FINAL

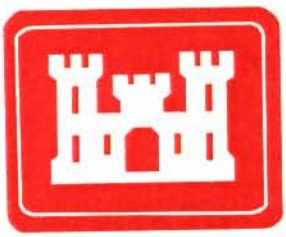
PHASE I REMEDIAL INVESTIGATION REPORT

FOR THE

PHASE I REMEDIAL INVESTIGATION OF HIGH PRIORITY AREAS OF CONCERN AT THE RAVENNA ARMY AMMUNITION PLANT, RAVENNA, OHIO

VOLUME I – MAIN TEXT

Prepared for



US Army Corps of Engineers®

Nashville District
Contract No. DACA-62-94-D-0029
Delivery Order Nos. 0010 and 0022

February 1998

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Phase I
Remedial Investigation Report
for the
Phase I Remedial Investigation of
High Priority Areas of Concern
at the Ravenna Army Ammunition Plant,
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contributed to the preparation of this document and should not be considered an eligible contractor for its review.

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ACRONYMS

AOC	Areas of Concern
ARAR	applicable or relevant and appropriate requirement
ASTM	American Society for Testing and Materials
BGS	below ground surface
BRA	baseline risk assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC	chain of custody
COPC	chemical of potential concern
DCA	dichloroethane
DNB	dinitrobenzene
DNT	dinitrotoluene
DoD	U.S. Department of Defense
DQO	Data Quality Objective
EM	electromagnetic
EPA	U.S. Environmental Protection Agency
F	Fahrenheit
FS	Feasibility Study
GOCO	government-owned, contractor-operated
GPD/ft	gallons per day per foot
GPM	gallons per minute
HI	hazard index
HMX	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HRS	Hazard Ranking System
HTRW	Hazardous, Toxic, and Radioactive Waste
IDW	investigation-derived waste
IEUBK	Integrated Exposure Uptake Biokinetic Model
ILCR	incremental lifetime cancer risk
IOC	Industrial Operations Command
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
MCL	maximum contaminant level
MCX	Mandatory Center of Expertise
MRD	Missouri River Division
MS	matrix spike
MSD	matrix spike duplicate
NFA	No Further Action
NFRAP	No Future Remedial Action Plan
NPDES	National Pollution Discharge and Elimination System
NPL	National Priorities List
OD	open detonation
ODNR	Ohio Department of Natural Resources
OEPA	Ohio Environmental Protection Agency
ORD	Ohio River Division

OVM	organic vapor meter
PA	Preliminary Assessment
PAH	polycyclic aromatic hydrocarbon
PAS	Preliminary Assessment Screening
PCB	polychlorinated biphenyl
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
QCSR	Quality Control Summary Report
RAGS	Risk Assessment Guidance for Superfund
RAI	Ravenna Arsenal Inc.
RCRA	Resource Conservation and Recovery Act
RDX	hexahydro-1,3,5-trinitro-1, 3,5-triazine
RFA	RCRA Facility Assessment
RI	Remedial Investigation
RVAAP	Ravenna Army Ammunition Plant
SAIC	Science Applications International Corporation
SAP	Sampling and Analysis Plan
SDWA	Safe Drinking Waters Act
SRC	site-related contaminant
SSL	soil screening level
SVOC	semi-volatile organic compound
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TBC	to-be-considered
TCL	Target Compound List
TKN	total kjeldahl nitrogen
TNB	trinitrobenzene
TNT	trinitrotoluene
TOC	Total Organic Carbon
USACE	U.S. Army Corps of Engineers
USAEHA	U.S. Army Environmental Hygiene Agency
USATHAMA	U.S. Army Toxic and Hazardous Materials Agency
USGS	U.S. Geological Survey
UTL	upper tolerance limit
UXO	unexploded ordnance
VOC	volatile organic compound

DEFINITIONS

Action Plan (AP)	An annual plan submitted by U.S. Army installations showing the status of current and future planned environmental activities at the installations.
Ammatol	A mixture of ammonium nitrate and TNT.
Area of Concern (AOC)	Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a site where contamination is known or suspected to exist.
Composition B	Explosive compound composed of a mixture of TNT and RDX.
Defense Environmental Restoration Program (DERP)	A program established by Congress in 1984 to evaluate and clean up contamination from past U.S. Department of Defense (DoD) activities (Title 10 U.S. Code 2701-2707 and 2810).
Facility	All contiguous land and structures, other appurtenances, and improvements within the boundaries of a property or parcels.
Facility-wide	A term used to reference all land and structures comprising a facility.
Facility-wide Sampling and Analysis Plan (SAP)	A submittal document comprised of the Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP); used to define all aspects of sampling and analytical work expected to be common to an installation. Not implementable without an investigation-specific SAP Addendum.
Feasibility Study (FS)	Based on data collected during the remedial investigation, options for final cleanup actions are developed and evaluated in the FS. The FS is divided into two phases: (1) an initial screening of alternatives, followed by (2) the detailed analysis of alternatives. The detailed analysis considers, among other things, cost-effectiveness, short- and long-term effectiveness, and the overall protection of human health and the environment.
Installation	A military facility or base.
Interim Remedial Action (IRA)	An early response action that is identified and implemented at any time during the study or design phase. IRAs are limited in scope, and they address only areas or media for which a final remedy will be developed by the remedial investigation (RI)/FS process. An IRA should be consistent with the final remedy for a site.

Investigation-Specific Sampling and Analysis Plan (SAP) Addendum	A submittal document comprised of the FSP and QAPP; used to define specific aspects of sampling and analytical work during the investigation of one or more AOCs. Tiered under the Facility-wide SAP and not implementable without the Facility-wide SAP.
No Further Action (NFA)	A no further action decision is a decision to close out a site from further response action. Such decisions can be made at different points in the process if data indicate that risks are within acceptable levels.
Phase I Remedial Investigation	Performed if the Preliminary Assessment (PA) recommends further investigation. Phase I investigations typically collect waste and environmental samples to determine the hazardous substances present at a site and whether they are being released to the environment.
Phase II Remedial Investigation (RI)	A field investigation that is more extensive than a Phase I RI. Its purpose is to characterize the nature and extent of contamination at a site. The Phase II RI also assesses the risks posed by on-site contamination to human health and the environment.
Pink Water	Waste water colored pink as a result of the photochemical reaction of TNT in water.
Preliminary Assessment (PA)	A limited-scope investigation designed to distinguish between sites that pose little or no threat to human health and the environment and sites that require further investigation. The PA is based on installation record searches, visual site inspections, and interviews of site personnel.
Relative Risk	The grouping of sites or AOCs in the DERP into High, Medium, and Low categories based on an evaluation of site information using three key factors: the contaminant hazard factor, the migration pathway factor, and the receptor factor.
Remedial Action (RA)	Involves the construction, operation, and implementation of the final cleanup remedy. Long-term RAs require continued monitoring, operation, and maintenance for a number of years.
Remedial Design (RD)	Involves the development of the actual design of the selected cleanup remedy, including preparation of all technical drawings and specifications needed to implement the cleanup action.

Removal Action	Taken to respond to a release, or threat of a release, of hazardous substances, pollutants, or contaminants so as to prevent, minimize, or mitigate harm to human health or the environment. Such actions may be taken during any phase of the site cleanup.
Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA)	The first step in the RCRA corrective action process. The RFA acts as a screen, first identifying and then eliminating solid waste management units (SWMUs), environmental media, or entire facilities from further consideration for corrective action. RFAs are performed as part of the RCRA permitting process.
Site	An area(s) of known or suspected release or source of contamination including all potentially affected media (soil, groundwater, surface water, sediment, air).
Solid Waste Management Unit (SWMU)	Under RCRA, a site where solid waste or wastelike material is known or suspected to exist.
Strategic and Critical Materials	A government phrase referring to substances/materials essential to the effective conduct of war.

EXECUTIVE SUMMARY

INTRODUCTION

This report documents the results of the Phase I Remedial Investigation (RI) for High-Priority Areas of Concern (AOCs) at the Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio. This RI was conducted for the RVAAP under the U.S. Department of Defense (DoD) Installation Restoration Program by Science Applications International Corporation under contract DACA62-94-D-0029, Delivery Order Nos. 0010 and 0022, with the U. S. Army Corps of Engineers (USACE), Nashville District. The Phase I RI was conducted in compliance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 following work plans reviewed and commented on by the Ohio Environmental Protection Agency.

A facility-wide *Preliminary Assessment for RVAAP* (USACE 1996a) was performed for the USACE in 1996 and identified 38 areas at RVAAP with known or suspected environmental concerns. The *Action Plan for RVAAP* (USACE 1996b) prioritized these AOCs for CERCLA actions based on a relative risk ranking methodology that considers potential threat to human health and the environment. The *Action Plan* identified the following 11 AOCs as having the highest risk rankings and, therefore, the highest priority for CERCLA actions:

- Demolition Area #2 (RVAAP-04),
- Winklepeck Burning Grounds (RVAAP-05),
- Load Line 1 and Dilution/Settling Pond (RVAAP-08),
- Load Line 2 and Dilution/Settling Pond (RVAAP-09),
- Load Line 3 and Dilution/Settling Pond (RVAAP-10),
- Load Line 4 and Dilution/Settling Pond (RVAAP-11),
- Load Line 12 and Dilution/Settling Pond (RVAAP-12),
- Building 1200 and Dilution/Settling Pond (RVAAP-13),
- Load Line 12 Pink Wastewater Treatment Plant (RVAAP-18),
- Landfill North of Winklepeck Burning Grounds (RVAAP-19), and
- Upper and Lower Cobbs Ponds (RVAAP-29).

This document summarizes the results of the Phase I RI field activities conducted in July and August 1996 at each of the 11 high-priority AOCs. The field program, environmental setting, and results for each of the AOCs are discussed. A preliminary risk evaluation, using published methods and action levels with background screening levels, was performed as part of the Phase I RI. Results of the data analysis and risk evaluation are used to develop a revised conceptual model for the facility and to re-prioritize the AOCs studied for future actions. The Phase I RI is consistent with the CERCLA requirements for a Site Investigation. The specific objectives of the Phase I RI are as follows:

- collect environmental samples from potentially impacted media to confirm if contamination is present and is being released to the environment; and

- determine the nature of the chemicals of potential concern (COPCs).

FIELD INVESTIGATION

The Phase I RI approach involved a combination of field and laboratory activities to characterize the 11 AOCs. Field investigation activities included surface soil and ditch sediment sampling, subsurface soil sampling, pond sediment sampling, geophysical surveying, and sampling of groundwater through the installation of monitoring wells and temporary well points. Aquifer testing was also conducted on the monitoring wells installed for this RI. The field program was conducted in accordance with the *RVAAP Facility-Wide Sampling and Analysis Plan* (SAP) (USACE 1996c) and the *Phase I RI SAP Addendum for High-Priority AOCs* (USACE 1996d).

Surface soils and drainage ditch sediments were sampled at all AOCs during Phase I RI to evaluate potential surface releases of munitions assembly and demilitarization wastes associated with process facilities, and the discharge of pink water effluent from process operations into open ditches. Subsurface soil sampling was also included in the field program at selected AOCs (Demolition Area #2 and Landfill North of Winklepeck Burning Grounds) where potential subsurface releases of munitions waste are suspected as a result of former wastes disposal operations at RVAAP. Sediment from unlined settling ponds receiving pink water effluent from former process operations associated with Load Lines 1, 2, 3, 4 , 12, and Building 1200 were evaluated during the Phase I RI. Eight settling ponds have been identified as receiving process effluent and surface water runoff via open ditches from former operations at these AOCs. Both soil and sediment analytical results were compared to values obtained from background soil samples as an initial screen. Groundwater was investigated during the Phase I RI to preliminarily assess groundwater conditions and the potential impacts from munitions and waste operations at perimeter locations in Load Lines 1, 2, 3 (Upper and Lower Cobbs Ponds), 4, and 12, and the Landfill North of Winklepeck Burning Grounds. No background data were available for groundwater. Geophysical surveys were performed at the Landfill North of Winklepeck Burning Grounds as part of the Phase I RI to locate landfill areas.

Inorganic analytical results for soil and sediment samples were evaluated by screening qualitatively against RVAAP site soil background data. Because background data were only available for the 11 identified process-related metals, analytical results were also compared qualitatively against U.S. Geological Survey (USGS) background reference concentrations for Ohio soils. Background data were not available for comparison to groundwater inorganic analytical results.

ANALYTICAL RESULTS

The results of the Phase I RI of high-priority AOCs at RVAAP are summarized below:

Demolition Area #2 (RVAAP-04)

Explosives, particularly TNT, and several inorganics including cadmium, lead, and mercury were detected frequently in both the surface and subsurface soils at Demolition Area #2. Detected contaminants occur predominantly in the southern portions of the AOC and at the old open detonation area. Explosives appear to be similarly distributed in both surface and subsurface soils. Non-explosive organics were not detected in the soils. Concentrations of inorganic compounds in

sediment appear to be within background values. Soil-related organic chemicals were not detected in stream sediments downgradient/downstream of the AOC; therefore, it is assumed that contaminants are not migrating away from the AOC via surface runoff based on those sediment location sampled. Groundwater was not investigated at this AOC.

Winklepeck Burning Grounds (RVAAP-05)

Several discreet areas of elevated explosive, organic, and inorganic compounds were detected in soils at the Winklepeck Burning Grounds. These areas include: near the burning trays in the east-central portions of the AOC; south of Pallet Road A, West; south of Pallet Road E, West; and south of Pallet Road E, East. The highest concentrations of explosives were detected south of Pallet Road E, East. Cadmium and lead were detected frequently above site background and USGS reference concentrations and appear to be co-located with explosives. There does not appear to be widespread migration of contamination from soils to sediments at this AOC based on those sediment locations sampled. Low concentrations of explosives (< 1 mg/kg) and manganese above background concentrations were detected in sediment samples taken north of the Resource Conservation and Recovery Act (RCRA) burning trays, but no other sediment samples indicate the presence of process-related chemicals. Groundwater was not investigated at this AOC.

Load Line 1 (RVAAP-08)

Elevated concentrations of explosives (TNT and DNT), inorganics, and organic PAH and PCB compounds in soils occur in the central portion of the load line complex, particularly around the doorways, drains, and vacuum pumps associated with the melt/pour buildings, Buildings CB-3A and CB-101, and near the main concrete settling tanks adjacent to LL1mw-063. The maximum concentrations of arsenic, chromium, lead, and selenium are higher in Load Line 1 soils than any other AOC investigated during the Phase I RI. Concentrations of metals and explosives in sediment do not exhibit a similar pattern of distribution. Inorganics and several organic compounds (e.g., heptachlor) were detected in groundwater. No explosives were detected in groundwater samples located at the AOC perimeter.

Load Line 2 (RVAAP-9)

Elevated concentrations of TNT and other explosives, inorganics, and organics (PAHs and PCBs) in soils occur in the central portion of the load line, particularly around the doorways, drains, and vacuum pumps of the melt/pour buildings and other buildings. The maximum concentration of TNT was 12,000 mg/kg. Several inorganics including chromium, lead, and manganese occur at concentrations above background values. Explosives, inorganics, and PAHs/PCBs are observed in the drainages leading to Kelly's Pond and in pond sediments but do not appear to be exiting Kelly's Pond. Low concentrations (< 1 μg/L) of DNT were found in groundwater at the AOC perimeter, and inorganics were also detected. Most other chemicals found in soil and sediment do not appear to have migrated to groundwater in the sampled locations.

Load Line 3 (RVAAP-10)

Elevated concentrations of TNT and other explosives, inorganics, and organic PAH and PCB compounds in soils occur particularly around the doorways, drains, and vacuum pumps of the melt/pour buildings and other buildings. Explosives occur at high concentrations in soil (maximum TNT concentration 390,000 mg/kg). Chromium, copper, and lead occur at concentrations in excess of site-related background criteria and USGS reference values. Explosives occur at moderate concentrations in sediment (maximum concentration of TNT is 4.6 mg/kg), especially in ditches around the melt/pour buildings. The highest concentrations of metals in sediments occur near building EB-4 and in the drainage channel leading to Upper and Lower Cobbs Ponds. Groundwater was not investigated at this AOC.

Load Line 4 (RVAAP-11)

TNT, inorganics including cadmium, lead, and zinc, and organic PAH and PCB compounds were observed in soils concentrated around Buildings G-12, G-12A, G-8, and G-13. Ditch sediment samples also contain TNT and inorganics, but at lower concentrations than in soil. Cadmium, lead, and zinc were the most prevalent metals. Pond sediments contain elevated concentrations of cadmium, lead, and zinc, but not explosives or organics. No explosives or organic compounds were detected in groundwater at the AOC perimeter, several inorganics were detected in at least one groundwater sample.

Load Line 12 (RVAAP-12 and RVAAP-18)

TNT and other explosives, inorganics, and organics occur at elevated concentrations in soil throughout this AOC. Explosives are concentrated around the Building 904 (demilitarization facility), Building 900 fertilizer/demilitarization operations facility, and the Nitrate Settling Basin and Filter Bed facility. Cadmium, chromium, lead, and mercury are also concentrated at these three areas and Building FF-19. Other organic contaminants detected include PAHs in the Building 904 area, and pesticides/PCBs in the vicinity of Buildings 900 and FF-19. Sediments also exhibited elevated concentrations of the explosives TNT and DNT, inorganics, and organics. Explosive concentrations were several orders of magnitude lower in sediment than in soil, and the maximum concentration was detected in the area of the Nitrate Settling Basin and Filter Beds. The maximum concentration of many inorganics and organic compounds was in the sample adjacent to Building FF-19. There does appear to be some migration of contaminants in sediment, with likely sources at Buildings 904, 900, FF-19, and the Nitrate Settling Basin and Filter Beds. The extent of sediment contamination beyond the AOC boundary was not determined at this AOC during the Phase I RI. There were no detections in the single groundwater sample analyzed for VOCs from this AOC.

Building 1200 (RVAAP-13)

No widespread contamination was detected in soil at Building 1200. No inorganics were detected above background values, and no explosives were detected in soils. PAHs were detected in one soil sample analyzed for organics adjacent to Building 1200. Low concentrations (< 1 mg/kg) of explosives were detected in the drainage sediments leading from Building 1200.

Inorganics were below USGS values in the sediments. Low levels of explosives were observed in the settling pond sediments.

Landfill North of Winklepeck Burning Grounds (RVAAP-19)

No widespread organic contamination was detected in the nine trench samples from the landfill area. Low levels of pesticides and PCBs (e.g., <0.1 mg/kg) were detected in some samples. Nickel was detected in groundwater slightly above the maximum contaminant level risk screening level (110 vs. 100 mg/kg). Scattered detections of inorganic were observed above soil background criteria in sediments from drainage leading to and from the beaver pond north of the landfill with the highest concentrations occurring downstream of this pond. There does not appear to be a defined source of contamination or evidence of contaminant migration in the area, based on the samples collected.

Upper and Lower Cobbs Ponds (RVAAP-29)

Several inorganics including lead, chromium, copper, mercury, and selenium were detected above soil background values in the Upper and Lower Cobbs Pond sediments, primarily in the center of each pond. This may be a result of sediment settling and accumulation. There is no clear distribution pattern of the various metals. A single occurrence of explosives was detected in pond sediments. Manganese was detected in groundwater and in sediments adjacent to the stream exiting Lower Cobbs Ponds. It has not been determined whether the manganese is naturally occurring or process-related.

RISK EVALUATION RESULTS

A screening risk evaluation was performed on the data. This evaluation was performed by comparing the contaminant concentrations detected at the site to readily available risk-based screening levels identified by the State of Ohio. **Table E.1** summarizes the results of the risk-based screening and lists the COPCs for each of the RVAAP AOCs based on the Phase I findings. The following points summarize the major findings:

- The greatest exceedances of risk-based action levels are associated with explosives detected in soils near the load lines. TNT, DNT, and RDX were detected at levels that exceeded residential-based and industrial-based screening levels by several orders of magnitude. Explosives were also high in the Winklepeck Burning Grounds.

- Metals were detected in soils above action levels at the same locations. The primary metals of concern appear to be arsenic, cadmium, chromium, and lead. Metals were frequently detected above action levels at the Demolition Area #2 in addition to the load lines and Winklepeck Burning Grounds.

- Although some site-related chemicals are detected in sediments downgradient and downstream of sources, the migration is limited. Sediment concentrations for most site-related chemicals are generally low, with a few exceedances slightly above screening levels. This suggests chemicals are not migrating away from the source areas in large masses.

Table E.1. Chemicals of Potential Concern Based on 1996 Sampling Event[a]

Area of Concern	Soil COPCs[b]	Sediment COPCs[c]	Groundwater COPCs
Building 1200 (-13)	Beryllium, B(a)P	—[d]	NS[e]
Demolition Area #2 (-04)	Arsenic, beryllium, lead, DNT	—	NS
Landfill North of Winklepeck Burning Grounds (-19)	Beryllium	—	Nickel
Load Line 1 (-08)	TNT, DNT, TNB, RDX, arsenic, barium, beryllium, cadmium, chromium, lead, thallium, vanadium, PCBs, dieldrin, PAHs	Antimony, cadmium, chromium, copper, lead, mercury, nickel, silver, zinc, pesticides, PCB, PAHs	Arsenic, manganese
Load Line 2 (-09)	TNT, TNB, RDX, beryllium, cadmium, lead, thallium, chlordane, PCBs, PAHs	Silver, zinc, PAHs	2,4-DNT
Load Line 3 (-10)	TNT, TNB, arsenic, beryllium, lead, thallium, vanadium, heptachlor, chlordane, PCBs, PAHs	Silver, zinc, DDT,	NS
Load Line 4 (-11)	Beryllium, thallium, aldrin, PCBs, PAHs	—	Manganese
Load Line 12 (-12) (-18)	TNT, DNT, RDX, beryllium, lead, PCBs, PAHs	Arsenic, copper, nickel, silver, zinc	—
Upper and Lower Cobbs Pond (-29)	NS	Chromium, copper	Manganese
Winklepeck Burning Grounds(-05)	TNB, TNT, RDX, arsenic, barium, beryllium, cadmium, lead	—	NS

[a] These COPCs were identified from results of 1996 sampling activities and may not be inclusive of all COPCs at RVAAP.

[b] Chemicals exceeding Ohio, federal, or risk-based soil screening levels for residential exposures are identified as COPCs. Chemicals that exceeded screening levels based on leaching to groundwater are summarized in Tables 5.6 through 5.29. The following COPCs were identified above the soil screening levels; however, screening values may be within the range of naturally occurring levels: arsenic, beryllium, and thallium.

[c] Chemicals detected above the Environmental Protection Agency Region IV benchmarks are identified as COPCs for sediment. Silver was identified above sediment screening levels; however, the silver screening value may be within the range of naturally occurring background levels.

[d] Designates no COPCs identified for this media.

[e] Not sampled.

- There does not appear to be any widespread groundwater contamination at perimeter locations sampled within the facility; however, this conclusion is based on limited data. The lack of contamination in collected samples is likely related to the types of chemical detected in the source soils: immobile, explosives, metals, and PAHs. The only chemical detected in groundwater above screening levels with any regularity was manganese. It has not been determined whether the elevated manganese reflects relatively high background levels in the region; however, source soil sampling does not indicated elevated manganese in the source area soils.

CONCLUSIONS

The following bullets summarize the general conclusions of the Phase I RI of high-priority AOCs at the RVAAP:

- Load Lines 1, 2, 3, 4, and 12 appear to be the most highly contaminated AOCs investigated during the Phase I RI at RVAAP. In these areas, soil concentrations of explosives, primarily TNT, are several orders of magnitude greater than soil risk-based screening levels. Maximum TNT concentrations in the load lines area soils range from 5,800 mg/kg (Load Line 1) to 390,000 mg/kg (Load Line 3). TNT concentrations in soil samples at Load Line 4 were slightly above risk screening levels.

- Demolition Area #2 and the Winklepeck Burning Grounds contain contaminant concentrations in soils that clearly exceed risk-based screening levels.

- Contamination at the Landfill North of Winklepeck Burning Grounds, Upper and Lower Cobbs Ponds, and Building 1200 is limited to a small number (<2 mg/kg) of inorganic compounds occurring at low concentrations but exceeding risk-based screening levels.

- Because of the sporadic and isolated occurrence of contamination, contaminants do not appear to be migrating horizontally away from source areas to adjacent soils and sediment. Further, based on the Phase I RI groundwater assessment, contamination does not appear to have reached the water table in significant concentrations at the perimeter locations and depths sampled.

- Limited perimeter groundwater monitoring at Load Lines 1 and 2 suggests that contamination may not be migrating from the RVAAP facility via groundwater at these locations and at the specified depths.

- Manganese appears to be elevated throughout the AOCs in sediments and groundwater. It has not been determined whether the elevated manganese reflects relatively high background levels in the region or actual site-related contamination; however, sampling in source areas does not indicate elevated manganese in the source area soils.

- Beryllium was identified as a COPC for several AOCs; however, the risk-based screening values for beryllium are extremely conservative, e.g., less than observed background levels.

- Re-prioritization of the RVAAP high-priority AOCs using Phase I RI data and the DoD Relative Risk Evaluation Methodology indicates the following priority of AOCs:

  High Priority

  Demolition Area #2 (RVAAP-04)
  Winklepeck Burning Grounds (RVAAP-05)
  Load Line 1 (RVAAP-08)
  Load Line 2 (RVAAP-09)
  Load Line 3 (RVAAP-10)
  Load Line 4 (RVAAP-11)
  Load line 12 (RVAAP-12)

  Medium Priority

  Building 1200 (RVAAP-13)
  Landfill North of Winklepeck Burning Grounds (RVAAP-19)
  Upper and Lower Cobbs Ponds (RVAAP-29)

RECOMMENDATIONS

The following bullets summarize general recommendations for follow-on activities at the AOCs investigated:

- Conduct a Phase II RI to determine extent of soil and sediment contamination at high- and medium-priority AOCs as defined by Phase I RI, and collect data (i.e., geotechnical soil properties, contaminated material volumes, aquifer testing, etc.) to support development of a Feasibility Study, if necessary, at these AOCs.

- Evaluate groundwater within and immediately downgradient of known secondary (e.g., soils) source areas within high- and medium-priority AOCs as defined by Phase I RI.

- Evaluate background (soil and groundwater) conditions at each AOC requiring further investigation.

- Further evaluate potential off-site (facility) contaminant migration potential via groundwater at other high-priority AOCs located adjacent to the facility boundary (e.g., additional perimeter monitoring).

- Evaluate potential off-site contaminant migration potential via surface water from high-priority AOCs (e.g., perimeter monitoring).

- Perform a Baseline Risk Assessment (human health and ecological) including Ecological Assessment of the RVAAP facility to support decision making regarding environmental conditions and remedial alternatives at RVAAP.