FINAL

PHASE I REMEDIAL INVESTIGATION REPORT

FOR

DEMOLITION AREA 1 AT THE RAVENNA ARMY AMMUNITION PLANT RAVENNA, OHIO

Prepared for

US Army Corps of Engineers®

U.S. Army Corps of Engineers – Louisville District
Contract No. DACA62-94-D-0029
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LIST OF ACRONYMS

amsl	above mean sea level
AOCs	Areas of concern
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	chain of custody
COCs	chemicals of concern
COPCs	chemicals of potential concern
CQC	Contractor Quality Control
DA1	Demolition Area 1
DAF	dilution attenuation factor
DNB	dinitrobenzene
DNT	dinitrotoluene
DoD	U.S. Department of Defense
DQCRs	Daily Quality Control Reports
DQOs	data quality objectives
EDQLs	Ecological Data Quality Levels
EPA	U.S. Environmental Protection Agency
ERA	ecological risk assessment
FCOs	field change orders
FS	Feasibility Study
HMX	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HPLC	High Pressure Liquid Chromatography
HQ	hazard quotient
IRA	interim removal action
IRP	Installation Restoration Program
LCS	laboratory control standard
M&TE	Measuring and Testing Equipment
MCX	Mandatory Center of Expertise
MPRs	Monthly Progress Reports
MS	matrix spike
MSD	matrix spike duplicate
NACA	National Advisory Committee on Aeronautics
NCRs	nonconformance reports
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NTA	NACA Test Area
OAC	Ohio Administrative Code
OB	open burning
OD	open detonation
OE	ordnance and explosives
OHARNG	Ohio Army National Guard
Ohio EPA	Ohio Environmental Protection Agency
OSC	Operations Support Command
PCBs	polychlorinated biphenyls
PRG	preliminary remediation goal
PVC	polyvinyl chloride
QA	quality assurance

QAPP	Quality Assurance Program Plan
QC	quality control
QCSR	Quality Control Summary Report
RCRA	Resource Conservation and Recovery Act
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
RI	Remedial Investigation
RPD	relative percent difference
RRSE	relative risk site evaluation
RVAAP	Ravenna Army Ammunition Plant
SAIC	Science Applications International Corporation
SAP	Sampling and Analysis Plan
SCM	site conceptual model
SOW	Statement of Work
SRCs	site-related contaminants
SVOCs	semivolatile organic compounds
TAL	Target Analyte List
TELs	Threshold Effects Levels
TNB	trinitrobenzene
TNT	trinitrotoluene
TOC	total organic carbon
USACE	U.S. Army Corps of Engineers
USACHPPM	U.S. Army Center for Health Promotion and Preventive Medicine
USCS	Unified Soil Classification System
VOCs	volatile organic compounds
WBG	Winklepeck Burning Grounds

EXECUTIVE SUMMARY

This Phase I Remedial Investigation (RI) report characterizes the occurrence and distribution of contamination in soil, sediment, and surface water and evaluates potential risk to human health and the environment resulting from operations at Demolition Area 1 (DA1) at the Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio. Additionally, one groundwater sample was obtained using direct-push boring techniques to provide a general indication of whether source contamination has leached into the groundwater. DA1, designated as Area of Concern (AOC) RVAAP-003, was in operation from 1941 to 1949. The Phase I characterization area covers approximately 0.6 hectare (1.5 acres) in the southwestern quadrant of the facility and is surrounded by the National Advisory Committee on Aeronautics (NACA) Test Area (AOC number RVAAP-038). The site was used for treatment of munitions, explosives, and related materials by open burning (OB) and open detonation (OD).

HISTORY AND CURRENT SITE CONDITIONS

The AOC lies immediately south of the NACA Test Area (NTA) runway opposite the access road. Prominent features of the AOC, as derived from aerial photos of the site circa 1940s and 1950s, depict an oval OB/OD area surrounded by an earthen berm that is approximately 7.6-meters (25-feet) wide at the top. The top of the berm appears to have been an extension of Demolition Road. Following, and possibly concurrent with, its use as a demolition area, the area outside of the berm (plane storage area) was used to stage aircraft used during NTA operations (1947–1953). It is not known whether releases of hydraulic fluids, antifreezes, or fuels from the aircraft occurred during the time that planes were stored at DA1. Such releases, if they occurred, may have contributed contaminants to the soil.

Currently, the earthen berm surrounding the former OB/OD area is from approximately 0.3- to 0.4-meter (1- to 1.5-feet) high. Areas of bare soil measuring from 9 to 14 cubic meters (100 to 150 cubic feet) lie immediately outside of the berm within the plane storage area. Fragments, fuzes, booster cups, and other debris are visible on the bare soil surface outside the berm. The occurrence of these materials on the ground surface outside the thermal demolition area suggests that kickouts and shrapnel were generated during thermal destruction of ammunition or that small areas within the plane storage area were also used for periodic thermal treatment of munitions. In addition, environmental investigations have indicated that, when they became congested with debris, burning areas were cleared using heaving equipment by pushing the debris to the periphery of the area. This activity may have contributed to the spread of contaminants.

The site currently is covered with grass and is mowed periodically. Topographic relief across the site varies by only a few feet. Surface water drainage is primarily to the south. A small culvert beneath the south end of the berm drains the former OB/OD area and discharges to a shallow ditch flowing south until dissipating into a wooded area about 46 meters (150 feet) south of the AOC. A low area immediately east of the AOC also collects runoff during rainfall events.

Areas within NTA adjoining DA1 have been used since 1969 for dismounted troop training, bivouac (temporary encampment), and vehicle parking by the Ohio Army National Guard. The following restrictions apply to training activities at NTA: (1) parking and vehicle traffic is limited to the former NTA concrete runway and established trails, (2) digging of soil is prohibited, (3) disposal of trash is prohibited other than in designated above-ground receptacles, and (4) disposal of gray water is prohibited. Fires and the firing of live ammunition are prohibited. Firing of blank ammunition that is 7.62 millimeters or smaller is permitted within the training area as approved by the Training Site Commander.

Primary sources of contamination at DA1 are residues from the OB/OD of explosives and munitions such as trinitrotoluene (TNT), hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), dinitrotoluene (DNT), and associated metals (e.g., cadmium, chromium, lead, and mercury). In addition, slag is present at the site as fill around the berm and adjacent NTA crash strip. This aluminum-rich slag, the use of which was widespread throughout RVAAP, may account for some elevated concentrations of metals (especially aluminum, barium, beryllium, and manganese). However, Ohio Administrative Code (OAC) 3745-27-01(B)40 specifically exempts slag as a solid waste (Ohio EPA 2000).

OBJECTIVES

The overall purpose of the Phase I RI is to assess the occurrence, distribution, and potential risk from contamination in soil to a depth of 2.4 meters (8 feet) below ground surface (bgs), sediment, and surface water. Screening data for groundwater are specified to determine whether any inputs to this medium have occurred. The specific objectives of the Phase I RI are to

- Determine the potential types and sources of contamination at DA1 using historical process information and previous sampling data to establish data quality objectives (DQOs) and sampling locations for Phase I RI characterization;
- Identify whether releases of contamination beyond the AOC boundary are occurring by collecting environmental samples (surface water and sediment) within surface water runoff conveyances;
- Perform a screening risk evaluation to determine the potential magnitude of risk associated with any contamination detected and if additional investigation is warranted; and
- Provide preliminary recommendations for additional investigations and/or actions.

PAST AND CURRENT INVESTIGATIONS

Previous studies at DA1 consist of collection and analysis of three surface soil samples as part of a relative risk site evaluation in 1996 (USACHPPM 1996). Data from the Water Quality Surveillance Program (USATHAMA 1980–1992) obtained at surface water monitoring station HC-2 at the southern installation boundary along Hinkley Creek, which drains DA1 and a large surrounding area, also are relevant to this investigation. Low concentrations of copper, zinc, and RDX were observed on one occasion at HC-2. Seven metals and 2,4,6-TNT (maximum concentration of 23,000 mg/kg) were detected in site soil. However, these data were insufficient for determining the occurrence and distribution of contamination or for evaluating potential risk. Additionally, annual storm water sampling is conducted each fall at three facility outfalls, including HC-2. The samples are tested for toxicity to *Ceriodaphnia dubia* (water fleas) larvae and *Pimephales promelas* (fathead minnow). Analyses for metals and explosives are also conducted. The most recent data (August 2000) show no toxicity or detectable explosives at HC-2. Arsenic, chromium, and magnesium were detected above RVAAP facility-wide background levels.

The following DQOs were identified to guide the implementation of the Phase I RI and to help ensure that data needs for the project were met.

Source Area Soil. Potential source areas and contaminant accumulation points were the specific focus of the Phase I RI sampling effort. The former OB/OD area, the berm, and adjacent plane storage area were targeted for sampling using a grid approach in order to ensure representative characterization of these areas. The ditch draining the AOC to the south (dry sediment) and bare soil areas having visible contamination or debris were specifically targeted using biased samples.

Sediment. Low-lying areas were identified as the most likely sites for contaminant accumulation due to transport of eroded soil in storm runoff. Also, sediment may function as a transport mechanism because contaminants adsorbed to particulates can be mobilized by surface water flow. Sediment from a tributary channel beginning about 30 meters (100 feet) south of the AOC boundary, which may represent a transport pathway for contaminants, was sampled at its confluence with Hinkley Creek about 122 meters (400 feet) south of the AOC. In addition, a slight topographic low area east of the AOC collects runoff from the eastern half of DA1 outside of the berm and portions of NTA; therefore, this area was targeted for biased sampling. Station HC-2 was sampled to provide current data on potential impacts to sediment at the facility exit point for Hinkley Creek. A station along Hinkley Creek upstream of both DA1 and NTA was sampled to provide data on ambient (background) conditions.

Surface Water. Co-located surface water samples were planned along with sediment samples at the low-lying area east of the unit, the tributary to Hinkley Creek draining the area south of DA1, station HC-2, and the Hinkley Creek ambient station to characterize surface water quality. Due to dry conditions, no sample could be collected in the low-lying area east of DA1.

Groundwater. Source area (soil) contamination was confirmed as a result of the 1996 relative risk site evaluation; however, groundwater characterization was limited in the Phase I RI until more source area data were collected. In addition, potential site-related contaminants (SRCs) based on operations history (e.g., inorganics, explosives, and propellants) are readily attenuated or have low mobility in groundwater. Therefore, only one groundwater screening sample was planned from a piezometer installed in a soil boring south of the berm (station DA1-027). This screening sample provided a general indication of whether leaching of soil contaminants has occurred at the AOC. The potential for leaching to groundwater is also evaluated based on the newly acquired source area data. An ongoing interim removal action (IRA) was initiated at DA1 in October 2000. The IRA was undertaken to address potential safety hazards related to ordnance and explosives (OE). In addition, chemical contamination from residual explosives is being addressed concurrently using preliminary data from this Phase I RI, in part, as well as confirmation samples as excavation progresses. Soil excavation is being conducted in a series of 16 grids to a depth of 4 feet for OE removal. Additional excavation is performed in areas where detectable concentrations of explosives are encountered at a depth of 4 feet.

AVAILABLE DATA

The environmental database for the DA1 Phase I RI includes only data obtained from the field activities conducted in 1999. Historical data did not have sufficient quality documentation for use in this Phase I RI. The data collected under this Phase I RI include

- 42 surface soil samples,
- 77 subsurface soil samples,
- 4 sediment samples,
- 3 surface water samples, and
- 1 groundwater sample.

DISTRIBUTION AND OCCURRENCE OF CONTAMINATION

The RI evaluated the occurrence and distribution of contamination in five media: surface soil [from 0 to 0.3 meter (0 to 1 foot) bgs]; subsurface soil [from 0.3 to 1 meter (1 to 3 feet), 1 to 1.6 meters (3 to 5 feet), and 2 to 2.6 meters (6 to 8 feet)]; sediment; surface water; and groundwater. The results of this evaluation are summarized by medium.

Surface Soil

- Low levels of explosives and propellants in surface soil are limited in extent to (1) the northern portion of the former OB/OD area, (2) scattered locations on top of the berm, and (3) scattered locations in the western and southern portions of the plane storage area outside of the berm. The highest concentrations of explosives and propellants are clustered along the south drainage ditch, indicating prior migration and deposition via surface water runoff across the AOC.

- The highest concentrations of metals occur in the western half of the AOC in the plane storage area outside of the berm, primarily at a cluster of stations including DA1-023 through DA1-029 and DA1-042. The observed distribution roughly corresponds to a number of observed bare soil areas containing OE debris in the western and southern portions of the plane storage area. Lower concentrations of inorganics occur on top of the berm, and most detected concentrations inside the berm area are less than two times the background criteria.

- Barium, copper, mercury, and zinc exceeded their background criteria in 45 percent or more of the sample population and are considered to be the principal inorganic SRCs.

- Five surface soil samples were analyzed for semivolatile organic compounds (SVOCs), volatile organic compounds (VOCs), and polychlorinated biphenyls (PCBs). Trace levels of three SVOCs and two VOCs were detected in surface soil. One SVOC was identified as a chemical of potential concern (COPC) by default because no risk screening criteria exist for comparison. PCBs were not detected. Based on these limited Phase I RI data, little impact to surface soil related to these classes of compounds is apparent.

Subsurface Soil

- A low concentration of 2,4,6-TNT was detected only at station DA1-040 in the south drainage ditch, which had the highest concentrations of explosives and propellants in surface soil. No other explosives or propellants were detected in subsurface soil, indicating that impacts related to this class of compounds are limited to the surface interval.

- Aluminum, arsenic, barium, cobalt, copper, lead, manganese, nickel, vanadium, and zinc rarely exceeded their background criteria in subsurface soil samples. Almost all exceedances of background values for inorganics occur in the western half of the AOC, corresponding to the observed distribution in surface soil. On this basis, a majority of inorganic contamination above background values is restricted to surface soil, except at a few points (i.e., “hot spots”).

- Six subsurface soil samples were analyzed for SVOCs and VOCs; five subsurface soil samples were analyzed for PCBs. Trace levels of one SVOC and five VOCs were detected in subsurface soil. None of the constituents were identified as COPCs, and PCBs were not detected. The Phase I RI data do not demonstrate widespread impact to subsurface soil related to these classes of compounds based on the limited data.

Sediment

- Based on the distribution of lead concentrations above the background criterion, the low-lying area east of DA1 is the only area where data suggest potential transport of contamination from DA1 and accumulation within sediment.

Surface Water

- Zinc concentrations above background were observed at station DA1-045 in Hinkley Creek closest to the AOC to the south.

- The explosive RDX was detected once at the facility exit point (HC-2) at an estimated concentration (0.24 µg/L) of less than the detection limit.

Groundwater

Trace levels of 1,3-dinitrobenzene (1,3-DNB), acetone, and carbon disulfide were observed in the groundwater screening sample collected from station DA1-027. Neither 1,3-DNB nor carbon disulfide was detected in any other media at DA1 or NTA. Acetone, although detected at trace levels, is not suspected to be site-related. Copper concentrations in the unfiltered sample were slightly in excess of its background criterion; however, the concentration in filtered groundwater was less than background. Based on these screening data, no clear evidence exists that leaching to groundwater has occurred at station DA1-027. These limited data do not necessarily represent conditions in other portions of the AOC.

HUMAN HEALTH RISK EVALUATION

A screening-level human health risk evaluation was performed using conservative assumptions and screening criteria for each of the four media sampled. The selection of COPCs is based on comparisons of maximum contaminant concentrations to the screening criteria. Screening criteria do not exist for every constituent; where no criterion is available, the constituent is retained as a COPC. Results from the screening groundwater sample collected from the piezometer at station DA1-027 were not screened in the risk evaluation because these data were not collected from a monitoring well of standard construction specifications. The following points summarize the results of the risk evaluation presented in Chapter 5.0.

Surface Soil

- The explosive 2,4,6-TNT, aluminum, arsenic, cadmium, chromium, lead, and manganese were detected at levels above both their respective residential and industrial screening values. All of these constituents exceeded their respective residential screening values by one order of magnitude or more and are retained as COPCs.

- The COPCs 2,4-DNT, antimony, barium, copper, and zinc were detected above their residential screening levels but below their industrial screening levels.

- Although frequently detected, mercury did not exceed its risk-based criterion and was not retained as a COPC.

- The greatest number and magnitude of exceedances of residential screening criteria occurred in the western and southern portions of the plane storage area.

- Nitrocellulose, detected three times with a maximum concentration of 175 mg/kg at station DA1-040, is retained as a COPC in absence of a screening criterion for comparison.

- The explosive 2,4-DNT and six metals (antimony, arsenic, barium, cadmium, chromium, and zinc), identified as COPCs, exceed their respective migration to groundwater screening criteria [dilution attenuation factor (DAF) = 1].

Subsurface Soil

- Aluminum, arsenic, cadmium, chromium, and lead occurred at levels above both their respective residential and industrial screening values and are retained as COPCs. Aluminum and lead were detected within one order of magnitude of their residential screening values, while the other three metals are detected at levels greater than one order of magnitude above their respective residential screening values.

- Two COPCs—copper and zinc—were both detected above their residential screening levels but below their industrial screening levels.

- Exceedances of residential screening criteria were limited to only 7 of 42 soil sampling stations, 5 of which were located within the former OB/OD area and on top of the berm.

- Screening of subsurface soil data against migration to groundwater screening criteria (DAF = 1) shows that arsenic, cadmium, and chromium levels exceed their respective criteria.

Sediment

- Aluminum and chromium are identified as sediment COPCs. The residential and industrial screening values for both constituents are less than background criteria; however, both were detected at levels just above background. The maximum detected chromium value was from the ambient station in Hinkley Creek. The maximum detected aluminum value was from the low-lying wet area east of the AOC.

Surface Water

- The explosive RDX, bis(2-ethylhexyl)phthalate, and chloroform are identified as surface water COPCs. The maximum detected values for both bis(2-ethylhexyl)phthalate and chloroform occurred at the ambient station in Hinkley Creek. The explosive RDX was detected once at the facility exit point (HC-2) at an estimated concentration (0.24 µg/L) of less than the detection limit.

SCREENING ECOLOGICAL RISK EVALUATION

The screening level ecological risk evaluation was performed using conservative assumptions to estimate risk in surface water and sediment. Suitable ecological screening criteria do not exist for soil. Maximum concentrations of constituents were compared to the ecological screening criteria. The following points summarize the results of the ecological risk evaluation presented in Chapter 5.0.

Sediment

- Maximum detected values for lead and nickel slightly exceeded their ecological sediment screening values. PCB-1260 (one detected value less than reporting limits) is identified also as a sediment ecological COPC. Aluminum and magnesium are retained as sediment ecological COPCs in absence of available screening values for comparison.

Surface Water

- Zinc (one detection above background) and bis(2-ethylhexyl)phthalate (maximum detection at the ambient station in Hinkley Creek) exceeded their respective ecological screening criteria.

- The explosive RDX [one detection at station HC-2 (0.24 µg/L, less than detection limit)] and calcium are identified as surface water ecological COPCs because no screening values are available for these constituents.

SITE CONCEPTUAL MODEL

Information gathered during the Phase I RI was used to develop a site conceptual model (SCM) for DA1. The elements of the SCM include source term definition and contaminant release mechanisms, contaminant migration pathways and exit points, and uncertainties.

Source Areas and Release Mechanisms

The primary mechanisms for releases of contaminants from the source areas listed above include the past thermal destruction of waste munitions, explosives, and associated wastes and leaching of constituents from residual debris into site soil. Explosives, propellants, and inorganics are present in soil primarily in the western and southern portions of the plane storage area. The majority of contamination is restricted to the surface soil interval, which is less than 0.3 meter (1 foot) deep. The observed distribution of soil contamination in these areas is spotty and generally associated with bare soil areas and the south ditch draining the former OB/OD area. Contamination was also observed in the northern portion of the former OB/OD area, but to a lesser degree than in the plane storage area and south ditch. Based on the Phase I RI data, surface soil within the areas noted above is considered to be a residual or secondary source of contamination. Current data show that soil in the eastern portion of the AOC does not appear to have been significantly contaminated and therefore is not a significant secondary source.

Contaminant Migration Pathways and Exit Points

Migration of contaminants from secondary soil sources to surface water conveyances occurs primarily by (1) mobilization of particle-bound contaminants in surface water runoff and (2) transport of dissolved phase constituents in surface water. Upon reaching surface water conveyances or a low-lying accumulation area, flow velocities decrease, and particle-bound contaminants largely settle out as sediment accumulation. Sediment-bound contaminants may be remobilized (resuspensed) during storm events or may partition to surface water and be transported in the dissolved phase.

Some contaminants exceed conservative soil leaching screening criteria for both surface and subsurface soil. However, concentrations of contaminants decreased significantly by depths of 0.9 meter (3 feet) in subsurface soil. For example, only seven metals were identified as subsurface soil COPCs, and these occurred only at 7 of 42 soil sampling stations. These observations suggest that leaching processes are of less importance than erosional processes for the migration of contaminants.

The primary contaminant exit pathway identified at DA1 is the south ditch, which is fed by a small culvert that drains the former OB/OD area and runs beneath the berm. Sampling data show that surface water runoff within the former OB/OD area entrains contaminants, which flow through the culvert where they are subsequently deposited along the ditch line. The only other accumulation area or conveyance for storm runoff is to the east of the AOC. Phase I RI data, however, do not show significant accumulation of contaminants in this area. The Phase I data do not demonstrate any substantial impacts to Hinkley Creek due to DA1 operations.

Uncertainties

The SCM is developed based on available site characterization and chemical data. Uncertainties are inherent in the SCM where selected data do not exist or are sparse. The uncertainties within the SCM for DA1 include the following.

- Contaminant migration from source areas to groundwater via leaching or surface water infiltration is an unknown element of the conceptual model at present. A number of contaminants identified as COPCs also exceeded conservative soil leaching screening criteria; however, the observed vertical distribution of soil contamination did not indicate significant leaching from surface soil to subsurface soil.

CONCLUSIONS

The Phase I RI at DA1 identified site-related contamination in soil at DA1. These contaminants—exclusively explosives and metals—were subjected to a preliminary risk evaluation to determine whether further action or investigation is warranted. Screening of chemical data for soil against risk-based criteria shows the presence of human health COPCs. Constituents identified as human health or ecological COPCs in surface water and sediment in Hinkley Creek do not conclusively reflect contamination related to DA1.

Surface Soil

- 2,4,6-TNT; 2,4-DNT; aluminum; antimony; arsenic; barium; cadmium; chromium; copper; lead; manganese; and zinc were identified as surface soil COPCs.

- The south ditch and “hot spots” in the western and southern portions of the plane storage area represent the principal locations having contamination above background levels and human health risk screening criteria. The highest concentrations of explosives and propellants are clustered along the south drainage ditch, indicating contaminant migration via surface water runoff across the AOC and deposition along the ditch. The highest metals concentrations are clustered at sample stations in the western and southern portions of the plane storage area and are frequently in association with bare soil areas containing debris.

- Mercury, although persistently detected in surface soil, did not exceed its risk-based criterion and was not identified as a COPC.

- Limited Phase I RI analyses for SVOCs and VOCs indicate they are not COPCs in surface soil.

Subsurface Soil

- Aluminum, arsenic, cadmium, chromium, copper, lead, and zinc were identified as COPCs in subsurface soil. Exceedances above background and risk-based screening levels occur at comparatively few stations relative to surface soil, and concentrations in general are substantially lower in subsurface soil than in surface soil.

- Limited Phase I RI analyses for explosives, SVOCs, and VOCs indicate they are not COPCs in subsurface soil.

Sediment and Surface Water

- Aluminum and chromium were the only constituents identified as human health COPCs in sediment. The maximum detected value for aluminum (14,400 mg/kg) slightly exceeds its background criterion (13,900 mg/kg). The only chromium result greater than both background and risk-based criteria occurred at station DA1-046 at HC-2. All other results, while exceeding risk-based criteria, were less than background values.

- Aluminum and magnesium were identified as ecological COPCs for sediment in the absence of screening criteria. Lead and nickel exceeded ecological screening criteria only at stations DA1-044 and DA1-046 at HC-2, respectively. PCB-1260 (detected only at station DA1-044) was also retained as an ecological COPC.

- RDX, bis(2-ethylhexyl)phthalate, and chloroform were identified as human health COPCs for surface water. RDX exceeded risk-based screening criteria only at station DA1-046 (HC-2; facility exit point). The remaining two compounds exceeded their risk-based screening criteria at station DA1-043 upstream of DA1 and NTA.

- Zinc, bis(2-ethylhexyl)phthalate, and RDX were identified as ecological COPCs for surface water on the basis of available screening values. Zinc exceeded its ecological risk-based criteria only at station DA1-045. As noted above, the two organic constituents are unrelated to DA1. Calcium was identified as an ecological COPC in absence of a screening criteria; this constituent exceeded background at all three surface water stations and is not an SRC.

- The data collected during the Phase I RI do not demonstrate that sediment and surface water in Hinkley Creek have been significantly contaminated as a result of former operations at DA1.

Groundwater

- Based on the available limited screening data, leaching of contaminants from soil to shallow groundwater in the vicinity of station DA1-027 has not occurred. These data from DA1-027 do not necessarily represent conditions in other portions of the AOC.

RECOMMENDATIONS

Based on the human health and ecological screening risk evaluations, COPCs were identified for soil, sediment, and surface water. Based on the occurrence of COPCs (in particular, for soil) site conditions do not support a “no further action” decision. Additional characterization, a baseline human health risk assessment, and a screening ecological risk assessment (ERA) are recommended under the auspices of a combined DA1/NTA Phase II RI. Any future risk assessment must take into consideration the interim removal action for soil. Specific recommendations include

- The ongoing IRA for OE contamination will address, in part, the inorganic contamination identified above as the risk screening levels in the Phase I RI. Therefore, it is recommended that additional characterization of soil in the vicinity of DA1 be accomplished in the context of a combined DA1/NTA soil exposure unit.

- Human health and ecological COPCs were identified for sediment and surface water collected during the Phase I RI; however, no definitive evidence exists correlating the COPCs identified in the Hinkley Creek main stem to DA1. Subsequent investigation of DA1 is recommended in the context of a combined DA1/NTA exposure unit for surface water and sediment in streams and ditches within the AOC and downstream to the confluence with Hinkley Creek. Confirmation of the presence of constituents above background criteria at HC-2 and within the Hinkley Creek main stem will be addressed under a separate investigation.

- As noted in DQOs presented in the Phase I RI SAP Addendum, collection of site-specific hydrogeologic data is indicated because soil constituents exceeded generic migration to groundwater criteria. Collection of these data is recommended in the context of a combined DAl/NTA groundwater exposure unit. Based on the observed vertical distribution of soil contaminants and high likelihood of attenuation within the vadose zone, the scope of these efforts should be limited in extent and target only shallow groundwater in the unconsolidated zone immediately downgradient of and within the principal source areas. Deeper groundwater may be evaluated if shallow groundwater is found to be contaminated.

- Upon collection of groundwater characterization data, chemical fate and transport modeling and finalization of the SCM are recommended as necessary to identify contaminant migration potential within this medium and to facilitate the decision-making process for any necessary remedial actions.

- A screening ecological risk assessment is recommended to address soil, sediment, and surface water media considering that sufficient quantity and quality of habitat are present for the combined DA1/NTA exposure units. Sediment and surface water data will be grouped inside the combined AOC to the confluence with Hinkley Creek. The screening ERA, using hazard quotients for specific receptors, will be preceded by a pre-screen using ecological screening values. Thus, a tiered approach will be followed.

- A baseline human health risk assessment is recommended to address soil, surface water, and sediment media and, if warranted, based on additional characterization, a groundwater exposure unit for the combined AOC. Dry sediment located in the low-lying area immediately east of DA1 should be addressed in the same manner as the soil exposure pathways.

1.0 INTRODUCTION

This report documents the results of the Phase I Remedial Investigation (RI) at Demolition Area 1 (DA1) at the Ravenna Army Ammunition Plant, (RVAAP), Ravenna, Ohio (Figures 1-1 and 1-2). The Phase I RI was conducted for the U.S. Army Operations Support Command (OSC) under the U.S. Department of Defense (DoD) Installation Restoration Program (IRP) by Science Applications International Corporation (SAIC) and its subcontractors, under contract number DACA62-94-D-0029, Delivery Order No. 0076, with the U.S. Army Corps of Engineers (USACE), Louisville 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 (Ohio EPA).

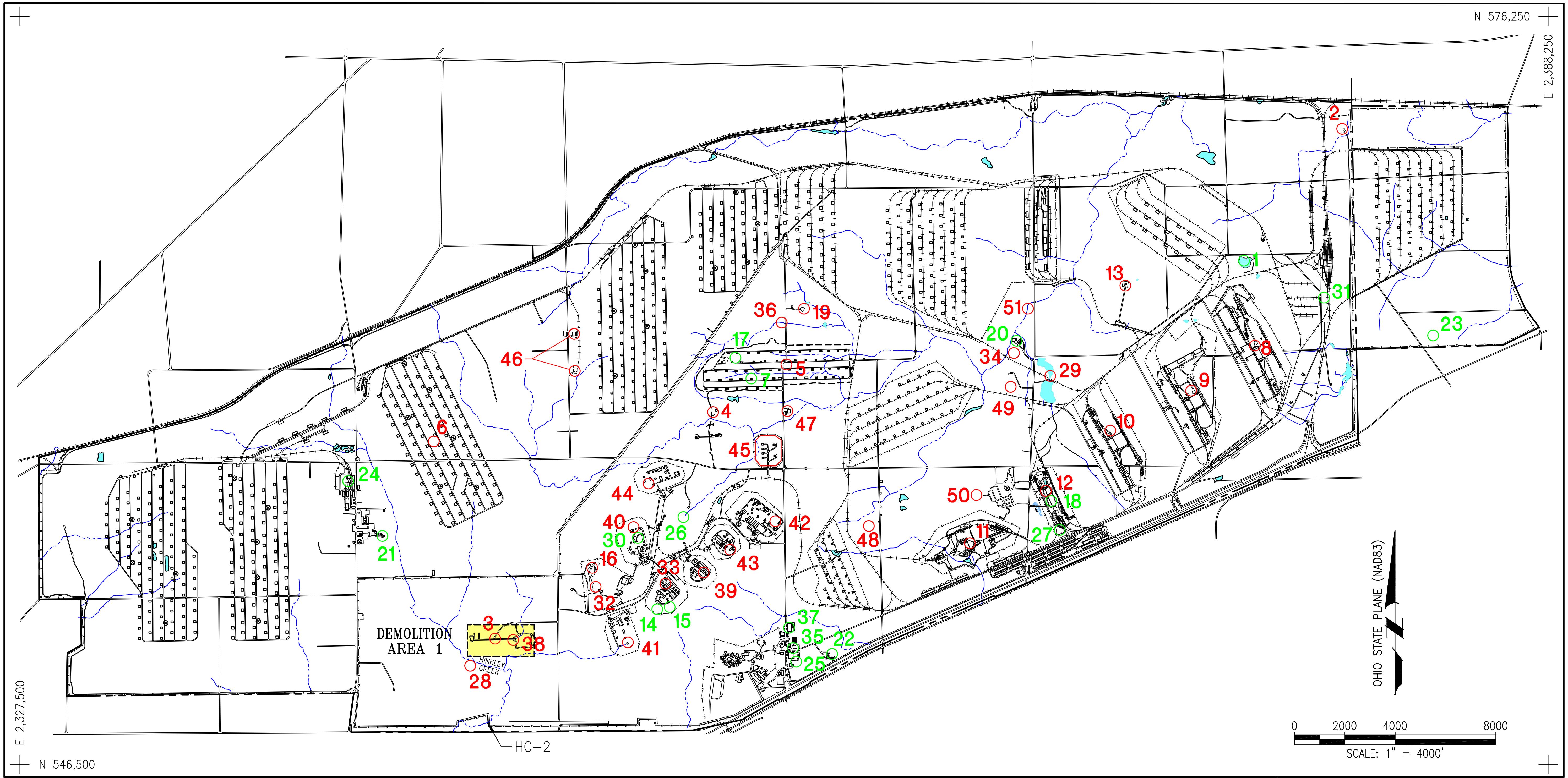
This document summarizes the results of the Phase I RI field activities conducted during October and November 1999 at DA1. The field program, environmental setting, distribution, and occurrence of contamination are discussed. Human health and ecological screening risk evaluations were performed as part of the Phase I RI. Results of the contaminant occurrence and distribution and risk evaluations were used to develop a site conceptual model (SCM) for DA1 that summarizes the results of the investigation, presents conclusions, and forms the framework for decisions regarding future IRP actions at DA1.

1.1 PURPOSE AND SCOPE

Figure 1-3 presents the approach to implementing the CERCLA process under the guidance of the IRP. Priorities for environmental investigation and possible restoration at Areas of Concern (AOCs) at RVAAP are based on their relative potential threat to human health and the environment as derived from Relative Risk Site Evaluations (RRSEs) conducted by the U.S. Army. Thirty-eight AOCs were originally identified at RVAAP in the *Preliminary Assessment for the Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 1996a). Thirteen new AOCs were identified in 1998 as a result of additional records searches and site walkovers. The AOCs were ranked by the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) and entered into an OSC database. Those AOCs ranked as high-priority sites (i.e., those with high RRSE scores) are targeted first for Phase I RIs. DA1 is a high-priority site. Medium- and low-priority sites will be characterized in Phase I RIs following completion of the RIs for high-priority AOCs. Investigations and remedial actions under the CERCLA process are implemented at the AOCs in order of priority as funding is available or as other priorities surface, such as land use needs.

The objective of a Phase I RI for any AOC at RVAAP is to determine whether environmental contamination is present in all relevant media, to identify source areas, and to evaluate the general distribution and occurrence of contaminants sufficient to support a preliminary risk evaluation. The evaluation of risk determines whether a more specific investigation of the AOC (Phase II RI) is warranted. The purpose of the Phase II RI is to determine the nature and extent of contamination so that quantitative human health and ecological risk assessments (ERAs) can be performed. Depending upon the outcome of the risk assessments, an AOC will either require no further action or will be the subject of a Feasibility Study (FS) to evaluate potential remedies and future actions.

Figure 1-1. General Location and Orientation of RVAAP



LEGEND OF SITES:

1	RAMSDELL QUARRY LANDFILL
2	ERIE BURNING GROUNDS
3	**DEMOLITION AREA 1**
4	DEMOLITION 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 GROUNDS
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
37	PESTICIDE STORAGE BUILDING T-4452
38	NACA TEST AREA
39	LOAD LINE 5 / FUZE LINE 1
40	LOAD LINE 7 / BOOSTER LINE 1
41	LOAD LINE 8 / BOOSTER LINE 2
42	LOAD LINE 9 / DETONATOR LINE
43	LOAD LINE 10 / PERCUSSION ELEMENT
44	LOAD LINE 11 / ARTILLERY PRIMER
45	WET STORAGE AREA
46	BUILDINGS F-15 AND F-16
47	BUILDING T-5301 DECONTAMINATION
48	ANCHOR TEST AREA
49	CENTRAL BURN PITS
50	ATLAS SCRAP YARD
51	DUMP ALONG PARIS-WINDHAM ROAD
○ XX	CERCLA
○ XX	RCRA
○ XX	OTHER REGULATORY

US Army Corps
of Engineers
Louisville District

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

RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
FACILITY MAP

DRAWN BY:	REV. NO./DATE:	CAD FILE:
R. BEELER	REV. B / 05-18-01	/99039/DWGS/J14RVAP1

Figure 1-2. RVAAP Installation Map

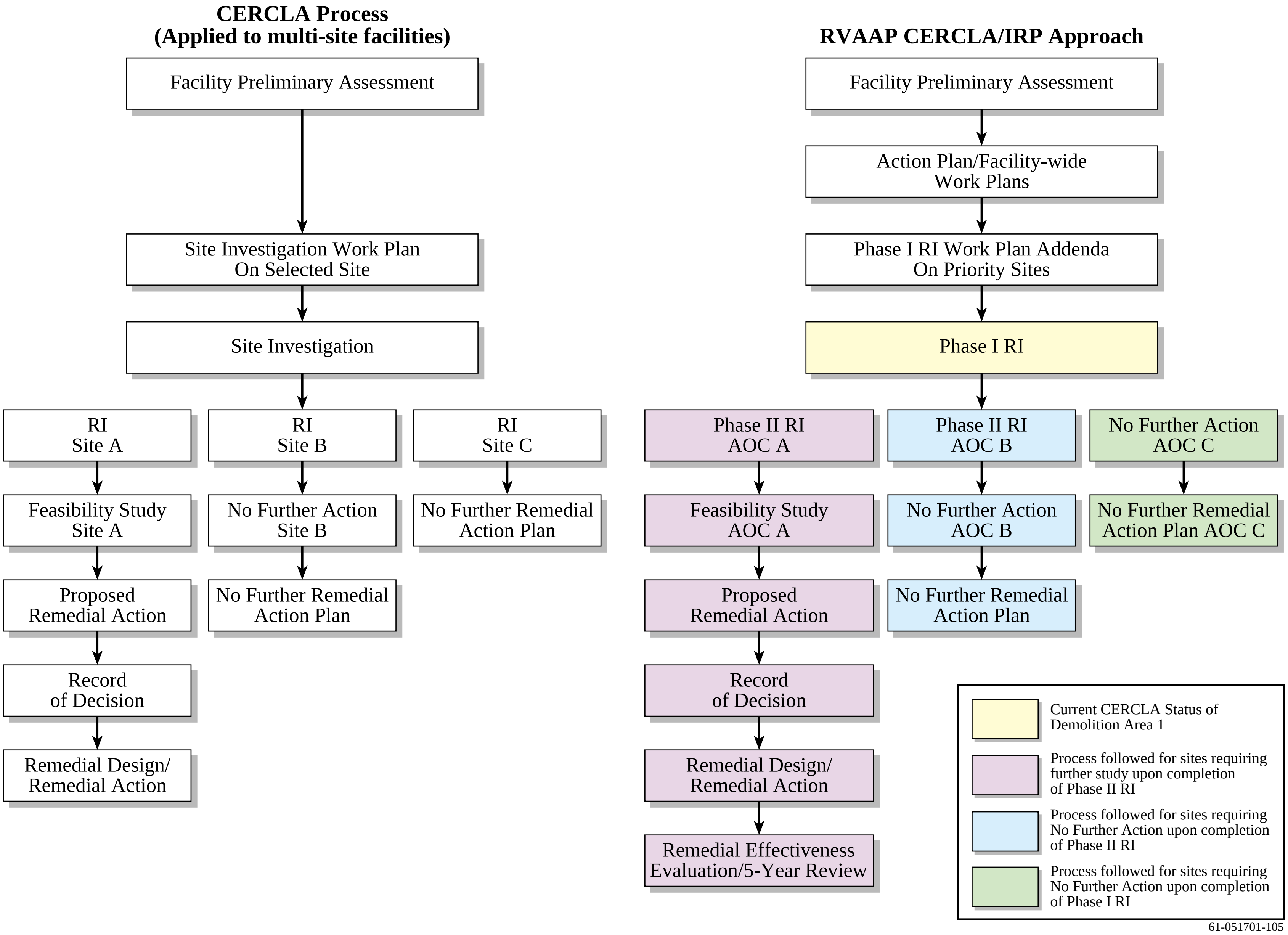


Figure 1-3. CERCLA Approach at RVAAP

Under the RVAAP CERCLA process, the primary project objectives for the Phase I RI of DA1 are as follows.

- determine the potential types and sources of contamination using historical process information and previous sampling data;

- identify whether releases of contamination beyond the AOC boundary are occurring by collecting environmental samples (surface water and sediment) downstream of the AOC boundary within exit conveyances;

- perform a screening risk evaluation to determine if additional investigation is warranted; human health and ecological risk screening will be used to determine the potential magnitude of risk associated with any contamination detected; and

- provide preliminary recommendations for any additional investigations and/or actions.

To meet the primary project objectives, investigation-specific data quality objectives (DQOs) were developed using the approach presented in the *Facility-wide Sampling and Analysis Plan for the Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 1996b), hereafter referred to as the Facility-wide Sampling and Analysis Plan (SAP). The DQOs specific to the DA1 Phase I RI are discussed in Section 1.3.4. In addition, data collected during the concurrent Phase I RI at the National Advisory Committee on Aeronautics (NACA) Test Area, which surrounds DA1, will be used as needed to achieve the primary project objectives.

The investigation approach to the Phase I RI at DA1 involved a combination of field and laboratory activities to characterize the AOC. Field investigation techniques included soil boring and sampling as well as sampling of surface water and sediment. Geoprobe techniques were employed to obtain one groundwater screening sample for qualitative evaluation of groundwater quality conditions. The field program was conducted in accordance with the Facility-wide SAP and the *SAP Addendum No. 1 for the Phase I Remedial Investigation of Demolition Area 1 at the Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 1999a).

1.2 GENERAL FACILITY DESCRIPTION

1.2.1 Historical Mission and Current Status

RVAAP is a government-owned, contractor-operated OSC facility. RVAAP is located in northeastern Ohio within Portage and Trumbull counties, approximately 4.8 kilometers (3 miles) east–northeast of the town of Ravenna and approximately 1.6 kilometers (1 mile) northwest of the town of Newton Falls. The installation consists of 8,668.3 hectares (21,419 acres) contained in a 17.7-kilometer- (11-mile)-long, 5.6 kilometer- (3.5 mile)-wide tract bounded by State Route 5, the Michael J. Kirwan Reservoir, and the CSX System Railroad on the south; Garrettsville and Berry roads on the west; and the CONRAIL Railroad on the north (see Figures 1-1 and 1-2). The installation is surrounded by several more populous communities: Windham on the north; Garrettsville, which is 9.6 kilometers (6 miles) to the northwest; Newton Falls, which is 1.6 kilometers (1 mile) to the east; Charlestown to the southwest; and Wayland, which is 4.8 kilometers (3 miles) southeast.

Industrial operations at RVAAP consisted of 12 munitions assembly facilities referred to as "load lines." Load Lines 1 through 4 were used to melt and load trinitrotoluene (TNT) and Composition B into large-caliber shells and bombs. The operations on the load lines produced explosive dust, spills, and vapors that collected on the floors and walls of each building. Periodically the floors and walls would be cleaned with water and steam. The liquid, containing TNT and Composition B, was known as “pink water” for its characteristic color. Pink water was collected in concrete holding tanks, filtered, and pumped into unlined ditches for transport to earthen settling ponds. Load Lines 5 through 11 were used to manufacture fuzes, primers, and boosters. Potential contaminants in these load lines include lead compounds, mercury compounds, and explosives. Load Line 12 was used to produce ammonium nitrate for explosives and fertilizers prior to its use as a weapons demilitarization facility.

RVAAP had several areas used for the burning, demolition, and testing of munitions. These burning grounds consist of large parcels of open land or abandoned quarries. Potential contaminants at these AOCs include explosives, propellants, metals, waste oils, and sanitary waste.

RVAAP has been inactive since 1992. The only activities still being carried out from the wartime era are the storage of bulk explosives and the infrequent demolition of unexploded ordnance found at the installation. The Army is also overseeing the reclamation of railroad track, telephone line, and steel for reuse or recycling. The Army has begun the demolition of excess buildings at Load Lines 1 and 2, which includes the removal of friable asbestos. Building demolition has been completed at Load Lines 1 and 12.

1.2.2 Demography and Land Use

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

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

Until May 1999, about 1,010 hectares (2,497 acres) of land and some existing facilities at RVAAP were used by the National Guard Bureau for training purposes administered by the Ohio Army National Guard (OHARNG). Training and related activities include field operations and bivouac training, convoy training, equipment maintenance, and storage of heavy equipment. In May 1999, about 6,544 hectares (16,164 acres) of land at RVAAP were transferred from the Army OSC to the National Guard Bureau for expanded training missions. The OHARNG is currently preparing a comprehensive Environmental Assessment and an Integrated Natural Resources Management Plan, which will address future uses of the property. These uses include two live-fire rifle ranges, hand grenade practice and qualification ranges, a light demolition range, and two armored vehicle maneuver areas. Additional field support and cantonment facilities will be constructed to support future training. The Ohio Air National Guard and the U.S. Air Force Reserve plan to partner with the OHARNG to construct a 1,219-meter (4,000-foot) unpaved tactical runway. Currently, property within the NACA Test Area (NTA) surrounding DA1 is used by the OHARNG for bivouac training.

1.3 DEMOLITION AREA 1 SITE DESCRIPTION

A detailed history of process operations and waste processes for the original 38 identified AOCs at RVAAP, including DA1, is presented in the Preliminary Assessment for RVAAP (USACE 1996a). The following is a summary of the history and related contaminants for DA1.

1.3.1 Operational History

DA1, designated as AOC RVAAP-03, covers approximately 0.6 hectare (1.5 acres) in the southwestern quadrant of the facility and is surrounded by NTA (AOC number RVAAP-38; see Figure 1-2). DA1 is immediately south of the NTA runway (Figure 1-4). The site was used to conduct open burning of explosives and related materials from 1941 to 1949. Treated materials included bulk, obsolete, and off-specification explosives. Aerial photos of the site from the 1940s and 1950s depict an oval open burning/open detonation (OB/OD) area surrounded by an earthen berm, which is approximately 7.6-meters (25-feet) wide across the top, immediately south of the NTA runway opposite the access road. The top of the berm currently is approximately 1-foot high and appears to have been an extension of Demolition Road. The AOC occupies an open, gently sloping parcel of land that is bounded to the south, east, and west by tree cover.

Following, and possibly concurrent with, its use as a demolition area, DA1 was used to stage aircraft that were employed during NTA operations. NTA was constructed and used between 1947 and 1953. Aerial photographs of DA1 from 1952 show two aircraft parked atop the earthen berm in the southwestern corner of the site and another less than 30.5 meters (100 feet) east of the berm. Some equipment used for NTA operations may have been stored at DA1 for extended periods of time. It is not known whether releases of hydraulic fluids, antifreezes, or fuels from the aircraft occurred during the time that planes were stored at DA1. Such releases, if they occurred, may have contributed contaminants to the soil.

Currently, the earthen berm surrounding the former thermal treatment area is from approximately 0.3 to 0.4 meter (1 to 1.5 feet). Around the perimeter of the berm are areas of bare ground that measure from 30.5- to 46-meters (100- to 150-feet) square. A low area immediately east of the berm collects runoff during rainfall events. Shrapnel, fuzes, booster cups, and other debris are visible on the bare soil surface outside the berm. The occurrence of these materials on the ground surface outside the thermal demolition area suggests that kickouts and shrapnel were generated during thermal destruction of ammunition. In addition, historical operations have indicated that, when congested with debris, burning areas were cleared using heavy equipment by pushing the debris to the periphery of the area. This activity may have contributed to the spread of contaminants.

Areas adjoining DA1 have been used since 1969 for dismounted troop training, bivouac, and vehicle parking by the OHARNG (AGOH 1997). The following restrictions apply to training activities at NTA: (1) parking and vehicle traffic is limited to the former NTA concrete runway and established trails, (2) digging of soil is prohibited, (3) disposal of trash is prohibited other than in designated above-ground receptacles, and (4) disposal of gray water is prohibited. Fires and the firing of live ammunition are prohibited. Firing of blank ammunition of 7.62 mm and smaller is permitted within the training area as approved by the Training Site Commander.

Primary sources of contamination at DA1 are residues from the open burning of explosives, such as TNT, hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), dinitrotoluene (DNT), and associated metals (e.g., cadmium, chromium, lead, and mercury). Munitions fragments (scrap metal, small arms primers, and fuzes) and areas of bare soil exist outside of the bermed area (USACHPPM 1996; USAEHA 1994). In addition, slag is present at the site as fill around the berm and adjacent NTA runway. This aluminum-rich slag—the use of which was widespread throughout RVAAP—may account for some elevated concentrations of metals (especially aluminum, barium, beryllium, and manganese). However, Ohio Administrative Code (OAC) 3745-27-01(B)40 specifically exempts slag as a solid waste (Ohio EPA 2000).

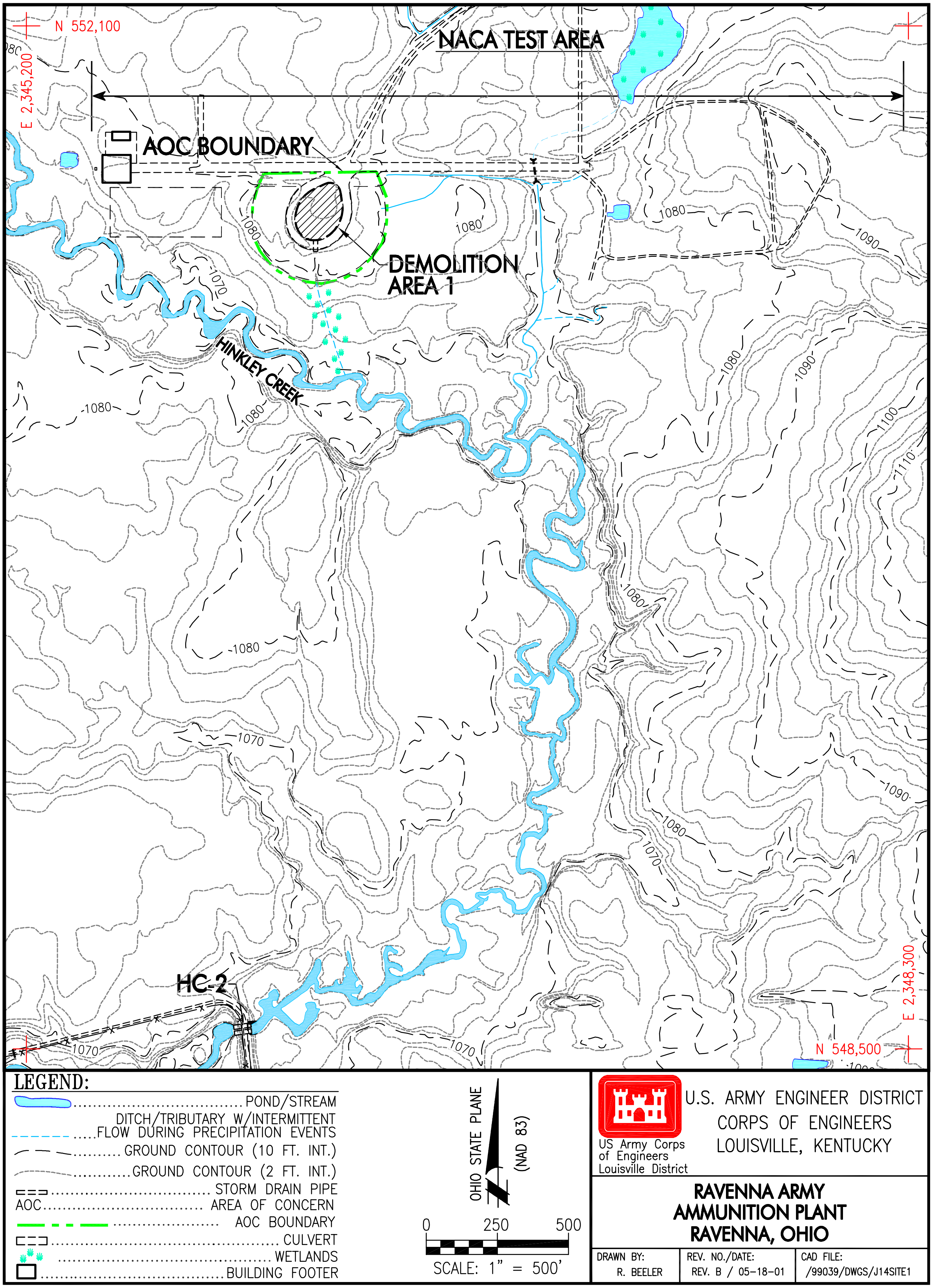


Figure 1-4. Demolition Area 1 Site Map

1.3.2 Regulatory Status

DA1 is currently considered a high-priority AOC for remedial investigation and possible cleanup. The priority is based upon preliminary evidence of soil contamination discovered in the RRSE (USACHPPM 1996), as described in Section 1.3.3 below, and use of the surrounding areas for OHARNG training. A Phase I RI, which is equivalent to a site investigation, will be conducted at all RVAAP AOCs. No other regulations [e.g., Resource Conservation and Recovery Act (RCRA), National Pollutant Discharge Elimination System (NPDES), etc.] pertain to past waste disposal and potential contamination at this AOC.

An ongoing interim removal action (IRA) was initiated at DA1 in October 2000 under the direct authority and supervision of the RVAAP IRP. The IRA was undertaken to address potential safety hazards related to ordnance and explosives (OE). In addition, chemical contamination from residual explosives is being addressed concurrently using preliminary data from this Phase I RI, in part, as well as confirmation samples as excavation progressed. Soil excavation is being conducted in a series of 16 grids to a depth of 4 feet for OE removal. Additional excavation is performed in areas where detectable concentrations of explosives are encountered at a depth of 4 feet.

1.3.3 Previous Investigations at Demolition Area 1

Table 1-1 presents a summary of the results from previous investigations performed at DA1. As originally discussed in the Phase I RI SAP Addendum for DA1 (USACE 1999a), two previous investigations have been conducted. These investigations include data from the Water Quality Surveillance Program (USATHAMA 1980–1992) and the RRSE (USACHPPM 1996). No groundwater sampling has been conducted in the past. Figure 1-5 illustrates the locations and media sampled during these investigations.

Table 1-1. Summary of Results of Previous Investigations Performed at Demolition Area 1

Parameter	HC-2 Water Quality Surveillance (water, µg/L)[a]	RRSE (soil, mg/kg)[b]
Arsenic	ND	9
Barium	ND	162
Cadmium	ND	41.1
Chromium	ND	33.8
Copper	11	13.3
Mercury	ND	0.26
Zinc	31	61.5
RDX	4.8	<0.82
2,4,6-Trinitrotoluene	ND	23,000

[a] *Source*: USATHAMA 1980–1992. Values are maximum detected concentrations. Detection limits varied overtime.
[b] *Source*: USACHPPM 1996. Values are maximum detected concentrations.
ND = Not detected.
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.

The Water Quality Surveillance Program collected samples at nine locations throughout RVAAP. The data most relevant to DA1 were collected from a large gauging station along Hinkley Creek downstream of the drainage area of DA1 and NTA at the southern RVAAP boundary (station HC-2; Figure 1-5). All surface water that exits DA1 intercepts Hinkley Creek and passes through station HC-2. However, the drainage from a large area in addition to DA1 is added to the flow system prior to exiting through this station. Copper, chromium, hexavalent chromium, lead, zinc, 2,4,6-TNT, and RDX were monitored annually in surface water between 1980 and 1992. Cadmium was added to the annual list of

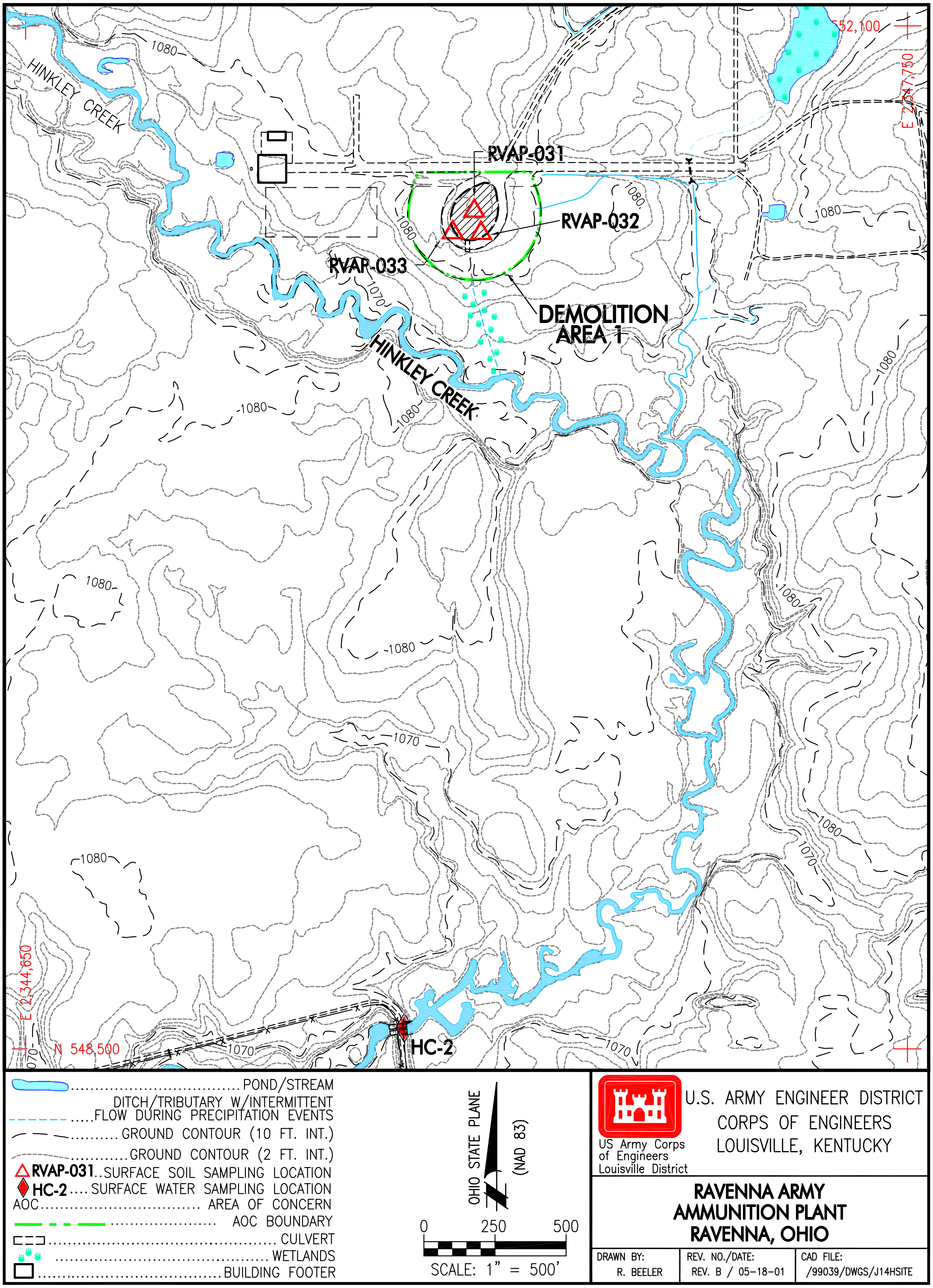


Figure 1-5. Historical Sampling Locations for Demolition Area 1

metal 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, nitrite, and phosphorus were analyzed semiannually. Samples collected from HC-2 during the period of sampling showed low concentrations of zinc, copper, and RDX on one occasion. Detection limits and analytical methods employed by this program changed over time. Therefore, results must be interpreted cautionally, particularly for older measurements.

Three surface soil samples were collected during the RRSE at DA1 (USACHPPM 1996). Two soil samples were collected from the treatment area inside the berm, and one sample was collected on top of the berm (Figure 1-5). The RRSE sampling was biased to areas of obvious contamination. The samples were analyzed for arsenic, barium, chromium, cadmium, copper, mercury, zinc, and 2,4,6-TNT. All seven metals and 2,4,6-TNT were detected. The maximum concentration of 2,4,6-TNT was 23,000 mg/kg from a location inside the berm. Of the detected metals, cadmium exceeded its RRSE standard criterion; in addition, 2,4,6-TNT exceeded its criterion. The contaminant hazard factor for DA1 was determined to be "moderate" because of these two constituents. Because no engineering or access controls were in place, exposure to potential human receptors was noted in the RRSE. On this basis, the overall relative risk attributed to surface soil was determined to be "medium."

Additionally, annual storm water sampling is conducted under an NPDES permit each fall at three facility outfalls, including HC-2 (Outfall 903). The samples are tested for toxicity to *Ceriodaphnia dubia* (water flea) larvae and *Pinephales promelas* (fathead minnow). In addition, samples for chemical analyses for the following constituents are collected: (1) total metals (arsenic, barium, cadmium, chromium, lead, selenium, silver, magnesium, mercury); (2) dissolved magnesium; (3) cyanide; (4) explosives; and (5) selected anions and nonspecific indicator parameters (pH, oil and grease, chemical oxygen demand, total nitrogen, total organic carbon, and total dissolved solids).

Results of the most recent annual sampling event (August 2000) at Outfall 903 show that stormwater toxicity endpoints all passed. No explosives were detected. The detected metals included arsenic (9.0 µg/L), barium (38 µg/L), chromium (6.8 µg/L), and magnesium (total results = 14,000 µg/L). Of these four detected metals, arsenic and magnesium exceeded their respective facility-wide background criteria (3.2 µg/L and 10,800 µg/L, respectively). Chromium was not detected in the facility-wide background data set; therefore, any detected values is considered to be above background.

1.3.4 Chemicals of Potential Concern

Based on available process knowledge and previous investigation results, the primary sources of contamination at DA1 include explosives and propellants residues (e.g., TNT, RDX, and nitrocellulose) and associated metals from the thermal treatment of munitions and explosives.

Operational data suggest that the anticipated primary chemicals of potential concern (COPCs) will include those shown in Table 1-2. These COPCs represent chemicals encountered in process wastes associated with open burning of explosives and explosive wastes. From the COPCs identified in this Phase I RI, a subset of chemicals of concern (COCs) may be developed from baseline human health and ERAs under a later RI phase.

1.3.5 Demolition Area 1 Phase I RI Data Quality Objectives

Process knowledge, historical records, and previous investigation results were used to design the Phase I RI effort using the DQO approach presented in the Facility-wide SAP. The DQOs were presented in

Table 1-2. Chemicals of Potential Concern at Demolition Area 1

Chemical Group	Chemical	Rationale
Explosives	TNT	Munitions explosive; previously detected
	DNT isomers	Munitions explosive
	RDX	Munitions explosive
	HMX	Munitions explosive
	Trinitrobenzene	Associated with explosives
	Dinitrobenzene	Associated with explosives
	Nitrobenzene	Associated with explosives
	Nitrotoluene	Associated with explosives
Propellants	Nitroglycerine	Associated with explosives
	Nitroguanidine	Associated with explosives
	Nitrocellulose	Associated with explosives
Metals[a]	Arsenic	Previously detected
	Aluminum	Munitions booster cups; common fuze casings are made of aluminum
	Barium	Previously detected
	Cadmium	Previously detected; plating of many small metallic munitions components and all metallic shipping components for rust prevention
	Chromium	Common to munitions processing; previously detected
	Copper	Previously detected; common munitions (propellant) casing are made of brass (69 percent copper, 30 percent zinc)
	Lead	Common to munitions processing, previously detected
	Manganese	Previously detected at other AOCs
	Mercury	Common to munitions processing; previously detected
	Selenium	Previously detected at other AOCs
	Silver	Common to munitions processing
	Zinc	Previously detected; common munitions (propellant) casing are made of brass (69 percent copper, 30 percent zinc)
VOCs	---	Associated with aircraft/industrial processes
SVOCs	---	Associated with open burning/aircraft
PCBs	---	Associated with industrial processes
Pesticides	---	Associated with industrial processes

[a] Most common projectile casings are made of steel (iron with minor carbon content).
AOC = Area of concern.
DNT = Dinitrotoluene.
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.
PCBs = Polychlorinated biphenyls.
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.
SVOCs = Semivolatile organic compounds.
VOCs = Volatile organic compounds.

detail in the Phase I RI SAP Addendum for DA1 (USACE 1999a). A summary of the DQOs is presented below for reference purposes in this report.

1.3.5.1 Source area soil

Previous soil sampling results indicated potential impacts related to explosives and metals. Soil within the bermed area was a specific focus of the Phase I RI to determine if residual contamination exists. Historical investigations also noted that munitions fragments were present on the ground surface on top of the berm and outside of the bermed enclosure. In addition, operational data show that aircraft were staged within and adjacent to the demolition area during operation of NTA. Based on these data, the former treatment area, the berm, and adjacent areas outside of the berm were targeted for sampling using a grid approach. Bare soil areas or locations having visible contamination (e.g., stained soil, OE) or debris were targeted using biased contingency samples.

1.3.5.2 Sediment

Low-lying areas were identified as the most likely sites from contaminant accumulation due to transport of eroded soil in storm runoff. Also, sediment may function as a transport mechanism because contaminants adsorbed to particulates can be mobilized by surface water flow. The AOC is slightly elevated relative to its immediate surroundings, and drainage is away from the site to the east, west, and south. Within the bermed enclosure, the land surface slopes very gently to the south. Runoff exits the bermed enclosure through a small culvert beneath the berm, which is located at the southern-most point of the berm (see Figure 1-4). Below the culvert, a small ditch conveys runoff to the south for a short distance until it simply dissipates to the ground surface. Sampling at the outlet of this culvert along the small ditch was performed to investigate any potential migration beyond the former treatment area. A tributary to Hinkley Creek begins about 30 meters (100 feet) south of the AOC boundary, which may represent a transport pathway for contaminants. Sediment from this tributary was sampled just upstream of its confluence with Hinkley Creek. In addition, a slight topographic low east of the AOC collects runoff from the eastern half of DA1 outside the berm and portions of NTA; therefore, this area was targeted for biased sampling. A biased sediment sample was also collected from Hinkley Creek about 122 meters (400 feet) due south of the AOC to determine if contaminant migration to this receptor has occurred. Sediment from station HC-2 was sampled to provide current data on potential impacts to sediment at the facility exit point for Hinkley Creek.

1.3.5.3 Surface water

Historical surface water sampling has not been performed at the tributaries and Hinkley Creek in the vicinity of DA1. As denoted above for sediment, the most likely points to observe surface water contamination are the small drainage ditch south of the unit, the low-lying area east of the unit, and the tributary to Hinkley Creek draining the area south of DA1. Co-located surface water samples were planned at all of the sediment stations noted above. Also, surface water was sampled at station HC-2 to provide current data on surface water quality downstream of DA1 and NTA.

1.3.5.4 Groundwater

Analytical evidence for source area (soil) contamination was obtained during the RRSE. However, potential site-related contaminants (SRCs) based on operations history (e.g., inorganics, explosives, and propellants) are readily attenuated or have low mobility in groundwater. Therefore, investigation of potential impacts to groundwater was limited in the Phase I RI until more source area data were collected. One groundwater screening sample from a deep soil boring south of the berm was identified to provide a general indication of whether leaching of soil contaminants has occurred at the AOC. The potential for leaching to groundwater is also evaluated in this Phase I RI report using conservative soil leaching screening criteria from the U.S. Environmental Protection Agency (EPA) (see Chapter 5.0).

1.3.6 Report Organization

This Phase I RI report is organized to meet Ohio EPA requirements in accordance with CERCLA and USACE guidance. The report consists of an Executive Summary, Chapters 1.0 through 7.0, and supporting appendices. Chapter 1.0 describes the purpose, objectives, and organization of this report and provides a description and history of DA1. Chapter 2.0 describes the environmental setting at RVAAP and DA1, including the geology, hydrogeology, climate, population, and ecological resources.

Chapter 3.0 describes the specific Phase I RI methods used for field data collection and describes the approach to analytical data management and laboratory programs. Chapter 4.0 presents the data generated during the Phase I RI and discusses the occurrence and distribution of contamination at DA1. Chapter 5.0 includes the methodology and results of the human health and ecological risk evaluations. Chapter 6.0 summarizes the results and conclusions of this study. Chapter 7.0 provides a list of referenced documents used to support this Phase I RI.

Appendices (A through I) to the Phase I RI report for DA1 contain supporting data collected in the Phase I RI. These appendices consist of soil and Geoprobe sampling logs, sediment and surface water sampling logs, a project quality assurance summary, data quality control summary report, analytical results, topographic survey report, OE avoidance survey report, investigation-derived waste management report, and geotechnical laboratory data, respectively.

2.0 ENVIRONMENTAL SETTING

This section describes the physical characteristics of DA1 and the surrounding environment that are important to understanding the potential contaminant transport pathways, risk receptors, and exposure scenarios. Site-specific data collected during the Phase I RI and observations made in the field, as well as local and regional information, are used to refine the SCM, the basic framework of which was presented in the SAP Addendum No. 1 for the DA1 Phase I RI (USACE 1999a). The refined SCM, which contains interpretive conclusions, is presented in Chapter 6.0.

2.1 PHYSIOGRAPHIC SETTING

RVAAP is located within the Southern New York Section of the Appalachian Plateaus physiographic province (USGS 1968). This province is characterized by elevated uplands underlain primarily by Mississippian- and Pennsylvanian-age bedrock units that are horizontal or gently dipping. The province is characterized by its rolling topography with incised streams having dendritic drainage patterns. The Southern New York Section has been modified by glaciation, which rounded ridges, filled major valleys, and blanketed many areas with glacially derived unconsolidated deposits (e.g., sand, gravel, and finer-grained outwash deposits). As a result of glacial activity in this section, old stream drainage patterns were disrupted in many locales, and extensive wetland areas developed.

2.2 SURFACE FEATURES AND SITE TOPOGRAPHY

DA1 is situated in the southwestern quadrant of RVAAP, as shown in Figure 1-2. The topography of DA1 was mapped by the USACE in 1998 on a 0.6-meter (2-foot) contour interval, with an accuracy of 0.006 meter (0.02 feet), from aerial photographs taken in 1997. This survey is the basis for the topographic features presented in the figures in this Phase I RI report. Topographic relief at DA1 is subdued (Figure 1-4). Elevations vary by less than 2 feet across the AOC, from approximately 330 to 331 meters (1,083 to 1,085 feet) above mean sea level (amsl). The former treatment area within the berm slopes very slightly to the south–southwest toward Hinkley Creek, which is about 122 meters (400 feet) away in the principal direction of runoff. A low area is also present east of the AOC. Figures 2-1 and 2-2 illustrate site conditions at the time of the Phase I RI field effort in October and November 1999.

The AOC lies within an open grass area immediately south of the NTA runway and directly opposite the end of Demolition Road. Remaining cultural features at DA1 consist only of the earthen berm that encloses the former treatment area. The berm is raised above the ground surface by approximately 0.3 to 0.4 meter (1 to 1.5 feet). Remnants of an unpaved roadbed (stone and slag base material) exist on top of the berm. There are no buildings at DA1 at present, and no evidence exists of permanent buildings or infrastructure in historical photos and drawings. Warning signs placed on steel posts are present, which demarcate the AOC boundaries. A mature hardwood forest lies about 30 meters (100 feet) south of the berm. Scrub and immature hardwood cover is also present about 30 meters (100 feet) east of the berm.

Surface water drainage flows from north to south within the former treatment area and exits through a small culvert beneath the berm at the southern-most point. The culvert discharges to a shallow ditch that directs flow for a short distance prior to dissipating to the ground surface near the tree line south of the AOC. The headwaters of an unnamed intermittent tributary to Hinkley Creek begin about 60 meters (200 feet) south of the berm within a heavily wooded area. Surface water drainages from the AOC in general and

Figure 2-1. Demolition Area 1 Site Conditions

(View is to the east–southeast. The tree line demarcates the AOC boundary.)

from the central portion of NTA are directed toward this tributary, which ultimately intersects Hinkley Creek about 122 meters (400 feet) south of DA1. All surface water within Hinkley Creek exits the installation through station HC-2 (Figure 1-2) at the south perimeter fence, which is about halfway between Greenleaf Road and Route 80. Although the facility exit point and Hinkley Creek are not within the AOC boundary proper, they are included in the Phase I RI in order to determine whether potential contamination is migrating beyond the AOC boundary.

2.3 SOIL AND GEOLOGY

2.3.1 Regional Geology

The regional geology in the RVAAP vicinity consists of horizontal to gently dipping bedrock strata of Mississippian- and Pennsylvanian-age overlain by varying thicknesses of unconsolidated glacial deposits. The bedrock and unconsolidated geology at RVAAP and geology specific to DA1 are presented in the following subsections.

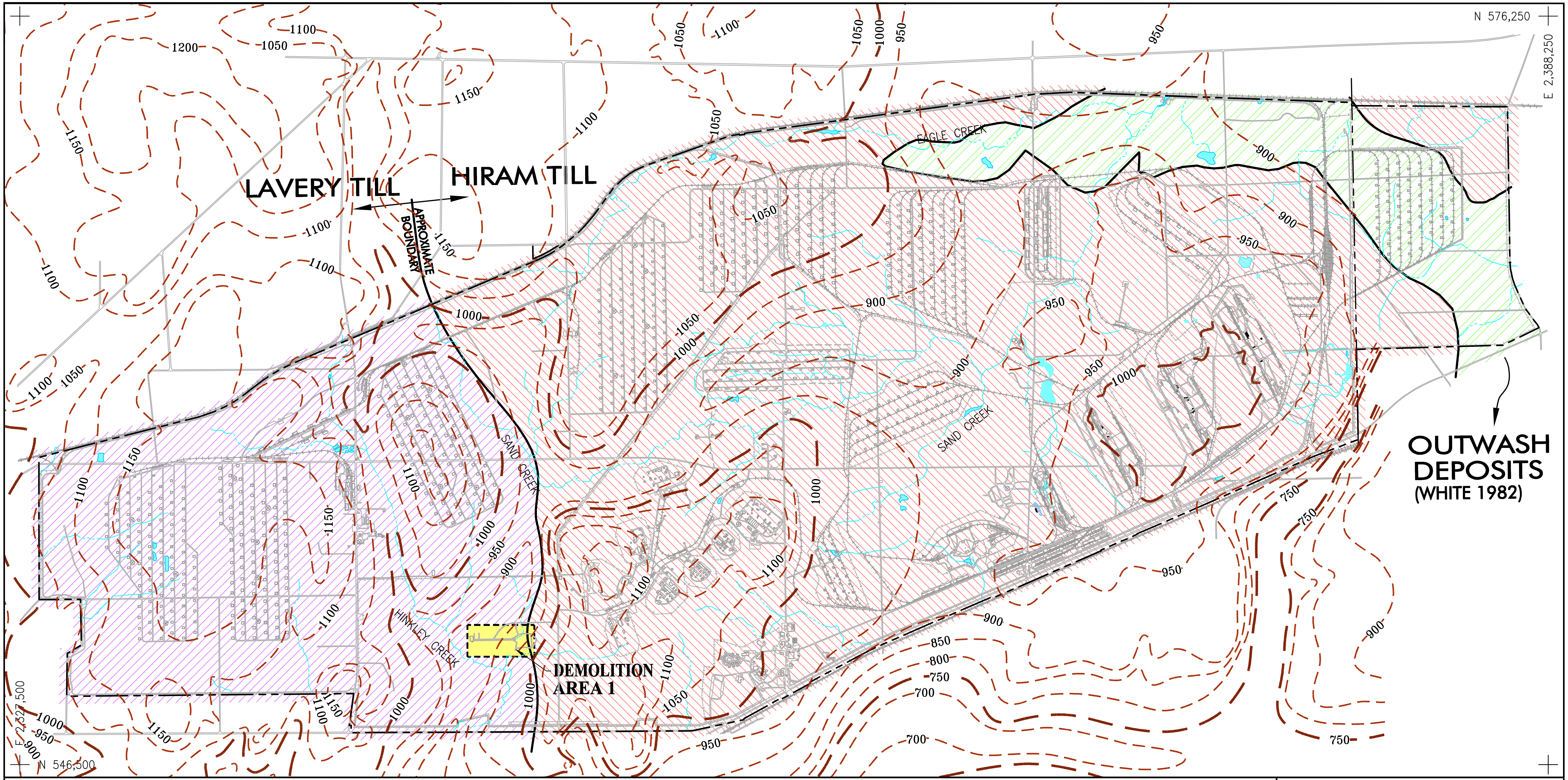
Figure 2-2. OE and Debris Observed in the Plane Storage Area at Demolition Area 1

[OE (fuzes) and metallic melted debris remaining from OB activities. Bare soil is present in right half of photograph.]

2.3.1.1 Soil and glacial deposits

Bedrock at RVAAP is overlain by deposits of the Wisconsin-age Lavery Till in the western portion of the facility and by the younger Hiram Till and associated outwash deposits in the eastern portion (ODNR 1982). Unconsolidated glacial deposits vary considerably in their character and thickness across RVAAP. In the suspected buried bedrock valley that trends northeast–southwest through the installation (Figure 2-3), the thickness of the glacial deposits may exceed 45 meters (150 feet).

Thin coverings of glacial materials have been completely removed as a consequence of human activities at many locations such as Ramsdell Quarry and Load Line 1 (USACE 1999b). Where these glacial materials are present, their distribution and character indicate their origin as ground moraine. These tills consist of laterally discontinuous assemblages of yellow-brown, brown, and gray silty clays to clayey silts, with sand and rock fragments. Deposits from standing water bodies may also have been encountered in the form of deposits of uniformly light gray silt that are thicker than 15 meters (50 feet) (USACE 1999c).



LEGEND:

— - —	PROPERTY BOUNDARY
~	STREAM OR CREEK
●	POND
- - -	BEDROCK SURFACE CONTOUR (50 FT INTERVAL)
— —	BEDROCK SURFACE CONTOUR (250 FT INTERVAL)
▨	LAVERY TILL
▨	HIRAM TILL
▨	OUTWASH DEPOSITS

DATA SOURCE:

1.) SLUCHER, 1996: BEDROCK TOPOGRAPHY OF THE WINDHAM AND RAVENNA, OH, QUADRANGLES (ELEVATION ABOVE SEA LEVEL OF BEDROCK SURFACE) CONTOUR INTERVAL = 50 FT.

OHIO STATE PLANE (NAD83)

0 2000 4000 8000

SCALE: 1" = 4000'

US Army Corps of Engineers Louisville District

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

RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
INSTALLATION MAP

DRAWN BY:	REV. NO./DATE:	CAD FILE:
R. BEELER	D / 12-12-01	/99039/DWGS/J14GEOL1

Figure 2-3. Geologic Map of Unconsolidated Deposits on RVAAP, Superimposed on Bedrock Surface Map

According to ODNR (1982), DA1 is situated near the approximate eastern limit of the Lavery Till surficial deposits. A suspected pre-glacial bedrock valley may lie in the vicinity of DA1. On this basis, glacial materials in the AOC are suspected to be very thick. The Lavery Till is a clayey silty till; in general, it contains about 28 percent sand and 30 percent clay, but the percentages vary. The Lavery Till contains only a few cobbles and boulders. Pebbles in the Lavery Till are flat, angular pieces of shale and siltstone. The till is rich in calcium. Unweathered Lavery Till is dark gray and weathers to dark brown. Surficial weathering of the till results in a very pebbly, almost gravely material.

Soil at RVAAP is generally derived from the silty clay glacial till that overlies bedrock. Distributions of soil types are discussed and mapped in the *Soil Survey of Portage County, Ohio* (USDA 1978). According to this survey, the major soil types found in the high-priority AOCs are silt or clay loams with permeabilities ranging from 6.0×10^{-7} to 1.4×10^{-3} cm/s.

2.3.1.2 Bedrock stratigraphy

The Pennsylvanian Pottsville Formation unconformably overlies the eroded Cuyahoga Formation throughout RVAAP. The Connoquennessing, Mercer, and Homewood members of the Pottsville Formation are known to underlie the western half of the installation. The Sharon Member is not present in this area.

The Connoquennessing Member is a coarse, gray sandstone with thin interbeds and partings of sandy shale. The Mercer Member overlies the Connoquennessing and consists of silty to carbonaceous shale with thin, discontinuous sandstone lenses. The Homewood Member, which unconformably overlies the Mercer Member, consists of coarse-grained, cross-bedded sandstone.

2.3.2 Geologic Setting of Demolition Area 1

Forty-six soil and sediment boring locations were sampled as part of the Phase I RI of DA1. Information from these borings is used to characterize the surface and subsurface geology of DA1 and to develop an SCM. The limitations of these data for this purpose are as follows:

- Minimal geologic information was collected below a depth of 1.5 meters (5 feet) below ground surface (bgs). Unconsolidated zone stratigraphic data were obtained from four borings installed to a depth of 2.44 meters (8 feet) inside the former treatment area and one Geoprobe boring installed to a depth of 9.14 meters (30 feet) south of the berm.

- It is assumed that surface soil was substantially reworked in the course of preparing the site for use as a demolition area and during the deactivation of DA1.

- Bedrock was not penetrated in any of the soil borings.

2.3.2.1 Soil

Soil at DA1 is the Fitchville Series silt loam. Native soil is derived from the weathering of glacial till or outwash or from more recent alluvial material. The *Soil Survey of Portage County, Ohio* (USDA 1978) describes this soil type as gently sloping, somewhat poorly drained, and formed from silty, water-deposited sediment. The soil type typically exhibits low strength, is soft and compressible when wet, and has low permeability. Hydraulic conductivity values range from 6.56×10^{-5} cm/sec to 1.41×10^{-3} cm/sec (0.6 to 2.0 in./hr) in the upper 18 centimeters (7 inches) to 2.19×10^{-5} to 6.56×10^{-5} cm/sec (0.2 to 0.6 in./hr) below a depth of 18 centimeters (7 inches). Geotechnical data for soil and sediment collected during the Phase I RI are presented in Chapter 4.0 and Appendix F of this report. Stratigraphic descriptions of soil types encountered in borings installed during the Phase I RI show substantial variability across the site and evidence of reworking. Soil stratigraphy for each of the sub-areas at DA1 is presented below.

Berm Area

Along the berm enclosing the former treatment area, soil from the ground surface to approximately 0.48 meter (1.5 feet) bgs is predominantly 10YR 5/6 (yellowish-brown) to 10YR 4/6 (dark yellowish-brown) gravelly sand with some silt (SW). The sand is fine- to medium-grained, well-graded, subrounded, loose, and moist. A sand/cobble layer (GP), assumed to be road ballast, was encountered at depths of from 0.15 to 0.3 meter (0.5 to 1 foot) in 6 of the 11 sample locations on the berm, resulting in auger refusal.

At the locations where the subsurface soil samples [from 0.3 to 1 meter (1 to 3 feet)] were collected, the soil was 10YR 5/8 (yellowish-brown) clay (CL) with very fine, subrounded sand. The clay was moist and mottled with medium stiffness.

Former Treatment Area

Within the treatment area inside of the berm, soil in the northern portion (locations 12 to 17) differed slightly from the soil in the southern portion (locations 18 to 21). In the northern portion, soil from the ground surface to approximately 0.48 meter (1.5 feet) bgs ranged from 10YR 4/6 (dark yellowish-brown) to 2.5Y 4/4 (olive brown) sandy silt (ML) with some well-graded gravel to gravelly sand with some silt (SW). The sand was fine to medium grained, subrounded, well-graded, moist, and loose. Below approximately 0.48 meter (1.5 feet), the soil was 10YR 5/6 (yellowish-brown) to 10YR /1 (variegated gray) silty clay (CL). The clay was moist with medium stiffness and moderate plasticity. With increasing depth, the clay became very moist to wet and very stiff. In the southern portion, soil from the ground surface to approximately 1.2 meters (4 feet) bgs ranged from 10YR 7/2 (variegated light gray) to 10YR 6/8 (brownish-yellow) silty clay (CL). The clay was moist, stiff, and moderately plastic.

At depths below about 1.2 meters (4 feet) in the treatment area, soil types ranged from a 2.5Y 5/4 (light olive brown) clayey silt (ML) to a 10YR 6/8 (brownish-yellow) silty clay (CL). The silt was wet, loose, and slightly plastic. The clay was moist, stiff, and of moderate plasticity. In some auger holes the clay was fissile. From an upper range of from 1.07 to 1.68 meters (3.5 to 5.5 feet) bgs to depths of 2.44 meters (8 feet), the soil graded into a 2.5Y 4/4 (olive brown) clay with traces of silt (CL). The clay was moist, very stiff, and of moderate plasticity.

Plane Storage Area and South Ditch – Outside Berm

In the surface soil interval from ground surface to approximately 0.3 meter (1 foot) bgs, a very thin, 0.03-meter- (0.1-foot)-thick layer of 2.5Y 2.5/1 (black) organic, moist, very soft silt (OH/OL) with traces of sand was observed in some areas. Generally, soil ranged from a 2.5Y 4/2 (dark grayish brown) to 2.5Y 4/4 (olive brown) sandy organic silt (OL/OH) to sandy silt (ML). The soil was moist, loose, and very soft.

From approximately 0.3 to 0.76 meter (1 to 2.5 feet) bgs, soil ranged from a 2.5Y 5/3 (light olive brown) to 10YR 7/1 (variegated light gray) and from a silty clay (CL) to silty sand (SM). Occasional lens of silty sand (SP-SM) were observed. The sand was medium to coarse grained, well-graded, and subrounded. The soil was moist and loose. However, when the clay content of the soil increased, the soil became stiff and slightly plastic.

From approximately 0.76 to 1.5 meters (2.5 to 5 feet) bgs, soil ranged from 2.5Y 6/3 (light yellow brown) to 10YR 7/2 (variegated light gray). At depth, the color became less variegated. The soil types ranged from a clayey silt (ML) to a silty clay (CL). The silt was moist, loose, and slightly plastic. The clay was moist and ranged from stiff to very stiff and was sometimes fissile.

In one location (DA1-027), a geoprobe was used to obtain soil core to a depth of 9.14 meters (30 feet). From approximately 1.5 to 2.4 meters (5 to 8 feet) bgs, soil ranged from 2.5Y 4/3 (light olive brown) to 2.5Y 7/1 (variegated light gray) moist and very stiff silty clay (CL). From approximately 2.4 meters (8 feet) bgs to the bottom of the borehole, the soil was 10YR 5/4 (yellowish-brown), well-graded, gravelly, subrounded coarse sand (GW) or (SW-SM). Below 5.33 meters (17.5 feet) bgs, the sand was saturated.

2.3.2.2 Bedrock geology

Bedrock elevations of the Pottsville Formation in the vicinity of DA1 are unknown. No outcrops were observed at DA1 or in nearby Hinkley Creek during the Phase I RI, and no soil borings penetrated bedrock. Determination of depth to bedrock and characterization of bedrock geology were not part of the scope of this Phase I RI.

2.4 HYDROLOGY

2.4.1 Regional Hydrogeology

Sand and gravel aquifers are present in the buried-valley and outwash deposits in Portage County as described in the *Phase I Remedial Investigation Report for 11 High-Priority Sites at RVAAP* (USACE 1997). Generally, these saturated zones are too thin and localized to provide large quantities of water for industrial or public water supplies. However, they are sufficient for residential water supplies. Lateral continuity of these aquifers is not known. Recharge of these units comes from surface water infiltration of precipitation and surface streams. Specific groundwater recharge and discharge areas at RVAAP have not been delineated.

Hydraulic conductivity measurements (slug tests or pump tests) were not collected during the Phase I RI at DA1. The closest sites to DA1 having hydraulic data include Winklepeck Burning Grounds (WBG) and Load Line 1 in the central and eastern portions of RVAAP, respectively. Data from these two sites show moderately high horizontal hydraulic conductivities within the unconsolidated materials. Hydraulic conductivities measured during the Phase II RI at WBG (USACE 1999c) range from 3.87×10^{-2} to 5.65×10^{-4} cm/s. However, these values may not be representative of the facility as a whole.

2.4.2 Demolition Area 1 Hydrogeologic Setting

Characterization of the groundwater regime through monitoring well installation and sampling was not part of the scope of this Phase I RI. Subsurface hydrogeologic conditions at DA1 are largely inferred from surface topography, surface water flow, soil conditions, and information from the surrounding NTA. The depth to the water table at DA1 was measured at 4.83 meters (15.85 feet) in a temporary piezometer installed in boring DA1-027.

Shallow groundwater present in the unconsolidated glacial material is suspected to flow across the AOC from north to south, following topographic trends and surface water flow patterns. However, topographical relief is so small across the AOC that other factors may have a greater influence on groundwater movement (e.g., confining units, recharge areas, etc.). Because of the presence of a suspected regional buried bedrock valley beneath the AOC, it is likely that multiple deeper saturated zones are present in the glacial materials. Any deeper groundwater is likely to flow along strike of the buried valley, i.e., to the southwest, and off of the RVAAP property.

Within the adjacent NTA, groundwater was encountered in one Geoprobe boring (NTA-38) installed about 427 meters (1,400 feet) east–northeast and upslope of DA1. The depth to groundwater at this location in October 1999 was 5.1 meters (16.6 feet). A southward-flowing drainage swale (topographic low) between the NTA crash area and DA1 may constitute a minor groundwater divide.

2.5 CLIMATE

RVAAP has a humid continental climate characterized by warm, humid summers and cold winters. Precipitation varies widely throughout the year. The driest month is, on average, February, and the wettest month is July. Data from the National Weather Service compiled over the past 47 years indicate that the average rainfall for the area is 0.98 meter (38.72 inches) annually. The average snowfall is 1.1 meters (43.4 inches) annually. Severe weather, in the form of thunder, hail, or snow storms, is common in summer and winter. Tornadoes are infrequent in Portage County.

The Phase I RI was conducted after an extremely dry summer that was part of a prolonged dry period in northeastern Ohio. Therefore, groundwater and surface water conditions encountered during the RI are suspected to be lower than those under normal conditions.

2.6 POTENTIAL RECEPTORS

This Phase I RI includes an evaluation of potential risks to human receptors from exposure to contaminants in surface soil, subsurface soil, sediment, and surface water. Risks to ecological receptors from exposure to sediment and surface water are also evaluated (Chapter 5.0). This section describes potential receptor populations in the DA1 vicinity based on current land use and site conditions.

2.6.1 Human Receptors

RVAAP is located in a primarily rural area and is not close to any major industrial or residential areas. Based on data from the 2000 U.S. Census and the Portage County Soil and Water Conservation District *Resource Inventory* (1985), approximately 55 percent of Portage County, in which the majority of the RVAAP acreage lies, consists of either woodland or farmland. The population centers located closest to RVAAP include the city of Ravenna (2000 population 11,771), which is located about 3.2 kilometers (3 miles) from the western boundary in Portage County, and the city of Newton Falls (2000 population 5,002), which is located about 1.6 kilometers (1 mile) from the southeastern site boundary in Trumbull County. The Michael J. Kirwan Reservoir (also known as the West Branch Reservoir) is the closest major recreational area and is located adjacent to the western half of RVAAP south of State Route 5.

RVAAP is not accessible to the general public. The facility is completely fenced and patrolled by security personnel. Approximately 14 OSC and full-time operating contractor staff (i.e., security, grounds, and maintenance workers) are located on-site. Additional subcontractor staff are on-site for varying periods of time, ranging from several weeks to more than 12 months, to complete specific demolition/decommissioning projects. Training activities under the OHARNG involve an average of 4,500 personnel during the course of a month, who are typically on-site for periods of 2 weeks (annual training) or 3 days (inactive duty or weekend training).

Potential human receptors at DA1 include OHARNG personnel, maintenance workers, security staff, and infrequent trespassers. The site is off-limits to recreational users such as hunters. There are no residents at the site or within 914 meters (3,000 feet) of the site. OHARNG personnel do not train within the AOC boundary of DA1, but they use adjacent areas of NTA for limited dismounted troop training as described in

Chapter 1.0 of this RI report. Groundskeeping is limited to periodic mowing (tractor-mounted equipment) and hand-clearing of the open areas. Security activities consist primarily of drive-through surveillance.

2.6.2 Ecological Receptors

The dominant vegetative cover types at RVAAP, including DA1 and its immediate surroundings, are forests and old fields of various ages. More than 80 percent of RVAAP is now in forest. Most of the old field cover is the result of earlier agricultural practices that left these sites with poor topsoil that limits forest regeneration. Several thousand acres of agricultural fields were planted in trees during the 1950s and 1960s, but these plantings were not successful in areas with poor topsoil. Some fields, leased for cattle grazing during the same time period, were delayed in their reversion to forest. A few fields have been periodically mowed, maintaining them as old field, and 36 hectares (90 acres) are leased as hay fields (Morgan 1999). DA1 is covered with grass that is periodically mowed as part of routine maintenance activities.

From one-half to two-thirds [4,046 to 6,070 hectares (10,000 to 15,000 acres)] of RVAAP’s land area meet the regulatory definition of jurisdictional wetland. Wetland areas at RVAAP include seasonally saturated wetlands, wet fields, and forested wetlands. Most of these wetlands exist because of the presence of poorly drained and hydric soil. Beaver impoundments contribute to wetland diversification in some parts of the site. No wetland areas exist within the DA1 boundary; however, a forested wetland area occurs south of the AOC within the headwaters of the tributary draining to Hinkley Creek.

The flora and fauna present at RVAAP are varied and widespread. No federal threatened or endangered or candidate federal threatened or endangered species have been observed on RVAAP. A listing of state endangered, state threatened, or potentially threatened and state special interest species confirmed to be on RVAAP is provided on Table 2-1 (Morgan 2000). Additionally, five rare plant communities/significant natural areas have been identified on RVAAP, including the northern woods, Wadsworth Glen, Group 3 woods, B&O Wye Road area, and South Patrol Road swamp forest.

Restricted land use and sound forest management practices have preserved and enabled large forest tracts to mature. Habitat conversion at RVAAP, unlike most other habitat conversions occurring nationwide, has been toward restoration of the forests that covered the area prior to its being cleared for agriculture. The reversion of these agricultural fields to mature forest provides a diversity of habitats from old field through several successional stages. Overall, the trend toward forest cover enhances the area for use by forest species, both plant and animal. There are no federal, state, or local parks or protected areas on RVAAP property.

Table 2-1. RVAAP Rare Species List as of April 19, 2000

A. State Endangered
   1. Northern harrier, *Circus cyaneus*
   2. Common barn owl, *Tyto alba*
   3. Yellow-bellied sapsucker, *Sphyrapicus varius*
   4. Mountain brook lamprey, *Ichthyomyzon greeleyi*
   5. Graceful underwing, *Catocala gracilis*
   6. Ovate spikerush, *Eleocharis ovata* (Blunt spike-rush)
   7. Lurking leskea, *Plagiothecium latebricola*
   8. Northern river otter, *Lutra canadensis*
   9. Little blue heron, *Egretta caerulea* (suspected)
   10. American bittern, *Botaurus lentiginosu* (migrant)
   11. Canada warbler, *Wilsonia canadensis* (migrant)
   12. Osprey, *Junco hyemalis* (migrant)
   13. Trumpeter swan, *Cygnus buccinator* (migrant)
   14. Little blue heron, *Egretta caerulea* (migrant)

B. State Threatened
   1. Simple willow-herb, *Epilobium strictum*

C. State Potentially Threatened
   1. Gray birch, *Betula populifolia*
   2. Round-leaved sundew, *Drosera rotundifolia*
   3. Closed gentian, *Gentiana clausa*
   4. Butternut, *Juglans cinerea*
   5. Blunt mountain-mint, *Pycnanthemum muticum*
   6. Northern rose azalea, *Rhododendron nudiflorum* var. *roseum*
   7. Large cranberry, *Vaccinium macrocarpon*
   8. Hobblebush, *Viburnum alnifolium*
   9. Long beech fern, *Phegopteris connectilis*
   10. Woodland horsetail, *Equisetum sylvaticum*
   11. Weak sedge, *Carex debilis* var. *debilis*
   12. Straw sedge, *Carex straminea*
   13. Water avens, *Geum rivale*
   14. Tall St. John's wort, *Hypercium majus*
   15. Swamp oats, *Sphenopholis pensylvanica*
   16. Shining ladies'-tresses, *Spiranthes lucida*

D. State Special Interest
   1. Sora, *Porzana carolina*
   2. Virginia rail, *Rallus limicola*
   3. Four-toed salamander, *Hemidactylium scutatum*
   4. Smooth green snake, *Opheodrys vernalis*
   5. Woodland jumping mouse, *Napaeozapus insignis*
   6. Sharp-shinned hawk, *Accipiter striatus*
   7. Solitary vireo, *Vireo solitarius*
   8. Pygmy shrew, *Sorex hoyi*
   9. Star-nosed mole, *Condylura cristata*
   10. Red-shouldered hawk, *Buteo lineatus*
   11. Henslow's sparrow, *Ammodramus henslowii*
   12. Cerulean warbler, *Dendroica cerulea*
   13. Common moorhen, *Gallinula chloropus*
   14. Eastern box turtle, *Carolina carolina*
   15. *Capperia evansi* (moth)
   16. *Zanclognatha martha* (moth)
   17. *Oligia bridghami* (moth)
   18. *Chaetaglaea sericea* (moth)
   19. *Sutyna privata* (moth)
   20. *Homorthodes frufurata* (moth)

Source: Morgan (2000).

3.0 STUDY AREA INVESTIGATIONS

This chapter presents information on locations and rationale of samples collected during the field effort and provides a synopsis of the sampling methods employed during the investigation. Field activities were conducted from October 18 to November 4, 1999. The rationale and sampling method for each component of the field program are described in the following sections. Specific notation is made where site conditions required a departure from planned activities in the DA1 Phase I RI SAP Addendum (USACE 1999a). Information regarding field decontamination methods, sample container types, preservation techniques, sample labeling, chain-of-custody, and packaging and shipping requirements implemented during the field investigation may be found in the Facility-wide SAP (USACE 1996b) and the DA1 Phase I RI SAP Addendum.

In order to organize and track sampling efforts for the Phase I RI at DA1, the AOC was separated into eight functional areas based on site characteristics, operational data, available maps, and historical aerial photographs. These functional areas and a summary of the environmental matrices that were sampled within each are listed in Table 3-1 and illustrated on Figure 3-1.

Table 3-1. Phase I RI Functional Areas at Demolition Area 1

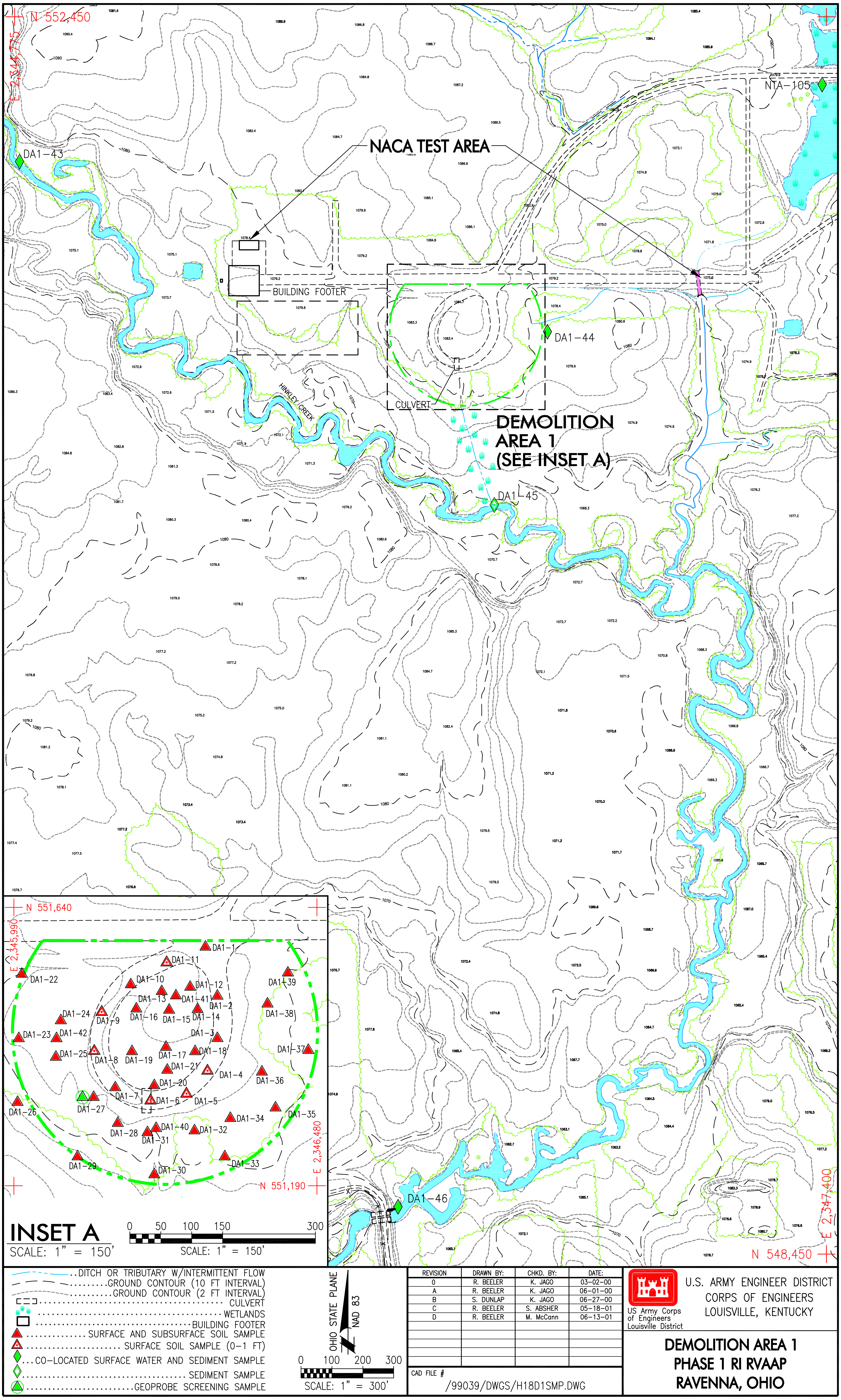
Area No.	Description	Sample Matrices
1	Along top of berm	Surface soil/subsurface soil
2	Inside the bermed OB/OD area	Surface soil/subsurface soil
3	Plane storage area and kickout zone (outside berm)	Surface soil/subsurface soil/groundwater
4	Ditch draining to the south of DA1	Soil (dry sediment)
5	Hinkley Creek upstream of DA1	Sediment and surface water
6	Drainage area east of DA1	Sediment and surface water
7	Hinkley Creek due south of DA1	Sediment and surface water
8	Hinkley Creek at RVAAP exit point HC-2	Sediment and surface water

DA1 = Demolition Area 1. OB/OD = Open burning/open detonation. RVAAP = Ravenna Army Ammunition Plant.

Functional areas 1 and 4 were sampled to characterize potential residual sources resulting from former site operations and treatment of munitions outside of the bermed area for which visual evidence existed. Functional area 2 was sampled to evaluate potential residual contamination within the former treatment zone of DA1. The remaining areas were sampled to evaluate potential contaminant migration off of the AOC via surface water and/or sediment.

3.1 TOPOGRAPHIC SURVEY

A topographic survey was conducted between November 1 and November 5, 1999, by Adams Craft Herz Walker, Inc. to locate all soil and sediment/surface water sampling points at DA1. All stations except two were located with traditional survey methods. Stations DA1-43 and DA1-46 were located directly with Global Positioning System technology. Horizontal and vertical controls were based on existing benchmarks RAV 4 and RAV 5, for which coordinates and elevations were provided by the USACE. All supporting documentation for the topographic survey can be found in Appendix F.



REVISION	DRAWN BY:	CHKD. BY:	DATE:
0	R. BEELER	K. JAGO	03-02-00
A	R. BEELER	K. JAGO	06-01-00
B	S. DUNLAP	K. JAGO	06-27-00
C	R. BEELER	S. ABSHER	05-18-01
D	R. BEELER	M. McCann	06-13-01

CAD FILE #
/99039/DWGS/H18D1SMP.DWG

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

DEMOLITION AREA 1
PHASE 1 RI RVAAP
RAVENNA, OHIO

Figure 3-1. Demolition Area 1 Phase I RI Soil, Sediment, and Surface Water Sample Locations.

3.2 ORDNANCE AND EXPLOSIVES AVOIDANCE AND FIELD RECONNAISSANCE

OE technicians were present during all field operations. The OE Team Leader led an initial safety briefing to train all field personnel to recognize and avoid propellants and OE. Daily tailgate safety briefings included reminders regarding OE avoidance. Site visitors were briefed on OE avoidance prior to being permitted into the AOC.

Prior to the start of sampling activities, access routes to all soil and sediment/surface water sample locations within and adjacent to the AOC boundary were cleared for potential OE. Clearance was done using visual surveys and hand-held magnetometers. The OE team, accompanied by the USACE technical representative and SAIC technical manager, verified that the proposed sample location was anomaly-free by using a magnetometer. A steel pin flag with the sample station identification number was placed at the sample point approved by the OE technician. An OE technician remained with the sampling crew as work progressed. At stations where subsurface soil samples were to be collected, a magnetometer was lowered into the borehole to screen for subsurface magnetic anomalies at the top of the subsurface interval. Where circumstances dictated that a borehole be deepened beyond 0.9 meter (3 feet) bgs, a magnetometer reading was taken at the top of each subsequent 0.6-meter (2-foot) interval prior to augering. Similarly, magnetometer readings were taken at 0.6-meter (2-foot) intervals during piezometer installation.

3.3 SOIL AND VADOSE ZONE SAMPLING

Soil samples were collected from a total of 42 stations. Surface soil samples were collected at all of the stations. Subsurface soil samples were specified for all of the stations; however, they could not be collected at all locations because of auger refusal. In several instances, subsurface samples that could not be collected at a particular station were reassigned to other locations to increase the depth of vadose zone characterization. Figure 3-1 illustrates the locations for surface soil and subsurface soil sampling. Table 3-2 lists the soil stations sampled during the Phase I RI field effort.

3.3.1 Rationale

Surface soil samples were collected during the Phase I RI at DA1 to identify impacted areas due to thermal destruction of explosives and other munitions wastes and other historical site operations (i.e., plane storage). Additionally, the soil samples provided data to identify the potential for contaminant migration by leaching or erosion from surface soil sources to receptor media such as sediment and surface water. The analytical results from soil samples were also used to identify whether potential leaching to groundwater may occur by comparing results to EPA Soil Screening Guidance Criteria (see Section 4.1 and Chapter 5.0). The sampling locations were selected on the basis of operational records, project DQOs as discussed in Section 1.3.5, and analytical results from previous sampling events. A combination of grid and biased sampling approaches were employed to maximize the potential to identify contamination and to obtain data representative of site conditions. Sampling approaches were tailored to the characteristics of each functional area.

Surface and subsurface soil samples collected along the top of the berm (Area 1), within the former OB/OD area inside of the berm (Area 2), and in the plane storage area outside of the berm (Area 4) represent suspected source areas. Two planned contingency stations were spotted at locations approved in the field by the USACE technical representative. The ditch line draining DA1 was considered to represent receptor points for runoff from the potential source areas, as well as an exit pathway from the AOC. Surface soil samples were collected from the 0- to 0.3-meter (0- to 1-foot) interval for compatibility with DQOs for the risk screening and any future baseline risk assessment. A total of 77 subsurface soil samples were collected from the 0.2- to 0.9-meter (1- to 3-foot) interval, the 0.9- to 1.5-meter (3- to 5-foot) interval, and

Table 3-2. Sample List and Rationale, Demolition Area 1 Phase I RI

Functional Area	No. Sample Stations	Sample Station ID	Location Description	Sample Station Rationale	Sample ID	Depth (feet)	Sample Collected (Yes/No)	Comments
Surface and Subsurface Soil Samples								
Berm	**11**	DA1-001	Top of berm	Possible contaminant source area	DA1ss-001-0001-SO	0 - 1	Yes	
					DA1so-001-0002-SO	1 -3	Yes	
		DA1-002	Top of berm	Possible contaminant source area	DA1ss-002-0003-SO	0 - 1	Yes	
					DA1so-002-0004-SO	1 - 3	Yes	
		DA1-003	Top of berm	Possible contaminant source area	DA1so-003-0005-SO	0 - 1	Yes	
					DA1ss-003-0006-SO	1 - 3	Yes	
		DA1-004	Top of berm	Possible contaminant source area	DA1ss-004-0007-SO	0 - 1	Yes	
					DA1so-004-0008-SO	1 - 3	No	Refusal, sample reassigned to DA1-018
		DA1-005	Top of berm	Possible contaminant source area	DA1ss-005-0009-SO	0 - 1	Yes	
					DA1so-005-0010-SO	1 -3	No	Refusal, sample reassigned to DA1-019
		DA1-006	Top of berm	Possible contaminant source area	DA1ss-006-0011-SO	0 - 1	Yes	
					DA1so-006-0012-SO	1 - 3	No	Refusal, sample reassigned to DA1-020
		DA1-007	Top of berm	Possible contaminant source area	DA1ss-007-0013-SO	0 - 1	Yes	
					DA1so-007-0014-SO	1 - 3	Yes	
		DA1-008	Top of berm	Possible contaminant source area	DA1ss-008-0015-SO	0 - 1	Yes	
					DA1so-008-0016-SO	1 - 3	No	Refusal, sample reassigned to DA1-021
		DA1-009	Top of berm	Possible contaminant source area	DA1ss-009-0017-SO	0 - 1	Yes	
					DA1so-009-0018-SO	1 - 3	No	Refusal, sample reassigned to DA1-041
		DA1-010	Top of berm	Possible contaminant source area	DA1ss-010-0019-SO	0 - 1	Yes	
					DA1so-010-0020-SO	1 - 3	Yes	
		DA1-011	Top of berm	Possible contaminant source area	DA1ss-011-0021-SO	0 - 1	Yes	
					DA1so-011-0022-SO	1 - 3	No	Refusal, sample reassigned to DA1-042

Table 3-2. Sample List and Rationale, Demolition Area 1 Phase I RI (continued)

Functional Area	No. Sample Stations	Sample Station ID	Location Description	Sample Station Rationale	Sample ID	Depth (feet)	Sample Collected (Yes/No)	Comments
Inside bermed area	**10**	DA1-012	Interior of former OB/OD area	Possible contaminant source area	DA1ss-012-0023-SO	0 - 1	Yes	
					DA1so-012-0024-SO	1 - 3	Yes	
					DA1so-012-0025-SO	3 - 5	Yes	
		DA1-013	Interior of former OB/OD area	Possible contaminant source area	DA1ss-013-0026-SO	0 - 1	Yes	
					DA1so-013-0027-SO	1 - 3	Yes	
					DA1so-013-0028-SO	3 - 5	Yes	
		DA1-014	Interior of former OB/OD area	Possible contaminant source area	DA1ss-014-0029-SO	0 - 1	Yes	
					DA1so-014-0030-SO	1 - 3	Yes	
					DA1so-014-0031-SO	3 - 5	Yes	
		DA1-015	Interior of former OB/OD area	Possible contaminant source area	DA1ss-015-0032-SO	0 - 1	Yes	
					DA1so-015-0033-SO	1 - 3	Yes	
					DA1so-015-0034-SO	3 - 5	Yes	
					DA1so-015-0035-SO	1 - 3	Yes	Geotech only
		DA1-016	Interior of former OB/OD area	Possible contaminant source area	DA1ss-016-0036-SO	0 - 1	Yes	
					DA1so-016-0037-SO	1 - 3	Yes	
					DA1so-016-0038-SO	3 - 5	Yes	
		DA1-017	Interior of former OB/OD area	Possible contaminant source area	DA1ss-017-0039-SO	0 - 1	Yes	
					DA1so-017-0040-SO	1 - 3	Yes	
					DA1so-017-0041-SO	3 - 5	Yes	
		DA1-018	Interior of former OB/OD area	Possible contaminant source area	DA1ss-018-0042-SO	0 - 1	Yes	
					DA1so-018-0043-SO	1 - 3	Yes	
					DA1so-018-0044-SO	3 - 5	Yes	
					DA1so-018-0160-SO	6 - 8	Yes	
		DA1-019	Interior of former OB/OD area	Possible contaminant source area	DA1ss-019-0045-SO	0 - 1	Yes	
					DA1so-019-0046-SO	1 - 3	Yes	
					DA1so-019-0047-SO	3 - 5	Yes	
					DA1so-019-0161-SO	6 - 8	Yes	
		DA1-020	Interior of former OB/OD area	Possible contaminant source area	DA1ss-020-0048-SO	0 - 1	Yes	
					DA1so-020-0049-SO	1 - 3	Yes	
					DA1so-020-0050-SO	3 - 5	Yes	
					DA1so-020-0162-SO	6 - 8	Yes	

Table 3-2. Sample List and Rationale, Demolition Area 1 Phase I RI (continued)

Functional Area	No. Sample Stations	Sample Station ID	Location Description	Sample Station Rationale	Sample ID	Depth (feet)	Sample Collected (Yes/No)	Comments
Inside bermed area (continued)	**10** (continued)	DA1-021	Interior of former OB/OD area	Possible contaminant source area	DA1ss-021-0051-SO	0 - 1	Yes	
					DA1so-021-0052-SO	1 - 3	Yes	
					DA1so-021-0053-SO	3 - 5	Yes	
					DA1so-021-0163-SO	6 - 8	Yes	
Plane storage area – outside berm	**18**	DA1-022	Plane storage area and potential kickout zone	Possible contaminant source area	DA1ss-022-0054-SO	0 - 1	Yes	
					DA1so-022-0055-SO	1 - 3	Yes	
					DA1so-022-0056-SO	3 - 5	Yes	
		DA1-023	Plane storage area and potential kickout zone	Possible contaminant source area	DA1ss-023-0057-SO	0 - 1	Yes	
					DA1so-023-0058-SO	1 - 3	Yes	
					DA1so-023-0059-SO	3 - 5	Yes	
		DA1-024	Plane storage area and potential kickout zone	Possible contaminant source area	DA1ss-024-0060-SO	0 - 1	Yes	
					DA1so-024-0061-SO	1 - 3	Yes	
					DA1so-024-0062-SO	3 - 5	Yes	
		DA1-025	Plane storage area and potential kickout zone	Possible contaminant source area	DA1ss-025-0063-SO	0 - 1	Yes	
					DA1so-025-0064-SO	1 - 3	Yes	
					DA1so-025-0065-SO	3 - 5	Yes	
		DA1-026	Plane storage area and potential kickout zone	Possible contaminant source area	DA1ss-026-0066-SO	0 - 1	Yes	
					DA1so-026-0067-SO	1 - 3	Yes	
					DA1so-026-0068-SO	3 - 5	Yes	
		DA1-027	Plane storage area and potential kickout zone	Possible contaminant source area	DA1ss-027-0069-SO	0 - 1	Yes	
					DA1so-027-0070-SO	1 - 3	Yes	
					DA1so-027-0071-SO	3 - 5	Yes	
					DA1so-027-0072-SO	1 - 3	Yes	Geotech only
		DA1-028	Plane storage area and potential kickout zone	Possible contaminant source area	DA1ss-028-0073-SO	0 - 1	Yes	
					DA1so-028-0074-SO	1 - 3	Yes	
					DA1so-028-0075-SO	3 - 5	Yes	
		DA1-029	Plane storage area and potential kickout zone	Possible contaminant source area	DA1ss-029-0076-SO	0 - 1	Yes	
					DA1so-029-0077-SO	1 - 3	Yes	
					DA1so-029-0078-SO	3 - 5	No	Perched water at 3 feet bgs
		DA1-030	Plane storage area and potential kickout zone	Possible contaminant source area	DA1ss-030-0079-SO	0 - 1	Yes	
					DA1so-030-0080-SO	1 - 3	Yes	
					DA1so-030-0081-SO	3 - 5	Yes	
		DA1-031	Plane storage area and potential kickout zone	Possible contaminant source area	DA1ss-031-0082-SO	0 - 1	Yes	
					DA1so-031-0083-SO	1 - 3	Yes	
					DA1so-031-0084-SO	3 - 5	Yes	

Table 3-2. Sample List and Rationale, Demolition Area 1 Phase I RI (continued)

Functional Area	No. Sample Stations	Sample Station ID	Location Description	Sample Station Rationale	Sample ID	Depth (feet)	Sample Collected (Yes/No)	Comments
Plane storage area – outside berm (continued)	**18** (continued)	DA1-032	Plane storage area and potential kickout zone	Possible contaminant source area	DA1ss-032-0085-SO	0 - 1	Yes	
					DA1so-032-0086-SO	1 - 3	Yes	
					DA1so-032-0087-SO	3 - 5	Yes	
		DA1-033	Plane storage area and potential kickout zone	Possible contaminant source area	DA1ss-033-0088-SO	0 - 1	Yes	
					DA1so-033-0089-SO	1 - 3	Yes	
					DA1so-033-0090-SO	3 - 5	Yes	
		DA1-034	Plane storage area and potential kickout zone	Possible contaminant source area	DA1ss-034-0091-SO	0 - 1	Yes	
					DA1so-034-0092-SO	1 - 3	Yes	
					DA1so-034-0093-SO	3 - 5	Yes	
		DA1-035	Plane storage area and potential kickout zone	Possible contaminant source area	DA1ss-035-0094-SO	0 - 1	Yes	
					DA1so-035-0095-SO	1 - 3	Yes	
					DA1so-035-0096-SO	3 - 5	Yes	
		DA1-036	Plane storage area and potential kickout zone	Possible contaminant source area	DA1ss-036-0097-SO	0 - 1	Yes	
					DA1so-036-0098-SO	1 - 3	Yes	
					DA1so-036-0099-SO	3 - 5	Yes	
		DA1-037	Plane storage area and potential kickout zone	Possible contaminant source area	DA1ss-037-0100-SO	0 - 1	Yes	
					DA1so-037-0101-SO	1 - 3	Yes	
					DA1so-037-0102-SO	3 - 5	Yes	
		DA1-038	Plane storage area and potential kickout zone	Possible contaminant source area	DA1ss-038-0103-SO	0 - 1	Yes	
					DA1so-038-0104-SO	1 - 3	Yes	
					DA1so-038-0105-SO	3 - 5	Yes	
		DA1-039	Plane storage area and potential kickout zone	Possible contaminant source area	DA1ss-039-0106-SO	0 - 1	Yes	
					DA1so-039-0107-SO	1 - 3	Yes	
					DA1so-039-0108-SO	3 - 5	Yes	
South ditch line	**1**	DA1-040	Center of ditch line below drainage culvert beneath berm	Exit pathway	DA1ss-040-0109-SO	0 - 1	Yes	
					DA1so-040-0110-SO	1 - 3	Yes	
Contingency locations	**2**	DA1-041	Interior of former OB/OD area	Possible contaminant source area	DA1ss-041-0109-SO	0 - 1	Yes	
					DA1so-041-0110-SO	1 - 3	Yes	
					DA1so-041-0111-SO	3 - 5	Yes	
					DA1so-041-0164-SO	6 - 8	Yes	
		DA1-042	Plane storage area and potential kickout zone	Bare soil zone and observed debris	DA1ss-042-0112-SO	0 - 1	Yes	
					DA1so-042-0113-SO	1 - 3	Yes	
					DA1so-042-0114-SO	3 - 5	Yes	
					DA1so-042-0165-SO	6 - 8	Yes	
TOTALS		**42**			**116**			

Table 3-2. Sample List and Rationale, Demolition Area 1 Phase I RI (continued)

Functional Area	No. Sample Stations	Sample Station ID	Location Description	Sample Station Rationale	Sample ID	Depth (feet)	Sample Collected (Yes/No)	Comments
Sediment and Surface Water Samples								
Hinkley Creek upstream	**1**	DA1-043	Hinkley Creek upstream of AOC	Ambient conditions	DA1sd-043-0115-SO	0-0.5 (sediment)	Yes	
Wet area east of AOC	**1**	DA1-044	Low area east of AOC	Potential accumulation area	DA1sd-044-0116-SO	0-0.5 (sediment)	Sediment only	Dry
Hinkley Creek south of AOC	**1**	DA1-045	Hinkley Creek closest to AOC	Exit pathway	DA1sd-045-0117-SO	0-0.5 (sediment)	Yes	
HC-2	**1**	DA1-046	Hinkley Creek at HC-2	Facility discharge point	DA1sd-046-0118-SO	0-0.5 (sediment)	Yes	
TOTALS		**4**			**4 sed/ 4 sw**			
Groundwater Screening Samples								
Plane storage area – outside berm	1	DA1-027	Plane storage area and potential kickout zone	Potential leaching to groundwater from soil source(s)	DA1gw-027-0125-GW	NA	Yes	Geoprobe
TOTALS		**1 Station**			**1 Sample**			

AOC = Area of concern.
NA = Not applicable.

the 1.8- to 2.4-meter (6- to 8-foot) interval. A synopsis of soil sampling efforts for each functional area is presented below.

- On top of the berm, surface soil samples were collected at all 11 stations as planned. Subsurface samples from the 0.2- to 0.9-meter (1- to 3-foot) interval were planned for all locations; however, auger refusal occurred at six stations due to rock fill material (DA1-004, DA1-005, DA1-006, DA1-008, DA1-009, and DA1-011).

- Within the former treatment area inside of the berm, surface and subsurface soil samples were collected as planned from 10 stations (Table 3-2). In addition, subsurface samples from the 1.8- to 2.4-meter (6- to 8-foot) interval were added at stations DA1-018, DA1-019, DA1-020, and DA1-021. These additional samples were necessary because of auger refusal at a number of stations on top of the berm.

- In the plane storage area outside of the berm, surface soil samples were collected at all 18 planned stations. Subsurface soil samples from the 0.2- to 0.9-meter (1- to 3-foot) interval and 0.9- to 1.5-meter (3- to 5-foot) interval were collected from each station as planned with one exception. The 0.9- to 1.5-meter (3- to 5-foot) sample was not collected at station DA1-029 due to the presence of a perched water zone at about 0.9 meter (3 feet) bgs. The field crew did not wish to penetrate a clay layer underlying the perched water zone to prevent downward migration of any potential contamination that may be present in the vicinity.

- The surface and subsurface samples were collected as planned from the sample station within the south ditch line draining DA1.

- Two contingency stations were sampled as planned. One contingency station supplemented characterization of the former treatment area (DA1-41); an additional subsurface soil sample from the 1.8- to 2.4-meter (6- to 8-foot) interval was collected at this station. The second contingency station (DA1-42) was located in an area of bare soil containing OE (inert fuzes) and debris in the former plane storage area.

3.3.2 Surface Soil Field Sampling Methods

3.3.2.1 Sampling techniques

A decontaminated bucket hand auger was used to collect surface soil samples at each station. Where required, a clean, unpainted spade was used initially to remove heavy vegetative debris or gravel and slag cover where present. Where explosives and propellant analyses were not specified, a single boring was hand augered at the approved locations, and all sample aliquots were obtained from this single boring. Soil from the sample interval was placed into a stainless steel bowl, homogenized, and placed into sample containers. Soil for VOC analyses was placed directly into sample jars from the auger bucket.

Where composite samples for explosives and propellants analyses were specified, three soil borings were hand augered in an equilateral triangle pattern measuring about 0.9 meter (3 feet) on a side. Soil from the three subsamples were placed into a large, decontaminated, stainless steel bowl, homogenized, and placed into sample containers. Composite sampling data for explosives analysis are considered acceptable for use in risk assessments (EPA 1996) where concentrations throughout a study area are expected to vary. Samples for inorganic constituents (metals and cyanide), semivolatile organic compounds (SVOCs), volatile organic compounds (VOCs), and polychlorinated biphenyls (PCBs) were collected from a boring located in the center of the equilateral triangle as described above.

After completion, each soil boring was filled with granular bentonite, staked with a 0.6-meter (2-foot) rebar stake, and labeled with a steel pin flag marked with the station number. The sample locations were later surveyed by a licensed surveyor. Excess soil from each borehole was placed in lined, labeled, 242-liter (55-gallon) drums that were sealed after each use and staged at Building 1036. Investigation-derived waste disposal for all media is discussed in Appendix H.

3.3.2.2 Field and laboratory analyses

Field classification of the soil was performed, and the data were recorded in the project logbooks in accordance with Section 4.4.2.3 of the Facility-wide SAP as specified in the Phase I RI SAP Addendum. Per the Phase I RI SAP Addendum, headspace gases were not screened in the field for organic vapors. Organic vapor measurements were made in the breathing zone during sampling and at the top of the boring and recorded in the field logbooks.

All surface soil samples were analyzed for Target Analyte List (TAL) metals, cyanide, and explosives. Forty-one samples were also analyzed for propellants. Five samples each received analyses for VOCs, SVOCs, and PCBs. The chemical analyses are presented in Appendix E of this RI report. Two disturbed geotechnical surface soil samples were collected at stations DA1-011 and DA1-17 and analyzed for grain size, moisture content, Atterberg limits, and Unified Soil Classification System (USCS) classification. The results of these analyses are presented in Appendix I of this RI report.

3.3.3 Subsurface Soil Sampling Methods

3.3.3.1 Sampling techniques

To collect subsurface samples, a decontaminated auger bucket was used to deepen the surface soil boring over the required depth interval. At locations where composite sampling was performed for explosives and propellants analyses, subsurface samples were obtained by deepening the surface soil boring located in the center of the equilateral triangle. When necessary due to obstructions by gravel or fill material, a hand-operated power auger was used to overdrill and advance the boring to the top of the subsurface interval, then a hand auger was used to collect the soil from the prescribed depths. Soil from the subsurface interval was placed into a stainless steel pan or bowl and homogenized, and representative aliquots were placed into the appropriate sample containers. All VOC samples were collected as discrete aliquots from the middle of the interval without homogenization.

On several occasions, refusal occurred when attempting to deepen the borings using the power auger. In these cases, the location was offset slightly [less than 0.3 meter (1 foot)], the power auger was used to bore to the top of the subsurface interval, and the sample was collected. Typically, two attempts were made to collect the subsurface sample at a station. If both of these attempts failed because of refusal, the subsurface sample was not collected. For stations requiring composite sampling where refusal occurred in the center boring, the subsurface samples were collected by deepening one of three surface subsampling points.

A Geoprobe rig was used to collect undisturbed geotechnical samples (Shelby tubes) at stations DA1-015 and DA1-027. Following geotechnical sample collection at station DA1-027, the Geoprobe rig was used to advance a 5-centimeter- (2-inch)-diameter steel core tube fitted with an acetate liner to collect lithologic cores to a depth of 9.1 meters (30 feet) bgs. This direct-push boring was converted to a piezometer as discussed in Section 3.5.

3.3.3.2 Field and laboratory analyses

Field classification of the soil was performed, and the results were recorded in the project logbooks in accordance with Section 4.4.2.3 of the Facility-wide SAP as specified in the Phase I RI SAP Addendum. Per the Phase I RI SAP Addendum, headspace gases were not screened in the field for organic vapors. Organic vapor measurements were made in the breathing zone during sampling and at the top of the boring and were recorded in the field logbooks.

All subsurface soil samples were analyzed for TAL metals, cyanide, and explosives. Twelve samples were also analyzed for propellants, six samples were analyzed for VOCs, six samples were analyzed for SVOCs, and five received analyses for PCBs. The chemical analyses are presented in Appendix E of this RI report.

Three disturbed geotechnical subsurface soil samples collected at stations DA1-011 [0.2 to 0.9 meter (1 to 3 feet)] and DA1-17 [0.2 to 0.9 meter (1 to 3 feet) and 0.9 to 1.5 meters (3 to 5 foot)] were analyzed for grain size, moisture content, Atterberg limits, and USCS classification. Two undisturbed geotechnical samples were collected from the 0.3- to 0.9-meter (1- to 3-foot) interval using a direct-push (Geoprobe) rig and conventional 7.6-centimeter- (3.0-inch)-diameter, 0.91-centimeter- (36-inch)-long Shelby tubes at locations DA1-015 and DA1-027. These samples were analyzed for an expanded list of geotechnical parameters including grain size, soil pH, redox potential, organic carbon content, bulk density, specific gravity, soil permeability, moisture content, and Atterberg limits in order to estimate dilution attenuation factors (DAF) for DA1 (Section 4.6). The results of these analyses are presented in Appendix I of this RI report.

3.4 SEDIMENT SAMPLING

Four sediment samples were collected in conjunction with the Phase I RI at DA1 (Table 3-2, Figure 3-1). All of the sediment stations were located outside of the AOC boundary and represented either potential accumulation points and/or exit pathways for contamination migrating off of the AOC in surface water runoff.

3.4.1 Rationale

Sediment sampling was conducted to evaluate potential contaminant accumulation and transport in the surface water migration pathway along Hinkley Creek (stations DA1-043, DA1-045, and DA1-046). Station DA1-043 was located upstream of both DA1 and NTA to provide characterization of ambient conditions. Station DA1-045 was located in Hinkley Creek at the point closest to DA1. Station DA1-046 was located along Hinkley Creek at the RVAAP exit point (HC-2) to assess potential contaminant migration off of the installation from both DA1 and NTA.

In addition, a sediment sample (station DA1-044) was collected in a low-lying area immediately east of the AOC. A defined drainage channel was not present in this area; however, visual evidence that the area was frequently inundated during storm events was noted during field activities. This station provides data as to whether contaminants potentially migrate downslope to the east and accumulate.

3.4.2 Sediment Field Sampling Methods

All sediments were collected as discrete samples from the 0- to 0.015-meter (0- to 0.5-foot) interval bgs or, for subaqueous samples, the sediment-water interface. Samples were collected using either a bucket hand auger or a stainless steel scoop or trowel as described in Section 4.2.2 of the SAP Addendum for the

DA1 Phase I RI. The VOC fraction was collected directly from the first materials obtained from the sample interval. The remaining sediments were homogenized in a stainless steel bowl before being placed into sample jars.

Visual classification of sediment materials according to the USCS was noted in the field logbooks. All samples were screened with an organic vapor analyzer in the field.

All four sediment samples were analyzed for explosives, propellants, TAL metals, cyanide, VOCs, SVOCs, PCBs, grain size distribution, and total organic carbon (TOC) content.

3.5 SURFACE WATER SAMPLING

Co-located surface water samples were collected from three of the sediment stations (DA1-043, DA1-45, and DA1-046) described in Section 3.3.1.

3.5.1 Rationale

Sampling of surface water was conducted because this medium represents the primary transport pathway within and off of the AOC (either in dissolved phase or adsorbed to particulates and sediment that are mobilized by runoff). These data were also collected to characterize ambient water quality in Hinkley Creek upstream of the AOC and to assess potential impacts at the facility exit point at HC-2.

Surface water samples were planned at all four sediment stations; however, a sample could not be collected from station DA1-044 because no water was present at the location during the time of the field investigation.

3.5.2 Surface Water Field Sampling Methods

Hand-held bottles were used to collect water in the stream adjacent to DA1. Each container was submerged into the water with the cap in place. The cap was removed, and the container was allowed to fill slowly and continuously using the cap to regulate the rate of sample entry into the container. Samples for VOC analysis were collected first. The filled container was slowly removed from the water with minimal disturbance to the sample.

In all cases, the sediment sampling was conducted after the surface water sample had been collected to minimize the amount of suspended solids in the surface water samples. Surface water sampling began at the sampling point furthest downstream in the channel and proceeded upstream to further minimize the effects of sediment turbidity on surface water quality. Field measurements performed during sample collection included pH, conductivity, temperature, and dissolved oxygen content.

All surface water samples were analyzed for explosives, propellants, TAL metals, cyanide, VOCs, SVOCs, and PCBs. Filtered samples were not collected during the Phase I RI. Analytical results for surface water are presented in Appendix F of this RI report.

3.6 GROUNDWATER SAMPLING

A groundwater sample was collected from the piezometer installed at sample location DA1-027 (Figure 3-1) in the plane storage area. This station, which lies between the AOC and Hinkley Creek, was thought to represent conditions downgradient of the site based on topographic and drainage patterns.

Because the sample was collected from a temporary piezometer, the data are considered qualitative and not sufficient to be incorporated into the human health risk evaluation. The objectives for installation of the piezometer and collection of a groundwater screening sampling were to

- evaluate whether contamination is present in groundwater and whether leaching of contaminants to groundwater near the source area is a potential problem; and
- collect preliminary hydrogeologic information (water levels) for future characterization of this area, if necessary.

A van-mounted Geoprobe rig was used to advance a boring for lithologic characterization, as described in Section 3.2.3. The direct-push boring was advanced using a 6.3-centimeter- (2-inch)-diameter stainless steel core tube fitted with acetate liners. The probe assembly was advanced in 1.2-meter (4-foot) sections by adding lengths of push rods. Upon completion of each 0.9-meter (3-foot) advance, the core tube was removed from the boring, and the liner containing a soil core was extracted. Groundwater was encountered at a depth of 5.33 meters (17.5 feet) bgs, and the boring was extended to about 9.1 meters (30 feet) bgs. Upon completion of lithologic logging, the sampling crew inserted a 3-meter- (10-foot)-long, slotted, 4.4-centimeter- (1.75-inch)-diameter polyvinyl chloride (PVC) screen and riser pipe to create a temporary piezometer straddling the water table interface. Medium-grained sand was poured into the annular space between the PVC pipe and the borehole to act as a filter for incoming groundwater.

Groundwater was collected using a peristaltic pump and flexible tubing to lift water from the piezometer. Low permeability in the saturated zone resulted in slow recharge to the borehole. Therefore, the piezometer was pumped and allowed to recover over several cycles to obtain sufficient sample volume for all required analyses.

The groundwater sample was analyzed for VOCs, SVOCs, explosives, propellants, TAL metals, PCBs, and cyanide. An ample volume of groundwater was collected so that both filtered (0.45 micron) and unfiltered specimens could be analyzed for dissolved and total metals, respectively. The fraction of the groundwater sample designated for TAL metals analysis was filtered in the field prior to analysis. Readings of pH, conductivity, and temperature were recorded in the project logbooks at the time the sample was collected.

3.7 ANALYTICAL PROGRAM OVERVIEW

Specific analyses conducted for each of the environmental media sampled are discussed in Sections 3.2 through 3.5. Sections 3.6.1 and 3.6.2 provide additional information regarding the laboratory analytical program.

3.7.1 Laboratory Analyses

All analytical laboratory procedures were completed in accordance with applicable professional standards, EPA requirements, government regulations and guidelines, and specific project goals and requirements. All samples collected during the investigation were analyzed by Quanterra Laboratories, Inc. (now known as Severn-Trent Laboratories, Inc.). The majority of analyses were performed at Quanterra’s North Canton, Ohio, facility. Explosives analyses were performed at its Knoxville, Tennessee, facility, and nitroguanidine/nitrocellulose analyses were performed at its Sacramento, California, facility. These laboratories have been validated by the USACE Missouri River Division Hazardous, Toxic, and Radioactive Waste Mandatory Center of Expertise (MCX) in Omaha, Nebraska. Quality assurance (QA) samples were collected by SAIC and submitted to GP Environmental, Inc., of

Gaithersburg, Maryland, a USACE-MCX contracted laboratory. SAIC-contracted laboratories supporting this work have statements of qualifications including organizational structures, QA manuals, and standard operating procedures that can be made available upon request.

Samples were analyzed according to the RVAAP Facility-wide SAP and the Phase I RI SAP Addendum. Prepared in accordance with USACE and EPA guidance, the SAP outlines the organization, objectives, intended data uses, and QA/quality control (QA/QC) activities to achieve the desired DQOs and to maintain the defensibility of the data. Project DQOs were established in accordance with EPA Region 5 guidance. Requirements for sample collection, handling, analysis criteria, target analytes, laboratory criteria, and data validation criteria for DA1 are consistent with EPA requirements for National Priority List sites. Analytical DQOs for this project included analytical precision, accuracy, representativeness, completeness, comparability, and sensitivity for the measurement data. Appendix D presents an assessment of those objectives as they apply to the analytical program.

Strict adherence to the requirements set forth in the SAP was required of the analytical laboratory so that conditions adverse to quality would not arise. The laboratory was required to perform all analyses in compliance with EPA SW-846 (EPA 1990), *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, analytical protocols. Chemical analytical procedures specified by EPA SW-846 were followed for the analyses of metals, VOCs, SVOCs, pesticides, PCBs, explosives, propellants, and cyanide. The laboratory was required to comply with all methods as written; recommendations were considered requirements.

The requisite number of QA/QC samples were obtained during the Phase I RI (refer to Appendix D). QC samples for this project included field blanks, trip blanks, field duplicates, laboratory method blanks, laboratory control samples, laboratory duplicates, and matrix spike/matrix spike duplicate (MS/MSD) samples. Field blanks, consisting of potable water used in the decontamination process, equipment rinsate blanks, and trip blanks, were submitted for analysis along with field duplicate (co-located) samples. These QC samples provide a means to assess the quality of the data resulting from the field sampling program. Field blank samples were analyzed to determine procedural contamination at the site that may contribute to sample contamination. Equipment rinsate blanks (associated with surface water sampling only) were used to assess the adequacy of equipment decontamination processes. Trip blanks were used to assess the potential for contamination of samples during sample shipment and storage. Field duplicate samples were analyzed to determine sample heterogeneity and sampling methodology reproducibility. Laboratory method blanks and laboratory control samples were employed to determine the accuracy and precision of the analytical method as implemented by the laboratory. Matrix spike samples provided information about the effect of the sample matrix on the measurement methodology. Laboratory sample duplicates and MSDs assisted in determining the analytical reproducibility and precision of the analysis for the samples of interest. Evaluation of these QC measures and of their contribution to documenting the project data quality is provided in Appendix D as the Quality Control Summary Report (QCSR).

SAIC is the custodian of the project file and will maintain the contents of the files for this investigation, including all relevant records, reports, logs, field notebooks, pictures, subcontractor reports, correspondence, and chain-of-custody (COC) forms. These files will remain in a secure area under the custody of the SAIC Project Manager until they are transferred to the USACE – Louisville District and RVAAP. Analytical data reports from Quanterra Laboratories, Inc. have been forwarded to the USACE-MCX laboratory for QA review and comparison. Quanterra will retain all original raw data information (both hard copy and electronic) in a secure area under the custody of the Laboratory Project Manager.

3.7.2 Data Review, Validation, and Quality Assessment

Samples were properly packaged for shipment and dispatched to Quanterra Laboratories, Inc. for analysis. A separate, signed custody record was enclosed with each shipment with sample numbers, quantities, and locations listed. When transferring the possession of samples, the individuals who relinquished and received the samples signed, dated, and noted the time on the record. All shipments were in compliance with applicable Department of Transportation regulations for environmental samples.

Data were produced, reviewed, and reported by the laboratory in accordance with specifications outlined in the project SAP and the laboratory's QA manual. Laboratory reports included documentation verifying analytical holding time compliance.

Quanterra Laboratories, Inc. performed in-house analytical data reduction under the direction of the Laboratory Project Manager and QA Officer. These individuals were responsible for assessing data quality and informing SAIC and USACE of any datum that was considered "unacceptable" or required caution on the part of the data user in terms of its reliability. Data were reduced, reviewed, and reported as described in the laboratory QA manual and standard operating procedures. Data reduction, review, and reporting by the laboratory were conducted as follows:

- Raw data produced by the analyst were turned over to the respective area supervisor.
- The area supervisor reviewed the data for attainment of QC criteria as outlined in the established methods and for overall reasonableness.
- Upon acceptance of the raw data by the area supervisor, a report was generated and sent to the Laboratory Project Manager.
- The Laboratory Project Manager thoroughly reviewed all of the reports.
- Final reports were generated by the Laboratory Project Manager.
- Data were then delivered to SAIC, and copies of all data packages were forwarded to the USACE for evaluation and preparation of QA and data validation documents.

Quanterra Laboratories, Inc. prepared and retained full analytical and QC documentation for the project in both hard copy (paper) and electronic storage media (e.g., magnetic tape) as directed by the analytical methodologies employed. The analytical laboratory provided the following information to SAIC in each analytical data package submitted:

- cover sheets listing the sample included in the report and narrative comments describing problems encountered in analysis;
- tabulated results of inorganic and organic compounds identified and quantified; and
- analytical results for QC sample spikes, sample duplicates, initial and continuing calibration verifications of standards and blanks, method blanks, and laboratory control sample information.

A systematic process for data verification and evaluation was performed by SAIC to ensure that the precision and accuracy of the analytical data were adequate for their intended use. Analytical data verification equivalent to EPA Tier II validation was performed on 100 percent of the sample delivery groups to minimize the potential of using false positive or false negative results in the decision-making process (i.e., to ensure accurate identification of detected versus non-detected compounds). This approach was consistent with the DQOs for the project and with the analytical methods and was appropriate for determining contaminants of concern and for calculating risk. Samples were identified thorough implementation of "definitive" analytical methods. "Definitive" analytical methods are considered as methods, which are consistent with the protocols and procedures as presented by EPA methodologies (i.e., SW-846 Methods, EPA Drinking Water Methods, etc.) and are performed by a USACE-validated laboratory applying comprehensive analytical QC measures. "Definitive data" were reported consistent with the deliverables identified in the project statement of work. These "definitive data" were then validated through the review process outlined in the SAP and presented in Appendix E.

4.0 INVESTIGATION RESULTS

This chapter presents results of the Phase I RI data screening process to identify constituents indicative of impacts from AOC operations. The constituents that are deemed to be related to AOC operations are classified as SRCs. These SRCs are then evaluated to determine their occurrence and distribution in environmental media at DA1. The data incorporated in the evaluation include only those from the Phase I RI. The limited amount of historical data obtained during previous investigations (see Section 1.3.3) were not used quantitatively during the evaluation due to the lack of data quality documentation.

Section 4.1 of this chapter presents the statistical methods and facility-wide background screening criteria used to distinguish naturally occurring constituents from SRCs indicative of impacts from historical site operations. Sections 4.2 through 4.5 present nature and extent of identified SRCs within each of the data aggregates (surface soil, subsurface soil, sediment, and surface water) established for the purposes of this Phase I RI report. A summary of the results of the ordnance and explosives avoidance survey are presented in Section 4.6. Summary analytical results are presented in graphical or tabular formats in the sections addressing each environmental media. Complete analytical results are contained within Appendix E.

Some SRCs were identified at concentrations potentially posing a risk to human health or the environment based on additional risk screening processes discussed in Chapter 5.0; these SRCs are denoted as COPCs. The occurrence and distribution of those contaminants identified as COPCs are of particular interest and represent the focus of the evaluation in this chapter.

4.1 DATA EVALUATION METHODS

The processes used to evaluate DA1 Phase I RI analytical data for each environmental media involve four general steps: (1) reducing initial data; (2) defining data aggregates; (3) assessing data quality; and (4) screening against statistical, background, and weight-of-evidence criteria. The data evaluation methods applied for this study are consistent with those established in the Phase I RI for 11 High-Priority AOCs at RVAAP (USACE 1997). Screening methods were applied as specified in the DA1 Phase I RI SAP (USACE 1999a); no modifications were required during the time period between execution of field activities and issuance of this report.

4.1.1 Initial Data Reduction

More than 130 environmental soil, sediment, surface water, and field QC samples were collected with approximately 7,300 discrete analyses (i.e., analytes) being obtained, reviewed, and integrated into this RI. These totals do not include field measurements and field descriptions. Analytical results were reported by the laboratory in electronic format and loaded into a database. Verification of data was performed to ensure all requested data was received and complete. A data validation process (equivalent to EPA Tier II validation) was performed to document data quality. Data validation included evaluation of the following parameters:

- data completeness;
- holding times;
- calibration (initial and continuing);
- method blanks;
- sample results verification;

- surrogate recovery;
- laboratory control standard (LCS) analysis;
- internal standard performance;
- MS recovery;
- duplicate analysis comparison;
- reported detection limits;
- compound, element, and isotope quantification;
- reported detection levels; and
- secondary dilutions.

Validation qualifiers were assigned to each result based on the technical assessment of the validation criteria. Results were qualified as follows:

- U – Not detected
- UJ – Not detected, detection limit estimated
- J – Analyte present but concentration estimated
- R – Result not usable
- = – Analyte present and concentration accurate

In addition to assigning qualifiers, the validation process also selected the appropriate result to use when reanalyses or dilutions were performed. Where laboratory surrogate recovery data or laboratory quality control samples were outside of analytical method specifications, a determination was made regarding whether or not laboratory reanalysis should be used in place of an original reported result. If results were reported for both diluted and undiluted samples, results from the diluted sample were used only for those analytes that exceeded the calibration range of the undiluted sample.

A complete discussion of the results of the validation process is contained in the data QCSR presented in Appendix D. A summary of the results of the data quality assessment contained in the QCSR is presented in the sections below.

4.1.2 Definition of Aggregates

Results from the DA1 samples were grouped into data aggregates to produce statistical summaries, conduct the evaluation of contaminant occurrence and distribution, and perform the risk screening. These data aggregates were selected to be consistent with the facility-wide background criteria and risk screening approach. For soil, samples were grouped into a surface soil data aggregate, representing the interval from 0 to 0.3 meter (0 to 1 foot) bgs, and a subsurface soil interval, containing all samples collected greater than 0.3 meter (1 foot) bgs. All sediment samples were grouped into one data aggregate. Surface water samples were also grouped into one data aggregate. The groundwater sample collected from the piezometer installed in boring DA1-027 is considered as a screening sample only. These groundwater data are employed qualitatively to assess potential occurrence of contamination; however, they were not included in the risk screening process.

Sample groupings or data aggregates related to specific functional areas of DA1 (i.e., the berm, former OB/OD area within the berm, etc.) were not constructed for the purposes of data screening or the risk evaluation. However, analytical results for each environmental medium were evaluated qualitatively to determine whether any clustering of SRCs occurred within a particular functional area. Where such clustering was evident, a description of the types of SRCs and area of concentration was included in the occurrence and distribution discussions for each medium.

4.1.3 Data Quality Assessment

QA and QC procedures were followed to assure that data collected would meet the DQOs established in the Facility-wide SAP and the DA1 Phase I RI Addendum. The procedures and results of data quality assessment are described in the QCSR (Appendix D).

More than 99 percent of the data were considered of usable quality. Some analytical results were rejected for use based on the data validation criteria. The rejected results were primarily antimony in soil and hexachlorocyclopentadiene in water. Of the 113 soil grab samples analyzed for antimony, 19 were rejected because large negative blank values and low matrix spike recoveries increased the possibility of false negative results. Results for hexachlorocyclopentadiene in all four water samples collected were rejected because of low matrix spike recoveries. Two 3,3'-dichlorobenzidine, one 4-chlorobenzenamine, and one arsenic result were also rejected because of poor matrix spike recoveries.

Laboratory reporting limits were compared to the project quantitation goals to assure that analytes could be detected at concentrations low enough to meet project objectives. Reporting limits were at or below the project quantitation goals for all analytes in water samples.

Reporting limits were more variable in soil and sediment because of variability in sample size and moisture content. The lowest reporting levels were generally close to the quantitation limit goals. Overall data quality was good and sufficient to achieve the DQOs of this Phase I RI.

4.1.4 Data Screening

The data screening process employed to identify SRCs involved first calculating data summary statistics. Data were then evaluated using (1) a frequency of detection/weight of evidence screen, (2) screening against established facility-wide background values, and (3) screening of essential nutrients. All analytes having at least one detected value were included in the screening process. Analytes that were never detected were eliminated as SRCs. Site data were extracted from the database such that QC splits and field duplicates were excluded from the screening data sets. Samples that were rejected during data validation were excluded from the screening process. Additional screening of identified SRCs was conducted as part of the risk evaluation to identify human health and ecological COPCs (see Chapter 5.0).

4.1.4.1 Summary statistics and frequency of detection screen

Summary statistics calculated for each data aggregate included the minimum, maximum, and average (mean) detected values and the proportion of detected results to the total number of samples collected. Tables 4-1 through 4-4 show summary statistics for each constituent detected at least once. Non-detected results meeting contract-required detection limits were set to one-half of the reported detection limit during calculation of the mean result for each compound. Non-detected results with elevated detection limits (more than 5 times the contract-required detection limit) were excluded from the summary statistics in order not to skew the calculation of mean values.

For sample aggregates containing more than 20 samples (surface soil, subsurface soil, and sediment), a frequency of detection criterion greater than or equal to 5 percent was used to identify inorganic constituents, SVOCs, and VOCs as SRCs. If the frequency of detection for one of these classes of analytes was less than 5 percent, a weight-of-evidence approach was used to determine if the chemical was an SRC. The weight-of-evidence approach involved examining the magnitude and locations (clustering) of the detected results. If no clustering within a particular area was noted and concentrations were not substantially elevated relative to the detection limits, the detected results were considered spurious, and the compound was eliminated as an SRC.

Table 4-1. Summary Statistics and Determination of SRCs in Surface Soil

Analyte	**Units**	**Results > Detection Limit**	**Average Result**[a]	**Minimum Detect**	**Maximum Detect**	**Site Background Criteria**	**Site Related?**
Explosives and Propellants							
1,3,5-Trinitrobenzene	mg/kg	1/ 42	0.87	0.46	0.46	NB	Yes
2,4,6-Trinitrotoluene	mg/kg	6/ 42	48.02	0.15	2,000.00	NB	Yes
2,4-Dinitrotoluene	mg/kg	3/ 42	0.86	0.13	0.20	NB	Yes
HMX	mg/kg	1/ 42	1.67	0.20	0.20	NB	Yes
Nitrocellulose	mg/kg	4/ 42	5.42	2.20	175.00	NB	Yes
Nitroguanidine	mg/kg	3/ 42	0.12	0.04	0.12	NB	Yes
Inorganics							
Aluminum	mg/kg	42/ 42	13,370.00	1,730.00	85,700.00	17,700.00	Yes
Antimony	mg/kg	8/ 36	1.29	0.54	19.80	0.96	Yes
Arsenic	mg/kg	42/ 42	10.98	5.00	31.40	15.40	Yes
Barium	mg/kg	42/ 42	184.10	23.40	1,840.00	88.40	Yes
Beryllium	mg/kg	15/ 42	0.27	0.15	0.94	0.88	Yes
Cadmium	mg/kg	13/ 42	122.90	0.27	4,910.00	0.00	Yes
Calcium[b]	mg/kg	42/ 42	33,500.00	250.00	248,000.00	15,800.00	No
Chromium	mg/kg	42/ 42	18.51	3.40	174.00	17.40	Yes
Cobalt	mg/kg	42/ 42	8.34	2.70	26.50	10.40	Yes
Copper	mg/kg	42/ 42	436.00	5.80	7,250.00	17.70	Yes
Cyanide	mg/kg	1/ 42	0.31	0.83	0.83	0.00	No
Iron[b]	mg/kg	42/ 42	25,120.00	5,820.00	231,000.00	231,00.00	No
Lead	mg/kg	42/ 42	48.99	8.00	772.00	26.10	Yes
Magnesium[b]	mg/kg	42/ 42	2,439.00	797.00	5,300.00	3,030.00	No
Manganese	mg/kg	42/ 42	943.90	138.00	14,600.00	1,450.00	Yes
Mercury	mg/kg	30/ 42	0.05	0.01	0.16	0.04	Yes
Nickel	mg/kg	42/ 42	20.28	7.90	82.70	21.10	Yes
Potassium[b]	mg/kg	42/ 42	1,029.00	302.00	2,950.00	927.00	No
Selenium	mg/kg	13/ 42	0.72	0.57	6.10	1.40	Yes
Silver	mg/kg	3/ 42	0.58	0.31	0.41	0.00	Yes
Sodium[b]	mg/kg	1/ 42	132.40	293.00	293.00	123.00	No
Thallium	mg/kg	35/ 42	0.29	0.14	0.48	0.00	Yes
Vanadium	mg/kg	42/ 42	17.10	3.80	26.60	31.10	No
Zinc	mg/kg	42/ 42	504.60	31.90	6,320.00	61.80	Yes
Semivolatile Organic Compounds							
2-Methylnaphthalene	mg/kg	1/ 5	0.18	0.04	0.04	NB	Yes
Bis(2-ethylhexyl)phthalate	mg/kg	1/ 5	0.17	0.05	0.05	NB	Yes
Pyrene	mg/kg	1/ 5	0.18	0.05	0.05	NB	Yes
Volatile Organic Compounds							
Acetone	mg/kg	1/ 5	0.01	0.01	0.01	NB	Yes
Dimethylbenzene	mg/kg	1/ 5	0.003	0.002	0.002	NB	Yes
Toluene	mg/kg	2/ 5	0.003	0.003	0.005	NB	Yes

[a] Values less than the detection limit were set to one-half of the reporting limit in calculation of the average.
[b] Eliminated as an SRC based on the essential element screen.
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.
NB = No facility-wide background criterion established.

Table 4-2. Summary Statistics and Determination of SRCs in Subsurface Soil

Analyte	**Units**	**Results > Detection Limit**	**Average Result[a]**	**Minimum Detect**	**Maximum Detect**	**Site Background Criteria**	**Site Related?**
Explosives and Propellants							
2,4,6-Trinitrotoluene	mg/kg	1/ 70	0.12	0.12	0.12	NB	Yes
Inorganics							
Aluminum	mg/kg	70/ 70	13,000.00	6,280.00	28,600.00	19,500.00	Yes
Antimony	mg/kg	10/ 58	0.65	0.54	1.30	0.96	Yes
Arsenic	mg/kg	69/ 69	15.01	8.30	21.90	19.80	Yes
Barium	mg/kg	70/ 70	75.38	26.10	179.00	124.00	Yes
Beryllium	mg/kg	31/ 70	0.36	0.29	0.80	0.88	No
Cadmium	mg/kg	2/ 70	1.87	0.27	110.00	0.00	Yes
Calcium[b]	mg/kg	68/ 70	5,088.00	569.00	35,700.00	35,500.00	No
Chromium	mg/kg	70/ 70	18.58	10.10	34.70	27.20	Yes
Cobalt	mg/kg	70/ 70	11.34	4.50	20.50	23.20	No
Copper	mg/kg	70/ 70	31.12	9.20	597.00	32.30	Yes
Iron[b]	mg/kg	69/ 69	29,020.00	18,000.00	49,200.00	35,200.00	No
Lead	mg/kg	70/ 70	19.00	8.70	401.00	19.10	Yes
Magnesium[b]	mg/kg	70/ 70	3,902.00	1,450.00	9,170.00	8,790.00	No
Manganese	mg/kg	70/ 70	366.00	103.00	2,180.00	3,030.00	No
Mercury	mg/kg	42/ 70	0.03	0.01	0.29	0.04	Yes
Nickel	mg/kg	70/ 70	27.73	11.40	55.90	60.70	No
Potassium[b]	mg/kg	70/ 70	1,691.00	506.00	4,430.00	3,350.00	No
Selenium	mg/kg	17/ 70	0.41	0.46	1.20	1.50	No
Silver	mg/kg	1/ 70	0.60	0.48	0.48	0.00	No
Sodium[b]	mg/kg	1/ 70	112.70	669.00	669.00	145.00	No
Thallium	mg/kg	58/ 70	0.34	0.24	0.49	0.91	No
Vanadium	mg/kg	70/ 70	20.91	11.60	39.90	37.60	Yes
Zinc	mg/kg	70/ 70	106.30	35.60	2,830.00	93.30	Yes
Semivolatile Organic Compounds							
Bis(2-ethylhexyl)phthalate	mg/kg	1/ 6	0.18	0.04	0.04	NB	Yes
Volatile Organic Compounds							
Acetone	mg/kg	2/ 6	0.01	0.004	0.02	NB	Yes
Dimethylbenzene	mg/kg	1/ 6	0.003	0.001	0.001	NB	Yes
Methylene chloride	mg/kg	1/ 6	0.003	0.001	0.001	NB	Yes
Styrene	mg/kg	1/ 6	0.003	0.001	0.001	NB	Yes
Toluene	mg/kg	4/ 6	0.004	0.002	0.01	NB	Yes

[a] Values less than the detection limit were set to one-half of the reporting limit in calculation of the average.

[b] Eliminated as an SRC based on the essential element screen.

NB = No facility-wide background criterion established.

Table 4-3. Summary Statistics and Determination of SRCs in Sediment

Analyte	Units	Results > Detection Limit	Average Result[a]	Minimum Detect	Maximum Detect	Site Background Criteria	Site Related?
Inorganics							
Aluminum	mg/kg	4/ 4	8,268.00	2,570.00	14,400.00	13,900.00	Yes
Arsenic	mg/kg	4/ 4	6.15	5.20	7.60	19.50	No
Barium	mg/kg	4/ 4	49.05	19.90	85.40	123.00	No
Calcium[b]	mg/kg	4/ 4	1,293.00	563.00	1,960.00	5,510.00	No
Chromium	mg/kg	4/ 4	10.80	4.10	18.80	18.10	Yes
Cobalt	mg/kg	4/ 4	5.28	3.50	9.40	9.10	Yes
Copper	mg/kg	4/ 4	9.73	3.40	15.90	27.60	No
Iron[b]	mg/kg	4/ 4	14,290.00	9,360.00	25,200.00	28,200.00	No
Lead	mg/kg	4/ 4	13.43	5.00	31.10	27.40	Yes
Magnesium[b]	mg/kg	4/ 4	1,873.00	852.00	3,690.00	2,760.00	No
Manganese	mg/kg	4/ 4	223.70	91.90	350.00	1,950.00	No
Mercury	mg/kg	4/ 4	0.03	0.01	0.06	0.06	No
Nickel	mg/kg	4/ 4	13.63	8.10	25.40	17.70	Yes
Potassium[b]	mg/kg	4/ 4	797.80	292.00	1,460.00	1,950.00	No
Thallium	mg/kg	2/ 4	0.31	0.30	0.33	0.89	No
Vanadium	mg/kg	4/ 4	12.65	3.70	21.60	26.10	No
Zinc	mg/kg	4/ 4	49.98	34.00	73.60	532.00	No
Miscellaneous							
Total organic carbon	mg/kg	4/ 4	9,710.00	140.00	34,000.00	NB	NA
PCBs							
PCB-1260	mg/kg	1/ 4	0.02	0.01	0.01	NB	Yes
Volatile Organic Compounds							
Acetone	mg/kg	1/ 4	0.01	0.01	0.01	NB	Yes

[a] Values less than the detection limit were set to one-half of the reporting limit in calculation of the average.
[b] Eliminated as an SRC based on the essential element screen.
NA = Not applicable.
NB = No facility-wide background criterion established.
PCB = Polychlorinated biphenyl.

Table 4-4. Summary Statistics and Determination of SRCs in Surface Water

Analyte	Units	Results > Detection Limit	Average Result[a]	Minimum Detect	Maximum Detect	Site Background Criteria	Site Related?
Explosives and Propellants							
RDX	µg/L	1/ 3	0.25	0.24	0.24	NB	Yes
Inorganics							
Barium	µg/L	3/ 3	40.67	38.00	44.00	47.50	No
Calcium[b]	µg/L	3/ 3	49,070.00	47,900.00	50,200.00	41,400.00	No
Zinc	µg/L	1/ 3	66.67	180.00	180.00	42.00	Yes
Semivolatile Organic Compounds							
Bis(2-ethylhexyl)phthalate	µg/L	3/ 3	4.50	3.90	5.10	NB	Yes
Volatile Organic Compounds							
Acetone	µg/L	3/ 3	5.87	5.00	7.50	NB	Yes
Chloroform	µg/L	1/ 3	2.07	1.20	1.20	NB	Yes
Toluene	µg/L	2/ 3	1.43	0.79	1.00	NB	Yes

[a] Values less than the detection limit were set to one-half of the reporting limit in calculation of the average.
[b] Eliminated as an SRC based on the essential element screen.
NB = No facility-wide background criterion established.
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.

All detected explosives and propellants were considered as SRCs irregardless of the frequency of detection and subjected to the risk evaluation (Chapter 5.0). However, appropriate qualification is made in the assessment of occurrence and distribution for those explosives and propellants having a frequency of detection less than 5%.

4.1.4.2 Facility-wide background screen

For each inorganic constituent passing the frequency of detection screen, concentrations were compared against final facility-wide background values established in the WBG Phase II RI report (USACE 1999c). Background criteria for all analytes detected at least once are included in the screening summary tables for each data aggregate (Tables 4-1 through 4-4). For inorganic constituents, if the maximum detected concentration of an analyte exceeded its respective background criterion, it was considered to be an SRC. In the event a constituent was not detected in the background data set, the background value was set to zero, and any detected result for that constituent was considered above background. This conservative process ensured that detected constituents were not eliminated as SRCs simply because they were not detected in the background data set. All organic compounds that passed the frequency of detection screen were considered to be above background because these classes of compounds do not occur naturally.

4.1.4.3 Essential nutrients screen

Chemicals that are considered as essential nutrients (calcium, chloride, iodine, iron, magnesium, potassium, phosphorus, and sodium) are an integral part of the food supply and are often added to foods as supplements. Thus, these constituents are not generally addressed as contaminants (EPA 1989, 1996) unless they are grossly elevated relative to background values. For the DA1 Phase I RI, analyses were conducted for calcium, iron, magnesium, potassium, and sodium. These five constituents were eliminated as SRCs in all environmental media based on comparison to background values.

4.1.5 Data Presentation

Within each of the sections addressing the nature and extent of contamination, analytical results for SRCs are presented as tabular summaries. Selected constituents are presented in graphical format to depict aerial distribution. Because sampling depths were limited to 1.5 meters (5 feet) bgs in almost all cases, vertical profiles of contaminant distribution were not prepared. Data summary statistics and screening results to identify SRCs in each data aggregate are presented in Tables 4-1 through 4-4.

All identified SRCs are evaluated within the text of the contaminant occurrence and distribution sections below. However, certain SRCs are of specific interest and represent the focus of the assessment. The basis for identifying SRCs of specific interest involved several considerations. Those SRCs known to be related to historical operations (i.e., explosives and propellants) are highlighted. SRCs that were most frequently detected (i.e., in greater than 50 percent of samples) or at the highest concentrations above background also represent a focus for discussion. In addition, certain SRCs occurred at concentrations high enough to exceed risk-based screening criteria, as presented in Chapter 5.0; therefore, these constituents also represent a focus for evaluation. For a particular data aggregate, graphical depictions in each chemical class of compounds are typically limited to four or five SRCs of specific interest for clarity of presentation.

4.2 SURFACE SOIL

4.2.1 Geotechnical Results

Disturbed geotechnical samples were collected from surface soil stations DA1-011 and DA1-017 and analyzed for moisture content, Atterberg limits, grain size distribution, and USCS classification. DA1-011 is located on the northern edge of the AOC on top of the berm, while DA1-017 is located approximately in the middle of the former OB/OD area inside the berm. Table 4-5 provides a summary of the data obtained from the geotechnical analysis; Appendix I contains complete analytical results.

Table 4-5. Geotechnical Data for Demolition Area 1 Phase I RI Surface Soil Samples

Sample Station	**DA1-011**	**DA1-017**
Depth of sample	0 – 1 foot	0 – 1 foot
Moisture content (%)	22.3	20.4
Atterberg limits: LL	Non-plastic	43.3
PL		22.7
PI		20.60
USCS classification	SC (clayey sand)	CL (lean clay)
Grain Size Analysis (% passing)		
3 inches – 3/4 inch	100	100
3/8 inch	100	100
#4	79.54	99.90
#10	66.06	99.72
#20	59.87	99.58
#40	56.97	99.52
#60	52.85	99.46
#140	24.31	99.35
#200	22.85	99.34

LL = Liquid limit.
PI = Plasticity index.
PL = Plastic limit.
USCS = U.S. Classification System.

4.2.2 Explosives and Propellants

4.2.2.1 Explosives

Four explosives were detected at least once in DA1 surface soil samples collected during the Phase I RI. Table 4-6 presents a summary of analytical results for all detected explosive compounds. Of the detected explosive compounds, 2,4,6-TNT was the most widespread, occurring in 14 percent (6 of 42) of the sample population. Three other explosive compounds were detected: 2,4-DNT in 3 of 42 samples; 1,3,5-trinitrobenzene (TNB) in 1 of 42 samples; and octahydro-1,3,5,5-tetranitro-1,3,5,7-tetrazocine (HMX) in 1 of 42 samples (Table 4-1). The distribution of explosives and propellants in surface soil at DA1 is illustrated on Figure 4-1.

Evaluation of the explosives data for surface soil shows that the overall extent of these compounds is scattered across the AOC, with detectable concentrations only in the northern half of the former OB/OD area and randomly distributed along the top of the berm. In the plane storage area outside of the berm, detectable explosives were clustered along the southern portion of the AOC, which is consistent with the predominant drainage patterns. The occurrence of the detected explosive compounds is described in detail below.

Table 4-6. Explosives and Propellants Detected in Surface Soil at Demolition Area 1

Location		**Inside Bermed Area**	**Inside Bermed Area**	**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**	**On Berm**
Station		**DA1-041**	**DA1-014**	**DA1-022**	**DA1-029**	**DA1-030**	**DA1-001**
Sample ID		**DA10111**	**DA10029**	**DA10054**	**DA10076**	**DA10079**	**DA10001**
Customer ID		**DA1ss-041-0111-SO**	**DA1ss-014-0029-SO**	**DA1ss-022-0054-SO**	**DA1ss-029-0076-SO**	**DA1ss-030-0079-SO**	**DA1ss-001-0001-SO**
Date		**11/03/1999**	**10/21/1999**	**10/25/1999**	**10/26/1999**	**10/26/1999**	**10/19/1999**
Depth (feet)		**0 - 1**	**0 - 1**	**0 - 1**	**0 - 1**	**0 - 1**	**0 - 1**
Field Type		**Grab**	**Grab**	**Grab**	**Grab**	**Grab**	**Grab**
Analyte	Units						
1,3,5-Trinitrobenzene	mg/kg				0.46 =		
2,4,6-Trinitrotoluene	mg/kg	0.15 J			0.82 =	6.6 =	1.8 =
2,4-Dinitrotoluene	mg/kg		0.13 J	0.2 J			
HMX	mg/kg						
Nitrocellulose	mg/kg			3.8 =		2.6 =	
Nitroguanidine	mg/kg	0.083 J					

Location		**On Berm**	**On Berm**	**On Berm**	**On Berm**	**South Ditch Line**
Station		**DA1-003**	**DA1-005**	**DA1-006**	**DA1-010**	**DA1-040**
Sample ID		**DA10005**	**DA10009**	**DA10011**	**DA10019**	**DA10109**
Customer ID		**DA1ss-003-0005-SO**	**DA1ss-005-0009-SO**	**DA1ss-006-0011-SO**	**DA1ss-010-0019-SO**	**DA1ss-040-0109-SO**
Date		**10/19/1999**	**10/19/1999**	**10/20/1999**	**10/20/1999**	**11/03/1999**
Depth (feet)		**0 - 1**	**0 - 1**	**0 - 1**	**0 - 1**	**0 - 1**
Field Type		**Grab**	**Grab**	**Grab**	**Grab**	**Grab**
Analyte	Units					
1,3,5-Trinitrobenzene	mg/kg					
2,4,6-Trinitrotoluene	mg/kg				2.9 =	2000 =
2,4-Dinitrotoluene	mg/kg				0.13 J	
HMX	mg/kg	0.2 J				
Nitrocellulose	mg/kg			2.2 =		175 =
Nitroguanidine	mg/kg		0.12 J			0.035 J

= = Analyte present and concentration accurate.
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.
J = Estimated value less than laboratory reporting limit.

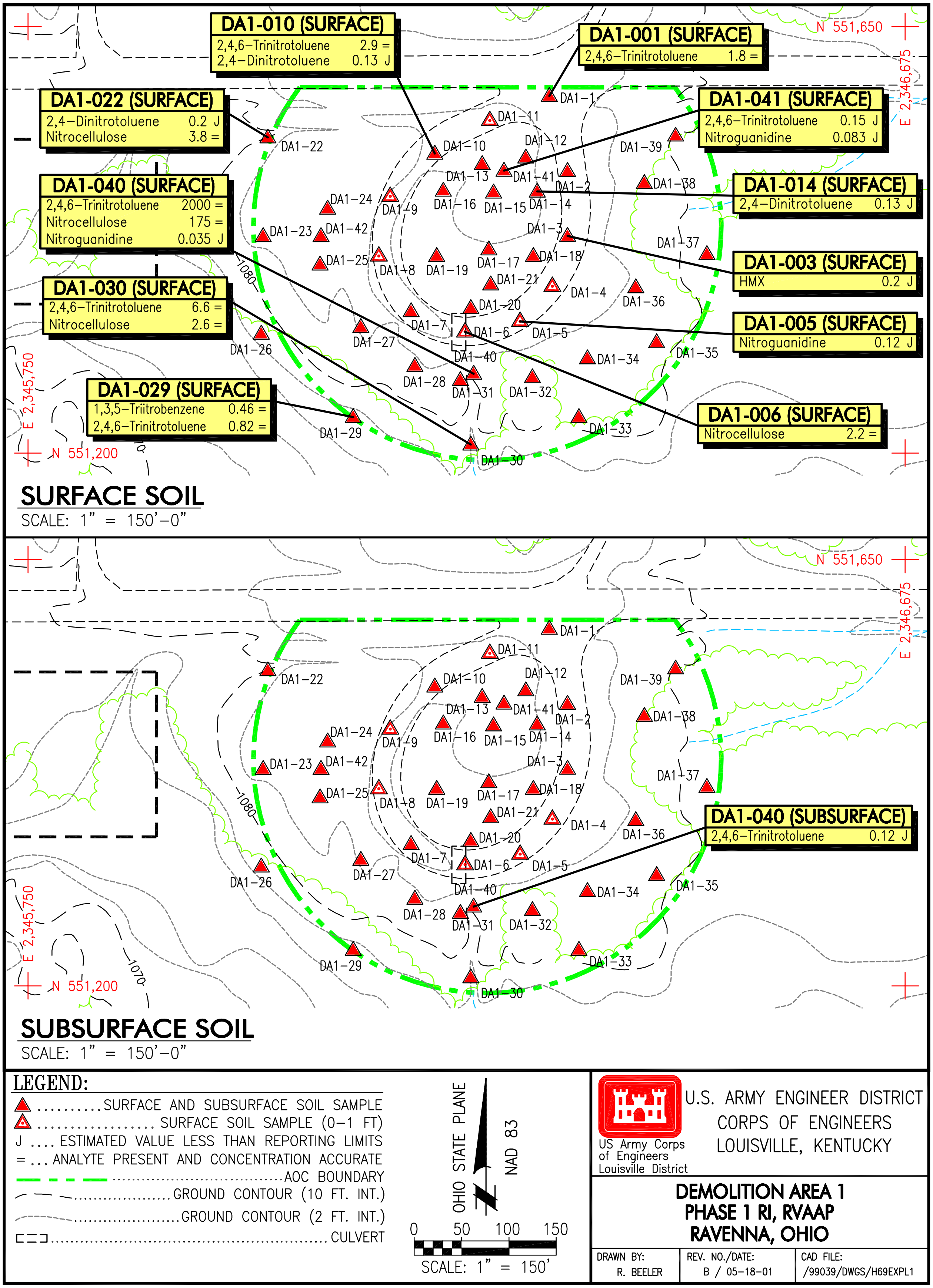


Figure 4-1. Maximum Detected Explosives and Propellants in Surface and Subsurface Soil

- **2,4,6-Trinitrotoluene.** This explosive compound occurred at two locations (DA1-001 and DA1-041) within the former OB/OD area and at one station (DA1-010) along the top of the bermed area. Concentrations at these stations ranged from 0.15J mg/kg (the J qualifier denoting an estimated value less than reporting limits) to 2.9 mg/kg. Three stations in the southern plane storage area had detectable levels of 2,4,6-TNT. The highest concentration (2,000 mg/kg) occurred at station DA1-040 in the ditch draining the former OB/OD area. Much lower concentrations of this explosive (6.6 mg/kg) were found at station DA1-030, which is also located in the drainage ditch at the southern AOC boundary where it is almost indistinguishable.

- **2,4-Dinitrotoluene.** Low estimated concentrations (0.2 mg/kg or less) were detected at three locations in the northern portion of the AOC: station DA1-014 within the former OB/OD area, station DA1-010 on top of the berm, and station DA1-022 at the western boundary of the AOC.

- **1,3,5-Trinitrobenzene.** This explosive was detected on one occasion (station DA1-029) on the southwestern boundary of the AOC.

- **HMX.** This compound was also detected on one occasion (station DA1-003) at station DA1-003 located on top of the berm.

4.2.2.2 Propellants

Two propellants, nitrocellulose and nitroguanidine, were detected in 4 of 42 and 3 of 42 samples, respectively. As with the explosive compounds, detectable levels of propellants are somewhat sporadic across the AOC and occur within the former OB/OD area, on top of the berm, and in the plane storage area. Concentrations of nitroguanidine are all 0.12 mg/kg or less, while nitrocellulose concentrations are somewhat higher, particularly at station DA1-040 along the southern drainage ditch (175 mg/kg).

4.2.3 TAL Metals and Cyanide

Table 4-1 contains summary statistics and results of the background comparison for inorganic compounds (metals and cyanide) in surface soil. A total of 24 inorganic compounds were detected at least once in surface soil samples collected during the Phase I RI. Seven of the detected constituents were eliminated as potential surface soil SRCs because they were either considered as essential nutrients (calcium, iron, potassium, magnesium, and sodium), the frequency of detection was less than 5 percent (cyanide), or the maximum detected value did not exceed the background criterion (vanadium). Cadmium, silver, and thallium were retained as SRCs because they were detected in surface soil, but these constituents were not detected in the background sample population and the background value was set to zero.

Of those 17 metals retained as SRCs and carried forward to the risk screening step (Chapter 5.0), aluminum, arsenic, barium, chromium, cobalt, copper, lead, manganese, nickel, and zinc were detected in every sample analyzed. Copper, mercury, and zinc exceeded their background criteria in more than 50 percent of the samples and are considered as prevalent inorganic SRCs. In addition, barium is considered a prevalent SRC because it was detected above background in 45 percent of the sample population. Table 4-7 provides summary data for inorganic SRCs in surface soil at DA1. To provide a representative illustration of the nature and extent for this class of contaminants, the distribution and magnitude of the four prevalent SRCs are shown on Figures 4-2 through 4-5.

In general, the occurrence of metals above background criteria occurred throughout the AOC, with slightly higher concentrations and greater frequency in the western portion of the plane storage area. The maximum concentration of most inorganics in surface soil occurred in one of a cluster of stations,

Table 4-7. Summary of Principal Site-Related Inorganics in Surface Soil

Location		**On Berm**	**On Berm**	**On Berm**	**On Berm**	**On Berm**
Station		**DA1-001**	**DA1-002**	**DA1-003**	**DA1-004**	**DA1-005**
Customer ID		**DA1ss-001-0001-SO**	**DA1ss-002-0003-SO**	**DA1ss-003-0005-SO**	**DA1ss-004-0007-SO**	**DA1ss-005-0009-SO**
Date		**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**
Depth (feet)		**0 - 1**	**0 - 1**	**0 - 1**	**0 - 1**	**0 - 1**
Field Type		**Grab**	**Grab**	**Grab**	**Grab**	**Grab**
Analyte	Units					
Aluminum	mg/kg	15,000 J	1,940 J	3,000 J	3,610 J	4,300 J
Antimony	mg/kg					
Arsenic	mg/kg	14.5 =	6.2 =	5.3 =	11 =	7.9 =
Barium	mg/kg	86.9 =	58.6 =	177 = *	96.5 = *	93.9 = *
Beryllium	mg/kg					
Cadmium	mg/kg				0.27 J *	1 = *
Chromium	mg/kg	19.5 = *	4.3 =	4.4 =	7.2 =	4.1 =
Cobalt	mg/kg	10.7 = *	3.6 J	2.7 J	3.1 J	3.2 J
Copper	mg/kg	24.3 J *	7.1 J	8.9 J	13.6 J	10.9 J
Lead	mg/kg	18.4 =	10.5 =	11.2 =	13.9 =	14.6 =
Manganese	mg/kg	739 J	376 J	531 J	523 J	463 J
Mercury	mg/kg	0.041 J *	0.0078 J	0.02 J	0.024 J	0.013 J
Nickel	mg/kg	22 J *	11.5 J	9.9 J	12.5 J	10.6 J
Selenium	mg/kg	0.57 J				
Silver	mg/kg					
Thallium	mg/kg	0.42 J *	0.21 J *	0.15 J *	0.14 J *	0.29 J *
Zinc	mg/kg	103 J *	31.9 J	31.9 J	43.4 J	45.4 J

Table 4-7. Summary of Principal Site-Related Inorganics in Surface Soil (continued)

Location		**On Berm**	**On Berm**	**On Berm**	**On Berm**	**On Berm**
Station		**DA1-005**	**DA1-006**	**DA1-007**	**DA1-008**	**DA1-009**
Customer ID		**DA1ss-005-0127-SO**	**DA1ss-006-0011-SO**	**DA1ss-007-0013-SO**	**DA1ss-008-0015-SO**	**DA1ss-009-0017-SO**
Date		**10/19/1999**	**10/20/1999**	**10/20/1999**	**10/20/1999**	**10/20/1999**
Depth (feet)		**0 - 1**	**0 - 1**	**0 - 1**	**0 - 1**	**0 - 1**
Field Type		**Field Duplicate**	**Grab**	**Grab**	**Grab**	**Grab**
Analyte	Units					
Aluminum	mg/kg	2,760 J	3,610 =	10,700 =	7,240 =	1,730 =
Antimony	mg/kg		0.61 J	1.4 J *	0.54 J	
Arsenic	mg/kg	7.7 =	8.6 =	6.4 =	5 =	5.1 =
Barium	mg/kg	71.1 =	124 = *	310 = *	252 = *	92.1 = *
Beryllium	mg/kg		0.34 J	0.81 =	0.94 = *	0.15 J
Cadmium	mg/kg	0.81 = *	0.91 = *	14 = *	1.1 = *	0.5 J *
Chromium	mg/kg	4.3 =	6.2 =	10.4 =	4.1 =	3.4 =
Cobalt	mg/kg	2.4 J	5.3 J	4.6 J	3.8 J	2.8 J
Copper	mg/kg	10.6 J	35.4 = *	152 = *	55.2 = *	25.2 = *
Lead	mg/kg	15.1 =	17 =	196 = *	12.4 =	8.2 =
Manganese	mg/kg	320 J	502 =	1,070 =	947 =	519 =
Mercury	mg/kg	0.011 J	0.013 J	0.16 J *	0.076 J *	0.023 J
Nickel	mg/kg	8 J	20 =	19.8 =	15.4 =	11.8 =
Selenium	mg/kg					
Silver	mg/kg					
Thallium	mg/kg	0.19 J *	0.23 J *	0.14 J *	0.22 J *	0.2 J *
Zinc	mg/kg	38.9 J	107 = *	191 = *	63.9 = *	33.9 =

Table 4-7. Summary of Principal Site-Related Inorganics in Surface Soil (continued)

Location		**On Berm**	**On Berm**	**Inside Bermed Area**	**Inside Bermed Area**	**Inside Bermed Area**
Station		**DA1-010**	**DA1-011**	**DA1-012**	**DA1-013**	**DA1-014**
Customer ID		**DA1ss-010-0019-SO**	**DA1ss-011-0021-SO**	**DA1ss-012-0023-SO**	**DA1ss-013-0026-SO**	**DA1ss-014-0029-SO**
Date		**10/20/1999**	**10/20/1999**	**10/21/1999**	**10/21/1999**	**10/21/1999**
Depth (feet)		**0 - 1**	**0 - 1**	**0 - 1**	**0 - 1**	**0 - 1**
Field Type		**Grab**	**Grab**	**Grab**	**Grab**	**Grab**
Analyte	Units					
Aluminum	mg/kg	5,650 =	2,670 =	12,600 =	9,580 =	9,520 =
Antimony	mg/kg	0.93 J				
Arsenic	mg/kg	11 =	9.2 =	11.9 =	9.3 =	9.3 =
Barium	mg/kg	83.8 =	43.7 =	343 = *	78.2 =	58.1 =
Beryllium	mg/kg	0.15 J	0.16 J	0.56 J	0.3 J	0.24 =
Cadmium	mg/kg	0.33 J *				
Chromium	mg/kg	8.6 =	5.3 =	12.6 =	12.3 =	12.4 =
Cobalt	mg/kg	4.9 J	3.2 J	26.5 = *	7.6 =	7.6 =
Copper	mg/kg	70.3 = *	12.1 =	11.1 J	27.3 = *	10.8 J
Lead	mg/kg	36.4 = *	12.4 =	26.9 = *	15.3 =	18.3 =
Manganese	mg/kg	367 =	314 =	14,600 = *	575 =	820 =
Mercury	mg/kg	0.035 J	0.012 J	0.041 J *	0.069 J *	
Nickel	mg/kg	11.7 =	9.2 =	23.4 = *	14 =	10 =
Selenium	mg/kg	0.93 =		3 J *	0.8 =	
Silver	mg/kg			0.31 J *		
Thallium	mg/kg	0.21 J *	0.26 J *	0.31 J *	0.36 J *	0.35 J *
Zinc	mg/kg	107 = *	36.2 =	78.7 J *	119 = *	52.9 J

Table 4-7. Summary of Principal Site-Related Inorganics in Surface Soil (continued)

Location **Station** **Customer ID** **Date** **Depth (feet)** **Field Type**		**Inside Bermed Area** **DA1-015** **DA1ss-015-0032-SO** **10/21/1999** **0 - 1** **Grab**	**Inside Bermed Area** **DA1-016** **DA1ss-016-0036-SO** **10/21/1999** **0 - 1** **Grab**	**Inside Bermed Area** **DA1-016** **DA1ss-016-0128-SO** **10/21/1999** **0 - 1** **Field Duplicate**	**Inside Bermed Area** **DA1-017** **DA1ss-017-0039-SO** **10/21/1999** **0 - 1** **Grab**	**Inside Bermed Area** **DA1-018** **DA1ss-018-0042-SO** **10/22/1999** **0 - 1** **Grab**
Analyte	Units					
Aluminum	mg/kg	14,100 =	11,400 =	11,800 =	11,800 =	16,200 J
Antimony	mg/kg					
Arsenic	mg/kg	10.9 =	12.4 =	12.1 =	10.6 =	15.1 =
Barium	mg/kg	66.2 =	91.2 = *	81.2 =	35.8 =	58.3 J
Beryllium	mg/kg	0.28 J	0.36 J	0.28 J	0.23 J	
Cadmium	mg/kg					
Chromium	mg/kg	17 =	14.6 =	15.3 =	15.3 =	22.6 = *
Cobalt	mg/kg	9.4 =	9.5 =	8.9 =	5.9 J	14 = *
Copper	mg/kg	12.1 =	40.8 J *	28.8 J *	11.9 J	23.5 J *
Lead	mg/kg	16.9 =	18.7 =	16 =	11.6 =	16.3 =
Manganese	mg/kg	543 =	608 =	421 =	176 =	242 J
Mercury	mg/kg	0.05 J *		0.038 J *		0.03 J
Nickel	mg/kg	14.7 =	13.7 =	14 =	14.3 =	31.9 = *
Selenium	mg/kg	0.88 =				
Silver	mg/kg					
Thallium	mg/kg	0.48 J *	0.31 J *	0.32 J *	0.33 J *	0.31 J *
Zinc	mg/kg	57.7 =	78.8 J *	68.5 J *	41.4 J	74.2 = *

Table 4-7. Summary of Principal Site-Related Inorganics in Surface Soil (continued)

Location		**Inside Bermed Area**	**Inside Bermed Area**	**Inside Bermed Area**	**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**
Station		**DA1-019**	**DA1-020**	**DA1-021**	**DA1-022**	**DA1-023**
Customer ID		**DA1ss-019-0045-SO**	**DA1ss-020-0048-SO**	**DA1ss-021-0051-SO**	**DA1ss-022-0054-SO**	**DA1ss-023-0057-SO**
Date		**10/22/1999**	**10/22/1999**	**10/24/1999**	**10/25/1999**	**10/25/1999**
Depth (feet)		**0 - 1**	**0 - 1**	**0 - 1**	**0 - 1**	**0 - 1**
Field Type		**Grab**	**Grab**	**Grab**	**Grab**	**Grab**
Analyte	Units					
Aluminum	mg/kg	15,000 J	13,900 J	11,100 =	13,400 =	85,700 = *
Antimony	mg/kg					
Arsenic	mg/kg	11.3 =	13.2 =	10.3 =	14.6 =	10.4 =
Barium	mg/kg	53.8 J	100 J *	34.7 =	98.5 = *	367 = *
Beryllium	mg/kg					
Cadmium	mg/kg					48.7 J *
Chromium	mg/kg	18.8 = *	20.7 = *	14.6 J	16.5 =	52 = *
Cobalt	mg/kg	6.4 =	9.6 =	5.2 J	20.1 = *	6.4 J
Copper	mg/kg	20.1 J *	27.4 J *	13.2 J	11.8 J	7,250 J *
Lead	mg/kg	15.7 =	16.4 =	12.3 J	22.7 =	163 = *
Manganese	mg/kg	205 J	262 J	139 =	3,920 J *	456 J
Mercury	mg/kg	0.03 J	0.045 J *	0.032 J	0.049 J *	0.12 J *
Nickel	mg/kg	15 =	27.4 = *	14.9 =	19 J	73.8 J *
Selenium	mg/kg					1.8 = *
Silver	mg/kg					0.38 J *
Thallium	mg/kg	0.32 J *	0.33 J *	0.24 J *		
Zinc	mg/kg	69.2 = *	86.2 = *	45.6 J	68.6 J *	6,320 J *

Table 4-7. Summary of Principal Site-Related Inorganics in Surface Soil (continued)

Location		**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**
Station		**DA1-023**	**DA1-024**	**DA1-025**	**DA1-026**	**DA1-027**
Customer ID		**DA1ss-023-0130-SO**	**DA1ss-024-0060-SO**	**DA1ss-025-0063-SO**	**DA1ss-026-0066-SO**	**DA1ss-027-0069-SO**
Date		**10/25/1999**	**10/25/1999**	**10/25/1999**	**10/25/1999**	**10/20/1999**
Depth (feet)		**0 - 1**	**0 - 1**	**0 - 1**	**0 - 1**	**0 - 1**
Field Type		**Field Duplicate**	**Grab**	**Grab**	**Grab**	**Grab**
Analyte	Units					
Aluminum	mg/kg	105,000 = *	15,700 =	8,730 =	14,400 J	22,800 = *
Antimony	mg/kg				1.3 R	3.1 J *
Arsenic	mg/kg	8.5 =	11.7 =	8.7 =	11.4 J	15.2 =
Barium	mg/kg	654 = *	1,670 = *	229 = *	74.1 =	70.6 =
Beryllium	mg/kg					0.25 J
Cadmium	mg/kg	92.2 J *	3.7 J *		0.7 J *	107 = *
Chromium	mg/kg	62.6 = *	16.4 =	11.1 =	17.8 J *	26.2 = *
Cobalt	mg/kg	6.8 =	6.3 =	8.7 =	10 J	8.4 =
Copper	mg/kg	11,100 J *	853 J *	108 J *	70.4 J *	747 = *
Lead	mg/kg	213 = *	41.7 = *	24.9 =	19.5 =	128 = *
Manganese	mg/kg	580 J	301 J	793 J	483 J	349 =
Mercury	mg/kg	0.11 J *	0.082 J *	0.095 J *	0.048 J *	0.14 J *
Nickel	mg/kg	95.4 J *	18 J	11.2 J	16.7 J	26.7 = *
Selenium	mg/kg	1.8 = *			1.3 =	1.4 =
Silver	mg/kg	0.67 J *				
Thallium	mg/kg					0.36 J *
Zinc	mg/kg	6,890 J *	668 J *	184 J *	186 J *	1,420 = *

Table 4-7. Summary of Principal Site-Related Inorganics in Surface Soil (continued)

Location		**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**
Station		**DA1-028**	**DA1-029**	**DA1-030**	**DA1-031**	**DA1-032**
Customer ID		**DA1ss-028-0073-SO**	**DA1ss-029-0076-SO**	**DA1ss-030-0079-SO**	**DA1ss-031-0082-SO**	**DA1ss-032-0085-SO**
Date		**10/26/1999**	**10/26/1999**	**10/26/1999**	**10/26/1999**	**10/27/1999**
Depth (feet)		**0 - 1**	**0 - 1**	**0 - 1**	**0 - 1**	**0 - 1**
Field Type		**Grab**	**Grab**	**Grab**	**Grab**	**Grab**
Analyte	Units					
Aluminum	mg/kg	13,000 J	17,700 J	12,400 =	12,100 =	6,940 =
Antimony	mg/kg	1.2 R	19.8 J *	1.2 R	0.63 J	1.2 R
Arsenic	mg/kg	12.4 J	31.4 J *	13.5 J	14.4 J	7.9 J
Barium	mg/kg	72 =	131 = *	78.4 J	55.7 J	54.9 J
Beryllium	mg/kg					
Cadmium	mg/kg		4,910 J *			
Chromium	mg/kg	16.8 J	174 J *	18.1 J *	15.8 J	7.9 J
Cobalt	mg/kg	6.1 J	16.4 J *	12.5 J *	5.4 J	6.9 J
Copper	mg/kg	37.7 J *	1,860 J *	45.6 J *	69.8 J *	5.8 J
Lead	mg/kg	15.6 =	772 = *	17.6 =	19 =	17 =
Manganese	mg/kg	138 J	834 J	471 J	230 J	667 J
Mercury	mg/kg	0.063 J *	0.077 J *	0.038 J *	0.023 J	0.052 J *
Nickel	mg/kg	13.4 J	82.7 J *	27.2 J *	13 J	7.9 J
Selenium	mg/kg	1.2 =	6.1 = *			
Silver	mg/kg					
Thallium	mg/kg			0.4 J *	0.41 J *	0.3 J *
Zinc	mg/kg	89.9 J *	4,970 J *	90.2 = *	317 = *	36.4 =

Table 4-7. Summary of Principal Site-Related Inorganics in Surface Soil (continued)

Location **Station** **Customer ID** **Date** **Depth (feet)** **Field Type**		**Plane Storage Area – Outside Berm** **DA1-033** **DA1ss-033-0088-SO** **10/27/1999** **0 - 1** **Grab**	**Plane Storage Area – Outside Berm** **DA1-034** **DA1ss-034-0091-SO** **10/27/1999** **0 - 1** **Grab**	**Plane Storage Area – Outside Berm** **DA1-035** **DA1ss-035-0094-SO** **11/01/1999** **0 - 1** **Grab**	**Plane Storage Area – Outside Berm** **DA1-036** **DA1ss-036-0097-SO** **11/02/1999** **0 - 1** **Grab**	**Plane Storage Area – Outside Berm** **DA1-037** **DA1ss-037-0100-SO** **11/02/1999** **0 - 1** **Grab**
Analyte	Units					
Aluminum	mg/kg	5,550 =	16,100 =	6,580 =	11,600 =	8,980 =
Antimony	mg/kg	1.3 R	1.2 R			
Arsenic	mg/kg	7.9 J	15.6 J *	8.8 =	9.6 =	9.9 =
Barium	mg/kg	45.7 J	114 J *	23.4 =	70.9 =	60.6 =
Beryllium	mg/kg					
Cadmium	mg/kg					
Chromium	mg/kg	7.3 J	22.7 J *	8.6 =	14.5 =	12.5 =
Cobalt	mg/kg	7.7 J	15.4 J *	6.9 =	8.3 =	9.7 =
Copper	mg/kg	10.8 J	22.6 J *	13.2 =	18.6 = *	11.5 =
Lead	mg/kg	22.2 =	15.3 =	8 J	20.2 J	16.2 J
Manganese	mg/kg	550 J	467 J	227 =	447 =	656 =
Mercury	mg/kg		0.022 J			
Nickel	mg/kg	8.6 J	35.9 J *	11.9 J	15.5 J	15.5 J
Selenium	mg/kg					
Silver	mg/kg					
Thallium	mg/kg	0.36 J *	0.47 J *	0.26 J *	0.41 J *	0.31 J *
Zinc	mg/kg	38 =	72.5 = *	33.8 =	86.8 = *	47.9 =

Table 4-7. Summary of Principal Site-Related Inorganics in Surface Soil (continued)

Location **Station** **Customer ID** **Date** **Depth (feet)** **Field Type**		**Plane Storage Area – Outside Berm** **DA1-038** **DA1ss-038-0103-SO** **11/02/1999** **0 - 1** **Grab**	**Plane Storage Area – Outside Berm** **DA1-038** **DA1ss-038-0129-SO** **11/02/1999** **0 - 1** **Field Duplicate**	**Plane Storage Area – Outside Berm** **DA1-039** **DA1ss-039-0106-SO** **11/02/1999** **0 - 1** **Grab**	**South Ditch Line** **DA1-040** **DA1ss-040-0109-SO** **11/03/1999** **0 - 1** **Grab**	**South Ditch Line** **DA1-040** **DA1ss-040-0126-SO** **11/03/1999** **0 - 1** **Field Duplicate**
Analyte	Units					
Aluminum	mg/kg	12,300 =	11,000 =	8,850 =	14,900 =	14,200 =
Antimony	mg/kg					
Arsenic	mg/kg	10.5 =	10.2 =	8 =	15.5 = *	17.5 = *
Barium	mg/kg	109 = *	91.9 = *	53.3 =	124 = *	73.6 =
Beryllium	mg/kg	0.42 J	0.47 J		0.52 J	0.36 J
Cadmium	mg/kg					
Chromium	mg/kg	15 =	13.5 =	10.8 =	21.5 = *	19.6 = *
Cobalt	mg/kg	10.9 = *	10.2 =	9.4 =	13.1 = *	9 =
Copper	mg/kg	12.4 =	11.6 =	6.9 =	33.5 J *	92.1 J *
Lead	mg/kg	20 J	18 J	16.1 J	18.5 =	22.5 =
Manganese	mg/kg	2,300 = *	1,690 = *	644 =	380 =	456 =
Mercury	mg/kg					
Nickel	mg/kg	19.4 J	16.4 J	10.3 J	34.4 = *	17.6 =
Selenium	mg/kg				1 =	1.2 =
Silver	mg/kg					
Thallium	mg/kg	0.38 J *	0.42 J *	0.37 J *	0.34 J *	0.26 J *
Zinc	mg/kg	60.6 =	53.6 =	41.4 =	190 J *	99.6 J *

Table 4-7. Summary of Principal Site-Related Inorganics in Surface Soil (continued)

Location		Inside Bermed Area	Plane Storage Area – Outside Berm
Station		DA1-041	DA1-042
Customer ID		DA1ss-041-0111-SO	DA1ss-042-0114-SO
Date		11/03/1999	11/03/1999
Depth (feet)		0 - 1	0 - 1
Field Type		Grab	Grab
Analyte	Units		
Aluminum	mg/kg	7,740 =	61,300 = *
Antimony	mg/kg		2.6 J *
Arsenic	mg/kg	8 =	11.1 =
Barium	mg/kg	53.8 =	1,840 = *
Beryllium	mg/kg		
Cadmium	mg/kg		65.5 = *
Chromium	mg/kg	9.7 =	43.8 = *
Cobalt	mg/kg	6.2 =	5.9 J
Copper	mg/kg	11.3 J	6,500 J *
Lead	mg/kg	11.5 =	149 = *
Manganese	mg/kg	345 =	466 =
Mercury	mg/kg		
Nickel	mg/kg	10.9 =	46 = *
Selenium	mg/kg	0.74 =	0.87 =
Silver	mg/kg		0.41 J *
Thallium	mg/kg	0.25 J *	0.28 J *
Zinc	mg/kg	93.8 J *	4,680 J *

= = Analyte present and concentration accurate.
* = Rejected value.
J = Estimated value less than reporting limits.
Blank cells represent non-detect values.

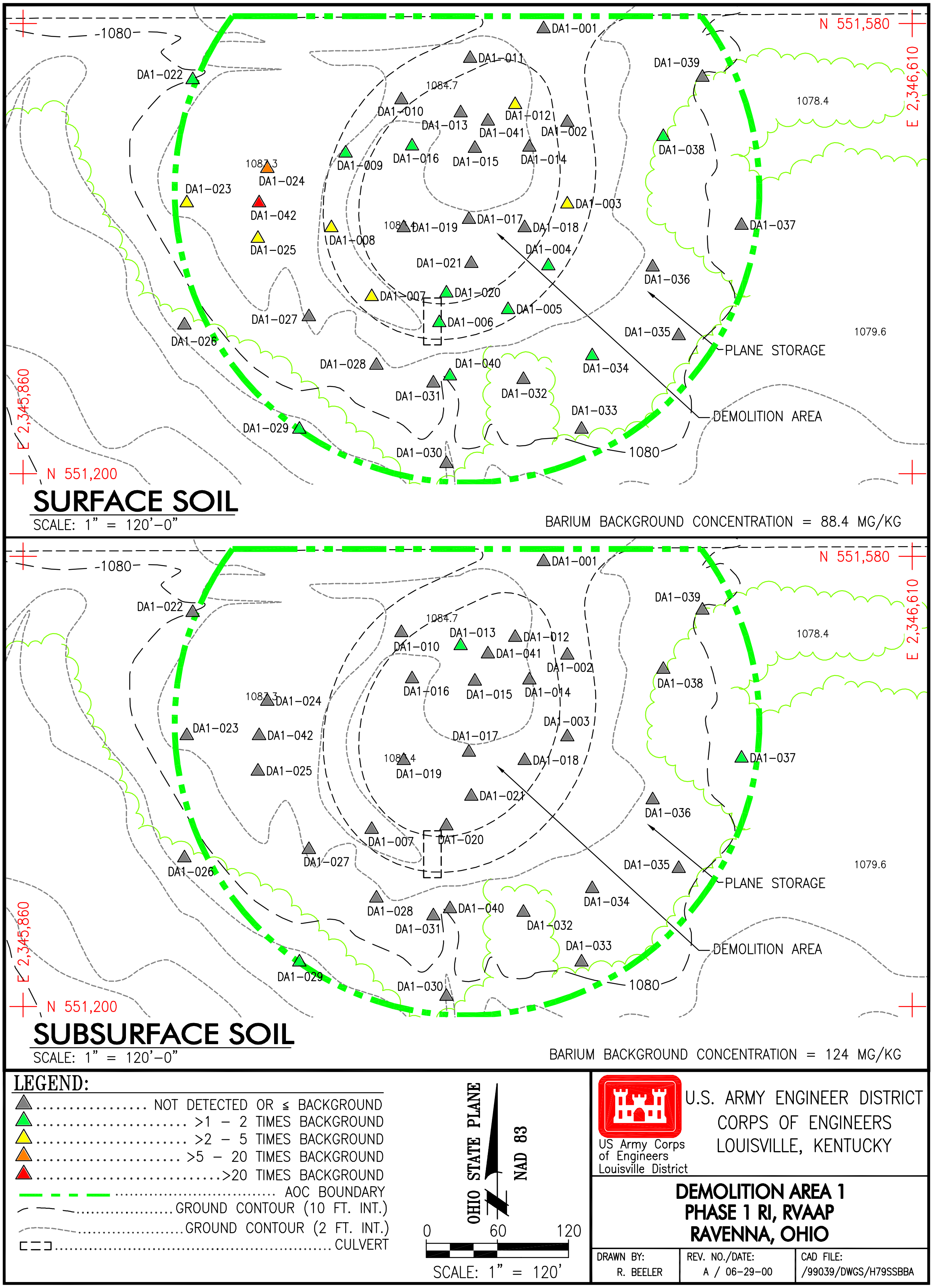


Figure 4-2. Maximum Barium Detects in Surface and Subsurface Soil

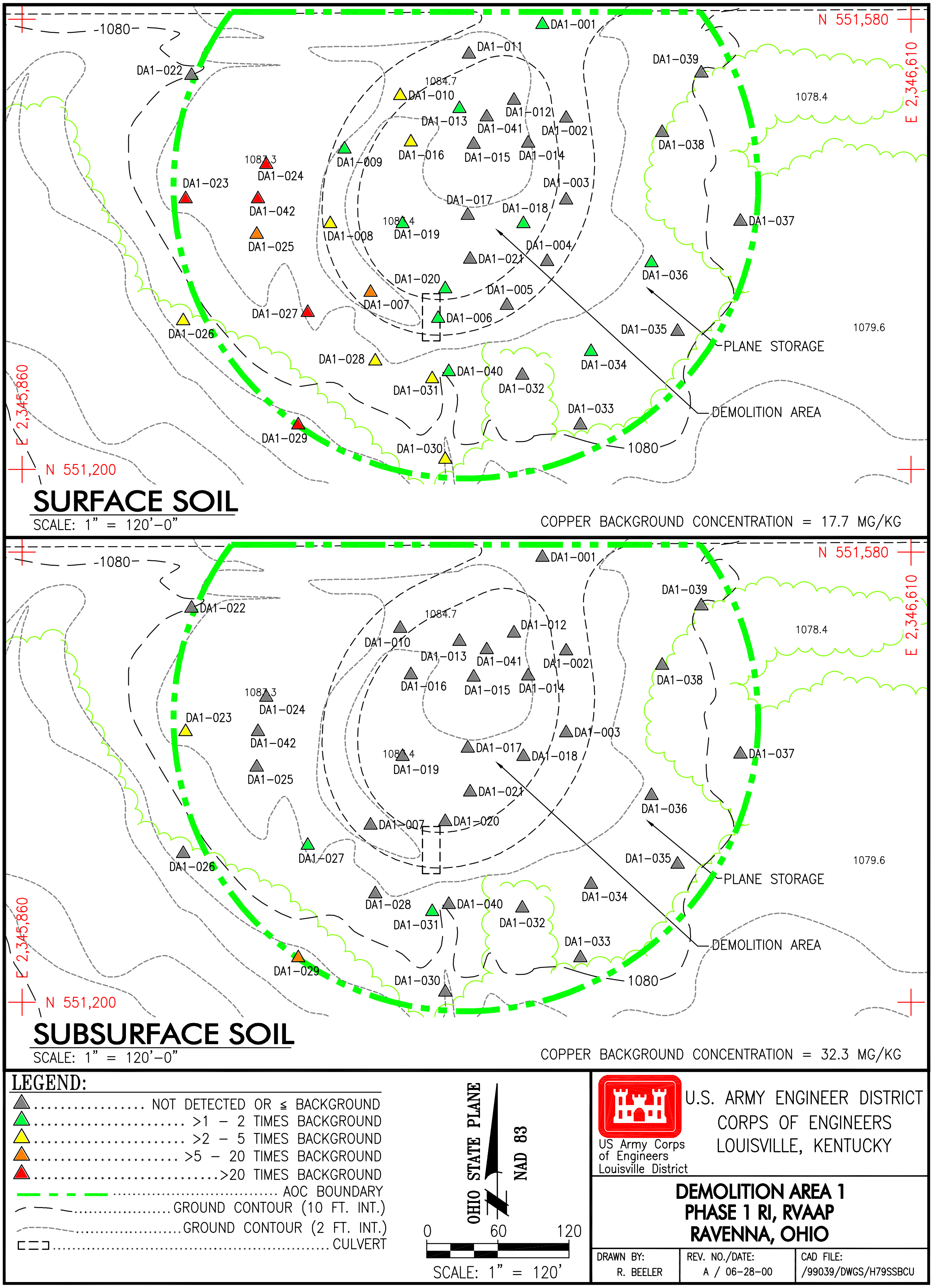


Figure 4-3. Maximum Copper Detects in Surface and Subsurface Soil

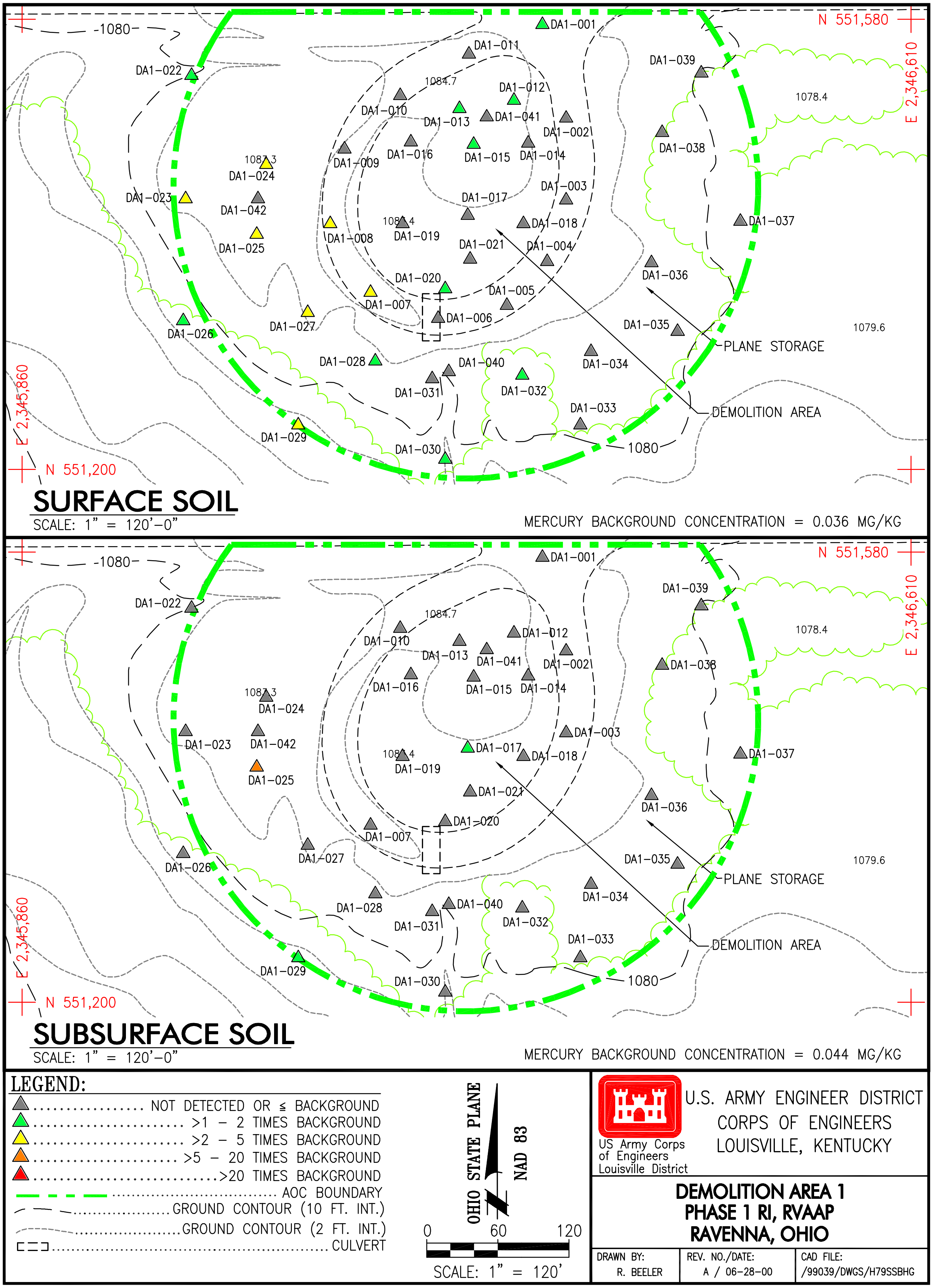


Figure 4-4. Maximum Mercury Detects in Surface and Subsurface Soil

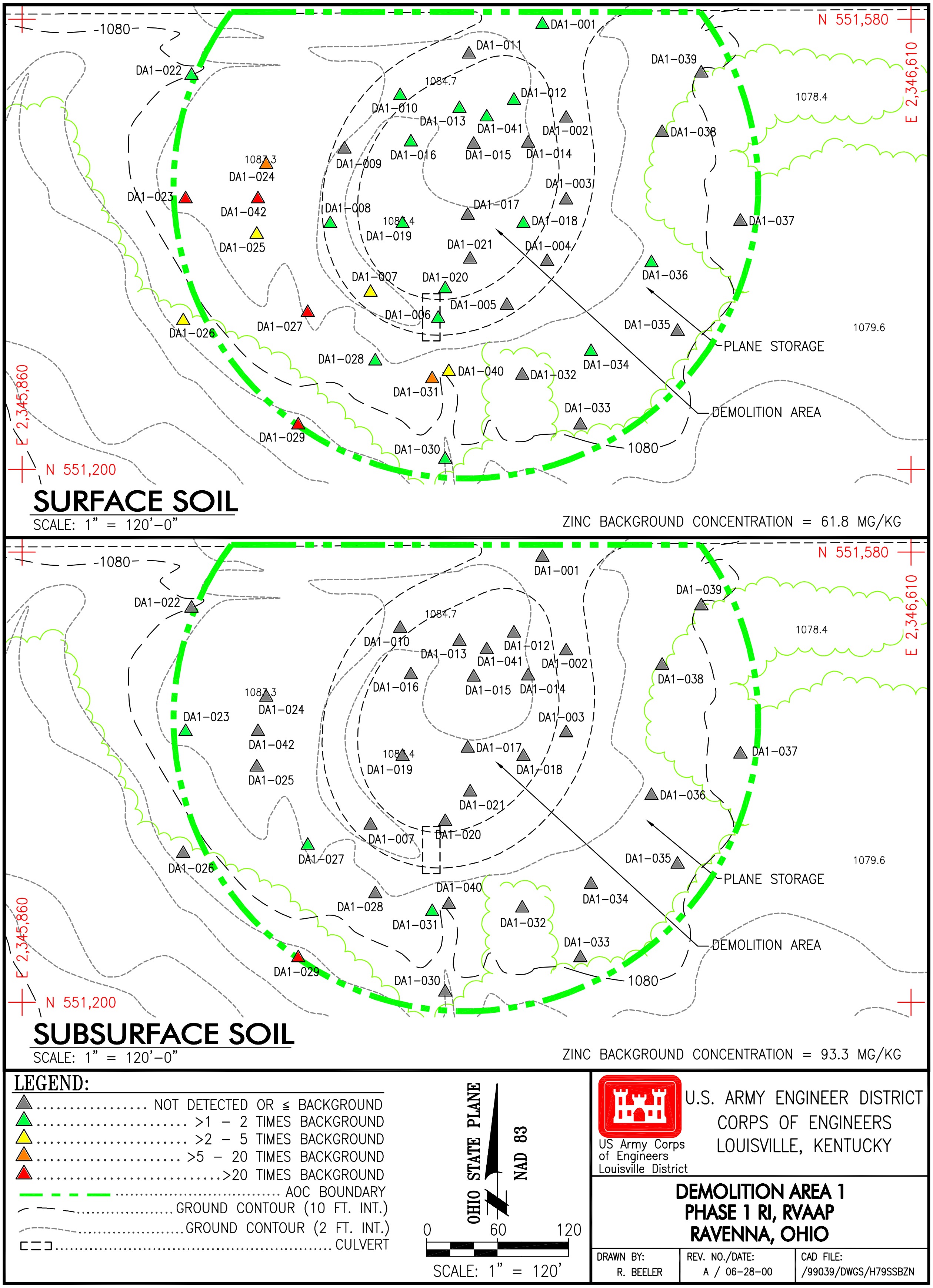


Figure 4-5. Maximum Zinc Detects in Surface and Subsurface Soil

including DA1-023 through DA1-029 and DA1-042. The observed distribution roughly corresponds to a number of observed bare soil areas containing OE and debris in the western and southern portions of the plane storage area. Station DA1-042 was specifically located in a large area of bare soil containing surface OE (inert fuzes) and debris. The discussion below contains a brief summary of the nature and extent for each of the four prevalent inorganic SRCs.

- Barium exceeded its background criterion in 19 samples, with the average detected value exceeding background by a factor of 2.1 times. Concentrations above background ranged from 91.2 mg/kg to a maximum of 1,840 mg/kg, which occurred at station DA1-042. The highest concentrations of barium occur in a cluster of stations comprised of DA1-008, DA1-023, DA1-024, DA1-025, and DA1-042, with concentrations ranging from 2.6 to more than 20 times above the background criterion (Figure 4-2).

- Copper exceeded its background criterion in 24 samples. Most all detected levels were at least twice the background value, with the average value (436 mg/kg) exceeding background by nearly 25 times. The highest detected concentrations of copper occur at stations DA1-023 (7,250 mg/kg) and DA1-042 (6,500 mg/kg) (Figure 4-3). High concentrations of copper were also detected at stations DA1-029 (1,860 mg/kg), DA1-024 (853 mg/kg), and DA1-027 (747 mg/kg).

- Mercury was detected in 30 of 42 samples analyzed and occurred above its background criterion in 17 samples. The average detected value was 1.4 times background. Mercury values above background were clustered in the northern portion of the former OB/OD and in the western portion of the plane storage area. Concentrations above background ranged from 0.041 to 0.16 mg/kg, which is from 1.02 to 4.0 times background. The maximum concentration was detected at station DA1-007 along the berm (Figure 4-4).

- Zinc was detected above its background criterion in 26 of samples. The average detected value was 8.2 times background. The highest concentrations, as with the other inorganic compounds noted above, occur in the western and southern portions of the AOC in the vicinity of stations DA1-023 through DA1-029 and DA1-042, with concentrations up to 6,320 mg/kg (102 times background) (Figure 4-5).

In addition to the four prevalent metals, a number of additional inorganics of interest were detected at relatively high frequencies (aluminum, arsenic, chromium, cobalt, lead, manganese, and nickel). However, these constituents were detected at relatively low concentrations compared to the background criteria. Average concentrations of all of these inorganics, except chromium and lead, were less than their respective background criteria. Although average chromium and lead concentrations exceeded background criteria, only 14 and 8 individual results, respectively, exceeded their respective background values. In general, concentrations of these constituents were highest in the western and southern portions of the plane storage area. Manganese, cobalt, and lead concentrations above background were also noted within the former OB/OD area. The maximum values of arsenic (31.4 mg/kg), chromium (174 mg/kg), lead (772 mg/kg), and nickel (82.7 mg/kg) all occurred at station DA1-029 (see Table 4-7). The maximum value for aluminum (85,700 mg/kg) was observed at station DA1-023. The maximum detected concentration of cobalt (26.5 mg/kg) and manganese (14,600 mg/kg) occurred at station DA1-012 inside the former OB/OD area. The maximum value for chromium occurred at DA1-029.

Cadmium (13 of 42 detections), silver (3 of 42 detections), and thallium (35 of 42 detections) were detected occasionally; however, background criteria for these inorganics were set to zero (see Section 4.14). Cadmium was detected primarily on the western side of the AOC, with the maximum concentration (4,910 mg/kg) occurring at station DA1-029. Cadmium was not detected inside the former OB/OD area. Silver was detected once inside the berm (station DA1-012) and at two locations on the west side of the AOC outside the berm. All detected concentrations were less than 0.5 mg/kg. Thallium was detected in many stations at low concentrations (less than 0.5 mg/kg), but, unlike most other inorganic constituents, it was detected more frequently on the eastern side of the AOC than on the western side.

4.2.4 SVOCs

A total of 64 SVOCs were analyzed for in five surface soil samples collected at DA1 during the Phase 1 RI. Of these, three SVOCs were detected once; thus, they exceed the 5 percent frequency of detection screen and are retained as SRCs. Two SVOCs, 2-methylnaphthalene (0.043 mg/kg) and pyrene (0.049 mg/kg), were detected in the surface soil sample from station DA1-007 located on the berm. Bis(2-ethylhexyl)phthalate was detected at station DA1-023 on the western boundary of the AOC at a concentration of 0.051 mg/kg. Figure 4-6 shows the occurrence of SVOCs in surface soil at DA1.

4.2.5 VOCs and PCBs

4.2.5.1 VOCs

A total of 35 VOCs were analyzed for in 5 surface soil samples. Dimethylbenzene was detected at a concentration of 0.0018 mg/kg at station DA1-029. Acetone was detected at a concentration of 0.068 mg/kg at station DA1-040 in the south ditch. Toluene was detected at two locations: stations DA1-023 (0.0025 mg/kg) and DA1-029 (0.0046 mg/kg). Figure 4-7 shows the distribution of VOCs in surface soil at DA1.

4.2.5.2 PCBs

A total of seven PCB compounds (Aroclors) were analyzed for in five surface soil samples. No PCB compounds were detected.

4.3 SUBSURFACE SOIL

4.3.1 Geotechnical Results

Three subsurface disturbed geotechnical samples (grab samples) were collected from two soil stations and submitted for moisture, Atterberg limits, USCS classification, and grain size distribution analyses. These samples were collected from the 0.3- to 0.9-meter (1- to 3-foot) and 0.9- to 1.5-meter (3- to 5-foot) intervals at station DA1-017 and from the 0.3- to 0.9-meter (1- to 3-foot) interval at station DA1-019. In addition, two Shelby tube samples were collected from the 0.3- to 0.9-meter (1- to 3-foot) interval at stations DA1-015 and DA1-027 and submitted for an expanded list of geotechnical parameters as noted below. Table 4-8 presents results of the geotechnical analyses for subsurface soil samples.

Analytical results indicate a high degree of similarity in both the disturbed and undisturbed samples. The samples from station DA1-027 (southwestern plane storage area) reflect slightly higher moisture content, were coarser grained, and had slightly higher permeability and porosity than samples from the other stations.

4.3.2 Explosives and Propellants

4.3.2.1 Explosives

One explosive compound (2,4,6-TNT) was detected at a concentration of 0.12 mg/kg in the sample collected from the 0.3- to 0.9-meter (1- to 3-foot) interval at station DA1-040 (south ditch). This single

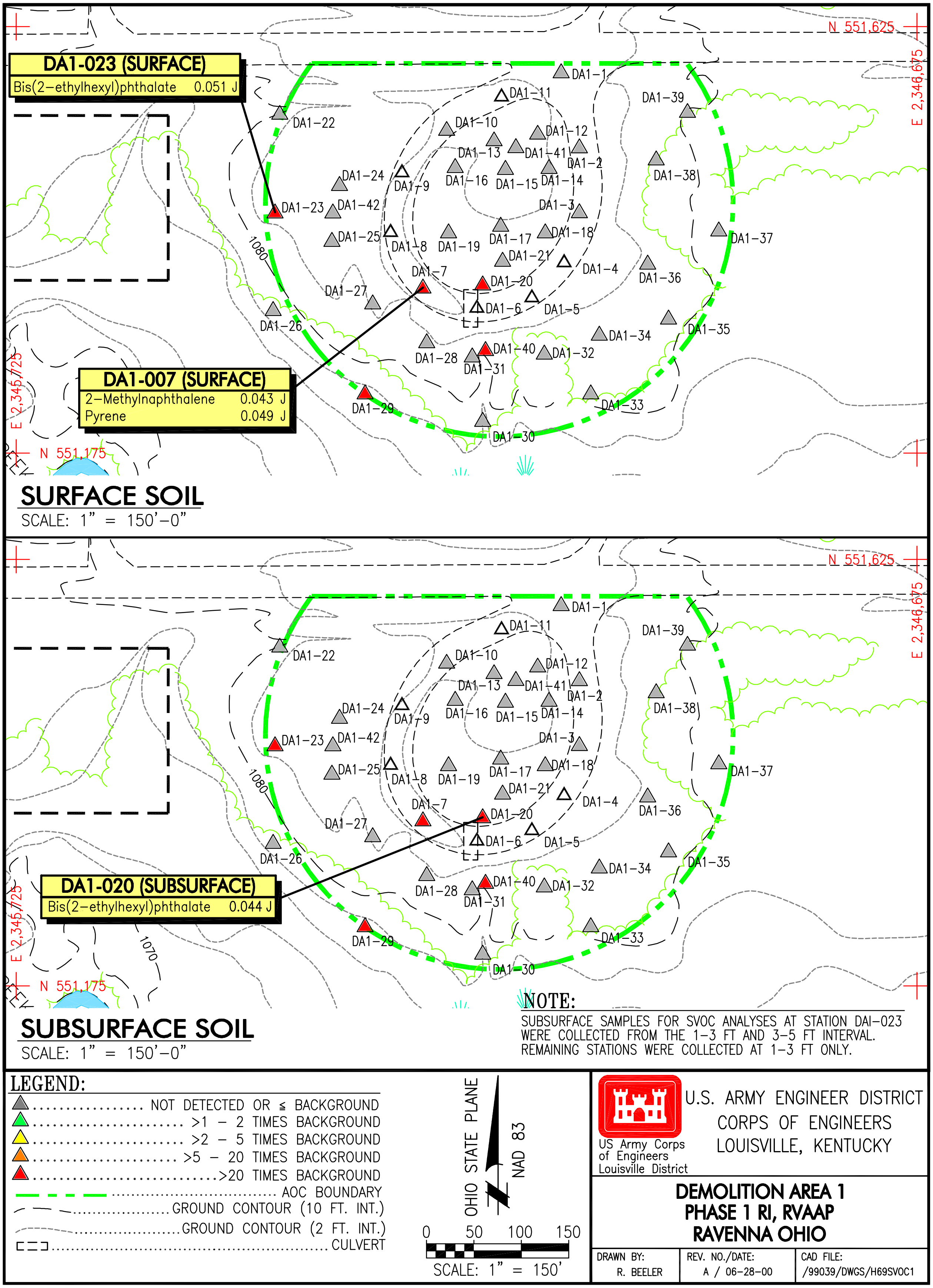


Figure 4-6. Maximum Detected SVOCs in Surface and Subsurface Soil

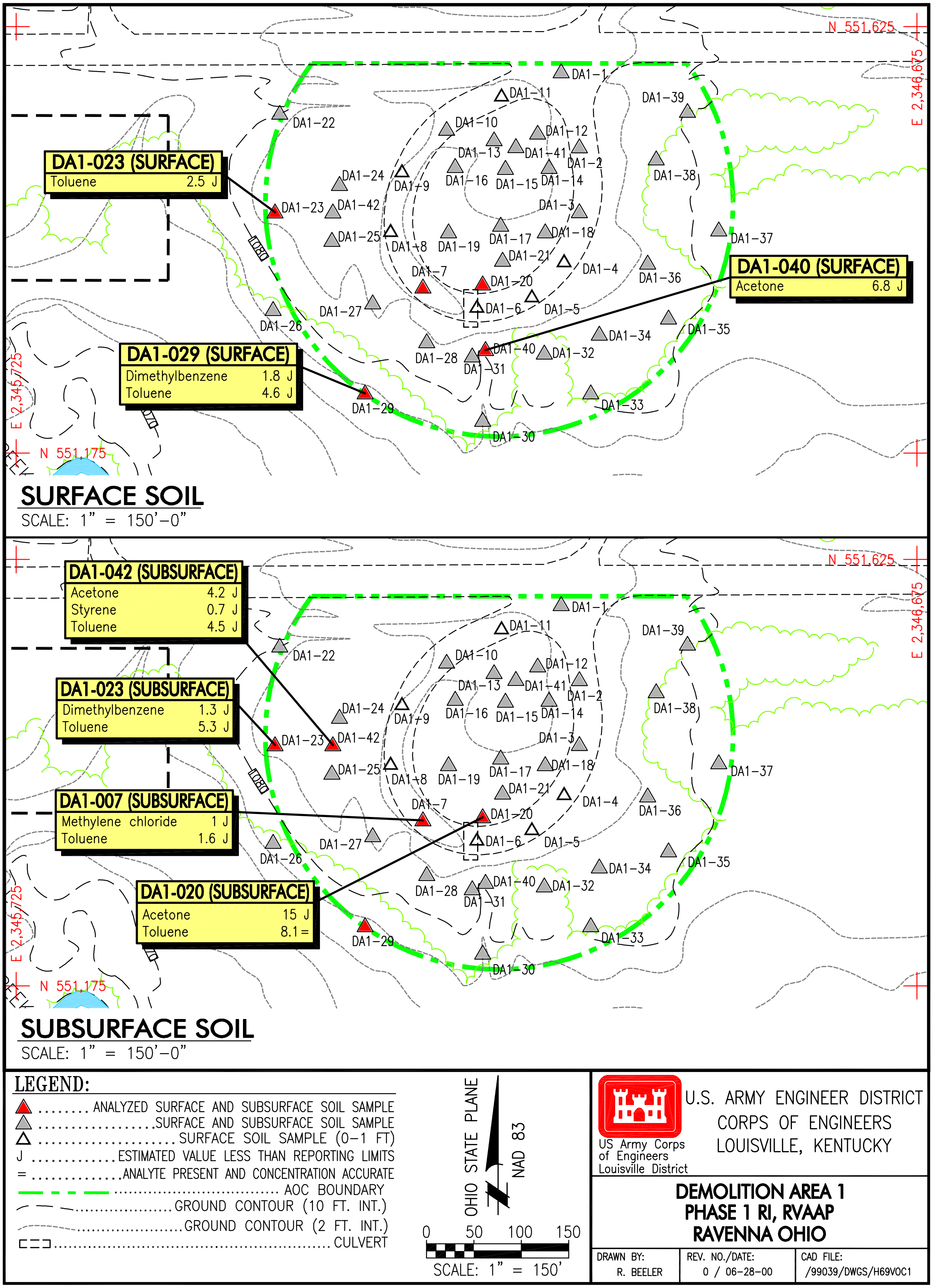


Figure 4-7. Maximum Detected VOCs in Surface and Subsurface Soil

Table 4-8. Geotechnical Data for Demolition Area 1 Phase I RI Subsurface Soil Samples

Sample Station	**DA1-015**	**DA1-027**	**DA1-017**	**DA1-017**	**DA1-019**
Depth of sample	**1 – 3 feet**	**1 – 3 feet**	**1 – 3 feet**	**3 – 5 feet**	**1 – 3 feet**
Disturbed Sample Analysis					
Moisture content (%)	19.87	24.53	18.90	22.30	21.70
Atterberg limits: LL	47.5	49.4	31.7	41.3	49.1
PL	31.3	24.6	9.6	21.0	25.9
PI	16.82	24.8	22.1	20.3	23.2
Classification	ML	CL	CL	CL	CL
Disturbed Sample Grain Size Analysis (% passing)					
3 inches – 3/4 inch	100	100	100	100	100
3/8 inch	100	100	100	100	100
#4	99.95	94.63	99.90	99.67	99.90
#10	99.67	92.09	99.65	99.49	99.72
#20	99.20	88.46	99.44	99.16	99.58
#40	98.44	84.87	99.25	98.92	99.52
#60	97.57	81.92	99.13	98.73	99.46
#140	96.85	79.06	98.59	98.04	99.35
#200	96.04	76.21	98.47	97.82	99.34
Shelby Tube (Undisturbed) Sample Analysis					
Bulk density, pcf	106.71	102.73	NA	NA	NA
Porosity	0.36	0.38	NA	NA	NA
Permeability (cm/sec)	3.38E-07	3.06E-06	NA	NA	NA
Specific gravity	2.66	2.64	NA	NA	NA
pH in water	3.76	5.00	NA	NA	NA
pH in 0.01 calcium chloride	4.11	4.94	NA	NA	NA
Total organic carbon (%)	4.80	4.31	NA	NA	NA
Redox potential	494	458	NA	NA	NA

CL = Lean clay.
LL = Liquid limit.
ML = Sandy silt.
NA = Not applicable.
PCF = Pounds per cubit foot.
PI = Plasticity index.
PL = Plastic limit.

detection may reflect leaching from the surface soil interval considering that the concentration of 2,4,6-TNT at the surface at this location was 2,000 mg/kg (Figure 4-1).

4.3.2.2 Propellants

No propellants were detected in subsurface soil samples collected during the Phase I RI.

4.3.3 TAL Metals and Cyanide

Table 4-2 contains summary statistics and results of the background screen for inorganic constituents in subsurface soil. A total of 23 metals were detected at least once in subsurface soil samples collected during the Phase I RI. Thirteen of these were eliminated as potential SRCs because they were either considered as essential nutrients (calcium, iron, potassium, magnesium, and sodium); the frequency of detection was less than 5 percent (cadmium and silver); or there were no detections above the background criteria (beryllium, cobalt, manganese, nickel, selenium, and thallium).

Cadmium was retained as an SRC due to weight of evidence. Cadmium was detected twice with a maximum value of 110J mg/kg at DA1-029. Station DA1-029 also has elevated concentrations above background for a number of other metals. Thus, although the frequency of detection is less than 5 percent across the subsurface soil aggregate, cadmium was retained as an SRC in subsurface soil considering that the result at DA1-029 appears to represent site-related contamination.

For the 11 inorganics retained as SRCs (Table 4-2), none had more than 6 results (copper) that exceeded their respective background criteria. All other inorganic SRCs had four or less results in excess of their background values. Therefore, none of these SRCs may be considered as prevalent in subsurface soil. In general, occurrences of inorganic SRCs above background in the subsurface soil aggregate coincide with those stations having observed concentrations above background in the surface soil aggregate. Thus, detections above background cluster in the western and southern portions of the plane storage area and in the northern portion of the former OB/OD area. Stations DA1-023 through DA1-029 and DA1-031 exhibit the majority of the detected values above background. In order to provide a consistent comparison with surface soil, the distribution and magnitude of barium, copper, mercury, and zinc in subsurface soil are highlighted on Figures 4-2 through 4-5 along with that observed in surface soil. These four compounds were identified as the prevalent surface soil inorganic SRCs. Summary data for inorganic SRCs in the subsurface soil aggregate are shown on Table 4-9.

Average concentrations of all inorganic SRCs in the subsurface soil aggregate were substantially lower than those observed in surface soil. Maximum observed concentrations were also lower in subsurface soil for every SRC except mercury and vanadium. The maximum values for each of the 11 subsurface soil SRCs clustered at only four stations are as follows:

- Station DA1-027 [0.1- to 0.3-meter (1- to 3-foot) depth interval] contained the maximum detected value for arsenic, and the 0.9- to 1.5-meter (3- to 5-foot) depth interval contained the maximum detected values for aluminum, antimony, chromium, and vanadium.

- Station DA1-029 [0.3- to 0.9-meter (1- to 3-foot) depth interval] contained the maximum detected values for cadmium, copper, lead, and zinc.

- Station DA1-013 contained the maximum barium concentration in the 0.9- to 1.5-meter (3- to 5-foot) depth interval.

- The maximum mercury concentration was detected at station DA1-025 in the 0.3- to 0.9-meter (1- to 3-foot) depth interval.

4.3.4 SVOCs

A total of 64 SVOC compounds were analyzed for in 6 subsurface soil samples collected at 5 stations during the Phase I RI. The only SVOC detected was bis(2-ethylhexyl)phthalate (0.044 mg/kg), which was present in the sample from the 0.1- to 0.3-meter (1- to 3-foot)] depth interval at station DA1-020 (Figure 4-6). No other SVOCs were detected in subsurface soil at DA1.

4.3.5 VOCs and PCBs

4.3.5.1 VOCs

A total of 35 VOC compounds were analyzed for in 6 subsurface soil samples from DA1. Five compounds were detected in at least one subsurface soil sample (Table 4-2). Toluene was detected in

Table 4-9. Summary of Selected Site-Related Inorganics in Subsurface Soil

Location **Station** **Customer ID** **Date** **Depth (feet)** **Field Type**		**Inside Bermed Area** **DA1-041** **DA1so-041-0112-SO** **11/03/1999** **1 - 3** **Grab**	**Inside Bermed Area** **DA1-041** **DA1so-041-0113-SO** **11/03/1999** **3 - 5** **Grab**	**Inside Bermed Area** **DA1-041** **DA1so-041-0164-SO** **11/03/1999** **6 - 8** **Grab**	**Plane Storage Area – Outside Berm** **DA1-042** **DA1so-042-0115-SO** **11/03/1999** **1 - 3** **Grab**
Analyte	Units				
Aluminum	mg/kg	15,700 =	11,600 =	10,500 =	15,100 =
Antimony	mg/kg	1.2 UJ	1.2 UJ	1.3 UJ	1.2 UJ
Arsenic	mg/kg	15.8 =	17.7 =	14.1 =	15 =
Barium	mg/kg	54.6 =	57.4 =	61.2 =	65.1 =
Cadmium	mg/kg	0.6 U	0.61 U	0.64 U	0.6 U
Chromium	mg/kg	20 =	17.1 =	16.6 =	19.3 =
Copper	mg/kg	19 J	23.5 J	20.6 J	19.7 J
Lead	mg/kg	14.5 =	13.3 =	12.1 =	14.3 =
Mercury	mg/kg	0.042 U	0.04 U	0.037 U	0.041 U
Vanadium	mg/kg	26 =	19.9 =	17.5 =	25.7 =
Zinc	mg/kg	52.8 J	60.4 J	64.4 J	76.6 J

Location **Station** **Customer ID** **Date** **Depth (feet)** **Field Type**		**Plane Storage Area – Outside Berm** **DA1-042** **DA1so-042-0116-SO** **11/03/1999** **3 - 5** **Grab**	**Plane Storage Area – Outside Berm** **DA1-042** **DA1so-042-0165-SO** **11/03/1999** **6 - 8** **Grab**	**Inside Bermed Area** **DA1-012** **DA1so-012-0024-SO** **10/21/1999** **1 - 3** **Grab**	**Inside Bermed Area** **DA1-012** **DA1so-012-0025-SO** **10/21/1999** **3 - 5** **Grab**
Analyte	Units				
Aluminum	mg/kg	12,600 =	14,800 =	12,800 =	11,600 =
Antimony	mg/kg	1.2 UJ	1.2 UJ	1.2 UJ	1.2 UJ
Arsenic	mg/kg	15.7 =	14.5 =	17.7 =	14.1 =
Barium	mg/kg	118 =	73.7 =	64 =	80.7 =
Cadmium	mg/kg	0.59 U	0.62 U	0.59 U	0.61 U
Chromium	mg/kg	19.6 =	21.7 =	18.7 =	18.1 =
Copper	mg/kg	23.1 J	22.4 J	21.8 J	21.7 J
Lead	mg/kg	14.1 =	13.5 =	15.7 =	12.4 =
Mercury	mg/kg	0.03 U	0.043 U	0.031 U	0.03 U
Vanadium	mg/kg	20.9 =	24.5 =	22.2 =	18.6 =
Zinc	mg/kg	79.6 J	74.3 J	59.2 J	64.3 J

Table 4-9. Summary of Selected Site-Related Inorganics in Subsurface Soil (continued)

Location Station Customer ID Date Depth (feet) Field Type		**Inside Bermed Area DA1-013 DA1so-013-0027-SO 10/21/1999 1 - 3 Grab**	**Inside Bermed Area DA1-013 DA1so-013-0028-SO 10/21/1999 3 - 5 Grab**	**Inside Bermed Area DA1-014 DA1so-014-0030-SO 10/21/1999 1 - 3 Grab**	**Inside Bermed Area DA1-014 DA1so-014-0031-SO 10/21/1999 3 - 5 Grab**
Analyte	Units				
Aluminum	mg/kg	18,700 =	19,700 = *	14,600 =	15,300 =
Antimony	mg/kg	0.77 J	0.54 J	0.78 J	0.96 J
Arsenic	mg/kg	15.7 =	13.4 =	15.9 =	15.3 =
Barium	mg/kg	75.3 =	179 = *	85.8 =	90.9 =
Cadmium	mg/kg	0.6 U	0.59 U	0.59 U	0.6 U
Chromium	mg/kg	22 =	24.9 =	19.5 =	22 =
Copper	mg/kg	17.3 =	20.9 =	23.5 =	22.8 =
Lead	mg/kg	15.6 =	11.9 =	15.2 =	13.9 =
Mercury	mg/kg	0.041 J	0.036 J	0.035 J	0.015 J
Vanadium	mg/kg	32 =	26.4 =	23.6 =	24 =
Zinc	mg/kg	54.4 =	70.2 =	58.9 =	70.5 =

Location Station Customer ID Date Depth (feet) Field Type		**Inside Bermed Area DA1-015 DA1so-015-0033-SO 10/21/1999 1 - 3 Grab**	**Inside Bermed Area DA1-015 DA1so-015-0034-SO 10/21/1999 3 - 5 Grab**	**Inside Bermed Area DA1-016 DA1so-016-0037-SO 10/21/1999 1 - 3 Grab**	**Inside Bermed Area DA1-016 DA1ss-016-0132-SO 10/21/1999 1 - 3 Field Duplicate**
Analyte	Units				
Aluminum	mg/kg	14,000 =	17,000 =	12,700 =	12,300 =
Antimony	mg/kg	0.79 J	1.2 UJ	1.2 UJ	1.2 UJ
Arsenic	mg/kg	17 =	18 =	17 =	15.2 =
Barium	mg/kg	42.3 =	78.3 =	74.4 =	71.7 =
Cadmium	mg/kg	0.58 U	0.59 U	0.59 U	0.59 U
Chromium	mg/kg	19.1 =	22.2 =	19.4 =	18.1 =
Copper	mg/kg	24 =	26.3 =	20.9 J	21.5 J
Lead	mg/kg	14.5 =	15.1 =	13.4 =	13.9 =
Mercury	mg/kg	0.034 J	0.021 J	0.021 U	0.026 U
Vanadium	mg/kg	21 =	25.9 =	21.1 =	19.8 =
Zinc	mg/kg	59.4 =	70.4 =	65.4 J	68.2 J

Table 4-9. Summary of Selected Site-Related Inorganics in Subsurface Soil (continued)

Location		**Inside Bermed Area**	**Inside Bermed Area**	**Inside Bermed Area**	**Inside Bermed Area**
Station		**DA1-016**	**DA1-017**	**DA1-017**	**DA1-018**
Customer ID		**DA1so-016-0038-SO**	**DA1so-017-0040-SO**	**DA1so-017-0041-SO**	**DA1so-018-0043-SO**
Date		**10/21/1999**	**10/21/1999**	**10/21/1999**	**10/22/1999**
Depth (feet)		**3 - 5**	**1 - 3**	**3 - 5**	**1 - 3**
Field Type		**Grab**	**Grab**	**Grab**	**Grab**
Analyte	Units				
Aluminum	mg/kg	8,430 =	10,700 =	11,300 =	12,600 J
Antimony	mg/kg	1.2 UJ	1.2 UJ	1.3 UJ	1.2 UJ
Arsenic	mg/kg	14.3 =	15.1 =	15.1 =	17.5 =
Barium	mg/kg	64.5 =	43.5 =	69.7 =	77.5 J
Cadmium	mg/kg	0.6 U	0.6 U	0.63 U	0.61 UJ
Chromium	mg/kg	13.2 =	15.7 =	17.2 =	18.8 =
Copper	mg/kg	20.1 J	20.3 J	20.6 J	22.1 J
Lead	mg/kg	11.9 =	13.6 =	11.8 =	15.4 =
Mercury	mg/kg	0.0078 U	0.054 J *	0.018 U	0.014 J
Vanadium	mg/kg	13.9 =	16.5 =	18.7 =	19.1 =
Zinc	mg/kg	56.8 J	53.8 J	60.8 J	66.2 =
Location		**Inside Bermed Area**	**Inside Bermed Area**	**Inside Bermed Area**	**Inside Bermed Area**
Station		**DA1-018**	**DA1-018**	**DA1-018**	**DA1-019**
Customer ID		**DA1ss-018-0131-SO**	**DA1so-018-0044-SO**	**DA1so-018-0160-SO**	**DA1so-019-0046-SO**
Date		**10/22/1999**	**10/22/1999**	**10/22/1999**	**10/22/1999**
Depth (feet)		**1 - 3**	**3 - 5**	**6 - 8**	**1 - 3**
Field Type		**Field Duplicate**	**Grab**	**Grab**	**Grab**
Analyte	Units				
Aluminum	mg/kg	12,500 J	10,700 J	7,850 J	16,300 J
Antimony	mg/kg	1.2 UJ	1.2 UJ	1.2 UJ	1.2 UJ
Arsenic	mg/kg	13.1 =	16.3 =	16.6 =	21.1 = *
Barium	mg/kg	79.9 J	52.9 J	55.9 J	59.7 J
Cadmium	mg/kg	0.62 UJ	0.62 UJ	0.62 UJ	0.62 UJ
Chromium	mg/kg	18.3 =	17 =	13.4 =	22.4 =
Copper	mg/kg	20.4 J	21.2 J	22 J	28 J
Lead	mg/kg	11.5 =	13.9 =	14.1 =	17.5 =
Mercury	mg/kg	0.0085 J	0.0066 J	0.12 U	0.038 J
Vanadium	mg/kg	17.9 =	17.7 =	13.6 =	23.9 =
Zinc	mg/kg	63.9 =	63.7 =	66.4 =	72.3 =

Table 4-9. Summary of Selected Site-Related Inorganics in Subsurface Soil (continued)

Location		**Inside Bermed Area**	**Inside Bermed Area**	**Inside Bermed Area**	**Inside Bermed Area**
Station		**DA1-019**	**DA1-019**	**DA1-020**	**DA1-020**
Customer ID		**DA1so-019-0047-SO**	**DA1so-019-0161-SO**	**DA1so-020-0049-SO**	**DA1so-020-0050-SO**
Date		**10/22/1999**	**10/22/1999**	**10/22/1999**	**10/22/1999**
Depth (feet)		**3 - 5**	**6 - 8**	**1 - 3**	**3 - 5**
Field Type		**Grab**	**Grab**	**Grab**	**Grab**
Analyte	Units				
Aluminum	mg/kg	9,130 J	13,800 J	18,300 J	13,300 J
Antimony	mg/kg	1.2 UJ	1.2 UJ	1.2 UJ	1.2 UJ
Arsenic	mg/kg	16 =	17.8 =	20.2 = *	14.8 =
Barium	mg/kg	52.2 J	65.2 J	108 J	69.7 J
Cadmium	mg/kg	0.62 UJ	0.61 UJ	0.61 UJ	0.61 UJ
Chromium	mg/kg	14.1 =	20.7 =	27.8 = *	20.5 =
Copper	mg/kg	19.6 J	18.7 J	27.9 J	19.7 J
Lead	mg/kg	13.4 =	13.1 =	17.9 =	12.6 =
Mercury	mg/kg	0.12 U	0.025 J	0.029 J	0.015 J
Vanadium	mg/kg	15.3 =	21.7 =	27.2 =	20.7 =
Zinc	mg/kg	56.6 =	66.1 =	93.2 =	68.9 =

Location		**Inside Bermed Area**	**Inside Bermed Area**	**Inside Bermed Area**	**Inside Bermed Area**
Station		**DA1-020**	**DA1-021**	**DA1-021**	**DA1-021**
Customer ID		**DA1so-020-0162-SO**	**DA1so-021-0052-SO**	**DA1so-021-0053-SO**	**DA1so-021-0163-SO**
Date		**10/22/1999**	**10/24/1999**	**10/24/1999**	**10/24/1999**
Depth (feet)		**6 - 8**	**1 - 3**	**3 - 5**	**6 - 8**
Field Type		**Grab**	**Grab**	**Grab**	**Grab**
Analyte	Units				
Aluminum	mg/kg	16,900 J	13,800 =	12,900 =	13,500 =
Antimony	mg/kg	1.2 UJ	1.2 UJ	1.2 UJ	1.3 UJ
Arsenic	mg/kg	13.1 =	14.3 =	15.4 =	18.8 =
Barium	mg/kg	104 J	70.1 =	68.4 =	79.7 =
Cadmium	mg/kg	0.61 UJ	0.61 UJ	0.62 UJ	0.63 UJ
Chromium	mg/kg	25.2 =	17.5 J	17.1 J	18.8 J
Copper	mg/kg	22.7 J	20.6 J	20.8 J	20.4 J
Lead	mg/kg	13.9 =	12.8 J	13.7 J	14.1 J
Mercury	mg/kg	0.014 J	0.031 J	0.017 J	0.13 U
Vanadium	mg/kg	25.8 =	18.7 =	18.9 =	20.5 =
Zinc	mg/kg	80.1 =	61 J	65.7 J	71.1 J

Table 4-9. Summary of Selected Site-Related Inorganics in Subsurface Soil (continued)

Location		**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**
Station		**DA1-022**	**DA1-022**	**DA1-023**	**DA1-023**
Customer ID		**DA1so-022-0055-SO**	**DA1so-022-0056-SO**	**DA1so-023-0058-SO**	**DA1so-023-0059-SO**
Date		**10/25/1999**	**10/25/1999**	**10/25/1999**	**10/25/1999**
Depth (feet)		**1 - 3**	**3 - 5**	**1 - 3**	**3 - 5**
Field Type		**Grab**	**Grab**	**Grab**	**Grab**
Analyte	Units				
Aluminum	mg/kg	14,500 =	13,500 =	17,600 =	14,100 =
Antimony	mg/kg	1.2 UJ	1.2 UJ	1.2 UJ	1.2 UJ
Arsenic	mg/kg	13.7 =	12.8 =	14.3 =	15.1 =
Barium	mg/kg	86.2 =	70.5 =	77.6 =	89.4 =
Cadmium	mg/kg	0.59 UJ	0.59 UJ	0.6 UJ	0.61 UJ
Chromium	mg/kg	20.6 =	19.5 =	22.7 =	20.8 =
Copper	mg/kg	19.6 J	18.1 J	87.3 J *	33.8 J *
Lead	mg/kg	11.3 =	11.4 =	16.6 =	14.3 =
Mercury	mg/kg	0.038 J	0.014 J	0.029 J	0.018 J
Vanadium	mg/kg	22.6 =	21.9 =	26.9 =	23.4 =
Zinc	mg/kg	61.1 J	61.2 J	167 J *	88.2 J

Location		**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**
Station		**DA1-024**	**DA1-024**	**DA1-025**	**DA1-025**
Customer ID		**DA1so-024-0061-SO**	**DA1so-024-0062-SO**	**DA1so-025-0064-SO**	**DA1so-025-0065-SO**
Date		**10/25/1999**	**10/25/1999**	**10/25/1999**	**10/25/1999**
Depth (feet)		**1 - 3**	**3 - 5**	**1 - 3**	**3 - 5**
Field Type		**Grab**	**Grab**	**Grab**	**Grab**
Analyte	Units				
Aluminum	mg/kg	15,500 =	9,840 =	12,100 =	13,700 =
Antimony	mg/kg	1.3 UJ	1.2 UJ	1.2 UJ	1.2 UJ
Arsenic	mg/kg	14.7 =	13.9 =	13 =	15 =
Barium	mg/kg	91.7 =	59.1 =	60 =	108 =
Cadmium	mg/kg	0.64 UJ	0.61 UJ	0.58 UJ	0.61 UJ
Chromium	mg/kg	19.8 =	15.7 =	17.1 =	20.7 =
Copper	mg/kg	30.2 J	20.9 J	18 J	21.2 J
Lead	mg/kg	13.3 =	12.4 =	12.4 =	13.4 =
Mercury	mg/kg	0.038 J	0.019 J	0.29 = *	0.012 J
Vanadium	mg/kg	24.9 =	16.6 =	20.2 =	22.4 =
Zinc	mg/kg	66.3 J	79.6 J	55.7 J	71.3 J

Table 4-9. Summary of Selected Site-Related Inorganics in Subsurface Soil (continued)

Location		**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**
Station		**DA1-026**	**DA1-026**	**DA1-027**	**DA1-027**
Customer ID		**DA1so-026-0067-SO**	**DA1so-026-0068-SO**	**DA1so-027-0070-SO**	**DA1so-027-0071-SO**
Date		**10/25/1999**	**10/25/1999**	**10/20/1999**	**10/20/1999**
Depth (feet)		**1 - 3**	**3 - 5**	**1 - 3**	**3 - 5**
Field Type		**Grab**	**Grab**	**Grab**	**Grab**
Analyte	Units				
Aluminum	mg/kg	13,900 J	15,000 J	14,600 =	28,600 = *
Antimony	mg/kg	1.2 R	1.2 R	0.75 J	1.3 J *
Arsenic	mg/kg	15.8 J	16.7 J	16.2 =	20.9 = *
Barium	mg/kg	67.4 =	89.4 =	75 =	107 =
Cadmium	mg/kg	0.61 UJ	0.62 UJ	0.59 U	0.59 U
Chromium	mg/kg	20 J	22.6 J	19.2 =	34.7 = *
Copper	mg/kg	23.9 J	24.1 J	39.2 = *	35.3 = *
Lead	mg/kg	15 =	14.5 =	16.5 =	19.4 = *
Mercury	mg/kg	0.0076 J	0.022 J	0.015 J	0.0096 J
Vanadium	mg/kg	22.8 J	24.4 J	19.9 =	39.9 = *
Zinc	mg/kg	68.8 J	74 J	82.4 =	97 = *

Location		**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**
Station		**DA1-028**	**DA1-028**	**DA1-029**	**DA1-030**
Customer ID		**DA1so-028-0074-SO**	**DA1so-028-0075-SO**	**DA1so-029-0077-SO**	**DA1so-030-0080-SO**
Date		**10/26/1999**	**10/26/1999**	**10/26/1999**	**10/26/1999**
Depth (feet)		**1 - 3**	**3 - 5**	**1 - 3**	**1 - 3**
Field Type		**Grab**	**Grab**	**Grab**	**Grab**
Analyte	Units				
Aluminum	mg/kg	14,100 J	12,500 J	17,900 =	14,400 =
Antimony	mg/kg	1.2 R	1.2 R	1.2 J *	1.2 R
Arsenic	mg/kg	16.6 J	17.3 J	12.7 J	14.7 J
Barium	mg/kg	99.5 =	79 =	155 J *	78 J
Cadmium	mg/kg	0.6 UJ	0.61 UJ	110 J *	0.6 UJ
Chromium	mg/kg	20 J	19.9 J	22 J	22.2 J
Copper	mg/kg	23 J	24.2 J	597 J *	21.3 J
Lead	mg/kg	12.5 =	13.8 =	401 = *	13.1 =
Mercury	mg/kg	0.024 J	0.018 J	0.052 J *	0.016 J
Vanadium	mg/kg	23.5 J	20.7 J	17.4 =	24.3 =
Zinc	mg/kg	67.2 J	74.8 J	2830 = *	67.7 =

Table 4-9. Summary of Selected Site-Related Inorganics in Subsurface Soil (continued)

Location		**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**
Station		**DA1-031**	**DA1-031**	**DA1-032**	**DA1-032**
Customer ID		**DA1so-031-0083-SO**	**DA1so-031-0084-SO**	**DA1so-032-0086-SO**	**DA1so-032-0087-SO**
Date		**10/26/1999**	**10/26/1999**	**10/27/1999**	**10/27/1999**
Depth (feet)		**1 - 3**	**3 - 5**	**1 - 3**	**3 - 5**
Field Type		**Grab**	**Grab**	**Grab**	**Grab**
Analyte	Units				
Aluminum	mg/kg	13,300 =	11,600 =	10,400 =	14,200 =
Antimony	mg/kg	1.2 R	1.2 R	1.1 U	1.2 R
Arsenic	mg/kg	15.8 J	13.5 J	11.6 J	15.2 R
Barium	mg/kg	71.8 J	90.4 J	35.8 J	107 J
Cadmium	mg/kg	0.59 UJ	0.61 UJ	0.56 UJ	0.59 UJ
Chromium	mg/kg	18.7 J	19.5 J	13.2 J	21.6 J
Copper	mg/kg	47.3 J *	25 J	17.3 J	22.5 J
Lead	mg/kg	16.1 =	12.8 =	11.5 =	13.5 =
Mercury	mg/kg	0.032 J	0.015 J	0.11 U	0.12 U
Vanadium	mg/kg	22.1 =	19.6 =	18.8 =	22.7 =
Zinc	mg/kg	125 = *	82.9 =	48.5 =	74.6 =

Location		**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**
Station		**DA1-033**	**DA1-033**	**DA1-034**	**DA1-034**
Customer ID		**DA1so-033-0089-SO**	**DA1so-033-0090-SO**	**DA1so-034-0092-SO**	**DA1so-034-0093-SO**
Date		**10/27/1999**	**10/27/1999**	**10/27/1999**	**10/27/1999**
Depth (feet)		**1 - 3**	**3 - 5**	**1 - 3**	**3 - 5**
Field Type		**Grab**	**Grab**	**Grab**	**Grab**
Analyte	Units				
Aluminum	mg/kg	10,500 =	9,530 =	9,730 =	6,370 =
Antimony	mg/kg	1.2 R	1.3 R	1.2 R	1.2 R
Arsenic	mg/kg	12.7 J	12.2 J	17.9 J	13.7 J
Barium	mg/kg	68.9 J	56.9 J	62.1 J	35.1 J
Cadmium	mg/kg	0.59 UJ	0.64 UJ	0.6 UJ	0.62 UJ
Chromium	mg/kg	15.3 J	14.9 J	15.6 J	10.8 J
Copper	mg/kg	18.9 J	18.7 J	22.8 J	18.9 J
Lead	mg/kg	11.6 =	11.4 =	13.4 =	11.2 =
Mercury	mg/kg	0.028 J	0.014 J	0.037 J	0.12 U
Vanadium	mg/kg	17.7 =	17.1 =	17.2 =	11.6 =
Zinc	mg/kg	58.1 =	57.7 =	59.4 =	51.2 =

Table 4-9. Summary of Selected Site-Related Inorganics in Subsurface Soil (continued)

Location		**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**
Station		**DA1-035**	**DA1-035**	**DA1-036**	**DA1-036**
Customer ID		**DA1so-035-0095-SO**	**DA1so-035-0096-SO**	**DA1so-036-0098-SO**	**DA1so-036-0099-SO**
Date		**11/01/1999**	**11/01/1999**	**11/02/1999**	**11/02/1999**
Depth (feet)		**1 - 3**	**3 - 5**	**1 - 3**	**3 - 5**
Field Type		**Grab**	**Grab**	**Grab**	**Grab**
Analyte	Units				
Aluminum	mg/kg	7,140 =	12,400 =	14,000 =	8,720 =
Antimony	mg/kg	1.2 UJ	1.2 UJ	1.2 UJ	1.2 UJ
Arsenic	mg/kg	12.2 =	12.5 =	15.1 =	9.1 =
Barium	mg/kg	38.7 =	74.9 =	103 =	54.2 =
Cadmium	mg/kg	0.58 U	0.62 U	0.61 U	0.59 U
Chromium	mg/kg	10.2 =	19.2 =	20.8 =	14 =
Copper	mg/kg	16.7 =	19.4 =	22.5 =	14.7 =
Lead	mg/kg	9.5 J	12.8 J	13.9 J	8.7 J
Mercury	mg/kg	0.024 U	0.026 U	0.033 U	0.023 U
Vanadium	mg/kg	13.4 =	19.3 =	22.5 =	14.3 =
Zinc	mg/kg	45.8 =	69.6 =	74.9 =	47.1 =

Location		**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**
Station		**DA1-037**	**DA1-037**	**DA1-038**	**DA1-038**
Customer ID		**DA1so-037-0101-SO**	**DA1so-037-0102-SO**	**DA1so-038-0104-SO**	**DA1ss-038-0133-SO**
Date		**11/02/1999**	**11/02/1999**	**11/02/1999**	**11/02/1999**
Depth (feet)		**1 - 3**	**3 - 5**	**1 - 3**	**1 - 3**
Field Type		**Grab**	**Grab**	**Grab**	**Field Duplicate**
Analyte	Units				
Aluminum	mg/kg	8,740 =	8,070 =	10,400 =	8,870 =
Antimony	mg/kg	1.1 UJ	1.1 UJ	1.1 UJ	1.2 UJ
Arsenic	mg/kg	9.5 =	12.7 =	13.6 =	10.8 =
Barium	mg/kg	43.3 =	172 = *	81 =	60.9 =
Cadmium	mg/kg	0.55 U	0.27 J *	0.57 U	0.58 U
Chromium	mg/kg	10.2 =	11 =	17.5 =	12.8 =
Copper	mg/kg	11 =	22 =	20.2 =	14.7 =
Lead	mg/kg	11.6 J	14 J	13.1 J	10.2 J
Mercury	mg/kg	0.028 U	0.02 U	0.03 U	0.036 U
Vanadium	mg/kg	16.5 =	17.1 =	19.1 =	16.5 =
Zinc	mg/kg	41.9 =	56.1 =	57 =	43.3 =

Table 4-9. Summary of Selected Site-Related Inorganics in Subsurface Soil (continued)

Location		**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**	**Plane Storage Area – Outside Berm**
Station		**DA1-038**	**DA1-038**	**DA1-039**	**DA1-039**
Customer ID		**DA1so-038-0105-SO**	**DA1ss-038-0134-SO**	**DA1so-039-0107-SO**	**DA1so-039-0108-SO**
Date		**11/02/1999**	**11/02/1999**	**11/02/1999**	**11/02/1999**
Depth (feet)		**3 - 5**	**3 - 5**	**1 - 3**	**3 - 5**
Field Type		**Grab**	**Field Duplicate**	**Grab**	**Grab**
Analyte	Units				
Aluminum	mg/kg	6,280 =	6,370 =	12,300 =	10,300 =
Antimony	mg/kg	1.2 UJ	1.2 UJ	1.2 UJ	1.2 UJ
Arsenic	mg/kg	14.7 =	14.2 =	11.7 =	11.3 =
Barium	mg/kg	42.2 =	38.7 =	59.3 =	65 =
Cadmium	mg/kg	0.59 U	0.6 U	0.59 U	0.58 U
Chromium	mg/kg	10.4 =	10.7 =	16.8 =	15.8 =
Copper	mg/kg	21.7 =	21 =	14.4 =	18.6 =
Lead	mg/kg	12.1 J	11.6 J	11.5 J	10.8 J
Mercury	mg/kg	0.01 U	0.012 U	0.02 U	0.019 U
Vanadium	mg/kg	11.8 =	12.8 =	22.1 =	17.8 =
Zinc	mg/kg	56.7 =	57.1 =	47.1 =	57.9 =

Location		**On Berm**	**On Berm**	**On Berm**	**On Berm**
Station		**DA1-001**	**DA1-002**	**DA1-003**	**DA1-007**
Customer ID		**DA1so-001-0002-SO**	**DA1so-002-0004-SO**	**DA1so-003-0006-SO**	**DA1so-007-0014-SO**
Date		**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/20/1999**
Depth (feet)		**1 - 3**	**1 - 3**	**1 - 3**	**1 - 3**
Field Type		**Grab**	**Grab**	**Grab**	**Grab**
Analyte	Units				
Aluminum	mg/kg	15,500 J	8,520 J	7,150 J	20,100 = *
Antimony	mg/kg	1.2 UJ	1.2 UJ	1.1 UJ	0.95 J
Arsenic	mg/kg	17 =	8.3 =	10.6 =	16.3 =
Barium	mg/kg	91 =	43.9 =	26.1 =	67.9 =
Cadmium	mg/kg	0.59 U	0.58 U	0.56 U	0.6 U
Chromium	mg/kg	21.9 =	11.7 =	10.1 =	26 =
Copper	mg/kg	23.2 J	9.2 J	13.3 J	25.7 =
Lead	mg/kg	14.2 =	10.6 =	10.5 =	17.1 =
Mercury	mg/kg	0.023 J	0.037 J	0.024 J	0.023 J
Vanadium	mg/kg	24.3 =	15.6 =	13.9 =	28.9 =
Zinc	mg/kg	70.7 J	36.3 J	35.6 J	77.5 =

Table 4-9. Summary of Selected Site-Related Inorganics in Subsurface Soil (continued)

Location **Station** **Customer ID** **Date** **Depth (feet)** **Field Type**		**On Berm** **DA1-007** **DA1ss-007-0135-SO** **10/20/1999** **1 - 3** **Field Duplicate**	**On Berm** **DA1-010** **DA1so-010-0020-SO** **10/20/1999** **1 - 3** **Grab**	**South Ditch Line** **DA1-040** **DA1so-040-0110-SO** **11/03/1999** **1 - 3** **Grab**
Analyte	Units			
Aluminum	mg/kg	17,800 =	13,700 =	13,300 =
Antimony	mg/kg	0.64 J	1 J *	1.3 UJ
Arsenic	mg/kg	17.2 =	21.9 = *	15 =
Barium	mg/kg	68.1 =	66 =	85.3 =
Cadmium	mg/kg	0.6 U	0.62 U	0.65 U
Chromium	mg/kg	22.8 =	18.9 =	19.7 =
Copper	mg/kg	24.3 =	23.2 =	21.8 J
Lead	mg/kg	15.4 =	15.2 =	13.1 =
Mercury	mg/kg	0.04 J	0.035 J	0.031 U
Vanadium	mg/kg	26.3 =	25.1 =	21.9 =
Zinc	mg/kg	71.2 =	45.6 =	68.5 J

= = Analyte present and concentration accurate.
* = Rejected value.
J = Estimated value less than reporting limits.
R = Result not usable.
U = Not detected.
UJ = Not detected, detection limit estimated.
Blank cells represent non-detect values.

four samples, with concentrations ranging from 0.0016 mg/kg at station DA1-007 [0.1- to 0.3-meter (1- to 3-foot) interval] on top of the berm to a maximum of 0.0081 mg/kg at station DA1-020 inside the berm [0.1- to 0.3-meter (1- to 3-foot) interval]. Toluene was detected on two occasions in the 0.9- to 1.5-meter (3- to 5-foot) depth interval of stations DA1-023 (0.0053 mg/kg) and DA1-042 (0.0045 mg/kg). Acetone was detected twice: at 15 µg/kg in the 0.1- to 0.3-meter (1- to 3-foot) depth interval of DA1-020 and the 0.9- to 1.5-meter (3- to 5-foot) depth interval of DA1-042. Styrene, dimethylbenzene, and methylene chloride were each detected in one sample, as shown on Figure 4-7. The distribution of VOC compounds in the subsurface soil aggregate was limited to four stations. Three of the four stations with subsurface soil VOCs had no detectable surface soil VOCs.

4.3.5.2 PCBs

A total of seven PCBs (Aroclors) were analyzed for in five subsurface soil samples. No PCB compounds were detected.

4.4 SEDIMENT

As described in Section 3.3, four sediment samples from four separate stations were collected for geotechnical and chemical analysis during the DA1 Phase I RI. Table 3-1 lists the sediment samples and designated functional areas from which they were collected. Figure 3-1 illustrates the locations for these four sediment samples. Three of the sediment sampling stations were located along Hinkley Creek including an ambient (background) station (DA1-043) located upstream of DA1 and NTA, station DA1-045 closest to DA1 to the south, and station DA1-046 at the facility exit point (HC-2). Sediment samples from these three stations represent subaqueous sediment from the stream bed. Station DA1-044 (dry sediment) was located in a low-lying area east of the AOC where visual evidence suggested that water frequently accumulated during rainfall events.

4.4.1 Geotechnical Results

Geotechnical samples were collected from all four sediment stations and submitted for grain size distribution and TOC analyses. All of the sediment samples were disturbed (grab) samples. Table 4-10 presents summary results of the geotechnical analyses for sediment samples. Appendix I contains complete geotechnical laboratory results.

Table 4-10. Geotechnical Data for Demolition Area 1 Phase I RI Sediment Samples

Station	DA1-043	DA1-044	DA1-045	DA1-046
Total Organic Carbon (mg/kg)				
	1,400	34,000	140	3,300
Disturbed Sample Grain Size Analysis (% passing)				
3 inches – 3/4 inch	100	100	100	100
3/8 inch	100	100	100	100
#4	90.46	96.02	83.73	95.44
#10	81.85	87.24	50.83	89.88
#20	72.57	75.80	24.85	86.49
#40	53.32	62.35	12.42	83.19
#60	34.27	45.83	7.86	77.54
#140	16.14	34.46	6.55	68.46
#200	14.74	33.12	6.51	66.63

The maximum TOC values correspond to the sediment sample collected from the wet area east of DA1. The analyses reflect that sediment in the narrow channel of Hinkley Creek at stations DA1-043 and DA1-045 has a higher sand and silt content due to winnowing action by the comparatively fast current. The wet area east of DA1 (station DA1-044) contained a higher relative proportion of silt and clay as did the pool located at station DA1-046 (upstream of the weir) from which the sediment sample was collected.

4.4.2 Explosives and Propellants

No explosives or propellants were detected in the sediment samples collected during the Phase I RI.

4.4.3 TAL Metals and Cyanide

Table 4-3 contains summary statistics and results of the background comparison for inorganics in sediment. A total of 17 metals were detected at least once in the sediment sample population. Twelve of the detected metals were eliminated as potential SRCs because they were either major geochemical constituents normally considered as essential elements (calcium, iron, potassium, and magnesium) or the maximum detected value was less than the background criterion. No metal was eliminated on the basis of frequency of detection due to the low number of samples collected.

Those metals retained as SRCs include aluminum, chromium, cobalt, lead, and nickel. A summary of the analytical results for these SRCs is presented in Table 4-11. As evident from the data, all metals concentrations were lowest at station DA1-045, which is the station most likely to receive drainage directed from the AOC to the south. In the wet area east of DA1, lead is the only metal potentially indicative of runoff and contaminant accumulation from the AOC. The sample collected from the facility exit point (HC-2) had the highest concentrations of chromium, cobalt, and nickel. However, the results observed at HC-2 (DA1-046) do not conclusively indicate a link to DA1 considering that concentrations in Hinkley Creek at station DA1-045 closest to the AOC are less than or equal to those observed at HC-2 and at the upstream station.

Table 4-11. Summary Data for Site-Related Metals in Sediment

Station	DA1-043	DA1-044	DA1-045	DA1-046
Aluminum	3,300J	14,400=*	2,570J	12,800J
Chromium	5.5=	14.8J	4.1=	18.8=*
Cobalt	3.5J	4.7J	3.5J	9.4=*
Lead	6.0=	31.1J*	5.0=	11.6=
Nickel	9.1=	11.9J	8.1=	25.4=*

All results in mg/kg.
*Value above facility-wide background criterion.
= = Analyte present and concentration accurate.
J = Estimated values less than laboratory reporting limit.

4.4.4 SVOCs

No SVOCs were detected in the sediment samples collected during the Phase I RI.

4.4.5 VOCs and PCBs

Acetone was detected at station DA1-046 (HC-2) at a concentration of 0.012J mg/kg. No other VOCs were detected.

One PCB compound, Aroclor-1260, was detected in dry sediment at station DA1-044 east of DA1 at a concentration of 0.011J mg/kg. No other PCBs were detected.

4.5 SURFACE WATER

Co-located surface water samples were collected from Hinkley Creek at stations DA1-043, DA1-045, and DA1-046. No water was present at station DA1-044 east of the AOC due to lack of significant rainfall during the field investigation.

4.5.1 Explosives and Propellants

One explosive compound (RDX) was detected at trace levels (0.24J µg/L) in the sample collected at station DA1-046 (HC-2). No other explosive or propellant compound was detected.

4.5.2 TAL Metals and Cyanide

Table 4-4 contains summary statistics and results of the background comparison for inorganics in surface water. Three metals were detected at least once in the surface water sample population (barium, calcium, and zinc). Barium was eliminated as a potential SRC because no value exceeded the background criterion. Calcium was eliminated on the basis of the essential element screen. Zinc was detected above its facility-wide background value (42 µg/L) only in the sample from station DA1-045 (180 µg/L).

4.5.3 SVOCs

Low concentrations of bis(2-ethylhexyl)phthalate were detected in all three surface water samples. This constituent was retained as an SRC because SVOCs are considered anthropogenic (not naturally occurring) so any detected organic compound is considered to be an SRC. The maximum value of 5.1J µg/L was observed at upstream station DA1-043, whereas the minimum value of 3.9J µg/L was detected at station DA1-045. The observed distribution indicates that this SVOC is not related to the AOC.

4.5.4 VOCs and PCBs

Low concentrations of three VOC compounds were detected at least once in DA1 Phase I RI surface water samples. All of the detected values were estimated concentrations less than laboratory reporting limits. The maximum detected values for all three VOCs occurred at upstream station DA1-043. The observed distribution indicates that these VOCs are not related to the AOC.

No PCB compounds were detected in surface water samples collected during the DA1 Phase I RI.

4.6 GROUNDWATER SCREENING SAMPLE RESULTS

One groundwater sample was collected from the temporary piezometer installed in boring DA1-027. Both filtered and unfiltered samples were collected for analysis of inorganics. Because the piezometer was not constructed following protocols designated for monitoring wells and was not developed, the groundwater results are considered as screening data and are used for qualitative evaluation only.

Summary results for detected constituents in the groundwater sample are contained in Table 4-12. All organic results were trace levels qualified as estimated levels below reporting limits. The values shown for inorganics are from the unfiltered sample; these values were consistently much higher than the filtered

Table 4-12. Summary of Detected Constituents in Groundwater at Station DA1-027

Analyte	Unfiltered	Filtered
1,3-DNB	0.045J	N/A
Barium	32.0J	32J
Calcium	40,800J	39,000J
Copper	290J*	25U
Iron	550J	100U
Magnesium	10,700=	10,100=
Potassium	940J	1,000J
Acetone	4.40J	N/A
Carbon disulfide	1.20J	N/A

All results in µg/L.
*Value above facility-wide background criterion.
DNB = Dinitrobenzene.
= = Analyte present and concentration accurate.
J = Estimated value less than laboratory reporting limit.
N/A = Not analyzed.
U = Not detected.

sample results. Of the detected organic constituents, only 1,3-dinitrobenzene (DNB), acetone, and carbon disulfide may be considered as potential SRCs, because these chemicals are anthropogenic (not naturally occurring) and any detected organic constituent is considered to be an SRC. The observed barium concentration did not exceed either the unfiltered or filtered unconsolidated background values. Calcium, iron, magnesium, and potassium may be eliminated as potential SRCs because they are essential elements and because the concentrations were all less than both unfiltered and filtered background values. Copper concentrations in the unfiltered sample slightly exceeded its corresponding background value for unfiltered unconsolidated zone samples (290 µg/L). The copper value in the corresponding filtered groundwater sample from DA1-027 was less than detection limits.

The explosive 1,3-DNB and carbon disulfide observed in the groundwater sample were not detected in any other media at DA1 or NTA. Acetone, although detected at trace levels, is not suspected to be site related. Copper was identified as a principal SRC in surface soil at DA1. Copper concentrations in surface soil at station DA1-027 were substantially elevated above background; subsurface soil copper values only slightly exceeded the background levels. Considering that the observed concentration of copper in unfiltered groundwater at DA1-027 was nearly equal to background and that the filtered result was less than background, no clear evidence exists that copper has leached to groundwater at this station

As part of the human health screening risk evaluation discussed in Chapter 5.0, the maximum concentrations of constituents identified as SRCs are compared to generic soil screening levels for the protection of groundwater contained in the *Soil Screening Guidance: Technical Background Document* (EPA 1996). The generic soil screening criteria are extremely conservative in that they assume contamination extends to the top of the saturated zone, which does not appear to apply at DA1 based on observed soil characterization results. The generic soil screening values are based on a DAF of 10, which, for the purposes of Phase I RI screening at RVAAP, were divided by a factor of 10 (effective DAF = 1). Site-specific conditions affecting the DAF include (1) concentrations decreased substantially in subsurface soil below 0.3 meter (1 feet) bgs; (2) the depth to the water table is about 4.83 meters (15.86 feet); (3) subsurface lithology is a silty clay to clay; and (4) inorganics and explosives have comparatively high retardation factors, especially in a clay-rich matrix. A rough estimation of a site-specific dilution-attenuation factor was performed using the empirical dilution model presented in EPA (1996):

$$DAF = 1 + (Kid/IL)$$

where

DAF = dilution/attenuation factor,
K = hydraulic conductivity (m/yr),
i = hydraulic gradient,
I = infiltration rate (m),
L = length of source parallel to flow (m), and
d = mixing zone depth.

$$d = (0.0112L^2)^{0.5} + d_a \{1\text{-exp}[(\text{-}LI)/Kid_a)]\},$$

where

d_a = aquifer depth (m).

The maximum value for K derived from Phase I RI geotechnical analysis of subsurface soil at DA1 is 9.65×10^{-1} m/yr. This value was obtained from silt clay beneath the site at a depth of about 3 feet. A fine-grained, saturated sand was encountered at a depth of about 25 feet, but no K values were obtained for this unit. The absence of monitoring wells at the site precludes an accurate assessment of hydraulic gradient. However, the water level obtained from the piezometer at station DA1-027 compared to that in the piezometer installed at station NTA-038, east of the AOC, provides the maximum approximation of the overall flat gradients in the area (gradient value of 0.0006). Site-specific infiltration rates are not available for DA1; therefore, the average value for glacial till in the north-central United States overlying shale/sandstone (0.14 m/yr) was employed (EPA 1996). Conservatively, the length of the source parallel to flow was assumed to be the entire length of DA1 from the north to south AOC boundaries [114 meters (375 feet)]. The unconsolidated aquifer thickness is estimated at 45 meters (150 feet), as noted in Chapter 2.0.

When applied, these assumptions produce an estimated DAF of 1.002 at the AOC. This empirical model does not account for chemical or biological attenuation in the vadose zone or aquifer; thus, it likely is an under-representation of actual DAF. Additionally, hydraulic conductivity and gradient data for the site have a high degree of uncertainty. Application of numerical modeling (i.e., Seasonal Compartment Soil [SESOIL]) to estimate leaching potential utilizing soil and monitoring well data would provide a better approximation of anticipated contaminant concentrations at a groundwater receptor point.

4.7 ORDNANCE AND EXPLOSIVES AVOIDANCE SURVEY SUMMARY

Inert fuzes and suspect metallic and non-metallic debris were observed during visual field reconnaissance and magnetometer surveys of access routes and proposed sample points. Most of the observed OE and debris were associated with a number of bare soil areas, some of which were suspected to have been small OB sites outside of the bermed enclosure of DA1. These bare soil areas were primarily located in the western and southern portions of the plane storage area. A number of subsurface magnetic anomalies were also noted within the former OB/OD area and in the plane storage area; these were marked appropriately as part of OE avoidance. During sampling activities, soil borings and the direct-push boring were screened at 0.6-meter (2-foot) intervals to ensure that no metallic anomalies were encountered. No boring had to be abandoned due to the presence of subsurface anomalies. A detailed report of OE avoidance activities is contained in Appendix G.

4.8 SUMMARY OF CONTAMINANT OCCURRENCE AND DISTRIBUTION

Based on the evaluation of the occurrence and distribution of contamination in soil, sediment, and surface water, the following conclusions are made.

Surface Soil

- Low levels of explosives and propellants in surface soil are limited in extent to the northern portion of the former OB/OD area, at scattered locations on top of the berm, and at scattered locations in the western and southern portions of the plane storage area outside of the berm. The highest concentrations of explosives and propellants are clustered along the south drainage ditch, indicating prior migration and deposition via surface water runoff across the AOC.

- Barium, copper, mercury, and zinc exceeded their background criteria in 45 percent or more of the sample population and are considered as the principal inorganic SRCs.

- The highest concentrations of metals occur in the western half of the AOC in the plane storage area outside of the berm primarily at a cluster of stations including DA1-023 through DA1-029 and DA1-042. The observed distribution roughly corresponds to a number of observed bare soil areas containing OE and debris in the western and southern portions of the plane storage area. Lower concentrations of inorganics occur on top of the berm, and most detected concentrations inside the bermed area are less than two times the background criteria.

- Trace levels of three SVOCs and two VOCs were detected in surface soil. PCBs were not detected. The Phase I RI data demonstrate that little impact has occurred to surface soil related to these three classes of compounds.

Subsurface Soil

- A low concentration of 2,4,6-TNT was detected only at station DA1-040 in the south drainage ditch, which had the highest concentrations of explosives and propellants in surface soil. No other explosives or propellants were detected in subsurface soil, indicating that impacts related to explosive compounds are limited to the surface interval.

- Aluminum, arsenic, barium, cobalt, copper, lead, manganese, nickel, vanadium, and zinc rarely exceeded their background criteria in subsurface soil samples. Almost all exceedances of background occur in the western half of the AOC corresponding to the observed distribution in surface soil. On this basis, inorganic contamination above background values is restricted almost exclusively to surface soil, except at a few points (i.e., “hot spots”).

- Trace levels of one SVOC and five VOCs were detected in subsurface soil. PCBs were not detected. The Phase I RI data demonstrate little impact to subsurface soil related to these three classes of compounds.

Sediment

- Based on the distribution of lead concentrations above the background criterion, the wet area east of DA1 is the only area where data suggest potential transport of contamination from DA1 and accumulation within sediment. The data collected during the Phase I RI indicate that sediment in Hinkley Creek has not been significantly affected by former operations at DA1.

Surface Water

- Zinc concentrations above background were observed at station DA1-045 closest to the AOC to the south. Aside from this single detected result, the data collected during the Phase I RI indicate that surface water within Hinkley Creek has not been significantly affected by former operations at DA1.

Groundwater

- Based on the available limited screening data, leaching of contaminants from soil to shallow groundwater in the vicinity of station DA1-027 has not occurred. These data from DA1-027 do not necessarily represent conditions in other portions of the AOC.

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5.0 RISK EVALUATION

5.1 INTRODUCTION

A risk evaluation process is applied to the Phase I sampling results to determine the potential magnitude of risk associated with contamination detected in DA1. COPCs are identified by performing the two-part process outlined below (Figure 5-1):

1. Identify SRCs (see Chapter 4.0):

    - Identify chemicals for exclusion from further risk evaluation based on a frequency of detection screening. Each chemical for each environmental medium is evaluated to determine its frequency of detection. Chemicals never detected are not considered to be SRCs. For media with greater than 20 samples and a frequency of detection of less than 5 percent, a weight-of-evidence approach is used to determine if the chemical is an SRC. The magnitudes and locations (clustering) of the detected concentrations are evaluated. A chemical with detected results that show no clustering and a frequency of detection less than 5 percent is considered spurious and is eliminated as an SRC. Explosives and propellants with a frequency of detection less than 5 percent are exceptions and are not eliminated as SRCs since they are most likely related to previous processes/activities performed at DA1.

    - Identify inorganic chemicals that pass the background screening process. Inorganic chemicals whose maximum detected concentrations are below the background screening criteria are not considered to be SRCs.

    - Identify essential human nutrients that can be eliminated from further consideration in the human health risk screening process. Chemicals that are considered as essential nutrients (calcium, chloride, iodine, iron, magnesium, potassium, phosphorous, and sodium) are not evaluated as SRCs unless grossly elevated relative to background. These chemicals are an integral part of the country’s food supply and are often added to foods as supplements; thus, these constituents are not generally addressed as contaminants (EPA 1989) in the human health risk evaluation. However, essential nutrients detected above background levels are evaluated in the ecological risk evaluation.

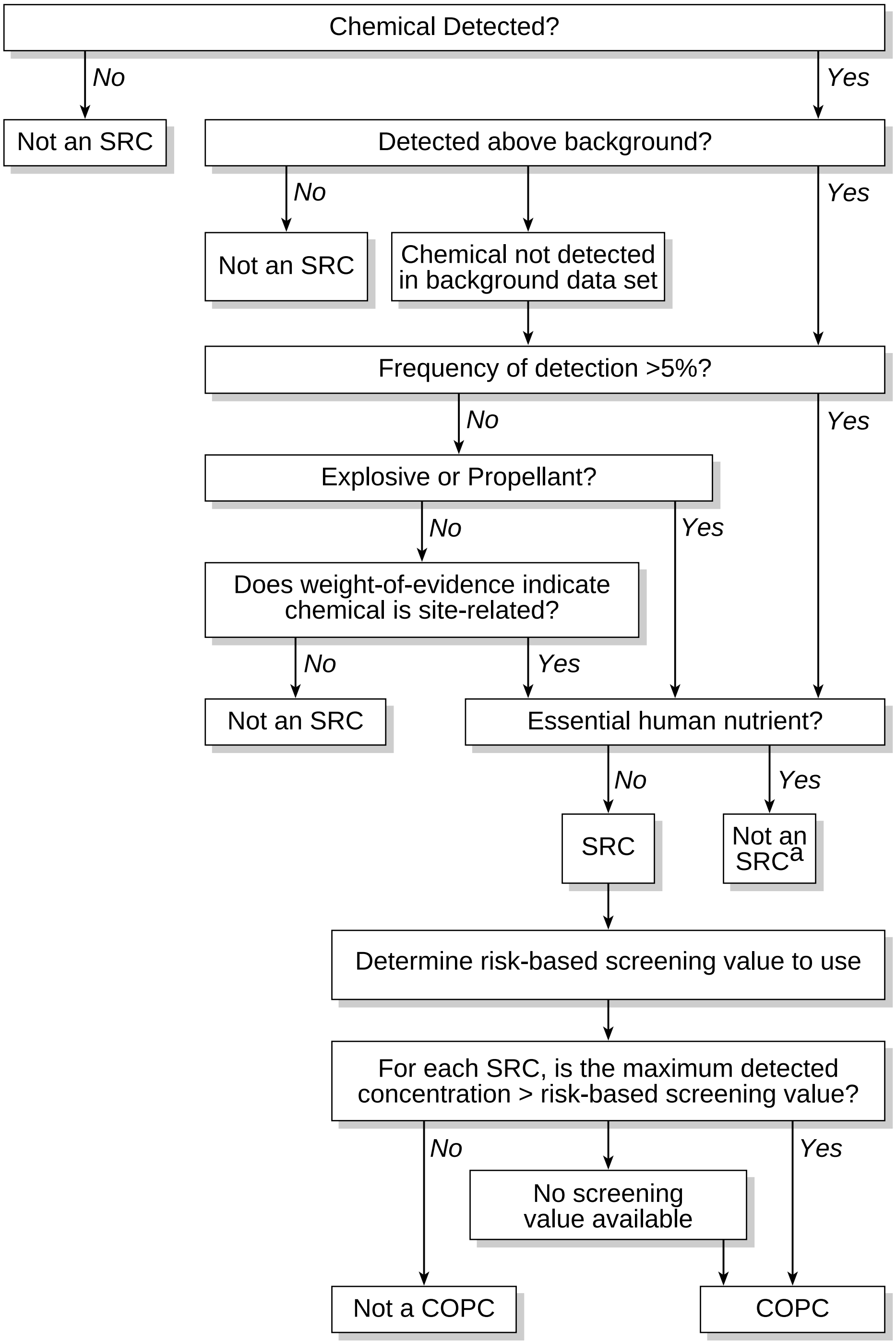
    - Those chemicals excluded as SRCs are not carried through the risk-based screening.

2. Screen against risk-based screening levels:

    - Identify potential migration and exposure pathways associated with the site and identify potential exposure scenarios that should be used to select screening levels (see Section 5.3).

    - Identify risk-based and applicable and relevant or appropriate-based screening levels for each chemical detected at least once above background level for each medium at DA1 (see Section 5.4).

    - Compare concentrations to screening levels to determine if site conditions warrant additional characterization or action (see Sections 5.4.2 and 5.5).



[a] These essential human nutrients are considered as SRCs for subsequent ecological risk-based screening, but are not considered as SRCs for subsequent human health risk-based screening.

60-050301-091a

Figure 5-1. Flow Chart of Risk-Based Screening Process

Only those data passing the data quality assessment (see Section 5.2) are used for the purposes of the risk evaluation. This assessment is necessary to address the impact of any data quality issues on the use of the data for decision making. Of particular importance are the analytical detection limits used and how these detection limits relate to the risk-based screening values.

5.2 DATA QUALITY ASSESSMENT

Section 4.1 and Appendix D present a detailed assessment of the quality of the Phase I sampling analytical results. For purposes of this risk evaluation, it is necessary to address the impact of any data quality issues on the use of the data for decision-making purposes. In particular, an evaluation of the detection limits relative to risk-screening values is performed.

An evaluation is made to determine if chemicals eliminated based on frequency of detection (e.g., those never detected) have detection limits that are elevated above human health risk-based screening levels. As indicated in Table 5-1, several chemicals that were not detected during the Phase I RI have detection limits that are above their respective human health risk-based screening criteria. In this situation, it is impossible to determine whether the chemical is present at levels above or below the risk-based screening values. Thus, the results cannot be used to determine if action is necessary to address that chemical. However, as seen in Table 5-1, the project quantitation limits oftentimes exceed the human health screening criteria. In these cases, it should be noted that most of these risk-based screening levels represent levels that are not easily achieved analytically.

5.3 EXPOSURE PATHWAY ANALYSIS

The demography and land use for RVAAP are presented in Section 1.2 of this Phase I RI report. Potential receptors are discussed in Section 2.6. The exposure pathway analysis presented here summarizes the points from these earlier sections that are relevant to the risk evaluation.

5.3.1 Site History and Current Land Use

The largest population centers closest to DA1 are the town of Ravenna (population 11,771), which is located approximately 3.2 kilometers (2 miles) west of RVAAP, and Newton Falls (population 5,002), which is located approximately 1.6 kilometers (1 mile) to the southeast of RVAAP. The land use immediately surrounding RVAAP and DA1 is primarily rural. Land use within the facility is restricted access. The current land use status for RVAAP is “inactive-modified (un-maintained) caretaker,” which indicates that the facility is no longer needed to mobilize for war efforts. The only remaining federally mandated mission of the facility is ammunition and bulk explosives storage and environmental restoration.

DA1, and the adjacent NTA, lie within OHARNG Training Area “G” in the southwestern portion of RVAAP. Currently, the area consists of a circular 0.3- to 0.4-meter- (1- to 1.5-foot)-high berm surrounding a grassed area that is from approximately 0.3- to 0.4-meter (1 to 1.5-foot) in size. Around the perimeter of the berm are areas of bare ground that are from approximately 30 to 46 square meters (100 to 150 square feet) in size. Munition fragments, including scrap metal, small arms primers, and fuzes, have been observed on the ground surface outside the bermed area. The areas of bare ground surrounding the bermed area suggest possible soil contamination (USACHPPM 1996; USAEHA 1994). The AOC is marked with Seibert stakes and signs warning against unauthorized entry; however, no physical barriers (i.e., fencing or gates) block access.

Table 5-1. Detection Limits in Excess of Risk-Based Screening Values

Chemical[a]	Frequency of Detection	Minimum Detection Limit	Maximum Detection Limit	Project Quantitation Limit[b]	Residential RBSC[c]	Industrial RBSC[d]
Surface Soil (mg/kg)						
Explosives						
1,3-Dinitrobenzene	0/42	0.25	62	1	0.611	8.81
2,6-Dinitrotoluene	0/42	0.25	62	1	0.0715	88.1
2-Nitrotoluene	0/42	0.25	62	1	36.7	100
3-Nitrotoluene	0/42	0.25	62	1	36.7	100
4-Nitrotoluene	0/42	0.25	62	1	36.7	100
Nitrobenzene	0/42	0.25	62	1	1.96	11.4
Nitroglycerin	0/42	2.5	620	1	3.47	17.6
RDX	0/42	0.5	120	2	0.442	2.24
Tetryl	0/42	0.65	160	5	61.1	881
PCBs						
PCB-1221	0/5	0.037	0.044	0.067	0.0222	0.1
PCB-1232	0/5	0.037	0.044	0.033	0.0222	0.1
PCB-1242	0/5	0.037	0.044	0.033	0.0222	0.1
PCB-1248	0/5	0.037	0.044	0.033	0.0222	0.1
PCB-1254	0/5	0.037	0.044	0.033	0.0222	0.1
PCB-1260	0/5	0.037	0.044	0.033	0.0222	0.1
Semivolatile Organic Compounds						
1,4-Dichlorobenzene	0/5	0.37	0.44	0.33	0.344	0.813
2-Nitrobenzenamine	0/5	0.89	1.1	0.8	0.349	5.03
3,3'-Dichlorobenzidine	0/5	0.37	0.44	0.33	0.108	0.548
Benz(a)anthracene	0/5	0.37	0.44	0.33	0.0621	0.289
Benzo(a)pyrene	0/5	0.37	0.44	0.33	0.00621	0.0289
Benzo(b)fluoranthene	0/5	0.37	0.44	0.33	0.0621	0.289
Bis(2-chloroisopropyl) ether	0/5	0.37	0.44	0.33	0.288	0.808
Dibenz(a,h)anthracene	0/5	0.37	0.44	0.33	0.00621	0.0289
Hexachlorobenzene	0/5	0.37	0.44	0.33	0.0304	0.154
Indeno(1,2,3-cd)pyrene	0/5	0.37	0.44	0.33	0.0621	0.289
N-Nitroso-di-n-propylamine	0/5	0.37	0.44	0.33	0.00695	0.0352
Pentachlorophenol	0/5	0.89	1.1	0.8	0.298	1.11
Bis(2-chloroethyl) ether	0/5	0.37	0.44	0.33	0.0211	0.062
Volatile Organic						
1,1-Dichloroethene	0/5	0.0055	0.0067	0.005	0.00536	0.0119
1,2-Dibromoethane	0/5	0.0055	0.0067	NA	0.000689	0.00483
Vinyl chloride	0/5	0.011	0.013	0.01	0.0022	0.0049
Subsurface Soil (mg/kg)						
Explosives						
2,4-Dinitrotoluene	0/70	0.25	0.25	1	0.0715	176
2,6-Dinitrotoluene	0/70	0.25	0.25	1	0.0715	88.1
RDX	0/70	0.5	0.5	2	0.442	2.24
PCBs						
PCB-1221	0/5	0.04	0.044	0.067	0.0222	0.1
PCB-1232	0/5	0.04	0.044	0.033	0.0222	0.1
PCB-1242	0/5	0.04	0.044	0.033	0.0222	0.1

Table 5-1. Detection Limits in Excess of Risk-Based Screening Values (continued)

Chemical[a]	Frequency of Detection	Minimum Detection Limit	Maximum Detection Limit	Project Quantitation Limit[b]	Residential RBSC[c]	Industrial RBSC[d]
PCB-1248	0/5	0.04	0.044	0.033	0.0222	0.1
PCB-1254	0/5	0.04	0.044	0.033	0.0222	0.1
PCB-1260	0/5	0.04	0.044	0.033	0.0222	0.1
Semivolatile Organic Compounds						
1,4-Dichlorobenzene	0/6	0.4	0.44	0.33	0.344	0.813
2-Nitrobenzenamine	0/6	0.96	1.1	0.8	0.349	5.03
3,3'-Dichlorobenzidine	0/5	0.4	0.44	0.33	0.108	0.548
Benz(a)anthracene	0/6	0.4	0.44	0.33	0.0621	0.289
Benzo(a)pyrene	0/6	0.4	0.44	0.33	0.00621	0.0289
Benzo(b)fluoranthene	0/6	0.4	0.44	0.33	0.0621	0.289
Bis(2-chloroisopropyl) ether	0/6	0.4	0.44	0.33	0.288	0.808
Dibenz(a,h)anthracene	0/6	0.4	0.44	0.33	0.00621	0.0289
Hexachlorobenzene	0/6	0.4	0.44	0.33	0.0304	0.154
Indeno(1,2,3-cd)pyrene	0/6	0.4	0.44	0.33	0.0621	0.289
N-Nitroso-di-n-propylamine	0/6	0.4	0.44	0.33	0.00695	0.0352
Pentachlorophenol	0/6	0.96	1.1	0.8	0.298	1.11
Bis(2-chloroethyl) ether	0/6	0.4	0.44	0.33	0.0211	0.062
Volatile Organic Compounds						
1,1-Dichloroethene	0/6	0.0059	0.0067	0.005	0.00536	0.0119
1,2-Dibromoethane	0/6	0.0059	0.0067	NA	0.000689	0.00483
Vinyl chloride	0/6	0.012	0.013	0.01	0.0022	0.0049
Sediment (mg/kg)						
Explosives						
2,4-Dinitrotoluene	0/4	0.25	0.25	1	0.0715	176
2,6-Dinitrotoluene	0/4	0.25	0.25	1	0.0715	88.1
RDX	0/4	0.5	0.5	2	0.442	2.24
PCBs						
PCB-1221	0/4	0.039	0.046	0.067	0.0222	0.1
PCB-1232	0/4	0.039	0.046	0.033	0.0222	0.1
PCB-1242	0/4	0.039	0.046	0.033	0.0222	0.1
PCB-1248	0/4	0.039	0.046	0.033	0.0222	0.1
PCB-1254	0/4	0.039	0.046	0.033	0.0222	0.1
Semivolatile Organic Compounds						
1,4-Dichlorobenzene	0/4	0.39	0.46	0.33	0.344	0.813
2-Nitrobenzenamine	0/4	0.95	1.1	0.8	0.349	5.03
3,3'-Dichlorobenzidine	0/3	0.39	0.43	0.33	0.108	0.548
Benz(a)anthracene	0/4	0.39	0.46	0.33	0.0621	0.289
Benzo(a)pyrene	0/4	0.39	0.46	0.33	0.00621	0.0289
Benzo(b)fluoranthene	0/4	0.39	0.46	0.33	0.0621	0.289
Bis(2-chloroisopropyl) ether	0/4	0.39	0.46	0.33	0.288	0.808
Dibenz(a,h)anthracene	0/4	0.39	0.46	0.33	0.00621	0.0289
Hexachlorobenzene	0/4	0.39	0.46	0.33	0.0304	0.154
Indeno(1,2,3-cd)pyrene	0/4	0.39	0.46	0.33	0.0621	0.289

Table 5-1. Detection Limits in Excess of Risk-Based Screening Values (continued)

Chemical[a]	Frequency of Detection	Minimum Detection Limit	Maximum Detection Limit	Project Quantitation Limit[b]	Residential RBSC[c]	Industrial RBSC[d]
N-Nitroso-di-n-propylamine	0/4	0.39	0.46	0.33	0.00695	0.0352
Pentachlorophenol	0/4	0.95	1.1	0.8	0.298	1.11
Bis(2-chloroethyl) ether	0/4	0.39	0.46	0.33	0.0211	0.062
Volatile Organic Compounds						
1,1-Dichloroethene	0/4	0.0059	0.007	0.005	0.00536	0.0119
1,2-Dibromoethane	0/4	0.0059	0.007	NA	0.000689	0.00483
Vinyl chloride	0/4	0.012	0.014	0.01	0.0022	0.0049
Surface Water (µg/L)						
Explosives						
2,4-Dinitrotoluene	0/3	0.13	0.13	0.1	0.00989	
2,6-Dinitrotoluene	0/3	0.13	0.13	0.1	0.00989	
Nitroglycerin	0/3	2.5	2.5	10	0.48	
Inorganics						
Antimony	0/3	5	5	5	1.46	
Arsenic	0/3	5	5	5	0.00448	
Cadmium	0/3	5	5	5	1.82	
Thallium	0/3	2	2	2	0.292	
Vanadium	0/3	50	50	50	25.5	
PCBs						
PCB-1016	0/3	1	1	1	0.096	
PCB-1221	0/3	1	1	2	0.00336	
PCB-1232	0/3	1	1	1	0.00336	
PCB-1242	0/3	1	1	1	0.00336	
PCB-1248	0/3	1	1	1	0.00336	
PCB-1254	0/3	1	1	1	0.00336	
PCB-1260	0/3	1	1	1	0.00336	
Semivolatile Organic Compounds						
1,3-Dichlorobenzene	0/3	10	10	10	0.548	
1,4-Dichlorobenzene	0/3	10	10	10	0.0502	
2,4,6-Trichlorophenol	0/3	10	10	10	0.611	
2,4-Dinitrophenol	0/3	25	25	25	7.3	
2-Chlorophenol	0/3	10	10	10	3.04	
2-Nitrobenzenamine	0/3	25	25	25	0.209	
3,3'-Dichlorobenzidine	0/3	10	10	10	0.0149	
Benz(a)anthracene	0/3	10	10	10	0.00921	
Benzo(a)pyrene	0/3	10	10	10	0.000921	
Benzo(b)fluoranthene	0/3	10	10	10	0.00921	
Benzo(k)fluoranthene	0/3	10	10	10	0.0921	
Bis(2-chloroisopropyl) ether	0/3	10	10	10	0.0274	
Carbazole	0/3	10	10	10	0.336	
Chrysene	0/3	10	10	10	0.921	
Dibenz(a,h)anthracene	0/3	10	10	10	0.000921	
Dibenzofuran	0/3	10	10	10	2.43	

Table 5-1. Detection Limits in Excess of Risk-Based Screening Values (continued)

Chemical[a]	Frequency of Detection	Minimum Detection Limit	Maximum Detection Limit	Project Quantitation Limit[b]	Residential RBSC[c]	Industrial RBSC[d]
Hexachlorobenzene	0/3	10	10	10	0.0042	
Hexachlorobutadiene	0/3	10	10	10	0.0862	
Hexachloroethane	0/3	10	10	10	0.48	
Indeno(1,2,3-cd)pyrene	0/3	10	10	10	0.00921	
Isophorone	0/3	10	10	10	7.08	
N-Nitroso-di-n-propylamine	0/3	10	10	10	0.00096	
N-Nitrosodiphenylamine	0/3	10	10	10	1.37	
Naphthalene	0/3	10	10	10	0.62	
Pentachlorophenol	0/3	25	25	25	0.056	
Bis(2-chloroethyl) ether	0/3	10	10	10	0.000978	
Volatile Organic Compounds						
1,1,2,2-Tetrachloroethane	0/3	5	5	5	0.00553	
1,1,2-Trichloroethane	0/3	5	5	5	0.02	
1,1-Dichloroethene	0/3	5	5	5	0.00456	
1,2-Dibromoethane	0/3	5	5	NA	0.0000757	
1,2-Dichloroethane	0/3	5	5	5	0.0123	
1,2-Dichloropropane	0/3	5	5	5	0.0165	
Benzene	0/3	5	5	5	0.041	
Bromodichloromethane	0/3	5	5	5	0.0181	
Bromoform	0/3	5	5	NA	0.851	
Bromomethane	0/3	10	10	10	0.866	
Carbon tetrachloride	0/3	5	5	5	0.0171	
Chloroethane	0/3	10	10	10	0.464	
Chloromethane	0/3	10	10	10	0.151	
Dibromochloromethane	0/3	5	5	5	0.0133	
Methylene chloride	0/3	5	5	5	0.428	
Tetrachloroethene	0/3	5	5	5	0.108	
Trichloroethene	0/3	5	5	5	0.164	
Vinyl chloride	0/3	10	10	10	0.00198	

[a] Only chemicals with all non-detected concentrations are shown in this table. The chemicals shown have detection limits that exceed the human health risk-based screening values.

[b] Project quantitation limits are from Table 4 in the *Sampling and Analysis Plan Addendum No. 1 for the RVAAP Demolition Area 1 Phase I RI*. Since some units of measure are shown in µg/kg in the work plan, these values are converted to mg/kg for this table.

[c] Residential screening value for surface soil, subsurface soil, and sediment is one-tenth of the EPA Region 9 residential soil PRG. The residential screening value for surface water is one-tenth of the EPA Region 9 tap water PRG.

[d] Industrial screening value for surface soil, subsurface soil, and sediment is one-tenth of the EPA Region 9 industrial soil PRG. Determination of human health COPCs is based on the screen against the residential RBSC; industrial RBSCs are provided for information only for soil and sediment (there are no industrial RBSCs for surface water).

NA = Not available.
PCBs = Polychlorinated biphenyls.
PRG = Preliminary remediation goal.
RBSC = Risk-based screening criteria.
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.

Since 1969, the Ohio National Guard has been the licensed user of Training Area "G." DA1 currently is not used for training, but the surrounding NTA currently is used for dismounted troop training, bivouacking of the troops in training, and vehicle parking. The training area has also been used as a helicopter day and night landing zone. Firing of small (7.62 millimeter and smaller) blank ammunition is permitted within the Training Area as approved by the Training Site Commander. In addition to training activities, occasional mowing activity (tractor mounted) occurs within the boundaries of DA1. Groundwater currently is not used for potable or non-potable purposes by the OHARNG.

5.3.2 Future Land Use

Future use of DA1 has not been determined at this time, although the site may eventually revert to the OHARNG for training use. Under a baseline human health risk assessment, potential use of groundwater for potable and non-potable purposes by OHARNG would be evaluated as applicable. For the purpose of this risk evaluation, it is conservatively assumed that DA1 land could revert back to rural farmland in the future.

5.3.3 Selected Exposure Pathways

Phase I risk screening methods generally require the use of the most conservative potential land use assumptions for a site (EPA 1991, 1996; ASTM 1995). This ensures that a site with a potential future hazard will not be identified as needing "no further action" too early in the CERCLA process. Based on this approach, the land use assumed for this DA1 risk evaluation is rural residential farmland. For this land use assumption, the following exposure pathways and assumptions have been identified by EPA Region 9 for developing screening levels.

5.3.3.1 Soil and sediment

- Soil/Sediment Ingestion – Because contact rates may be different for children and adults, carcinogenic effects during the first 30 years of life are evaluated using age-adjusted factors. For carcinogenic effects, the receptor's exposure comes from a weighted average of a 15-kilogram (33-pound) child ingesting 200 milligrams (0.007 ounce) of soil/sediment per day over a 6-year period and a 70-kilogram (154-pound) adult ingesting 100 milligrams (.0035 ounce) of soil/sediment per day over a 24-year period. For noncarcinogenic effects, the child and adult are evaluated independently, using the ingestion parameters listed above, with the adult exposed over a 30-year period.

- Soil/Sediment Inhalation – For consistency with the ingestion pathway, inhalation carcinogenic effects come from a weighted average of a 15-kilogram (33-pound) child who inhales volatile organics and particulates at a rate of 10 m^3/day over a 6-year period and a 70-kilogram (154-pound) adult who inhales volatile organics and particulates at a rate of 20 m^3/day over a 24-year period. For noncarcinogenic effects, the child and adult are evaluated independently, using the inhalation parameters listed above, with the adult exposed over a 30-year period.

- Soil/Sediment Dermal Contact – For consistency with the ingestion and inhalation pathways, dermal carcinogenic effects come from a weighted average of a 15-kilogram (33-pound) child with 2,900 cm^2 skin surface area exposed per day over a 6-year period and a 70-kilogram (154-pound) adult with 5,700 cm^2 skin surface area exposed per day over a 24-year period. For noncarcinogenic effects, the child and adult are evaluated independently, using the dermal parameters listed above, with the adult exposed over a 30-year period.

- Leaching of contaminants to groundwater, with subsequent ingestion of groundwater.

Surface Water

- Ingestion of Surface Water – Although it is unrealistic to drink the surface water, the receptor is conservatively assumed to ingest 2 liters (0.5 gallon) of surface water per day over a 30-year period.

- Inhalation while Showering – Although it is unrealistic to use surface water for domestic use (i.e., while showering), the receptor is assumed to inhale volatile organics from the surface water at a rate of 20 m^3/day over a 30-year period.

For this Phase I RI, the groundwater medium is not evaluated, as monitoring wells were not installed. One screening groundwater sample was collected but is not evaluated in this risk evaluation. The surface water evaluation conservatively assumes that the surface water in Hinkley Creek is a potential drinking water source.

Because of the high degree of modeling uncertainty associated with the gardening/irrigation exposure pathway, this pathway is not evaluated in the Phase I risk evaluation screen. It may be identified as a complete pathway in a Phase II baseline risk assessment, if required.

5.4 SCREENING LEVELS

Sources of screening levels are presented for surface soil, subsurface soil, sediment, and surface water data in Sections 5.4.1 to 5.4.4, respectively, with actual values for these screening levels shown in the associated tables within Sections 5.5.1 to 5.5.4. These levels reflect Tier 1-type screening values (ASTM 1995), e.g., values that are easily obtainable and, due to their conservative nature, can be used with a high degree of confidence to indicate sites for which no further action is necessary. The regulatory screening values reflect a residential land use and thus are appropriate for a Phase I evaluation. Soil screening levels based on industrial land use are also provided for reference, as DA1 may ultimately be used by the OHARNG for training purposes. Future land use may be addressed more thoroughly as part of a baseline risk assessment, if deemed necessary. Ecological risk screening is performed for surface water and sediment only, as discussed in Sections 5.5.3 and 5.5.4.

5.4.1 Screening Levels

The following sections present the source of the screening levels and the comparison methods used in the risk evaluation for each medium type. Because no screening criterion is currently available for 2-methylnaphthalene, the value for naphthalene was used as a surrogate criterion to evaluate this constituent.

5.4.1.1 Screening levels for surface and subsurface soil

Surface soil and subsurface soil screening levels used in the human health risk evaluation represent screening values developed by EPA Region 9 (EPA 1999). No ecological risk evaluation is made for soil as discussed below. The EPA Region 9 soil screening values reflect the following:

- residential and industrial land use;

- soil screening levels for the protection of groundwater, derived using default values in standardized equations presented in EPA's *Soil Screening Guidance* (EPA 1996); and

- risk target goals of 10^{-6} for carcinogens and a hazard quotient (HQ) of 1 for noncarcinogens.

The residential and industrial Region 9 values have been adjusted to reflect the Ohio EPA target screening goals of 10^{-7} risk and a HQ of 0.1. Thus, the values used for screening are one-tenth of the Region 9 preliminary remediation goals (PRGs). The Region 9 values reflect the following exposure pathways:

- ingestion,
- inhalation of particulates,
- inhalation of VOCs, and
- dermal absorption.

The industrial values are provided for information only; these values should be carefully applied in a Phase I risk evaluation since use of these values implies that some action—*land use restrictions*—must be implemented.

The soil levels developed for protection of groundwater are derived (by EPA Region 9) from standardized equations presented in EPA's *Soil Screening Guidance* (EPA 1996). These values back-calculate an acceptable concentration in soil based on acceptable groundwater concentrations. They incorporate several sensitive assumptions and thus should be used with caution. Some of the more important assumptions used in developing these values include

- soil contamination extends to the top of the aquifer; thus, there is no accounting for dilution/attenuation in the unsaturated zone; and

- use of a default DAF of 1.0 in the saturated zone suggests unconfined, unconsolidated conditions in the aquifer.

These assumptions could be extremely conservative for DA1. Values based on leaching to groundwater are significantly lower than other screening values and thus should be applied with caution.

Soil screening levels for lead reflect current EPA guidance (EPA 1994a, 1994b). The values were developed by EPA using the Integrated Exposure Uptake Biokinetic Model.

For ecological risk evaluation of soil, no reliable screening data sources exist as was discussed for the WBG Phase II RI on March 18, 1998, at RVAAP among the U.S. Army, Ohio EPA, and SAIC ecological risk assessors. Assuming an ERA is required as part of a subsequent RI phase, soil will be evaluated using a HQ and weight-of-evidence approach.

5.4.1.2 Screening levels for sediment

Sediment screening levels reflect levels protective of ecological and human receptors. The most conservative (i.e., smallest) ecological screening level is chosen from the following sources as the sediment ecological screening value for DA1. These values and hierarchy are in harmony with the work plan approved at the time:

- Ecological Data Quality Levels (EDQLs) from EPA Region V (EPA 1989);

- Ontario Ministry of the Environment (Persaud, Jaagumagi, and Hayton et al. 1993);

- National Oceanic and Atmospheric Administration (NOAA) Screening Quick Reference Tables Threshold Effects Levels (TELs) (Buchman 1998); and

- NOAA Effect Range Lows (Jones, Suter, and Hull et al. 1997, from sources such as Long and Morgan 1991).

Table 5-2 shows the preferred sediment screening values using data from the sources mentioned above. These screening values are then used to screen DA1 sediment data in order to determine ecological COPCs for sediment.

Sediment concentrations are also screened against the adjusted EPA Region 9 (i.e., one-tenth of the Region 9 PRGs) soil screening values for human health, as presented in Section 5.4.1.1. The exception is that the soil levels developed for protection of groundwater are not used to screen sediment concentrations at DA1.

5.4.1.3 Screening levels for surface water

Surface water criteria used for human health screening are adjusted EPA Region 9 PRGs for tap water. The calculated risk-based values presented in the Region 9 PRG table reflect the default exposure pathways and parameters identified by EPA (EPA 1999). For most chemicals, the risk-based screening value reflects the water ingestion scenario; the inhalation pathway is included for VOCs only. The screening values used in the human health risk evaluation are based on a carcinogenic risk level of 10^{-7} or on a noncarcinogenic HQ of 0.1. Thus, the human health screening values are one-tenth of the Region 9 PRGs.

For ecological screening of surface water, the most conservative (i.e., smallest) ecological screening level is chosen from the following sources as the surface water ecological screening value for DA1. These values and hierarchy are in harmony with the work plan approved at that time:

- Ecotox thresholds from the EDQLs from EPA Region 5 (EPA 1998);

- Chapter 3745-1-25 of the Ohio Administrative Code (Ohio Water Quality Standards) for the Mahoning River, which is in the Lake Erie Basin (Ohio EPA 1999); and

- a compilation of toxicological benchmarks from Oak Ridge National Laboratory (Suter and Tsao 1996).

Table 5-3 shows the preferred surface water screening values using the sources provided above. These screening values are used to screen DA1 surface water data in order to determine ecological COPCs.

5.4.2 Screening Comparison Method

The screening level comparison is a systematic screening of sample results against the appropriate screening levels. Chemicals that are not screened out during this process will be considered as potential COPCs for DA1. Initial screening is performed for all media to determined site-related chemicals (see Chapter 4.0 and Section 5.1). Results of the SRC identification are used in the following manner:

- Chemicals that are never detected are not considered to be COPCs.

- Metals detected at or below background are not considered to be COPCs.

- Essential human nutrients are not considered to be human health COPCs (if detected above background, essential human nutrients could potentially be ecological COPCs).

Table 5-2. Ecological Biotic Screening Values for Chemical Constituents in Sediment at RVAAP – Demolition Area 1

		Sediment									
	CAS Registry	Ecological Data Quality Levels (EDQLs)[a]		Ontario MOE[b] Low		NOAA SQuiRTs[c] Threshold Effects Level (TEL)		NOAA[d] Effects Range–Low (ER-L)		Preferred Sediment [e] Value (PSV)	
Chemicals	**Number**	**Number**	**Source**	**Number**	**Source**	**Number**	**Source**	**Number**	**Source**	**Number**	**Source**
Metals											
(Target Analyte List)				(mg/kg)		(mg/kg)		(mg/kg)		(mg/kg)	
Aluminum	7429-90-5				--		--		--	--	--
Antimony	7440-36-0				--		--	2	NOAA ER-L	2	NOAA ER-L
Arsenic (Diss)	7440-38-2	5.9	EDQL EPA Region 5 (1998)	6	Ontario MOE low	5.9	SQuiRTs TEL (1998)	8.2	NOAA ER-L	5.9	EDQL EPA Region 5 (1998)
Barium	7440-39-3				--		--		--	--	--
Beryllium	7440-41-7				--		--		--	--	--
Cadmium (Diss)	7440-43-9	0.596	EDQL EPA Region 5 (1998)	0.6	Ontario MOE low	0.596	SQuiRTs TEL (1998)	1.2	NOAA ER-L	0.596	EDQL EPA Region 5 (1998)
Calcium	7440-70-2				--		--		--	--	--
Chromium (Diss)	7440-47-3	26	EDQL EPA Region 5 (1998)	26	Ontario MOE low	37.3	SQuiRTs TEL (1998)	81	NOAA ER-L	26	EDQL EPA Region 5 (1998)
Cobalt	7440-48-4	50	EDQL EPA Region 5 (1998)		--		--		--	50	EDQL EPA Region 5 (1998)
Copper (Diss)	7440-50-8	16	EDQL EPA Region 5 (1998)	16	Ontario MOE low	35.7	SQuiRTs TEL (1998)	34	NOAA ER-L	16	EDQL EPA Region 5 (1998)
Cyanide	57-12-5	0.0001	EDQL EPA Region 5 (1998)		--		--		--	0.0001	EDQL EPA Region 5 (1998)
Iron	7439-89-6			20	Ontario MOE low		--		--	20	Ontario MOE low
Lead (Diss)	7439-92-1	31	EDQL EPA Region 5 (1998)	31	Ontario MOE low	35	SQuiRTs TEL (1998)	46.7	NOAA ER-L	31	EDQL EPA Region 5 (1998)
Magnesium	7439-95-4				--		--		--	--	--
Manganese	7439-96-5			460	Ontario MOE low		--		--	460	Ontario MOE low
Mercury	7439-97-6	0.174	EDQL EPA Region 5 (1998)	0.2	Ontario MOE low	0.174	SQuiRTs TEL (1998)	0.15	NOAA ER-L	0.15	NOAA ER-L
Nickel (Diss)	7440-02-0	16	EDQL EPA Region 5 (1998)	16	Ontario MOE low	18	SQuiRTs TEL (1998)	20.9	NOAA ER-L	16	EDQL EPA Region 5 (1998)
Potassium	7440-07-7				--		--		--	--	--
Selenium (Diss)	7782-49-2				--		--		--	--	--
Silver (Diss)	7440-22-4	0.5	EDQL EPA Region 5 (1998)		--		--	1	NOAA ER-L	0.5	EDQL EPA Region 5 (1998)
Sodium	7440-23-5				--		--		--	--	--
Thallium	7440-28-0				--		--		--	--	--
Vanadium	7440-62-2				--		--		--	--	--
Zinc (Diss)	7440-66-6	120	EDQL EPA Region 5 (1998)	120	Ontario MOE low	123.1	SQuiRTs TEL (1998)	150	NOAA ER-L	120	EDQL EPA Region 5 (1998)
Organic Compounds		(µg/kg)		(µg/kg)		(µg/kg)		(µg/kg)			
Acenaphthene	83-32-9	6.71	EDQL EPA Region 5 (1998)		--		--	16	NOAA ER-L	6.71	EDQL EPA Region 5 (1998)
Acenaphthylene	208-96-8	5.87	EDQL EPA Region 5 (1998)		--		--	44	NOAA ER-L	5.87	EDQL EPA Region 5 (1998)
Acetone	67-64-1	453.37	EDQL EPA Region 5 (1998)		--		--		--	453.37	EDQL EPA Region 5 (1998)
Aldrin	309-00-2	2	EDQL EPA Region 5 (1998)	2	Ontario MOE low		--			2	EDQL EPA Region 5 (1998)
Anthracene	120-12-7	46.9	EDQL EPA Region 5 (1998)	220	Ontario MOE low		--	85.3	NOAA ER-L	46.9	EDQL EPA Region 5 (1998)
Aroclor-1016	12674-11-2			7	Ontario MOE low		--		--	7	Ontario MOE low
Aroclor-1221	11104-28-2				--		--		--	--	--
Aroclor-1232	11141-16-5				--		--		--	--	--
Aroclor-1242	53469-21-9				--		--		--	--	--
Aroclor-1248	12672-29-6			30	Ontario MOE low		--		--	30	Ontario MOE low
Aroclor-1254	11097-69-1			60	Ontario MOE low		--		--	60	Ontario MOE low
Aroclor-1260	11096-82-5			5	Ontario MOE low		--		--	5	Ontario MOE low

Table 5-2. Ecological Biotic Screening Values for Chemical Constituents in Sediment at RVAAP – Demolition Area 1 (continued)

		Sediment									
	CAS Registry Number	Ecological Data Quality Levels (EDQLs)[a]		Ontario MOE[b] Low		NOAA SQuiRTs[c] Threshold Effects Level (TEL)		NOAA[d] Effects Range–Low (ER-L)		Preferred Sediment [e] Value (PSV)	
Chemicals		**Number**	**Source**	**Number**	**Source**	**Number**	**Source**	**Number**	**Source**	**Number**	**Source**
Benzene	71-43-2	141.57	EDQL EPA Region 5 (1998)		--		--		--	141.57	EDQL EPA Region 5 (1998)
Benzo(a)anthracene	56-55-3	31.7	EDQL EPA Region 5 (1998)	320	Ontario MOE low	31.7	SQuiRTs TEL (1998)	261	NOAA ER-L	31.7	EDQL EPA Region 5 (1998)
Benzo(a)pyrene	50-32-8	31.9	EDQL EPA Region 5 (1998)	370	Ontario MOE low	31.9	SQuiRTs TEL (1998)	430	NOAA ER-L	31.9	EDQL EPA Region 5 (1998)
Benzo(b)fluoranthene	205-99-2	10,400	EDQL EPA Region 5 (1998)		--		--		--	10,400	EDQL EPA Region 5 (1998)
Benzo(g,h,i)perylene	191-24-2	170	EDQL EPA Region 5 (1998)	170	Ontario MOE low		--		--	170	EDQL EPA Region 5 (1998)
Benzo(k)fluoranthene	207-08-9	240	EDQL EPA Region 5 (1998)	240	Ontario MOE low		--		--	240	EDQL EPA Region 5 (1998)
BHC	608-73-1			3	Ontario MOE low		--		--	3	Ontario MOE low
BHC, alpha	319-84-6	6	EDQL EPA Region 5 (1998)	6	Ontario MOE low		--		--	6	EDQL EPA Region 5 (1998)
BHC, beta	319-85-7	5	EDQL EPA Region 5 (1998)	5	Ontario MOE low		--		--	5	EDQL EPA Region 5 (1998)
Biphenyl	92-52-4				--		--		--	--	--
Bis(2-chloroethoxy) methane	111-91-1	349.71	EDQL EPA Region 5 (1998)		--		--		--	349.71	EDQL EPA Region 5 (1998)
Bis(2-chloroethyl) ether	111-44-4	211.96	EDQL EPA Region 5 (1998)		--		--		--	211.96	EDQL EPA Region 5 (1998)
Bis(2-ethylhexyl)phthalate	117-81-7	182	EDQL EPA Region 5 (1998)		--		--		--	182	EDQL EPA Region 5 (1998)
Bromodichloromethane	74-97-5	1.13	EDQL EPA Region 5 (1998)		--		--		--	1.13	EDQL EPA Region 5 (1998)
Bromomethane	74-83-9	0.148	EDQL EPA Region 5 (1998)		--		--		--	0.148	EDQL EPA Region 5 (1998)
4-Bromophenyl-phenylether	101-55-3	1,550	EDQL EPA Region 5 (1998)		--		--		--	1,550	EDQL EPA Region 5 (1998)
2-Butanone	78-93-3	136.96	EDQL EPA Region 5 (1998)		--		--		--	136.96	EDQL EPA Region 5 (1998)
Butylbenzylphthalate	85-68-7	4,190	EDQL EPA Region 5 (1998)		--		--		--	4190	EDQL EPA Region 5 (1998)
Carbazole	86-74-8				--		--		--	--	--
Carbon disulfide	75-15-0	133.97	EDQL EPA Region 5 (1998)		--		--		--	133.97	EDQL EPA Region 5 (1998)
Carbon tetrachloride	56-23-5	35.73	EDQL EPA Region 5 (1998)		--		--		--	35.73	EDQL EPA Region 5 (1998)
4-Chloroaniline	106-47-8	146.08	EDQL EPA Region 5 (1998)		--		--		--	146.08	EDQL EPA Region 5 (1998)
Chlorobenzene	108-90-7	61.94	EDQL EPA Region 5 (1998)		--		--		--	61.94	EDQL EPA Region 5 (1998)
Chlordane	12789-03-6			7	Ontario MOE low	4.5	SQuiRTs TEL (1998)	0.5	NOAA ER-L	0.5	NOAA ER-L
Chloroethane	75-00-3	58,600	EDQL EPA Region 5 (1998)		--		--		--	58,600	EDQL EPA Region 5 (1998)
Chloroform	67-66-3	27	EDQL EPA Region 5 (1998)		--		--		--	27	EDQL EPA Region 5 (1998)
Chloromethane	74-87-3	0.0785	EDQL EPA Region 5 (1998)		--		--		--	0.0785	EDQL EPA Region 5 (1998)
2-Chloronaphthalene	91-58-7	417.23	EDQL EPA Region 5 (1998)		--		--		--	417.23	EDQL EPA Region 5 (1998)
2-Chlorophenol	95-57-8	11.7	EDQL EPA Region 5 (1998)		--		--		--	11.7	EDQL EPA Region 5 (1998)
4-Chlorophenyl-phenyl ether	7005-72-3	656.12	EDQL EPA Region 5 (1998)		--		--		--	656.12	EDQL EPA Region 5 (1998)
4-Chloro-3-methylphenol	59-50-7	388.18	EDQL EPA Region 5 (1998)		--		--		--	388.18	EDQL EPA Region 5 (1998)
Chrysene	218-01-9	57.1	EDQL EPA Region 5 (1998)	340	Ontario MOE low	57.1	SQuiRTs TEL (1998)	384	NOAA ER-L	57.1	EDQL EPA Region 5 (1998)
4,4'-DDD	72-54-8	5.53	EDQL EPA Region 5 (1998)	8	Ontario MOE low	3.54	SQuiRTs TEL (1998)	2	NOAA ER-L	2	NOAA ER-L
4,4'-DDE	72-55-9	1.42	EDQL EPA Region 5 (1998)	5	Ontario MOE low	1.42	SQuiRTs TEL (1998)	2.2	NOAA ER-L	1.42	EDQL EPA Region 5 (1998)
4,4'-DDT	50-29-3	1.19	EDQL EPA Region 5 (1998)	7	Ontario MOE low	6.98	SQuiRTs TEL (1998)	1.58	NOAA ER-L	1.19	EDQL EPA Region 5 (1998)
Diazinon	333-41-5				--		--		--	--	--
Dibenzo(a,h)anthracene	53-70-3	6.22	EDQL EPA Region 5 (1998)	60	Ontario MOE low		--	63.4	NOAA ER-L	6.22	EDQL EPA Region 5 (1998)
Dibenzofuran	132-64-9	1520	EDQL EPA Region 5 (1998)		--		--		--	1520	EDQL EPA Region 5 (1998)
Dibromochloromethane	124-48-1	267.61	EDQL EPA Region 5 (1998)		--		--		--	267.61	EDQL EPA Region 5 (1998)

Table 5-2. Ecological Biotic Screening Values for Chemical Constituents in Sediment at RVAAP – Demolition Area 1 (continued)

		Sediment									
	CAS Registry	Ecological Data Quality Levels (EDQLs)[a]		Ontario MOE[b] Low		NOAA SQuiRTs[c] Threshold Effects Level (TEL)		NOAA[d] Effects Range–Low (ER-L)		Preferred Sediment [e] Value (PSV)	
Chemicals	Number	Number	Source	Number	Source	Number	Source	Number	Source	Number	Source
1,2-Dichlorobenzene	95-50-1	231.32	EDQL EPA Region 5 (1998)		--		--		--	231.32	EDQL EPA Region 5 (1998)
1,3-Dichlorobenzene	541-73-1	3,010	EDQL EPA Region 5 (1998)		--		--		--	3,010	EDQL EPA Region 5 (1998)
1,4-Dichlorobenzene	106-46-7	1,450	EDQL EPA Region 5 (1998)		--		--		--	1,450	EDQL EPA Region 5 (1998)
3,3'-Dichlorobenzidine	91-94-1	28.22	EDQL EPA Region 5 (1998)		--		--		--	28.22	EDQL EPA Region 5 (1998)
1,1-Dichloroethane	75-34-3	0.575	EDQL EPA Region 5 (1998)		--		--		--	0.575	EDQL EPA Region 5 (1998)
1,2-Dichloroethane	107-06-2	54.18	EDQL EPA Region 5 (1998)		--		--		--	54.18	EDQL EPA Region 5 (1998)
1,1-Dichloroethene	75-35-4	23.27	EDQL EPA Region 5 (1998)		--		--		--	23.27	EDQL EPA Region 5 (1998)
1,2-Dichloroethene (total)	540-59-0				--		--		--	--	--
2,4-Dichlorophenol	120-83-2	133.63	EDQL EPA Region 5 (1998)		--		--		--	133.63	EDQL EPA Region 5 (1998)
1,2-Dichloropropane	78-87-5	351.61	EDQL EPA Region 5 (1998)		--		--		--	351.61	EDQL EPA Region 5 (1998)
Cis-1,3-dichloropropene	10061-02-6	2.96	EDQL EPA Region 5 (1998)		--		--		--	2.96	EDQL EPA Region 5 (1998)
Trans-1,3-dichloropropene	10061-02-6	2.96	EDQL EPA Region 5 (1998)		--		--		--	2.96	EDQL EPA Region 5 (1998)
Dieldrin	60-57-1	2	EDQL EPA Region 5 (1998)	2	Ontario MOE low	2.85	SQuiRTs TEL (1998)	0.02	NOAA ER-L	0.02	NOAA ER-L
Diethylphthalate	84-66-2	8.04	EDQL EPA Region 5 (1998)		--		--		--	8.04	EDQL EPA Region 5 (1998)
Dimethylphthalate	131-11-3	24.95	EDQL EPA Region 5 (1998)		--		--		--	24.95	EDQL EPA Region 5 (1998)
2,4-Dimethylphenol	105-67-9	304.53	EDQL EPA Region 5 (1998)		--		--		--	304.53	EDQL EPA Region 5 (1998)
Di-n-butylphthalate	84-74-2	110.5	EDQL EPA Region 5 (1998)		--		--		--	110.5	EDQL EPA Region 5 (1998)
Di-n-octylphthalate	117-84-0	40,600	EDQL EPA Region 5 (1998)		--		--		--	40,600	EDQL EPA Region 5 (1998)
1,3-Dinitrobenzene	99-65-0	0.924	EDQL EPA Region 5 (1998)		--		--		--	0.924	EDQL EPA Region 5 (1998)
2,4-Dinitrophenol	51-28-5	1.33	EDQL EPA Region 5 (1998)		--		--		--	1.33	EDQL EPA Region 5 (1998)
2,4-Dinitrotoluene	121-14-2	75.13	EDQL EPA Region 5 (1998)		--		--		--	75.13	EDQL EPA Region 5 (1998)
2,6-Dinitrotoluene	606-20-2	20.62	EDQL EPA Region 5 (1998)		--		--		--	20.62	EDQL EPA Region 5 (1998)
4,6-Dinitro-2-methylphenol	534-52-1	10.38	EDQL EPA Region 5 (1998)		--		--		--	10.38	EDQL EPA Region 5 (1998)
Endosulfan, alpha	959-98-8	0.175	EDQL EPA Region 5 (1998)		--		--		--	0.175	EDQL EPA Region 5 (1998)
Endosulfan, beta	33213-65-9	0.104	EDQL EPA Region 5 (1998)		--		--		--	0.104	EDQL EPA Region 5 (1998)
Endosulfan, mixed isomers	--				--		--		--	--	--
Endosulfan sulfate	1031-07-8	34.6	EDQL EPA Region 5 (1998)		--		--		--	34.6	EDQL EPA Region 5 (1998)
Endrin	72-20-8	2.67	EDQL EPA Region 5 (1998)	3	Ontario MOE low	2.67	SQuiRTs TEL (1998)	0.02	NOAA ER-L	0.02	NOAA ER-L
Ethylbenzene	100-41-4	0.1	EDQL EPA Region 5 (1998)		--		--		--	0.1	EDQL EPA Region 5 (1998)
Fluoranthene	206-44-0	111.3	EDQL EPA Region 5 (1998)	750	Ontario MOE low	111	SQuiRTs TEL (1998)	600	NOAA ER-L	111	SQuiRTs TEL (1998)
Fluorene	86-73-7	21.2	EDQL EPA Region 5 (1998)	190	Ontario MOE low		--	19	NOAA ER-L	19	NOAA ER-L
Gamma-BHC (lindane)	58-89-9	0.94	EDQL EPA Region 5 (1998)	3	Ontario MOE low	0.94	SQuiRTs TEL (1998)		--	0.94	EDQL EPA Region 5 (1998)
Heptachlor Epoxide	1024-57-3	0.6	EDQL EPA Region 5 (1998)	5	Ontario MOE low	0.6	SQuiRTs TEL (1998)		--	0.6	EDQL EPA Region 5 (1998)
Hexachlorobenzene	118-74-1	20	EDQL EPA Region 5 (1998)	20	Ontario MOE low		--		--	20	EDQL EPA Region 5 (1998)
Hexachlorobutadiene	87-68-3	1,380	EDQL EPA Region 5 (1998)		--		--		--	1,380	EDQL EPA Region 5 (1998)
Hexachlorocyclopentadiene	77-47-4	900.74	EDQL EPA Region 5 (1998)		--		--		--	900.74	EDQL EPA Region 5 (1998)
Hexachloroethane	67-72-1	2,230	EDQL EPA Region 5 (1998)		--		--		--	2,230	EDQL EPA Region 5 (1998)
2-Hexanone	591-78-6	1,010	EDQL EPA Region 5 (1998)		--		--		--	1,010	EDQL EPA Region 5 (1998)
HMX (octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)	2691-41-0				--		--		--	--	--

Table 5-2. Ecological Biotic Screening Values for Chemical Constituents in Sediment at RVAAP – Demolition Area 1 (continued)

		Sediment									
		Ecological Data Quality Levels (EDQLs)[a]		Ontario MOE[b] Low		NOAA SQuiRTs[c] Threshold Effects Level (TEL)		NOAA[d] Effects Range–Low (ER-L)		Preferred Sediment [e] Value (PSV)	
Chemicals	**CAS Registry Number**	**Number**	**Source**	**Number**	**Source**	**Number**	**Source**	**Number**	**Source**	**Number**	**Source**
Indeno(1,2,3-cd)pyrene	193-39-5	200	EDQL EPA Region 5 (1998)	200	Ontario MOE low		--		--	200	EDQL EPA Region 5 (1998)
Isophorone	78-59-1	422.3	EDQL EPA Region 5 (1998)		--		--		--	422.3	EDQL EPA Region 5 (1998)
Malathion	121-75-5				--		--		--	--	--
Methoxychlor	72-43-5	3.59	EDQL EPA Region 5 (1998)		--		--		--	3.59	EDQL EPA Region 5 (1998)
Methylene chloride	75-09-2	1,260	EDQL EPA Region 5 (1998)		--		--		--	1,260	EDQL EPA Region 5 (1998)
2-Methylnaphthalene	91-57-6	20.2	EDQL EPA Region 5 (1998)		--		--	70	NOAA ER-L	20.2	EDQL EPA Region 5 (1998)
2-Methylphenol	95-48-7	0.826	EDQL EPA Region 5 (1998)		--		--		--	0.826	EDQL EPA Region 5 (1998)
4-Methylphenol	106-44-5	0.808	EDQL EPA Region 5 (1998)		--		--		--	0.808	EDQL EPA Region 5 (1998)
4-Methyl-2-pentanone	108-10-1	544.37	EDQL EPA Region 5 (1998)		--		--		--	544.37	EDQL EPA Region 5 (1998)
Mirex	2385-85-5			7	Ontario MOE low		--		--	7	Ontario MOE low
Naphthalene	91-20-3	34.6	EDQL EPA Region 5 (1998)		--		--	160	NOAA ER-L	34.6	EDQL EPA Region 5 (1998)
2-Nitroaniline	88-74-4	0.222	EDQL EPA Region 5 (1998)		--		--		--	0.222	EDQL EPA Region 5 (1998)
3-Nitroaniline	99-09-2	0.222	EDQL EPA Region 5 (1998)		--		--		--	0.222	EDQL EPA Region 5 (1998)
4-Nitroaniline	100-01-6	0.222	EDQL EPA Region 5 (1998)		--		--		--	0.222	EDQL EPA Region 5 (1998)
Nitrobenzene	99-95-3	487.6	EDQL EPA Region 5 (1998)		--		--		--	487.6	EDQL EPA Region 5 (1998)
Nitrobenzene	99-95-3				--		--		--	--	--
Nitrocellulose	9004-70-0				--		--		--	--	--
Nitroglycerin	55-63-0				--		--		--	--	--
Nitroquanidine	--				--		--		--	--	--
2-Nitrophenol	88-75-5	7.77	EDQL EPA Region 5 (1998)		--		--		--	7.77	EDQL EPA Region 5 (1998)
4-Nitrophenol	100-02-7	7.78	EDQL EPA Region 5 (1998)		--		--		--	7.78	EDQL EPA Region 5 (1998)
M-nitrotoluene	99-08-1				--		--		--	--	--
N-nitroso-di-n-dipropylamine	621-64-7	0.217	EDQL EPA Region 5 (1998)		--		--		--	0.217	EDQL EPA Region 5 (1998)
N-nitrosodiphenylamine	86-30-6	155.24	EDQL EPA Region 5 (1998)		--		--		--	155.24	EDQL EPA Region 5 (1998)
O-nitrotoluene	88-72-2				--		--		--	--	--
2,2'-Oxybis(1-chloropropane)	108-60-1	68.78	EDQL EPA Region 5 (1998)		--		--		--	68.78	EDQL EPA Region 5 (1998)
Pentachlorophenol	87-86-5	30,100	EDQL EPA Region 5 (1998)		--		--		--	30,100	EDQL EPA Region 5 (1998)
Pentachlorobenzene	608-93-5	1,260	EDQL EPA Region 5 (1998)		--		--		--	1,260	EDQL EPA Region 5 (1998)
Phenanthrene	85-01-8	41.9	EDQL EPA Region 5 (1998)	560	Ontario MOE low	41.9	SQuiRTs TEL (1998)	240	NOAA ER-L	41.9	EDQL EPA Region 5 (1998)
Phenol	108-95-2	27.26	EDQL EPA Region 5 (1998)		--		--		--	27.26	EDQL EPA Region 5 (1998)
Polynuclear aromatic hydrocarbons				4,000	Ontario MOE low		--	4,022	NOAA ER-L	4,000	Ontario MOE low
Polychlorinated biphenyls	1336-36-3	34.1	EDQL EPA Region 5 (1998)	70	Ontario MOE low	34.1	SQuiRTs TEL (1998)	22.7	NOAA ER-L	22.7	NOAA ER-L
P-nitrotoluene	99-99-0				--		--		--	--	--
Pyrene	129-00-0	53	EDQL EPA Region 5 (1998)	490	Ontario MOE low	53	SQuiRTs TEL (1998)	665	NOAA ER-L	53	EDQL EPA Region 5 (1998)
RDX (cyclonite) Hexahydro-1,3,5-trinitro-1,3,5-triazine	121-82-4				--		--		--	--	--
Styrene	100-42-5	444.96	EDQL EPA Region 5 (1998)		--		--		--	444.96	EDQL EPA Region 5 (1998)
Tetrachloroethene	127-18-4	195.83	EDQL EPA Region 5 (1998)		--		--		--	195.83	EDQL EPA Region 5 (1998)
Tetrachloroethylene	127-18-4	195.83	EDQL EPA Region 5 (1998)		--		--		--	195.83	EDQL EPA Region 5 (1998)
1,1,2,2-Tetrachloroethane	79-34-5	29.08	EDQL EPA Region 5 (1998)		--		--		--	29.08	EDQL EPA Region 5 (1998)

Table 5-2. Ecological Biotic Screening Values for Chemical Constituents in Sediment at RVAAP – Demolition Area 1 (continued)

Chemicals	CAS Registry Number	Sediment									
		Ecological Data Quality Levels (EDQLs)[a]		Ontario MOE[b] Low		NOAA SQuiRTs[c] Threshold Effects Level (TEL)		NOAA[d] Effects Range–Low (ER-L)		Preferred Sediment [e] Value (PSV)	
		Number	**Source**	**Number**	**Source**	**Number**	**Source**	**Number**	**Source**	**Number**	**Source**
Tetrachloromethane	56-23-5	35.73	EDQL EPA Region 5 (1998)		--		--		--	35.73	EDQL EPA Region 5 (1998)
Tetryl	479-45-8				--		--		--	--	--
Toluene	108-88-3	52,500	EDQL EPA Region 5 (1998)		--		--		--	52,500	EDQL EPA Region 5 (1998)
Toxaphene	8001-35-2	0.109	EDQL EPA Region 5 (1998)		--		--		--	0.109	EDQL EPA Region 5 (1998)
Tribromomethane	75-25-2	996.27	EDQL EPA Region 5 (1998)		--		--		--	996.27	EDQL EPA Region 5 (1998)
Trichloroethene	79-01-6	179.56	EDQL EPA Region 5 (1998)		--		--		--	179.56	EDQL EPA Region 5 (1998)
1,2,4-Trichlorobenzene	120-82-1	11700	EDQL EPA Region 5 (1998)		--		--		--	11,700	EDQL EPA Region 5 (1998)
1,1,1-Trichloroethane	71-55-6	246.85	EDQL EPA Region 5 (1998)		--		--		--	246.85	EDQL EPA Region 5 (1998)
1,1,2-Trichloroethane	79-00-5	673.51	EDQL EPA Region 5 (1998)		--		--		--	673.51	EDQL EPA Region 5 (1998)
Trichloroethylene	79-01-6	179.56	EDQL EPA Region 5 (1998)		--		--		--	179.56	EDQL EPA Region 5 (1998)
2,4,5-Trichlorophenol	95-95-4	85.56	EDQL EPA Region 5 (1998)		--		--		--	85.56	EDQL EPA Region 5 (1998)
2,4,6-Trichlorophenol	88-06-2	84.84	EDQL EPA Region 5 (1998)		--		--		--	84.84	EDQL EPA Region 5 (1998)
1,3,5-Trinitrobenzene	99-35-4	0.121	EDQL EPA Region 5 (1998)		--		--		--	0.121	EDQL EPA Region 5 (1998)
2,4,6-Trinitrotoluene	118-96-7				--		--		--	--	--
Vinyl chloride	75-01-4	2	EDQL EPA Region 5 (1998)		--		--		--	2	EDQL EPA Region 5 (1998)
Xylenes (total)	1330-20-7	1,880	EDQL EPA Region 5 (1998)		--		--		--	1,880	EDQL EPA Region 5 (1998)

[a] EPA (1998). RCRA QAPP Instructions, USEPA Region 5, Chicago, IL, April 1998 revision. http://www.epa.gov/reg5rcra/wptdiv/cars/cars.htm.

[b] Jones, D.S., G.W. Suter II, and R.N. Hull (1997). *Toxicological Benchmarks for Screening Constituents of Potential Concern for Effects on Sediment-Associated Biota: 1997 Revision*. ES/ER/TM-95/R4. Lockheed Martin Energy Systems, Inc., November.

[c] Buchman, M.F. (1998). NOAA Screening Quick Reference Tables, NOAA HAZMAT Report 97-2, Hazardous Material Response and Assessment Division, National Oceanic and Atmospheric Administration, Seattle, WA.

[d] Jones, D.S., G.W. Suter II, and R.N. Hull (1997). *Toxicological Benchmarks for Screening Constituents of Potential Concern for Effects on Sediment-Associated Biota: 1997 Revision*. ES/ER/TM-95/R4. Lockheed Martin Energy Systems, Inc., November.

[e] The Preferred Sediment Value is the lowest value among the EDQLs, the MOE, NOAA SQuiRTs, and NOAA ER-L sediment values.

-- = No value.

DDD = Dichlorodiphenyl dichloroethane.

DDE = Dichlorodiphenyl dichloroethylene.

DDT = Dichlorodiphenyl trichloroethane.

Diss. = Dissolved.

Table 5-3. Ecological Biotic Screening Values for Chemical Constituents in Surface Water at RVAAP – Demolition Area 1

Chemicals	CAS Registry Number	Surface Water							
		Ecological Data Quality Levels (EDQL)[a]		Ohio EPA OMZA (Outside Mixing Zone Average)[b]		Suter and Tsao (1996)[c]		Preferred Surface Water Value[d]	
		Number (µg/L)	Source	Number (µg/L)	Source	Number (µg/L)	Source	Number (µg/L)	Source
Metals									
(Target Analyte List)									
Aluminum	7429-90-5		EDQL EPA Region 5 (1998)		--	87	NAWQC (Suter & Tsao 1996)	87	NAWQC (Suter & Tsao 1996)
Antimony	7440-36-0	31	EDQL EPA Region 5 (1998)	190	Ohio Administrative Code	30	Draft FCV values (EPA 1988b in Suter & Tsao 1996)	30	Draft FCV values (EPA 1988b in Suter & Tsao 1996)
Arsenic III (Diss)	7440-38-2	53	EDQL EPA Region 5 (1998)	150	Ohio Administrative Code	190	NAWQC (Suter & Tsao 1996)	53	EDQL EPA Region 5 (1998)
Arsenic (TR)	7440-38-2	53	EDQL EPA Region 5 (1998)	150	Ohio Administrative Code		--	53	EDQL EPA Region 5 (1998)
Arsenic V (Diss)	7440-38-2	53	EDQL EPA Region 5 (1998)		--	3.1	Tier II (Suter & Tsao 1996)	3.1	Tier II (Suter & Tsao 1996)
Barium	7440-39-3	5,000	EDQL EPA Region 5 (1998)	220	Ohio Administrative Code	4.0	Tier II (Suter & Tsao 1996)	4	Tier II (Suter & Tsao 1996)
Beryllium (TR)	7440-41-7	7.6	EDQL EPA Region 5 (1998)	11[e]	Ohio Administrative Code	0.66	Tier II (Suter & Tsao 1996)	0.66	Tier II (Suter & Tsao 1996)
Boron	7440-42-8			950	Ohio Administrative Code	1.6	Tier II (Suter & Tsao 1996)	1.6	Tier II (Suter & Tsao 1996)
Cadmium (Diss)	7440-43-9	0.7	EDQL EPA Region 5 (1998)	2.2[e]	Ohio Administrative Code	1.1	NAWQC (Suter & Tsao 1996)	0.7	EDQL EPA Region 5 (1998)
Cadmium (TR)	7440-43-9	0.7	EDQL EPA Region 5 (1998)	2.5[e]	Ohio Administrative Code		--	0.7	EDQL EPA Region 5 (1998)
Calcium	7440-70-2				--		--	--	--
Chlorine (TR)	7782-50-5			11	Ohio Administrative Code		--	11	Ohio Administrative Code
Chromium III (Diss)	7440-47-3	42	EDQL EPA Region 5 (1998)	74[e]	Ohio Administrative Code	210	Tier II (Suter & Tsao 1996)	42	EDQL EPA Region 5 (1998)
Chromium (TR)	7440-47-3	42	EDQL EPA Region 5 (1998)	86[e]	Ohio Administrative Code		--	42	EDQL EPA Region 5 (1998)
Chromium VI (Diss)	7440-47-3	42	EDQL EPA Region 5 (1998)		--	11	Tier II (Suter & Tsao 1996)	11	Tier II (Suter & Tsao 1996)
Cobalt	7440-48-4	5	EDQL EPA Region 5 (1998)	24	Ohio Administrative Code	23	Tier II (Suter & Tsao 1996)	5	EDQL EPA Region 5 (1998)
Copper (Diss)	7440-50-8	5	EDQL EPA Region 5 (1998)	9.0[e]	Ohio Administrative Code	12	NAWQC (Suter & Tsao 1996)	5	EDQL EPA Region 5 (1998)
Copper (TR)	7440-50-8	5	EDQL EPA Region 5 (1998)	9.3[e]	Ohio Administrative Code		--	5	EDQL EPA Region 5 (1998)
Cyanide	57-12-5	5.2	EDQL EPA Region 5 (1998)	5.2	Ohio Administrative Code	5.2	NAWQC (Suter & Tsao 1996)	5.2	NAWQC (Suter & Tsao 1996)
Iron	7439-89-6				--	1,000	NAWQC (Suter & Tsao 1996)	1,000	NAWQC (Suter & Tsao 1996)
Lead (Diss)	7439-92-1	1.3	EDQL EPA Region 5 (1998)	5.1[e]	Ohio Administrative Code	3.2	NAWQC (Suter & Tsao 1996)	1.3	EDQL EPA Region 5 (1998)
Lead (TR)	7439-92-1	1.3	EDQL EPA Region 5 (1998)	6.4[e]	Ohio Administrative Code		--	1.3	EDQL EPA Region 5 (1998)
Magnesium	7439-95-4				--		--	--	--
Manganese (TR)	7439-96-5			180	Ohio Administrative Code	120	Tier II (Suter & Tsao 1996)	120	NAWQC (Suter & Tsao 1996)
Mercury (CVAA) (Diss)	7439-97-6	0.0013	EDQL EPA Region 5 (1998)	0.77	Ohio Administrative Code	1.3	Tier II (Suter & Tsao 1996)	0.0013	EDQL EPA Region 5 (1998)
Mercury (TR)	7439-97-6	0.0013	EDQL EPA Region 5 (1998)	0.91	Ohio Administrative Code		--	0.0013	EDQL EPA Region 5 (1998)
Mercury, Methyl	7439-97-6	0.0013	EDQL EPA Region 5 (1998)		--	0.0028	Tier II (Suter & Tsao 1996)	0.0013	EDQL EPA Region 5 (1998)
Molybdenum	7439-98-7			110	Ohio Administrative Code	370	Tier II (Suter & Tsao 1996)	110	Ohio Administrative Code
Nickel (Diss)	7440-02-0	29	EDQL EPA Region 5 (1998)	52[e]	Ohio Administrative Code	160	NAWQC (Suter & Tsao 1996)	29	EDQL EPA Region 5 (1998)
Nickel (TR)	7440-02-1	29	EDQL EPA Region 5 (1998)	52[e]	Ohio Administrative Code		--	29	EDQL EPA Region 5 (1998)
Potassium	7440-09-7				--		--	--	--
Selenium (Diss)	7782-49-2	5	EDQL EPA Region 5 (1998)	4.6	Ohio Administrative Code	5.0	NAWQC (Suter & Tsao 1996)	4.6	Ohio Administrative Code
Selenium (TR)	7782-49-2	5	EDQL EPA Region 5 (1998)	5.0	Ohio Administrative Code		--	5	EDQL EPA Region 5 (1998)
Silver (Diss)	7440-22-4	1	EDQL EPA Region 5 (1998)		--	0.36	Tier II (Suter & Tsao 1996)	0.36	Tier II (Suter & Tsao 1996)
Silver (TR)	7440-22-4	1	EDQL EPA Region 5 (1998)	0.06	Ohio Administrative Code		--	0.06	Ohio Administrative Code
Sodium	7440-23-5				--		--	--	--
Strontium	7440-24-6			770	Ohio Administrative Code	1,500	Tier II (Suter & Tsao 1996)	770	Ohio Administrative Code

Table 5-3. Ecological Biotic Screening Values for Chemical Constituents in Surface Water at RVAAP – Demolition Area 1 (continued)

		Surface Water							
		Ecological Data Quality Levels (EDQL)[a]		Ohio EPA OMZA (Outside Mixing Zone Average)[b]		Suter and Tsao (1996)[c]		Preferred Surface Water Value[d]	
Chemicals	**CAS Registry Number**	**Number (µg/L)**	**Source**	**Number (µg/L)**	**Source**	**Number (µg/L)**	**Source**	**Number (µg/L)**	**Source**
Thallium	7440-28-0	0.6	EDQL EPA Region 5 (1998)	17	Ohio Administrative Code	12	Tier II (Suter & Tsao 1996)	0.6	EDQL EPA Region 5 (1998)
Tin	7440-31-5	73	EDQL EPA Region 5 (1998)	180	Ohio Administrative Code	73	Tier II (Suter & Tsao 1996)	73	EDQL EPA Region 5 (1998)
Uranium	7440-61-1				--	2.6	Tier II (Suter & Tsao 1996)	2.6	Tier II (Suter & Tsao 1996)
Vanadium	7440-62-2	19	EDQL EPA Region 5 (1998)	26	Ohio Administrative Code	20	Tier II (Suter & Tsao 1996)	19	EDQL EPA Region 5 (1998)
Zinc (Diss)	7440-66-6	59	EDQL EPA Region 5 (1998)	120[e]	Ohio Administrative Code	110	NAWQC (Suter & Tsao 1996)	59	EDQL EPA Region 5 (1998)
Zinc (TR)	7440-66-6	59	EDQL EPA Region 5 (1998)	120[e]	Ohio Administrative Code		--	59	EDQL EPA Region 5 (1998)
Zirconium	7440-67-7				--	17	Tier II (Suter & Tsao 1996)	17	Tier II (Suter & Tsao 1996)
Volatile Organic Compounds									
Acenaphthene	83-32-9	10	EDQL EPA Region 5 (1998)	9.4	Ohio Administrative Code	23	NAWQC (EPA 1993b in Suter & Tsao 1996)[f]	9.4	Ohio Administrative Code
Acenaphthylene	208-96-8	4,840	EDQL EPA Region 5 (1998)		--		--	4,840	EDQL EPA Region 5 (1998)
Acetonitrile	75-05-8	30,000	EDQL EPA Region 5 (1998)	12,000	Ohio Administrative Code		--	12,000	Ohio Administrative Code
Acetone	67-64-1	78,000	EDQL EPA Region 5 (1998)		--	1,500	Tier II (Suter & Tsao 1996)	1,500	Tier II (Suter & Tsao 1996)
Acrylonitrile	107-13-1	0.9	EDQL EPA Region 5 (1998)	78	Ohio Administrative Code		--	0.9	EDQL EPA Region 5 (1998)
Anthracene	120-12-7	0.3	EDQL EPA Region 5 (1998)	0.02	Ohio Administrative Code	0.73	Tier II (Suter & Tsao 1996)	0.02	Ohio Administrative Code
Aroclor-1016	12674-11-2				--		--	--	--
Aroclor-1221	11104-28-2				--	0.28	Tier II (Suter & Tsao 1996)	0.28	Tier II (Suter & Tsao 1996)
Aroclor-1232	11141-16-5				--	0.58	Tier II (Suter & Tsao 1996)	0.58	Tier II (Suter & Tsao 1996)
Aroclor-1242	53469-21-9				--	0.053	Tier II (Suter & Tsao 1996)	0.053	Tier II (Suter & Tsao 1996)
Aroclor-1248	12672-29-6				--	0.081	Tier II (Suter & Tsao 1996)	0.081	Tier II (Suter & Tsao 1996)
Aroclor-1254	11097-69-1				--	0.033	Tier II (Suter & Tsao 1996)	0.033	Tier II (Suter & Tsao 1996)
Aroclor-1260	11096-82-5				--	94	Tier II (Suter & Tsao 1996)	94	Tier II (Suter & Tsao 1996)
Benzene	71-43-2	114	EDQL EPA Region 5 (1998)	160	Ohio Administrative Code	130	Tier II (Suter & Tsao 1996)	114	EDQL EPA Region 5 (1998)
Benzidene	92-87-5				--	3.9	Tier II (Suter & Tsao 1996)	3.9	Tier II (Suter & Tsao 1996)
Benzo(a)anthracene	56-55-3	0.9	EDQL EPA Region 5 (1998)		--	0.027	Tier II (Suter & Tsao 1996)	0.027	Tier II (Suter & Tsao 1996)
Benzo(a)pyrene	50-32-8	0.1	EDQL EPA Region 5 (1998)		--	0.014	Tier II (Suter & Tsao 1996)	0.014	Tier II (Suter & Tsao 1996)
Benzo(b)fluoranthene	205-99-2	9.1	EDQL EPA Region 5 (1998)		--		--	9.1	EDQL EPA Region 5 (1998)
Benzo(g,h,i)perylene	191-24-2	7.6	EDQL EPA Region 5 (1998)		--		--	7.6	EDQL EPA Region 5 (1998)
Benzo(k)fluoranthene	207-08-9	0.0056	EDQL EPA Region 5 (1998)		--		--	0.0056	EDQL EPA Region 5 (1998)
Benzoic acid	65-85-0				--	42	Tier II (Suter & Tsao 1996)	42	Tier II (Suter & Tsao 1996)
Benzyl alcohol	100-51-6	281	EDQL EPA Region 5 (1998)		--	8.6	Tier II (Suter & Tsao 1996)	8.6	Tier II (Suter & Tsao 1996)
Bis(2-chloroethoxy) methane	111-91-1	6,400	EDQL EPA Region 5 (1998)		--		--	6,400	EDQL EPA Region 5 (1998)
Bis(2-chloroethyl) ether	111-44-4	1,140	EDQL EPA Region 5 (1998)		--		--	1,140	EDQL EPA Region 5 (1998)
Bis(2-ethylhexyl)phthalate	117-81-7	2.1	EDQL EPA Region 5 (1998)	8.4	Ohio Administrative Code	3.0	Tier II (Suter & Tsao 1996)	2.1	EDQL EPA Region 5 (1998)
Biphenyl	92-52-4				--	14.0	OSWER 1996 (in Suter & Tsao 1996)	14	OSWER 1996 (in Suter & Tsao 1996)
Bromodichloromethane	75-27-4			340	Ohio Administrative Code		--	340	Ohio Administrative Code

Table 5-3. Ecological Biotic Screening Values for Chemical Constituents in Surface Water at RVAAP – Demolition Area 1 (continued)

		Surface Water							
		Ecological Data Quality Levels (EDQL)[a]		Ohio EPA OMZA (Outside Mixing Zone Average)[b]		Suter and Tsao (1996)[c]		Preferred Surface Water Value[d]	
Chemicals	**CAS Registry Number**	**Number (µg/L)**	**Source**	**Number (µg/L)**	**Source**	**Number (µg/L)**	**Source**	**Number (µg/L)**	**Source**
Bromoform	75-25-2	466	EDQL EPA Region 5 (1998)	230	Ohio Administrative Code		--	230	Ohio Administrative Code
Bromomethane	74-83-9			16	Ohio Administrative Code		--	16	Ohio Administrative Code
4-Bromophenyl-phenylether	101-55-3	1.5	EDQL EPA Region 5 (1998)		--	1.5	OSWER 1996 (in Suter & Tsao 1996)	1.5	EDQL EPA Region 5 (1998)
2-Butanone	78-93-3	7,100	EDQL EPA Region 5 (1998)	22,000	Ohio Administrative Code	14,000	Tier II (Suter & Tsao 1996)	7,100	EDQL EPA Region 5 (1998)
Butylbenzylphthalate	85-68-7	49	EDQL EPA Region 5 (1998)	23	Ohio Administrative Code	19	OSWER 1996 (in Suter & Tsao 1996)	19	OSWER 1996 (in Suter & Tsao 1996)
Carbazole	86-74-8				--		--	--	--
Carbon disulfide	75-15-0	84	EDQL EPA Region 5 (1998)		--	0.92	Tier II (Suter & Tsao 1996)	0.92	Tier II (Suter & Tsao 1996)
Carbon tetrachloride	56-23-5	5.9	EDQL EPA Region 5 (1998)	240	Ohio Administrative Code	9.8	Tier II (Suter & Tsao 1996)	5.9	EDQL EPA Region 5 (1998)
4-Chloroaniline	106-47-8	232	EDQL EPA Region 5 (1998)		--		--	232	EDQL EPA Region 5 (1998)
Chlorobenzene	108-90-7	10	EDQL EPA Region 5 (1998)	47	Ohio Administrative Code	64	Tier II (Suter & Tsao 1996)	10	EDQL EPA Region 5 (1998)
Chlordane	12789-03-6				--	0.17	NAWQC(EPA 1993b in Suter & Tsao 1996)	0.17	NAWQC(EPA 1993b in Suter & Tsao 1996)
Chloroethane	75-00-3	230,000	EDQL EPA Region 5 (1998)		--		--	230,000	EDQL EPA Region 5 (1998)
Chloroform	67-66-3	79	EDQL EPA Region 5 (1998)	140	Ohio Administrative Code	28	Tier II (Suter & Tsao 1996)	28	Tier II (Suter & Tsao 1996)
Chloromethane	74-87-3				--		--	--	--
2-Chloronaphthalene	91-58-7	0.396	EDQL EPA Region 5 (1998)		--		--	0.396	EDQL EPA Region 5 (1998)
2-Chlorophenol	95-57-8	8.8	EDQL EPA Region 5 (1998)	32	Ohio Administrative Code		--	8.8	EDQL EPA Region 5 (1998)
4-Chlorophenyl-phenyl ether	7005-72-3				--		--	--	--
4-Chloro-3-methylphenol	59-50-7	34.79	EDQL EPA Region 5 (1998)		--		--	34.79	EDQL EPA Region 5 (1998)
Chrysene	218-01-9	0.033	EDQL EPA Region 5 (1998)		--		--	0.033	EDQL EPA Region 5 (1998)
Decane	124-18-5				--	49	Tier II (Suter & Tsao 1996)	49	Tier II (Suter & Tsao 1996)
Diazinon	333-41-5				--	0.043	Great Lakes Water Quality Initiative (in Suter & Tsao 1996)	0.043	Great Lakes Water Quality Initiative (in Suter & Tsao 1996)
Dibenzo(a,h)anthracene	53-70-3	0.0016	EDQL EPA Region 5 (1998)		--		--	0.0016	EDQL EPA Region 5 (1998)
Dibromochloromethane	124-48-1	6,400	EDQL EPA Region 5 (1998)	320	Ohio Administrative Code		--	320	Ohio Administrative Code
1,2-Dichlorobenzene	95-50-1	11	EDQL EPA Region 5 (1998)	23	Ohio Administrative Code	14	OSWER 1996 (in Suter & Tsao 1996)	11	EDQL EPA Region 5 (1998)
1,3-Dichlorobenzene	541-73-1	87	EDQL EPA Region 5 (1998)	22	Ohio Administrative Code	71	OSWER 1996 (in Suter & Tsao 1996)	22	Ohio Administrative Code
1,4-Dichlorobenzene	106-46-7	43	EDQL EPA Region 5 (1998)	9.4	Ohio Administrative Code	15	OSWER 1996 (in Suter & Tsao 1996)	9.4	Ohio Administrative Code
3,3'-Dichlorobenzidine	91-94-1	99.75	EDQL EPA Region 5 (1998)		--		--	99.75	EDQL EPA Region 5 (1998)
Dibenzofuran	132-64-9	20	EDQL EPA Region 5 (1998)		--	3.7	Tier II (Suter & Tsao 1996)	3.7	Tier II (Suter & Tsao 1996)
1,1-Dichloroethane	75-34-3	47	EDQL EPA Region 5 (1998)	410	Ohio Administrative Code	47	Tier II (Suter & Tsao 1996)	47	EDQL EPA Region 5 (1998)

Table 5-3. Ecological Biotic Screening Values for Chemical Constituents in Surface Water at RVAAP – Demolition Area 1 (continued)

		Surface Water							
		Ecological Data Quality Levels (EDQL)[a]		Ohio EPA OMZA (Outside Mixing Zone Average)[b]		Suter and Tsao (1996)[c]		Preferred Surface Water Value[d]	
Chemicals	**CAS Registry Number**	**Number (µg/L)**	**Source**	**Number (µg/L)**	**Source**	**Number (µg/L)**	**Source**	**Number (µg/L)**	**Source**
1,2-Dichloroethane	107-06-2	190	EDQL EPA Region 5 (1998)	2,000	Ohio Administrative Code	910	Tier II (Suter & Tsao 1996)	190	EDQL EPA Region 5 (1998)
1,1-Dichloroethene	75-35-4	78	EDQL EPA Region 5 (1998)		--	25	Tier II (Suter & Tsao 1996)	25	Tier II (Suter & Tsao 1996)
1,2-Dichloroethene (total)	540-59-0				--	590	Tier II (Suter & Tsao 1996)	590	Tier II (Suter & Tsao 1996)
1,1-Dichloroethylene	75-35-4	78	EDQL EPA Region 5 (1998)	210	Ohio Administrative Code		--	78	EDQL EPA Region 5 (1998)
2,4-Dichlorophenol	120-83-2	18	EDQL EPA Region 5 (1998)	11	Ohio Administrative Code		--	11	Ohio Administrative Code
1,2-Dichloropropane	78-87-5	380	EDQL EPA Region 5 (1998)	520	Ohio Administrative Code		--	380	EDQL EPA Region 5 (1998)
1,3-Dichloropropene	10061-02-6	7.9	EDQL EPA Region 5 (1998)	1.7	Ohio Administrative Code	0.055	Tier II (Suter & Tsao 1996)	0.055	Tier II (Suter & Tsao 1996)
4,4'-DDD	72-54-8	0.0011	EDQL EPA Region 5 (1998)		--	0.011	Tier II (Suter & Tsao 1996)	0.0011	EDQL EPA Region 5 (1998)
4,4'-DDT	50-29-3	0.001	EDQL EPA Region 5 (1998)		--	0.013	Tier II (Suter & Tsao 1996)	0.001	EDQL EPA Region 5 (1998)
Dieldrin	60-57-1	0.000026	EDQL EPA Region 5 (1998)	0.056	Ohio Administrative Code	0.062	NAWQC (EPA 1993b in Suter & Tsao 1996)	2.6E-05	EDQL EPA Region 5 (1998)
Diethylphthalate	84-66-2	3	EDQL EPA Region 5 (1998)	220	Ohio Administrative Code	210	Tier II (Suter & Tsao 1996)	3	EDQL EPA Region 5 (1998)
Dimethylphthalate	131-11-3	73	EDQL EPA Region 5 (1998)		--		--	73	EDQL EPA Region 5 (1998)
2,4-Dimethylphenol	105-67-9	100.17	EDQL EPA Region 5 (1998)	15	Ohio Administrative Code		--	15	Ohio Administrative Code
Di-n-butylphthalate	84-74-2	3	EDQL EPA Region 5 (1998)		Ohio Administrative Code		--	3	EDQL EPA Region 5 (1998)
Di-n-octylphthalate	117-84-0	30	EDQL EPA Region 5 (1998)		--		--	30	EDQL EPA Region 5 (1998)
1,3-Dinitrobenzene	99-65-0	2.36	EDQL EPA Region 5 (1998)		--		--	2.36	EDQL EPA Region 5 (1998)
2,4-Dinitrophenol	51-28-5	4.07	EDQL EPA Region 5 (1998)		--		--	4.07	EDQL EPA Region 5 (1998)
2,4-Dinitrotoluene	121-14-2	230	EDQL EPA Region 5 (1998)	44	Ohio Administrative Code		--	44	Ohio Administrative Code
2,6-Dinitrotoluene	606-20-2	42	EDQL EPA Region 5 (1998)	81	Ohio Administrative Code		--	42	EDQL EPA Region 5 (1998)
4,6-Dinitro-2-methylphenol	534-52-1	2.3	EDQL EPA Region 5 (1998)		--		--	2.3	EDQL EPA Region 5 (1998)
Endosulfan, mixed isomers					--	0.051	Tier II (Suter & Tsao 1996)	0.051	Tier II (Suter & Tsao 1996)
Endosulfan, alpha	959-98-8	0.003	EDQL EPA Region 5 (1998)		--		--	0.003	EDQL EPA Region 5 (1998)
Ethylene glycol	107-21-1			140,000	Ohio Administrative Code		--	140,000	Ohio Administrative Code
Endosulfan, beta	33213-65-9	0.003	EDQL EPA Region 5 (1998)		--		--	0.003	EDQL EPA Region 5 (1998)
Endrin	72-20-8	0.002	EDQL EPA Region 5 (1998)	0.036	Ohio Administrative Code	0.061	NAWQC (EPA 1993b in Suter & Tsao 1996)	0.002	EDQL EPA Region 5 (1998)
Ethylbenzene	100-41-4	17.2	EDQL EPA Region 5 (1998)	61	Ohio Administrative Code	7.3	Tier II (Suter & Tsao 1996)	7.3	Tier II (Suter & Tsao 1996)
Fluoranthene	206-44-0	8.1	EDQL EPA Region 5 (1998)	0.48	Ohio Administrative Code	6.16	NAWQC (EPA 1993b in Suter & Tsao 1996)	0.48	Ohio Administrative Code
Fluorene	86-73-7	3.9	EDQL EPA Region 5 (1998)	19	Ohio Administrative Code	3.9	OSWER 1996 (in Suter & Tsao 1996)	3.9	EDQL EPA Region 5 (1998)
Gamma-BHC (lindane)	58-89-9	0.01	EDQL EPA Region 5 (1998)	0.057	Ohio Administrative Code	0.08	NAWQC (EPA 1993b in Suter & Tsao 1996)	0.01	EDQL EPA Region 5 (1998)
Heptachlor	76-44-8	0.00039	EDQL EPA Region 5 (1998)		--	12	Tier II (Suter & Tsao 1996)	0.00039	EDQL EPA Region 5 (1998)
Hexachlorobenzene	118-74-1	0.00024	EDQL EPA Region 5 (1998)		--		--	0.00024	EDQL EPA Region 5 (1998)
Hexachlorobutadiene	87-68-3	0.223	EDQL EPA Region 5 (1998)		--		--	0.223	EDQL EPA Region 5 (1998)

Table 5-3. Ecological Biotic Screening Values for Chemical Constituents in Surface Water at RVAAP – Demolition Area 1 (continued)

		Surface Water							
		Ecological Data Quality Levels (EDQL)[a]		Ohio EPA OMZA (Outside Mixing Zone Average)[b]		Suter and Tsao (1996)[c]		Preferred Surface Water Value[d]	
Chemicals	CAS Registry Number	Number (μg/L)	Source	Number (μg/L)	Source	Number (μg/L)	Source	Number (μg/L)	Source
Hexachlorocyclopentadiene	77-47-4	77.04	EDQL EPA Region 5 (1998)		--		--	77.04	EDQL EPA Region 5 (1998)
Hexachloroethane	67-72-1	30.5	EDQL EPA Region 5 (1998)		--	12	OSWER 1996 (in Suter & Tsao 1996)	12	OSWER 1996 (in Suter & Tsao 1996)
Hexane	110-54-3				--	0.58	Tier II (Suter & Tsao 1996)	0.58	Tier II (Suter & Tsao 1996)
2-Hexanone	591-78-6	1,710	EDQL EPA Region 5 (1998)		--	99	Tier II (Suter & Tsao 1996)	99	Tier II (Suter & Tsao 1996)
HMX (octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)	2691-41-0				--		--	--	--
Indeno(1,2,3-cd)pyrene	193-39-5	4.31	EDQL EPA Region 5 (1998)		--		--	4.31	EDQL EPA Region 5 (1998)
Isophorone	78-59-1	900	EDQL EPA Region 5 (1998)	920	Ohio Administrative Code		--	900	EDQL EPA Region 5 (1998)
Isopropylbenzene	98-82-8			4.8	Ohio Administrative Code		--	4.8	Ohio Administrative Code
Malathion	121-75-5				--		--	--	--
Methoxychlor	72-43-5	0.005	EDQL EPA Region 5 (1998)		--	0.019	Tier II (Suter & Tsao 1996)	0.005	EDQL EPA Region 5 (1998)
Methylene chloride	75-09-2	430	EDQL EPA Region 5 (1998)	1,900	Ohio Administrative Code	2,200	Tier II (Suter & Tsao 1996)	430	EDQL EPA Region 5 (1998)
1-Methylnaphthalene	90-12-0				--	2.1	Tier II (Suter & Tsao 1996)	2.1	Tier II (Suter & Tsao 1996)
2-Methylnaphthalene	91-57-6	329.55	EDQL EPA Region 5 (1998)		--		--	329.55	EDQL EPA Region 5 (1998)
2-Methylphenol	95-48-7				Ohio Administrative Code	13	Tier II (Suter & Tsao 1996)	13	Tier II (Suter & Tsao 1996)
4-Methylphenol	106-44-5			53	Ohio Administrative Code		--	53	Ohio Administrative Code
4-Methyl-2-pentanone	108-10-1	3,680	EDQL EPA Region 5 (1998)		--		--	3,680	EDQL EPA Region 5 (1998)
Naphthalene	91-20-3	44	EDQL EPA Region 5 (1998)	21	Ohio Administrative Code	12	Tier II (Suter & Tsao 1996)	12	Tier II (Suter & Tsao 1996)
2-Nitroaniline	88-74-4				--		--	--	--
3-Nitroaniline	99-09-2				--		--	--	--
4-Nitroaniline	100-01-6				--		--	--	--
Nitrobenzene	99-95-3			330	Ohio Administrative Code		--	330	Ohio Administrative Code
Nitrocellulose	9004-70-0				--		--	--	--
Nitroglycerin	55-63-0				--		--	--	--
Nitroquanidine					--		--	--	--
2-Nitrophenol	88-75-5	13.5	EDQL EPA Region 5 (1998)	73	Ohio Administrative Code		--	13.5	EDQL EPA Region 5 (1998)
4-Nitrophenol	100-02-7	35	EDQL EPA Region 5 (1998)		--	300	Tier II (Suter & Tsao 1996)	35	EDQL EPA Region 5 (1998)
M-nitrotoluene	99-08-1				--		--	--	--
N-nitroso-di-n-dipropylamine	621-64-7				--		--	--	--
N-nitrosodiphenylamine	86-30-6	13	EDQL EPA Region 5 (1998)		--	210	Tier II (Suter & Tsao 1996)	13	EDQL EPA Region 5 (1998)
O-nitrotoluene	88-72-2				--		--	--	--
2-Octanone	111-13-7				--	8.3	Tier II (Suter & Tsao 1996)	8.3	Tier II (Suter & Tsao 1996)
2,2'-Oxybis(1-Chloropropane)	108-60-1	20	EDQL EPA Region 5 (1998)		--		--	20	EDQL EPA Region 5 (1998)
Parathion	56-38-2	0.008	EDQL EPA Region 5 (1998)	0.013	Ohio Administrative Code		--	0.008	EDQL EPA Region 5 (1998)
Pentachlorobenzene	608-93-5	0.47	EDQL EPA Region 5 (1998)		--		--	0.47	EDQL EPA Region 5 (1998)

Table 5-3. Ecological Biotic Screening Values for Chemical Constituents in Surface Water at RVAAP – Demolition Area 1 (continued)

		Surface Water							
		Ecological Data Quality Levels (EDQL)[a]		Ohio EPA OMZA (Outside Mixing Zone Average)[b]		Suter and Tsao (1996)[c]		Preferred Surface Water Value[d]	
Chemicals	CAS Registry Number	Number (µg/L)	Source	Number (µg/L)	Source	Number (µg/L)	Source	Number (µg/L)	Source
Pentachlorophenol	87-86-5	5.23	EDQL EPA Region 5 (1998)	11[f]	Ohio Administrative Code		--	5.23	EDQL EPA Region 5 (1998)
Phenanthrene	85-01-8	2.1	EDQL EPA Region 5 (1998)		--	6.3	NAWQC (EPA 1993b in Suter & Tsao 1996)	2.1	EDQL EPA Region 5 (1998)
1-Pentanol	71-41-0				--	110	Tier II (Suter & Tsao 1996)	110	Tier II (Suter & Tsao 1996)
Phenol	108-95-2	100	EDQL EPA Region 5 (1998)		--	110	Great Lakes Water Quality Initiative (in Suter & Tsao 1996)	100	EDQL EPA Region 5 (1998)
P-nitrotoluene	99-99-0				--		--	--	--
Polychlorinated biphenyls	1336-36-3	0.000029	EDQL EPA Region 5 (1998)		--		--	2.9E-05	EDQL EPA Region 5 (1998)
Polynuclear aromatic hydrocarbons					--		--	--	--
2-Propanol	67-63-0				--	7.5	Tier II (Suter & Tsao 1996)	7.5	Tier II (Suter & Tsao 1996)
Propylene glycol	57-55-6			78,000	Ohio Administrative Code		--	78,000	Ohio Administrative Code
Pyrene	129-00-0	0.3	EDQL EPA Region 5 (1998)	4.6	Ohio Administrative Code		--	0.3	EDQL EPA Region 5 (1998)
RDX (cyclonite) hexahydro-1,3,5-trinitro-1,3,5-triazine	121-82-4				--		--	--	--
Styrene	100-42-5	56	EDQL EPA Region 5 (1998)	32	Ohio Administrative Code		--	32	Ohio Administrative Code
Tetryl	479-45-8				--		--	--	--
Tetrachloroethene	127-18-4	8.9	EDQL EPA Region 5 (1998)		--	98	Tier II (Suter & Tsao 1996)	8.9	EDQL EPA Region 5 (1998)
1,1,1,2-Tetrachoroethane	630-20-6	90.25	EDQL EPA Region 5 (1998)	85	Ohio Administrative Code		--	85	Ohio Administrative Code
1,1,2,2-Tetrachloroethane	79-34-5	13	EDQL EPA Region 5 (1998)	260	Ohio Administrative Code	610	Tier II (Suter & Tsao 1996)	13	EDQL EPA Region 5 (1998)
Tetrachloroethylene	127-18-4	8.9	EDQL EPA Region 5 (1998)	53	Ohio Administrative Code		--	8.9	EDQL EPA Region 5 (1998)
Tetrachloromethane	56-23-5	5.9	EDQL EPA Region 5 (1998)		--	240	OSWER 1996 (in Suter & Tsao 1996)	5.9	EDQL EPA Region 5 (1998)
Toluene	108-88-3	253	EDQL EPA Region 5 (1998)	62	Ohio Administrative Code	9.8	Tier II (Suter & Tsao 1996)	9.8	Tier II (Suter & Tsao 1996)
Toxaphene	8001-35-2	0.0002	EDQL EPA Region 5 (1998)		--		--	0.0002	EDQL EPA Region 5 (1998)
Tribromomethane	75-25-2	466	EDQL EPA Region 5 (1998)		--	320	OSWER 1996 (in Suter & Tsao 1996)	320	OSWER 1996 (in Suter & Tsao 1996)
Trichloroethene	79-01-6	75	EDQL EPA Region 5 (1998)		--	47	Tier II (Suter & Tsao 1996)	47	Tier II (Suter & Tsao 1996)
1,2,4-Trichlorobenzene	120-82-1	69.2	EDQL EPA Region 5 (1998)		--	110	OSWER 1996 (in Suter & Tsao 1996)	69.2	EDQL EPA Region 5 (1998)
1,1,1-Trichloroethane	71-55-6	88	EDQL EPA Region 5 (1998)	76	Ohio Administrative Code	11	Tier II (Suter & Tsao 1996)	11	Tier II (Suter & Tsao 1996)
1,1,2-Trichloroethane	79-00-5	650	EDQL EPA Region 5 (1998)		--	1,200	Tier II (Suter & Tsao 1996)	650	EDQL EPA Region 5 (1998)
Trichloroethylene	79-01-6	75	EDQL EPA Region 5 (1998)	220	Ohio Administrative Code		--	75	EDQL EPA Region 5 (1998)
2,4,5-Trichlorophenol	95-95-4				--		--	--	--
2,4,6-Trichlorophenol	88-06-2	2	EDQL EPA Region 5 (1998)	4.9	Ohio Administrative Code		--	2	EDQL EPA Region 5 (1998)
1,2,4-Trimethylbenzene	95-63-6			15	Ohio Administrative Code		--	15	Ohio Administrative Code
1,3,5-Trimethylbenzene	108-67-8			26	Ohio Administrative Code		--	26	Ohio Administrative Code
1,3,5-Trinitrobenzene	99-35-4				--		--	--	--
2,4,6-Trinitrotoluene	118-96-7				--		--	--	--

Table 5-3. Ecological Biotic Screening Values for Chemical Constituents in Surface Water at RVAAP – Demolition Area 1 (continued)

		Surface Water							
		Ecological Data Quality Levels (EDQL)[a]		Ohio EPA OMZA (Outside Mixing Zone Average)[b]		Suter and Tsao (1996)[c]		Preferred Surface Water Value[d]	
Chemicals	**CAS Registry Number**	**Number (µg/L)**	**Source**	**Number (µg/L)**	**Source**	**Number (µg/L)**	**Source**	**Number (µg/L)**	**Source**
Urea	57-13-6			17,000	Ohio Administrative Code		--	17,000	Ohio Administrative Code
Vinyl acetate	108-05-4	248.03	EDQL EPA Region 5 (1998)		--	16	Tier II (Suter & Tsao 1996)	16	Tier II (Suter & Tsao 1996)
Vinyl chloride	75-01-4	9.2	EDQL EPA Region 5 (1998)		--		--	9.2	EDQL EPA Region 5 (1998)
O-xylene	95-47-6			35	Ohio Administrative Code		--	35	Ohio Administrative Code
M-xylene	108-38-3			67	Ohio Administrative Code	1.8	Tier II (Suter & Tsao 1996)	1.8	Tier II (Suter & Tsao 1996)
P-xylene	106-42-3			18	Ohio Administrative Code		--	18	Ohio Administrative Code
Xylenes (total)	1330-20-7	117	EDQL EPA Region 5 (1998)		--	13	Tier II (Suter & Tsao 1996)	13	Tier II (Suter & Tsao 1996)

[a] EPA (1998). RCRA QAPP Instructions, USEPA Region 5, Chicago, IL, April 1998 revision. http://www.epa.gov/reg5rcra/wptdiv/cars/cars.htm.

[b] Ohio EPA, Division of Surface Water (1999). Ohio Administrative Code, Chapter 3745-1-25, May 11 (Lake Erie Basin in which the Mahoning River runs).

[c] Suter, G. W., and C.L. Tsao (1996). *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision*, ES/ER/TM-96/R2 Lockheed Martin Energy Systems, Oak Ridge National Laboratory.

[d] The Preferred Surface Water Value is the lowest among the Ecotox, the Ohio Administrative Code, and Suter and Tsao surface water values.

[e] Hardness adjusted to 100 mg/L CaCO3.

[f] pH dependent, unless otherwise specified. Value is adjusted to 7.5 pH for all Ohio Administrative Code criteria.

-- = No value.

CVAA = Cold Vapor Atomic Absorption.

DDD = Dichlorodiphenyl dichloroethane.

DDT = Dichlorodiphenyl trichloroethane.

Diss. = Dissolved.

ID = Insufficient data available to calculate criterion.

NAWQC = National Ambient Water Quality Criteria.

OSWER = Office of Solid Waste and Emergency Response.

TR = Total Recoverable.

At this point of the process, the media-specific risk-based screens are applied. The following sections describe the risk-based screening process for soil, sediment, and surface water.

5.4.2.1 Human health screening process for soil

The final step used to finalize COPCs for soil is to compare maximum detected concentrations for SRCs against the human health soil screening levels presented in Section 5.4.1.1. Surface soil [collected from 0.0 to 0.3 meter (0 to 1 foot) bgs] and subsurface soil [collected from 0.3 to 0.9 meter (1 to 3 feet) bgs] are screened separately. When the maximum detected concentration exceeds the residential soil screening level (which is more conservative than the industrial screening value), the chemical is retained as a human health COPC. Chemicals exceeding the soil-leaching screen are noted (on the screening tables) but not identified as definitive COPCs because of the high degree of uncertainty and conservatism inherent in this screen (see Section 5.4.1.1).

5.4.2.2 Human health and ecological screening process for sediment

Sediment SRCs are screened against the same human health screening values used to evaluate soil (see Section 5.4.1.2), with the exception of the soil-leaching screen, which is not performed for sediment. When the maximum detected concentration exceeds the residential soil screening level (which is more conservative than the industrial screening value), the chemical is retained as a human health COPC.

Sediment SRCs also are screened against the ecological screening criteria established for sediment in Section 5.4.1.2 (see Table 5-2). When the maximum detected concentration exceeds the sediment ecological screening level, the chemical is retained as an ecological COPC for sediment.

5.4.2.3 Human health and ecological screening process for surface water

Surface water SRCs are screened against the surface water human health screening values established in Section 5.4.1.3. When the maximum detected concentration exceeds the screening level, the chemical is retained as a human health COPC for surface water.

Surface water SRCs are also screened against the ecological screening criteria established for surface water in Section 5.4.1.3 (see Table 5-3). When the maximum detected concentration exceeds the surface water ecological screening level, the chemical is retained as an ecological COPC for surface water.

5.5 RISK EVALUATION RESULTS

Results of the risk-screening process are presented for each medium in Sections 5.5.1 through 5.5.4. A summary of COPCs across all media is presented in Section 5.5.5.

5.5.1 Surface Soil Screening Results

Table 5-4 presents the results of the SRC screening and human health risk-based screening for all chemicals detected in DA1 surface soil. Chemicals that were never detected in surface soil are not shown on this table. Three explosives/propellants and 10 metals exceed the residential screening values and are identified as surface soil COPCs.

Table 5-4. Screening to Determine Human Health COPCs at Demolition Area 1 for Surface Soil

Analyte	Results > Detection Limit	Average Result[a]	Min. Detect	Max. Detect	Site Backgd. Criteria	Site Related?[b]	One-tenth Region 9 Residential Soil PRG[c]	Max Detect > Residential Soil Criteria?[c]	One-tenth Region 9 Industrial Soil PRG[d]	Max Detect > Industrial Soil Criteria?[d]	One-tenth Region 9 Migration to GW (DAF 1)[d]	Max Detect > Migration to Groundwater Criteria?[d]	COPC?[c,d]
Explosives (mg/kg)													
1,3,5-Trinitrobenzene	1/ 42	8.7E-01	4.6E-01	4.6E-01		Yes	1.8E+02	No	2.6E+03	No		None	No
2,4,6-Trinitrotoluene	6/ 42	4.8E+01	1.5E-01	2.0E+03		Yes	1.6E+00	Yes	8.2E+00	Yes		None	Yes
2,4-Dinitrotoluene	3/ 42	8.6E-01	1.3E-01	2.0E-01		Yes	7.2E-02	Yes	1.8E+02	No	4.0E-06	Yes	Yes
HMX	1/ 42	1.7E+00	2.0E-01	2.0E-01		Yes	3.1E+02	No	4.4E+03	No		None	No
Nitrocellulose	4/ 42	5.4E+00	2.2E+00	1.8E+02		Yes		None		None		None	Yes
Nitroguanidine	3/ 42	1.2E-01	3.5E-02	1.2E-01		Yes	6.1E+02	No	8.8E+03	No		None	No
Inorganics (mg/kg)													
Aluminum	42/ 42	1.3E+04	1.7E+03	8.6E+04	1.8E+04	Yes	7.6E+03	Yes	1.0E+04	Yes		None	Yes
Antimony	8/ 36	1.3E+00	5.4E-01	2.0E+01	9.6E-01	Yes	3.1E+00	Yes	8.2E+01	No	3.0E-02	Yes	Yes
Arsenic	42/ 42	1.1E+01	5.0E+00	3.1E+01	1.5E+01	Yes	3.9E-02	Yes	2.7E-01	Yes	1.0E-01	Yes	Yes
Barium	42/ 42	1.8E+02	2.3E+01	1.8E+03	8.8E+01	Yes	5.4E+02	Yes	1.0E+04	No	8.2E+00	Yes	Yes
Beryllium	15/ 42	2.7E-01	1.5E-01	9.4E-01	8.8E-01	Yes	1.5E+01	No	2.2E+02	No	3.0E-01	Yes	No
Cadmium	13/ 42	1.2E+02	2.7E-01	4.9E+03		Yes	3.7E+00	Yes	8.1E+01	Yes	4.0E-02	Yes	Yes
Calcium *	42/ 42	3.4E+04	2.5E+02	2.5E+05	1.6E+04	No		None		None		None	No
Chromium	42/ 42	1.9E+01	3.4E+00	1.7E+02	1.7E+01	Yes	3.0E+00	Yes	6.4E+00	Yes	2.0E-01	Yes	Yes
Cobalt	42/ 42	8.3E+00	2.7E+00	2.7E+01	1.0E+01	Yes	4.7E+02	No	1.0E+04	No		None	No
Copper	42/ 42	4.4E+02	5.8E+00	7.3E+03	1.8E+01	Yes	2.9E+02	Yes	7.6E+03	No		None	Yes
Cyanide	1/ 42	3.1E-01	8.3E-01	8.3E-01		No	1.2E+02	No	1.8E+03	No	2.0E-01	Yes	No
Iron *	42/ 42	2.5E+04	5.8E+03	2.3E+05	2.3E+04	No	2.3E+03	Yes	1.0E+04	Yes		None	No
Lead	42/ 42	4.9E+01	8.0E+00	7.7E+02	2.6E+01	Yes	4.0E+01	Yes	1.0E+02	Yes		None	Yes
Magnesium *	42/ 42	2.4E+03	8.0E+02	5.3E+03	3.0E+03	No		None		None		None	No
Manganese	42/ 42	9.4E+02	1.4E+02	1.5E+04	1.5E+03	Yes	1.8E+02	Yes	3.2E+03	Yes		None	Yes
Mercury	30/ 42	4.5E-02	7.8E-03	1.6E-01	3.6E-02	Yes	2.3E+00	No	6.1E+01	No		None	No
Nickel	42/ 42	2.0E+01	7.9E+00	8.3E+01	2.1E+01	Yes	1.6E+02	No	4.1E+03	No	7.0E-01	Yes	No
Potassium *	42/ 42	1.0E+03	3.0E+02	3.0E+03	9.3E+02	No		None		None		None	No
Selenium	13/ 42	7.2E-01	5.7E-01	6.1E+00	1.4E+00	Yes	3.9E+01	No	1.0E+03	No	3.0E-02	Yes	No
Silver	3/ 42	5.8E-01	3.1E-01	4.1E-01		Yes	3.9E+01	No	1.0E+03	No	2.0E-01	Yes	No
Sodium *	1/ 42	1.3E+02	2.9E+02	2.9E+02	1.2E+02	No		None		None		None	No
Thallium	35/ 42	2.9E-01	1.4E-01	4.8E-01		Yes	6.3E-01	No	1.6E+01	No	4.0E-02	Yes	No
Vanadium	42/ 42	1.7E+01	3.8E+00	2.7E+01	3.1E+01	No	5.5E+01	No	1.4E+03	No	3.0E+01	No	No
Zinc	42/ 42	5.0E+02	3.2E+01	6.3E+03	6.2E+01	Yes	2.3E+03	Yes	1.0E+04	No	6.2E+01	Yes	Yes
Semivolatile Organic Compounds (mg/kg)													
2-Methylnaphthalene[e]	1/ 5	1.8E-01	4.3E-02	4.3E-02		Yes	5.6E+00	None	1.9E+01	No	4.0E-01	No	No
Bis(2-ethylhexyl)phthalate	1/ 5	1.7E-01	5.1E-02	5.1E-02		Yes	3.5E+00	No	1.8E+01	No		None	No
Pyrene	1/ 5	1.8E-01	4.9E-02	4.9E-02		Yes	2.3E+02	No	5.4E+03	No	2.1E+01	No	No

Table 5-4. Screening to Determine Human Health COPCs at Demolition Area 1 for Surface Soil (continued)

Analyte	Results > Detection Limit	Average Result[a]	Min. Detect	Max. Detect	Site Backgd. Criteria	Site Related?[b]	One-tenth Region 9 Residential Soil PRG[c]	Max Detect > Residential Soil Criteria?[c]	One-tenth Region 9 Industrial Soil PRG[d]	Max Detect > Industrial Soil Criteria?[d]	One-tenth Region 9 Migration to GW (DAF 1)[d]	Max Detect > Migration to Groundwater Criteria?[d]	COPC?[c,d]
Volatile Organic Compounds (mg/kg)													
Acetone	1/ 5	6.3E-03	6.8E-03	6.8E-03		Yes	1.6E+02	No	6.2E+02	No	8.0E-02	No	No
Dimethylbenzene	1/ 5	2.8E-03	1.8E-03	1.8E-03		Yes	2.1E+01	No	2.1E+01	No	1.0E+00	No	No
Toluene	2/ 5	3.2E-03	2.5E-03	4.6E-03		Yes	5.2E+01	No	5.2E+01	No	6.0E-02	No	No

[a] Values less than the detection limit were set to one-half of the reporting limit in calculation of the average.

[b] Site-related status is based on the frequency of detection and background screens; see Section 5.1.

[c] COPC status is based on screening against the residential soil screening criteria. If a chemical is site-related and is detected above its residential screening value, then it is a COPC. If a chemical is site-related and no residential screening value is available, then the chemical is retained as a COPC.

[d] Comparisons are made against industrial soil screening criteria and against the migration to groundwater screening criteria for information purposes only. These screens are not used to determine COPC status.

[e] The PRGs for naphthalene were used as surrogate values to screen 2-methylnaphthalene.

* Essential element (not considered a human health site-related contaminant).

COPC = Chemical of potential concern.

GW = Groundwater.

HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.

PRG = Preliminary remediation goal.

Explosives and propellants identified as surface soil human health COPCs include

- 2,4,6-TNT, with a maximum detected concentration of 2,000 mg/kg (from station DA1-040), which is above the residential screening level (1.6 mg/kg) as well as the industrial screening level (8.2 mg/kg).

- 2,4-DNT, with a maximum detected concentration of 0.20 mg/kg (from station DA1-022), which is above the residential screening level (0.07 mg/kg) but below the industrial screening level (0.36 mg/kg).

- Nitrocellulose, detected three times with the maximum concentration of 175 mg/kg at station DA1-040, is retained as a COPC in absence of a screening criteria for comparison.

The 10 metals identified as surface soil human health COPCs, with their maximum detected concentrations noted below in parentheses, are as follows:

- Aluminum (85,700 mg/kg at station DA1-023), arsenic (31.4 mg/kg at station DA1-029), cadmium (4,910 mg/kg at station DA1-029), chromium (174 mg/kg at station DA1-029), lead (772 mg/kg at station DA1-029), and manganese (14,600 mg/kg at station DA1-012) were all detected at levels above both their respective residential and industrial screening values. All six of these metals were detected at levels more than one order of magnitude above their respective residential screening value, with the cadmium value being more than three orders of magnitude above its residential screening value.

- Antimony (19.8 mg/kg at station DA1-029), barium (1,840 mg/kg at station DA1-042), copper (7,250 mg/kg at station DA1-023), and zinc (6,320 mg/kg at station DA1-023) were all detected above their residential screening levels but below their industrial screening levels. Antimony, barium, and zinc were detected within one order of magnitude of their residential screening values. The maximum value for copper is 25 times its residential screening criterion.

Summary results of the surface soil data screening against migration to groundwater screening criteria (DAF = 1) are as follows:

- The explosive 2,4-DNT exceeds its criterion. The remaining explosive/propellant COPCs (2,4,6-TNT and nitrocellulose) did not have criteria available for comparison.

- Six metals identified as COPCs exceed their respective criteria: antimony, arsenic, barium, cadmium, chromium, and zinc. Four metals identified as COPCs (aluminum, copper, lead, and manganese) do not have criteria available for comparison.

5.5.2 Subsurface Soil Screening Results

Table 5-5 presents the results of the SRC screening and human health risk-based screening for all chemicals detected in DA1 subsurface soil. Chemicals that were never detected in subsurface soil are not shown on this table. As seen, seven metals are identified as subsurface soil COPCs. These seven COPCs, with their maximum detected concentrations noted in parentheses below, are as follows:

- Aluminum (28,600 mg/kg at station DA1-027), arsenic (21.9 mg/kg at station DA1-010), cadmium (110 mg/kg at station DA1-029), chromium (34.7 mg/kg at station DA1-027), and lead (401 mg/kg at station DA1-029) were all detected at levels above both their respective residential and industrial

Table 5-5. Screening to Determine Human Health COPCs at Demolition Area 1 for Subsurface Soil

Analyte	Results > Detection Limit	Average Result[a]	Min. Detect	Max. Detect	Site Backgd. Criteria	Site Related?[b]	One-tenth Region 9 Residential Soil PRG[c]	Max Detect > Residential Soil Criteria?[c]	One-tenth Region 9 Industrial Soil PRG[d]	Max Detect > Industrial Soil Criteria?[d]	One-tenth Region 9 Migration to GW (DAF 1)[d]	Max Detect > Migration to Groundwater Criteria?[d]	COPC?[c,d]
Explosives (mg/kg)													
2,4,6-Trinitrotoluene	1/ 70	1.2E-01	1.2E-01	1.2E-01		Yes	1.6E+00	No	8.2E+00	No		None	No
Metals (mg/kg)													
Aluminum	70/ 70	1.3E+04	6.3E+03	2.9E+04	2.0E+04	Yes	7.6E+03	Yes	1.0E+04	Yes		None	Yes
Antimony	10/ 58	6.5E-01	5.4E-01	1.3E+00	9.6E-01	Yes	3.1E+00	No	8.2E+01	No	3.0E-02	Yes	No
Arsenic	69/ 69	1.5E+01	8.3E+00	2.2E+01	2.0E+01	Yes	3.9E-02	Yes	2.7E-01	Yes	1.0E-01	Yes	Yes
Barium	70/ 70	7.5E+01	2.6E+01	1.8E+02	1.2E+02	Yes	5.4E+02	No	1.0E+04	No	8.2E+00	Yes	No
Beryllium	31/ 70	3.6E-01	2.9E-01	8.0E-01	8.8E-01	No	1.5E+01	No	2.2E+02	No	3.0E-01	Yes	No
Cadmium	2/ 70	1.9E+00	2.7E-01	1.1E+02		Yes	3.7E+00	Yes	8.1E+01	Yes	4.0E-02	Yes	Yes
Calcium *	68/ 70	5.1E+03	5.7E+02	3.6E+04	3.6E+04	No		None		None		None	No
Chromium	70/ 70	1.9E+01	1.0E+01	3.5E+01	2.7E+01	Yes	3.0E+00	Yes	6.4E+00	Yes	2.0E-01	Yes	Yes
Cobalt	70/ 70	1.1E+01	4.5E+00	2.1E+01	2.3E+01	No	4.7E+02	No	1.0E+04	No		None	No
Copper	70/ 70	3.1E+01	9.2E+00	6.0E+02	3.2E+01	Yes	2.9E+02	Yes	7.6E+03	No		None	Yes
Iron *	69/ 69	2.9E+04	1.8E+04	4.9E+04	3.5E+04	No	2.3E+03	Yes	1.0E+04	Yes		None	No
Lead	70/ 70	1.9E+01	8.7E+00	4.0E+02	1.9E+01	Yes	4.0E+01	Yes	1.0E+02	Yes		None	Yes
Magnesium *	70/ 70	3.9E+03	1.5E+03	9.2E+03	8.8E+03	No		None		None		None	No
Manganese	70/ 70	3.7E+02	1.0E+02	2.2E+03	3.0E+03	No	1.8E+02	Yes	3.2E+03	No		None	No
Mercury	42/ 70	2.8E-02	6.6E-03	2.9E-01	4.4E-02	Yes	2.3E+00	No	6.1E+01	No		None	No
Nickel	70/ 70	2.8E+01	1.1E+01	5.6E+01	6.1E+01	No	1.6E+02	No	4.1E+03	No	7.0E-01	Yes	No
Potassium *	70/ 70	1.7E+03	5.1E+02	4.4E+03	3.4E+03	No		None		None		None	No
Selenium	17/ 70	4.1E-01	4.6E-01	1.2E+00	1.5E+00	No	3.9E+01	No	1.0E+03	No	3.0E-02	Yes	No
Silver	1/ 70	6.0E-01	4.8E-01	4.8E-01		No	3.9E+01	No	1.0E+03	No	2.0E-01	Yes	No
Sodium *	1/ 70	1.1E+02	6.7E+02	6.7E+02	1.5E+02	No		None		None		None	No
Thallium	58/ 70	3.4E-01	2.4E-01	4.9E-01	9.1E-01	No	6.3E-01	No	1.6E+01	No	4.0E-02	Yes	No
Vanadium	70/ 70	2.1E+01	1.2E+01	4.0E+01	3.8E+01	Yes	5.5E+01	No	1.4E+03	No	3.0E+01	Yes	No
Zinc	70/ 70	1.1E+02	3.6E+01	2.8E+03	9.3E+01	Yes	2.3E+03	Yes	1.0E+04	No	6.2E+01	Yes	Yes
Semivolatile Organic Compounds (mg/kg)													
Bis(2-ethylhexyl)phthalate	1/ 6	1.8E-01	4.4E-02	4.4E-02		Yes	3.5E+00	No	1.8E+01	No		None	No
Volatile Organic Compounds (mg/kg)													
Acetone	2/ 6	7.3E-03	4.2E-03	1.5E-02		Yes	1.6E+02	No	6.2E+02	No	8.0E-02	No	No
Dimethylbenzene	1/ 6	2.8E-03	1.3E-03	1.3E-03		Yes	2.1E+01	No	2.1E+01	No	1.0E+00	No	No
Methylene chloride	1/ 6	2.8E-03	1.0E-03	1.0E-03		Yes	8.9E-01	No	2.1E+00	No	1.0E-04	Yes	No
Styrene	1/ 6	2.7E-03	7.0E-04	7.0E-04		Yes	1.7E+02	No	1.7E+02	No	2.0E-02	No	No
Toluene	4/ 6	4.3E-03	1.6E-03	8.1E-03		Yes	5.2E+01	No	5.2E+01	No	6.0E-02	No	No

[a] Values less than the detection limit were set to one-half of the reporting limit in calculation of the average.

[b] Site-related status is based on the frequency of detection and background screens; see Section 5.1.

[c] COPC status is based on screening against the residential soil screening criteria. If a chemical is site-related and is detected above its residential screening value, then it is a COPC. If a chemical is site-related and no residential screening value is available, then the chemical is retained as a COPC.

[d] Comparisons are made against industrial soil screening criteria and against the migration to groundwater screening criteria for information purposes only. These screens are not used to determine COPC status.

* Essential element (not considered a human health site-related contaminant).

COPC = Chemical of potential concern.

GW = Groundwater.

PRG = Preliminary remediation goal.

screening values. Aluminum and lead were detected within one order of magnitude of their residential screening values, while the other three metals were detected at levels greater than one order of magnitude above their respective residential screening values.

- Copper (597 mg/kg at station DA1-029) and zinc (2,830 mg/kg at station DA1-029) were both detected above their residential screening levels but below their industrial screening levels. Both are detected within an order of magnitude of their residential screening values.

Screening of subsurface soil data against migration to groundwater screening criteria (DAF = 1) show that arsenic, cadmium, and chromium level exceed their respective criteria. Three metals identified as COPCs (aluminum, copper, and lead) do not have criteria available for comparison.

5.5.3 Sediment Screening Results

Since both human health and ecological screens are performed for sediment, these two types of COPCs are discussed separately.

5.5.3.1 Human health screening results for sediment

Table 5-6 presents the results of the SRC screening and human health risk-based screening for all chemicals detected in DA1 sediment. Chemicals that were never detected in sediment are not shown on this table. As seen, aluminum (14,400 mg/kg at station DA1-044) and chromium (18.8 mg/kg at station DA1-046) are identified as sediment COPCs. However, their respective residential screening values (7,600 mg/kg for aluminum and 3.0 mg/kg for chromium) are less than background criteria (13,900 mg/kg for aluminum and 18.1 mg/kg for chromium). Because both metals were detected at levels just above background, they are retained as COPCs. Both constituents exceeded their respective industrial screening values (10,000 mg/kg for aluminum and 6.4 mg/kg for chromium), which are also equal to or below the background criteria.

5.5.3.2 Ecological screening results for sediment

Table 5-7 presents the results of the ecological risk-based screening for all chemicals determined to be SRCs in DA1 sediment. As seen, four metals and PCB–1260 are identified as sediment ecological COPCs.

The four metals, with maximum detected concentrations in parentheses, identified as sediment ecological COPCs include:

- Lead (31.1 mg/kg) and nickel (25.4 mg/kg), which were both detected at levels just above their ecological sediment screening values (31 mg/kg for lead and 16 mg/kg for nickel).

- Aluminum (14,400 mg/kg) and magnesium (3,690 mg/kg), which are retained as sediment ecological COPCs because no ecological screening values are available for comparison.

5.5.4 Surface Water Screening Results

Since both human health and ecological screens are performed for surface water, these two types of COPCs are discussed separately.

Table 5-6. Screening to Determine Human Health COPCs at Demolition Area 1 for Sediment

Analyte	Results > Detection Limit	Average Result[a]	Minimum Detect	Maximum Detect	Site Background Criteria	Site Related?[b]	One-tenth Region 9 Residential Soil PRG[c]	Max Detect > Residential Soil Criteria?[c]	One-tenth Region 9 Industrial Soil PRG[d]	Max Detect > Industrial Soil Criteria?[d]	COPC?[bc,d]
Metals (mg/kg)											
Aluminum	4/ 4	8.3E+03	2.6E+03	1.4E+04	1.4E+04	Yes	7.6E+03	Yes	1.0E+04	Yes	Yes
Arsenic	4/ 4	6.2E+00	5.2E+00	7.6E+00	2.0E+01	No	3.9E-02	Yes	2.7E-01	Yes	No
Barium	4/ 4	4.9E+01	2.0E+01	8.5E+01	1.2E+02	No	5.4E+02	No	1.0E+04	No	No
Calcium *	4/ 4	1.3E+03	5.6E+02	2.0E+03	5.5E+03	No		None		None	No
Chromium	4/ 4	1.1E+01	4.1E+00	1.9E+01	1.8E+01	Yes	3.0E+00	Yes	6.4E+00	Yes	Yes
Cobalt	4/ 4	5.3E+00	3.5E+00	9.4E+00	9.1E+00	Yes	4.7E+02	No	1.0E+04	No	No
Copper	4/ 4	9.7E+00	3.4E+00	1.6E+01	2.8E+01	No	2.9E+02	No	7.6E+03	No	No
Iron *	4/ 4	1.4E+04	9.4E+03	2.5E+04	2.8E+04	No	2.3E+03	Yes	1.0E+04	Yes	No
Lead	4/ 4	1.3E+01	5.0E+00	3.1E+01	2.7E+01	Yes	4.0E+01	No	1.0E+02	No	No
Magnesium *	4/ 4	1.9E+03	8.5E+02	3.7E+03	2.8E+03	No		None		None	No
Manganese	4/ 4	2.2E+02	9.2E+01	3.5E+02	2.0E+03	No	1.8E+02	Yes	3.2E+03	No	No
Mercury	4/ 4	3.2E-02	1.3E-02	5.6E-02	5.9E-02	No	2.3E+00	No	6.1E+01	No	No
Nickel	4/ 4	1.4E+01	8.1E+00	2.5E+01	1.8E+01	Yes	1.6E+02	No	4.1E+03	No	No
Potassium *	4/ 4	8.0E+02	2.9E+02	1.5E+03	2.0E+03	No		None		None	No
Thallium	2/ 4	3.1E-01	3.0E-01	3.3E-01	8.9E-01	No	6.3E-01	No	1.6E+01	No	No
Vanadium	4/ 4	1.3E+01	3.7E+00	2.2E+01	2.6E+01	No	5.5E+01	No	1.4E+03	No	No
Zinc	4/ 4	5.0E+01	3.4E+01	7.4E+01	5.3E+02	No	2.3E+03	No	1.0E+04	No	No
Semivolatile Organic Compounds (mg/kg)											
PCB-1260	1/ 4	1.8E-02	1.1E-02	1.1E-02		Yes	2.2E-02	No	1.0E-01	No	No
Volatile Organic Compounds (mg/kg)											
Acetone	1/ 4	7.9E-03	1.2E-02	1.2E-02		Yes	1.6E+02	No	6.2E+02	No	No

[a] Values less than the detection limit were set to one-half of the reporting limit in calculation of the average.
[b] Site-related status is based on the frequency of detection and background screens; see Section 5.1.
[c] COPC status is based on screening against the residential soil screening criteria. If a chemical is site-related and is detected above its residential screening value, then it is a COPC. If a chemical is site-related and no residential screening value is available, then the chemical is retained as a COPC.
[d] Comparisons are made against industrial soil screening criteria for information purposes only. This screen is not used to determine COPC status.
* Essential element (not considered a human health site-related contaminant).
COPC = Chemical of potential concern.
PCB = Polychlorinated biphenyl.
PRG = Preliminary remediation goal.

Table 5-7. Ecological Screening Table for Sediment at Demolition Area 1

Analytes Remaining after Background and Site-Related Screen	Sediment Site Maximum (mg/kg)	Screening Value (mg/kg)	Reference	Is Maximum Above or Below the Screening Value?	Ecological COPC?
Inorganics					
Aluminum	1.44E+04	None	None	No screening value	Yes
Chromium	1.88E+01	2.60E+01	EDQL EPA Region 5 (1998)	Below	No
Cobalt	9.40E+00	5.00E+01	EDQL EPA Region 5 (1998)	Below	No
Lead	3.11E+01	3.10E+01	EDQL EPA Region 5 (1998)	Above	Yes
Magnesium	3.69E+03	None	None	No screening value	Yes
Nickel	2.54E+01	1.60E+01	EDQL EPA Region 5 (1998)	Above	Yes
Volatile Organic Compounds					
Acetone	1.10E-02	4.53E-01	EDQL EPA Region 5 (1998)	Below	No
PCBs					
PCB-1260	1.10E-02	5.00E-03	Ontario MOE low	Above	Yes

Yes = Maximum concentration > screening value.
No = Maximum concentration < screening value.
COPC = Chemical of potential concern.
PCBs = Polychlorinated biphenyls.

5.5.4.1 Human health screening results for surface water

Table 5-8 presents the results of the SRC screening and human health risk-based screening for all chemicals in DA1 surface water. Chemicals that were never detected in surface water are not shown on this table. As seen, RDX, bis(2-ethylhexyl)phthalate, and chloroform are identified as surface water COPCs.

Table 5-8. Screening to Determine Human Health COPCs at Demolition Area 1 for Surface Water

Analyte	Results > Detection Limit	Average Result	Minimum Detect	Maximum Detect	Site Background Criteria	Site Related?[a]	One-tenth Region 9 Tap Water PRG[b]	Max. Detect > Tap Water Criteria?[b]	Ecological COPC?[b]
Explosives (µg/L)									
RDX	1/ 3	2.5E-01	2.4E-01	2.4E-01		Yes	6.1E-02	Yes	Yes
Inorganics (µg/L)									
Barium	3/ 3	4.1E+01	3.8E+01	4.4E+01	4.8E+01	No	2.6E+02	No	No
Calcium *	3/ 3	4.9E+04	4.8E+04	5.0E+04	4.1E+04	No		None	No
Zinc	1/ 3	6.7E+01	1.8E+02	1.8E+02	4.2E+01	Yes	1.1E+03	No	No
Semivolatile Organic Compounds (µg/L)									
Bis(2-ethylhexyl)phthalate	3/ 3	4.5E+00	3.9E+00	5.1E+00		Yes	4.8E-01	Yes	Yes
Volatile Organic Compounds (µg/L)									
Acetone	3/ 3	5.9E+00	5.0E+00	7.5E+00		Yes	6.1E+01	No	No
Chloroform	1/ 3	2.1E+00	1.2E+00	1.2E+00		Yes	1.6E-02	Yes	Yes
Toluene	2/ 3	1.4E+00	7.9E-01	1.0E+00		Yes	7.2E+01	No	No

[a] Site-related status is based on the frequency of detection and background screens; see Section 5.1.
[b] COPC status is based on screening against the tap water screening criteria. If a chemical is site-related and is detected above its tap water screening value, then it is a COPC. If a chemical is site-related and no tap water screening value is available, then the chemical is retained as a COPC.
* Essential element (not considered a human health site-related contaminant).
COPC = Chemical of potential concern.
PRG = Preliminary remediation goal.
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.

- RDX was detected once at 0.24 µg/L (station DA1-046; HC-2), which is within an order of magnitude of its tap water screening value of 0.061 µg/L.

- Bis(2-ethylhexyl)phthalate was detected in all three surface water samples taken, with concentrations ranging from 3.9 µg/L to 5.1 µg/L (station DA1-043; upstream), which are all above its tap water screening value of 0.48 µg/L.

- Chloroform was detected once at 1.2 µg/L (station DA1-043; upstream), which exceeds its tap water screening value of 0.016 µg/L.

5.5.4.2 Ecological screening results for surface water

Table 5-9 presents the results of the ecological risk-based screening for all chemicals determined to be SRCs in DA1 surface water. As seen, RDX, calcium, zinc, and bis(2-ethylhexyl)phthalate are identified as surface water ecological COPCs.

Table 5-9. Ecological Screening Table for Surface Water at Demolition Area 1

Analytes Remaining After Background and Site-Related Screen	Surface Water Site Maximum (µg/L)	Screening Value (µg/L)	Reference	Is Maximum Above or Below the Screening Value?	Ecological COPC?
Inorganics					
Calcium	5.02E+04	None	None	No screening value	Yes
Zinc	1.80E+02	5.90E+01	EDQL EPA Region 5 (1998)	Above	Yes
Semivolatile Organic Compounds					
Bis(2-ethylhexyl)phthalate	5.10E+00	2.10E+00	EDQL EPA Region 5 (1998)	Above	Yes
Volatile Organic Compounds					
Acetone	7.50E+00	1.50E+03	Tier II (Suter & Tsao 1996)	Below	No
Chloroform	1.20E+00	2.80E+01	Tier II (Suter & Tsao 1996)	Below	No
Toluene	1.00E+00	9.80E+00	Tier II (Suter & Tsao 1996)	Below	No
Explosives					
RDX	2.40E-01	None	None	No screening value	Yes

Yes = Maximum concentration > screening value.
No = Maximum concentration ≤ screening value.
COPC = Contaminant of potential concern.
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.

- RDX (0.24 µg/L) is retained as an ecological COPC for surface water because no screening value is available for this explosive.

- Calcium (50,200 µg/L) is retained as an ecological COPC for surface water because no screening value is available for this metal.

- Zinc (180 µg/L) was detected above its ecological surface water screening value (59 µg/L).

- Bis(2-ethylhexyl)phthalate was detected at a concentration of 5.1 µg/L, which is above its surface water screening value of 2.1 µg/L).

5.5.5 Summary of COPCs

Table 5-10 presents a summary of human health and ecological COPCs for surface soil, subsurface soil, sediment, and surface water media. As noted in the table, 4 explosives, 13 metals, 1 PCB, 1 SVOC, and 1 VOC are identified in at least one medium as a COPC at DA1.

Based on the abundance of COPCs (both for human health and ecological), site conditions do not support a "no further action" decision; additional characterization or action appears to be necessary.

Table 5-10. Summary of COPCs for Demolition Area 1

Analyte	Surface Soil COPC[a]	Subsurface Soil COPC[a]	Sediment COPC[a]	Surface Water COPC[a]
Explosives				
2,4,6-Trinitrotoluene	H			
2,4-Dinitrotoluene	H			
Nitrocellulose	**H**			
RDX				H, **E**
Inorganics				
Aluminum	H	H	H, **E**	
Antimony	H			
Arsenic	H	H		
Barium	H			
Cadmium	H	H		
Calcium				**E**
Chromium	H	H	H	
Copper	H	H		
Lead	H	H	E	
Magnesium			**E**	
Manganese	H			
Nickel			E	
Zinc	H	H		E
PCBs				
PCB-1260			E	
Semivolatile Organic Compounds				
Bis(2-ethylhexyl)phthalate				H, E
Volatile Organic Compounds				
Chloroform				H

[a] Human health COPCs are designated by "H," and ecological COPCs are designated by "E"; designations in bold indicate that the chemical is retained as a COPC because it was detected in the medium, but no risk-based screening value was available for comparison. Designations appearing in regular font (i.e., not in bold) indicate that the chemical was detected at levels above its risk-based screening value.

COPC = Chemical of potential concern.

PCBs = Polychlorinated biphenyls.

RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.

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6.0 CONCLUSIONS AND RECOMMENDATIONS

The DA1 Phase I RI presents an evaluation of the distribution and occurrence of contamination at the site along with a risk evaluation to determine whether additional investigations or actions are warranted. This chapter presents a refined SCM (originally outlined in the Phase I RI SAP Addendum), conclusions based on the data compiled during this Phase I RI, and recommendations.

6.1 SITE CONCEPTUAL MODEL

The SCM is a summary of the knowledge gathered at DA1. Elements of the SCM include

- contaminant source areas and release mechanisms,
- contaminant migration pathways and exit points, and
- data gaps and uncertainties.

The SCM integrates site chemical data with the physical characteristics of the AOC to illustrate where and how contaminants originate and the most likely mechanisms by which they can be transported. The SCM also identifies any information that is still needed to adequately characterize the AOC. The SCM does not incorporate hydrogeologic data because characterization of groundwater was not a DQO of the Phase I RI. An illustrated version of the SCM is provided in Figure 6-1 to assist in visualizing the concepts discussed below.

6.1.1 Source Areas and Release Mechanisms

The results of Phase I RI soil sampling indicate that the western and southern portions of the berm and the plane storage area are the portions of DA1 with the greatest numbers and concentrations of contaminants. Explosives, propellants, and inorganics are present in soil in these areas at concentrations greater than background or risk screening criteria. The majority of contamination is restricted to the surface soil interval, which is less than 0.3 meter (1 foot) deep. The observed distribution of soil contamination is spotty and generally associated with bare soil areas and the south ditch draining the former OB/OD area. No explosive or propellant residues were observed on the ground surface; however, OE and other debris were present in several bare soil areas within the plane storage area. Based on the Phase I RI data, surface soil within the areas noted above are considered to be residual or secondary sources of contamination at DA1.

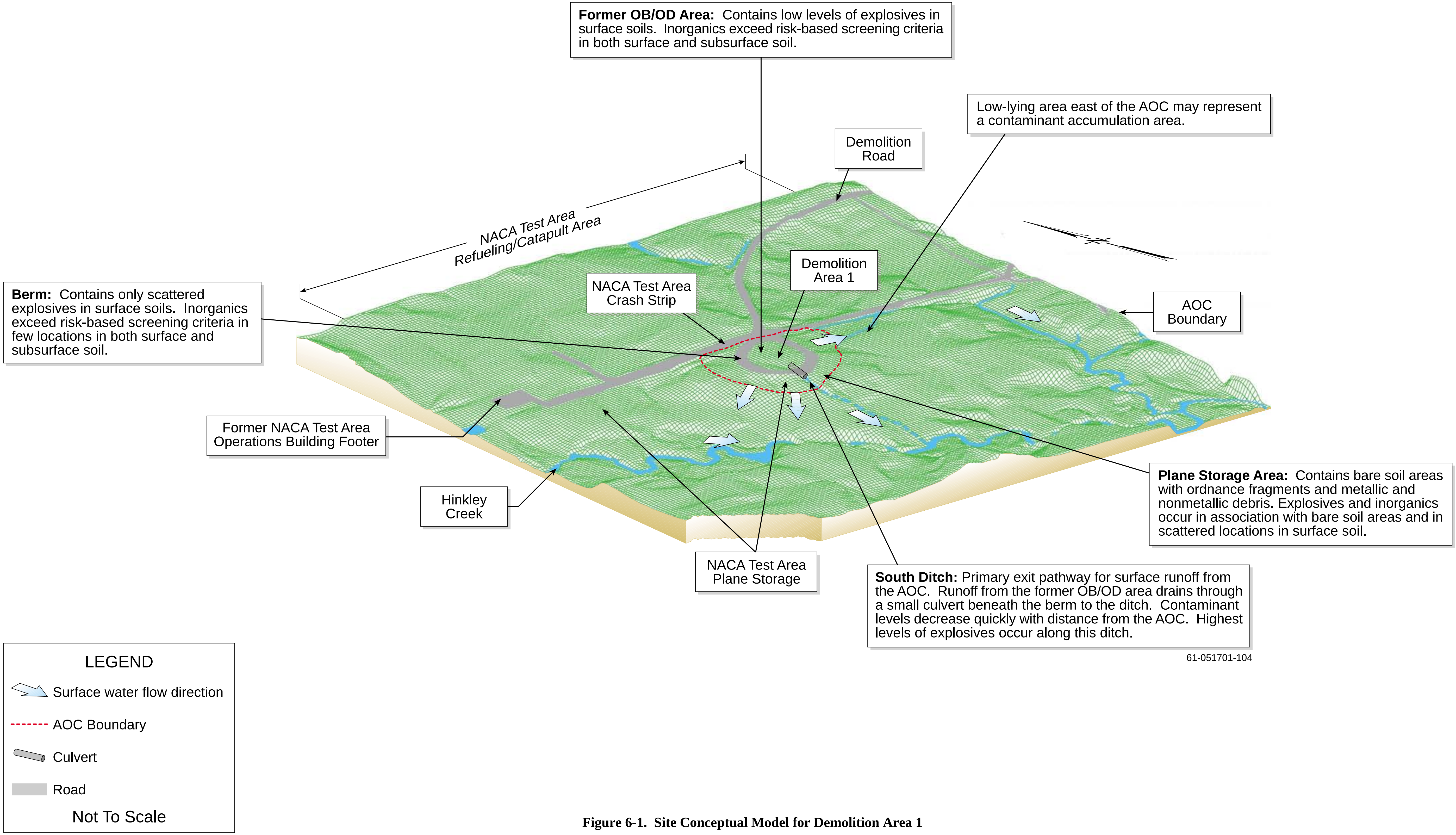
Contamination was also observed in the northern portion of the former OB/OD area but to a lesser degree than in the two functional areas noted above. Current data show that soil in the eastern portion of the AOC does not appear to have been significantly contaminated and therefore is not a significant secondary source.

The primary mechanisms for releases of contaminants from the source areas listed above include the following:

- past thermal destruction of waste munitions, explosives, and associated wastes;

- leaching of constituents from the residual debris into soil; and

- erosion of contaminated soil and redeposition along the drainageways exiting the site (i.e., south ditch).



Former OB/OD Area: Contains low levels of explosives in surface soils. Inorganics exceed risk-based screening criteria in both surface and subsurface soil.

Low-lying area east of the AOC may represent a contaminant accumulation area.

Berm: Contains only scattered explosives in surface soils. Inorganics exceed risk-based screening criteria in few locations in both surface and subsurface soil.

Plane Storage Area: Contains bare soil areas with ordnance fragments and metallic and nonmetallic debris. Explosives and inorganics occur in association with bare soil areas and in scattered locations in surface soil.

South Ditch: Primary exit pathway for surface runoff from the AOC. Runoff from the former OB/OD area drains through a small culvert beneath the berm to the ditch. Contaminant levels decrease quickly with distance from the AOC. Highest levels of explosives occur along this ditch.

Figure 6-1. Site Conceptual Model for Demolition Area 1

Inorganic (metals) contaminants in both surface and subsurface soil exceeded conservative criteria for soil leaching to groundwater. In addition, 2,4-DNT exceeded its leaching criterion. However, the data evaluation showed substantially fewer inorganic COPCs and lower concentrations in subsurface soil than in surface soil. Additionally, explosives contamination was generally absent in subsurface soil.

6.1.2 Contaminant Migration Pathways and Exit Points

Migration of contaminants from secondary soil sources to surface water conveyances occur primarily by (1) mobilization of particle-bound contaminants in surface water runoff, and (2) transport of dissolved phase constituents in surface water. Upon reaching surface water conveyances or low-lying flow velocities, decrease and particle-bound contaminants would largely settle out as sediment accumulation. Sediment-bound contaminants may be remobilized through resuspension during storm events or partition to surface water and be transported in a dissolved phase.

The primary identified contaminant exit pathway at DA1 is the south ditch, which is fed by a small culvert that drains the former OB/OD area and runs beneath the berm. The ditch line is approximately 0.6 meter (2 feet) deep and well defined near the berm, but it rapidly decreases in depth and dissipates to grade a short distance south of the AOC. Sampling data show that surface water runoff within the former OB/OD area entrains contaminants, which flow through the culvert where they are subsequently deposited along the ditch line.

The only other accumulation area or conveyance for storm runoff is to the east of the AOC. A well-defined drainage channel does not feed this area; rather, surface water runoff is directed by gentle topographic contours and ultimately accumulates in this low-lying area. Phase I RI data, however, do not show significant accumulation of contaminants in this area. In the remaining portions of the AOC (i.e., the berm and plane storage area), no conveyances exist, and runoff overall is directed to the south as overland flow. The Phase I data do not demonstrate any substantial contributions of contamination to Hinkley Creek due to DA1 operations.

6.1.3 Uncertainties

The SCM is developed based on available site characterization and chemical data. Uncertainties are inherent in the SCM where selected data do not exist or are sparse. The uncertainties within the SCM for DA1 include the following:

- Contaminant migration from source areas to groundwater via leaching or surface water infiltration is an unknown element of the conceptual model at present. A number of contaminants identified as COPCs also exceeded conservative soil leaching screening criteria. Observed vertical distribution of soil contamination did not indicate significant leaching from surface soil to subsurface soil.

6.2 CONCLUSIONS

In summary, the results of the Phase I RI at DA1 confirmed the presence of site-related contamination in soil. In terms of sediment and surface water contamination, Hinkley Creek does not appear to have received significant contamination related to AOC operations. Contaminant migration off of the AOC appears to be negligible based on the Phase I RI data. Screening of chemical data against risk-based criteria shows the presence of human health and ecological COPCs in each environmental medium (Chapter 5.0). However, as noted in the specific conclusions below, sediment and surface water COPCs may not reflect contributions related to DA1. Figures 6-2 and 6-3 present illustrated summaries of the distribution of explosives and inorganic COPCs in surface and subsurface soil, as well as the degree of contamination relative to risk evaluation criteria.

Surface Soil

- The south ditch and "hot spots" in the western and southern portions of the plane storage area represent the principal locations having contamination above background levels. The highest concentrations of explosives and propellants are clustered along the south drainage ditch, indicating contaminant migration via surface water runoff across the AOC and deposition along the ditch.

- Two explosives (2,4,6-TNT and 2,4-DNT) and nitrocellulose were identified as COPCs in surface soil. 2,4,6-TNT exceeded its residential risk-based screening criterion at only four stations (DA1-001, DA1-010, DA1-030, and DA1-040). 2,4-DNT exceeded its residential criterion at only three locations (DA1-010, DA1-014, and DA1-022).

- Ten metals were identified as COPCs. Of these, aluminum, arsenic, cadmium, chromium, lead, and manganese exceeded both background values and industrial risk-based screening criteria. The greatest exceedances of human health risk-based screening criteria include constituents in the western and southern portions of the plane storage area.

- Mercury, although persistently detected in surface soil, was not identified as a COPC.

- 4-Methylnapthlene was the only SVOC identified as a COPC due to lack of a risk-based screening criterion for comparison.

- VOCs are not COPCs in surface soil.

- Screening of data against migration to groundwater criteria (DAF = 1) shows that 2,4-DNT, antimony, arsenic, barium, cadmium, chromium, and zinc exceeded their respective criteria.

Subsurface Soil

- Explosives, SVOCs, and VOCs were not identified as COPCs in subsurface soil.

- Aluminum, arsenic, cadmium, chromium, copper, lead, and zinc were identified as COPCs in subsurface soil. All but copper and zinc exceeded both residential and industrial risk-based screening criteria. Almost all exceedances of background and risk-based screening levels occur in the western half of the AOC at comparatively few stations relative to surface soil.

- Concentrations of inorganic SRCs in general are substantially lower in subsurface soil than in surface soil.

- Screening of data against migration to groundwater criteria (DAF = 1) shows that arsenic, cadmium, and chromium exceeded their respective criteria.

Sediment and Surface Water

- Aluminum and chromium were the only constituents identified as human health COPCs in sediment. The maximum detected value of 14,400 mg/kg (dry sediment at station DA1-044) only slightly exceeds the background criteria (13,900 mg/kg) for this metal. All other results, while exceeding

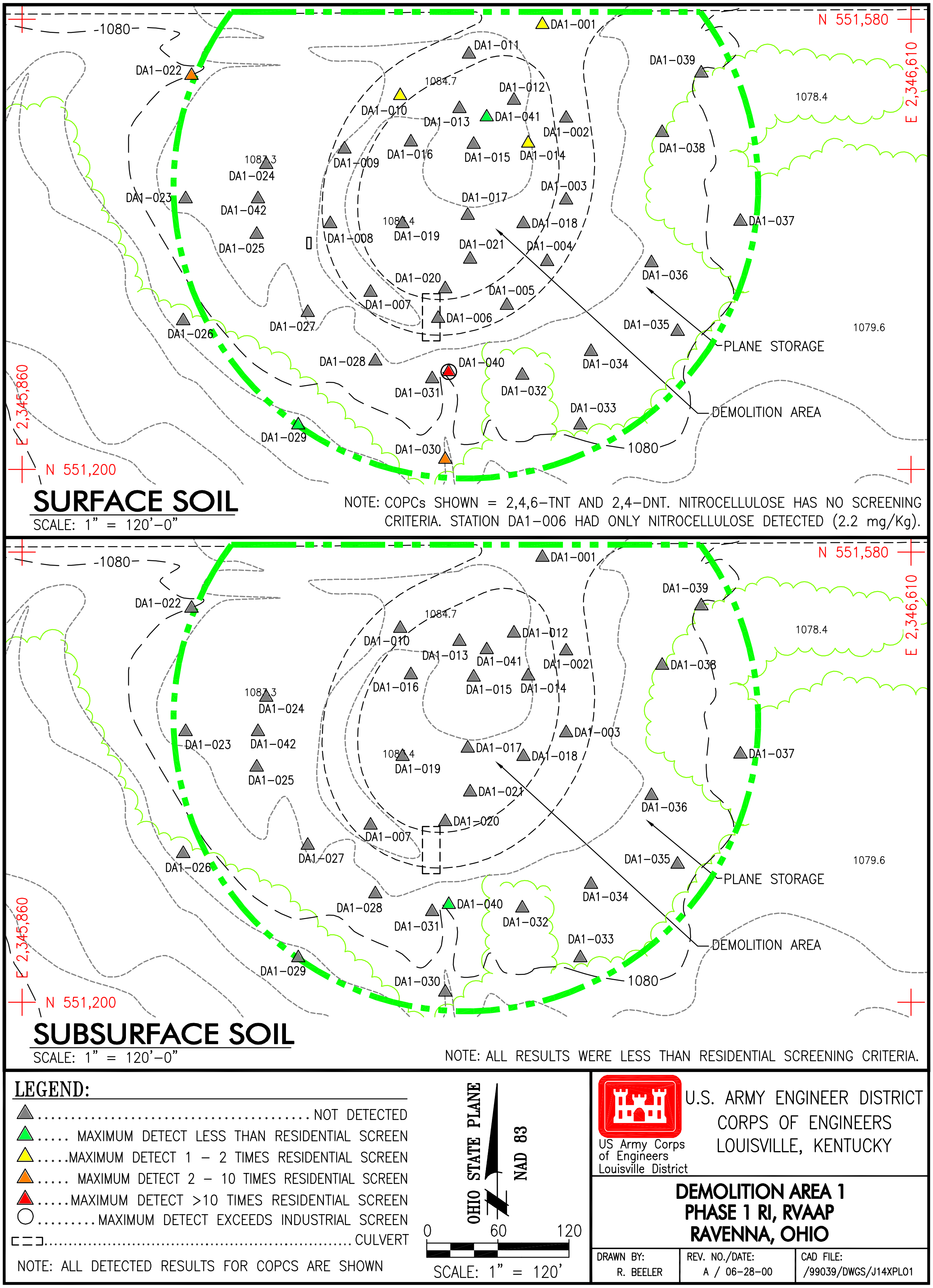


Figure 6-2. Distribution of Human Health COPCs in Soil - Explosives

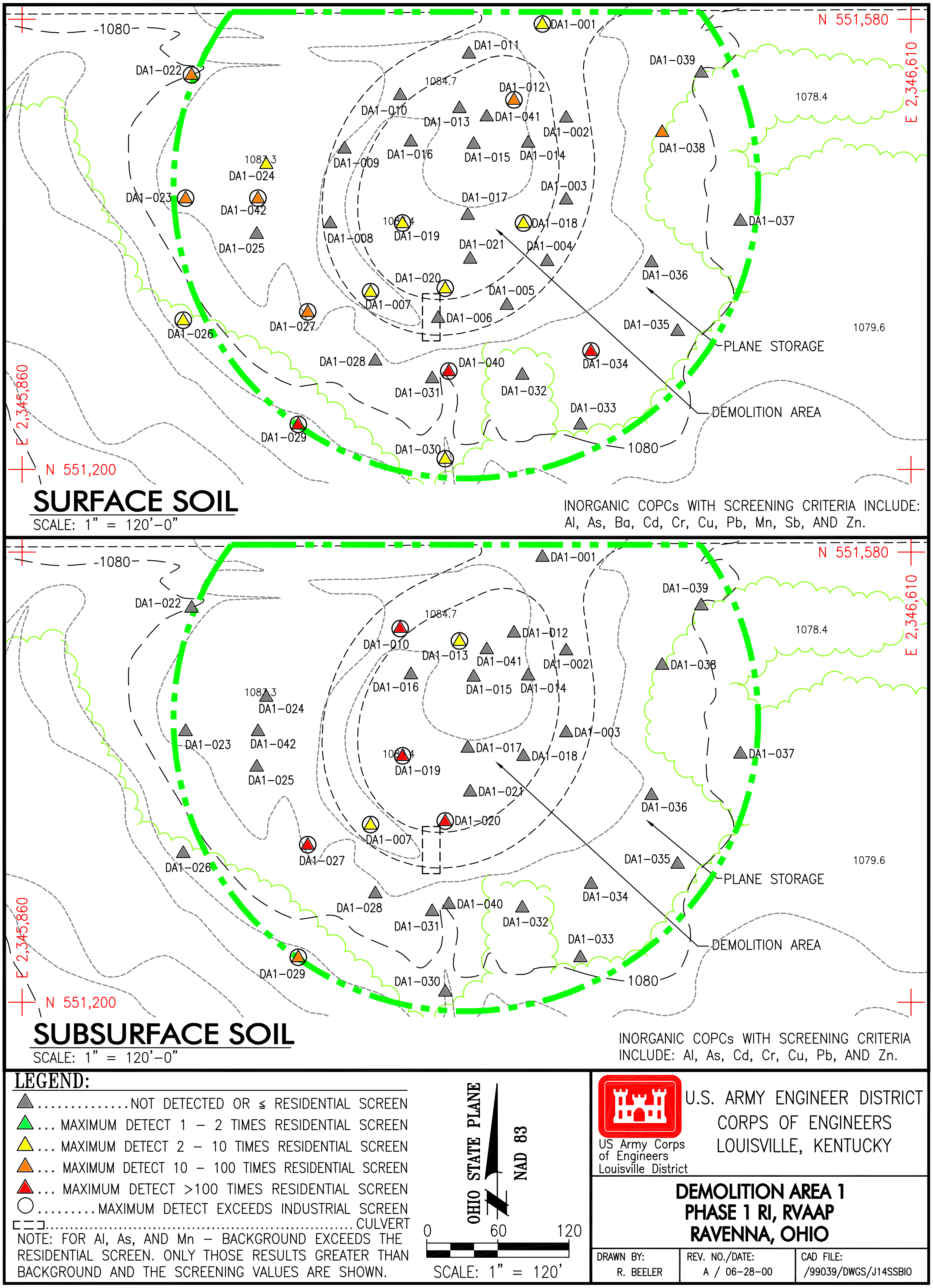


Figure 6-3. Distribution of Human Health COPCs in Soil - Inorganics

risk-based criteria, were less than background values. The only chromium result greater than both background and risk-based criteria occurred at station DA1-046 at HC-2.

- Aluminum and magnesium were identified as ecological COPCs in absence of risk-based screening criteria. Lead and nickel exceeded ecological screening criteria only at stations DA1-044 and DA1-046, respectively; hence, they were retained as ecological COPCs. PCB-1260 (detected only at station DA1-044) was also retained as an ecological COPC.

- RDX, bis(2-ethylhexyl)phthalate, and chloroform were identified as human health COPCs for surface water. RDX exceeded risk-based screening criteria only at station DA1-046 (HC-2; facility exit point). The remaining two compounds exceeded their risk-based screening criteria at station DA1-043, which is located upstream of DA1 and NTA.

- Zinc, bis(2-ethylhexyl)phthalate, and RDX were identified as ecological COPCs for surface water on the basis of available screening values. As noted above, the two organic constituents are unrelated to DA1. Zinc exceeded its ecological risk-based criteria only at station DA1-045. Calcium was identified as an ecological COPC in absence of a screening criteria; this constituent exceeded background at all three surface water stations and is not an SRC.

- The data collected during the Phase I RI indicate that sediment in Hinkley Creek has not been significantly contaminated as a result of former operations at DA1.

Groundwater

- Based on the available limited screening data, leaching of contaminants from soil to shallow groundwater in the vicinity of station DA1-027 has not occurred. These limited data do not necessarily represent conditions in other portions of the AOC.

6.3 RECOMMENDATIONS

Based on the human health and ecological screening risk evaluations, COPCs were identified for soil, sediment, and surface water. Based on the occurrence of COPCs (in particular for soil), site conditions do not support a “no further action” decision. Additional characterization, a baseline human health risk assessment, and a screening ERA are recommended under the auspices of a combined DA1/NTA Phase II RI. Any future risk assessment must take into consideration the interim removal action for soil. Specific recommendations include

- Based on the comprehensive characterization of surface and subsurface soil during the Phase I RI and low number of COPCs identified in subsurface soil at depths greater than 0.3m (1 foot), the lateral and vertical extent of soil explosives contamination has largely been determined within the DA1 boundary. In addition, the ongoing IRA for OE and explosives contamination will address, in part, the inorganic contamination identified above risk screening levels in the Phase I RI. Therefore, it is recommended that any additional characterization of soil in the vicinity of DA1 be accomplished in context of a combined DA1/NTA soil exposure unit.

- Human health and ecological COPCs were identified for sediment and surface water collected during the Phase I RI; however, no definitive evidence exists correlating the COPCs identified in the Hinkley Creek main stem to DA1. Subsequent investigation of DA1 is recommended in the context of a combined DA1/NTA exposure unit for surface water and sediment in streams and ditches within the AOC and downstream to the confluence with Hinkley Creek. Confirmation of the presence of constituents at HC-2 and within the Hinkley Creek main stem above background criteria will be addressed under a separate investigation.

- As noted in DQOs presented in the Phase I RI SAP Addendum, collection of site-specific hydrogeologic data is indicated because soil constituents exceeded generic migration to groundwater criteria. Collection of these data is recommended in context of a combined DA1/NTA groundwater exposure unit. Based on the observed vertical distribution of soil contaminants and the high likelihood of attenuation within the vadose zone, the scope of these efforts should be limited in extent and target only shallow groundwater in the unconsolidated zone immediately downgradient of or within the principal source areas. Deeper groundwater may be evaluated if shallow groundwater is found to be contaminated.

- Upon collection of groundwater characterization data, chemical fate and transport modeling and finalization of the SCM are recommended as necessary to identify contaminant migration potential within this medium and to facilitate the decision-making process for any necessary remedial actions.

- A screening ERA is recommended to address soil, sediment, and surface water considering that sufficient quantity and quality of habitat are present for the combined DA1/NTA exposure units. Sediment and surface water data will be grouped inside the combined AOC to the confluence with Hinkley Creek. The screening ERA, using hazard quotients for specific receptors, will be preceded by a pre-screen using ecological screening values. Thus, a tiered approach will be followed.

- A baseline human health risk assessment is recommended to address soil, surface water, and sediment media and, if warranted based on additional characterization, a groundwater exposure unit for the combined AOC. Dry sediment located in the low-lying area immediately east of DA1 should be addressed in the same manner as the soil exposure pathways.

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Draft Final Phase I Remedial Investigation Report for Demolition Area 1 at the Ravenna Army Ammunition Plant, Ravenna, Ohio
Comment Resolution

Comment No.	Page or Section	Comment	Response
		Ohio EPA (Eileen Mohr)	
		GENERAL COMMENTS (no text change required)	
1	General	Ohio EPA is requesting that the surface water at HC-2 be sampled prior to the institution of a facility-wide surface water initiative. The purpose of the additional sampling would be to confirm whether or not the explosive compound detected in the surface water as part of this Phase I remedial investigation (RI) at this location exists. As the installation-wide initiative is perhaps 2 years in the future, the question of whether or not site-related contaminants are exiting the facility at this location needs to be determined on a more timely basis. Further discussion of this issue is warranted.	Comment noted. Additional sampling of HC-2 may be considered in the investigation to be conducted prior to an installation-wide surface water initiative. No text changes required.
2	General	In future investigations conducted at the RVAAP, the State of Ohio Water Quality Standards (WQS) located in Ohio Administrative Code (OAC) are to be utilized as the primary surface water screening/regulatory values.	Clarification. The RVAAP team consensus screening process for surface water at RVAAP uses facility-wide background values to identify SRCs and 1/10 of the EPA Region 9 PRGs to identify human health COPCs. For ecological COPC screening, the lower of the values among the EPA Region 5 EDQLs, Ohio WQS, or toxicological benchmarks from an ORNL benchmark study are used. Thus, the Ohio WQS are incorporated if they are the most conservative values. Future clarification is required as to how in the screneing process the Ohio WQS should be applied in addition to the current use. No text changes required.
3	General	Please refer to the information regarding various groundwater models that was submitted to you, USACE, and SAIC on June 28, 2001. Although no text change is required on page 4-47, please be advised that SESOIL may not be the preferred groundwater model. Additional discussions regarding this modeling issue should be incorporated into the scoping efforts for the combined Open Demolition Area (ODA) #1 and NACA Test Area (NTA) Phase II RI.	Agreed. SESOIL is applied only as a vadose zone leaching model and is widely used. Other models are available and may be employed if agreed to by the RVAAP team. Groundwater transport is typically modeled using other industry standard models, such as ATD 123 or MODFLOW. No text changes required.
		SPECIFIC COMMENTS	
1	Page xiv, lines 6-7 and page 1-7, lines 46-48	Please remove the statement on page xiv (lines 6-7) regarding slag. It is not clear why this text was added to the draft-final report. (Also page 1-7, lines 46-48)	Disagree. The statement was added in response to comments received from RVAAP during the February 14, 2001, comment resolution meeting. The comment requested the addition of language from the January 19, 2000, Ohio EPA memo to clarify that clean-up decisions at

Draft Final Phase I Remedial Investigation Report for Demolition Area 1 at the Ravenna Army Ammunition Plant, Ravenna, Ohio
Comment Resolution

Comment No.	Page or Section	Comment	Response
			RVAAP would not be based solely on slag-derived contaminants.
2	Page xiv, line 43	On page xiv (line 43), please specify what "background levels" are being utilized.	Clarification. Text has been added to specify RVAAP facility-wide background levels.
3	Page xvi, line 42	On page xvi (line 42), please specify how many subsurface soil samples were analyzed for PCBs.	Clarification. Text has been added to specify that there were five subsurface soil samples analyzed for PCBs.
4	Page xxi, lines 47-50	Based upon the unexploded ordnance (UXO)/ordnance and explosive (OE) project being conducted by MKM Engineers at this AOC, please revise the text on page xxi (lines 47-50) to be less definitive that the vertical and horizontal extent of contamination has been determined. At least one area of concentrated OE waste has been excavated on the western side of this AOC, which was not detected by previous environmental investigations. This comment is also applicable to other constituents. For example, an area of volatile organic compound (VOC) contamination in the southern portion of the AOC was also discovered by MKM during excavation activities. As such, it is not unreasonable to suspect that additional areas of concentrated explosives or other constituents may exist at this AOC. This text change could be accomplished by removing the above-referenced text lines.	Agree. Text has been revised as requested.
5	Page 2-4, Figure 2-3	On Figure 2-3 (page 2-4), please provide an explanation for removing the approximate boundaries of the suspected buried valley. This feature should remain on this map, especially in light of the fact that it is referenced on pages 2-5 (line 2) and 2-7 (line 48).	Agree. After further discussions with Paul Zorko, (USACE), who originally requested this feature be removed from the RVAAP geologic map, it was agreed to add the feature back with somewhat smaller dimensions based on earlier geologic mapping (USGS 1966). The revised geologic map is also included in the Phase I Final RI report for Erie Burning Grounds and NACA Test Area.
6	Page 4-12, lines 36-37	Please revise the text on page 4-12 (lines 36-37) to reflect that background concentrations were determined during the Winklepeck Burning Grounds (WBG) Phase II RI. As such, it is incorrect to indicate that no background concentrations exist (Also page 4-45, line 27)	Clarification. The background soil investigation determined background levels only for inorganics. Three inorganics (cadmium, silver, and thallium) were not detected in the background data set, so the background level for these constituents was set to zero. VOCs, SVOCs, and pesticides/PCBs are considered anthropogenic, that is, not naturally occurring, so that any of these compounds with a frequency of detection >5% are considered to be SRCs. Any detected explosive or propellant compound is considered as an SRC regardless of the frequency of detection. The text has been revised for clarity.

Draft Final Phase I Remedial Investigation Report for Demolition Area 1 at the Ravenna Army Ammunition Plant, Ravenna, Ohio
Comment Resolution

Comment No.	Page or Section	Comment	Response
7	Page 4-46, lines 6-7	Please remove or modify the text on page 4-46 (lines 6-7) that indicates that "the background criteria is assumed to be the detection limit for these compounds." This statement is incorrect. As indicated in the comment above, facility-wide background concentrations were determined during the WBG Phase II RI, and the statement in the text was not one of the decision criteria utilized.	Agree. Text has been modified for clarity. While some organic analyses were conducted as part of the facility-wide background investigation, these chemicals are not naturally occurring, so any detection of these compounds qualifies them for SRC status. See also response to the above comment
8	Page 5-2, Figure 5-1	On Figure 5-1 (page 5-2), which was newly added to the draft-final report, please add propellants to the "explosives" box. In addition, remove or modify the text in the box which states, "no background concentration." Again, facility-wide background was determined during the WBG Phase II RI.	Agree. Figure 5-1 has been modified in this report as well as the other two reports (Erie Burning Grounds and NACA Test Area) for consistency.
9	Page 5-9, line 10	Please revise the text on page 5-9 (line 10) to read: "For this Phase I RI, the groundwater medium is not evaluated, as monitoring wells were not installed.	Agree. Text has been revised as requested.

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