure escape of hazardous wastes, hazardous constituents, leachate, contaminated run-off, or hazardous waste decomposition products to the ground, to surface waters, or to the atmosphere. Applicable to waste piles used to store soils that contain hazardous wastes. Relevant and appropriate to waste piles that manage soils not containing hazardous wastes.	40 *CFR* 264.111 OAC 3745-55-11
Storage of Hazardous-contaminated Soil in a Waste Pile	Waste piles must have a liner that is designed, constructed, and installed to prevent any migration of wastes out of the pile into the adjacent subsurface soils or groundwater.	Applicable to storage of hazardous-contaminated soils in waste piles, if the wastes contain free liquid or generate leachate and are not protected from wind disposal and surface water run-on. Potentially relevant and appropriate if excavated soils are determined to not contain listed wastes or exhibit the TC soils.	40 *CFR* 264.251 OAC 3745-56-51
	Waste piles must have a liner constructed of materials that have appropriate chemical properties and sufficient strength to prevent failures due to pressure gradients, contact with the waste, climatic conditions, and the stress of daily operation.	Applicable to storage of hazardous-contaminated soils in waste piles, if the wastes contain free liquid or generate leachate and are not protected from wind disposal and surface water run-on. Potentially relevant and appropriate if excavated soils are determined to not contain listed wastes or exhibit the TC soils.	40 *CFR* 264.251 OAC 3745-56-51
	Waste piles must be placed upon a base or foundation capable of supporting the liner and preventing failure of the liner due to settlement, compression, or uplift. Liners must be installed to cover all surrounding earth likely to contact the waste or leachate.	Applicable to storage of hazardous-contaminated soils in waste piles, if the wastes contain free liquid or generate leachate and are not protected from wind disposal and surface water run-on. Potentially relevant and appropriate if excavated soils are determined to not contain listed wastes or exhibit the TC soils.	40 *CFR* 264.251 OAC 3745-56-51
	Waste piles must be designed, constructed, and installed with a top liner (such as a geomembrane) that prevents migration of hazardous constituents into the liner and a bottom composite liner with a lower component constructed of at least 3 ft of compacted soil with a hydraulic conductivity of $<10^{-7}$ cm/sec.	Applicable to storage of hazardous-contaminated soils in waste piles, if the wastes contain free liquid or generate leachate and are not protected from wind disposal and surface water run-on. Potentially relevant and appropriate if excavated soils are determined to not contain listed wastes or exhibit the TC soils.	40 *CFR* 264.251 OAC 3745-56-51

Table D-2

Potential Action-Specific ARARs and TBC Guidance for Remediation of Soils at LLs 1-4

Action	Requirements	Prerequisite	Citation(s)
	Waste piles must be designed, constructed, and installed with a leachate collection and removal system between the liners that has a bottom slope of 1 % and is constructed of granular drainage material with a thickness of > 12 in. and a hydraulic conductivity > 10^{-2} cm/sec. The leachate-collection system shall be chemically compatible with the wastes and leachate. The leachate-collection system shall be designed to minimize clogging. The leachate-collection system shall be constructed with sumps and liquid removal systems that ensure that the leachate depth over the liner does not exceed 12 in.	Applicable to storage of hazardous-contaminated soils in waste piles, if the wastes contain free liquid or generate leachate and are not protected from wind disposal and surface water run-on. Potentially relevant and appropriate if excavated soils are determined to not contain listed wastes or exhibit the TC soils.	40 *CFR* 264.251 OAC 3745-56-51
	Waste piles must be designed, constructed, and operated with a run-on control system with a capacity to control the water volume from a 24-hr, 25-year storm event.	Applicable to storage of hazardous-contaminated soils in waste piles, if the wastes contain free liquid or generate leachate and are not protected from wind disposal and surface water run-on. Potentially relevant and appropriate if excavated soils are determined to not contain listed wastes or exhibit the TC soils.	40 *CFR* 264.251 OAC 3745-56-51
	Waste piles that are inside or under a structure that provides protection from precipitation, run-on, and wind dispersal, and that holds wastes that do not contain free liquids or generate leachate, are not required to meet the liner and leachate collection system requirements or the groundwater monitoring provisions of 40 *CFR* 264, Subpart F.	Applicable to waste piles that are engineered to be protected from precipitation, run-on, and wind dispersal where the wastes do not contain any free liquids and that store soils from excavation or construction and development of injection/monitoring wells.	40 *CFR* 264.250 40 *CFR* 264.90(b)(5)
	During construction, liners and cover system components must be inspected for uniformity, damage, or imperfections. During operation, a waste pile must be inspected weekly and after storms to detect signs of deterioration or improper operation of the run-on/run-off control systems, wind dispersal control systems, and leachate collection system. The volume of liquids collected from the leak detection system must be recorded weekly.	Applicable to waste piles used to store soils that contain hazardous wastes. Relevant and appropriate to waste piles that manage soils not containing hazardous wastes.	40 *CFR* 264.254 OAC 3745-56-54
Placement of Hazardous-contaminated Soil in a Waste Pile	A prohibited waste may be land-disposed only if it meets the treatment standards of 40 *CFR* 268, Subpart D.	Applicable to land disposal of hazardous wastes and hazardous debris by placement in a waste pile constituting land disposal by 40 *CFR* 268.2.	40 *CFR* 268.7 OAC 3745-270-40
	Hazardous-contaminated soils must be treated according to the alternative treatment standards of 40 *CFR* 268.49(c) or according to the UTSs specified in 40 *CFR* 268.48 applicable to the listed and/or characteristic waste contaminating the soil prior to land disposal.	Applicable to placement of soils that contain listed wastes or exhibit the TC in a waste pile.	40 *CFR* 268.49 (b) OAC 3745-270-49

Table D-2

Potential Action-Specific ARARs and TBC Guidance for Remediation of Soils at LLs 1-4

Action	Requirements	Prerequisite	Citation(s)
	Unless the wastes will be placed in a CAMU for storage and/or treatment only, CAMU-eligible wastes that have been determined to contain principal hazardous constituents must be treated to the following standards: • for non-metals, 90% reduction in total principal hazardous constituent; and • for metals, 90% reduction in principal hazardous constituent concentration as measured in the leachate by TCLP analysis.	Applicable to hazardous-contaminated soils replaced within the excavation with the excavation designated as a CAMU for purposes other than storage or treatment. Note that Ohio EPA has proposed to adopt these conforming changes to the CAMU rules but that the rule changes are not finalized.	40 *CFR* 264.552(e)(4)
	Groundwater monitoring that is sufficient to continue to detect and characterize the nature, direction, and movement of existing releases of hazardous constituents in groundwater must be conducted during operation. In addition, the groundwater monitoring must be able to detect and subsequently characterize releases of hazardous constituents to groundwater that may occur from areas of the CAMU in which wastes will remain in place after closure of the CAMU.	Not applicable to replacement of excavated soils because such soils will be returned to the excavation only if RGOs are met.	40 *CFR* 264.552(e)(5) 40 *CFR* 264.552(g)
	The owner/operator must conduct daily inspections of the aboveground portions of the tank system, monitoring and leak detection system data, and the secondary containment.	Potentially relevant and appropriate to wastewater that is determined to contain listed wastes or exhibits the TC and that is returned to the ground. Wastewater from RI activities has not exhibited the TC. It is expected that wastewater would be determined to not contain listed wastes. Therefore, these requirements are likely not applicable or relevant and appropriate.	40 *CFR* 264.195 OAC 3745.55.95
	Temporary tanks used to store hazardous remediation wastes may be designated as temporary units. The temporary unit must be located within the contiguous property under the control of the owner/operator where the waste was generated. For temporary units, the Ohio EPA Administrator may replace the design, operating, and closure standards of 40 *CFR* 264 with alternative requirements that are protective of human health and the environment. Temporary units are authorized to operate for up to 1 year.	Potentially applicable to storage of hazardous wastewaters prior to application to the soils returned to the excavation. Allows temporary storage without berms to meet all technical standards for permitted units. Designation of the tank as a temporary unit is achieved by permit or within the provision of the orders.	40 *CFR* 264.553(a) 40 *CFR* 264.553(d) OAC 3745-57-73
	The requirements for hazardous waste tank systems of 40 *CFR* 264, Subpart J do not apply to tanks that store or treat hazardous wastewaters that are part of a wastewater treatment facility subject to Section 402 or 307(b) of the CWA.	Applicable to tank systems that store or treat hazardous wastewaters prior to discharge to a POTW or surface water under Sections 307 or 402 of the CWA.	40 *CFR* 264.1(g)(c)

Table D-2

Potential Action-Specific ARARs and TBC Guidance for Remediation of Soils at LLs 1-4

Action	Requirements	Prerequisite	Citation(s)
Off-site Disposal of Waste-Excavated Soils, Debris, and Secondary Wastes			
Disposal of RCRA-Hazardous Waste in a Land-based Unit (i.e., lead, other debris, and soils exhibiting the TC or that contain listed waste)	RCRA-restricted waste may be land-disposed if it meets the requirements in the table "Treatment Standards for Hazardous Waste" at 40 *CFR* 268.40 before land disposal.	Applicable to land disposal, as defined in 40 *CFR* 268.2, of restricted RCRA waste. Applicable to disposal of exhumed hazardous wastes (i.e., soils and water from excavation and injection/monitoring well installation that exhibit a hazardous waste characteristic).	40 *CFR* 268.40(a)
	Hazardous debris may be land-disposed if it meets the requirements in the table "Alternative Treatment Standards for Hazardous Debris" at 40 *CFR* 268.45 before land disposal or the debris is treated to the waste-specific treatment standard provided in 40 *CFR* 268.40 for the waste contaminating the debris.	Applicable to land disposal, as defined in 40 *CFR* 268.2, of restricted RCRA-hazardous Debris.	40 *CFR* 268.45(a)
	Hazardous-contaminated soils must be treated according to the alternative treatment standards of 40 *CFR* 268.49 (c) or according to the UTSs specified in 40 *CFR* 268.48 applicable to the listed and/or characteristic waste contaminating the soil prior to land disposal.	Applicable to land disposal, as defined in 40 *CFR* 268.2, of restricted hazardous soils.	40 *CFR* 268.49(b) OAC 3745-270-49
Off-site Shipment of Hazardous Wastes, Debris, or Hazardous-contaminated Soils	A generator who transports or offers hazardous wastes for off-site transport must prepare a Uniform Hazardous Waste Manifest.	Applicable to the offsite shipment of soils or wastewater that contain listed wastes or that exhibit the TC.	40 *CFR* 262.20 OAC 3745-52-20
	Before transporting or offering a hazardous waste for transport, the generator must package the waste, label the package, and placard the carrier in accordance with DOT requirements.	Applicable to the off-site shipment of soils or wastewater that contain listed wastes or that exhibit the TC.	40 *CFR* 262.30 to 40 *CFR* 262.33 OAC 3745-52-30 to OAC 3745-52-33
	Prior to sale, lease, or transfer of the property from DOD control, a notation to the deed must be recorded that indicates that the property has been used as a disposal facility and that its use is restricted in accordance with the approved closure/post-closure plan.	Applicable to transfer of a solid waste disposal facility.	40 *CFR* 264.119 OAC 3745-55-19

Table D-2

Potential Action-Specific ARARs and TBC Guidance for Remediation of Soils at LLs 1-4

ARARs = Applicable or relevant and appropriate requirements.
CAMU = Corrective action management unit.
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act.
CFR = Code of Federal Regulations.
CWA = Clean Water Act.
DERR = Division of Emergency and Remedial Response (Ohio EPA).
DOD = U.S. Department of Defense.
DOT = U.S. Department of Transportation.
EPA = Environmental Protection Agency.
GDCS = Generic direct contact soils standard.
HTRW = Hazardous, toxic, and radioactive waste.
LLs 1-4 = Load Lines 1 through 4.
MEC = Munitions and explosives of concern.
NOI = Notice of Intent.
NPL = National Priorities Listing.
OAC = Ohio Administrative Code.
Ohio EPA = Ohio Environmental Protection Agency.
ORC = Ohio Revised Code.
PCBs = Polychlorinated biphenyls.
POTW = Publicly Owned Treatment Works.
RCRA = Resource Conservation and Recovery Act.
RGOs = Remedial Goal Options.
RI = Remedial investigation.
TBC = To be considered.
TC = Toxicity characteristic.
TCLP = Toxic characteristics leaching procedure.
TNT = 2,4,6-Trinitrotoluene.
TSCA = Toxic Substances Control Act.
UTSs = Universal treatment standards.
VAP = Voluntary Action Program.

Table D-2

Potential Action-Specific ARARs and TBC Guidance for Remediation of Soils at LLs 1-4

Location characteristic(s)	**Requirement(s)**	**Prerequisite**	**Citation(s)**
Wetlands			
Waters of the State, as Defined in ORC 6111.01	There may be no degradation of water quality that results in violation of the applicable water quality criteria or the impairment of existing uses.	Applicable to activities at LLs 1-4 that may impact waters of the state (connected drainageways). Applicable to any non-point source of pollution that adds a regulated pollutant or any state-isolated wetland permit application. The applicant of subject activities must submit documentation, as required under OAC 3745-1-5(B)(3). Submittal and review requirements do not apply to discharge to limited quality waters and discharges with less that 65 mg/L of total suspended solids.	OAC 3745-1-04 OAC 3745-1-5(B)(1) and (3) OAC 3745-1-5(D) OAC 3745-1-54

ARARs = Applicable or relevant and appropriate requirements.
LLs 1-4 = Load Lines 1 through 4.
mg/L = milligrams per Liter.
OAC = Ohio Administrative Code.
ORC = Ohio Revised Code.
TBC = To be considered.

Appendix E

Cost Analysis

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Summary of Estimated Costs for Alternative SDS2 - Capping of Soils

Task		Capital Costs	O&M Costs
Design		$ 229,482.00	$ -
Mobilization/Demobilization		$ 46,938.00	$ -
Site Preparation/Demo		$ 33,171.00	$ -
Cell Construction		$ 286,610.00	$ -
Soil Excavation		$ 403,725.00	$ -
Sampling/Analysis		$ 509,244.00	$ -
Backfill		$ 588,282.00	$ -
Loading/Offsite Disposal		$ 416,606.00	$ -
Cap Construction		$ 1,705,205.00	$ -
Sealing of Slabs		$ 23,286.00	$ -
Project Oversite		$ 727,496.00	$ 149,400.00
Long Term Monitoring		$ -	$ 2,212,789.00
5 Year Reviews		$ -	$ 347,400.00
Institutional Controls		$ -	$ 27,958.00
Sub Total:		$ 4,970,045.00	$ 2,737,547.00
Contingency	10%	$ 497,004.50	$ 273,754.70
Project Management	5%	$ 248,502.25	$ 136,877.35
Estimated Total:		**$ 5,715,551.75**	**$ 3,148,179.05**
Years of Operation			30
Discount Rate			7%
O&M PW			$ 1,114,055.87
Total Present Worth			**$ 6,829,607.62**

1. Contingency assumed as percentage of total project costs.
2. Discount Rates based on a "Guide to Developing Cost Estimates during the Feasibility Study", EPA, July 2000.

Ravenna Soil Cap
5/6/05

Project name	Ravenna Soil Cap
Estimator	Dennis Kelbley
Labor rate table	IT FY1999-1Q
Bid date	10/28/2004
Report format	*Sorted by 'Bid Item/Task'* *'Detail' summary* *Allocate addons* *Print item notes* *Print sort level notes* *Paginate*

Item	Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Unit Cost	Total Amount
	01 SITE PREPARATION										
	010003 CELL DESIGN										
WH05	PROGRAM MANAGER	24.00	HR	5,448	-	-		-	-	227.00 /HR	5,448
WH10	PROJECT MANAGER	300.00	HR	43,500	-	-		-	-	145.00 /HR	43,500
WH12	SITE SUPERINTENDENT / ON-SITE	72.00	HR	6,336	-	-		-	-	88.00 /HR	6,336
WH20	CIVIL ENGINEER	600.00	HR	39,000	-	-		-	-	65.00 /HR	39,000
WH25	PROCUREMENT MANAGER	120.00	HR	9,840	-	-		-	-	82.00 /HR	9,840
WH27	ENGINEER TECHNICIAN	1,050.00	HR	49,350	-	-		-	-	47.00 /HR	49,350
WH30	CERTIFIED HYGIENIST (CIH)	72.00	HR	9,288	-	-		-	-	129.00 /HR	9,288
WH35	REGULATORY SPECIALIST	180.00	HR	16,560	-	-		-	-	92.00 /HR	16,560
WH45	QUALITY CONTROL (QCS)	240.00	HR	18,480	-	-		-	-	77.00 /HR	18,480
WH85	DRAFTS/CADD OPERATOR	360.00	HR	19,080	-	-		-	-	53.00 /HR	19,080
WH87	WORD PROCESSOR	300.00	HR	12,600	-	-		-	-	42.00 /HR	12,600
	010003 CELL DESIGN			**229,482**							**229,482**
	3,318.00 Labor hours										
	010005 MOBE / DEMOBE										
WH10	PROJECT MANAGER	16.00	HR	2,320	-	-		-	-	145.00 /HR	2,320
WH12	SITE SUPERINTENDENT / ON-SITE	16.00	HR	1,408	-	-		-	-	88.00 /HR	1,408
WH15	CHEMIST	16.00	HR	1,008	-	-		-	-	63.00 /HR	1,008
WH27	ENGINEER TECHNICIAN	16.00	HR	752	-	-		-	-	47.00 /HR	752
WH32	SITE S & H OFFICER SSHO	16.00	HR	1,184	-	-		-	-	74.00 /HR	1,184
WH45	QUALITY CONTROL (QCS)	16.00	HR	1,232	-	-		-	-	77.00 /HR	1,232
PW10	EQUIP. OPER. P-W (ST) Ravenna	96.00	HR	4,416	-	-		-	-	45.999 /HR	4,416
PW25	LABOR P-W (ST) Ravenna	64.00	HR	1,905	-	-		-	-	29.765 /HR	1,905
PW40	TRUCK DRIVER P-W (ST) Ravenna	64.00	HR	2,181	-	-		-	-	34.075 /HR	2,181
V12D	PICKUP TRUCK	6.00	DY	-	-	-		189	-	31.495 /DY	189
V12f	FOGM PICKUP TRUCK	30.00	HR	-	-	-		-	240	8.011 /HR	240
V13D	PICKUP 4WD	6.00	DY	-	-	-		249	-	41.517 /DY	249
V13f	FOGM PICKUP 4WD	30.00	HR	-	-	-		-	280	9.338 /HR	280
----	M/D D-6 DOZER	4.00	EW	-	-	2,329		-	-	582.16 /EW	2,329
----	M/D 330 EXCAVATOR	4.00	EW	-	-	4,657		-	-	1,164.32 /EW	4,657
----	M/D 35 TON TRUCKS	8.00	EW	-	-	9,315		-	-	1,164.319 /EW	9,315
----	M/D WATER TRUCK	4.00	EW	-	-	4,657		-	-	1,164.32 /EW	4,657
----	M/D COMPACTOR	2.00	EW	-	-	1,863		-	-	931.455 /EW	1,863
----	M/D LOADER	2.00	EW	-	-	1,863		-	-	931.46 /EW	1,863
----	M/D BOBCAT	4.00	EW	-	-	1,164		-	-	291.08 /EW	1,164
----	M/D DECON TRAILER	2.00	EW	-	-	1,863		-	-	931.455 /EW	1,863
----	M/D OFFICE TRAILER	2.00	EW	-	-	1,863		-	-	931.455 /EW	1,863
	010005 MOBE / DEMOBE			**16,406**		**29,574**		**438**	**520**		**46,938**
	320.00 Labor hours										
	010010 SETUP / TEARDOWN										
	ASSUME 3 DAYS UP AND 5 DAYS DOWN										
	WORK DAYS = 8										
PW10	EQUIP. OPER. P-W (ST) Ravenna	80.00	HR	3,680	-	-		-	-	45.999 /HR	3,680
PW15	EQUIP.OPER. P-W (PT) Ravenna	12.00	HR	268	-	-		-	-	22.315 /HR	268
PW25	LABOR P-W (ST) Ravenna	160.00	HR	4,762	-	-		-	-	29.765 /HR	4,762
PW30	LABOR P-W (PT) Ravenna	24.00	HR	326	-	-		-	-	13.586 /HR	326
E08D	DOZER/185/LGP	8.00	DY	-	-	-		2,497	-	312.093 /DY	2,497
E08f	FOGM DOZER/185HP/LGP	80.00	HR	-	-	-		-	941	11.76 /HR	941
----	PARKING / ROAD STONE	200.00	TON	-	1,993	-		-	-	9.967 /TON	1,993
----	OFFICE TRAILER SET / TEARDOWN	2.00	EA	-	-	1,863		-	-	931.455 /EA	1,863

				Labor	Material	Subcontract		Equipment	Other	Total	
Item	**Description**	**Takeoff Qty**		**Amount**	**Amount**	**Amount**	**Name**	**Amount**	**Amount**	**Unit Cost**	**Amount**
	010010 SETUP / TEARDOWN										
	ASSUME 3 DAYS UP AND 5 DAYS DOWN										
	WORK DAYS = 8										
----	PHONE HOOKUP	1.00	EST	-	-	2,794		-	-	2,794.37 /EST	2,794
----	ELECTRICAL HOOKUP	1.00	EST	-	-	11,643		-	-	11,643.19 /EST	11,643
2002	Jtr Per Diem Single	24.00	day	-	-	-		-	2,403	100.132 /day	2,403
	010010 SETUP / TEARDOWN			**9,036**	**1,993**	**16,300**		**2,497**	**3,344**		**33,171**
	276.00 Labor hours										
	01 SITE PREPARATION			***254,924***	***1,993***	***45,874***		***2,935***	***3,864***		***309,591***
	3,914.00 Labor hours										

Item	Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
	02 CELL CONSTRUCTION										
	020003 SITE SURVEY / LAYOUT										
----	SURVEY AND SITE LAYOUT	80.00	HR	-	-	8,849		-	-	110.61 /HR	8,849
	020003 SITE SURVEY / LAYOUT					**8,849**					**8,849**
	020005 CLEAR and GRUB										
	ASSUME 5 ACRE AREA WILL REQUIRE CLEARING AND GRUBBING										
	ASSUME DEBRIS FROM THIS OPERATIONS TO BE LEFT ON SITE										
----	HEAVY CLEARING/GRUBBING	10.00	AC	-	-	25,615		-	-	2,561.503 /AC	25,615
	020005 CLEAR and GRUB					**25,615**					**25,615**
	020010 REMOVE 2 FOOT SOIL / STOCKPILE										
	REMOVE 2 FOOT SOIL AND STOCKPILE										
	6 ACRES = 19360 CUYDS										
	=25 DAYS										
PW10	EQUIP. OPER. P-W (ST) Ravenna	1,000.00	HR	45,999	-	-		-	-	45.999 /HR	45,999
PW15	EQUIP.OPER. P-W (PT) Ravenna	328.00	HR	7,319	-	-		-	-	22.315 /HR	7,319
PW25	LABOR P-W (ST) Ravenna	500.00	HR	14,883	-	-		-	-	29.765 /HR	14,883
PW30	LABOR P-W (PT) Ravenna	82.00	HR	1,114	-	-		-	-	13.586 /HR	1,114
PW40	TRUCK DRIVER P-W (ST) Ravenna	1,000.00	HR	34,075	-	-		-	-	34.075 /HR	34,075
PW45	TRUCK DRIVER P-W (PT) Ravenna	328.00	HR	5,211	-	-		-	-	15.887 /HR	5,211
E08D	DOZER/185/LGP	58.00	DY	-	-	-		18,101	-	312.092 /DY	18,101
E08f	FOGM DOZER/185HP/LGP	500.00	HR	-	-	-		-	5,880	11.76 /HR	5,880
E14D	EXCAVATOR/30 METRIC TON	29.00	DY	-	-	-		8,262	-	284.891 /DY	8,262
E14f	FOGM EXCAVATOR 30 METRIC TON	250.00	HR	-	-	-		-	2,940	11.76 /HR	2,940
E19D	DUMP/OFF ROAD/35 TON	87.00	DY	-	-	-		34,625	-	397.989 /DY	34,625
E19f	FOGM DUMP OFF ROAD/35TON	750.00	HR	-	-	-		-	13,588	18.117 /HR	13,588
E29D	WATER TRUCK/OFF ROAD/5-6K	29.00	DY	-	-	-		6,726	-	231.922 /DY	6,726
E29f	FOGM WATER TRUCK OFF ROAD 5-6K	250.00	HR	-	-	-		-	4,529	18.117 /HR	4,529
E31	VIB SOIL COMPACTOR/84"/SMOOTH	29.00	DAY	-	-	-		3,114	-	107.371 /DAY	3,114
E31f	FOGM SOIL COMPACTOR/84"/SMOOTH	250.00	HR	-	-	-		-	2,305	9.221 /HR	2,305
5312	PPE Level D Complete TYVEK	600.00	MDAY	-	14,337	-		-	-	23.895 /MDAY	14,337
2002	Jtr Per Diem Single	291.00	day	-	-	-		-	29,138	100.132 /day	29,138
	020010 REMOVE 2 FOOT SOIL / STOCKPILE			**108,601**	**14,337**			**70,828**	**58,380**		**252,146**
	3,238.00 Labor hours										
	02 CELL CONSTRUCTION			***108,601***	***14,337***	***34,464***		***70,828***	***58,380***		***286,610***
	3,238.00 Labor hours										

Item	Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount

03 IRA LL 1,2,3,4 WASTE

030005 EXCAVATION / PLACE WASTE IN CELL

ASSUME EXCAVATION OF 14,566 CUYDS SOIL PLACE ALL WASTE IN CELL EXCEPT FOR 1966 TONS TSCA WASTE

ASSUME EXCAVATION AND PLACEMENT RATE OF 500 CUYDS DAY

= 30 DAYS WORK

Item	Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Unit Cost	Total Amount
PW10	EQUIP. OPER. P-W (ST) Ravenna	1,800.00	HR	82,799	-	-		-	-	45.999 /HR	82,799
PW15	EQUIP.OPER. P-W (PT) Ravenna	360.00	HR	8,033	-	-		-	-	22.315 /HR	8,033
PW25	LABOR P-W (ST) Ravenna	600.00	HR	17,859	-	-		-	-	29.765 /HR	17,859
PW30	LABOR P-W (PT) Ravenna	120.00	HR	1,630	-	-		-	-	13.586 /HR	1,630
PW40	TRUCK DRIVER P-W (ST) Ravenna	1,200.00	HR	40,890	-	-		-	-	34.075 /HR	40,890
PW45	TRUCK DRIVER P-W (PT) Ravenna	240.00	HR	3,813	-	-		-	-	15.887 /HR	3,813
E02D	SKIDSTEER/50HP	84.00	DY	-	-	-		2,285	-	27.201 /DY	2,285
E02f	FOGM SKIDSTEER 50HP	600.00	HR	-	-	-		-	1,907	3.179 /HR	1,907
E08D	DOZER/185/LGP	48.00	DY	-	-	-		14,980	-	312.092 /DY	14,980
E08f	FOGM DOZER/185HP/LGP	300.00	HR	-	-	-		-	3,528	11.76 /HR	3,528
E14D	EXCAVATOR/30 METRIC TON	84.00	DY	-	-	-		23,931	-	284.891 /DY	23,931
E14f	FOGM EXCAVATOR 30 METRIC TON	600.00	HR	-	-	-		-	7,056	11.76 /HR	7,056
E19D	DUMP/OFF ROAD/35 TON	144.00	DY	-	-	-		57,310	-	397.989 /DY	57,310
E19f	FOGM DUMP OFF ROAD/35TON	900.00	HR	-	-	-		-	16,305	18.117 /HR	16,305
E29D	WATER TRUCK/OFF ROAD/5-6K	42.00	DY	-	-	-		9,741	-	231.922 /DY	9,741
E29f	FOGM WATER TRUCK OFF ROAD 5-6K	300.00	HR	-	-	-		-	5,435	18.117 /HR	5,435
E31	VIB SOIL COMPACTOR/84"/SMOOTH	42.00	DAY	-	-	-		4,510	-	107.371 /DAY	4,510
E31f	FOGM SOIL COMPACTOR/84"/SMOOTH	300.00	HR	-	-	-		-	2,766	9.221 /HR	2,766
5312	PPE Level D Complete TYVEK	360.00	MDAY	-	8,602	-		-	-	23.895 /MDAY	8,602
----	COMPACTION TESTING	25.00	DAY	-	-	23,286		-	-	931.456 /DAY	23,286
----	PRE-EXCAVATION SURVEY	150.00	HR	-	-	16,592		-	-	110.61 /HR	16,592
2002	Jtr Per Diem Single	504.00	day	-	-	-		-	50,466	100.132 /day	50,466
	030005 EXCAVATION / PLACE WASTE IN CEL			**155,024**	**8,602**	**39,878**		**112,757**	**87,464**		**403,725**
	4,320.00 Labor hours										

030010 POST EXCAVATION SAMPLING

BASED ON 30 DAYS

Item	Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Unit Cost	Total Amount
WH15	CHEMIST	300.00	HR	18,900	-	-		-	-	63.00 /HR	18,900
WH27	ENGINEER TECHNICIAN	600.00	HR	28,200	-	-		-	-	47.00 /HR	28,200
V12D	PICKUP TRUCK	84.00	DY	-	-	-		2,646	-	31.496 /DY	2,646
V12f	FOGM PICKUP TRUCK	300.00	HR	-	-	-		-	2,403	8.011 /HR	2,403
----	SAMPLE SUPPLIES	1,680.00	EA	-	4,186	-		-	-	2.492 /EA	4,186
5312	PPE Level D Complete TYVEK	120.00	MDAY	-	2,867	-		-	-	23.895 /MDAY	2,867
----	2,4,6 TNT / RDX ANALYSIS	668.00	EA	-	-	139,609		-	-	208.995 /EA	139,609
----	OPCB ANALYSIS	1,414.00	EA	-	-	148,171		-	-	104.789 /EA	148,171
----	LEAD/ARSENIC ANALYSIS	1,392.00	EA	-	-	36,466		-	-	26.197 /EA	36,466
----	MANGANCE ANALYSIS	550.00	EA	-	-	14,410		-	-	26.199 /EA	14,410
----	COPPER ANALYSIS	150.00	EA	-	-	3,931		-	-	26.205 /EA	3,931
----	PAH ANALYSIS	270.00	EA	-	-	66,017		-	-	244.507 /EA	66,017
----	HEPTACHLOR/DIELDRIN (PEST) ANALYSIS	164.00	EA	-	-	24,746		-	-	150.893 /EA	24,746
----	FEDERAL EXPRESS	70.00	EA	-	-	4,075		-	-	58.216 /EA	4,075
2002	Jtr Per Diem Single	126.00	day	-	-	-		-	12,617	100.132 /day	12,617

Item	Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Unit Cost	Total Amount
	030010 POST EXCAVATION SAMPLING			**47,100**	**7,053**	**437,426**		**2,646**	**15,020**		**509,244**
	900.00 Labor hours										
	030015 SITE EXCAVATION BACKFILL										
	ASSUMES BACKFILLING EXCAVATIONS WITH CLEAN FILL FROM OFF-SITE										
	ASSUME REMOVAL OF 14566 CUYDS WITH A BACKFILL RATE OF 500 CUYDS DAY										
	ASSUME ONLY MACHINE COMPACTION										
	SEED BACKFILLED AREAS										
	= 30 DAYS WORK										
PW1C	EQUIP. OPER. P-W (ST) Ravenna	600.00	HR	27,600	-	-		-	-	45.999 /HR	27,600
PW15	EQUIP.OPER. P-W (PT) Ravenna	120.00	HR	2,678	-	-		-	-	22.315 /HR	2,678
PW25	LABOR P-W (ST) Ravenna	600.00	HR	17,859	-	-		-	-	29.765 /HR	17,859
PW3C	LABOR P-W (PT) Ravenna	120.00	HR	1,630	-	-		-	-	13.586 /HR	1,630
PW4C	TRUCK DRIVER P-W (ST) Ravenna	600.00	HR	20,445	-	-		-	-	34.075 /HR	20,445
PW45	TRUCK DRIVER P-W (PT) Ravenna	120.00	HR	1,906	-	-		-	-	15.887 /HR	1,906
E02D	SKIDSTEER/50HP	84.00	DY	-	-	-		2,285	-	27.201 /DY	2,285
E02f	FOGM SKIDSTEER 50HP	600.00	HR	-	-	-		-	1,907	3.179 /HR	1,907
E08D	DOZER/185/LGP	84.00	DY	-	-	-		26,216	-	312.092 /DY	26,216
E08f	FOGM DOZER/185HP/LGP	600.00	HR	-	-	-		-	7,056	11.76 /HR	7,056
E29D	WATER TRUCK/OFF ROAD/5-6K	42.00	DY	-	-	-		9,741	-	231.922 /DY	9,741
E29f	FOGM WATER TRUCK OFF ROAD 5-6K	300.00	HR	-	-	-		-	5,435	18.117 /HR	5,435
5312	PPE Level D Complete TYVEK	180.00	MDAY	-	4,301	-		-	-	23.895 /MDAY	4,301
----	CLEAN OFF-SITE BACKFILL (1.4 WASTE)	20,392.00	CUYD	-	381,072	-		-	-	18.687 /CUYD	381,072
----	POST-EXCAVATION SURVEY	150.00	HR	-	-	16,592		-	-	110.61 /HR	16,592
----	ANALYSIS BACKFILL (Full sweep)	8.00	EA	-	-	8,383		-	-	1,047.888 /EA	8,383
----	SEEDING	20.00	AC	-	-	27,944		-	-	1,397.183 /AC	27,944
2002	Jtr Per Diem Single	252.00	day	-	-	-		-	25,233	100.132 /day	25,233
	030015 SITE EXCAVATION BACKFILL			**72,118**	**385,373**	**52,918**		**38,241**	**39,631**		**588,282**
	2,160.00 Labor hours										
	030020 PCB SOIL LOADOUT										
	LOADOUT 1966 TONS PCB SOIL FOR OFF-SITE DISPOSAL										
	ASSUME LOAD OUT RATE OF 242 TONS DAY										
	WORK DAYS = 8										
PW1C	EQUIP. OPER. P-W (ST) Ravenna	160.00	HR	7,360	-	-		-	-	45.999 /HR	7,360
PW15	EQUIP.OPER. P-W (PT) Ravenna	32.00	HR	714	-	-		-	-	22.315 /HR	714
PW25	LABOR P-W (ST) Ravenna	160.00	HR	4,762	-	-		-	-	29.765 /HR	4,762
PW3C	LABOR P-W (PT) Ravenna	32.00	HR	435	-	-		-	-	13.586 /HR	435
E08D	DOZER/185/LGP	11.00	DY	-	-	-		3,433	-	312.092 /DY	3,433
E08f	FOGM DOZER/185HP/LGP	80.00	HR	-	-	-		-	941	11.76 /HR	941
E22D	WHEEL LOADER/2.5 YD	11.00	DAY	-	-	-		1,071	-	97.35 /DAY	1,071
E22f	FOGM WHEEL LOADER/2.5 YD	80.00	HR	-	-	-		-	686	8.581 /HR	686
5312	PPE Level D Complete TYVEK	32.00	MDAY	-	765	-		-	-	23.895 /MDAY	765
----	DISPOSAL TSCA WASTE	1,966.00	TON	-	-	389,139		-	-	197.934 /TON	389,139
----	WASTE DISPOSAL ANALYSIS	2.00	EA	-	-	2,794		-	-	1,397.185 /EA	2,794
2002	Jtr Per Diem Single	45.00	day	-	-	-		-	4,506	100.132 /day	4,506

Item	Description	Takeoff Qty	Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
	030020 PCB SOIL LOADOUT		**13,271**	**765**	**391,933**		**4,504**	**6,133**		**416,606**
	384.00 Labor hours									
	03 IRA LL 1,2,3,4 WASTE		***287,513***	***401,793***	***922,155***		***158,148***	***148,248***		***1,917,857***
	7,764.00 Labor hours									

04 CAP CELL

Item	Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Unit Cost	Total Amount
	040015 PLACE 2 FOOT CLAY OVER LINER										
	PLACE 2 FOOT CLAY CAP OVER 6 ACRES = 19,260 CUYDS = 28 DAYS WORK										
PW1C	EQUIP. OPER. P-W (ST) Ravenna	1,120.00	HR	51,519	-	-		-	-	45.999 /HR	51,519
PW15	EQUIP.OPER. P-W (PT) Ravenna	224.00	HR	4,999	-	-		-	-	22.315 /HR	4,999
PW25	LABOR P-W (ST) Ravenna	560.00	HR	16,669	-	-		-	-	29.765 /HR	16,669
PW3C	LABOR P-W (PT) Ravenna	112.00	HR	1,522	-	-		-	-	13.586 /HR	1,522
PW4C	TRUCK DRIVER P-W (ST) Ravenna	1,120.00	HR	38,164	-	-		-	-	34.075 /HR	38,164
PW45	TRUCK DRIVER P-W (PT) Ravenna	224.00	HR	3,559	-	-		-	-	15.887 /HR	3,559
E08D	DOZER/185/LGP	78.00	DY	-	-	-		24,343	-	312.092 /DY	24,343
E08f	FOGM DOZER/185HP/LGP	560.00	HR	-	-	-		-	6,585	11.76 /HR	6,585
E14D	EXCAVATOR/30 METRIC TON	39.00	DY	-	-	-		11,111	-	284.892 /DY	11,111
E14f	FOGM EXCAVATOR 30 METRIC TON	280.00	HR	-	-	-		-	3,293	11.76 /HR	3,293
E19D	DUMP/OFF ROAD/35 TON	117.00	DY	-	-	-		46,565	-	397.989 /DY	46,565
E19f	FOGM DUMP OFF ROAD/35TON	840.00	HR	-	-	-		-	15,218	18.117 /HR	15,218
E29D	WATER TRUCK/OFF ROAD/5-6K	39.00	DY	-	-	-		9,045	-	231.922 /DY	9,045
E29f	FOGM WATER TRUCK OFF ROAD 5-6K	280.00	HR	-	-	-		-	5,073	18.117 /HR	5,073
E31	VIB SOIL COMPACTOR/84"/SMOOTH	39.00	DAY	-	-	-		4,187	-	107.371 /DAY	4,187
E31f	FOGM SOIL COMPACTOR/84"/SMOOTH	280.00	HR	-	-	-		-	2,582	9.221 /HR	2,582
----	PURCHASE CLAY (1.4% WASTE)	27,104.00	YD	-	506,501	-		-	-	18.687 /YD	506,501
----	COMPACTION TESTING	14.00	DAY	-	-	13,040		-	-	931.456 /DAY	13,040
2002	Jtr Per Diem Single	392.00	day	-	-	-		-	39,252	100.132 /day	39,252
	040015 PLACE 2 FOOT CLAY OVER LINER			**116,430**	**506,501**	**13,040**		**95,251**	**72,003**		**803,226**
	3,360.00 Labor hours										
	040020 PLACE 2 FOOT COVER SOILS										
PW1C	EQUIP. OPER. P-W (ST) Ravenna	1,120.00	HR	51,519	-	-		-	-	45.999 /HR	51,519
PW15	EQUIP.OPER. P-W (PT) Ravenna	224.00	HR	4,999	-	-		-	-	22.315 /HR	4,999
PW25	LABOR P-W (ST) Ravenna	560.00	HR	16,669	-	-		-	-	29.765 /HR	16,669
PW3C	LABOR P-W (PT) Ravenna	112.00	HR	1,522	-	-		-	-	13.586 /HR	1,522
PW4C	TRUCK DRIVER P-W (ST) Ravenna	1,120.00	HR	38,164	-	-		-	-	34.075 /HR	38,164
PW45	TRUCK DRIVER P-W (PT) Ravenna	224.00	HR	3,559	-	-		-	-	15.887 /HR	3,559
E08D	DOZER/185/LGP	78.00	DY	-	-	-		24,343	-	312.092 /DY	24,343
E08f	FOGM DOZER/185HP/LGP	560.00	HR	-	-	-		-	6,585	11.76 /HR	6,585
E14D	EXCAVATOR/30 METRIC TON	39.00	DY	-	-	-		11,111	-	284.891 /DY	11,111
E14f	FOGM EXCAVATOR 30 METRIC TON	280.00	HR	-	-	-		-	3,293	11.76 /HR	3,293
E19D	DUMP/OFF ROAD/35 TON	117.00	DY	-	-	-		46,565	-	397.989 /DY	46,565
E19f	FOGM DUMP OFF ROAD/35TON	840.00	HR	-	-	-		-	15,218	18.117 /HR	15,218
E29D	WATER TRUCK/OFF ROAD/5-6K	39.00	DY	-	-	-		9,045	-	231.922 /DY	9,045
E29f	FOGM WATER TRUCK OFF ROAD 5-6K	280.00	HR	-	-	-		-	5,073	18.117 /HR	5,073
E31	VIB SOIL COMPACTOR/84"/SMOOTH	39.00	DAY	-	-	-		4,187	-	107.371 /DAY	4,187
E31f	FOGM SOIL COMPACTOR/84"/SMOOTH	280.00	HR	-	-	-		-	2,582	9.221 /HR	2,582
----	PURCHASE COVER SOIL (1.4 WASTE)	27,104.00	YD	-	405,201	-		-	-	14.95 /YD	405,201
----	COMPACTION TESTING	14.00	DAY	-	-	13,040		-	-	931.456 /DAY	13,040

				Labor	Material	Subcontract		Equipment	Other	Total	
Item	**Description**	**Takeoff Qty**		**Amount**	**Amount**	**Amount**	**Name**	**Amount**	**Amount**	**Unit Cost**	**Amount**
	040020 PLACE 2 FOOT COVER SOILS										
2002	Jtr Per Diem Single	392.00	day	-	-	-		-	39,252	100.132 /day	39,252
	040020 PLACE 2 FOOT COVER SOILS			**116,430**	**405,201**	**13,040**		**95,251**	**72,003**		**701,925**
	3,360.00 Labor hours										
	040025 PLACE 6 INCHES TOPSOIL / SEED										
PW10	EQUIP. OPER. P-W (ST) Ravenna	80.00	HR	3,680	-	-		-	-	45.999 /HR	3,680
PW15	EQUIP.OPER. P-W (PT) Ravenna	16.00	HR	357	-	-		-	-	22.315 /HR	357
PW25	LABOR P-W (ST) Ravenna	80.00	HR	2,381	-	-		-	-	29.765 /HR	2,381
PW30	LABOR P-W (PT) Ravenna	16.00	HR	217	-	-		-	-	13.586 /HR	217
PW40	TRUCK DRIVER P-W (ST) Ravenna	40.00	HR	1,363	-	-		-	-	34.075 /HR	1,363
PW45	TRUCK DRIVER P-W (PT) Ravenna	8.00	HR	127	-	-		-	-	15.888 /HR	127
E08D	DOZER/185/LGP	8.00	DY	-	-	-		2,497	-	312.091 /DY	2,497
E08f	FOGM DOZER/185HP/LGP	80.00	HR	-	-	-		-	941	11.76 /HR	941
E29D	WATER TRUCK/OFF ROAD/5-6K	4.00	DY	-	-	-		928	-	231.923 /DY	928
E29f	FOGM WATER TRUCK OFF ROAD 5-6K	40.00	HR	-	-	-		-	725	18.117 /HR	725
----	PURCHASE TOP SOIL	5,000.00	YD	-	155,728	-		-	-	31.146 /YD	155,728
----	SEEDING	10.00	AC	-	-	29,108		-	-	2,910.799 /AC	29,108
2002	Jtr Per Diem Single	20.00	day	-	-	-		-	2,003	100.132 /day	2,003
	040025 PLACE 6 INCHES TOPSOIL / SEED			**8,126**	**155,728**	**29,108**		**3,424**	**3,668**		**200,054**
	240.00 Labor hours										
	04 CAP CELL			***240,986***	***1,067,430***	***55,189***		***193,927***	***147,673***		***1,705,205***
	6,960.00 Labor hours										

Item	Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
	05 SEALING SLABS LL1,2,3,4										
	050005 SEAL SLABS										
----	SEAL CONCRETE	1.00	EST	-	-	23,286		-	-	23,286.39 /EST	23,286
	050005 SEAL SLABS					**23,286**					**23,286**
	05 SEALING SLABS LL1,2,3,4			***0***	***0***	***23,286***		***0***	***0***		***23,286***

Item	Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
	40 PROJECT OVERSITE										
	400005 HOME / FIELD OVERSITE										
	BASED ON 160 WORKING DAYS AT 6 DAYS WEEK 10 HOURS DAY										
WH1(	PROJECT MANAGER (25%)	400.00	HR	58,000	-	-		-	-	145.00 /HR	58,000
WH1:	SITE SUPERINTENDENT / ON-SITE	1,600.00	HR	140,800	-	-		-	-	88.00 /HR	140,800
WH2!	PROCUREMENT MANAGER (10%)	160.00	HR	13,120	-	-		-	-	82.00 /HR	13,120
WH3:	SITE S & H OFFICER SSHO	1,600.00	HR	118,400	-	-		-	-	74.00 /HR	118,400
WH4!	QUALITY CONTROL (QCS)	800.00	HR	61,600	-	-		-	-	77.00 /HR	61,600
WH5(	ENVIRONMENTAL ENGINEER	1,600.00	HR	104,000	-	-		-	-	65.00 /HR	104,000
WH6(	HAZ WASTE SPECIALIST	40.00	HR	3,680	-	-		-	-	92.00 /HR	3,680
WH6!	CONTRACTS MANAGER	80.00	HR	10,320	-	-		-	-	129.00 /HR	10,320
WH7(	COST CONTROL ENGINEER (10%)	160.00	HR	20,160	-	-		-	-	126.00 /HR	20,160
K20D	Aerosol Monitor	187.00	DY	-	-	-		1,339	-	7.158 /DY	1,339
K50D	Photoionization Detector	187.00	DY	-	-	-		2,142	-	11.453 /DY	2,142
K54D	LEL 4 Gas Meter	187.00	DY	-	-	-		2,142	-	11.453 /DY	2,142
T09D	Decon/Office Trailer, 45'	187.00	DY	-	-	-		4,819	-	25.769 /DY	4,819
V12D	PICKUP TRUCK	561.00	DY	-	-	-		17,669	-	31.496 /DY	17,669
V12f	FOGM PICKUP TRUCK	1,200.00	HR	-	-	-		-	9,613	8.011 /HR	9,613
V13D	PICKUP 4WD	561.00	DY	-	-	-		23,291	-	41.517 /DY	23,291
V13f	FOGM PICKUP 4WD	1,200.00	HR	-	-	-		-	11,205	9.338 /HR	11,205
----	OFFICE TRAILER	6.00	MO	-	-	3,493		-	-	582.16 /MO	3,493
----	PORT-A-JON	6.00	MO	-	-	4,192		-	-	698.592 /MO	4,192
----	MISC DAILY COST	160.00	DAY	-	-	18,629		-	-	116.432 /DAY	18,629
----	ELECTRICAL USE	6.00	MO	-	-	6,986		-	-	1,164.32 /MO	6,986
----	PHONE USE	6.00	MO	-	-	13,972		-	-	2,328.64 /MO	13,972
2002	Jtr Per Diem Single	748.00	day	-	-	-		-	74,898	100.132 /day	74,898
4004	Rental Car	40.00	DY	-	-	-		-	3,027	75.681 /DY	3,027
	400005 HOME / FIELD OVERSITE			**530,080**		**47,271**		**51,401**	**98,744**		**727,496**
	6,440.00 Labor hours										
	40 PROJECT OVERSITE			***530,080***	***0***	***47,271***		***51,401***	***98,744***		***727,496***
	6,440.00 Labor hours										

Item	Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Unit Cost	Total Amount
	50 MONITORING										
	500005 WELL SAMPLING										
	INSTALL 20 WELLS AND SAMPLE SEMI ANNUAL FOR 30 YEARS										
	20 WELLS PLUS QA = 22 SAMPLES PER EVENT X 2 YEAR = 44 SAMPLES X 30 YEARS = 1320 SAMPLES										
	ASSUME 5 DAYS PER EVENT X 2 PER YEAR = 10 TINES 30 YEARS = 300 DAYS										
WH15	CHEMIST	3,000.00	HR	189,000	-	-		-	-	63.00 /HR	189,000
WH27	ENGINEER TECHNICIAN	3,000.00	HR	141,000	-	-		-	-	47.00 /HR	141,000
G02D	GENERATOR-6.5 KW	300.00	DY	-	-	-		3,006	-	10.021 /DY	3,006
G02f	FOGM GENERATOR 6.5 KW	3,000.00	HR	-	-	-		-	279	0.093 /HR	279
H38D	OIL/WATER LEVEL INDICATOR	300.00	DAY	-	-	-		3,006	-	10.021 /DAY	3,006
H42D	YSI 600/6820 WATER SURVEYOR	300.00	DAY	-	-	-		7,731	-	25.769 /DAY	7,731
H45D	D.O. METER	300.00	DAY	-	-	-		2,577	-	8.59 /DAY	2,577
H46D	PH/CONDUCTIVITY METER	300.00	DAY	-	-	-		1,718	-	5.726 /DAY	1,718
H47D	PH/TEMP METER	300.00	DAY	-	-	-		859	-	2.863 /DAY	859
H52D	PERISTALTIC PUMP	300.00	DAY	-	-	-		2,147	-	7.158 /DAY	2,147
K50D	Photoionization Detector	300.00	DY	-	-	-		3,436	-	11.453 /DY	3,436
K54D	LEL 4 Gas Meter	300.00	DY	-	-	-		3,436	-	11.453 /DY	3,436
V13D	PICKUP 4WD	300.00	DY	-	-	-		12,455	-	41.517 /DY	12,455
V13f	FOGM PICKUP 4WD	1,500.00	HR	-	-	-		-	14,007	9.338 /HR	14,007
----	SAMPLE SUPPLIES	1,320.00	EA	-	3,289	-		-	-	2.492 /EA	3,289
----	SAMPLE ANALYSIS (full sweep)	1,320.00	EA	-	-	1,383,212		-	-	1,047.888 /EA	1,383,212
----	INSTALL WELLS	20.00	EA	-	-	40,751		-	-	2,037.56 /EA	40,751
2002	Jtr Per Diem Single	600.00	day	-	-	-		-	60,079	100.132 /day	60,079
	500005 WELL SAMPLING			**330,000**	**3,289**	**1,423,963**		**40,372**	**74,365**		**1,871,989**
	6,000.00 Labor hours										
	500010 EPA TIER II DATA VALIDATION										
WH15	CHEMIST	1,200.00	HR	75,600	-	-		-	-	63.00 /HR	75,600
WH45	QUALITY CONTROL (QCS)	600.00	HR	46,200	-	-		-	-	77.00 /HR	46,200
WH50	ENVIRONMENTAL ENGINEER	1,200.00	HR	78,000	-	-		-	-	65.00 /HR	78,000
WH85	DRAFTS/CADD OPERATOR	300.00	HR	15,900	-	-		-	-	53.00 /HR	15,900
WH87	WORD PROCESSOR	300.00	HR	12,600	-	-		-	-	42.00 /HR	12,600
	500010 EPA TIER II DATA VALIDATION			**228,300**							**228,300**
	3,600.00 Labor hours										
	500015 REPORTS										
WH15	CHEMIST	600.00	HR	37,800	-	-		-	-	63.00 /HR	37,800
WH45	QUALITY CONTROL (QCS)	300.00	HR	23,100	-	-		-	-	77.00 /HR	23,100
WH50	ENVIRONMENTAL ENGINEER	600.00	HR	39,000	-	-		-	-	65.00 /HR	39,000
WH87	WORD PROCESSOR	300.00	HR	12,600	-	-		-	-	42.00 /HR	12,600
	500015 REPORTS			**112,500**							**112,500**
	1,800.00 Labor hours										
	50 MONITORING			***670,800***	***3,289***	***1,423,963***		***40,372***	***74,365***		***2,212,789***
	11,400.00 Labor hours										

Item	Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
	60 PROJECT OVERSITE										
	600005 PROJECT OVERSITE										
WH1(	PROJECT MANAGER (25%)	600.00	HR	87,000	-	-		-	-	145.00 /HR	87,000
WH2!	PROCUREMENT MANAGER (5%)	300.00	HR	24,600	-	-		-	-	82.00 /HR	24,600
WH7(	COST CONTROL ENGINEER (5%)	300.00	HR	37,800	-	-		-	-	126.00 /HR	37,800
	600005 PROJECT OVERSITE			**149,400**							**149,400**
	1,200.00 Labor hours										
	60 PROJECT OVERSITE			***149,400***	***0***	***0***		***0***	***0***		***149,400***
	1,200.00 Labor hours										

				Labor	Material	Subcontract		Equipment	Other	Total	
Item	**Description**	**Takeoff Qty**		**Amount**	**Amount**	**Amount**	**Name**	**Amount**	**Amount**	**Unit Cost**	**Amount**

70 5 YEAR REVIEWS

Item	Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Unit Cost	Total Amount
	700005 5 YR REVIEWS										
WH1(	PROJECT MANAGER	600.00	HR	87,000	-	-		-	-	145.00 /HR	87,000
WH1!	CHEMIST	900.00	HR	56,700	-	-		-	-	63.00 /HR	56,700
WH3!	REGULATORY SPECIALIST	600.00	HR	55,200	-	-		-	-	92.00 /HR	55,200
WH4!	QUALITY CONTROL (QCS)	300.00	HR	23,100	-	-		-	-	77.00 /HR	23,100
WH5(	ENVIRONMENTAL ENGINEER	1,080.00	HR	70,200	-	-		-	-	65.00 /HR	70,200
WH5!	RISK ASSESSOR	240.00	HR	30,000	-	-		-	-	125.00 /HR	30,000
WH8;	WORD PROCESSOR	600.00	HR	25,200	-	-		-	-	42.00 /HR	25,200
	700005 5 YR REVIEWS			**347,400**							**347,400**
	4,320.00 Labor hours										
	70 5 YEAR REVIEWS			***347,400***	***0***	***0***		***0***	***0***		***347,400***
	4,320.00 Labor hours										

				Labor	Material	Subcontract		Equipment	Other	Total	
Item	**Description**	**Takeoff Qty**		**Amount**	**Amount**	**Amount**	**Name**	**Amount**	**Amount**	**Unit Cost**	**Amount**

80 INSTITUTIONAL CONTROLS

Item	Description	Takeoff Qty	Unit	Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
	800005 INSTITUTIONAL CONTROLS										
----	SIGNAGE	250.00	EA	-	4,672	-		-	-	18.687 /EA	4,672
----	ORANGE CONSTRUCTION FENCE	10,000.00	LF	-	-	23,286		-	-	2.329 /LF	23,286
	800005 INSTITUTIONAL CONTROLS				**4,672**	**23,286**					**27,958**
	80 INSTITUTIONAL CONTROLS			***0***	***4,672***	***23,286***		***0***	***0***		***27,958***

Estimate Totals

Labor	2,589,704	2,589,704		45,236.000	hrs
Material	1,493,515	1,493,515			
Subcontract	2,575,489	2,575,489			
Equipment	517,609	517,609			
Other	531,275	531,275			
	7,707,591	**7,707,591**	**7,707,591**		
	Total		***7,707,591***		

Summary of Estimated Costs
for Alternative SDS3 - Offsite Disposal

Task		Capital Costs	O&M Costs
Design		$ 25,288.00	$ -
Mobilization/Demobilization		$ 63,880.00	$ -
Site Preparation/Demo		$ 150,987.00	$ -
Soil Excavation		$ 421,447.00	$ -
Sampling/Analysis		$ 542,858.00	$ -
Backfill		$ 448,919.00	$ -
Loading/Offsite Disposal		$ 2,459,696.00	$ -
Sealing of Slabs		$ 23,286.00	$ -
Project Oversite		$ 301,781.00	$ -
Long Term Monitoring		$ -	$ 101,803.00
Five Year Review		$ -	$ 57,900.00
Sub Total:		$ 4,438,142.00	$ 159,703.00
Contingency	10%	$ 443,814.20	$ 15,970.30
Project Management	5%	$ 221,907.10	$ 7,985.15
Estimated Total:		**$ 5,103,863.30**	**$ 183,658.45**
Years of Operation			5
Discount Rate			7%
O&M PW			$ 133,312.61
Total Present Worth Cost			**$ 5,237,175.91**

1. Contingency assumed as percentage of total project costs.
2. Discount Rates based on a "Guide to Developing Cost Estimates during the Feasibility Study", EPA, July 2000.

Ravenna Off-Site T&D
5/6/05

Project name	Ravenna Off-Site T&D Ravenna Portage /Trumbull Oh
Estimator	Dennis Kelbley
Labor rate table	IT FY1999-1Q
Bid date	10/28/2004
Report format	*Sorted by 'Bid Item/Task'* *'Detail' summary* *Allocate addons* *Print item notes* *Print sort level notes* *Paginate*

Item	Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
	010003 Design Work										
*** unassigned ***											
WH1(	PROJECT MANAGER	24.00	HR	3,480	-	-		-	-	145.00 /HR	3,480
WH2(	CIVIL ENGINEER	8.00	HR	520	-	-		-	-	65.00 /HR	520
WH3(	CERTIFIED HYGIENIST (CIH)	16.00	HR	2,064	-	-		-	-	129.00 /HR	2,064
WH35	REGULATORY SPECIALIST	16.00	HR	1,472	-	-		-	-	92.00 /HR	1,472
WH45	QUALITY CONTROL (QCS)	60.00	HR	4,620	-	-		-	-	77.00 /HR	4,620
WH5(	ENVIRONMENTAL ENGINEER	100.00	HR	6,500	-	-		-	-	65.00 /HR	6,500
WH6(	HAZ WASTE SPECIALIST	40.00	HR	3,680	-	-		-	-	92.00 /HR	3,680
WH85	DRAFTS/CADD OPERATOR	24.00	HR	1,272	-	-		-	-	53.00 /HR	1,272
WH87	WORD PROCESSOR	40.00	HR	1,680	-	-		-	-	42.00 /HR	1,680
	*** unassigned ***			**25,288**							**25,288**
	328.00 Labor hours										
	010003 Design Work			***25,288***	***0***	***0***		***0***	***0***	***25,288.00 /LS***	***25,288***
	1.00 LS										
	328.00 Labor hours										

400005 IRA LL 1,2,3,4 Mobe/Demobe

IRA LL 1,2,3,4 Mobe/Demobe

Item	Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
*** unassigned ***											
WH1(	PROJECT MANAGER	16.00	HR	2,320	-	-		-	-	145.00 /HR	2,320
WH12	SITE SUPERINTENDENT	48.00	HR	4,224	-	-		-	-	88.00 /HR	4,224
WH15	CHEMIST	16.00	HR	1,008	-	-		-	-	63.00 /HR	1,008
WH32	SITE S & H OFFICER SSHO	48.00	HR	3,552	-	-		-	-	74.00 /HR	3,552
WH45	QUALITY CONTROL (QCS)	24.00	HR	1,848	-	-		-	-	77.00 /HR	1,848
WH5(	ENVIRONMENTAL ENGINEER	48.00	HR	3,120	-	-		-	-	65.00 /HR	3,120
H315	Field Lead Tech IV - H07 (3-men)	48.00	HR	1,511	-	-		-	-	31.472 /HR	1,511
PW1(	EQUIP. OPER. SCA WAGE (ST)	64.00	HR	2,953	-	-		-	-	46.145 /HR	2,953
PW25	LABOR SCA WAGE (ST)	48.00	HR	1,433	-	-		-	-	29.86 /HR	1,433
PW4(	TRUCK DRIVER SCA WAGE (ST)	64.00	HR	2,188	-	-		-	-	34.183 /HR	2,188
V52D	Pick-Up Truck, 4WD	6.00	DY	-	-	-		266	-	44.38 /DY	266
V52f	FOGM Pick-Up Truck, 4WD	48.00	HR	-	-	-		-	302	6.287 /HR	302
V60D	Pick-Up Truck	6.00	DY	-	-	-		198	-	32.927 /DY	198
V60f	FOGM Pick-Up Truck	48.00	HR	-	-	-		-	302	6.287 /HR	302
----	M/D EXCAVATROR (2-units)	8.00	EW	-	-	9,315		-	-	1,164.32 /EW	9,315
----	M/D WATER TRUCKS (2-units)	8.00	EW	-	-	9,315		-	-	1,164.32 /EW	9,315
----	M/D OFF-ROAD TRUCKS (2-units)	8.00	EW	-	-	9,315		-	-	1,164.32 /EW	9,315
----	M/D DOZER (1-unit)	4.00	EW	-	-	2,329		-	-	582.16 /EW	2,329
----	M/D BODCAT (1-unit)	4.00	EW	-	-	2,329		-	-	582.16 /EW	2,329
----	M/D LOADER (1-unit)	4.00	EW	-	-	2,329		-	-	582.16 /EW	2,329
----	M/D DECON TRAILER (1unit)	4.00	EW	-	-	1,863		-	-	465.728 /EW	1,863
----	M/D OFFICE TRAILER (1-unit)	4.00	EW	-	-	1,863		-	-	465.73 /EW	1,863
	*** unassigned ***			**24,157**		**38,655**		**464**	**604**		**63,880**
	424.00 Labor hours										
	400005 IRA LL 1,2,3,4 Mobe/Demobe			***24,157***	***0***	***38,655***		***464***	***604***	***63,879.82 /LS***	***63,880***
	1.00 LS										
	424.00 Labor hours										

400010 IRA LL 1,2,3,4 Setup/Teardown

IRA LL 1,2,3,4 Setup/Teardown

PREPARE A CENTRAL STOCKPILING AND LOADOUT AREA FOR OFF SITE DISPOSAL OF SOILS ASSUME AREA OF 2 ACRES(300FT BY 300FT) WILL BE REQUIRED PLACE 40 MIL LINER AND CONSTRUCT SOIL BERMS AROUND LINER USING ON-SITE SOILS BASED ON 6 DAYS CONSTRUCTION AND 4 DAYS TEARDOWN= 10 WORK DAY

Item	Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
*** unassigned ***											
PW1C	EQUIP. OPER. SCA WAGE (ST)	400.00	HR	18,458	-	-		-	-	46.146 /HR	18,458
PW15	EQUIP.OPER.SCA WAGE (PT)	80.00	HR	1,791	-	-		-	-	22.386 /HR	1,791
PW25	LABOR SCA WAGE (ST)	600.00	HR	17,916	-	-		-	-	29.86 /HR	17,916
PW3C	LABOR SCA WAGE (PT)	120.00	HR	1,636	-	-		-	-	13.629 /HR	1,636
PW4C	TRUCK DRIVER SCA WAGE (ST)	200.00	HR	6,837	-	-		-	-	34.183 /HR	6,837
PW45	TRUCK DRIVER SCA WAGE(PT)	40.00	HR	638	-	-		-	-	15.938 /HR	638
E28D	320 Excavator or Equal	24.00	DY	-	-	-		4,604	-	191.836 /DY	4,604
E28f	FOGM 320 Excavator or Equal	160.00	HR	-	-	-		-	1,114	6.963 /HR	1,114
E48D	Dump Truck, 6x6 35 Ton	24.00	DY	-	-	-		10,308	-	429.484 /DY	10,308
E48f	FOGM Dump Truck, 6x6 35 Ton	160.00	HR	-	-	-		-	2,483	15.52 /HR	2,483
E50D	L90B Wheel Loader or Equal	24.00	DY	-	-	-		3,986	-	166.068 /DY	3,986
E50f	FOGM L90B Wheel Loader or Equal	160.00	HR	-	-	-		-	1,304	8.15 /HR	1,304
----	40 MIL LINER	205,300.00	SQFT	-	46,038	-		-	-	0.224 /SQFT	46,038
----	ORANGE CONSTRUCTION FENCE	40.00	RL	-	1,246	-		-	-	31.146 /RL	1,246
----	SILT FENCE	80.00	RL	-	2,193	-		-	-	27.408 /RL	2,193
----	FENCE POST	800.00	EA	-	3,239	-		-	-	4.049 /EA	3,239
----	OFFICE SET/TEAR	4.00	EA	-	-	1,863		-	-	465.728 /EA	1,863
----	ELECTRICAL HOOKUP	2.00	LS	-	-	11,643		-	-	5,821.60 /LS	11,643
----	PHONE HOOKUP	2.00	LS	-	-	2,794		-	-	1,397.185 /LS	2,794
2001	Jtr Per Diem Double Rooms	144.00	Day	-	-	-		-	10,898	75.681 /Day	10,898
	*** unassigned ***			**47,275**	**52,716**	**16,300**		**18,897**	**15,799**		**150,987**
	1,440.00 Labor hours										
	400010 IRA LL 1,2,3,4 Setup/Teardown	***1.00***	***LS***	***47,275***	***52,716***	***16,300***		***18,897***	***15,799***	***150,987.37 /LS***	***150,987***
	1,440.00 Labor hours										

400015 IRA LL 1,2,3,4 Excav./Stckpile

IRA LL 1,2,3,4 Excav./Stckpile

EXCAVATE SOILS AND PLACE IN LOADOUT AREA STOCKPILES FOR WASTE SAMPLING AND OFF-SITE DISPOSAL ASSUME EXCAVATION RATE OF 340 CUYDS DAY AT 14,566 YARD =43 DAYS AT10 HOURS DAY 5 DAYS WEEK (WORK DAYS =43)

FOR BASIS OF COMPARSON OF REMEDIAL OPTIONS AN ESTIMATED SOIL VOLUME OF 14,566 CUYDS WAS USED. SOIL VOLUMES MAY VARY BY 10 TO 15% DEPENDENT UPON UNKNOW SITE CONDITIONS AND CONTAMINENT DISTRIBUTION ENCOUNTERED DURING FIELD ACTIVITIES

				Labor	Material	Subcontract		Equipment	Other	Total	
Item	Description	Takeoff Qty		Amount	Amount	Amount	Name	Amount	Amount	Unit Cost	Amount
*** unassigned ***											
PW10	EQUIP. OPER. SCA WAGE (ST)	1,720.00	HR	79,370	-	-		-	-	46.146 /HR	79,370
PW15	EQUIP.OPER.SCA WAGE (PT)	344.00	HR	7,701	-	-		-	-	22.386 /HR	7,701
PW25	LABOR SCA WAGE (ST)	860.00	HR	25,680	-	-		-	-	29.86 /HR	25,680
PW30	LABOR SCA WAGE (PT)	172.00	HR	2,344	-	-		-	-	13.629 /HR	2,344
PW40	TRUCK DRIVER SCA WAGE (ST)	1,720.00	HR	58,795	-	-		-	-	34.183 /HR	58,795
PW45	TRUCK DRIVER SCA WAGE(PT)	344.00	HR	5,483	-	-		-	-	15.938 /HR	5,483
E14D	Bobcat, 4WD	120.00	DY	-	-	-		4,810	-	40.085 /DY	4,810
E14f	FOGM Bobcat, 4WD	860.00	HR	-	-	-		-	3,364	3.912 /HR	3,364
E28D	320 Excavator or Equal	120.00	DY	-	-	-		23,020	-	191.836 /DY	23,020
E28f	FOGM 320 Excavator or Equal	860.00	HR	-	-	-		-	5,988	6.963 /HR	5,988
E48D	Dump Truck, 6x6 35 Ton	180.00	DY	-	-	-		77,307	-	429.484 /DY	77,307
E48f	FOGM Dump Truck, 6x6 35 Ton	1,290.00	HR	-	-	-		-	20,021	15.52 /HR	20,021
E87D	Water Truck 5K TO 6Kor Equal	60.00	DY	-	-	-		14,173	-	236.216 /DY	14,173
E87f	FOGM Water Truck 5K TO 6K	430.00	HR	-	-	-		-	7,510	17.465 /HR	7,510
----	VISQUEEN	400.00	RL	-	13,455	-		-	-	33.637 /RL	13,455
5312	PPE Level D Complete TYVEK	430.00	MDAY	-	10,275	-		-	-	23.895 /MDAY	10,275
----	PRE EXCAV SURVEY	150.00	HR	-	-	16,592		-	-	110.61 /HR	16,592
2001	Jtr Per Diem Double Rooms	602.00	Day	-	-	-		-	45,560	75.681 /Day	45,560
	*** unassigned ***			**179,372**	**23,730**	**16,592**		**119,311**	**82,443**		**421,447**
	5,160.00 Labor hours										
	400015 IRA LL 1,2,3,4 Excav./Stckpile			***179,372***	***23,730***	***16,592***		***119,311***	***82,443***	***421,447.48 /LS***	***421,447***
	1.00 LS										
	5,160.00 Labor hours										

Item	Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount

400020 IRA LL 1,2,3,4 Post Excav.Samp

IRA LL 1,2,3,4 Post Excav.Samp

AFTER EXCAVATION OF SOILS FROM A GIVEN AREA POST EXCAVATIONS SAMPLES WILL BE TAKEN TO CONFIRM WASTE HAS BEEN REMOVED

AND REMAINING SOILS MEET THE CLEANUP GOALS POST EXCAVATION SAMPLING IS BASED ON EXCAVATION FLOOR SAMPLES AT (AREA/3.14) X POWER OF 0.5 WALL SAMPLING IS BASED ON ONE SAMPLE PER 25 LFT OR 1 PER WALL

WORK DAYS = 50

*** unassigned ***

Item	Description	Takeoff Qty	Unit	Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Unit Cost	Total Amount
WH15	CHEMIST	500.00	HR	31,500	-	-		-	-	63.00 /HR	31,500
H315	Field Lead Tech IV - H07	1,000.00	HR	31,472	-	-		-	-	31.472 /HR	31,472
h315	Field Lead Tech IV - H07 P/T	200.00	HR	1,751	-	-		-	-	8.753 /HR	1,751
V60D	Pick-Up Truck	70.00	DY	-	-	-		2,305	-	32.927 /DY	2,305
V60f	FOGM Pick-Up Truck	500.00	HR	-	-	-		-	3,144	6.287 /HR	3,144
----	SAMPLE SUPPLIES	1,680.00	EA	-	4,186	-		-	-	2.492 /EA	4,186
----	MISC SAMPLE SUPPLIES	4,608.00	EA	-	11,481	-		-	-	2.492 /EA	11,481
5312	PPE Level D Complete TYVEK	150.00	MDAY	-	3,584	-		-	-	23.895 /MDAY	3,584
----	2,4,6 TNT / RDX ANALYSIS	668.00	EA	-	-	139,609		-	-	208.995 /EA	139,609
----	PCB ANALYSIS	1,414.00	EA	-	-	148,171		-	-	104.789 /EA	148,171
----	LEAD / ARSENIC ANALYSIS	1,392.00	EA	-	-	36,467		-	-	26.197 /EA	36,467
----	MANGNESE ANALYSIS	550.00	EA	-	-	14,410		-	-	26.199 /EA	14,410
----	COPPER ANALYSIS	150.00	EA	-	-	3,931		-	-	26.205 /EA	3,931
----	PAH ANALYSIS	270.00	EA	-	-	66,017		-	-	244.507 /EA	66,017
----	HEPTACHLOR/DIELDRIN (PEST) ANALYSIS	164.00	EA	-	-	24,746		-	-	150.893 /EA	24,746
----	FEDERAL EXPRESS	70.00	EA	-	-	4,075		-	-	58.216 /EA	4,075
2001	Jtr Per Diem Double Rooms	120.00	Day	-	-	-		-	9,082	75.681 /Day	9,082
2002	Jtr Per Diem Single	70.00	day	-	-	-		-	6,928	98.967 /day	6,928
	*** unassigned ***			**64,723**	**19,252**	**437,426**		**2,305**	**19,153**		**542,858**
	1,700.00 Labor hours										

400020 IRA LL 1,2,3,4 Post Excav.Samp	***64,723***	***19,252***	***437,426***		***2,305***	***19,153***	***542,857.99 /LS***	***542,858***
1.00 LS								
1,700.00 Labor hours								

400025 IRA LL 1,2,3,4 Excav. Backfill

IRA LL 1,2,3,4 Excav. Backfill

BACKFILL EXCAVATION USING CLEAN SOIL FROM OFF-SITE =14566 CUYDS AT A RATE OF 700 CUYDS DAY GRADE SOIL TO DRAIN AND SEED= 21 DAYS WORK AT 10 HOURS DAY 5 DAYS WEEK

				Labor	Material	Subcontract		Equipment	Other	Total	
Item	Description	Takeoff Qty		Amount	Amount	Amount	Name	Amount	Amount	Unit Cost	Amount
*** unassigned ***											
PW1C	EQUIP. OPER. SCA WAGE (ST)	420.00	HR	19,381	-	-		-	-	46.145 /HR	19,381
PW15	EQUIP.OPER.SCA WAGE (PT)	84.00	HR	1,880	-	-		-	-	22.386 /HR	1,880
PW25	LABOR SCA WAGE (ST)	420.00	HR	12,541	-	-		-	-	29.86 /HR	12,541
PW3C	LABOR SCA WAGE (PT)	84.00	HR	1,145	-	-		-	-	13.629 /HR	1,145
PW4C	TRUCK DRIVER SCA WAGE (ST)	420.00	HR	14,357	-	-		-	-	34.183 /HR	14,357
PW45	TRUCK DRIVER SCA WAGE(PT)	84.00	HR	1,339	-	-		-	-	15.938 /HR	1,339
E18D	D-5H / D6M Dozer or Equal	59.00	DY	-	-	-		13,345	-	226.195 /DY	13,345
E18f	FOGM D-5H /D-6M Dozer or Equal	420.00	HR	-	-	-		-	2,738	6.52 /HR	2,738
E87D	Water Truck 5K TO 6Kor Equal	30.00	DY	-	-	-		7,086	-	236.216 /DY	7,086
E87f	FOGM Water Truck 5K TO 6K	210.00	HR	-	-	-		-	3,668	17.465 /HR	3,668
----	CLEAN OFF-SITE BACKFILL (1.4% waste)	20,392.00	CY	-	304,857	-		-	-	14.95 /CY	304,857
----	MISC SAMPLE SUPPLIES	44.00	EA	-	110	-		-	-	2.492 /EA	110
----	SEEDING/MAINTENANCE	20.00	AC	-	-	27,944		-	-	1,397.184 /AC	27,944
----	POST EXCAV SURVEY	150.00	HR	-	-	16,592		-	-	110.61 /HR	16,592
----	BACKFILL ANALYSIS (full sweep)	8.00	EA	-	-	8,383		-	-	1,047.888 /EA	8,383
----	FEDERAL EXPRESS	8.00	EA	-	-	233		-	-	29.109 /EA	233
2001	Jtr Per Diem Double Rooms	176.00	Day	-	-	-		-	13,320	75.681 /Day	13,320
	*** unassigned ***			**50,643**	**304,966**	**53,151**		**20,432**	**19,726**		**448,919**
	1,512.00 Labor hours										
	400025 IRA LL 1,2,3,4 Excav. Backfill			***50,643***	***304,966***	***53,151***		***20,432***	***19,726***	***448,918.62 /LS***	***448,919***
	1.00 LS										
	1,512.00 Labor hours										

Item	Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount

400030 IRA LL 1,2,3,4 Soil Loadout

IRA LL 1,2,3,4 Soil Loadout

14,566 CUYDS SOIL AT 1.35 TONS YARD = 19665 TONS

LOADOUT BASED ON 18 LOADS (396 TONS DAY)=50 DAYS AT 10 HOURS DAY 5 DAYS WEEK

*** unassigned ***

Item	Description	Takeoff Qty	Unit	Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Unit Cost	Total Amount
PW1(	EQUIP. OPER. SCA WAGE (ST)	1,000.00	HR	46,146	-	-		-	-	46.146 /HR	46,146
PW15	EQUIP.OPER.SCA WAGE (PT)	200.00	HR	4,477	-	-		-	-	22.386 /HR	4,477
PW25	LABOR SCA WAGE (ST)	1,000.00	HR	29,860	-	-		-	-	29.86 /HR	29,860
PW3(	LABOR SCA WAGE (PT)	200.00	HR	2,726	-	-		-	-	13.629 /HR	2,726
PW4(	TRUCK DRIVER SCA WAGE (ST)	1,000.00	HR	34,183	-	-		-	-	34.183 /HR	34,183
PW45	TRUCK DRIVER SCA WAGE(PT)	200.00	HR	3,188	-	-		-	-	15.938 /HR	3,188
E50D	L90B Wheel Loader or Equal	140.00	DY	-	-	-		23,249	-	166.067 /DY	23,249
E50f	FOGM L90B Wheel Loader or Equal	1,000.00	HR	-	-	-		-	8,150	8.15 /HR	8,150
E87D	Water Truck 5K TO 6Kor Equal	70.00	DY	-	-	-		16,535	-	236.216 /DY	16,535
E87f	FOGM Water Truck 5K TO 6K	500.00	HR	-	-	-		-	8,732	17.465 /HR	8,732
----	MISC SAMPLE SUPPLIES	200.00	EA	-	498	-		-	-	2.492 /EA	498
5312	PPE Level D Complete TYVEK	300.00	MDAY	-	7,168	-		-	-	23.895 /MDAY	7,168
----	NON-HAZ DISPOSAL	10,817.00	TON	-	-	629,722		-	-	58.216 /TON	629,722
----	HAZ WASTE DISPOSAL	6,882.00	TON	-	-	1,201,928		-	-	174.648 /TON	1,201,928
----	DISPOSAL TSCA WASTE	1,966.00	TON	-	-	389,139		-	-	197.934 /TON	389,139
----	TCLP METALS	18.00	EA	-	-	2,242		-	-	124.582 /EA	2,242
----	TCLP LEAD,CHROM,ARSENIC	26.00	EA	-	-	1,588		-	-	61.082 /EA	1,588
----	TCLP NICKEL,ANTIMONY,ZINK	10.00	EA	-	-	668		-	-	66.832 /EA	668
----	TCLP VOC	18.00	EA	-	-	2,440		-	-	135.579 /EA	2,440
----	TCLP SVOCs	18.00	EA	-	-	4,981		-	-	276.720 /EA	4,981
----	REACTIVE CN/SULFIDE/FLASHPOINT	18.00	EA	-	-	1,472		-	-	81.761 /EA	1,472
----	pH	18.00	EA	-	-	84		-	-	4.657 /EA	84
----	PCB	18.00	EA	-	-	1,257		-	-	69.859 /EA	1,257
----	EXPLOSIVES	18.00	EA	-	-	2,715		-	-	150.844 /EA	2,715
----	FEDERAL EXPRESS	26.00	EA	-	-	1,514		-	-	58.216 /EA	1,514
----	DISPOSAL / SITE DEBRIS	80.00	TON	-	-	3,246		-	-	40.576 /TON	3,246
2001	Jtr Per Diem Double Rooms	420.00	Day	-	-	-		-	31,786	75.681 /Day	31,786
	*** unassigned ***			**120,579**	**7,667**	**2,242,997**		**39,785**	**48,669**		**2,459,696**
	3,600.00 Labor hours										
	400030 IRA LL 1,2,3,4 Soil Loadout	***1.00***	***LS***	***120,579***	***7,667***	***2,242,997***		***39,785***	***48,669***	***2,459,696.42 /LS***	***2,459,696***
	3,600.00 Labor hours										

Item	Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
	400032 Sealing Slabs LL 1,2,3,4										
	Sealing Concrete Slabs LL 1,2,3,4										
*** unassigned ***											
----	SEAL CONCRETE	1.00	EST	-	-	23,286		-	-	23,286.40 /EST	23,286
	*** unassigned ***					**23,286**					**23,286**
	400032 Sealing Slabs LL 1,2,3,4	***1.00***	***LS***	***0***	***0***	***23,286***		***0***	***0***	***23,286.40 /LS***	***23,286***

Item	Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount

400035 IRA LL 1,2,3,4 Proj. Oversite

IRA LL 1,2,3,4 Proj. Oversite

BASED ON 60 WORKING DAY 5 DAYS WEEK 10 HOURS DAY

*** unassigned ***

Item	Description	Takeoff Qty	Unit	Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
WH1(	PROJECT MANAGER	80.00	HR	11,600	-	-		-	-	145.00 /HR	11,600
WH1:	SITE SUPERINTENDENT	600.00	HR	52,800	-	-		-	-	88.00 /HR	52,800
WH2!	PROCUREMENT MANAGER	40.00	HR	3,280	-	-		-	-	82.00 /HR	3,280
WH3:	SITE S & H OFFICER SSHO	600.00	HR	44,400	-	-		-	-	74.00 /HR	44,400
WH4!	QUALITY CONTROL (QCS)	600.00	HR	46,200	-	-		-	-	77.00 /HR	46,200
WH5(	ENVIRONMENTAL ENGINEER	600.00	HR	39,000	-	-		-	-	65.00 /HR	39,000
WH6(	HAZ WASTE SPECIALIST	40.00	HR	3,680	-	-		-	-	92.00 /HR	3,680
WH6!	CONTRACTS MANAGER	40.00	HR	5,160	-	-		-	-	129.00 /HR	5,160
WH7(	COST CONTROL ENGINEER	40.00	HR	5,040	-	-		-	-	126.00 /HR	5,040
K20D	Aerosol Monitor	84.00	DY	-	-	-		1,203	-	14.316 /DY	1,203
K50D	Photoionization Detector	84.00	DY	-	-	-		1,203	-	14.316 /DY	1,203
K54D	LEL 4 Gas Meter	84.00	DY	-	-	-		1,203	-	14.316 /DY	1,203
T09D	Decon/Office Trailer, 45'	84.00	DY	-	-	-		2,766	-	32.927 /DY	2,766
V52D	Pick-Up Truck, 4WD	252.00	DY	-	-	-		11,184	-	44.38 /DY	11,184
V52f	FOGM Pick-Up Truck, 4WD	420.00	HR	-	-	-		-	2,641	6.287 /HR	2,641
V60D	Pick-Up Truck	252.00	DY	-	-	-		8,298	-	32.927 /DY	8,298
V60f	FOGM Pick-Up Truck	420.00	HR	-	-	-		-	2,641	6.287 /HR	2,641
----	OFFICE TRAILER	3.00	MO	-	-	0		1,495	-	498.333 /MO	1,495
----	PORT A JONS	3.00	MO	-	-	0		2,243	-	747.503 /MO	2,243
----	MISC DAILY COST	60.00	DAY	-	7,475	-		-	-	124.582 /DAY	7,475
----	ELECTRIAL USE	3.00	MO	-	-	3,493		-	-	1,164.32 /MO	3,493
----	PHONE USE	3.00	MO	-	-	6,986		-	-	2,328.64 /MO	6,986
2002	Jtr Per Diem Single	336.00	day	-	-	-		-	33,253	98.967 /day	33,253
4004	Rental Car	60.00	DY	-	-	-		-	4,541	75.681 /DY	4,541
	*** unassigned ***			**211,160**	**7,475**	**10,479**		**29,592**	**43,075**		**301,781**
	2,640.00 Labor hours										

Description	Labor Amount	Material Amount	Subcontract Amount	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
400035 IRA LL 1,2,3,4 Proj. Oversite	***211,160***	***7,475***	***10,479***	***29,592***	***43,075***	***301,781.39 /LS***	***301,781***
1.00 LS							
2,640.00 Labor hours							

Item	Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
	440005 Long Term Montoring										
	ASSUME 6 WELLS FOR 3 YEARS SAMPLING QUARTERLY										
*** unassigned ***											
WH15	CHEMIST	192.00	HR	12,096	-	-		-	-	63.00 /HR	12,096
WH27	ENGINEER TECHNICIAN	192.00	HR	9,024	-	-		-	-	47.00 /HR	9,024
V12D	PICKUP TRUCK	24.00	DY	-	-	-		756	-	31.495 /DY	756
V12f	FOGM PICKUP TRUCK	192.00	HR	-	-	-		-	1,538	8.011 /HR	1,538
----	SAMPLE SUPPLIES	216.00	EA	-	538	-		-	-	2.492 /EA	538
----	ANALYSIS (FULL SWEEP)	72.00	EA	-	-	75,448		-	-	1,047.888 /EA	75,448
2002	Jtr Per Diem Single	24.00	day	-	-	-		-	2,403	100.132 /day	2,403
	*** unassigned ***			**21,120**	**538**	**75,448**		**756**	**3,941**		**101,803**
	384.00 Labor hours										
	440005 Long Term Montoring	***1.00***	***LS***	***21,120***	***538***	***75,448***		***756***	***3,941***	***101,803.21 /LS***	***101,803***
	384.00 Labor hours										

Item	Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
	470005 5 YEAR REVIEW										
	5 YEAR REVIEW										
*** unassigned ***											
WH1(	PROJECT MANAGER	100.00	HR	14,500	-	-		-	-	145.00 /HR	14,500
WH1!	CHEMIST	150.00	HR	9,450	-	-		-	-	63.00 /HR	9,450
WH3!	REGULATORY SPECIALIST	100.00	HR	9,200	-	-		-	-	92.00 /HR	9,200
WH4!	QUALITY CONTROL (QCS)	50.00	HR	3,850	-	-		-	-	77.00 /HR	3,850
WH5(	ENVIRONMENTAL ENGINEER	180.00	HR	11,700	-	-		-	-	65.00 /HR	11,700
WH5!	RISK ASSESSOR	40.00	HR	5,000	-	-		-	-	125.00 /HR	5,000
WH8i	WORD PROCESSOR	100.00	HR	4,200	-	-		-	-	42.00 /HR	4,200
	*** unassigned ***			**57,900**							**57,900**
	720.00 Labor hours										
	470005 5 YEAR REVIEW			***57,900***	***0***	***0***		***0***	***0***	***57,900.000/LS***	***57,900***
	1.00 LS										
	720.00 Labor hours										

Estimate Totals

Labor	802,217	802,217		17,908.000	hrs
Material	416,343	416,343			
Subcontract	2,914,335	2,914,335			
Equipment	231,542	231,542			
Other	233,410	233,410			
	4,597,847	**4,597,847**	**4,597,847**		
	Total		***4,597,847***		