FINAL

SAMPLING AND ANALYSIS PLAN ADDENDUM NO. 1

FOR THE

PHASE II REMEDIAL INVESTIGATION OF LOAD LINE 1 AT THE RAVENNA ARMY AMMUNITION PLANT, RAVENNA, OHIO

Prepared for

US Army Corps of Engineers®

Louisville District
Contract No. DACA27-97-D-0025

Delivery Order No. 0005

August 1999

SAIC®

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U.S. Army Corps of Engineers
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Prepared by

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August 1999

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

contributed to the preparation of this document and should not
be considered an eligible contractor for its review.

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PART I – FIELD SAMPLING PLAN ADDENDUM

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ABBREVIATIONS

A&E	architect and engineer
AOC	area of concern
ASTM	American Society for Testing and Materials
BGS	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COPC	chemical of potential concern
CRREL	Cold Regions Research and Engineering Laboratory
D&D	decontamination and decommissioning
DNT	dinitrotoluene
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
FID	flame ionization detector
HMX	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
ID	inside diameter
IDW	investigation-derived waste
IOC	Industrial Operations Command
IR	Industrial Readiness (Command)
MCL	maximum contaminant level
OE	ordnance and explosives
OVA	organic vapor analyzer
PAH	polyaromatic hydrocarbon
PCB	polychlorinated biphenyl
PID	photoionization detector
PRG	preliminary remediation goal
PVC	polyvinyl chloride
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RDX	hexahydro-1,2,5-trinitro-1,3,5-triazine
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
RVAAP	Ravenna Army Ammunition Plant
SAIC	Science applications International Corporation
SAP	Sampling and Analysis Plan
SVOC	semivolatile organic compound
TAL	Target Analyte List
TCLP	Toxicity Characteristic Leaching Procedure
TNB	trinitrobenzene
TNT	trinitrotoluene
USACE	U.S. Army Corps of Engineers
USCS	Unified Soil Classification System
UXO	unexploded ordnance
VOC	volatile organic compound

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1.0 PROJECT DESCRIPTION

1.1 INTRODUCTION

The Phase II Remedial Investigation (RI) for Load Line 1 at the Ravenna Army Ammunition Plant (RVAAP), Ohio (Figure 1-1) will evaluate the nature and extent and identify the risk to human health or the environment due to contaminants in soil, surface water, sediment, and groundwater. This Sampling and Analysis Plan (SAP) Addendum has been prepared for RVAAP by Science Applications International Corporation (SAIC) for the U.S. Army Corps of Engineers (USACE), Louisville District, under Contract No. DACA27-94-D-0025, Delivery Order No. 0003. Because of ongoing decontamination and decommissioning (D&D) of buildings at Load Line 1, field activities for the Phase II RI are being incrementally implemented. This SAP Addendum addresses only the groundwater field investigation component of the Phase II RI. Future addenda will encompass planned characterization activities for other environmental media (soil, sediment, and surface water) following completion of D&D activities, as well as data evaluation methods and baseline risk assessment protocols. The planned activities within the scope of this SAP Addendum include:

- drilling and installation of eight new monitoring wells,
- collection of geotechnical samples from well borings (unconsolidated interval only),
- well development,
- hydraulic conductivity measurements (slug testing) in the eight new wells,
- monitoring well purging, and
- groundwater sampling of both the eight new wells and the six existing wells at Load Lines 1 and 2.

This SAP Addendum has been developed to tier under and supplement the *Facility-Wide Sampling and Analysis Plan for the Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 1996a) for the purpose of performing a Phase II RI at Load Line 1. The facility-wide SAP provides the base documentation (i.e., technical and investigative protocols) for conducting investigation under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) at RVAAP, whereas this SAP Addendum includes all of the investigation-specific sampling and analysis objectives, rationale, planned activities, and criteria specific to the Phase II RI groundwater investigation at Load Line 1. Consequently, both documents are necessary in order to implement the groundwater investigation. Where appropriate, this SAP Addendum contains references to the facility-wide SAP for base procedures and protocols.

The facility-wide SAP and this SAP Addendum have been developed following the USACE guidance document, *Requirements for the Preparation of Sampling and Analysis Plans*, EM 200-1-3, September 1994 (USACE 1994a), to collectively meet the requirements established by the Ohio Environmental Protection Agency (Ohio EPA), Northeast District, and the U.S. Environmental Protection Agency (EPA) Region V for conducting CERCLA investigations.

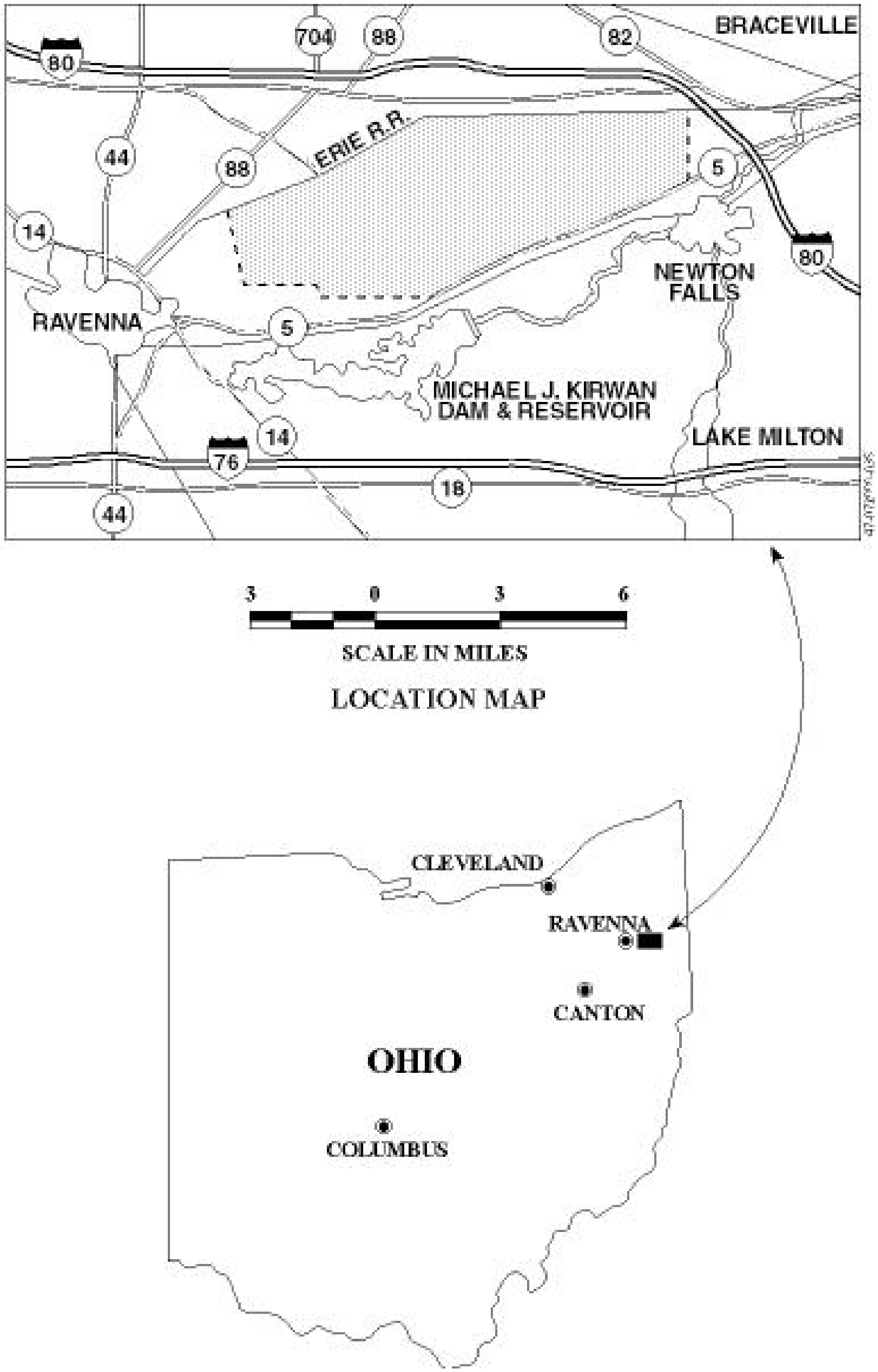

Figure 1-1. General Location and Orientation of RVAAP

1.2 LOAD LINE 1 HISTORY AND CONTAMINANTS

The RVAAP is located in northeastern Ohio in Portage and Trumbull Counties and lies about 16 km (10 miles) east of Ravenna, Ohio (Figure 1-1). Operations at the facility date to 1940 and include the storage, handling, and packing of military ammunition and explosives. The facility encompasses 8,668 hectares (21,419 acres) and is jointly operated by the Industrial Operations Command (IOC) of the U.S. Army and the National Guard Bureau. The IOC controls environmental areas of concern (AOCs) and bulk explosives storage areas. A detailed history of process operations and waste processes for each AOC at RVAAP is presented in the *Preliminary Assessment for the Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 1996b). The following is a summary of the history and related contaminants for Load Line 1.

Load Line 1 is located in the southeastern portion of RVAAP (Figure 1-2), began operation in 1941, and was used until 1971. A detailed site map of Load Line 1 is presented in Figure 1-3. All load lines operated at full capacity from 1941 through 1945. During World War II and the Korean War, Load Line 1 was used to melt and load trinitrotoluene (TNT) and Composition B explosives into large-caliber shells. Composition B is a mixture of TNT and hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX). Cadmium was applied to various components of the shells as a rust deterrent. 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. 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 chlorification 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-feet) concrete settling tanks and a set of three 1.5- × 4.6- × 0.9-m (5- × 15- × 3-feet) filter blocks in the bottom of the filtration tanks. Plant effluent entered the top of one end of the filtration unit and discharged to an earthen settling pond (Griggy’s Pond) via an unlined ditch. The settling pond at Load Line 1 was an unlined earthen impoundment approximately 0.4 hectare (1 acre) in size. The discharge from the impoundment immediately exited the installation. Sawdust from the filtration unit was disposed by open burning at Winklepeck Burning Grounds. During building washdown, pink water or loose explosive flakes or dust were occasionally swept out of doorways onto the ground.

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

More recently, Load Line 1 was the site of munitions rehabilitation activities following the Vietnam War. These activities primarily involved the dismantling, replacement of components, and repainting of mines. Much of this work was conducted in Building CB-10.

Load Line 1 was the subject of a Phase I RI in 1996 (USACE 1997a). The purpose of the investigation was to confirm whether contamination was present at the site and to determine the nature of the chemicals of potential concern (COPCs). The results of this investigation are summarized in Section 1.3.

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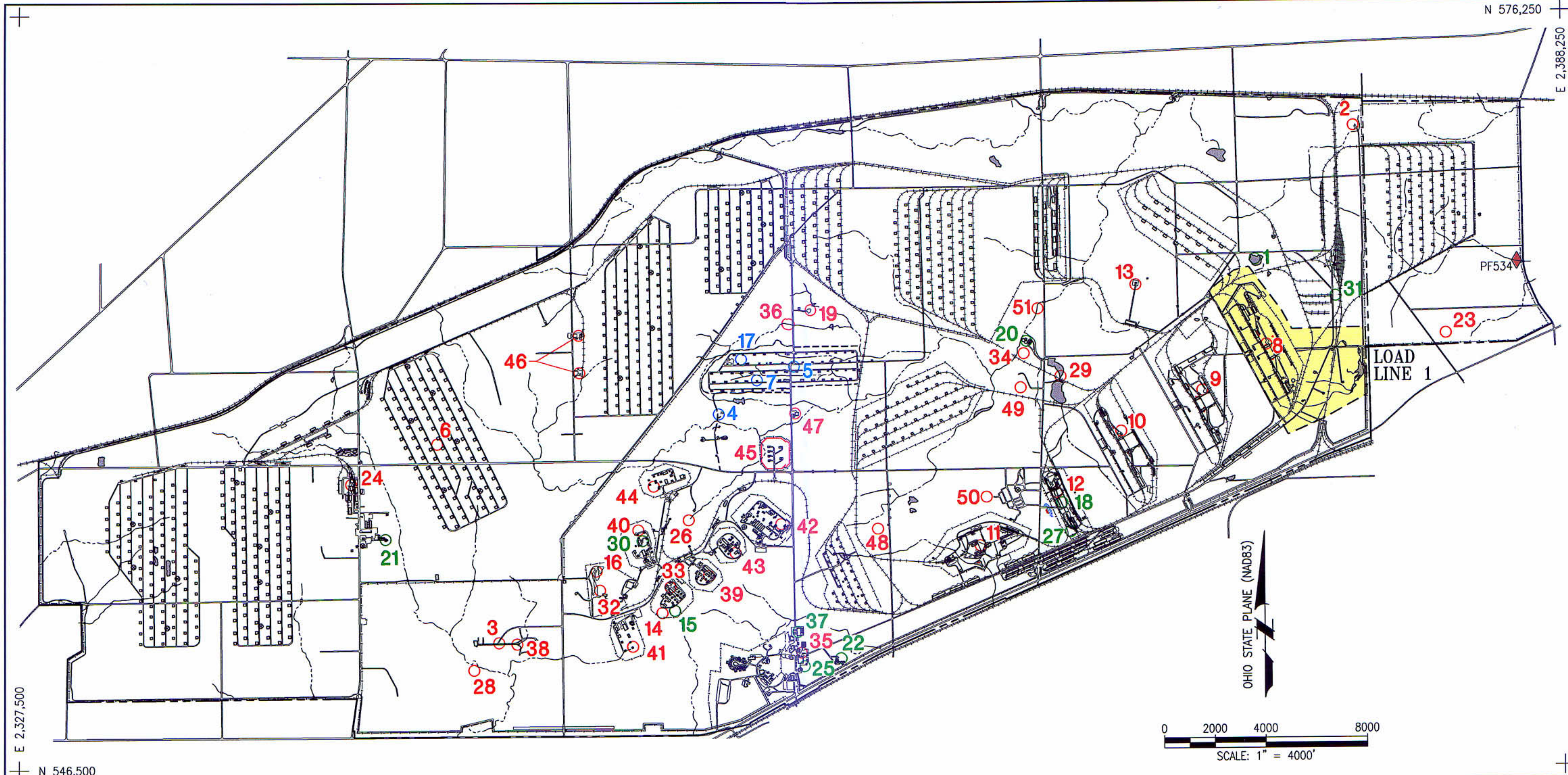

LEGEND OF SITES

1	RAMSDELL QUARRY LANDFILL
2	ERIE BURNING GROUNDS
3	DEMOLITIONS AREA #1
4	DEMOLITIONS AREA #2
5	WINKLEPECK BURNING GROUNDS
6	C BLOCK QUARRY
7	BLDG 1601 HAZARDOUS WASTE STORAGE
8	**LOAD LINE 1 AND DILUTION/SETTLING POND**
9	LOAD LINE 2 AND DILUTION/SETTLING POND
10	LOAD LINE 3 AND DILUTION/SETTLING POND
11	LOAD LINE 4 AND DILUTION/SETTLING POND
12	LOAD LINE 12 AND DILUTION/SETTLING POND
13	BLDG 1200 AND DILUTION/SETTLING POND
14	LOAD LINE 6, EVAPORATION UNIT
15	LOAD LINE 6, TREATMENT PLANT
16	QUARRY LANDFILL/FORMER FUZE & BOOSTER BURNING PITS
17	DEACTIVATION FURNACE
18	LOAD LINE 12 PINK WASTE WATER TREATMENT
19	LANDFILL NORTH OF WINKLEPECK BURNING GROUND
20	SAND CREEK SEWAGE TREATMENT PLANT
21	DEPOT SEWAGE TREATMENT PLANT
22	GEORGE ROAD SEWAGE TREATMENT PLANT
23	UNIT TRAINING SITE WASTE OIL TANK
24	RESERVE UNIT MAINTENANCE AREA WASTE OIL TANK
25	BLDG 1034 MOTOR POOL WASTE OIL TANK
26	FUZE BOOSTER AREA SETTLING TANKS
27	BLDG 854-PCB STORAGE
28	MUSTARD AGENT BURIAL SITE
29	UPPER AND LOWER COBBS POND COMPLEX
30	LOAD LINE 7 PINK WASTEWATER TREATMENT PLANT
31	ORE PILE RETENTION POND
32	40- AND 60-MM FIRING RANGE
33	FIRESTONE TEST FACILITY
34	SAND CREEK DISPOSAL ROAD LANDFILL
35	1037 BUILDING-LAUNDRY WASTEWATER SUMP
36	PISTOL RANGE
377	PESTICIDE STORAGE BUILDING T-4452
388	NACA TEST AREA
399	LOAD LINE 5 / FUZE LINE 1
400	LOAD LINE 7 / BOOSTER LINE 1
411	LOAD LINE 8 / BOOSTER LINE 2
422	LOAD LINE 9 / DETONATOR LINE
433	LOAD LINE 10 / PERCUSSION ELEMENT
444	LOAD LINE 11 / ARTILLERY PRIMER
455	WET STORAGE AREA
466	BUILDINGS F-15 AND F-16
477	BUILDING T-5301 DECONTAMINATION
488	ANCHOR TEST AREA
49	CENTRAL BURN PITS
50	ATLAS SCRAP YARD
51	DUMP ALONG PARIS-WINDHAM ROAD
○ (red)	CERCLA
○ (blue)	RCRA
○ (green)	OTHER REGULATORY
◆	SURFACE WATER QUALITY MONITORING STATION PF534

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers Louisville District

RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
FACILITY MAP

DRAWN BY:	REV. NO./DATE:	CAD FILE:
R. BEELER	REV. 0/ 07-29-99	/99035/DWGS/F47RVAAP

Figure 1-2. RVAAP Installation Map

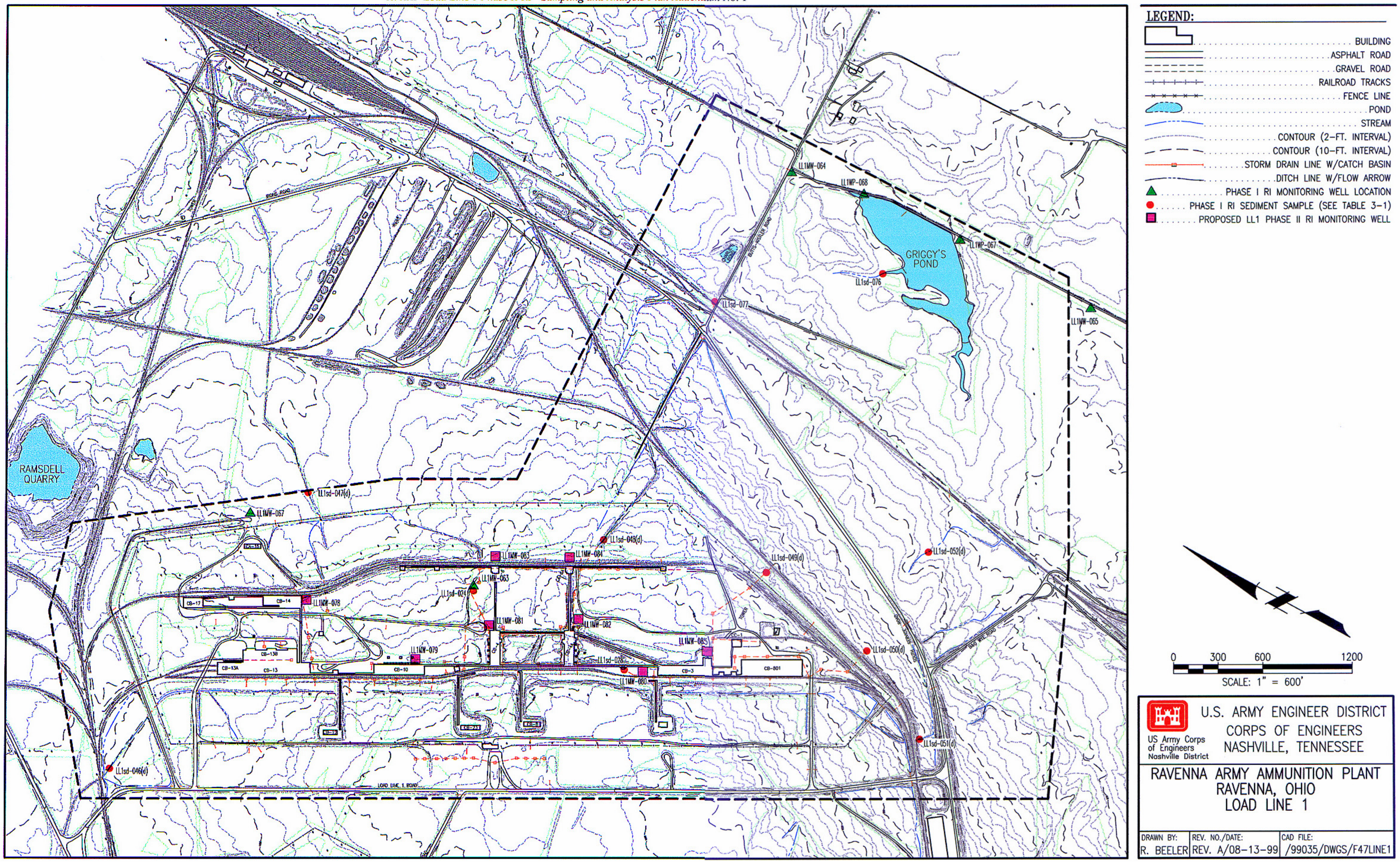

Figure 1-3. Existing Phase I RI and Proposed Phase II RI Monitoring Wells at Load Line 1.

Load Line 1 is currently undergoing D&D of buildings. All buildings with residual explosive dust were washed down, and the free-standing equipment was removed from the buildings, before the load line was declared inactive in 1971. Since 1996, salvaging contractors have been working at Load Line 1 to remove telephone lines and major rail spurs across the site. 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 U.S. Army Industrial Readiness (IR) Command. Transite (asbestos and concrete) siding and roofing, and any remaining recyclable steel, are also slated for removal. There is a concern that removal of the transite panels will introduce new contamination to the soil around the buildings in three important ways:

- Plugs of mortar that were packed between the corrugations in the transite and the flat foundations of several buildings may loosen and fall to the ground. These plugs are stained the characteristic red of TNT as a result of the accumulation of TNT-laden rinse water in these plugs. They may leach TNT onto the soil once they are exposed to the elements.

- Transite is non-friable as long as whole sheets are removed. There is a potential for a release of asbestos to the air and the soils if transite slabs are broken during removal. Several broken sheets were noted at Load Line 1 in July 1998.

- Removal of transite roofing on the buildings exposes the painted interior walls to the elements. Typically, the paint on the walls contains lead and other metals. Paint is peeling off the walls in all load line buildings and poses a potential for lead loading to the soils and groundwater at Load Line 1. In addition, exposure of interior walls and floors contaminated with residual explosive dust to the elements could produce contaminated runoff to soils beneath and adjacent to the buildings.

To minimize the spread of these contaminants, the following measures are being conducted during the demolition work:

- vacuuming and sweeping all dust and debris before transite removal/demolition begins, during removal activities as significant quantities of dust and debris accumulate, and at the completion of demolition activities;

- disposing dust and debris according to state and federal guidelines;

- 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.

Based on the site operational history, waste constituents and potential contaminants at Load Line 1 include TNT; RDX; octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX); Composition B; propellants; lead; cadmium; chromium; mercury; and arsenic from the handling and processing of materials used to assemble ammunition. Contaminants associated with support activities include petroleum products, solvents, pesticides, PCBs, and heavy metals. Additional information regarding site-related contamination identified in environmental investigations is presented in Section 1.3.

1.3 SUMMARY OF EXISTING DATA

Four previous investigations have been conducted wholly or in part at, or in the vicinity of, Load Line 1: (1) Water Quality Surveillance Program (USATHAMA 1980–1992); (2) the 1997 residential well sampling effort conducted by Ohio EPA in Fall 1997 (OEPA 1997); (3) the Cold Regions Research and Engineering Laboratory's (CRREL's) study of explosives contamination in surface soils (USACE 1997a); and (4) the *Phase 1 Remedial Investigation of High-Priority Areas of Concern at the Ravenna Army Ammunition Plant* (USACE 1997b). The sampling locations, dates, and analyses are documented for these studies. Other studies conducted are missing some or all documentation and are not discussed in this SAP Addendum. Table 1-1 presents a summary of the most relevant results of previous investigations of Load Line 1. The table shows results for available historical groundwater data, the CRREL soil study, and all Phase I monitoring wells and selected sediment samples. The remainder of the data from the Phase I RI and other previous investigations is available through the cited references.

The Water Quality Surveillance Program included monitoring of nine surface water locations throughout RVAAP between 1980 and 1992. In addition, groundwater samples were collected from former site production wells located in the Pottsville Formation. Of the surface water locations, the one of interest to this study is a Parshall Flume located near the eastern boundary of the installation, adjacent to Route 534 (station PF 534; see Figure 1-2). Surface water from Load Line 1, in part, discharged off the installation though this point. However, the station receives drainage from a large area in addition to Load Line 1. Copper, chromium, hexavalent chromium, lead, zinc, TNT, and RDX were monitored annually in surface water during the entire program. Cadmium was added to the annual list of metals analytes between 1988 and 1992.

Indicator parameters, such as pH, temperature, specific conductance, dissolved oxygen, oil and grease, total suspended solids, fecal coliform, and biochemical oxygen demand were monitored quarterly. Total organic carbon, total Kjehldal nitrogen, nitrate, and phosphorus were evaluated semiannually. Samples collected and analyzed from station PF 534 between 1980 and 1992 had no detectable quantities of explosives, with the exception of a November 6, 1987 sample (RDX at 64 μg/L) that was subsequently reanalyzed with a result of <0.25 μg/L. Low concentrations of zinc and copper were occasionally detected. Hexavalent chromium was detected on one occasion in 1985. Groundwater samples collected from site production wells had no detectable quantities of chromium, arsenic, or cadmium. Low concentrations of TNT were detected in site production wells samples in 1977. Detectable quantities of lead were also present in several wells during 1977 and 1980 sampling events (Table 1-1).

Ohio EPA's 1997 residential groundwater survey detected no explosive concentrations that exceeded maximum contaminant levels (MCLs) in domestic supply wells located hydraulically downgradient from Load Line 1. One arsenic result exceeded its respective MCL of 50 μg/L. The 1997 CRREL study evaluated explosives only in soils; TNT, DNT, and RDX were detected in site soil samples.

The Phase I RI performed in 1996 included sampling and analysis of groundwater, surface soils, ditch sediment, and sediment from Griggy's and Charlie's Ponds. 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-3A and CB-10), 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, -13B, and -14.

Table 1-1. Summary of Results of Previous Investigations

Sample ID	Date	TNT	RDX	DNT	Pb	Cr	As	Cd
RVAAP Water Quality Surveillance Program Water Production Wells (measurements in mg/L; analytical methods unknown)								
Well 25	9/77	0.002	ND	ND	<0.025	<0.025	<0.01	<0.005
Well 27	9/77	0.001	ND	ND	0.006	<0.025	<0.01	<0.005
	9/85	ND	ND	ND	<0.05	<0.02		<0.01
	12/89	ND	ND	ND	<0.02	<0.03		<0.01
	11/90	ND	ND	ND	<0.02	<0.03		<0.01
	8/91	ND	ND	ND	<0.015	<0.03		<0.01
Well 86	9/77	0.001	ND	ND	0.008	<0.025	<0.01	<0.005
Well 88	9/77	0.001			0.008	<0.025	<0.01	<0.005
	12/80	0	0		0.034	<0.01		
	12/89	<0.001	<0.001	<0.001	<0.02	<0.03		<0.01
	11/90	<0.001	<0.001	<0.001	<0.02	<0.03		<0.01
	8/91	<0.001	<0.001	<0.001	<0.015	<0.03		<0.01
CRREL Soil Sample Analysis (measurements in mg/kg; SW-846 method 8330)								
LL1-1 (0-6 ")	7/97	0.6	0.1	0.5				
LL11-1 (6-12")	7/97	ND	ND	ND				
LL1-2 (0-6")	7/97	0.1	ND	ND				
LL1-2 (6-12")	7/97	0.2	ND	ND				
LL1-2 (12-18")	7/97	0.3	ND	ND				
LL1-3 (0-6")	7/97	0.5	ND	0.3				
LL1-3 (6-12")	7/97	ND	ND	ND				
Phase I RI Groundwater (measurements in mg/L; SW-846 methods 6010A/7000 and 8330)								
LL1mw-063	8/96	ND	ND	ND	ND	ND	ND	ND
LL1mw-064	8/96	ND	ND	ND	ND	ND	ND	ND
LL1mw-065	8/96	ND	ND	ND	ND	ND	ND	ND
LL1mw-067	8/96	ND	ND	ND	ND	ND	ND	ND

Table 1-1 (continued)

Sample ID	Date	TNT	RDX	DNT	Pb	Cr	As	Cd
Phase I RI Sediments (measurements in mg/kg; SW-846 methods 6010A/7000 and 8330)								
LL1sd-024	7/96	770	ND	ND	356	54.8	12.5	8.7
LL1sd-028	7/96	16	ND	ND	2220	345	43.3	26.9
LL1sd-048	7/96	ND	ND	ND	30.7	12.1	10.7	1.5
LL1sd-049	7/96	0.43	16	ND	2160	218	12.9	2.5
LL1sd-050	7/96	ND	ND	ND	75.5	19.4	20.3	1.5
LL1sd-051	7/96	ND	ND	ND	16.2	13.3	14.4	0.04
LL1sd-052	7/96	ND	ND	ND	18.1	13.4	15.5	0.4
LL1sd-056	7/96	ND	0.43	ND	13	11.4	18.8	0.45

CRREL = Cold Regions Research and Engineering Laboratory
DNT = dinitrotoluene
ND = not detected
RDX = hexahydro-1,2,5-trinitro-1,3,5-triazine
RI = remedial investigation
TNT = trinitrotoluene

Aluminum, arsenic, barium, cadmium, chromium, iron, lead, manganese, magnesium, mercury, selenium, and zinc in soils were all found at concentrations above their respective background criteria. Maximum concentrations of inorganics in soils are higher at Load Line 1 than at any of the remaining high-priority AOCs investigated, but occurrences of high concentrations of metals do not coincide with high concentrations of explosives. Pond sediment samples did not contain explosives. Explosives were not detected in groundwater samples. 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).

Figure 1-3 illustrates the existing groundwater monitoring wells located at Load Line 1. Existing analytical data are discussed in greater detail in Chapter 4.0 of this SAP Addendum, where the sampling rationale is presented for each of the planned Phase II RI monitoring well locations to be drilled.

1.4 SPECIFIC SAMPLING AND ANALYSIS PROBLEMS

Because of the presence of propellants at the north end of Load Line 1 observed on the surface during the Phase I RI, all groundwater monitoring well locations will be marked prior to field activities. The locations will be cleared by ordnance and explosives (OE) technical support staff and approved by the RVAAP IOC representative. The OE support staff will train field sampling crews in unexploded ordnance (UXO) recognition and avoidance prior to site drilling activities.

Because the only OE hazard at Load Line 1 includes propellants spilled on the ground surface during site operations, subsurface OE monitoring is not necessary. No ordnance has been encountered during previous environmental investigations, and none is expected based on the site operational history.

Salvage and removal operations under way throughout RVAAP have resulted in the dismantling of rail and telephone lines at Load Line 1. In addition, steam lines and transite (asbestos and concrete) siding are being removed by demolition contractors from buildings throughout Load Line 1. At this writing, it is unknown to what degree these activities may alter the occurrences of contamination in soils documented in 1996, impact access routes to specific sampling sites, or impede work schedules. Bedrock occurs at or within 4 feet of the ground surface in many potential Phase II RI sample locations in Load Line 1 and poses some difficulties for gathering sufficient soil volume for geotechnical analyses.

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2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The Load Line 1 Phase II RI monitoring well installation project organization and responsibilities are presented in Figure 2-1. The functional responsibilities of key personnel are described in Chapter 2.0 of the facility-wide SAP and, therefore, are not presented here. Figure 2-1 shows the Project Organization Chart for the monitoring well installation effort. Table 2-1 presents the planned project schedule for the groundwater investigation component only.

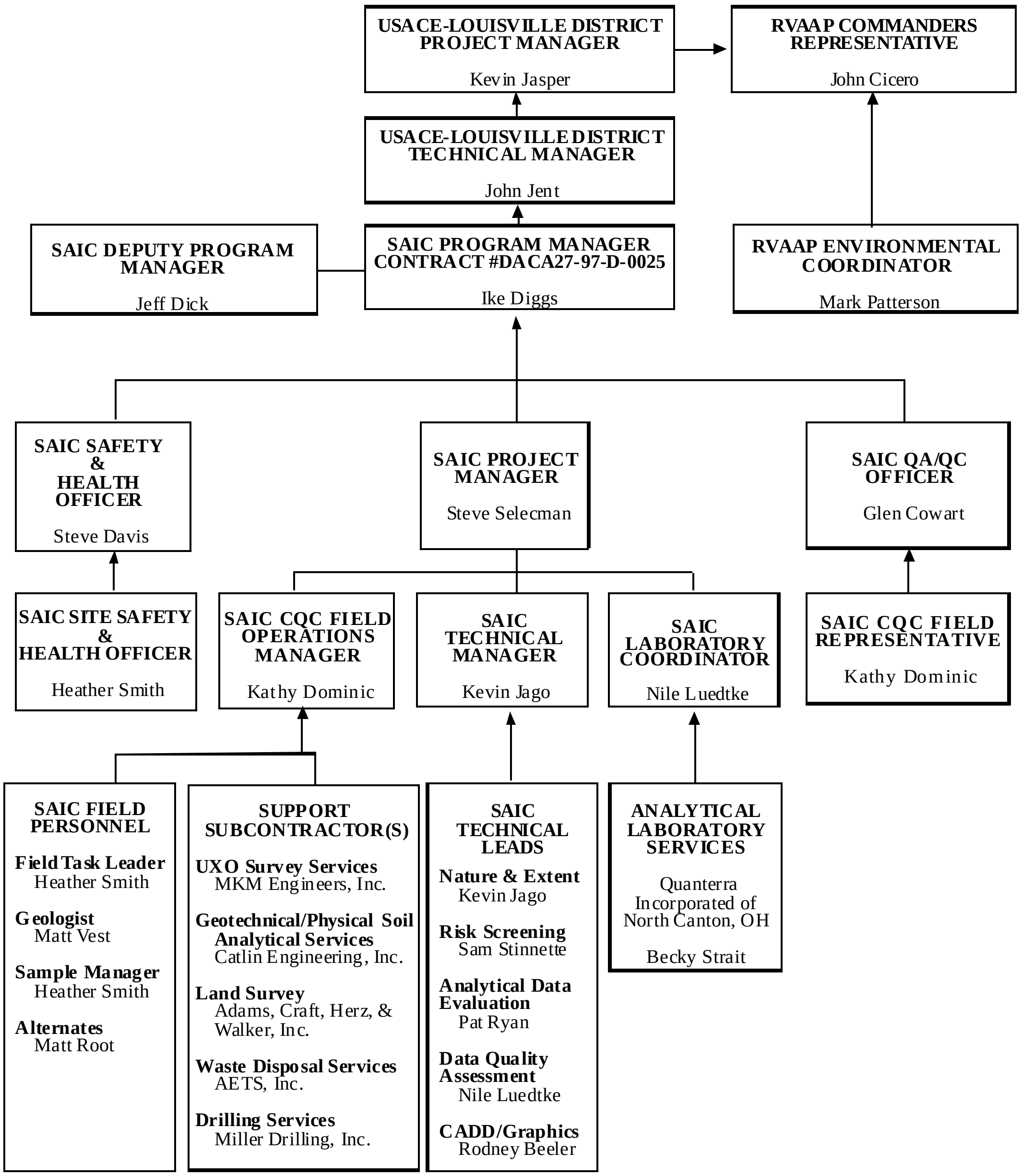

Figure 2-1. Project Organization Chart for the Phase II RI Groundwater Investigation for Load Line 1

Table 2-1. Project Schedule for the Load Line 1 Phase II RI Groundwater Investigation

Task Number	Activity	Start	Finish
1.2	Prepare Draft Work Plan	12 Jul 99	30 Jul 99
1.2	Submit Draft Work Plan	—	30 Jul 99
1.3	Review Draft Work Plan	30 Jul 99	08 Aug 99
1.4	Prepare Final Work Plan	09 Aug 99	13 Aug 99
1.4	Submit Final Work Plan	—	13 Aug 99
3.1	Mobilization	9 Aug 99	15 Aug 99
3.2	Groundwater Investigation	16 Aug 99	08 Sept 99
4.0	Surveying and Mapping	08 Sept 99	10 Sept 99
5.0	UXO Support	16 Aug 99	17 Aug 99
6.0	IDW Disposition	08 Oct 99	08 Dec 99
7.0	Analytical Investigation	30 Aug 99	11 Oct 99
7.0	Data Validation and Loading	12 Oct 99	12 Nov 99

IDW = investigation-derived waste
RI = remedial investigation
UXO = unexploded ordnance

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3.0 SCOPE AND OBJECTIVES

3.1 PHASE II RI MONITORING INSTALLATION SCOPE AND OBJECTIVES

The scope of the Load Line 1 Phase II RI is to determine the nature and extent of contamination in affected media (soils, sediment, surface water, and groundwater) identified during the Phase I RI. The primary technical objectives of the Phase II RI are as follows:

- Characterize the physical environment of Load Line 1 and its surroundings to the extent necessary to define potential transport pathways and receptor populations.

- Characterize sources; types, chemical properties, and quantities of contaminants; potential contaminant release mechanisms; and contaminant fate and transport; obtain sufficient engineering data to develop a site conceptual model suitable for use in a baseline risk assessment and to evaluate remedial action alternatives.

- Conduct a baseline risk assessment using characterization data and the site conceptual model to evaluate potential threats to human health and the environment and develop preliminary remediation goals (PRGs) for use in determining areas that may require remediation and evaluating remedial action alternatives.

- Assess the suitability of field-portable X-ray fluorescence spectrometry for performing in situ and ex situ analysis of metals on soil and sediment samples. Results of these tests will determine the suitability of metals field determinations for future environmental investigations and remedial activities.

Because this SAP Addendum includes only the groundwater field investigation component of the Phase II RI for Load Line 1, the above listed technical objectives are addressed only in the context of field activities to characterize this environmental medium. The Phase II RI technical objectives have been developed using the data quality objective (DQO) approach presented in the facility-wide SAP. The objectives specific to groundwater sampling and characterization are presented in Chapter 4.0 of this SAP Addendum.

3.2 PHASE II RI MONITORING WELL INSTALLATION DATA QUALITY OBJECTIVES

The project DQO is to provide sufficient high-quality data to address the primary project objectives identified in Section 3.1. Specific DQOs for the Phase II RI at Load Line 1 are to address remaining data gaps, which are listed below, identified by the Phase I RI:

- No subsurface soil sampling was conducted in the Phase I RI at Load Line 1.

- No samples were analyzed for propellants.

- Surface water in ditches and ponds was not characterized.

- Surface water drainage on the east side of the load line was not fully characterized.

- Groundwater was not fully characterized.
- The storm sewers were not evaluated.
- Deeper sediments (> 2 feet) were not characterized in the Phase I RI.
- For several inorganics in soil (e.g., beryllium) and for groundwater, surface water, and sediment, no background criteria were available in Phase I.
- The definition of lateral extent of contamination was not an objective of the Phase I study. Many buildings on the load line had minimal sample coverage.
- Some of the service buildings were later understood to have had multiple uses throughout the active life of the load line. The analytical suite for the bulk of the Phase I RI surface soil samples did not account for this.

In addition, facility-wide background values for use in the remedial investigation/feasibility study (RI/FS) process were identified as necessary for consistency in the RI/FS process at RVAAP. A Facility-Wide Background Investigation was begun in April 1998 to augment the Phase I RI background data set for groundwater, soils, surface water, and sediment. A complete discussion of the facility-wide background data is contained in the *Phase II Remedial Investigation Report for the Winklepeck Burning Grounds at the Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 1999).

3.2.1 Conceptual Site Model

Based on current knowledge, the conceptual site model presented in the facility-wide SAP is applicable to this element of the Phase II RI for Load Line 1. Operational information and analytical data collected during the Phase I RI of High-Priority Areas of Concern (USACE 1997b) and other historical environmental investigations have also been used to refine the conceptual model for Load Line 1 as follows:

Soils. During the Phase I RI, 48 surface soil samples were collected from 0 to 0.6 m (0 to 2 feet) and analyzed for explosives during the Phase I RI. Thirty-eight of these samples were also analyzed for process-related metals, and 12 samples received additional analysis for cyanide, volatile organic compounds (VOCs), SVOCs, and PCBs/pesticides. Relevant components of the site conceptual model for soils derived from the Phase I RI and historical studies include:

- The soil cover at Load Line 1 is thin (< 0.5 foot) or absent in many locations, and sandstone bedrock crops out or has been excavated at the change houses and the sites of the melt/pour buildings CB-4 and CB-4A. Consequently, contaminant leaching pathways from soil to bedrock are short or nonexistent in many areas.
- TNT was detected in 28 Phase I RI soil samples and trinitrobenzene (TNB) in 10 samples. Dinitrotoluene (DNT) was detected in five samples. Explosives were most concentrated in areas surrounding the melt/pour and washout buildings, the vacuum pump houses at Building CB-10, a settling tank, and east of Building CA-6. Building CB-3A also exhibits explosives contamination. High concentrations of explosives are localized around doorways, drains, and vacuum pumps.

- Inorganics were identified at concentrations above the Phase I RI background criteria for soils in many locations. Lead, cadmium, and zinc were the most frequently detected metals exceeding the background criteria. The highest concentrations for arsenic, cobalt, chromium, lead, vanadium, and selenium found in the Phase I RI were found at Load Line 1, but do not correlate with the highest concentrations of explosives.

- Organic compounds were present in 9 out of 12 Phase I RI surface soil samples. VOCs acetone, chloroform, and toluene were present in eight samples, at concentrations of 0.017 mg/kg or less. SVOCs, including several polyaromatic hydrocarbons (PAHs) and phthalates, were encountered in seven sampling locations, with the maximum concentrations for the PAHs centering on Building CB-101's pump houses. PCBs or pesticides were also encountered in seven samples.

Sediment. Twenty-two Phase I RI sediment samples were collected from the ditches and settling ponds and analyzed for explosives and process-related inorganic compounds. Three of these samples also received analyses for VOCs, SVOCs, and PCBs/pesticides. Relevant aspects of the site conceptual model for sediments include:

- Load Line 1 surface water drainage pathways convey sediment southeastward off the installation. These drainages do not appear to be connected to Eagle Creek or the other streams that comprise the tributary system at RVAAP. All drainages are unlined, man-made extensions of natural drainage trends. These ditches are generally dry except immediately following storm events.

- Explosives were not detected in Phase I RI sediment samples from three of the four main drainage ditches that exit Load Line 1 from the south, or from a ditch that exits the load line at its northern end. Pond sediments from Griggy's and Charlie's Ponds exhibit no detectable contamination with explosives. Explosives were detected in sediments in concrete settling tanks and in one ditch at the south end of the load line. However, some drainages at the load line were not sampled during Phase I.

- All 11 site-related metals were detected at concentrations exceeding the Phase I background criteria. The highest concentrations of metals occurred predominantly in locations where no detectable quantities of explosives were present. Maximum concentrations of many analytes occurred in Griggy's or Charlie's Ponds, including the maximum value of chromium in any RVAAP sediment.

- Three Phase I RI samples were analyzed for organic compounds. Acetone and chloroform were detected once. PAHs were present in all three samples. Pesticides and PCBs were found in two samples in the southern third of the load line and in one ditch that discharges to Griggy's Pond.

Groundwater. Groundwater samples were collected from four monitoring wells and three temporary well points installed for the Phase I RI. The samples were analyzed for inorganic and explosive compounds, VOCs, SVOCs, and pesticides/PCBs. Known aspects of the site conceptual model for groundwater include:

- Groundwater occurs in the highly permeable sandstones of the Pottsville Formation and in unconsolidated sands overlying the Pottsville south of Load Line 1. Groundwater flow is presumed to be southeastward, toward Griggy's Pond.

- No explosives were detected in either the monitoring wells or well points.

- All metals present in groundwater, with the exception of essential nutrients, are considered to be site related. Comparison of detected constituents to facility-wide background levels was not performed because facility-wide background criteria were not developed at the time of the Phase I RI.

- Organic compounds are generally not found in groundwater at the perimeter locations sampled. Heptachlor and phthalates were present in minor concentrations in a single well point sample.

3.2.2 Problem Definition

Wastewater effluent from steam cleaning of explosives-handling buildings and residuals from various support activities have potentially contaminated surface and subsurface soils. The potential exists for contaminant migration to groundwater via infiltration and leaching through soils. The potential for surface water runoff to drainage ditches and surface water bodies exists; however, this pathway was not identified as a major component of the conceptual model because the Phase I RI showed no significant contamination of ditch sediments. The Phase I RI demonstrated that contamination is present in surface soils, with the highest concentrations occurring near the melt-pour buildings. Also, contamination of storm sewers throughout Load Line 1 has possibly occurred. Migration of contaminants to surface water (by flushing during storm events) or groundwater (through leaking storm sewers) from the storm sewer system is a pathway of concern. Groundwater contamination is most likely in the vicinity of primary operational facilities (i.e., melt/pour buildings) or heavily contaminated secondary sources (i.e., soil or storm sewers); thus, Phase II RI monitoring well locations are biased to these areas.

3.2.3 Remedial Action Objectives

See Section 3.2.3 of the facility-wide SAP.

3.2.4 Identify Decisions

The key decisions for all investigations at RVAAP have been identified in Section 3.2.4 and Table 3-1 of the facility-wide SAP. Phase II RI data, inclusive of the baseline risk assessment results, are necessary for refinement of the site conceptual model, development of PRGs, and initiation of the FS process.

3.2.5 Define the Study Boundaries

The investigation area boundary for Load Line 1 is that presented in Figure 1-3. The AOC includes both Griggy’s and Charlie’s Ponds. The boundary was established to encompass all known or reported historical activities and potential surface water exit pathways.

3.2.6 Identify Decision Rules

Decision rules used to guide remediation decisions are provided in Chapter 3.0 of the facility-wide SAP. As stated therein, Phase I RI data were not sufficient to define nature and extent of contamination; therefore, these data were insufficient to fully evaluate risk due to exposure to these contaminants.

3.2.7 Identify Inputs to the Decisions

Input to the decisions are analytical results that can be used to estimate risk.

3.2.8 Specify Limits on Decision Error

Limits on decision errors are addressed in Section 3.2.8 of the facility-wide SAP.

3.2.9 Optimize Sample Design

The sample design for the Phase II RI of Load Line 1 will be described in detail in Chapter 4.0 of this SAP Addendum.

3.3 DATA EVALUATION METHODS

Analytical results will be reported by the laboratory in electronic form and loaded into an established database. Data reduction and validation will be performed on groundwater analytical data in accordance with the QAPP. Data will be held in the database pending completion of field activities for the Phase II RI for Load Line 1. Upon completion of the Phase II RI activities, data screening and evaluation processes will be implemented for the entire data set as part of the RI report preparation. The data aggregation, screening, and evaluation steps to be implemented as part of the Phase II RI will be presented in a subsequent addendum addressing the remaining field activities. As a part of the future data aggregation, screening, and evaluation, Phase II RI results from Load Line 1 will be compared to facility-wide background values for RVAAP as developed in the *Phase II Remedial Investigation Report for the Winklepeck Burning Grounds at the Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 1999).

3.4 RISK EVALUATION

The risk evaluation processes to be employed for the Phase II RI for Load Line 1 will be addressed in a subsequent addendum addressing the remaining field activities.

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4.0 FIELD ACTIVITIES

4.1 GROUNDWATER

4.1.1 Rationales

The locations of groundwater monitoring wells focus on: (1) known areas of soil contamination identified by the Phase I RI and (2) areas directly downgradient of former operational facilities within the constraints imposed by site access restrictions. The planned placement of the wells maximizes the potential to identify impacted groundwater due to leaching and infiltration mechanisms near known and suspected source areas. Adequate characterization of the uppermost aquifer and groundwater quality is the rationale for collection of geotechnical and groundwater samples, as well as performing slug tests.

4.1.1.1 Monitoring well locations and installation

Eight monitoring wells will be installed as a part of the Phase II RI at Load Line 1 (Figure 1-3). The rationale for placement of each of the wells is as follows:

- LL1mw-078: Directly downgradient of Building CA-14, which formerly housed demilitarization activities. The Phase I RI identified elevated levels of metals, PCB-1254, several pesticides, and explosives in soil in this area. Propellant pellets also were observed on the surface adjacent to this building.

- LL1mw-079: Directly downgradient of Building CB-10, which contained drill and booster operations. The Phase I RI showed high levels of PCB-1254, gamma chlordane, lead, and chromium in soil in this area, as well as detectable explosives.

- LL1mw-080: Adjacent to a former concrete washdown settling tank located at Building CB-3A. The Phase I RI indicated elevated levels of metals (including lead in excess of 1000 mg/kg), pesticides, PCB-1254, and detectable levels of PAHs in soil in this area.

- LL1mw-081: Near Building CB-4, which was a former melt/pour building. The Phase I RI showed elevated levels of PCB-1254, pesticides, metals (including lead in excess of 1000 mg/kg), and explosives in the site vicinity.

- LL1mw-082: Downgradient of Building CB-4A, which was a former melt/pour building. The Phase I RI showed elevated levels of pesticides, metals (including lead in excess of 1000 mg/kg), and explosives in the site vicinity.

- LL1mw-083: Downgradient of former shaker/high explosive preparation Building CA-6. The Phase I RI showed elevated levels of metals and explosives in the site vicinity.

- LL1mw-084: Downgradient of former shaker/high explosive preparation Building CA-6A. The Phase I RI showed elevated levels of metals and explosives in the site vicinity.

- LL1mw-085: Downgradient of Building CB-20, which was a former paint mixing and solvent storage building. Other facilities in the area include a former paint and oil storage building (CB-19), shell painting building (CB-3), and truck maintenance building (CB-2).

All of the planned wells will monitor the water table interval, which is anticipated to vary between 1.5 m (5 feet) and 5.5 m (18 feet) below ground surface (BGS), based on existing potentiometric data from the Phase I RI and other previous studies. The maximum depth of each shallow monitoring well is expected to be ~ 9.1 m (30 feet) BGS or less. It is anticipated that the depth to bedrock will occur at or near the surface in many locations, but may range up to 2 m (7 feet) in some areas filled during facility construction (i.e., LL1mw-081 and -082).

4.1.1.2 Overburden sample collection for geotechnical analysis

If, during coring, it is determined that the shallowest groundwater bearing zone is located within the unconsolidated interval, sampling of soil within the monitoring interval will be accomplished using a thin-walled (Shelby) tube sampler and geotechnical analyses will be conducted. These samples will provide data on the physical characteristics of the unconsolidated interval. Two wells are assumed to have monitoring intervals within the unconsolidated interval. Samples will be collected using a Shelby tube device prior to reaming of the boreholes using air rotary equipment. An additional three contingency samples are planned for the overburden interval. Although up to five geotechnical samples may be collected and retained as needed during drilling operations, only two samples within the final identified monitoring intervals (one from each well) will be submitted for laboratory analysis. The USACE technical representative will be consulted on the selection of the two samples submitted for analysis. All samples will receive analyses for moisture content, grain size (sieve analysis only), Atterberg limits, Unified Soil Classification System (USCS), bulk density, porosity, hydraulic conductivity, specific gravity, and pH .

4.1.1.3 Groundwater sample collection for field and laboratory analysis

Both the eight new wells installed for the Phase II RI and the six existing Phase I RI monitoring wells (LLmw-059, LLmw-060, LLmw-063, LLmw-064, LLmw-065, and LLmw-067) located at Load Line 1 and Load Line 2 will be sampled for chemical analyses to characterize contaminant nature and extent. All monitoring wells will be field screened for VOCs prior to sample collection using a hand-held photoionization detector (PID) or flame ionization detector (FID) organic vapor analyzer (OVA) at the top of the riser pipe. No samples will be collected for additional headspace analysis. Field measurement of pH, temperature, specific conductance, and dissolved oxygen will be recorded for each groundwater sample. Water level measurements will be collected immediately prior to groundwater sampling.

Unfiltered groundwater samples will be collected from each monitoring well and submitted for laboratory analysis of explosives, propellants, Target Analyte List (TAL) metals, and cyanide. Filtered TAL metals will also be collected from all monitoring wells. Additional samples for VOCs, SVOCs, and PCBs will be collected from wells LL1mw-079 and LL1mw-085. These additional samples will be collected from well LL1mw-079 in order to characterize a known area of concentrated soil contamination identified in the Phase I RI. Well LL1mw-085 is selected for additional samples due to its location near the former solvent storage building (CB-20). Table 4-1 summarizes the number of samples and the types of groundwater analyses to be performed during the Phase II RI.

4.1.1.4 Quality assurance (QA)/quality control (QC), and blank samples and frequency

QA/QC field duplicate samples, equipment rinsate blanks, source blanks, and trip blanks will be collected during the Phase II RI. Duplicates and equipment rinsates will be selected on a random statistical basis and analyzed for the same parameters as the environmental samples. Duplicate

Table 4-1. Summary of Phase II RI Groundwater Investigation Sampling at Load Line 1

Sampling Media	Sample Stations	Sampling Method	Depth (feet)	Samples/Station	Total No. of Samples	Explosives (8330)	Propellants (8330/352.2)	TAL Metals (6010/7000/7841/7470/7471)	Cyanide (9012)	Filtered TAL Metals (6010/7000/7841/7470/7471)	VOCs (8260B)	SVOCs (8270C)	Pesticides/PCBs (8082)	Grain Size (ASTM D422)	Moisture Content (ASTM D2216)	Atterberg Limits (ASTM D4318)	Unified Soil Classification System	Bulk Density (ASTM D4531)	Porosity (EM-1110-2-1906)	Hydraulic Conductivity (ASTM D5084)	Specific Gravity (ASTM D854)	pH (SW-946-9045)
Groundwater Samples																						
Groundwater	14	Grab	NA	1	14	14	14	14	14	14	2	2	2									
Total Planned	14				14	14	14	14	14	14	2	2	2									
Geotechnical Samples																						
Subsurface Soil	2	Shelby Tube	TBD	1	2									2	2	2	2	2	2	2	2	2
Groundwater QC Samples (A&E)																						
Field Duplicates		Grab	NA	-	-	2	2	2	2	1	1	1	1									
Field Blanks		Grab	NA	-	-	2	2	2	2	1	1	1	1									
Source Blanks		Grab	NA	-	-	2	2	2	2	1	1	1	1									
Trip Blanks		Grab	NA	-	-						1											
Total QC Samples						6	6	6	6	3	4	3	3									
Groundwater QA Samples (USACE)																						
Groundwater		Grab	NA	-	1	1	1	1	1	1		1	1									
Total QA Samples					1	1	1	1	1	1		1	1									

A&E = Architect and engineer; ASTM = American Society for Testing and Materials; NA = not applicable; PCBs = polychlorinated biphenyls; QA = quality assurance; QC = quality control; RI = remedial investigation; SVOCs = semivolatile organic compounds; TAL = target analyte list; TBD = to be determined; USACE = U.S. Army Corps of Engineers; VOCs = volatile organic compounds.

samples and equipment rinsate blanks will be collected at a frequency of at least 10 percent of environmental samples. Equipment rinsate blanks are not required if dedicated equipment is used. Split samples will be collected at a frequency of at least 5 percent (1 per 20 environmental samples) and will be selected on a random basis. Split samples will be submitted to the following USACE subcontract laboratory for independent analysis: GP Environmental, Inc., 202 Perry Parkway, Gaithersburg, MD 20877, (301) 926-6802. Trip blanks will accompany shipment of all VOC groundwater samples and will be analyzed for VOCs only.

One source blank sample will be collected from the potable water source(s) used for potable wash and rinse water for equipment decontamination during the Phase II RI. One source blank will also be collected from the deionized/distilled [American Society for Testing and Materials (ASTM) Type I] water source used. The potable source blank will be analyzed for explosives, propellants, filtered and unfiltered TAL metals and cyanide, SVOCs, VOCs, and PCBs/pesticides. The ASTM Type I source blank will be analyzed for explosives, propellants, TAL metals, and cyanide; no filtered sample is allotted for this source blank. Alternately, if a deionized water blank is determined not to be needed, the second source blank may be used to analyze a second potable water source if used. Chapter 8.0 of this Phase II RI SAP Addendum summarizes QA/QC sampling.

4.1.2 Monitoring Well Installation

4.1.2.1 Drilling methods and equipment

4.1.2.1.1 Equipment condition and cleaning

Requirements for the condition and cleaning of equipment used for well installation are described in Section 4.3.2.1.1 of the facility-wide SAP. These requirements, as applicable, will be employed for equipment used to install monitoring wells during the Phase II RI.

4.1.2.1.2 Drilling methods

Conventional drilling techniques (hollow-stem auger and air rotary) will be used to install monitoring wells, as described in Section 4.3.2.1.2 of the facility-wide SAP.

4.1.2.1.2 Drilling scenarios

It is anticipated that the third drilling scenario, described under Section 4.3.2.1.3 of the facility-wide SAP, will be applicable for the installation of the eight monitoring wells at Load Line 1. A temporary surface may be employed during coring and reaming operations, if unconsolidated materials are prone to sloughing or collapse.

4.1.2.2 Materials

4.1.2.2.1 Casing/screen

The casing and screen materials for monitoring wells will be as presented in Section 4.3.2.2.1 of the facility-wide SAP.

4.1.2.2.2 Filter pack, bentonite, and grout

The filter pack, bentonite, and grout materials for monitoring wells will be as presented in Section 4.3.2.2.2 of the facility-wide SAP.

4.1.2.2.3 Surface completion

All wells will be constructed as aboveground installations using materials and specifications as described in Section 4.3.2.2.3 of the facility-wide SAP.

4.1.2.2.4 Water source

Potable water to be used during this investigation for monitoring well and decontamination purposes will be purchased from a municipal supplier (Newton Falls). The collection and evaluation of the water source sample will follow Section 4.3.2.2.4 of the facility-wide SAP.

4.1.2.2.5 Delivery, storage, and handling of materials

All monitoring well construction materials will be delivered, stored, and handled following Section 4.3.2.2.5 of the facility-wide SAP.

4.1.2.3 Installation

4.1.2.3.1 Test holes

Test holes will not be required during the Load Line 1 Phase II RI groundwater investigation.

4.1.2.3.2 Soil sampling and rock coring during drilling

Soil samples will be collected continuously from the surface to bedrock refusal or borehole termination, using a split-barrel sampler, for lithologic logging. As noted in Section 4.1.1.2 of this SAP Addendum, two of the planned monitoring wells are assumed to have monitoring intervals within the unconsolidated interval. Two geotechnical samples will be collected (one from each well) from the bottom of the monitoring interval using a Shelby tube device prior to reaming of the boreholes using air rotary equipment. An additional three contingency samples are planned for the overburden interval. Although up to five geotechncial samples may be collected and retained as needed during drilling operations, only two samples within the final identified monitoring intervals (one from each well) will be submitted for laboratory analysis. All samples will receive analyses for moisture content, grain size (sieve analysis only), Atterberg limits, and USCS. Shelby tube sampling will proceed as discussed in Section 4.4.2.4.1 of the facility-wide SAP.

If bedrock is encountered before borehole termination, the bedrock interval will be cored using an air rotary rig fitted with an NQ-size coring device. The purpose of coring is to determine lithologies and the degree and nature of weathering and fracturing in bedrock. Coring will follow procedures described in Section 4.3.2.3.2 of the facility-wide SAP. All rock cores will be stored in USACE-approved wooden boxes in such a manner as to preserve their relative positions by depth. Intervals of lost core shall be noted in the core sequence with wooden or Styrofoam blocks. Boxes will be marked on the outside to provide the boring number, cored interval, and box number, if there are multiple boxes. All cores collected during the Phase II RI will be documented (including photographing the core after it has been properly placed and labeled in the core boxes), and temporarily stored at RVAAP in accordance with Ohio EPA *Technical Guidance for Hydrogeologic Investigations and Groundwater Monitoring* (OEPA 1995) and EM-1110-1-4000, *Monitoring Well Design, Installation, and Documentation at Hazardous and/or Toxic Waste Sites* (USACE 1994b).

4.1.2.3.3 Borehole diameter and depth

Unconsolidated surficial material in each location will be drilled using a 16.5-cm (6.5-inch) inside diameter (ID) hollow-stem auger. Coring, where required, will be performed using an NQ-size coring device. Following coring, the core hole will be reamed using air rotary methods and a nominal 10.6-cm (6.25-inch)-diameter tricone roller bit.

All monitoring well installation will be in accordance with the procedures for installations as presented in Sections 4.3.2.3.4 through 4.3.2.3.9 of the facility-wide SAP. All monitoring well boreholes will be drilled to sufficient depth to install the bottom of a 3-m (10-feet) well screen, ~2.1 m (7 feet) below the current water table elevation. It is anticipated that the depth to the water table will range from 1.5 m (5 feet) to 5.5 m (18 feet) BGS, based on existing information. The maximum depth of each monitoring well is expected to be ~9.1 m (30 feet) BGS or less. It is anticipated that the depth to bedrock will occur at or near the surface in many locations, but may range up to 2 m (7 feet) in some areas filled during facility construction (i.e., LL1mw-081 and -082).

All monitoring wells will be constructed using nominal 5.0-cm (2.0-inch) ID, schedule 40 polyvinyl chloride (PVC) casing and screen. Surface casings are not required as part of the permanent installation, but may be used if the overburden interval at a location is prone to sloughing or collapse. All monitoring wells will be completed with above-grade well heads.

4.1.2.3.4 Screen and well casing placement

Screen and casing placement will follow procedures described in Section 4.3.2.3.4 of the facility-wide SAP.

4.1.2.3.5 Filter pack placement

Filter pack placement will follow procedures described in Section 4.3.2.3.5 of the facility-wide SAP.

4.1.2.3.6 Bentonite seal

Bentonite seal placement will follow procedures described in Section 4.3.2.3.6 of the facility-wide SAP.

4.1.2.3.7 Cement/bentonite grout placement

Grouting will follow procedures described in Section 4.3.2.3.7 of the facility-wide SAP.

4.1.2.3.8 Concrete/gravel pad placement

Concrete pad placement will follow procedures described in Section 4.3.2.3.8 of the facility-wide SAP.

4.1.2.3.9 Protective cover/casing placement

Protective casing placement will be conducted following procedures described in Section 4.3.2.3.9 of the facility-wide SAP.

4.1.2.3.10 Well identification

Well identification will follow procedures described in Section 4.3.2.3.10 of the facility-wide SAP.

4.1.2.3.11 Well development

Development of monitoring wells, photo-documentation samples, and monitoring well washing will be accomplished with a pump following procedures described in Section 4.3.2.3.11 of the facility-wide SAP. Pumps may be replaced with bottom-filling bailers where well size or slow recharge rates restrict pump usage. Development will proceed until the criteria listed in Section 4.3.2.3.11 of the facility-wide SAP are met.

4.1.2.3.12 Well survey

Monitoring wells will be surveyed as specified in Section 4.3.2.3.12 of the facility-wide SAP.

4.1.2.3.13 Alignment testing

Alignment testing will be conducted on each monitoring well as specified in Section 4.3.2.3.13 of the facility-wide SAP.

4.1.2.4 Documentation

4.1.2.4.1 Logs and well installation diagrams

Boring Logs

Boring logs will be completed for all monitoring well boreholes following Section 4.3.2.4.1.1 of the facility-wide SAP. Visually determined USCS of unconsolidated interval split-spoon lithologic samples and any geotechnical samples will be recorded on each boring log.

Well Construction Diagrams

All monitoring well activities will be documented according to the procedures presented in Section 4.3.2.4.1.2 of the facility-wide SAP.

4.1.2.4.2 Development records

All monitoring well development activities will be documented according to the procedures presented in Section 4.3.2.4.2 of the facility-wide SAP.

4.1.2.4.3 Photographs

Photographic documentation will be conducted according to the procedures presented in Section 4.3.2.4.3 of the facility-wide SAP.

4.1.2.5 Well abandonment

Any monitoring wells or borehole abandoned during the Phase II RI will be abandoned according to the procedures presented in Section 4.3.2.5 of the facility-wide SAP.

4.1.2.6 Water level measurement

Water level measurements will follow the procedure presented in Section 4.3.2.6 of the facility-wide SAP. Prior to purging and sampling activities, water level measurements will be collected during a single day from all 14 specified monitoring wells (see Section 4.1.1). In addition, water level measurements will be taken from the following wells at Ramsdell Quarry: RQLmw-006, RQLmw-007, RQLmw-008, RQLmw-009, RQLmw-010, RQLmw-011, and MW-2 through MW-5. These data will provide contemporaneous potentiometric data in the Load Line 1 area to better assess overall flow patterns.

4.1.3 Field Measurement Procedures and Criteria

All field measurement procedures and criteria will follow Section 4.3.3 of the facility-wide SAP. All monitoring wells will be field screened for VOCs using a PID OVA or FID OVA during groundwater sample collection. Screening will be accomplished by monitoring the headspace vapors at the top of the riser pipe. No samples will be collected for additional headspace analysis.

4.1.4 Sampling Methods for Groundwater

Groundwater sampling from monitoring wells will follow the procedures presented in Section 4.3.4 of the facility-wide SAP. The integrity of existing wells will be checked by visual inspection of the surface casing and riser pipe and by performing an alignment test in accordance with Section 4.3.2.3.13 of the facility-wide SAP. If the integrity of an existing well is questioned, the well will not be sampled and the USACE technical representative will be notified.

4.1.4.3 Groundwater sample collection for field and laboratory analysis

Unfiltered groundwater samples will be collected from each monitoring well and submitted for laboratory analysis of explosives, propellants, TAL metals, and cyanide. Filtered TAL metals will be collected from all monitoring wells. Additional samples for VOCs, SVOCs, and PCBs will be collected from wells LL1mw-079 and LL1mw-085. Well LL1mw-079 is selected due to the fact that an empty hazardous waste collection drum was observed near Building CB-10 during the Phase I RI; this vessel may have formerly contained solvent or waste oils. Well LL1mw-85 is selected for additional organics analysis due to its location near several buildings housing paint mixing and paint/oil storage operations. Table 4-1 summarizes the number of samples and the types of groundwater analyses to be performed during the Phase II RI.

4.1.4.1 Well purging methods

In order to minimize the quantity of liquid investigation-derived waste (IDW) generated as a result of well purging, wells will be micro-purged where conditions permit, in accordance with Ohio EPA technical guidance (OEPA 1995), as follows:

- a dedicated bladder or submersible pump will be used for purging;

- the purge rate will not exceed 100 mL/minute unless it can be shown that higher rates will not disturb the stagnant water column above the well screen (i.e., will not result in water level drawdown);

- the volume purged will be either two pump and tubing volumes or a volume established through in-line monitoring and stabilization of water quality indicators such as dissolved oxygen and specific conductance; and

- sample collection shall occur immediately after purging.

Where micro-purging cannot be accomplished for any reason, then purging of all monitoring wells installed during the Phase II RI will be conducted in accordance with procedures discussed in Section 4.3.4 of the facility-wide SAP.

4.1.4.2 Collection of filtered and unfiltered samples

Unfiltered samples will be collected upon completion of purging. Bottles will be filled directly from the bladder pump discharge line. The discharge line will not be allowed to touch any part of the interior of the sample container or the sample matrix within the container. If standard purging and sampling methods are employed (i.e., teflon bailer), unfiltered samples will be collected by slowly pouring directly into the sample container.

For wells sampled using a bladder pump and micropurge methods, an in-line 0.45 µm filter will be employed to collect filtered samples for metals analyses. If standard purge methods must be applied, then groundwater samples collected for dissolved metals will be filtered by negative pressure using a hand-operated pump, collection flask, polytetrafluoroethylene tubing, and a pre-sterilized, disposable 0.45-µm pore size filter assembly. Before collecting the water sample, the pump and filter apparatus will be assembled. A bailer will then be lowered into the monitoring well, filled with groundwater, and raised to the surface. The groundwater will be transferred from the bailer to a decontaminated collection flask and poured into the filter funnel portion of the filter assembly. Care will be taken to avoid transferring solids that may have settled to the bottom of the collection flask. The hand-operated pump will be used to create a vacuum in the assembly to start filtration. Sample bottles will be filled with the filtered water. Filters will be replaced as they become restricted by solids buildup as well as between sample collection sites.

4.1.5 Sample Containers and Preservation Techniques

Requirements for sample containers and preservation techniques for groundwater samples are presented in Section 4.3.6 of the facility-wide SAP and in the accompanying Phase II RI groundwater investigation Quality Assurance Project Plan (QAPP) Addendum.

4.1.6 Field Quality Control Sampling Procedures

QC samples for monitoring well groundwater sampling activities will include field duplicate samples, equipment rinsate blanks, source blanks, and trip blanks as described in Section 4.1.1.4 of this SAP Addendum. Split samples will be sent to the USACE laboratory (GP Environmental, Inc.) for independent analyses. Duplicates and equipment rinsates will be selected on a random statistical basis and analyzed for the same parameters as the environmental samples. Duplicate samples and equipment rinsate blanks will be collected at a frequency of 10 percent of environmental samples. Split samples will be collected at a frequency of 5 percent (1 per

20 environmental samples) and will be selected on a random basis. Split samples will be submitted to the USACE subcontract laboratory (GP Environmental, Inc.) for independent analysis. Trip blanks will accompany shipment of all VOC groundwater samples and will be analyzed for VOCs only.

One source blank sample will be collected from the potable water source(s) used for potable wash and rinse water for equipment decontamination during the Phase II RI. One source blank will also be collected from the deionized/distilled (ASTM Type I) water source used. The potable source blank will be analyzed for explosives, propellants, filtered and unfiltered TAL metals and cyanide, SVOCs, VOCs, and PCBs/pesticides. The ASTM Type I source blank will be analyzed for explosives, propellants, TAL metals, and cyanide; no filtered sample is allotted for this source blank. Table 4-1 and the accompanying Phase II RI groundwater investigation QAPP Addendum detail QA/QC sampling requirements.

4.1.7 Decontamination Procedures

Decontamination of equipment associated with groundwater sampling will be in accordance with the procedure presented in Section 4.3.8 of the facility-wide SAP, except that a 2 percent hydrochloric acid (HCl) rinse will be used instead of a 10 percent solution.

4.1.8 In Situ Permeability Testing

Slug testing will be performed in each of the eight monitoring wells installed as part of the Phase II RI to determine the hydraulic conductivity of the geologic material surrounding each well. The slug test method involves lowering or raising the static water level in a well bore by the removal or insertion of a cylinder (slug) of known volume. The return of the water level to a pre-test static level is then measured over time. The change in water level over time is plotted on a logarithmic scale to determine hydraulic conductivity (K). K is a function of the formation permeability and the fluid in the formation. K is influenced by well construction.

The slug removal (rising head) test will be used for this investigation. If possible, the slug test will be performed in such a manner to prevent the water level in the well from dropping below the top of the screened interval when the slug is removed. All tests will be performed after the groundwater has been sampled as described in Section 4.1.4, and will be contingent upon a monitoring well containing sufficient water to allow testing.

Slug tests will only be initiated after the well has recovered from groundwater sampling, or a minimum of 12 hours has elapsed since sampling. Prior to the start of the test, plastic sheeting will be placed around the well in a manner to minimize water contact with the ground surface. The static water level will be measured with an electronic water level indicator and recorded to the nearest 0.003 m (0.01 foot) below top of casing. The total depth of the well will be measured with an electronic water level indicator and recorded to the nearest 0.003 m (0.01 foot) below top of casing. These measurements will be used to calculate the water column height in the well. Use of the electronic water level meter will follow procedures outlined in Section 4.3.3.1 of the facility-wide SAP.

To begin the test a pressure transducer and decontaminated slug will be inserted into the well and the water level allowed to equilibrate to static conditions, or until at least six hours have elapsed. A slug that displaces a minimum of 0.3 m (1 foot) of water will be used and should be sufficient to provide an adequate response for the analysis. The slug will be withdrawn quickly from the well without surging, The time of the test will begin as soon as the slug leaves the water column.

Water level measurements will be recorded continuously during the test with the pressure transducer and data logger programmed to make measurements to within 0.003 m (0.01 foot) and record them on a logarithmic scale. Water level change will be recorded for a period of 6 hours or until the well re-equilibrates to 90 percent of the pre-test water level, whichever occurs first.

The test data will be evaluated by the Bouwer and Rice method (Bouwer and Rice 1976 and Bouwer 1989) or the Cooper et al. method (Cooper et al. 1967). If the test geometry is not conducive to analysis to either of these two methods, an alternate method will be used.

4.1.9 Ordnance and Explosives Screening

OE staff will conduct a field survey of the ground surface at each monitoring well location and of the access routes into the drilling site prior to drilling activities. Previous investigations and site operational history indicate that OE concerns include only propellants at the ground surface. In addition, the thin soil cover present over most of Load Line 1 minimizes the likelihood of ordnance being disposed of at the site. Therefore, downhole screening for metallic ordnance is not required while drilling. The OE Team Leader will train all field personnel to recognize and stay away from propellants and OE. Safety briefings for OE will also be provided to all site personnel and site visitors. The OE Team Leader will clearly mark the boundaries of the cleared drilling locations and access routes. If, during the clearance survey, surface OE is encountered at a proposed drilling location, the area will be clearly marked, the RVAAP Environmental Coordinator and USACE site representatives notified, and the location moved to another clear area. In any area where surface metallic OE is encountered, a magnetometer will be used to ensure that no subsurface OE exists. Under any circumstances, if the field team encounters OE at any work location, the approach path will be diverted away from the OE, the area clearly marked, and the OE Team Leader notified. If OE is encountered while drilling, work will be stopped immediately, personnel will move beyond the flagged work zone, and the OE Team Leader will be notified.

4.2 SUBSURFACE SOILS

Subsurface soil field sampling activities to be implemented as part of the Phase II RI will be addressed in a subsequent addendum for the Phase II RI addressing the remaining field activities.

4.3 SURFACE SOIL AND SEDIMENT

Surface soil and sediment field sampling activities to be implemented as part of the Phase II RI will be addressed in a subsequent addendum for the Phase II RI addressing the remaining field activities.

4.4 SURFACE WATER

Surface water field sampling activities to be implemented as part of the Phase II RI will be addressed in a subsequent addendum for the Phase II RI addressing the remaining field activities.

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5.0 SAMPLE CHAIN OF CUSTODY/DOCUMENTATION

5.1 FIELD LOGBOOK

All field logbook information will follow structures identified in Section 5.1 of the facility-wide SAP.

5.2 PHOTOGRAPHS

Photographic documentation of field efforts will be performed in accordance with Section 4.3.2.4.3 of the facility-wide SAP. Representative photographs of field activities and any significant observations will be taken during the Phase II RI groundwater investigation. Photographs will be suitable for presentation in a public forum, as well as for documenting scientific information.

5.3 SAMPLE NUMBERING SYSTEM

The sample numbering system that will be used to identify samples collected during the Phase II RI groundwater investigation is explained in Section 5.3 of the facility-wide SAP. The specific identifying information that will be used to implement this system during the field activities is presented in Figure 5-1. Table 5-1 presents the baseline sample identification listing for the Phase II RI groundwater investigation. Samples collected in addition to the baseline set will be sequentially identified following the numbering system. If a sample in the baseline set is not collected, a specific reason and notation will be made in the project field logbooks.

5.4 SAMPLE DOCUMENTATION

All sample label, logbook, field record, and field form information will follow structures identified in Section 5.4 of the facility-wide SAP.

5.5 DOCUMENTATION PROCEDURES

Documentation and tracking of samples and field information will be performed in accordance with Section 5.5 of the facility-wide SAP.

5.6 CORRECTIONS TO DOCUMENTATION

Corrections to documentation will follow the protocol established in Section 5.6 of the facility-wide SAP.

5.7 MONTHLY REPORTS

A total of six monthly reports will be submitted during the field investigation and analytical investigation tasks for the Load Line 1 Phase II RI.

Sample Station Location Identification: XXXmm-NNN(n)

XXX = Area Designator
Load 1 = LL1

mm = Sample Location Type
mw = Groundwater monitoring well

NNN = Sequential Sample Location Number
Unique sequence for each area designator continuing the sequence established by the Phase I RI.
Phase I RI sample location number sequence ended at 077.

(n) = Special Identifier (optional)

Sample Identification: XXXmm-NNN(n)-####-tt

= Sequential Sample Number
Unique for the entire project site, continuing the sequence established by the Phase I RI.
Phase I RI sample number sequence ended at 0685.
0001–9999

tt = Sample Type
GF = Groundwater Sample (filtered)
GW = Groundwater Sample (unfiltered)
SO = Soil Sample
TB = Trip Blank
FB = Field Blank
ER = Equipment Rinsate

Figure 5-1. Load Line 1 Phase II RI Groundwater Investigation Sample Identification

Table 5-1. Load Line 1 Phase II RI Groundwater Investigation Baseline Sample Identification List

		CHEMICAL ANALYSES							
Sample Station ID	**Sample ID**	**VOCs**	**SVOCs**	**Pest/PCBs**	**Explosives**	**Propellants**	**Total Metals**	**Filtered Metals**	**Cyanide**
Baseline Samples [a]									
LL1mw-059	LL1mw-059-0686-GW				X	X	X		X
	LL1mw-059-0687-GF							X	
LL1mw-060	LL1mw-060-0688-GW				X	X	X		X
	LL1mw-060-0689-GF							X	
LL1mw-063	LL1mw-063-0690-GW				X	X	X		X
	LL1mw-063-0691-GF							X	
LL1mw-064	LL1mw-064-0692-GW				X	X	X		X
	LL1mw-064-0693-GF							X	
LL1mw-065	LL1mw-065-0694-GW				X	X	X		X
	LL1mw-065-0695-GF							X	
LL1mw-067	LL1mw-067-0696-GW				X	X	X		X
	LL1mw-067-0697-GF							X	
LL1mw-078	LL1mw-078-0698-GW				X	X	X		X
	LL1mw-078-0699-GF							X	
LL1mw-079	LL1mw-079-0700-GW	X	X	X	X	X	X		X
	LL1mw-079-0701-GF							X	
LL1mw-080	LL1mw-080-0702-GW				X	X	X		X
	LL1mw-080-0703-GF							X	
LL1mw-081	LL1mw-081-0704-GW				X	X	X		X
	LL1mw-081-0705-GF							X	
LL1mw-082	LL1mw-082-0706-GW				X	X	X		X
	LL1mw-082-0707-GF							X	

Table 5-1 (continued)

Sample Station ID	Sample ID	VOCs	SVOCs	Pest/PCBs	Explosives	Propellants	Total Metals	Filtered Metals	Cyanide
LL1mw-083	LL1mw-083-0708-GW				X	X	X		X
	LL1mw-083-0709-GF							X	
LL1mw-084	LL1mw-084-0710-GW				X	X	X		X
	LL1mw-084-0711-GF							X	
LL1mw-085	LL1mw-085-0712-GW	X	X	X	X	X	X		X
	LL1mw-085-0713-GF							X	
TOTALS	**14 Stations**	**2**	**2**	**2**	**14**	**14**	**14**	**14**	**14**
QA/QC Samples									
Field Duplicates		1	1	1	2	2	2	1	2
USACE QA Split Samples			1	1	1	1	1	1	1
Trip Blanks		1							
Source Blanks [b]		1	1	1	2	2	2	1	2
Equipment Rinsates [c]		1	1	1	2	2	2	1	2

[a] Five subsurface soil samples will be collected in the field during drilling operations. The sample locations will be determined in the field. Two of these to be determined by the USACE will be submitted for the following geotechnical analyses: grain size, moisture content, atterberg limits, USCS, bulk density, porosity, hydraulic conductivity, specific gravity, and pH.
[b] Option includes up to two potable water sources or one potable source and one deionized source water blank as needed,
[c] Equipment rinsates are required only where nondedicated sampling devices are used.

6.0 SAMPLE PACKAGING AND SHIPPING REQUIREMENTS

Sample packaging and shipping will generally follow the protocols in Chapter 6.0 of the facility-wide SAP. Because that analytical laboratory is located less than 80 km (50 miles) from the site, the contract laboratory will provide same-day pickup of coolers containing samples. This courier service will reduce the need for some of the packaging measures described in the facility-wide SAP, which are intended for air-shipped coolers. Specifically:

- Chain-of-custody forms can be hand carried by the courier to the laboratory.
- No airbills will be attached to coolers shipped by courier.
- “THIS END UP” and “FRAGILE” stickers will not be required for containers transported by courier.

Sample coolers shipped to the USACE independent subcontract laboratory (GP Environmental, Inc.) will be prepared and shipped in accordance with the facility-wide SAP.

Geotechnical samples do not required refrigeration or other preservation and will be shipped to the contract laboratory at the conclusion of the sampling effort by conventional methods.

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7.0 INVESTIGATION-DERIVED WASTE

All IDW, including auger cuttings, personal protective equipment, disposable sampling equipment, and decontamination fluids, will be properly handled, labeled, characterized, and managed in accordance with Chapter 7.0 of the facility-wide SAP. At the conclusion of the field activities for the groundwater investigation, a letter report will be submitted documenting characterization and classification of the wastes, and all solid and liquid IDW will be removed from the site and disposed of by a licensed waste disposal contractor. All shipments of IDW off site will be coordinated through the RVAAP Environmental Coordinator. The following specific protocols will be followed during the Phase II RI groundwater investigation at Load Line 1:

General: The following types of IDW are anticipated. The different types of IDW will be contained separately:

- solid drill cuttings (auger, coring and air rotary) – up to eight 55-gallon drums;
- personal protective equipment – up to two 55-gallon drums;
- disposable sampling equipment – up to two 55-gallon drums;
- IDW water (liquid drilling effluents, development water, and purge water) – up to twenty 55-gallon drums of liquid IDW; and
- decontamination fluids – one 1500-gallon polytank.

Drilling effluents generated during coring and air rotary reaming activities (and any required auger drilling) will be contained. Auger cuttings will be placed directly into drums. All core and air rotary drilling effluent will be diverted to a containment vessel where solid cuttings (soil/rock) will be allowed to settle. Liquid drilling effluent (i.e., groundwater and potable water additive) will be decanted from the solid cuttings and contained separately. Solids will be removed from the containment vessel and drummed. Both liquid and solid cuttings will be segregated by well. Due to the thin soil cover present over most of the site and because potable water will be required for drilling, segregation of cuttings from the unsaturated and saturated zone will not be done. Disposition of drummed drilling effluents will be based on the results of associated environmental groundwater samples collected from each of the well upon completion. Should environmental sample data indicate that the contents of a drum are potentially hazardous, then Toxicity Characteristic Leaching Procedure (TCLP) samples (either solid or liquid) will be collected for additional characterization purposes.

Excess water generated during well development, purging and sampling will be placed in 55-gallon drums. Management of this type of IDW will be based on analytical results for environmental groundwater samples. Decontamination fluids disposition will be based on collection and analysis of a liquid TCLP sample.

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FINAL

QUALITY ASSURANCE PROJECT PLAN ADDENDUM NO. 1 FOR THE PHASE II REMEDIAL INVESTIGATION OF LOAD LINE 1 AT THE RAVENNA ARMY AMMUNITION PLANT, RAVENNA, OHIO

Prepared for

U.S. Army Corps of Engineers
Louisville District
Contract No. DACA 27-97-D-0025
Delivery Order No. 0005

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August 1999

CONTENTS

PART II – QUALITY ASSURANCE PROJECT PLAN ADDENDUM

TABLES

ABBREVIATIONS

COC	chain of custody
CX	Center of Excellence
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
HTRW	Hazardous, Toxic, and Radioactive Waste
LCS	laboratory control sample
MS	matrix spike
MSD	matrix spike duplicate
PCB	polychlorinated biphenyl
QA	quality assurance
QC	quality control
QAMP	Quality Assurance Management Plan
QAPP	Quality Assurance Project Plan
RI	remedial investigation
RVAAP	Ravenna Army Ammunition Plant
SAP	Sampling and Analysis Plan
SOP	standard operating procedure
TAL	Target Analyte List
TCL	Target Compound List
USACE	U.S. Army Corps of Engineers

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INTRODUCTION

This Quality Assurance Project Plan (QAPP) addendum addresses supplemental project-specific information in relation to the Site-Wide QAPP for the Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio. Each QAPP section is presented documenting adherence to the site-wide QAPP or stipulating project-specific addendum requirements.

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1.0 PROJECT DESCRIPTION

1.1 SITE HISTORY/BACKGROUND INFORMATION

This information is contained in Section 1.1 of the Load Line 1 Phase II Remedial Investigation (RI) groundwater investigation Sampling and Analysis Plan (SAP) Addendum.

1.2 PAST DATA COLLECTION ACTIVITY/CURRENT STATUS

This information is contained in Section 1.2 of the Load Line 1 Phase II RI groundwater investigation SAP Addendum.

1.3 PROJECT OBJECTIVES AND SCOPE

This information is contained in Chapter 3.0 of the Load Line 1 Phase II RI groundwater investigation SAP Addendum.

1.4 SAMPLE NETWORK DESIGN AND RATIONALE

This information is contained in Chapter 4.0 of the Load Line 1 Phase II RI groundwater investigation SAP Addendum.

1.5 PARAMETERS TO BE TESTED AND FREQUENCY

Sample matrix types, analytical parameters, and analytical methods are discussed in Chapter 4.0 of the Load Line 1 Phase II RI groundwater investigation SAP Addendum. These are summarized in Table 1-1 of this QAPP addendum, in conjunction with anticipated sample numbers, quality assurance (QA) sample frequencies, and field quality control (QC) sample frequencies.

1.6 PROJECT SCHEDULE

The Load Line 1 Phase II RI groundwater investigation project schedule is discussed in Chapter 2.0 of the SAP Addendum.

Table 1-1. Phase II RI of Load Line 1 Groundwater, RVAAP – Sampling and Analytical Requirements

Parameter	Methods	Field Samples	Field Duplicate Samples	Site Source Water[a]	Rinsate Samples	Trip Blanks	Total A-E Samples	USACE QA Split Samples	USAEC Trip Blanks
Groundwater									
Volatile Organics, TCL	SW-846, 5035/8260B	2	1	1	1	1	6	-	-
Semivolatile Organics, TCL	SW-846, 8270C	2	1	1	1	-	5	1	-
Pesticides, TCL	SW-846, 8081A	2	1	1	1	-	5	1	
PCBs, TCL	SW-846, 8082	2	1	1	1	-	5	1	-
Explosives	SW-846, 8330	14	2	2	2	-	20	1	-
Propellants	SW-846, 8330	14	2	2	2	-	20	1	-
Metals – total, TAL	SW-846, 6010B/7471	14	2	2	2	-	20	1	-
Metals – dissolved, TAL	SW-846, 6010B/7471	14	1	1	1	-	17	1	-
Cyanide	SW-846, 9011/9010	14	2	2	2	-	20	1	-

[a]Site source water = one potable and one deionized water source supply for the project or two potable water sources.
QA = quality assurance
RI = remedial investigation
TAL = Target Analyte List
TCL = Target Compound List
USACE = U.S. Army Corps of Engineers

2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

The functional project organization and responsibilities are described in Chapter 2.0 of the facility-wide SAP and the Load Line 1 Phase II RI groundwater investigation SAP Addendum.

Analytical support for this work has been assigned to Quanterra Environmental Services, Inc. The majority of analysis will be completed by Quanterra's North Canton, Ohio facility, with explosive determinations being performed by the Knoxville, Tennessee facility and nitrocellulose/nitroguanidine analyses being performed by the Sacramento, California facility. These laboratories have been validated by the U.S. Army Corp of Engineers (USACE) Hazardous, Toxic, and Radioactive Waste (HTRW) Center of Excellence (CX), Omaha, Nebraska. Quanterra Environmental Services' Quality Assurance Management Plan (QAMP), Revision 3, November 1998, is available for review upon request. The laboratory's organizational structure, roles, and responsibilities are identified in Section 1 of their QAMP and facility-specific appendices. Addresses and telephone numbers for each of the Quanterra facilities are as follows:

Analytical Facilities

Quanterra Environmental Services, Inc. – general analytical services:

North Canton, OH
4101 Shuffel Drive, N.W.
North Canton, OH 44720

Tel: (330) 497-9396
Fax: (330) 497-0772

Quanterra Environmental Services, Inc. – explosives analyses:

Knoxville, TN
5815 Middlebrook Pike
Knoxville, TN 37921

Tel: (423) 588-6401
Fax: (423) 584-4315

Quanterra Environmental Services, Inc. – nitrocellulose/nitroguanidine analyses:

Sacramento, CA
880 Riverside Parkway
West Sacramento, CA 95605

Tel: (916) 373-5600
Fax: (916) 372-1059

3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT

3.1 DATA QUALITY OBJECTIVES

Data quality objectives (DQO) summaries for this investigation will follow Tables 3-1 and 3-2 in the facility-wide QAPP. All QC parameters stated in the specific U.S. Environmental Protection Agency (EPA) SW-846 methods will be adhered to for each chemical listed. SW-846 Method references found in the facility-wide QAPP have been revised to the Update III Methods (i.e., 8260A is now 8260B, 8270B is now 8270C, etc.). Laboratories are required to comply with all methods as written; recommendations are considered requirements.

3.2 LEVEL OF QUALITY CONTROL EFFORT

QC efforts will follow Section 3.2 of the facility-wide QAPP. Field QC measurements will include field source water blanks, trip blanks, field duplicates, and equipment rinsate blanks. Laboratory QC measurements will include method blanks, laboratory control samples (LCSs), laboratory duplicates, and matrix spike/matrix spike duplicate (MS/MSD) samples.

3.3 ACCURACY, PRECISION, AND SENSITIVITY OF ANALYSIS

Accuracy, precision, and sensitivity goals identified in Section 3.3 and Tables 3-1 through 3-3 of the facility-wide QAPP will be imposed for this investigation.

3.4 COMPLETENESS, REPRESENTATIVENESS, AND COMPARABILITY

Completeness, representativeness, and comparability goals identified in Section 3.4 and Tables 3-1 and 3-2 of the facility-wide QAPP will be imposed for this investigation.

4.0 SAMPLING PROCEDURES

Sampling procedures are discussed in Chapter 4.0 of the facility-wide SAP and SAP Addendum for the Phase II RI groundwater investigation at Load Line 1.

Table 4-1 summarizes sample container, preservation, and holding time requirements for the groundwater matrices for this investigation. The number of containers required is estimated in this table.

Table 4-1. Container Requirements for Water Samples for the Load Line 1 Phase II RI Groundwater Investigation at Ravenna Army Ammunition Plant[a]

Analyte Group	Approx. No. of Containers incl. Field QC	Container	Minimum Sample Size	Preservative	Holding Time
Volatile Organic Compounds	18	Three, 40-mL glass vials with Teflon®-lined septum (no headspace)	80 mL	HCl to pH <2 Cool, 4°C	14 d
Semivolatile Organic Compounds	12	Two, 1-L amber glass bottles with Teflon®-lined lid	1000 mL	Cool, 4°C	7 d (extraction) 40 d (analysis)
Pesticide Compounds	12	Two, 1-L amber glass bottles with Teflon®-lined lid	1000 mL	Cool, 4°C	7 d (extraction) 40 d (analysis)
PCB Compounds	12	Two, 1-L amber glass bottles with Teflon®-lined lid	1000 mL	Cool, 4°C	7 d (extraction) 40 d (analysis)
Explosive Compounds	42	Two, 1-L amber glass bottles with Teflon®-lined lid	1000 mL	Cool, 4°C	7 d (extraction) 40 d (analysis)
Propellant Compounds	42	Two, 1-L amber glass bottles with Teflon®-lined lid	1000 mL	Cool, 4°C	7 d (extraction) 40 d (analysis)
Metals (total and dissolved)	39	1-L polybottle	500 mL	HNO_3 to pH <2 Cool, 4°C	180 d
Cyanide	21	1-L polybottle	500 mL	NaOH to pH >12 Cool, 4°C	14 d

[a]One sample will be tripled in volume for the laboratory to perform appropriate laboratory quality control analysis.
PCB = polychlorinated biphenyl
QC = quality control
RI = remedial investigation

5.0 SAMPLE CUSTODY

5.1 FIELD CHAIN-OF-CUSTODY PROCEDURES

Sample handling, packaging, and shipment procedures will follow those identified in Section 5.1 of the facility-wide QAPP.

5.2 LABORATORY CHAIN-OF-CUSTODY PROCEDURES

Laboratory chain of custody (COC) will follow handling and custody procedures identified in Section 8.5.3 of the Quanterra QAMP.

5.3 FINAL EVIDENCE FILES CUSTODY PROCEDURES

Custody of evidence files will follow those criteria defined in Section 5.3 of the facility-wide QAPP.

6.0 CALIBRATION PROCEDURES AND FREQUENCY

6.1 FIELD INSTRUMENTS/EQUIPMENT

Field instruments and equipment calibrations will follow those identified in Section 6.1 of the facility-wide QAPP.

6.2 LABORATORY INSTRUMENTS

Calibration of laboratory equipment will follow procedures identified in Section 8.5.4 of the Quanterra QAMP, corporate, and facility-specific operating procedures.

7.0 ANALYTICAL PROCEDURES

7.1 LABORATORY ANALYSIS

Analytical methods, parameters and quantitation or detection limits are those listed in Table 3-3 of the facility-wide QAPP.

Quanterra's QAMP Section 8.0 and the facility-specific addenda for the North Canton, Knoxville, and Sacramento facilities will be followed during the analysis of these samples. The following laboratory Standard Operating Procedures (SOPs) will implement the defined EPA methods.

- GC/MS Volatile Organics Analysis Based on Methods 8240B and 8260B, SW-846, CORP-MS-0002, rev 2, 12/15/97.
- GC/MS Semivolatile Analysis Based on Methods 8270C, SW-846, CORP-MS-0001, Rev. 2, 12/15/97.
- Gas Chromatographic Analysis Based on Method 8000A, 8010B, 8020A, 8021A, 8080A, 8081, 8082, 8150B, and 8051, SW-846, CORP-GC-0001, Rev. 5.1, 3/30/99.
- Extraction and Cleanup of Organic Compounds from Waters and Soils, Based on SW-846 3500 Series, 3600 Series, 8150, 8151, and 600 Series Methods, CORP-OP-0001, Rev. 3.4, 4/15/99.
- Analysis of Nitroaromatic and Nitramine Explosives by HPLC, KNOX-LC-0001, Rev. 1, 4/28/97.
- Total Organic Carbon and Total Inorganic Carbon, NC-WC-0017, Rev. 2, 2/15/99.
- Inductively Coupled Plasma-Atomic Emission Spectroscopy, Spectrometric Method for Trace Element Analysis, Methods 6010B and 200.7, CORP-MT-0001, Rev. 2, 12/15/97.
- Graphite Furnace Atomic Absorption Spectroscopy, SW-846 Methods 7000A and MCAWW 200 series methods, CORP-MT-0003, Rev. 1, 08/22/95.
- Mercury in Aqueous Samples by Cold Vapor Atomic Absorption, SW-846 7470A and MCAWW 245.1, CORP-MT-0005NC, Rev. 1.1, 04/19/97.
- Preparation and analysis of Nitrocellulose in Aqueous, Soil, and Sediments by Colorimetric Autoanalyzer, SAC-WC-0050, Rev. 0.
- Determination of nitroaromatics, nitramines, and specialty explosives in water and soil by high performance liquid chromatography/ultraviolet detector (HPLC/UV) and liquid chromatography/ thermospray/mass spectrometry (LC/TSP/MS), SAC-LC-0001, Rev. 5.0.

Quanterra facilities will at all times maintain a safe and contaminant free environment for the analysis of samples. The laboratories will demonstrate, through instrument blanks, holding blanks, and analytical method blanks, that the laboratory environment and procedures will not and do not impact analytical results.

Quanterra facilities will also implement all reasonable procedures to maintain project reporting levels for all sample analyses. Where contaminant and sample matrix analytical interferences impact the laboratory's ability to obtain project reporting levels, the laboratory will institute sample clean-up processes, minimize dilutions, adjust instrument operational parameters, or propose alternative analytical methods or procedures. Elevated reporting levels will be kept to a minimum throughout the execution of this work.

7.2 FIELD SCREENING ANALYTICAL PROTOCOLS

Procedures for field analysis are identified in Chapter 6.0 of the facility-wide SAP and in Chapter 4.0 of the Load Line 1 Phase II RI groundwater investigation SAP Addendum.

8.0 INTERNAL QUALITY CONTROL CHECKS

8.1 FIELD SAMPLE COLLECTION

Field QC sample types, numbers, and frequencies are identified in Chapter 4.0 of the Load Line 1 Phase II RI groundwater investigation SAP Addendum. In general, field duplicates will be collected at a frequency of 10 percent, field equipment rinsates and blanks will be collected at a frequency of 10 percent for samples collected with non-dedicated equipment, and volatile organic trip blanks will accompany all shipments containing volatile organic water samples.

8.2 FIELD MEASUREMENT

Refer to Chapter 4.0 of the Load Line 1 Phase II RI groundwater investigation SAP Addendum for details regarding these measurements.

8.3 LABORATORY ANALYSIS

Analytical QC procedures will follow those identified in the referenced EPA methodologies. These will include method blanks, LCS, MS, MSD, laboratory duplicate analysis, calibration standards, internal standards, surrogate standards, and calibration check standards.

Quanterrra facilities will conform to their QAMP, facility-specific appendices, and implement their established SOPs to perform the various analytical methods required by the project. QC frequencies will follow those identified in Section 8.3 of the facility-wide QAPP.

9.0 DATA REDUCTION, VALIDATION, AND REPORTING

9.1 DATA REDUCTION

Sample collection and field measurements will follow the established protocols defined in the facility-wide QAPP, facility-wide SAP, and Load Line 1 Phase II RI groundwater investigation SAP Addendum. Laboratory data reduction will follow Quanterra's QAMP (Section 8.6) guidance and conform to general direction provided by the facility-wide QAPP.

9.2 DATA VALIDATION

Data validation will follow the direction provided in the facility-wide QAPP.

9.3 DATA REPORTING

Analytical data reports will follow the direction provided in the facility-wide QAPP.

10.0 PERFORMANCE AND SYSTEM AUDITS

10.1 FIELD AUDITS

A minimum of one field surveillance for the media being sampled during the investigation will be performed by the SAIC QA Officer and/or the SAIC Field Team Leader. This audit will encompass the sampling of groundwaters from the wells. Surveillances will follow SAIC QAPP No. 18.3.

USACE, EPA Region V, or Ohio EPA audits may be conducted at the discretion of the respective agency.

10.2 LABORATORY AUDITS

Routine Missouri River Division HTRW CX on-site laboratory audits will be conducted by the USACE. EPA Region V or Ohio EPA audits may be conducted at the discretion of the respective agency.

Internal performance and systems audits will be conducted by Qaunterra's QA staff as defined in the laboratory QAMP, Section 9.2.

11.0 PREVENTIVE MAINTENANCE PROCEDURES

11.1 FIELD INSTRUMENTS AND EQUIPMENT

Maintenance of all field analytical and sampling equipment will follow direction provided in Section 11.1 of the facility-wide QAPP.

11.2 LABORATORY INSTRUMENTS

Routine and preventive maintenance for all laboratory instruments and equipment will follow the direction of Section 8.11 of Quanterra's QAMP.

12.0 SPECIFIC ROUTINE PROCEDURES TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

12.1 FIELD MEASUREMENTS DATA

Field data will be assessed as outlined in Section 12.1 of the facility-wide QAPP.

12.2 LABORATORY DATA

Laboratory data will be assessed as outlined in Section 12.2 of the facility-wide QAPP.

13.0 CORRECTIVE ACTIONS

13.1 SAMPLE COLLECTION/FIELD MEASUREMENTS

Field activity corrective action protocol will follow directions provided in Section 13.1 of the facility-wide QAPP.

13.2 LABORATORY ANALYSES

Laboratory activity corrective action protocol will follow directions provided in Section 13.2 of the facility-wide QAPP and Section 9.1 of Quanterra's QAMP.

14.0 QA REPORTS TO MANAGEMENT

Procedures and reports will follow the protocol identified in Section 14 of the facility-wide QAPP and those directed by Section 9.4 of Quanterra's QAMP.

15.0 REFERENCES

Additional references to the facility-wide QAPP are:

Quanterra Environmental Services, Inc. 1998. *Quality Assurance Management Plan*, Revision 3, November 2, 1998.

GC/MS Volatile Organics Analysis Based on Methods 8240B and 8260B, SW-846, CORP-MS-0002, rev 2, 12/15/97.

GC/MS Semivolatile Analysis Based on Methods 8270C, SW-846, CORP-MS-0001, Rev. 2, 12/15/97.

Gas Chromatographic Analysis Based on Method 8000A, 8010B, 8020A, 8021A, 8080A, 8081, 8082, 8150B, and 8051, SW-846, CORP-GC-0001, Rev. 5.1, 3/30/99.

Extraction and Cleanup of Organic Compounds from Waters and Soils, Based on SW-846 3500 Series, 3600 Series, 8150, 8151, and 600 Series Methods, CORP-OP-0001, Rev. 3.4, 4/15/99.

Analysis of Nitroaromatic and Nitramine Explosives by HPLC, KNOX-LC-0001, Rev. 1, 4/28/97.

Total Organic Carbon and Total Inorganic Carbon, NC-WC-0017, Rev. 2, 2/15/99.

Inductively Coupled Plasma-Atomic Emission Spectroscopy, Spectrometric Method for Trace Element Analysis, Methods 6010B and 200.7, CORP-MT-0001, Rev. 2, 12/15/97.

Graphite Furnace Atomic Absorption Spectroscopy, SW-846 Methods 7000A and MCAWW 200 series methods, CORP-MT-0003, Rev. 1, 08/22/95.

Mercury in Aqueous Samples by Cold Vapor Atomic Absorption, SW-846 7470A and MCAWW 245.1, CORP-MT-0005NC, Rev. 1.1, 04/19/97.

Mercury in Solid Samples by Cold Vapor Atomic Absorption, SW-846 7471A and MCAWW 245.5, CORP-MT-0007NC, Rev. 1.1, 04/17/97.

Analysis of Nitroaromatic and Nitramine Explosives by High Performance Liquid Chromatography, KNOX-LC-0001, Rev. 1, 04/28/97.

Preparation and Analysis of Nitrocellulose in Aqueous, Soil, and Sediments by Colorimetric Autoanalyzer, SAC-WC-0500, Rev. 0.0.

Determination of nitroaromatics, nitramines, and specialty explosives in water and soil by high performance liquid chromatography/ultraviolet detector (HPLC/UV) and liquid chromatography/ thermospray/mass spectrometry (LC/TSP/MS), SAC-LC-0001, Rev. 5.0.

FINAL

SITE SAFETY AND HEALTH PLAN ADDENDUM NO. 1

FOR THE

PHASE II REMEDIAL INVESTIGATION OF LOAD LINE 1 AT THE RAVENNA ARMY AMMUNITION PLAN, RAVENNA, OHIO

Prepared for

US Army Corps of Engineers®

Louisville District
Contract No. DACA27-97-D-0025

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Prepared for

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Louisville, Kentucky 40201
Contract No. DACA27-97-D-0025

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August 1999

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

contributed to the preparation of this document and should not
be considered an eligible contractor for its review.

APPROVALS

SITE SAFETY AND HEALTH PLAN ADDENDUM NO. 1
FOR THE
PHASE II REMEDIAL INVESTIGATION
OF THE
LOAD LINE 1
AT THE
RAVENNA ARMY AMMUNITION PLANT,
RAVENNA, OHIO

Stephen B. Selecman, SAIC Project Manager Date

Stephen L. Davis, CIH, CSP, SAIC Health and Safety Manager Date

CONTENTS

TABLES

ACRONYMS

CIH	Certified Industrial Hygienist
CPR	cardiopulmonary resuscitation
CSP	Certified Safety Personnel
D&D	decontamination and decommissioning
DNT	dinitrotoluene
FP	flash point
FSHP	Facility-wide Safety and Health Plan
H&S	health and safety
HMX	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
IDLH	immediately dangerous to life and health
IP	ionization potential
MSDS	Material Safety Data Sheet
NA	not available
NIOSH	National Institute for Occupational Safety and Health
OE	ordnance and explosives
PEL	permissible exposure limit
PID	photoionization detector
PPE	personal protective equipment
ppm	parts per million
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
RI	Remedial Investigation
RVAAP	Ravenna Army Ammunition Plant
SAIC	Science Applications International Corporation
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
STEL	short-term exposure limit
SVOC	semivolatile organic compound
TNT	trinitrotoluene
TLV	threshold limit value
TWA	time-weighted average
USGS	U.S. Geological Survey
VP	vapor pressure

INTRODUCTION

Science Applications International Corporation's (SAIC's) formal policy, as stated in the Environmental Compliance and Health and Safety Program manual, is to take every reasonable precaution to protect the health and safety of our employees, the public, and the environment. To this end, the Ravenna Army Ammunition Plant Facility-wide Safety and Health Plan (FSHP) and this Site Safety and Health Plan (SSHP) Addendum collectively set forth the specific procedures required to protect SAIC and SAIC subcontractor personnel involved in the field activities. All field personnel are required to comply with the requirements of these plans. In addition, subcontractors are responsible for providing their employees with a safe workplace, and nothing in these plans relieves such subcontractors of this responsibility. If the requirements of these plans are not sufficient to protect the employees of a subcontractor, then the subcontractor is required to supplement this information with work practices and procedures that will ensure the safety of its personnel.

The FSHP addresses program issues and hazards and hazard controls common to the entire installation. This SSHP Addendum to the FSHP serves as the lower-tier document addressing the hazards and controls specific to this project. Copies of the FSHP and this SSHP Addendum will be present at the work site.

SAIC will perform a Phase II Remedial Investigation (RI) at the Load Line 1 location. From 1941 to 1971, this area of concern produced large volumes of process effluent (pink water) resulting from the loading, packing, and assembly of munitions. The wastewater passed through concrete sumps and sawdust filtration units prior to entering a settling pond via unlined ditches. The unlined settling pond received washdown water and wastewater from the load line operations. Building washdown water was also swept through doorways onto the ground surrounding load line buildings. Potential contaminants of concern identified in the Phase I RI include ordnance and explosives (OE); explosives residues; metals (arsenic, lead, chromium, and mercury); and semivolatile organic compounds (SVOCs) (USACE 1998). Low levels of polychlorinated biphenyls and pesticides were observed in seven samples collected during the Phase I RI.

Environmental characterization will be conducted incrementally during the Phase II RI under the auspices of the sequential Sampling and Analysis Plan Addenda. Groundwater will be the first environmental medium characterized, followed by soil, sediment, and surface water. This SSHP Addendum addresses all planned characterization activities.

The following are tasks to be performed as part of this project:

- collect 350 samples using hand augers or trowels;
- collect 175 subsurface soil samples from 2- to 4-foot depths using hand augers and hand-held power augers and 88 samples from 4- to 6-foot depths using hand-held power augers;
- drill and install eight new wells using NX coring and subsequent overdrilling with a 4-inch air rotary bit;
- develop the eight new wells;
- perform slug testing in the eight new wells;
- perform groundwater sampling using low-flow purging techniques for eight new wells and six existing wells;
- perform field analyses for trinitrotoluene (TNT) and hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) using on-site colorimetric analyses and metals using X-ray fluorescence; and

- decontaminate sampling equipment.

Potential hazards posed by the tasks planned at these locations include OE, moving equipment (power auger and drill rig), hand-held power tools and hand tools for brush clearing, fuel or decontamination solvent fires, chemical exposure, temperature extremes, noise, stinging/biting insects, poisonous plants, and snakes. These hazards will be minimized through the application of various control measures, such as area clearance by OE specialists, exclusion zones around heavy equipment, protective clothing, etc. These controls are detailed elsewhere in this document.

The potential for chemical overexposure appears to be low given the nature of the planned tasks. All of the expected contaminants have low vapor pressures, making overexposure through vapor inhalation very unlikely. All of the planned tasks, with the exception of air rotary drilling, pose a minimal potential for creating airborne particulates. Potable water will be used as needed to manage dust generation. Air rotary drill discharge will not be routed through a particulate control system to minimize airborne particulates unless other measures fail to perform adequately. There is some potential for adverse effects due to dermal contact with contaminated soil. The crew will use protective gloves to handle potentially contaminated materials and, if necessary, the Site Safety and Health Officer (SSHO) will upgrade the required personal protective equipment (PPE) to prevent dermal contact with potentially contaminated materials. The SSHO will observe all site tasks during daily safety inspections and will use professional judgment, coupled with instrument readings, to determine if upgrading of PPE is required. A detailed analysis of these hazards and specific appropriate controls is presented in Chapter 2, Table 2-2.

This investigation will be performed in Level D PPE, plus chemical-resistant gloves will be used when handling potentially contaminated materials, unless one of several action levels is exceeded, or the potential for increased risk becomes apparent during the investigation. Protective procedures, including protective clothing, will be upgraded as necessary by the SSHO based on established action levels or judgment.

1.0 SITE DESCRIPTION AND CONTAMINATION CHARACTERIZATION

1.1 SITE DESCRIPTION

The Ravenna Army Ammunition Plant (RVAAP) is located in northeastern Ohio within Portage and Trumbull Counties, approximately 48 km (3 miles) northeast of the town of Ravenna. The installation consists of 8,668 hectares (21,419 acres) in a 17.7-km (11-mile)-long, 5.6-km (3.5-mile)-wide tract bordered by a sparsely inhabited private residential area. The site is an inactive government-owned armament, munitions, and chemical command facility maintained by a contracted caretaker, R&R International, Inc.

The installation was active from 1941 to 1992. Activities included loading, assembling, storing, and packing military ammunition; demilitarization of munitions; production of ammonium nitrate fertilizer; and disposal of "off-spec" munitions. Munitions handled on the installation included artillery rounds of 90 mm or more and 2000-lb bombs.

The buildings associated with Load Line 1 are currently undergoing decontamination and decommissioning (D&D). These activities will be in progress during the Phase II Remedial Investigation (RI) groundwater investigation, but are expected to be completed before the RI characterization of soil, sediment, and surface is initiated.

1.2 CONTAMINANTS

The Phase I RI (USACE 1998) detected a number of contaminants at this location. Explosives residues were the most notable contaminants. Explosives residues were detected in 29 of the 46 soil samples analyzed. The maximum concentration of trinitrotoluene (TNT) was 5800 mg/kg. See Tables 1-1 and 1-2 for detailed sampling results. Inclusion in this table indicates the presence of a contaminant but does not necessarily indicate that the contaminant is present in sufficient quantity to pose a health risk to project workers.

Table 1-1. Load Line 1 Phase I RI Analytical Results (Surface Soil and Sediment)

Analyte	Units	Frequency of Detects	Background Criteria	Detects > Background	Minimum Detect	Maximum Detect	USGS Value	Site Related?	Justification
Surface Soil									
Cyanide	mg/kg	8/ 12	•		0.11			Yes	No Background Data Available
1,3,5-Trinitrobenzene	µg/kg	10/ 47	•		550	110000		Yes	No Background Data Available
2,4,6-Trinitrotoluene	µg/kg	28/ 47	•		260	5800000		Yes	Detected > 5% of Samples
2,4-Dinitrotoluene	µg/kg	5/ 47	•		100	1500		Yes	Detected > 5% of Samples
HMX	µg/kg	2/ 47	•		2600	9100		Yes	No Background Data Available
RDX	µg/kg	2/ 47	•		1800	49000		Yes	No Background Data Available
Aluminum	mg/kg	47/ 47	15600	4/ 47	1860	47600	20000 – 100000	Yes	> 5% Detect Above Background
Antimony	mg/kg	8/ 12	•		0.45	8.8		Yes	No Background Data Available
Arsenic	mg/kg	47/ 47	19.6	3/ 37	4.5	77	5.2 – 27.0	Yes	> 5% Detect Above Background
Barium	mg/kg	47/ 47	75	21/ 47	22.2	1380	300 – 700	Yes	> 5% Detect Above Background
Beryllium	mg/kg	12/ 12	•		0.2	2.5	1.5 – 2.0	Yes	No Background Data Available
Cadmium	mg/kg	42/ 47	0.29	35/ 47	0.15	23.5	1 – 2	Yes	> 5% Detect Above Background
Calcium	mg/kg	12/ 12	•		452	56700	1100 – 31000	No	Essential Nutrient
Chromium	mg/kg	47/ 47	18.7	17/ 47	4.8	394	15.0 – 100.0	Yes	> 5% Detect Above Background
Cobalt	mg/kg	12/ 12	•		3.9	33.7	7 – 20	Yes	No Background Data Available
Copper	mg/kg	12 / 12	•		11.3	110	7.0 – 70.0	Yes	No Background Data Available
Iron	mg/kg	12/ 12	•		13500	75600	15000 – 50000	No	Essential Nutrient

Table 1-1 (continued)

Analyte	Units	Frequency of Detects	Background Criteria	Detects > Background	Minimum Detect	Maximum Detect	USGS Value	Site Related?	Justification
Lead	mg/kg	47/ 47	17.9	41/ 47	10.8	3610	15 – 30	Yes	> 5% Detect Above Background
Magnesium	mg/kg	12/ 12	•		750	9100	3000 – 15000	No	Essential Element
Manganese	mg/kg	47/ 47	728	10/ 47	113	2140	150 – 1000	Yes	> 5% Detect Above Background
Mercury	mg/kg	41/ 47	0.08	14/ 47	0.03	1.4	0.03 – 0.22	Yes	> 5% Detect Above Background
Nickel	mg/kg	12/ 12	•		9.4	45.8	15 – 50	Yes	No Background Data Available
Potassium	mg/kg	12/ 12	•		358	2690	11800 – 25100	No	Essential Element
Selenium	mg/kg	44/ 47	2.6	4/ 47	0.32	4.3	< 0.1 – 1.2	Yes	> 5% Detect Above Background
Silver	mg/kg	1/ 47	0.24	0/ 47	0.24	0.24	0.7	No	Below Background
Sodium	mg/kg	12/ 12	•		148	535	5000 – 7000	No	Essential Element
Thallium	mg/kg	12/ 12	•		0.84	7.9		Yes	No Background Data Available
Vanadium	mg/kg	12/ 12	•		5.5	92.9	20 – 150	Yes	No Background Data Available
Zinc	mg/kg	47/ 47	72.1	34/ 47	34.1	1560	25 – 110	Yes	> 5% Detect Above Background
4,4′-DDD	µg/kg	2/ 12	•		42	250		Yes	No Background Data Available
4,4′-DDE	µg/kg	4/ 12	•		3.3	840		Yes	No Background Data Available
4,4′-DDT	µg/kg	3/ 12	•		63	450		Yes	No Background Data Available
Aldrin	µg/kg	1/ 12	•		2.5	2.5		Yes	No Background Data Available
Alpha chlordane	µg/kg	3/ 12	•		19	140		Yes	No Background Data Available
Aroclor-1254	µg/kg	5/ 12	•		95	36000		Yes	No Background Data Available
Aroclor-1260	µg/kg	1/ 12	•		680	680		Yes	No Background Data Available

Table 1-1 (continued)

Analyte	Units	Frequency of Detects	Background Criteria	Detects > Background	Minimum Detect	Maximum Detect	USGS Value	Site Related?	Justification
Dieldrin	µg/kg	1/ 12	•		170	170		Yes	No Background Data Available
Endosulfan I	µg/kg	1/ 12	•		40	40		Yes	No Background Data Available
Endosulfan II	µg/kg	1/ 12	•		8.7	8.7		Yes	No Background Data Available
Endrin	µg/kg	1/ 12	•		37	37		Yes	No Background Data Available
Endrin aldehyde	µg/kg	2/ 12	•		9.6	53		Yes	No Background Data Available
Gamma chlordane	µg/kg	4/ 12	•		1.9	250		Yes	No Background Data Available
Heptachlor epoxide	µg/kg	1/ 12	•		2.3	2.3		Yes	No Background Data Available
Anthracene	µg/kg	1/ 12	•		60	60		Yes	No Background Data Available
Benzo(a)anthracene	µg/kg	5/ 12	•		77	330		Yes	No Background Data Available
Benzo(a)pyrene	µg/kg	5/ 12	•		86	420		Yes	No Background Data Available
Benzo(b)fluoranthene	µg/kg	4/ 12	•		100	400		Yes	No Background Data Available
Bis(2-ethylhexyl)phthalate	µg/kg	4/ 12	•		74	530		Yes	No Background Data Available
Carbazole	µg/kg	5/ 12	•		94	500		Yes	No Background Data Available
Chrysene	µg/kg	5/ 12	•		42	1400		Yes	Detected > 5% of Samples
Di-n-butyl phthalate	µg/kg	1/ 12	•		36	36		Yes	No Background Data Available
Dibenzo(a,h)anthracene	µg/kg	6/ 12	•		90	600		Yes	No Background Data Available
Dimethyl phthalate	µg/kg	4/ 12	•		410	14000		Yes	No Background Data Available

Table 1-1 (continued)

Analyte	Units	Frequency of Detects	Background Criteria	Detects > Background	Minimum Detect	Maximum Detect	USGS Value	Site Related?	Justification
Fluoranthene	µg/kg	3/ 12	•		40	160		Yes	No Background Data Available
Indeno(1,2,3-cd)pyrene	µg/kg	1/ 12	•		1900	1900		Yes	No Background Data Available
N-nitrosodiphenylamine	µg/kg	2/ 12	•		110	270		Yes	No Background Data Available
Pentachlorophenol	µg/kg	1/ 12	•		3900	3900		Yes	No Background Data Available
Phenanthrene	µg/kg	4/ 12	•		67	500		Yes	No Background Data Available
Pyrene	µg/kg	5/ 12	•		110	890		Yes	No Background Data Available
Acetone	µg/kg	1/ 9	•		270	270		Yes	No Background Data Available
Chloroform	µg/kg	3/ 12	•		2	2		Yes	Detected > 5% of Samples
Toluene	µg/kg	5/ 12	•		6	31		Yes	Detected > 5% of Samples
Sediment									
Cyanide	mg/kg	2/ 3	•		0.35	1.1		Yes	No Background Data Available
1,3,5-Trinitrobenzene	µg/kg	2/ 22	•		380	6800		Yes	No Background Data Available
2,4,6-Trinitrotoluene	µg/kg	3/ 22	•		430	770000			Detected > 5% of Samples
HMX	µg/kg	2/ 22	•		2800	12000		Yes	No Background Data Available
RDX	µg/kg	2/22	•		430	16000		Yes	No Background Data Available
Aluminum	mg/kg	22/ 22	15600	2/ 22	3400	19900	20000 – 100000		> 5% Detect Above Background
Antimony	mg/kg	2/ 3	•		15.3	2460		Yes	No Background Data Available

Table 1-1 (continued)

Analyte	Units	Frequency of Detects	Background Criteria	Detects > Background	Minimum Detect	Maximum Detect	USGS Value	Site Related?	Justification
Arsenic	mg/kg	22/ 22	19.6	7/ 22	6.9	67.1	5.2 – 27.0	Yes	> 5% Detect Above Background
Barium	mg/kg	22/ 22	75	16/ 22	38.5	269	300 – 700	Yes	> 5% Detect Above Background
Beryllium	mg/kg	3/ 3	•		0.38	1.7	1.5 – 2.0	Yes	No Background Data Available
Cadmium	mg/kg	20/ 22	0.29	18/ 22	0.21	26.9	1 – 2	Yes	> 5% Detect Above Background
Calcium	mg/kg	3/ 3	•		3040	36200	1100 – 31000	No	Essential Nutrient
Chromium	mg/kg	22/ 22	18.7	7/ 22	9.5	345	15.0 – 100.0	Yes	> 5% Detect Above Background
Cobalt	mg/kg	3/ 3	•		4.7	43.2	7 – 20	Yes	No Background Data Available
Copper	mg/kg	3/ 3	•		9	558	7.0 – 70.0	Yes	No Background Data Available
Iron	mg/kg	3/ 3	•		9340	199000	15000 – 50000	No	Essential Nutrient
Lead	mg/kg	22/ 22	17.9	14/ 22	12.9	2220	15 – 30	Yes	> 5% Detect Above Background
Magnesium	mg/kg	3/ 3	•		2110	9370	3000 – 15000	No	Essential Nutrient
Manganese	mg/kg	22/ 22	728	9/ 22	80.1	2340	150 – 1000	Yes	> 5% Detect Above Background
Mercury	mg/kg	15/ 22	0.08	7/ 22	0.05	1.4	0.03 – 0.22	Yes	> 5% Detect Above Background
Nickel	mg/kg	3/ 3	•		9.8	108	15 – 50	Yes	No Background Data Available
Potassium	mg/kg	3/ 3	•		185	673	11800 – 25100	No	Essential Nutrient
Selenium	mg/kg	20/ 22	2.6	4/ 22	0.43	10.3	< 0.1 – 1.2	Yes	> 5% Detect Above Background
Silver	mg/kg	2/ 22	0.24	2/ 22	1.5	3.9	0.7	Yes	> 5% Detect Above Background
Sodium	mg/kg	3/ 3	•		195	484	5000 – 7000	No	Essential Nutrient
Thallium	mg/kg	3/ 3	•		0.8	8.1		Yes	No Background Data Available

Table 1-1 (continued)

Analyte	Units	Frequency of Detects	Background Criteria	Detects > Background	Minimum Detect	Maximum Detect	USGS Value	Site Related?	Justification
Vanadium	mg/kg	3/ 3	•		11.9	14.5	20 – 150	Yes	No Background Data Available
Zinc	mg/kg	22/ 22	72.1	17/ 22	48.2	2530	25 – 110	Yes	> 5% Detect Above Background
4,4′-DDD	µg/kg	1/ 3	•		12	12		Yes	No Background Data Available
4,4′-DDE	µg/kg	1/ 3	•		740	740		Yes	No Background Data Available
4,4′-DDT	µg/kg	1/ 3	•		440	440		Yes	No Background Data Available
Alpha chlordane	µg/kg	1/ 3	•		9.9	9.9		Yes	No Background Data Available
Aroclor-1254	µg/kg	2/ 3	•		290	44000		Yes	No Background Data Available
Endrin	µg/kg	1/ 3	•		160	160		Yes	No Background Data Available
Endrin aldehyde	µg/kg	1/ 3	•		320	320		Yes	No Background Data Available
Gamma chlordane	µg/kg	2/ 3	•		11	130		Yes	No Background Data Available
Heptachlor	µg/kg	1/ 3	•		3.4	3.4		Yes	No Background Data Available
Anthracene	µg/kg	1/ 3	•		260	260		Yes	No Background Data Available
Benzo(a)anthracene	µg/kg	2/ 3	•		260	860		Yes	No Background Data Available
Benzo(a)pyrene	µg/kg	3/ 3	•		350	1300		Yes	No Background Data Available
Benzo(b)fluoranthene	µg/kg	2/ 3	•		600	3000		Yes	No Background Data Available
Benzo(g,h,i)perylene	µg/kg	2/ 3	•		460	1400		Yes	No Background Data Available
Benzo(k)fluoranthene	µg/kg	2/ 3	•		500	1500		Yes	No Background Data Available

Table 1-1 (continued)

Analyte	Units	Frequency of Detects	Background Criteria	Detects > Background	Minimum Detect	Maximum Detect	USGS Value	Site Related?	Justification
Bis(2-ethylhexyl)phthalate	µg/kg	2/ 3	•		120	490		Yes	Detected > 5% of Samples
Carbazole	µg/kg	1/ 3	•		240	240		Yes	No Background Data Available
Chrysene	µg/kg	3/ 3	•		130	1800		Yes	No Background Data Available
Di-n-butyl phthalate	µg/kg	1/ 3	•		870	870		Yes	No Background Data Available
Dibenzo(a,h)anthracene	µg/kg	2/ 3	•		180	560		Yes	No Background Data Available
Fluoranthene	µg/kg	2/ 3	•		510	2100		Yes	No Background Data Available
Indeno(1,2,3-cd)pyrene	µg/kg	2/ 3	•		440	1100		Yes	No Background Data Available
Phenanthrene	µg/kg	2/ 3	•		190	380		Yes	No Background Data Available
Pyrene	µg/kg	3/ 3	•		140	1400		Yes	No Background Data Available
Acetone	µg/kg	1/ 2	•		110	110		Yes	No Background Data Available
Chloroform	µg/kg	1/ 3	•		4	4		Yes	Detected > 5% of Samples

HMX = octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
RDX = hexahydro-1,3,5-trinitro-1,3,5-triazine
RI = remedial investigation
USGS = U.S. Geological Survey

Table 1-2. Load Line 1 Phase I RI Analytical Results (Groundwater)

Analyte	Frequency of Detects	Minimum Detect (mg/L)	Maximum Detect (mg/L)
Groundwater			
Cyanide	1/ 7	2.9	2.9
Aluminum	7/ 7	27.8	235
Arsenic	3/ 7	8.4	64.1
Barium	7/ 7	20.3	105
Beryllium	2/ 6	0.33	0.43
Calcium	6/ 6	4050	196000
Cobalt	5/ 6	1.4	27.5
Copper	4/ 6	0.93	7.4
Iron	4/ 6	37.3	822
Magnesium	6/ 6	2590	80700
Manganese	7/ 7	130	3120
Mercury	3/ 7	0.1	0.13
Nickel	6/ 6	1.6	73.2
Potassium	6/ 6	1010	5090
Sodium	6/ 6	4360	18100
Zinc	4/ 7	9.1	82.5
Heptachlor	1/ 6	0.05	0.05
2,4-Dimethylphenol	1/ 5	1	1
Diethyl phthalate	1/ 6	1	1
Acetone	1/ 4	18	18
Methylene chloride	1/ 7	11	11

RI = remedial investigation

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2.0 HAZARD/RISK ANALYSIS

The purpose of the task hazard/risk analysis is to identify and assess potential hazards that may be encountered by personnel and to prescribe required controls. Table 2-1, a general checklist of hazards that may be posed by this project, indicates whether a particular major type of hazard is present. If additional tasks or significant hazards are identified during the work, this document will be modified by addendum or field change order to include the additional information.

Table 2-1. Hazards Inventory

Yes	No	Hazard
	X	Confined space entry
	X	Excavation entry (deeper than 1.2 m)
X		Heavy equipment (drill rigs and power augers)
X		Fire and explosion (fuels)
X		Electrical shock (utilities)
X		Exposure to chemicals (contaminants and chemical tools)
X		Temperature extremes
X		Biological hazards (ticks, poisonous plants)
	X	Radiation or radioactive contamination
X		Noise (drill rigs, power augers, and power tools for brush clearing)
	X	Drowning
X		OE (residual explosives and propellants only)

OE = ordnance and explosives

Specific tasks are as follows:

- OE surveys and sample location clearance,
- vegetation clearing with machete and chainsaw,
- surface soil sampling with hand augers or scoops,
- subsurface soil boring and sampling with power augers and hollow-stem auger rig,
- surface water and sediment sampling using hand tools,
- bedrock coring and air rotary drilling,
- equipment decontamination at the central equipment decontamination facility,
- field analysis of explosives and metals, and
- characterization and handling of investigation-derived wastes.

2.1 TASK-SPECIFIC HAZARD ANALYSIS

Table 2-2 presents task-specific hazards, task-specific hazard analyses (Risk Assessment Code), relevant hazard controls, and required monitoring, if appropriate, for all of the planned site tasks. The Risk Assessment Codes in Table 2-2 are derived through a qualitative risk assessment process using probability codes and severity codes. The severity codes are:

- I = injuries/illnesses involving permanent total disability or death;
- II = injuries/illnesses with permanent partial disability or temporary total disability;
- III = injuries/illnesses resulting in temporary, reversible conditions with period of disability of less than 3 months; and
- IV = injuries/illnesses with reversible adverse effects requiring only minor treatment.

The probability codes are

- A = likely to occur immediately;
- B = probably will occur in time;
- C = possible to occur in time; and
- D = unlikely to occur.

2.2 POTENTIAL EXPOSURES

Environmental contamination is known to exist at this location, and controls will be used to minimize exposure. Information on the significant contaminants and chemical tools that will be used for the project is contained in Table 2-3. This table includes contaminants that pose a potential to cause adverse effects in site workers during, or after, the execution of this project. It excludes potential contaminants that are unlikely to pose a threat to site workers.

Table 2-2. Hazards Analysis

Safety and Health Hazards	Risk Assess. Codes	Controls	Monitoring
Vegetation Clearing with Machetes and Chainsaws			
General safety hazards (rotating machinery, moving equipment, slips, and falls)	B, II	Level D PPE (see Section 5.0) plus hardhat, heavy-duty work gloves, and chainsaw chaps. Uninvolved personnel will be kept at a distance of at least 50 feet. An audible warning will be used to alert personnel when a tree is falling. No elevated (climbing trees, standing on ladders, etc.) chainsaw use. Only personnel experienced with chainsaw use will operate saws. Team members will be at least 10 feet apart but within visual contact during cutting. Chainsaw equipped with anti-kickback protection. Chainsaw adjusted so that chain does not move at idle speed. Chainsaw will not be used to cut above shoulder height. Machetes equipped with lanyard and lanyard looped around wrist during use to prevent accidental release of machete.	Daily safety inspections.
Contact with OE	C, II	Pre-entry screening survey and continuous escort by OE specialist support. On-site training in ordnance recognition for all field personnel. Withdrawal of all SAIC and subcontractor personnel from immediate area and field marking of suspect area if ordnance or suspected ordnance is discovered. Notification of USACE Project Manager and facility EOD personnel if ordnance is discovered.	Visual and instrument surveys for ordnance conducted by OE expert personnel.
Exposure to chemicals (see Table 2-3)	D, IV	No contact with potentially contaminated material is expected during this task. As a precaution, hands will be washed prior to taking anything by mouth. Medical clearance will be required.	Daily safety inspections.
Gunfire (deer hunting with shotguns loaded with slugs is allowed in some areas on Fridays and Saturdays during season, October and November)	D, I	No field work during hunting season.	None.
Noise	B, II	Hearing protection while operating or within 25 feet of operating chainsaw.	Daily safety inspections.

Table 2-2. (continued)

Safety and Health Hazards	Risk Assess. Codes	Controls	Monitoring
Fire (fuels)	D, III	Chainsaw turned off and allowed to cool for 5 minutes prior to fueling. Fuel in safety cans with flame arresters. No ignition sources in fuel storage or refueling areas. Fire extinguisher (see Section 9.0).	Daily safety inspections.
Biological hazards (bees, ticks, wasps, snakes, and poison ivy)	C, III	PPE (boots, work clothes). Pants tucked into boots or wrapped with duct tape. Insect repellant, as necessary.	Visual survey.
Electric shock	D, II	None expected. SSHO will verify.	Visual survey of all work areas.
Temperature extremes	C, II	Administrative controls (see Section 8.0).	Ambient temperature, heart rates as appropriate.
Soil and Shallow Sediment Sampling with Hand Augers or Scoops			
General safety hazards (manual lifting, slips, falls, traffic, and nearby D&D activities)	D, IV	Level D PPE (see Section 5). Hard hat if overhead hazards are present; HAZWOPER training. Buddy system. Coordination with D&D program personnel, high-visibility vests and other control measures if traffic poses a hazard.	Daily site safety inspections.
Contact with OE	D, II	OE clearance of sample locations in advance. Ordnance is not known or expected; thus, full-time OE support is not required during sampling. On-site training in ordnance recognition for all field personnel. Visual surveillance for OE. Withdrawal of all SAIC and subcontractor personnel and field marking of the area if ordnance or suspected ordnance is discovered. Notification of USACE Project Manager and facility EOD personnel if ordnance is discovered.	Visual and instrument surveys for ordnance conducted by OE specialist personnel. Visual surveillance for OE by all site workers.
Drowning (highly unlikely, ditches and creek expected to be less than 2 feet deep)	D, IV	Coast guard-approved personal flotation devices if working on or near water deeper than 4 feet.	Daily safety inspections.
Exposure to chemicals (see Table 2-3)	D, III	Natural rubber or similar gloves for contact with potentially contaminated material. Gloves will be disposed after single use. Washing face and hands and any other exposed areas prior to taking anything by mouth. Minimal contact. Fifteen-minute eyewash within 100 feet if corrosive sample preservatives are being poured. Hazardous Waste operations medical clearance.	Photoionization detector, visual surveillance for significant contamination.

Table 2-2 (continued)

Safety and Health Hazards	Risk Assess. Codes	Controls	Monitoring
Gunfire (deer hunting with shotguns loaded with slugs allowed in some areas on Fridays and Saturdays during season)	D, I	No field work at dawn or dusk in areas open to hunting (during open hunting season). High-visibility vests in these areas. When possible, schedule work in these areas for Sunday through Thursday.	None.
Biological hazards (poison ivy, bees, ticks, and wasps)	C, III	PPE (boots, work clothes). Pants tucked into boots or wrapped with duct tape. Insect repellant, as necessary.	Visual survey.
Temperature extremes	C, II	Administrative controls (see Section 9.0). Chilled fluids available if >70 degrees Fahrenheit. Frequent breaks in shaded area.	Ambient temperature, heart rates as appropriate.
Soil Boring and Soil Sampling Using a Hand-Operated Power Auger			
General safety hazards (rotating machinery, moving equipment, slips, falls, traffic, and nearby D&D activities)	C, II	Level D PPE (see Section 5.0). Hard hat if overhead hazards are present. Operate auger per manufacturers' directions. Positive action control (Deadman switch) or easily accessible kill switch on power auger. HAZWOPER training. Buddy system. Coordination with D&D program personnel, high-visibility vests and other control measures if traffic poses a hazard.	Daily site safety inspections.
Contact with OE	D, II	OE clearance of sample locations in advance. Ordnance is not known or expected; thus, full-time OE support is not required during sampling. On-site training in ordnance recognition for all field personnel. Withdrawal of all SAIC and subcontractor personnel from immediate area and field marking of suspect area if ordnance or suspected ordnance is discovered. Notification of USACE Project Manager and facility EOD personnel if ordnance is discovered.	Visual and instrument surveys for ordnance conducted by OE expert personnel. Visual surveillance for OE by all site personnel.
Exposure to chemicals (see Table 2-3)	D, IV	Natural rubber or similar gloves for contact with potentially contaminated material. Gloves will be disposed after single use. Fifteen-minute eyewash within 100 feet if corrosive sample preservatives are being poured. Washing face and hands and any other exposed areas prior to taking anything by mouth. Minimal contact. Medical clearance.	PID monitoring, visual surveillance for dust generation, and visual surveillance for significant contamination.

Table 2-2 (continued)

Safety and Health Hazards	Risk Assess. Codes	Controls	Monitoring
Gunfire (deer hunting with shotguns loaded with slugs is allowed in some areas on Fridays and Saturdays during season)	D, I	No field work at dawn or dusk in areas open to hunting during hunting season. High-visibility vests in these areas. When possible, schedule work in these areas for Sunday through Thursday.	None.
Noise	B, II	Hearing protection within 7.6 m (25 feet) of equipment when operating.	Daily safety inspections.
Fire (fuels)	D, III	Fuel in safety cans with flame arresters. No ignition sources in fuel storage or refueling areas. Fire extinguisher rated at least 10-ABC immediately available (see Section 9.0). Allow power auger to cool for at least 10 minutes before refueling.	Daily safety inspection.
Biological hazards (poison ivy, bees, ticks, and wasps)	C, III	PPE (boots, work clothes). Pants tucked into boots or wrapped with duct tape. Insect repellant, as necessary.	Visual survey.
Electric shock	D, II	Identification and clearance of underground utilities. Contact local utilities clearance organization and appropriate site personnel.	Visual of all work areas.
Temperature extremes	C, II	Administrative controls (see Section 9.0). Chilled fluids if > 70 degrees Fahrenheit.	Ambient temperature, heart rates as appropriate.
Installation of Monitoring Wells Using NX Coring and Subsequent Overdrilling with 4-inch Air Rotary Bit			
General safety hazards (power machinery, moving equipment, slips, falls, traffic, and nearby D&D activities)	D, III	Level D PPE (see Section 5.0) plus hard hat. Personnel not involved with equipment will stand clear during operation. HAZWOPER training. Buddy system. Medical clearance. Drilling locations will be mowed and cleared prior to mobilization of the field team to the site. Coordination with D&D program personnel, high-visibility vests and other control measures if traffic poses a hazard.	Daily site safety inspections.
Contact with OE	D, II	Drilling sites will be cleared by OE specialist personnel. Ordnance is not known or expected; thus, full-time OE support is not required during sampling. On-site training in ordnance recognition for all field personnel. Visual surveillance for OE. Withdrawal of all SAIC and subcontractor personnel and field marking of the area if ordnance or suspected ordnance is discovered. Notification of USACE Project Manager and facility EOD personnel if ordnance is discovered.	Visual and instrument surveys for ordnance conducted by OE specialist personnel. Visual surveillance for OE by all site personnel.

Table 2-2 (continued)

Safety and Health Hazards	Risk Assess. Codes	Controls	Monitoring
Exposure to chemicals (see Table 2-3)	D, III	Natural rubber or similar gloves for contact with potentially contaminated material. Gloves will be disposed after single use. Washing face and hands and any other exposed areas prior to taking anything by mouth. Minimal contact. Air rotary drill rigs will be equipped with dust suppression systems. Fifteen-minute eyewash in the immediate area.	Photoionization detector, visual surveillance for dust generation, and visual surveillance for significant contamination.
Gunfire (deer hunting with shotguns loaded with slugs is allowed in some areas on Fridays and Saturdays during season)	D, I	No field work at dawn or dusk in areas open to hunting (during hunting season). High-visibility vests in these areas. When possible, schedule work in these areas for Sunday through Thursday.	None.
Noise	B, III	Hearing protection within 7.6 m (25 feet) of equipment during operation.	Daily safety inspections.
Fire (fuels)	D, III	Fuel in safety cans with flame arresters. Ignition sources excluded from fuel storage and fuel pouring areas. Fire extinguisher rated at least 10-ABC immediately available (see Section 9.0).	Daily safety inspection.
Biological hazards (poison ivy, bees, ticks, and wasps)	C, III	PPE (boots, work clothes). Pants tucked into boots or wrapped with duct tape. Insect repellant, as necessary.	Visual survey.
Electric shock	D, II	Identification and clearance of aboveground and underground utilities. Contact local utilities locating organization and appropriate site personnel to locate buried utilities. Observe minimum distances from aboveground utilities specified in Section 9.0.	Visual of all work areas.
Temperature extremes	C, II	Administrative controls (see Section 9.0). Chilled fluids immediately available if temperature > 70 degrees Fahrenheit.	Ambient temperature, heart rates as appropriate.
Well Development, Slug Testing, Groundwater Sampling Using Low-Flow Purging Techniques			
Safety hazards associated with equipment, traffic, and nearby D&D activities	D, IV	Level D PPE. Hard hat if overhead hazards are present (see Section 5.0). HAZWOPER training. Buddy system. Coordination with D&D program personnel, high-visibility vests and other control measures if traffic poses a hazard.	Daily safety inspections of SAIC operations.

Table 2-2 (continued)

Safety and Health Hazards	Risk Assess. Codes	Controls	Monitoring
Contact with unexploded ordinance (OE)	D, II	Pre-clearance of well areas by OE specialist personnel. Training in ordnance recognition for all field personnel. Visual surveillance for the presence of OE. Withdrawal of all SAIC and subcontractor personnel and field marking of the area if ordnance or suspected ordnance is discovered. Notification of USACE and facility EOD personnel if ordnance is discovered.	Visual surveys for ordnance.
Exposure to chemicals (see Table 2-3)	D, IV	Natural rubber or similar gloves for contact with potentially contaminated material. Gloves will be disposed after single use. Washing face and hands and any other exposed areas prior to taking anything by mouth. Minimal contact. Fifteen-minute eyewash within 100 feet if corrosive sample preservatives are being poured.	PID if previous monitoring indicated a potential overexposure.
Gunfire (deer hunting with shotguns loaded with slugs is allowed in some areas on Fridays and Saturdays during season)	D, I	No field work at dawn or dusk in areas open to hunting during season. High-visibility vests in these areas. When possible, schedule work in these areas for Sunday through Thursday.	None.
Biological hazards (poison ivy, bees, ticks, and wasps)	C, III	PPE (boots, work clothes). Pants tucked into boots or wrapped with duct tape. Insect repellant, as necessary.	Visual survey.
Temperature extremes	C, II	Administrative controls (see Section 9.0).	Ambient temperature, heart rates as appropriate.
Field Laboratory Analysis			
General safety hazards	D, IV	HAZWOPER training.	Daily site safety inspections.

Table 2-2 (continued)

Safety and Health Hazards	Risk Assess. Codes	Controls	Monitoring
Exposure to chemicals (see Table 2-3)	B, II	Natural rubber or similar gloves for contact with potentially contaminated material or chemicals. Safety glasses. Lab coat or long-sleeved shirt. Washing face and hands and any other exposed areas prior to taking anything by mouth. Minimal contact. Perform screening in well-ventilated outdoors area or in area with forced exhaust to draw vapors out of the room. If screening is done indoors, it must be done inside an exhaust hood or immediately in front of an exhaust fan. Fifteen-minute eyewash within 100 feet. The operator must thoroughly review (and document review) all applicable MSDSs.	PID monitoring at least twice per day after 1 hour of screening.
Fire (chemical reagents)	D, III	Flammable reagents closed when not in use. If flammable solvents are used, the exhaust fan must be turned on before beginning screening and kept on during screening. Flammables cabinet if more than 25 gallons of flammable material stored inside. Fire extinguisher rated at least 10-ABC nearby (see Section 9.0).	Daily safety inspection.
Disposal of Investigation-Derived Wastes (Soil Cuttings and Decontamination Rinsates)			
General safety hazards (power machinery, moving equipment, slips, and falls)	D, III	Level D PPE (see Section 5.0) plus heavy-duty work gloves. Hardhat if overhead hazards are present. Personnel not involved with equipment (trailer-mounted liquid tank, manual drum truck, drum grappler, Tommy lift, etc.) will stand clear during operation. HAZWOPER training. Buddy system. No personnel under lifted loads. Only adequately trained, experienced personnel will be allowed to operate equipment. Equipment used to lift or move drums will be used within its rated weight capacity. Coordination with D&D program management and protective measures, potentially including high-visibility vests, if traffic or other hazards are present.	Daily site safety inspections.

Table 2-2 (continued)

Safety and Health Hazards	Risk Assess. Codes	Controls	Monitoring
Contact with OE	D, II	On-site training in ordnance recognition for all field personnel. Visual surveillance for OE. Withdrawal of all SAIC and subcontractor personnel and field marking of the area if ordnance or suspected ordnance is discovered. Notification of USACE Project Manager and facility EOD personnel if ordnance is discovered.	Visual surveys for ordnance.
Exposure to chemicals (see Table 2-3)	D, III	Natural rubber or similar gloves for contact with potentially contaminated material. Washing face and hands and any other exposed areas prior to taking anything by mouth. Minimal contact Medical clearance.	Daily site safety inspections.
Gunfire (deer hunting with shotguns loaded with slugs allowed in some areas on Fridays and Saturdays during season)	D, I	No field work at dawn or dusk in areas open to hunting (during season). High-visibility vests in these areas. When possible, schedule work in these areas for Sunday through Thursday.	None.
Biological hazards (poison ivy, bees, ticks, and wasps)	C, III	PPE (boots, work clothes). Pants tucked into boots or wrapped with duct tape. Insect repellant, as necessary.	Visual survey.
Temperature extremes	C, II	Administrative controls (see Section 9.0). Chilled fluids immediately available if temperature > 70 degrees Fahrenheit.	Ambient temperature, heart rates as appropriate.
Equipment Decontamination (Hot Water Washing, Soap and Water Washing, Solvent Rinse)			
General equipment decontamination hazards (hot water, slips, falls, and equipment handling)	C, III	Level D+ PPE (see Section 5.0) plus: Nitrile or PVC gloves, face shield, and Saranax or rain suit (when operating steam washer). HAZWOPER training.	Daily safety inspections.
Noise (spray washer)	B, II	Hearing protection when within 7.6 m (25 feet) of operating washer.	Daily safety inspections.
Fire (flammable decontamination solvents and gasoline)	D, III	Exclusion of ignition sources during solvent use. Control of flammable materials (quantities in decontamination area limited to single-day use, proper storage). Fire extinguisher (see Section 9.0).	Daily safety inspections.

Table 2-2 (continued)

Safety and Health Hazards	Risk Assess. Codes	Controls	Monitoring
Exposure to chemicals (see Table 2-3)	D, III	Natural rubber or similar gloves for handling potentially contaminated materials. Adequate ventilation during solvent use. Washing face and hands and any other exposed areas prior to taking anything by mouth. Minimal contact. Medical clearance.	Daily safety inspection
Temperature extremes	C, II	Administrative controls (see Section 9.0).	Temperature measurements as appropriate, heart rate monitoring as appropriate.

D&D = Decontamination and Decommissioning
EOD = Explosives ordnance disposal
HAZWOPER = Hazardous Waste Operations and Emergency Response
MSDS = Material Safety Data Sheet
OE = Ordnance and explosives
PID = Photoionization detector
PPE = Personal protective equipment
PVC = Polyvinyl chloride
SAIC = Science Applications International Corporation
USACE = U.S. Army Corps of Engineers.

Table 2-3. Potential Exposures for the Phase II RI at Load Line 1

Chemical[a]	TLV/PEL/STEL/IDLH[b]	Health Effects/ Potential Hazards[c]	Chemical and Physical Properties[c]	Exposure Route(s)[c]
DNT (dinitrotoluene)	TLV/TWA: 0.2 mg/m^3, A2 IDLH: Ca [50 mg/m^3]	Suspected human carcinogen, anorexia, cyanosis, and reproductive effects	Orange-yellow solid, VP: 1 mm; FP: 404°F	Inhalation Absorption Ingestion Contact
Gasoline (used for fuel)	TLV/TWA: 300 ppm IDLH: Ca	Potential carcinogen per NIOSH, dizziness, eye irritation, and dermatitis	Liquid with aromatic odor; FP: -45°F; VP: 38 to 300 mm	Inhalation Ingestion Absorption Contact
Hydrochloric acid (potentially used to preserve water samples or for equipment decontamination)	TLV: 5 ppm ceiling IDLH: 50 ppm	Irritation of eyes, skin, and respiratory system	Liquid; VP: fuming; IP: 12.74 eV; FP: none	Inhalation Ingestion Contact
Isopropyl alcohol (potentially used for equipment decontamination)	TLV/TWA: 400 ppm STEL: 500 ppm IDLH: 2000 ppm	Irritation of eyes, skin, respiratory system; drowsiness, headache	Colorless liquid with alcohol odor; VP: 33 mm; IP: 10.10 eV; FP: 53°F	Inhalation Ingestion Contact
Lead	TLV/TWA: 0.05 mg/m^3, A3 PEL/TWA: 0.05 mg/m^3 IDLH: 100 mg/m^3	Weakness, anorexia, abdominal pain, anemia	Solid metal; VP: 0 mm; FP: NA; IP: NA	Inhalation Ingestion Contact
Liquinox (used for decontamination)	TLV/TWA: None	Inhalation may cause local irritation to mucus membranes	Yellow odorless liquid (biodegradable cleaner); FP: NA	Inhalation Ingestion
Methanol (potentially used for equipment decontamination)	TLV/TWA: 200 ppm Skin notation IDLH: 6000 ppm	Irritation of eyes, skin, respiratory system; headache; optic nerve damage	Liquid; VP: 96 mm; IP: 10.84 eV; FP: 52°F	Inhalation Absorption Ingestion Contact

Table 2-3 (continued)

Chemical[a]	TLV/PEL/STEL/IDLH[b]	Health Effects/ Potential Hazards[c]	Chemical and Physical Properties[c]	Exposure Route(s)[c]
HMX (octogen)	TLV/TWA: None established, toxicity assumed to be similar to RDX as compounds are very similar	Explosive; assumed irritation of eyes and skin, dizziness, weakness	Assumed similar to RDX- FP: explodes; VP: 0.0004 mm at 230°F	Assumed: Inhalation Absorption Ingestion Contact
RDX (cyclonite)	TLV/TWA: 0.5 mg/m^3, A4 Skin notation IDLH: none established	Explosive; irritation of eyes and skin, dizziness, weakness	White powder; FP: explodes; VP: 0.0004 mm at 230°F	Inhalation Absorption Ingestion Contact
TNT (trinitrotoluene)	TLV/TWA: 0.5 mg/m^3 Skin notation IDLH: 500 mg/m^3	Cluster headache; irritation of skin and mucus membranes, liver damage, and kidney damage	Pale solid; FP: explodes; VP: 0.0002 mm	Inhalation Absorption Ingestion Contact

[a]The potential chemicals were obtained from the *Phase I Remedial Investigation Report for the Phase I Remedial Investigation of High Priority Areas of Concern at the Ravenna Army Ammunition Plan, Ravenna, Ohio* (USACE 1998).
[b]From 1999 Threshold Limit Values, *NIOSH Pocket Guide to Chemical Hazards*, 1997.
[c]From 1997 *NIOSH Pocket Guide to Chemical Hazards, the Condensed Chemical Dictionary*, Tenth Edition.

IP = ionization potential
PEL = permissible exposure limit
STEL = short-term exposure limit
TLV = threshold limit value
RDX = hexahydro-1,3,5-trinitro-1,3,5-triazine
TWA = time-weighted average
VP = vapor pressure
NA = not available
NIOSH = National Institute for Occupational Safety and Health
FP = flash point
IDLH = immediately dangerous to life and health

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3.0 STAFF ORGANIZATION, QUALIFICATIONS, AND RESPONSIBILITIES

This section presents the personnel (and their associated telephone numbers) responsible for site safety and health and emergency response. Table 3-1 identifies the SAIC and subcontractor individuals who will fill key roles. See the Facility-wide Safety and Health Plan (FSHP) for information on the roles and responsibilities of key positions.

Table 3-1. Staff Organization

Position	Name	Phone
Program Manager (DACA62-94-D-0029)	Ike Diggs	423-481-8710
Health and Safety Manager	Steve Davis CIH, CSP	423-481-4755
Project Manager	Steve Selecman	423-481-8761
Technical Manager	Kevin Jago	423-481-4614
Field Operations Manager	Kathy Dominic	937-431-2220
Site Safety and Health Officer (well installation)	Heather Smith	423-481-4602
Site Safety and Health Officer (soil, sediment, and surface water sampling)	Martha Clough	937-431-2220

CIH = Certified Industrial Hygienist
CSP = Certified Safety Personnel

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4.0 TRAINING

Training requirements are outlined in the FSHP. In addition to the FSHP's requirements, at least two first aid/cardiopulmonary resuscitation (CPR)-trained personnel must be onsite during field activities.

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5.0 PERSONAL PROTECTIVE EQUIPMENT

General guidelines for the selection and use of PPE are presented in the FSHP. Specific PPE requirements for the Phase I RI at Erie Burning Grounds are presented in the hazard/risk analysis section (Chapter 2.0).

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6.0 MEDICAL SURVEILLANCE

Medical surveillance requirements are outlined in the FSHP.

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7.0 EXPOSURE MONITORING/AIR SAMPLING PROGRAM

Assessment of airborne chemical concentrations will be performed, as appropriate, to ensure that exposures do not exceed acceptable levels. Action levels, with appropriate actions, have been established for this monitoring. In addition to the specified monitoring, the Site Safety and Health Officer (SSHO) may perform, or require, additional monitoring such as organic vapor monitoring in the equipment decontamination area, personnel exposure sampling for specific chemicals, etc. The deployment of monitoring equipment will depend on the activities being conducted and the potential exposures. All personal exposure monitoring records will be maintained in accordance with 29 *Code of Federal Regulations* 1910.20. The minimum monitoring requirements and action levels are presented in Table 7-1.

Most of Phase II RI field work is not expected to pose airborne exposure hazards for the following reasons:

- the work will be performed in open areas with natural ventilation;
- the site has been inactive since 1971, and no activities have occurred at the site since the early 1990s; thus, any volatile contaminants should have evaporated;
- prior site sampling indicated that contaminants are unlikely to pose an airborne hazard; and
- the most probable contaminants (heavy metals and explosive residues) are materials with relatively low vapor pressures.

For these reasons, air monitoring using a photoionization detector (PID) or equivalent is planned only for subsurface soil boring and sampling and monitoring well drilling and installation. The SSHO will, of course, examine site conditions and will contact the Health and Safety Manager and initiate additional monitoring if there is any indication of potential airborne exposure.

Table 7-1. Monitoring Requirements and Action Limits

Hazard or Measured Parameter	Area	Interval	Limit	Action	Tasks
Airborne organics with PID or equivalent	Breathing zone [0.9 m (3 feet) from source or 0.36 m (14 inches)] in front of employee's shoulder	At least once every 30 minutes in areas of intrusive work, at least twice a day in the mobile lab (when lab in use)	<5 ppm >5 ppm	Level D Withdraw and evaluate • identify contaminants • notify Project Manager and H&S Manager	Drilling, soil sampling, well development, and groundwater sampling; if previous sampling indicates a potential for overexposure, on-site laboratory analysis.
Detector tubes	Breathing zone	If organic vapor >5 ppm	PEL/TLV	Withdraw and evaluate; controls may include engineering, administrative, or personal protective measures	
Flammability and oxygen content with combustible gas indicator	Near borehole and any area where flammable gases are suspected	Only if PID readings exceed 100 ppm or other indicators of flammability observed	<10% LEL >10% LEL	Continue and evaluate source Withdraw and allow area to ventilate; notify Project Manager and H&S Manager	Intrusive tasks
Noise	None; SAIC has performed monitoring of drill rigs and generators on previous projects	Only if there is some doubt about noise levels	85 dBA and any area perceived as noisy	Require the use of hearing protection	None; hearing protection will be worn within the exclusion zone around drill rigs, excavation equipment, power augers, and generators
Visible contamination	All	Continuously	Visible contamination of skin or personal clothing	Upgrade PPE to preclude contact; may include disposable coveralls, boot covers, etc.	All

Table 7-1 (continued)

Hazard or Measured Parameter	Area	Interval	Limit	Action	Tasks
Visible airborne dust	All	Continuously	Visible dust generation	Stop work; use dust suppression techniques such as wetting surface	All

H&S = Health and Safety
LEL = Lower explosive limit
PEL = Permissible exposure limit
PID = Photoionization detector
PPE = Personal protective equipment
ppm = parts per million
SAIC = Science Applications International Corporation
TLV = Threshold limit value

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8.0 HEAT/COLD STRESS MONITORING

General requirements for heat/cold stress monitoring are contained in the FSHP.

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9.0 STANDARD OPERATING SAFETY PROCEDURES

Standard operating safety procedures are described in the FSHP.

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10.0 SITE CONTROL MEASURES

Site control measures are described in the FSHP. Because Load Line 1 is currently undergoing demolition, multiple personnel are routinely working in some of the proposed sampling areas. For these reasons, site control will be implemented at subsurface soil boring and monitoring well drilling locations requiring the use of drilling rigs. Surface soil, surface water, and sediment sampling locations will not require site control measures under normal circumstances. If site conditions require site control, it will be implemented as described in the FSHP.

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11.0 PERSONNEL HYGIENE AND DECONTAMINATION

Personal hygiene and decontamination requirements are described in the FSHP and in Chapter 2.0 of this addendum.

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12.0 EQUIPMENT DECONTAMINATION

Equipment decontamination procedures are described in the FSHP.

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13.0 EMERGENCY PROCEDURES AND EQUIPMENT

Emergency contacts, telephone numbers, directions to the nearest medical facility, and general procedures can be found in the FSHP. The SAIC Field Operations Manager will remain in charge of all SAIC and subcontractor personnel during emergency activities. The SAIC field office will serve as the assembly point if it becomes necessary to evacuate one or more sampling locations. The SSHO will verify that the emergency information in the FSHP is correct during mobilization for the Phase II RI.

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14.0 LOGS, REPORTS, AND RECORD KEEPING

Logs, reports, and record keeping requirements are described in the FSHP.

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15.0 REFERENCES

NIOSH (National Institute for Occupational Safety and Health). 1997. NIOSH Pocket Guide to Chemical Hazards, the Condensed Chemical Dictionary, 10th edition.

USACE (U.S. Army Corps of Engineers). 1998. Phase I Remedial Investigation Report for the Phase I Remedial Investigation of High Priority Areas of Concern at the Ravenna Army Ammunition Plant, Ravenna, Ohio, DACA62-94-D-0029, D.O. 0010 and 0022, February.

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