MKM Engineers, Inc.

FINAL REPORT

# FINAL REPORT FOR THE PHASE I REMEDIAL INVESTIGATION AT LOAD LINE 9 (RVAAP 42)

**Ravenna Army Ammunition Plant**
**8451 State Route. 5**
**Ravenna, Ohio 44266**

***Prepared for:***

**US Army Joint Munitions Command (JMC)**
**Rock Island, Illinois 61299-6000**

***Prepared By:***

**MKM Engineers, Inc.**
**4153 Bluebonnet Drive**
**Stafford, TX 77477**

Contract No. DAAA09-02-C-0070

**August 2007**

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# LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| 95% UCL–L | log–normal 95% upper confidence level |
| 95% UCL–N | normal 95% upper confidence level |
| AET | apparent effects threshold |
| ABS$_{GI}$ | gastrointestinal absorption fraction |
| amsl | above mean sea level |
| AOC | area of concern |
| AST | above–ground storage tank |
| ATSDR | Agent for Toxic Substances and Disease Registry |
| AWQC | ambient water quality criteria |
| BCF | bioconcentration factor |
| BERA | baseline ecological risk assessment |
| bgs | below ground surface |
| BHHRA | baseline human health risk assessment |
| BRACD | Base Realignment and Closure Division |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| C | Celsius |
| CDI | chronic daily intake |
| cm/s | centimeter(s) per second |
| COC | chemical of concern |
| COPC | chemical of potential concern |
| CSF | cancer slope factor |

| | |
|---|---|
| CSM | conceptual site model |
| DLF | dust loading factor |
| DoD | Department of Defense |
| DQO | data quality objective |
| EB | explosive building |
| Eco–SSL | ecological soil screening level |
| EDD | electronic data deliverable |
| EDQL | ecological data quality level |
| EEQ | estrogenic equivalent |
| Eh | oxidation–reduction potential |
| EPC | exposure point concentration |
| ESL | ecological screening level |
| ESV | ecological screening value |
| F | Fahrenheit |
| $F_{oc}$ | fraction of organic carbon |
| ft | foot or feet |
| FWSAP | Facility–Wide Sampling and Analysis Plan |
| GAF | gastrointestinal absorption factor |
| GOCO | government–owned, contractor–operated |
| GPD/ft | gallon(s) per day per foot |
| GPM | gallon(s) per minute |
| GPL | General Physics Laboratories |

| | |
|---|---|
| HI | hazard index |
| HQ | hazard quotient |
| HSA | hollow–stem auger |
| IDW | investigation–derived waste |
| ILCR | incremental lifetime cancer risk |
| in | inch |
| IOC | Industrial Operations Command |
| IRP | Installation Restoration Program |
| JMC | Joint Munitions Command |
| Kd | soil–water distribution coefficient |
| $K_{oc}$ | organic carbon partition coefficient |
| $K_{ow}$ | octanol/water partition coefficient |
| km | kilometer(s) |
| L | liter(s) |
| LL | load line |
| LOAEL | lowest–observed–adverse–effect level |
| LOEC | lowest–observed–effect concentration |
| LPD/m | liter(s) per day per meter |
| LPM | liter(s) per minute |
| m | meter(s) |
| MCL | maximum contaminant level |
| MEC | munitions and explosives of concern |

| | |
|---|---|
| mg/kg | milligrams per kilogram |
| mg/L | milligrams per liter |
| $mg/m^3$ | milligrams per cubic meter |
| MI | mobility index |
| MKM | MKM Engineers, Inc. |
| ml/g | milliliters per gram |
| mm | millimeter(s) |
| mph | miles per hour |
| MS/MSD | matrix spike/matrix spike duplicate |
| MW | monitoring well |
| NAAQS | National Ambient Air Quality Standards |
| NAPL | non–aqueous phase liquids |
| nc | non–carcinogenic |
| NCEA | National Center for Environmental Assessment |
| NEB | non-explosive building |
| $NO_3$ | nitrate |
| NOAEL | no–observed–adverse–effect level |
| NOEC | no–observed–effect concentration |
| NTU | Nephelometric Turbidity Unit |
| NWS | National Weather Service |
| Ohio EPA | Ohio Environmental Protection Agency |
| OHARNG | Ohio Army National Guard |

| | |
|---|---|
| OMZM | outside mixing zone maximum |
| PAH | polycyclic aromatic hydrocarbon |
| PBT | persistent, bioaccumulative, and toxic |
| PCB | polychlorinated biphenyl |
| PEC | probable effects concentration |
| PEF | particulate emission factor |
| pH | measurement used to express the intensity of the acid or alkaline condition of a solution |
| PID | photoionization detector |
| PM10 | particulate matter ≤10 microns in diameter |
| PPRTV | Peer–Reviewed Toxicity Value |
| PRG | preliminary remediation goal |
| PVC | polyvinyl chloride |
| QA | quality assurance |
| QC | quality control |
| QCSR | quality control summary report |
| RAGS | Risk Assessment Guidance for Superfund |
| RBSC | risk–based screening concentration |
| RCRA | Resource Conservation and Recovery Act |
| RDA | recommended daily allowance |
| RDI | recommended daily intake |
| RDF | regional disposal facility |
| RDX | hexahydro–1,3,5–trinitro–1,3,5–triazine |

| | |
|---|---|
| RfC | reference concentration |
| RfD | reference dose |
| RGO | remedial goal option |
| RI | remedial investigation |
| RME | reasonable maximum exposure |
| RRSE | relative risk site evaluation |
| RTLS | Ravenna Training and Logistics Site |
| RVAAP | Ravenna Army Ammunition Plant |
| SAIC | Science Applications International Corporation |
| SdSL | sediment screening level |
| SDWA | Safe Drinking Water Act |
| SERA | Screening Ecological Risk Assessment |
| SQG | soil quality guideline |
| SRC | site related chemical |
| SRV | sediment reference value |
| SSL | soil screening levels |
| SSSL | shallow soil screening level |
| STL | Severn Trent Laboratories, Inc. |
| STSC | Superfund Health Risk Technical Support Center |
| SVOC | semi–volatile organic compound |
| SWSL | surface water screening level |
| TAL | target analyte list |

| | |
|---|---|
| TCE | trichloroethene |
| TEC | threshold effect concentration |
| TNT | 2,4,6–trinitrotoluene |
| TOC | total organic carbon |
| TRV | toxicity reference value |
| TSCA | Toxic Substances Control Act |
| UCL | upper confidence level |
| µg/kg | micrograms per kilogram |
| µg/L | micrograms per liter |
| USACE | U.S. Army Corps of Engineers |
| USAEC | U.S. Army Environmental Command |
| USACHPPM | U.S. Army Center for Health Promotion and Preventive Medicine |
| USEPA | U.S. Environmental Protection Agency |
| USP&FO | U.S. Property and Fiscal Officer |
| UTL | upper tolerance limit |
| UXO | unexploded ordnance |
| VF | volitization factor |
| VOC | volatile organic compound |
| WBG | Winklepeck Burning Grounds |
| WQC | water quality criteria |

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# EXECUTIVE SUMMARY

This Phase I Remedial Investigation (RI) Report characterizes the nature and extent of contamination, evaluates the fate and transport of contaminants, and assesses the potential risk to human health and the environment resulting from past operations at Load Line 9 (LL–9), also known as RVAAP–42, at the Ravenna Army Ammunition Plant (RVAAP), within Portage and Trumbull counties, Ravenna, Ohio. LL–9 is located in the south-central region of the RVAAP along Fuze and Booster Road.

The RI was conducted to fulfill the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and to prioritize future environmental restoration efforts at RVAAP's areas of concern (AOCs). The results of a United States Army Center for Health Promotion and Preventive Medicine (USACHPPM) investigation and an azide screening operation, as well as past activities at LL–9, were used to develop the objectives and sampling design of the RI. The objectives of the RI were to:

- Define the vertical and horizontal extent of contamination at LL–9;
- Gather sufficient data to conduct a Baseline Human Health Risk Assessment (BHHRA) and a Screening Ecological Risk Assessment (SERA);
- Define potential transport pathways and receptor populations; and
- Provide sufficient data for the selection of remedial action alternatives.

To fulfill these objectives, field investigations were conducted in March 2002 and October to December 2003. During the field investigations, samples were collected from surface soils, subsurface soil borings, surface water, sediments, and groundwater. Samples were analyzed for possible contamination resulting from the production of artillery fuzes such as explosives, propellants, target analyte list (TAL) metals, nitrates, cyanide, sulfides, semi-volatile organic compounds (SVOCs), and volatile organic compounds (VOCs). The surface and subsurface soil, groundwater, surface water, and sediment results are summarized for each matrix.

### *Surface Soils (0 to 1 ft below ground surface [bgs])*

Propellants (nitrocellulose and nitroguanidine), SVOCs (benzo[a]pyrene and dibenzo[a,h]anthracene) and metals (aluminum, arsenic, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, vanadium, and zinc) were detected in surface soils at concentrations greater than RVAAP installation background (USACE, 2001b) concentrations, Region 9 residential soil preliminary remediation goals (PRGs), or both.

### *Subsurface Soils (1 – 3 ft bgs)*

Aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, iron, lead, manganese, mercury, vanadium, and zinc were detected at concentrations greater than the RVAAP installation background concentrations, Region 9 residential soil PRGs, or both. In addition, one propellant (nitrocellulose) and one explosive (hexahydro–1,3,5–trinitro–1,3,5–triazine [RDX]) were detected in subsurface soils. However, only 10% of the subsurface samples collected were analyzed for explosives and propellants.

### *Groundwater*

Nitrocellulose and five metals (antimony, cobalt, copper, iron, and manganese) were detected in seven groundwater samples (and 1 duplicate) at concentrations exceeding the RVAAP-specific consolidated bedrock background criteria, the Region 9 tap water PRG or both. However, the nitrocellulose concentrations results were qualified as estimated (J), or (B) the concentration of nitrocellulose in the method blank was detected above the reporting limit, or both (B) (J).

### *Surface Water*

Metals including aluminum, arsenic, barium, beryllium, chromium, cobalt, copper, lead, manganese, mercury, nickel, vanadium, and zinc were detected in surface water at concentration exceeding the RVAAP-specific surface water installation background values established by USACE (2000), the Region 9 tap water PRGs, or both. Nitrocellulose was detected in two samples at concentrations above the method detection limit but below the reporting limit. However, the nitrocellulose concentrations results were qualified as estimated (J), or (B) the concentration of nitrocellulose in the method blank was detected above the reporting limit, or both (B) (J).

### *Sediments*

Propellants (nitrocellulose and nitroguanidine), SVOCs (benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3–cd)pyrene) and metals (aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium and vanadium) were detected in sediment samples at concentrations exceeding the RVAAP-specific sediment background values established by USACE (2000), Region 9 residential soil PRGs, or both.

## Fate and Transport

The primary contaminant migration pathways for the contaminants identified during the RI conducted at LL–9 are:

- Leaching from soils to groundwater,
- Leaching from sediments to surface water,

- Leaching from sewer lines to groundwater, and
- Transport in surface drainage channels.

## Baseline Human Health Risk Assessment

A BHHRA was performed to assess the potential current and future risks associated with human exposure to site-related contaminants found in LL–9. Risks were evaluated for a National Guard trainee (the primary receptor of concern), a National Guard resident/trainer, a hunter/trapper, security guard/maintenance worker, and a resident farmer (adult and child). The risk assessment demonstrated that some potential risks exist for the following receptors:

- National Guard resident trainer – HI>1; the total cancer risk estimate is within United States Environmental Protection Agency (USEPA) target incremental cancer risk range of 1E-04 to 1E-06, and exceeds Ohio Environmental Protection Agency's (Ohio EPA) target risk value of 1E-05.
- National guard trainee – Total HI>1; the total cancer risk estimate is within USEPA target incremental cancer risk range of 1E-04 to 1E-06, and exceeds Ohio EPA's target risk value of 1E-05.
- Adult resident farmer – HI>1; the total cancer risk estimate exceeds the USEPA target incremental cancer risk range of 1E-04 to 1E-06, and exceeds Ohio EPA's target risk value of 1E-05.
- Child resident farmer – HI>1; the total cancer risk estimate exceeds the USEPA target incremental cancer risk range of 1E-04 to 1E-06, and exceeds Ohio EPA's target risk value of 1E-05.
- Lifelong resident farmer – The total cancer risk estimate is within USEPA target incremental cancer risk range of 1E-04 to 1E-06, and exceeds Ohio EPA's target risk value of 1E-05.

Several significant uncertainties associated with the risk assessment were identified and must be considered carefully when making any risk management decisions. A significant uncertainty is the fact that the nature and extent of the contamination in soil, sediment, surface water, and groundwater at LL-9 have not been completely defined. Therefore, the results of the human health risk assessment are preliminary and subject to change based on the data collected in the Phase II RI.

## Screening Ecological Risk Assessment

A SERA was performed to assess whether adverse ecological impacts are present as a result of site-related contaminants found in LL–9. Ecological impact was evaluated for plants, soil and sediment invertebrates, aquatic organisms, and terrestrial wildlife. Three types of mammals and birds were evaluated:  insectivores, herbivores, and carnivores.  The ecological risk calculations showed that the only significant potential risks for terrestrial plants and soil invertebrates are from metals (copper, lead, mercury, and zinc) in the area surrounding sample location LL9SS-011-0001-SO.  However, the nature and extent of the contamination in soil, sediment, surface water, and groundwater at LL–9 have not been determined.  Therefore, the results of the ecological risk assessment are preliminary and subject to change based on the data collected in the Phase II RI.

## Conclusions

Contaminants in surface soil, subsurface soil and sediments were detected at concentrations greater than the RVAAP installation background concentrations, Region 9 residential soil PRGs, or both. The lateral and vertical extent of contamination including explosives, propellants, metals, and SVOCs in surface soils, subsurface soil, and sediments were not fully delineated during the Phase I RI.  In addition, the presence of metals in groundwater and surface water at concentrations greater than RVAAP-specific background criteria (USACE, 2001b) indicate that contamination present in soils and sediment may be leaching into surface water and groundwater.

The Phase I risk assessment demonstrated that potential risks exist for National Guard resident/trainer and a resident farmer (adult and child).  The total cancer risk estimate summarized for each media (2E-05) for the primary receptor of concern, the National Guard trainee, is within the USEPA target cancer risk range (1E-04 to 1E-06) but exceeds the Ohio EPA target risk criterion of 1E-05.  The total non-cancer risk (HI) estimate summarized for each media for the primary receptor of concern equals 2.  Manganese (inhalation of air particulates being the route of exposure) was the significant contributor to the non-carcinogenic risk. However, significant uncertainties were identified, including the risk estimates for arsenic, manganese, and chromium in soils, and for the inhalation pathway and should be considered by the risk management team for RVAAP when making further remedial decisions for LL–9.

Copper, lead, mercury, and zinc were retained as chemicals of potential concern (COPCs) for terrestrial plants and soil invertebrates in the area surrounding sample location LL9SS–011–0001–SO.  No COPCs were retained for direct toxicity to benthic invertebrates, aquatic organism, and terrestrial wildlife.

## Recommendations

Concentrations of target analytes (primarily metals, SVOCs, and propellants) were detected in surface soil, subsurface soil, and sediment samples at concentrations exceeding RVAAP installation background (USACE, 2001b) concentrations, Region 9 residential soil PRGs, or both.  Most of the contaminants (except for metals) were detected in very few samples and there are insufficient occurrences to provide statistically valid analysis for contaminant distribution. Therefore, the nature and extent of the contamination in soil, sediment, surface water and groundwater at LL–9 have not been fully determined and additional sampling is necessary to fully identify the lateral and vertical extent of the contamination at LL–9. A Phase II RI should be conducted to fill data gaps identified in this Phase I RI.

The conclusions of the risk assessments are based on available data. If data collected in the Phase II RI alters the conceptual site model presented in this Phase I RI, then the risk assessment findings presented in this report will require revision. Although the BHHRA indicated potential risk to a National Guard trainee due to exposure to arsenic, chromium, and manganese, conservative toxicity and exposure values (such as PEF) were used to calculate the potential risk. Thus, the risk estimates presented for those chemicals likely overestimate the potential for non-carcinogenic risk. It is recommended that the risk management team consider the need for any further remedial action based on the risk assessment results presented for this receptor. Copper, lead, mercury, and zinc in surface soil require further evaluation to determine the extent of contamination because these chemicals may pose a risk to plants and invertebrates.

# 1.0 INTRODUCTION

This report documents the results of the Phase I Remedial Investigation (RI) conducted at Load Line 9 (LL–9) by MKM Engineers, Inc. (MKM) under Contract Number DAAA09–98–G–0001/DAAA09–02–C–0070. LL–9 is located at the U. S. Army Base Realignment and Closure Division (BRACD) Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio (Figure 1–1). The RI was conducted under the U.S. Department of Defense (DoD) Installation Restoration Program (IRP) and performed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). The RI was conducted in accordance with work plans reviewed and approved by the Ohio Environmental Protection Agency (Ohio EPA) (MKM, 2003a).

This document summarizes the results of the field activities conducted during March 2002 (azide screening) and the RI conducted from October 2003 to December 2003 at LL–9. The environmental setting, fieldwork, nature, and extent of contamination are discussed. Human health and ecological risk assessments were performed as part of the RI. Results of the data analysis and risk assessments were used to develop a revised conceptual model for LL–9. The conclusions and recommendations of the RI form the framework for decisions regarding future remedial actions at LL–9.

## 1.1 Purpose and Scope

The purposes of this RI Report are to (1) describe the investigations conducted at RVAAP LL–9; (2) evaluate and identify the environmental impact posed by past DoD industrial operations; (3) determine if there is contamination that poses a risk; or exceeds a preliminary remediation goal (PRG); (cleanup criteria established by the United States Environmental Protection Agency [USEPA]). The specific objectives of the RI are to:

- Describe the physical environment of LL–9 and its surroundings to the extent necessary to define potential transport pathways and receptor populations and provide sufficient data for preliminary screening of remedial action alternatives.
- Characterize the nature and extent of contamination at LL–9 such that a baseline risk assessment can be conducted to evaluate the potential risks to human health and the environment.
- Identify the sources of contamination at LL–9 to evaluate selection of remedial actions. Source locations, types and amounts of contaminants, potential releases, physical and chemical properties of wastes present and engineering characteristics have been evaluated.

Investigation-specific objectives were developed using the data quality objective (DQO) approach presented in the *Final Facility-Wide Sampling and Analysis Plan (FWSAP)* for Ravenna Army Ammunition Plant (USACE, 2001a).

Figure 1-1. Ravenna Army Ammunition Plant Location Map

The investigative approach to the RI at LL–9 involved a combination of field and laboratory activities to characterize the area of concern (AOC). Field investigation techniques included shallow soil sampling, subsurface soil sampling, surface water sampling, sediment sampling, monitoring well (MW) installation, groundwater sampling, and aquifer testing. The field program was conducted in accordance with the FWSAP (USACE, 2001a) and the *FWSAP Addendum for the Remedial Investigation at Load Line 9 (RVAAP 42)* (MKM, 2003a).

## 1.2 Background Information

This section briefly describes the RVAAP facility and LL–9, previous investigations, and the regulatory guidance followed when conducting the RI.

### 1.2.1 General Facility Description

Until 1999, the RVAAP was defined as a 21,419 acre installation. The Ohio Army National Guard (OHARNG) surveyed the property boundary and the total acreage was found to be 21,683.289 acres. As of February 2006, a total of 20,403 acres of the former 21,683 acre RVAAP has been transferred to the United States Property and Fiscal Officer (USP&FO) for Ohio for use as an OHARNG training site. Currently, RVAAP consists of 1,280 acres in several distinct parcels scattered throughout the confines of the OHARNG's Ravenna Training and Logistics Site (RTLS). RVAAP's remaining parcels of land are located completely within the RTLS, and are completely enclosed by the RTLS perimeter fence.

The RTLS is located in northeastern Ohio within Portage and Trumbull counties, approximately 4.8 kilometers (km) (3 miles) east/northeast of the City of Ravenna and approximately 1.6 km (1 mile) northwest of the City of Newton Falls. The RVAAP portions of the property are completely located within Portage County. The RTLS (inclusive of RVAAP) is a parcel of property approximately 17.7 km (11 miles) long and 5.6 km (3.5 miles) wide. The facility is bounded by State Route 5, the Michael J. Kirwan Reservoir, and the CSX System Railroad on the south; Garrett, McCormick, and Berry Roads on the west; the Norfolk Southern Corporation railroad on the north; and State Route 534 on the east.

The RTLS is surrounded by several communities: Windham on the north, Garrettsville 9.6 km (6 miles) to the northwest; City of Newton Falls 1.6 km (1 mile) to the southeast; Charlestown to the southwest; and Wayland 4.8 km (3 miles) to the south. RTLS did not exist when the RVAAP was operational, and the entire 21,683–acre parcel was a government-owned, contractor-operated (GOCO) industrial facility. The RVAAP Installation Restoration Program (IRP) encompasses investigation and cleanup of past activities over the entire 21,683 acres of the former RVAAP, so references to the RVAAP in this document consider the historical extent of the RVAAP, inclusive of the combined acreages of the current RTLS and RVAAP, unless otherwise specifically stated.

DoD activities at RVAAP began in 1940 and have included manufacturing, loading, handling, storage, and disposition of military ammunition and explosives. The industrial operations at RVAAP consisted of 12 munitions assembly facilities, referred to as load lines (Figure 1–2). Load Lines 1–4 and 12 were used as melt pour facilities to load high explosives into projectiles and bombs. Load Lines 5, 6, 7, 8, and 10 were used to manufacture fuzes, primers, and boosters. LL–9 was used to produce detonators. Potential contaminants in these load lines may include lead azide, lead styphnate, lead thiocyanate, antimony sulfide, potassium chlorate, mercury fulminate, black powder, 2,4,6–trinitrotoluene (TNT), composition B, octol, nitrocellulose, nitroguanidine, and nitroglycerin.

### 1.2.2 AOC Description and History

LL–9, which is approximately 69 acres in size, is located in the south-central portion of RVAAP at the intersection of Fuze and Booster Road and George Road (Figure 1–3). From 1941 to 1945, LL–9 produced detonators. In 1945, the load line was deactivated, and the equipment was removed. There are no documented activities at LL–9 since closure in 1945.

Infrastructure at LL–9 consists mainly of a gravel road that follows the perimeter of main production area. The buildings at LL–9 were thermally decontaminated and demolished in 2003 (MKM, 2003b). Demolition was completed to 2 ft below ground surface (bgs) and the foundations were subsequently removed by Lakeshore Engineering. The concrete and brick were crushed for reuse at the RVAAP to maintain the roads. An unused water tower is the only structure remaining at LL–9. Table 1–1 lists the building usage and hazard classifications for LL–9 at the RVAAP.

**Table 1–1**

**Building Usage and Hazard Classifications for LL–9 at the RVAAP**

| BLDG. # | Function | Explosive | Reference | Hazard Class |
|---|---|---|---|---|
| **DT–1** | Napkin Prep Fulminate | Mercury Fulminate | Property Cards and Maps | EB |
| **DT–2** | Mix House Fulminate | Mercury Fulminate | Property Cards and Maps | EB |
| **DT–3** | Dry House Fulminate | Mercury Fulminate | Property Cards and Maps | EB |
| **DT–4** | Receptacle House Azide | Lead Azide | Property Cards and Maps | EB |
| **DT–5** | Mix House Azide | Lead Azide | Property Cards and Maps | EB |
| **DT–6** | Dry House Azide | Lead Azide | Property Cards and Maps | EB |
| **DT–7** | Screen House Azide | Lead Azide | Property Cards and Maps | EB |
| **DT–8** | Dry House Azide | Lead Azide | Property Cards and Maps | EB |
| **DT–9** | Dry House Azide | Lead Azide | Property Cards and Maps | EB |

## Table 1–1 (Continued)

## Building Usage and Hazard Classifications for LL–9 at the RVAAP

| BLDG. # | Function | Explosive | Reference | Hazard Class |
|---|---|---|---|---|
| **DT–10** | Vacuum Pump House | Lead Azide/Mercury Fulminate | Property Cards and Maps | EB |
| **DT–11** | Napkin Prep Azide | Lead Azide | Property Cards and Maps | EB |
| **DT–12** | Saw Dust Storage | Lead Azide/Mercury Fulminate | Property Cards and Maps | EB |
| **DT–13** | Final Insp, Pack, & Ship | Lead Azide/Mercury Fulminate | Property Cards and Maps | EB |
| **DT–14** | Detonator Rumbling | Lead Azide/Mercury Fulminate | Property Cards and Maps | EB |
| **DT–15** | Detonator Rest House | Lead Azide/Mercury Fulminate | Property Cards and Maps | EB |
| **DT–16** | M22 Booster Det Assembly | Lead Azide/Mercury Fulminate | Property Cards and Maps | EB |
| **DT–17** | M22 Charge House | Lead Azide/Mercury Fulminate | Property Cards and Maps | EB |
| **DT–18** | Detonator Test Bldg | Lead Azide/Mercury Fulminate | Property Cards and Maps | EB |
| **DT–18A** | Detonator Test Bldg | Lead Azide/Mercury Fulminate | Property Cards and Maps | EB |
| **DT–19** | Prep Pimer Mix Azide Mag | Lead Azide | Property Cards and Maps | EB |
| **DT–20** | Loading Bldg | Lead Azide/Mercury Fulminate | Property Cards and Maps | EB |
| **DT–21** | Loading Bldg | Lead Azide/Mercury Fulminate | Property Cards and Maps | EB |
| **DT–22** | Loading Bldg | Lead Azide/Mercury Fulminate | Property Cards and Maps | EB |
| **DT–23** | Tetryl Pellet Mag | Tetryl | Property Cards and Maps | EB |
| **DT–24** | Tetryl Pellet Bldg | Tetryl | Property Cards and Maps | EB |
| **DT–25** | Service Mag Fulminate | Mercury Fulminate | Property Cards and Maps | EB |
| **DT–26** | Tetryl Screening & Blending | Tetryl | Property Cards and Maps | EB |
| **DT–27** | Tetryl Service Mag | Tetryl | Property Cards and Maps | EB |
| **DT–28** | Change House | Lead Azide/Mercury Fulminate | Property Cards and Maps | EB |
| **DT–29** | Change House | Lead Azide/Mercury Fulminate | Property Cards and Maps | EB |
| **DT–30*** | Inert Storage | n/a | Property Cards and Maps | NEB |
| **DT–31*** | Shipping Bldg | n/a | Property Cards and Maps | NEB |
| **DT–33** | Solvent Storage | Lead Azide/Mercury Fulminate | Property Cards and Maps | EB |
| **DT–34** | Detonator Destroying House | Lead Azide/Mercury Fulminate | Property Cards and Maps | EB |

### Table 1–1 (Continued)

### Building Usage and Hazard Classifications for LL–9 at the RVAAP

| BLDG. # | Function | Explosive | Reference | Hazard Class |
|---|---|---|---|---|
| **DT–35** | Control House | Lead Azide/Mercury Fulminate | Property Cards and Maps | EB |
| **DT–52** | Dining Facility | Lead Azide/Mercury Fulminate | Property Cards and Maps | EB |
| **DT–54** | Dry House | Lead Azide/Mercury Fulminate | Property Cards and Maps | EB |
| **DT–55** | Dry House | Lead Azide/Mercury Fulminate | Property Cards and Maps | EB |
| **DT–56** | Dry House | Lead Azide/Mercury Fulminate | Property Cards and Maps | EB |
| **9–51** | Gate House | Lead Azide/Mercury Fulminate | Property Cards and Maps | EB |

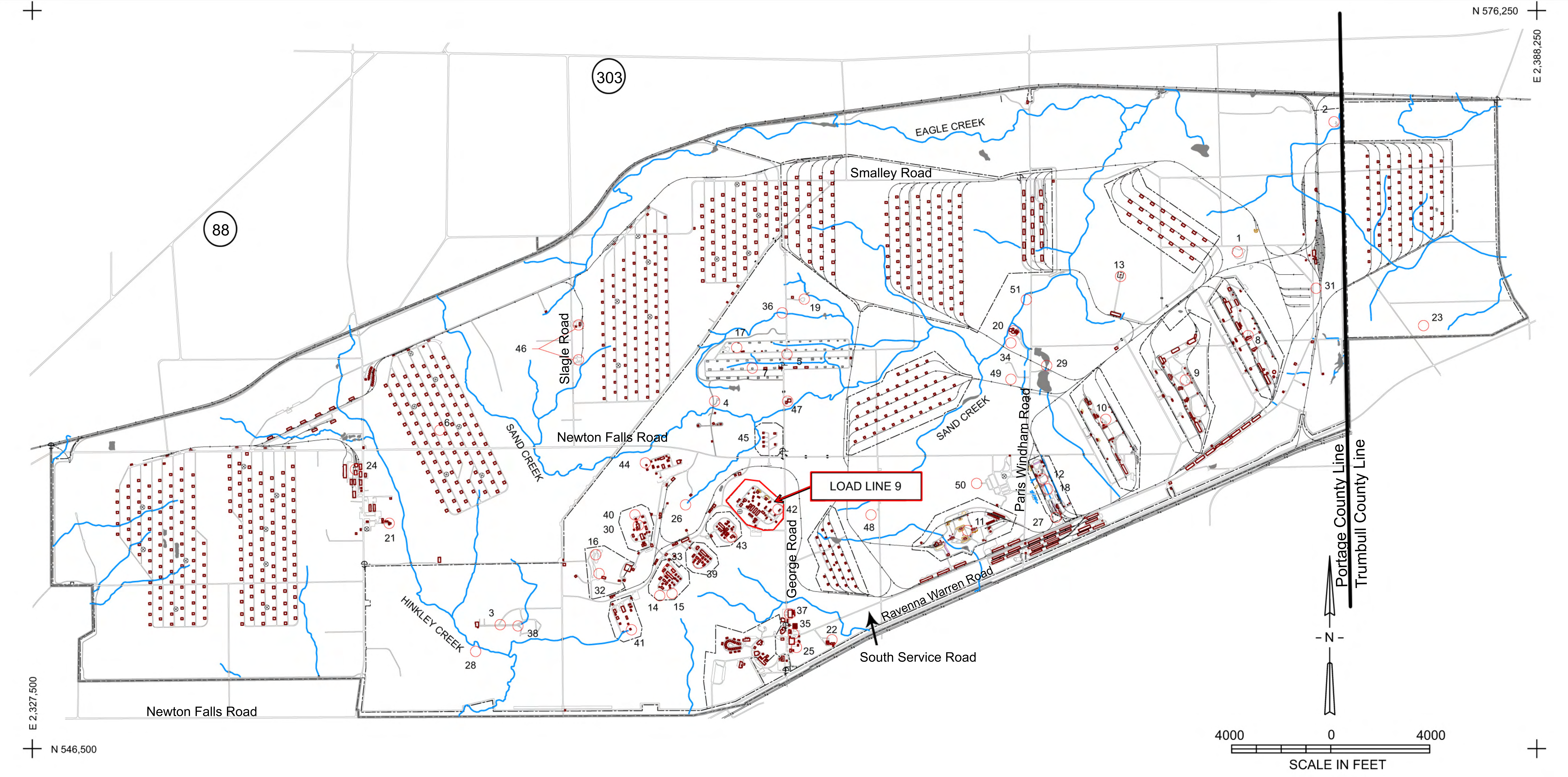
**Notes:**
EB – Explosive building (Shaded)
NEB – Non-explosive building (Un-shaded)
* Un-shaded building numbers indicate a NEB.

### 1.2.3 Previous Investigations

LL–9 has undergone several investigations since its closure as a production facility. The U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) conducted a Relative Risk Site Evaluation (RRSE) for newly added sites at the RVAAP in 1998. The samples were analyzed for explosives and metals. Based on sampling results, the 1998 USACHPPM report identified surface/subsurface soils and groundwater as potential media for contaminant migration. Hunters and recyclers (contractors removing recyclable materials) were identified as potential receptors. The Relative Risk Site Evaluation for the AOC was scored Medium.

In March 2002, the Operational Support Command-RVAAP, in conjunction with USACE, conducted an azide screening operation at LL–9 for the purposes of evaluating the health and safety of future operations as well as to provide additional information for the selection of analytes for the RI. Samples were collected from strategic locations within the load line to screen for primary (azide) and secondary (TNT and hexahydro–1,3,5–trinitro–1,3,5–triazine [RDX]) explosives. Results from the March 2002 sample screening indicate that there is no detectable safety concern related to azide contamination at LL–9. The March 2002 screening results also indicated that there is minimal contamination of secondary explosives at LL–9.

Six shallow soil, three surface water, and three sediment samples were collected during the March 2002 azide screening operation and submitted for laboratory analysis of the TAL metals list. Metals were reported in concentrations that exceeded the RVAAP installation background criteria (USACE, 2001b) values, Region 9 PRGs for residential soil, or both. Since these data were confirmed by laboratory analyses, the results are included in the RI and subsequent risk assessment and are discussed in various portions of this document.



## LEGEND OF SITES:

| | |
|---|---|
| 1 | RAMSDELL QUARRY LANDFILL |
| 2 | ERIE BURNING GROUNDS |
| 3 | DEMOLITIONS AREA #1 |
| 4 | DEMOLITIONS AREA #2 |
| 5 | WINKLEPECK BURNING GROUNDS |
| 6 | C BLOCK QUARRY |
| 7 | BLDG 1601 HAZARDOUS WASTE STORAGE |
| 8 | LOAD LINE 1 AND DILUTION/SETTLING POND |
| 9 | LOAD LINE 2 AND DILUTION/SETTLING POND |
| 10 | LOAD LINE 3 AND DILUTION/SETTLING POND |
| 11 | LOAD LINE 4 AND DILUTION/SETTLING POND |
| 12 | LOAD LINE 12 AND DILUTION/SETTLING POND |
| 13 | BLDG 1200 AND DILUTION/SETTLING POND |
| 14 | LOAD LINE 6, EVAPORATION UNIT |
| 15 | LOAD LINE 6, TREATMENT PLANT |
| 16 | QUARRY LANDFILL/FORMER FUZE & BOOSTER BURNING PITS |
| 17 | DEACTIVATION FURNACE |
| 18 | LOAD LINE 12 PINK WASTE WATER TREATMENT |
| 19 | LANDFILL NORTH OF WINKLEPECK BURNING GROUND |
| 20 | SAND CREEK SEWAGE TREATMENT PLANT |
| 21 | DEPOT SEWAGE TREATMENT PLANT |
| 22 | GEORGE ROAD SEWAGE TREATMENT PLANT |
| 23 | UNIT TRAINING SITE WASTE OIL TANK |
| 24 | RESERVE UNIT MAINTENANCE AREA WASTE OIL TANK |
| 25 | BLDG 1034 MOTOR POOL WASTE OIL TANK |
| 26 | FUZE BOOSTER AREA SETTLING TANKS |
| 27 | BLDG 854-PCB STORAGE |
| 28 | MUSTARD AGENT BURIAL SITE |
| 29 | UPPER AND LOWER COBBS POND COMPLEX |
| 30 | TREATMENT PLANT LOAD LINE 7 PINK WASTEWATER |
| 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 BUILDING S-44S2 |
| 38 | NACA TEST AREA |
| 39 | LOAD LINE 5/FUZE LINE 1 |
| 40 | LOAD LINE 7/BOOSTER LINE 1 |
| 41 | LOAD LINE 8/BOOSTER LINE 1 |
| 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 TEXT AREA |
| 49 | CENTRAL BURN PITS |
| 50 | ATLAS SCRAP YARD |
| 51 | DUMP ALONG PARIS - WINDHAM ROAD |

| | |
|---|---|
| ┼┼┼┼┼┼┼┼ | RAILROAD TRACKS |
| ── | FENCELINE |
| ── | PROPERTY BOUNDARY |
| 〰 | STREAM OR CREEK |
| ○ 20 | AREAS OF CONCERN |
| □ | **IGLOO** |
| ▭ | **BUILDING** |

**FIGURE 1-2** Revised
**FACILITY LOCATION MAP**
**LOAD LINE 9 - REMEDIAL INVESTIGATION**
**Ravenna Army Ammuntion Plant**
**Ravenna, OH**

Drawn By: ST
Date Drawn: 10/17/07

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MKM

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Stafford, TX 77477

RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO

FIGURE 1-3

LOAD LINE 9 SITE MAP

LL 9 REMEDIAL INVESTIGATION

| SIZE | PROJECT NO. | DATE: | REV |
|---|---|---|---|
| B | 02-02-0085 | AUG 2007 | 3 |

| DRAWN BY | KP | APPR. BY | MT |
|---|---|---|---|

### 1.2.4 Regulatory Authorities

The approach to addressing environmental conditions at RVAAP is regulatory-based following the frameworks established by the following regulatory drivers: CERCLA, Resource Conservation and Recovery Act (RCRA), Toxic Substances Control Act (TSCA), and applicable Ohio environmental regulations including the State of Ohio EPA Director's Final Findings and Orders (DFFO).

## 1.3 Report Organization

This RI Report is organized to meet Ohio EPA requirements in accordance with guidance from the USEPA, CERCLA Superfund process, and USACE.  The remainder of the report covers the following:

- Section 2.0 – Physical setting of the study area;
- Section 3.0 – Data collection methods, data management, and laboratory programs;
- Section 4.0 – Summarizes LL–9 RI data and the nature and extent of contamination;
- Section 5.0 – Fate and transport of the contaminants of concern;
- Section 6.0 – Baseline human health risk assessment;
- Section 7.0 – Screening ecological risk assessment;
- Section 8.0 – Summary of results and conclusions;
- Section 9.0 – Recommendations; and
- Section 10.0 – References.

The appendices contain RI data and information including boring logs, well construction diagrams, analytical data tables, data quality assessments, a quality assurance summary, risk assessment data tables, and other detailed information used to interpret existing LL–9 conditions.

# 2.0 RVAAP ENVIRONMENTAL SETTING

This section describes the physical characteristics of the RVAAP facility, including LL–9 (RVAAP–42) and its adjacent environment. These characteristics are factors in interpreting the potential contaminant transport pathways, receptor populations, and exposure scenarios with respect to the evaluation of human health and ecological risks.

## 2.1 Surface Features

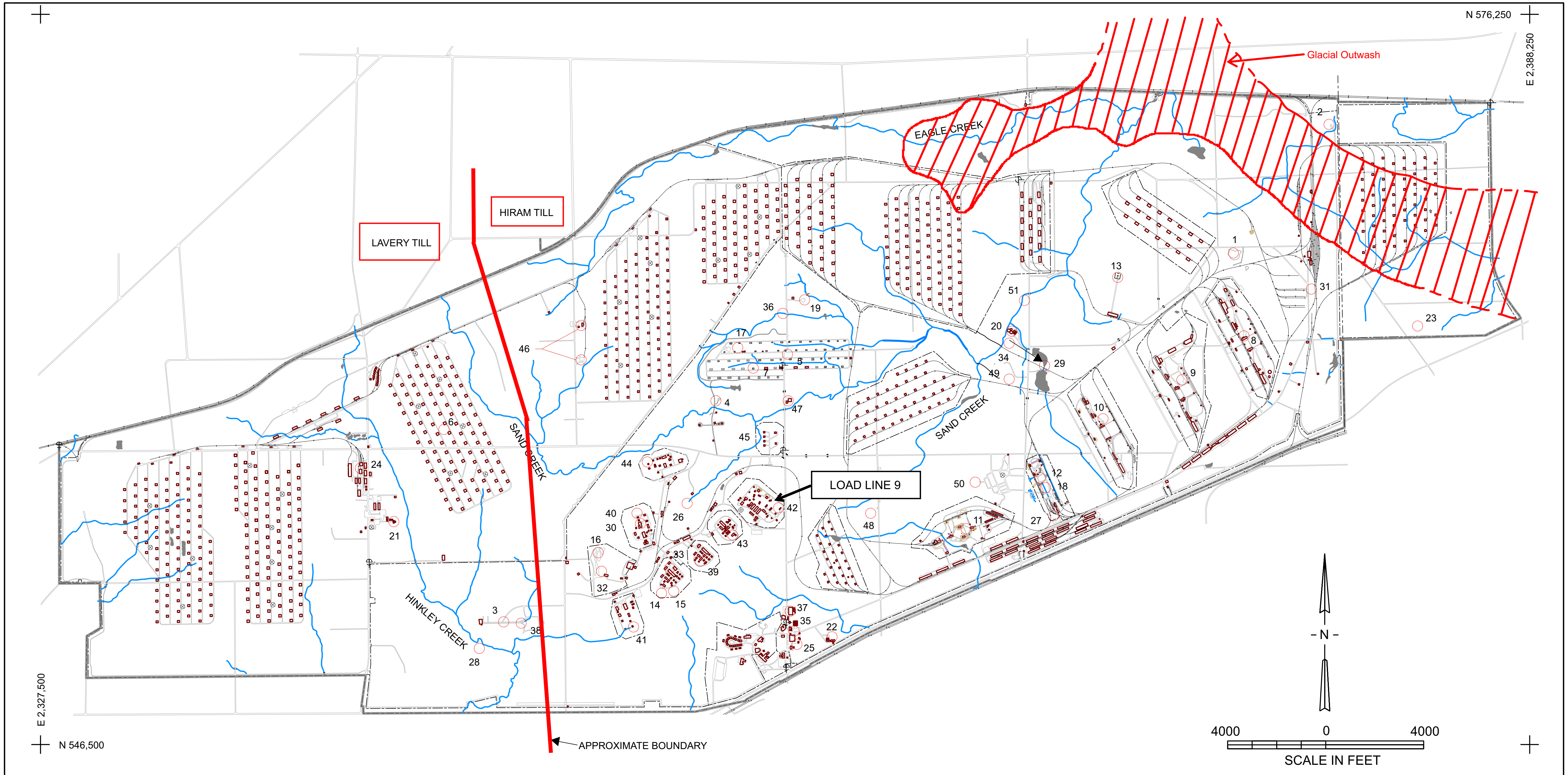
The topography at RVAAP is characterized by gently undulating contours that decrease in elevation from a topographic high in the far western portion of the facility of approximately 1,220 ft above mean sea level (amsl) to lows in far eastern portion of the facility of approximately 930 ft amsl (Figure 2–1). The topography of LL–9 consists of gently sloping (to the north) land where the LL–9 buildings were located. There is a sharp drop in elevation north and east of the LL–9 perimeter road. Elevations range from 1,135 ft in the production area (southwest) to 1,090 ft to the north along the perimeter road.

USACE mapped the installation topography in February 1998 using a 0.61–meter (m) (2 ft) contour interval with an accuracy of 0.204 m (0.67 ft). USACE based the topographic information on aerial photographs taken during spring 1997. The USACE survey is the basis for the topographical information illustrated in figures included in this RI report.

## 2.2 Meteorology and Climate

The general climate of the RVAAP area is continental, characterized by moderately warm and humid summers, reasonably cold and cloudy winters, and wide variations in precipitation from year to year. The following climatological data were obtained from the National Weather Service Office (NWS, 1995) at the Youngstown-Warren Regional Airport in Trumbull County and are based on a 30-year average.

Total annual rainfall in the RVAAP area is approximately 37.3 inches (in), with the highest monthly average occurring in July (4.07 in) and the lowest monthly average occurring in February (2.03 in). Average annual snowfall totals approximately 56.2 in with the highest monthly average occurring in January (12.9 in). It should be noted that snowfall totals vary widely throughout northeastern Ohio, given the influence of lake-effect snowfall events associated with Lake Erie (located approximately 35 miles to the northwest of RVAAP). The average annual daily temperature in the RVAAP area is 48.3 degrees Fahrenheit (ºF), with an average daily high temperature of 57.7 ºF and an average daily low temperature of 38.7 ºF.



## LEGEND OF SITES:

| | |
|---|---|
| 1 | RAMSDELL QUARRY LANDFILL |
| 2 | ERIE BURNING GROUNDS |
| 3 | DEMOLITIONS AREA #1 |
| 4 | DEMOLITIONS AREA #2 |
| 5 | WINKLEPECK BURNING GROUNDS |
| 6 | C BLOCK QUARRY |
| 7 | BLDG 1601 HAZARDOUS WASTE STORAGE |
| 8 | LOAD LINE 1 AND DILUTION/SETTLING POND |
| 9 | LOAD LINE 2 AND DILUTION/SETTLING POND |
| 10 | LOAD LINE 3 AND DILUTION/SETTLING POND |
| 11 | LOAD LINE 4 AND DILUTION/SETTLING POND |
| 12 | LOAD LINE 12 AND DILUTION/SETTLING POND |
| 13 | BLDG 1200 AND DILUTION/SETTLING POND |
| 14 | LOAD LINE 6, EVAPORATION UNIT |
| 15 | LOAD LINE 6, TREATMENT PLANT |
| 16 | QUARRY LANDFILL/FORMER FUZE & BOOSTER BURNING PITS |
| 17 | DEACTIVATION FURNACE |
| 18 | LOAD LINE 12 PINK WASTE WATER TREATMENT |
| 19 | LANDFILL NORTH OF WINKLEPECK BURNING GROUND |
| 20 | SAND CREEK SEWAGE TREATMENT PLANT |
| 21 | DEPOT SEWAGE TREATMENT PLANT |
| 22 | GEORGE ROAD SEWAGE TREATMENT PLANT |
| 23 | UNIT TRAINING SITE WASTE OIL TANK |
| 24 | RESERVE UNIT MAINTENANCE AREA WASTE OIL TANK |
| 25 | BLDG 1034 MOTOR POOL WASTE OIL TANK |
| 26 | FUZE BOOSTER AREA SETTLING TANKS |
| 27 | BLDG 854-PCB STORAGE |
| 28 | MUSTARD AGENT BURIAL SITE |
| 29 | UPPER AND LOWER COBBS POND COMPLEX |
| 30 | TREATMENT PLANT LOAD LINE 7 PINK WASTEWATER |
| 31 | ORE PILE RETENTION POND |
| 32 | 40 AND 60 MM FIRING RANGE |
| 33 | LOAD LINE 6/FIRESTONE TEST FACILITY |
| 34 | SAND CREEK DISPOSAL ROAD LANDFILL |
| 35 | 1037 BUILDING-LAUNDRY WASTEWATER SUMP |
| 36 | PISTOL RANGE |
| 37 | PESTICIDE BUILDING S-44S2 |
| 38 | NACA TEST AREA |
| 39 | LOAD LINE 5/FUZE LINE 1 |
| 40 | LOAD LINE 7/BOOSTER LINE 1 |
| 41 | LOAD LINE 8/BOOSTER LINE 1 |
| 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 TEXT AREA |
| 49 | CENTRAL BURN PITS |
| 50 | ATLAS SCRAP YARD |
| 51 | DUMP ALONG PARIS - WINDHAM ROAD |
| ++++++++ | RAILROAD TRACKS |
| ― | FENCELINE |
| ― | PROPERTY BOUNDARY |
| | STREAM OR CREEK |
| ○ 20 | AREAS OF CONCERN |
| ▫ | **IGLOO** |
| ▭ | **BUILDING** |

Glacial data from - White, George, Glacial Geology of Northeast Ohio. Bulletin 68, 1982

Figure 2-1
Load Line 9 Remedial Investigation Glacial Till Map
Ravenna Army Ammunition Plant, Ravenna, Ohio

Drawn By: ST
Date Drawn: 06/17/2005

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The record high temperature of 100 ºF occurred in July 1988, and the record low temperature of -22 ºF occurred in January 1994. The prevailing wind direction at RVAAP is from the southwest, with the highest average wind speed occurring in January (11.6 miles per hour [mph]) and the lowest average wind speed occurring in August (7.4 mph). Thunderstorms occur on approximately 35 days per year and are most abundant from April through August. The RVAAP area is susceptible to tornadoes; minor structural damage to several buildings on the facility occurred as the result of a tornado in 1985.

## 2.3 Surface Water Hydrology

The entire RVAAP facility is situated within the Mahoning River Basin, with the West Branch of the Mahoning River representing the major surface stream in the area. The West Branch generally flows in a north-to-south direction adjacent to the west end of the facility. It eventually flows into the Michael J. Kirwan Reservoir, which is located to the south of State Route 5. The West Branch flows out of the reservoir along the southern facility boundary before joining the Mahoning River east of RVAAP.

The western and northern portions of the RVAAP facility have low hills and a dendritic surface drainage pattern. The eastern and southern portions are characterized by an undulating to moderately level surface, with less dissection of the surface drainage. The facility is marked with marshy areas and flowing and intermittent streams whose headwaters are located in the facility's hills. Three primary water courses drain RVAAP: (1) the South Fork of Eagle Creek, (2) Sand Creek, and (3) Hinckley Creek. Each of these water courses has many associated tributaries. Sand Creek, with a drainage area of 13.9 square mile (sq mi), flows generally in a northeast direction to its confluence with the South Fork of Eagle Creek. In turn, the South Fork of Eagle Creek then continues in a northerly direction for 2.7 miles to its confluence with Eagle Creek. The drainage area of the South Fork of Eagle Creek is 26.2 sq mi, including the area drained by Sand Creek. Hinckley Creek originates just southeast of the intersection between State Routes 88 and 303 to the north of the facility. Hinckley Creek, with a drainage area of 11.0 sq mi, flows in a southerly direction through the facility to its confluence with the West Branch of the Mahoning River south of the facility.

Approximately 50 ponds are scattered throughout the facility. Many were built within natural drainage ways to function as settling ponds or basins for process effluent and runoff. Others are natural in origin, resulting from glacial action or beaver (*Castor canadensis*) activity. Most water bodies at RVAAP support an abundance of aquatic vegetation and contain large fish populations. The ponds within the installation are not used as a water supply source. Stormwater runoff is controlled primarily by natural drainage, except in facility operations areas where an extensive storm sewer network helps to direct runoff to drainage ditches and settling ponds. In addition, the storm sewer system was one of the primary drainage mechanisms for process effluent during the period that production facilities (i.e., LL–9) were in operation.

Surface water follows the LL–9 surface contour gradient and drainage ditch system. The general gradient of the site is to the northeast. Surface runoff flows to and follows constructed drainage ditches, which feed into a natural drainage channel located in the north-central portion of the site. This natural drainage channel flows to an unnamed tributary of the Michael J. Kirwan Reservoir.

## 2.4 Geology

Lithologic logs from seven soil borings, which were advanced during the RI and completed as monitoring wells, were used to characterize the LL–9 surface and subsurface geology. The soils described during the advancement of the soil borings included medium to fine-grained sand and sandy silt. Grain size analysis from the Shelby tube samples included 19.8% to 40% clay, 38% to 40% silt, and 18% to 30% sand. Bedrock was encountered at a depth ranging from 2.0 to 16.0 ft bgs. The bedrock was cored and included brown, orange, and gray sandstone. Depositional and structural features are detailed in Section 2.4.2. The boring logs, which detail the vertical lithologic sequences, are found in Appendix A.

### 2.4.1 Glacial Deposits

RVAAP is located within the Glaciated Allegheny Plateau physiographic region of Ohio. Pennsylvanian bedrock is overlain by Wisconsinian Age glacial deposits. Two glacial advances during the Wisconsin Age of the Pleistocene Epoch resulted in the deposition of glacial till over the entire RVAAP installation. The Lavery Till is exposed in the western part of the installation, and the younger Hiram Till is exposed in the remaining portion of RVAAP, including LL–6, which is located in the south-central portion of RVAAP (White, 1982). Glacial outwash deposits are found in the north eastern part of RVAAP in the Eagle creek drainage area and the area described as Erie Burning Grounds (White, 1982).

The first glacial advance deposited the Lavery Till over the facility. The Lavery Till consists mostly of clay and silt with a few cobbles and sporadic boulders. In general the Lavery Till consists of 28% sand and 30% clay. The second glacial advance deposited the Hiram Till over the eastern two-thirds of the facility. The Hiram Till has the highest clay content of tills in northeastern Ohio (White, 1982) (Figure 2–1). Soil associated with the Hiram Till at RVAAP includes the Mahoning silt loam complex. The specific soils developed at LL–9 are detailed in Section 2.5. The typical Hiram Till consists of 12% sand, 41% silt, and 47% illite and chlorite clay minerals, and ranges in depth from 1.5 to 4.6 m (5 to 15 ft) bgs. Unweathered Hiram Till is dark gray and turns a dark brown when exposed to the atmosphere. The Hiram Till overlies thin beds of sandy outwash material in the far northeastern corner of the facility. Soil associated with the Hiram Till at RVAAP typically includes the Mahoning silt loam complex. The thickness of the glacial deposits varies across the installation.

Subsurface lithology at LL–9 consists mostly of thin clay to sand-rich silt tills/soils with interbedded sands scattered throughout. The soil profile at LL–9 has developed over sandstone bedrock high and is relatively thin (2.0 to 16.0 ft range with most in the 2.0 to 6.0 ft range). Based upon the subsurface sampling at the RVAAP, much of the till deposited (if any) was incorporated into the soil profile. Deposits with higher concentrations of sand generally control the elevation of the shallow water table zone (unconsolidated) if enough thickness is present over the bedrock. Cross-sections of the subsurface at LL–9 illustrate the lateral distribution and variation of these thin discontinuous glaciated sediments (Figures 2–2 to 2–6).

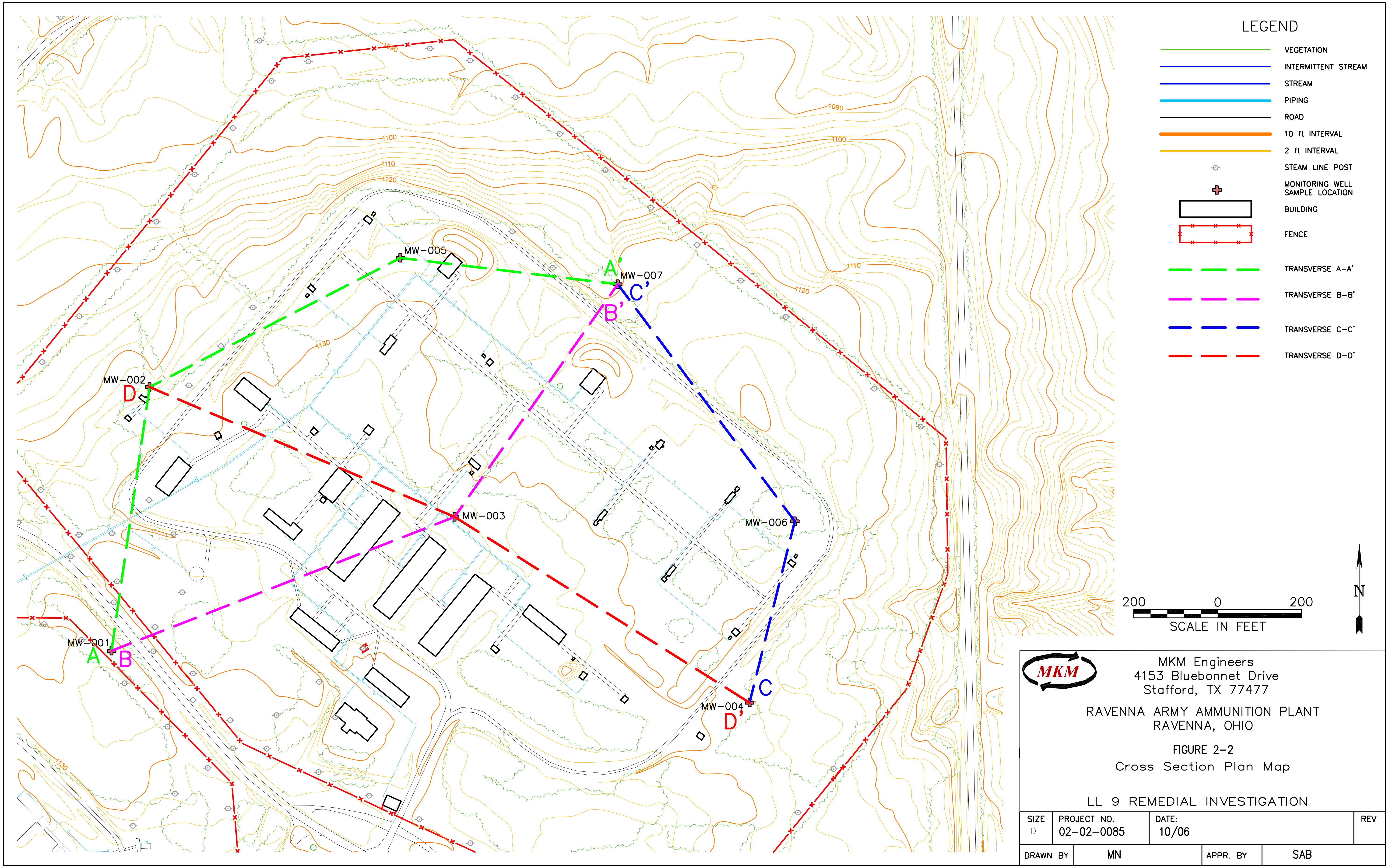
### 2.4.2 Sedimentary Rocks

Bedrock outcrops at several areas across RVAAP. According to general geological documents published by the State of Ohio, both Mississippian and Pennsylvanian Age bedrock is believed to underlay RVAAP (USACE, 2001a). The bedrock geology of Portage County is shown on Figure 2-7.

#### *2.4.2.1 RVAAP Sedimentary Rocks*

The bedrock geology of RVAAP consists of Carboniferous Age sedimentary rocks that lie stratigraphically beneath the glacial deposits of the Lavery and Hiram Tills. The oldest outcropping of bedrock at the surface within the facility is the Cuyahoga Group of the Mississippian Age. Three members comprise this formation: (1) the Orangeville Shale, (2) the Sharpsville Sandstone, and (3) the Meadville Shale. The Cuyahoga Group outcrops in the far northeastern corner of the facility and generally consists of blue-gray silty shale with interbedded sandstone. The regional dip of the Cuyahoga Group strata is between 1.5 and 3.0 m (5 and 11.5 ft) per mile to the south. The remainder of the facility is underlain by bedrock associated with the Pottsville Formation of Pennsylvanian Age. The Pottsville Formation, which lies unconformably on an erosional surface of the Cuyahoga Group, is divided into four members: (1) the Sharon, (2) the Connoquenessing, (3) the Mercer, and (4) the Homewood Sandstone. The Sharon Member consists of two individual units: the Sharon Conglomerate and the Sharon Shale.

The Sharon Conglomerate is porous, coarse-grained, gray-white sandstone that often exhibits thin layers of milky white quartzite pebbles. The Sharon Conglomerate also has locally occurring thin shale lenses in the upper portion of the unit. Owing to the differences in lithology between the Sharon Conglomerate and the underlying shales of the Cuyahoga Group, the contact between the Pottsville Formation and the Cuyahoga Group usually is quite distinct. The Sharon Shale overlies the Sharon Conglomerate and consists of sandy, gray-black, fissile shale with some plant fragments and thin flagstone beds. Sharon sandstones are exposed on the ground surface at Load Line 1 and the former Ramsdell Quarry.



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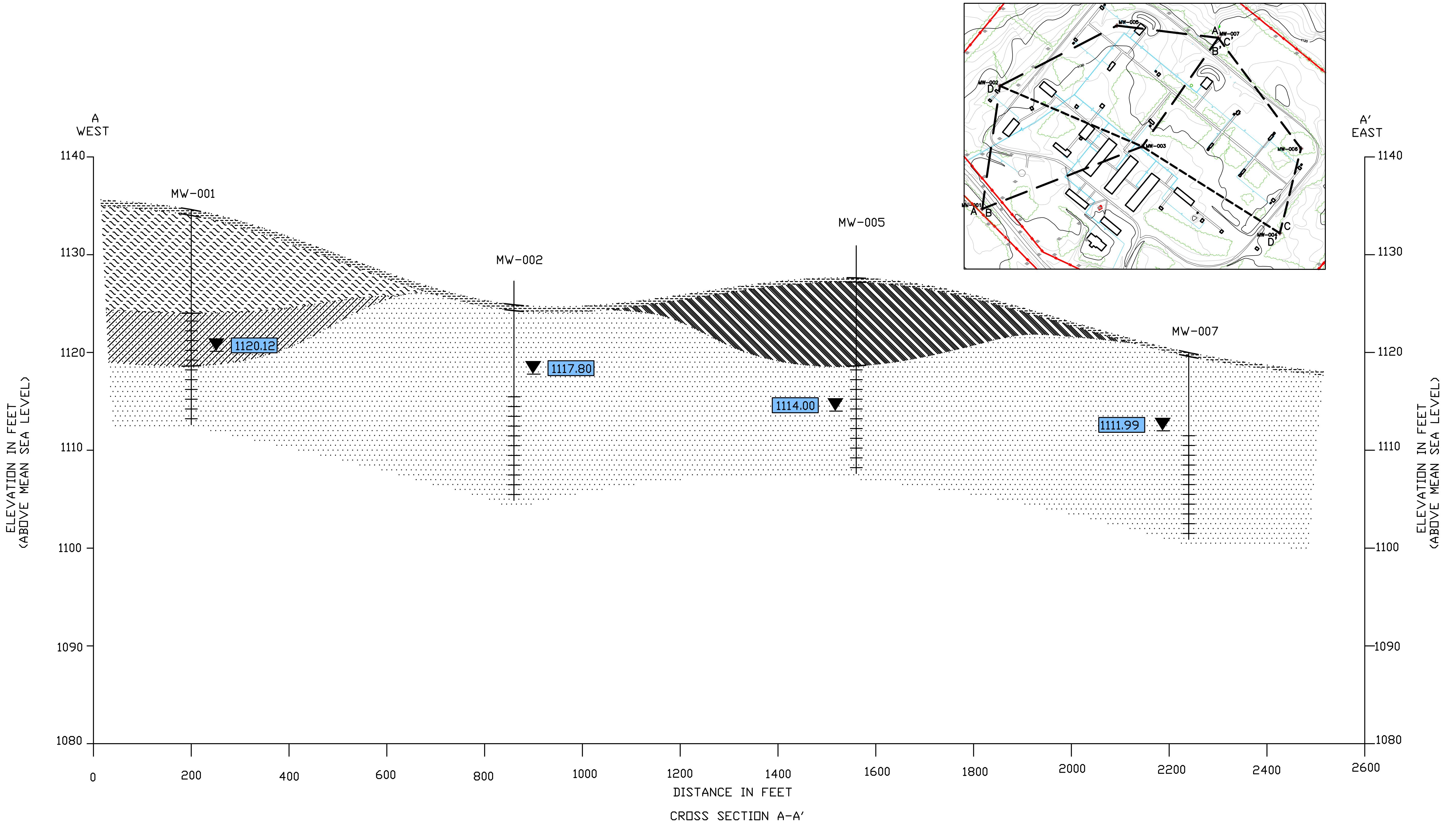
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO

FIGURE 2–2
Cross Section Plan Map

LL 9 REMEDIAL INVESTIGATION

| SIZE | PROJECT NO. | DATE: | REV |
|---|---|---|---|
| D | 02–02–0085 | 10/06 | |

| DRAWN BY | MN | APPR. BY | SAB |
|---|---|---|---|



CROSS SECTION A-A'

HORIZONTAL 1"=200'
VERTICAL 1"=10'

VERTICAL EXAGGERATION = 10X

**LEGEND**

| | |
|---|---|
| ▤ | TOP SOIL |
| ▧ | SANDY SILT |
| ▨ | SILTY SAND |
| ▧ | SILTY CLAY |
| ⠿ | SANDSTONE HOMEWOOD MEMBER |
| 1140.64 | GROUNDWATER ELEVATION (ft) - JUNE 2004 |
| ▼ | DEPTH GROUNDWATER ENCOUNTERED |
| Ɪ | SCREEN INTERVAL |
| — | KNOWN SUBSURFACE SOIL CONDITIONS |
| ...... | EXPECTED SUBSURFACE SOIL CONDITIONS |

REVISIONS

| ZONE | REV | DESCRIPTION | DATE | APPROVED |
|---|---|---|---|---|
| | 1 | | 10/15/06 | SAB |
| | 2 | | 04/31/07 | SL |

MKM

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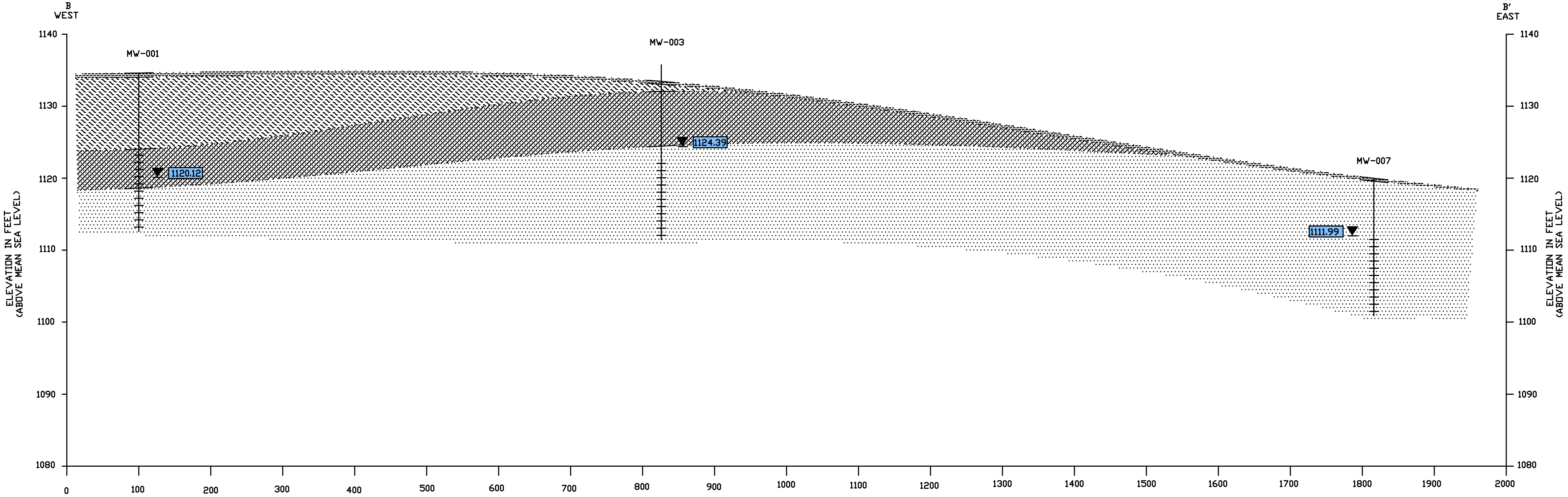
DATE DRAWN 11/18/05

FIGURE 2-3
LOAD LINE 9 REMEDIAL INVESTIGATION
GEOLOGIC CROSS SECTION A-A'
RAVENNA ARMY AMMUNITION PLANT, RAVENNA OHIO

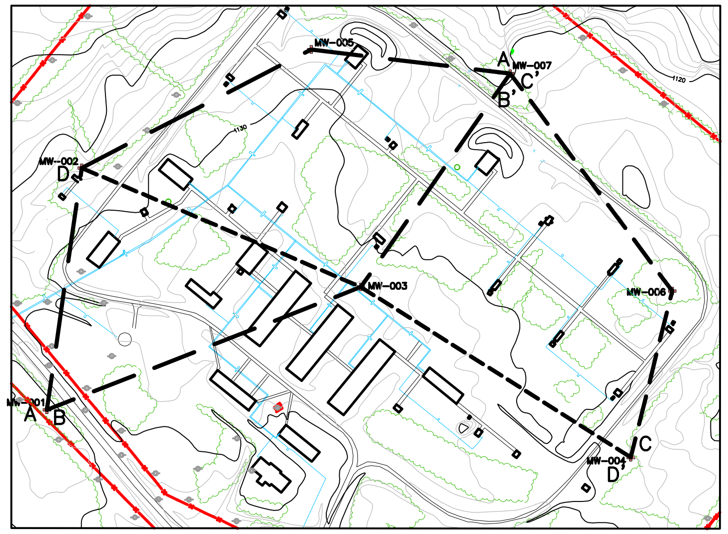
| SIZE | PROJECT NO. | DWG NO. | REV |
|---|---|---|---|
| D | 02-02-0085 | | 2 |

DRAWN BY ST/KP APPR. BY SRL



CROSS SECTION B-B'

HORIZONTAL 1"=150'
VERTICAL 1"=15'



VERTICAL EXAGGERATION = 10X

**LEGEND**

▤ TOP SOIL

▧ SANDY SILT

1140.64 GROUNDWATER ELEVATION (ft) – JUNE 2004

— KNOWN SUBSURFACE SOIL CONDITIONS

▨ SILTY SAND

⌶ SCREEN INTERVAL

▼ DEPTH GROUNDWATER ENCOUNTERED

...... EXPECTED SUBSURFACE SOIL CONDITIONS

⬚ SANDSTONE HOMEWOOD MEMBER

REVISIONS

| ZONE | REV | DESCRIPTION | DATE | APPROVED |
|---|---|---|---|---|
| | 1 | | 10/15/06 | SAB |
| | 2 | | 04/31/07 | SL |

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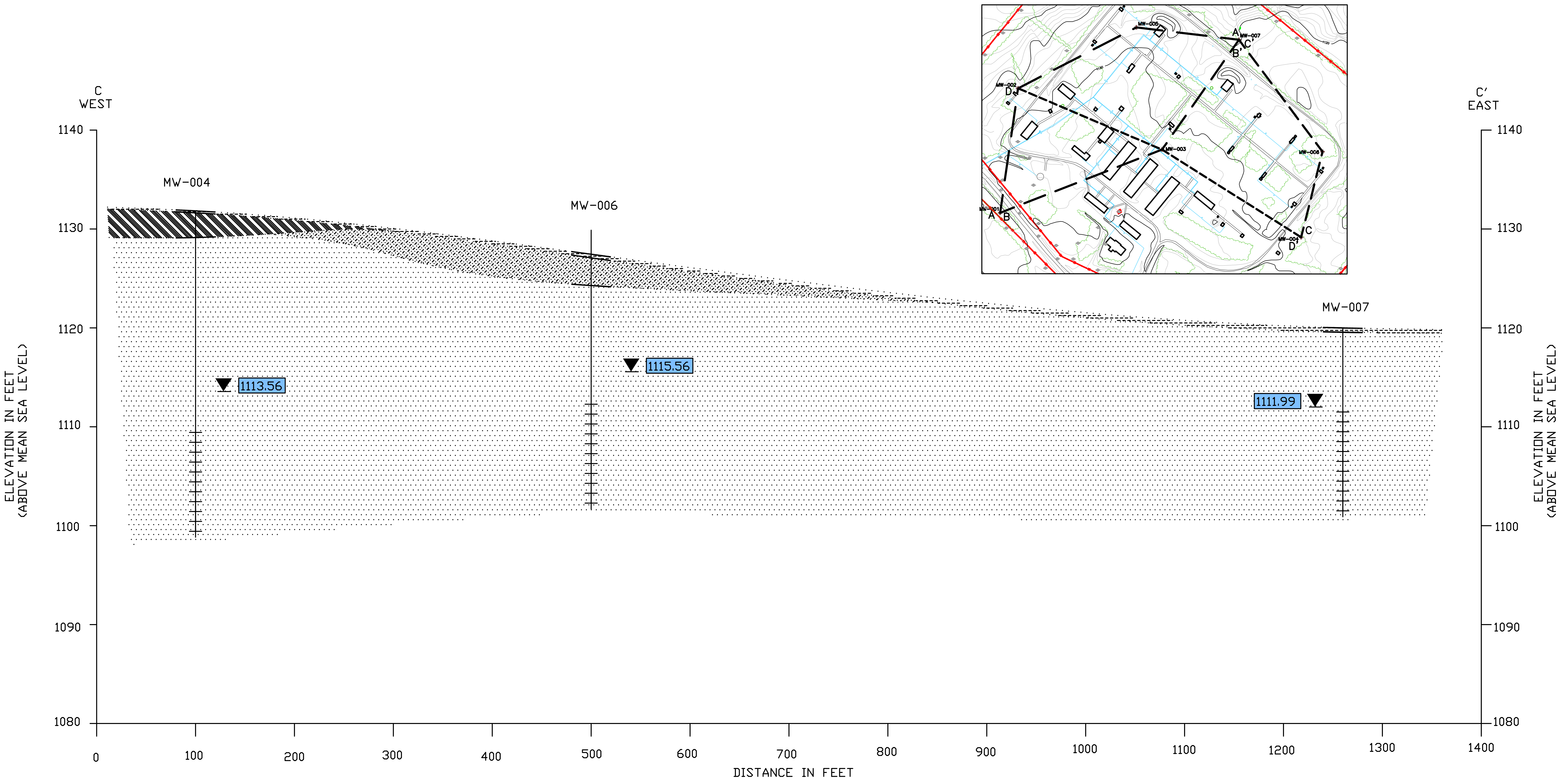
DATE DRAWN 11/18/05

FIGURE 2–4
LOAD LINE 9 REMEDIAL INVESTIGATION
GEOLOGIC CROSS SECTION B–B'
RAVENNA ARMY AMMUNITION PLANT, RAVENNA OHIO

| SIZE | PROJECT NO. | DWG NO. | REV |
|---|---|---|---|
| D | 02–02–0085 | | 2 |

DRAWN BY ST
APPR. BY SRL



CROSS SECTION C-C'

HORIZONTAL 1"=100'
VERTICAL 1"=10'

VERTICAL EXAGGERATION = 10X

**LEGEND**

- ▤ TOP SOIL
- ▧ SILTY CLAY
- ▒ CLAYEY SILT
- ⁞ SANDSTONE HOMEWOOD MEMBER
- ± SCREEN INTERVAL
- 1140.64 GROUNDWATER ELEVATION (ft) – JUNE 2004
- ▼ DEPTH GROUNDWATER ENCOUNTERED
- — KNOWN SUBSURFACE SOIL CONDITIONS
- ...... EXPECTED SUBSURFACE SOIL CONDITIONS

REVISIONS

| ZONE | REV | DESCRIPTION | DATE | APPROVED |
|---|---|---|---|---|
| | 1 | | 10/15/06 | SAB |
| | 2 | | 04/31/07 | SL |

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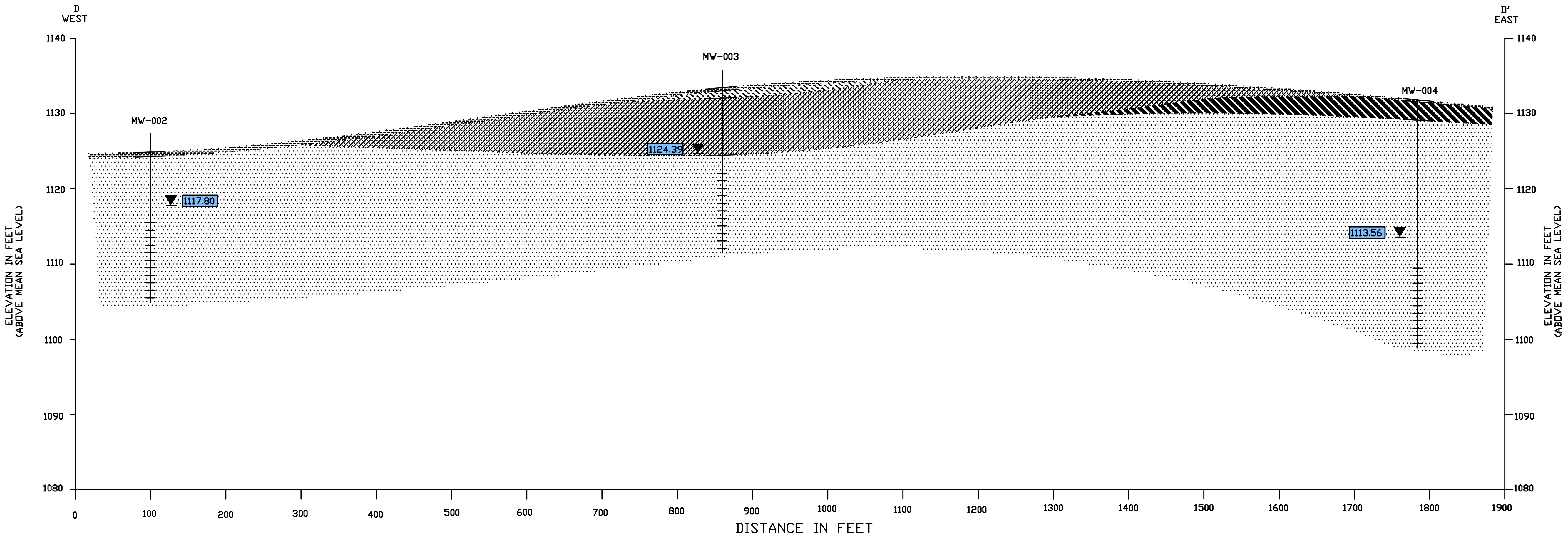
DATE DRAWN 11/17/05

FIGURE 2-5
LOAD LINE 9 REMEDIAL INVESTIGATION
GEOLOGIC CROSS SECTION C-C'
RAVENNA ARMY AMMUNITION PLANT, RAVENNA OHIO

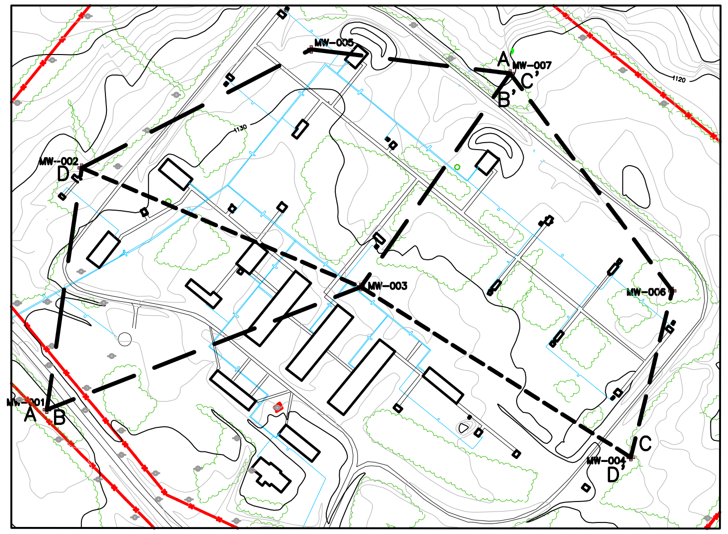
| SIZE | PROJECT NO. | DWG NO. | REV |
|---|---|---|---|
| D | 02-02-0085 | | 2 |

DRAWN BY ST
APPR. BY SRL



CROSS SECTION D-D'

HORIZONTAL 1"=150'
VERTICAL 1"=15'



VERTICAL EXAGGERATION = 10X

**LEGEND**

▤ TOP SOIL
▨ SANDY SILT
▨ SILTY CLAY
▨ SILTY SAND
▨ CLAYEY SILT
░ SANDSTONE HOMEWOOD MEMBER
1140.64 GROUNDWATER ELEVATION (ft) - JUNE 2004
Ŧ SCREEN INTERVAL
— KNOWN SUBSURFACE SOIL CONDITIONS
...... EXPECTED SUBSURFACE SOIL CONDITIONS
▼ DEPTH GROUNDWATER ENCOUNTERED

| REVISIONS | | | | |
|---|---|---|---|---|
| ZONE | REV | DESCRIPTION | DATE | APPROVED |
| | 1<br>2 | | 10/16/06<br>04/31/07 | SAB<br>SL |

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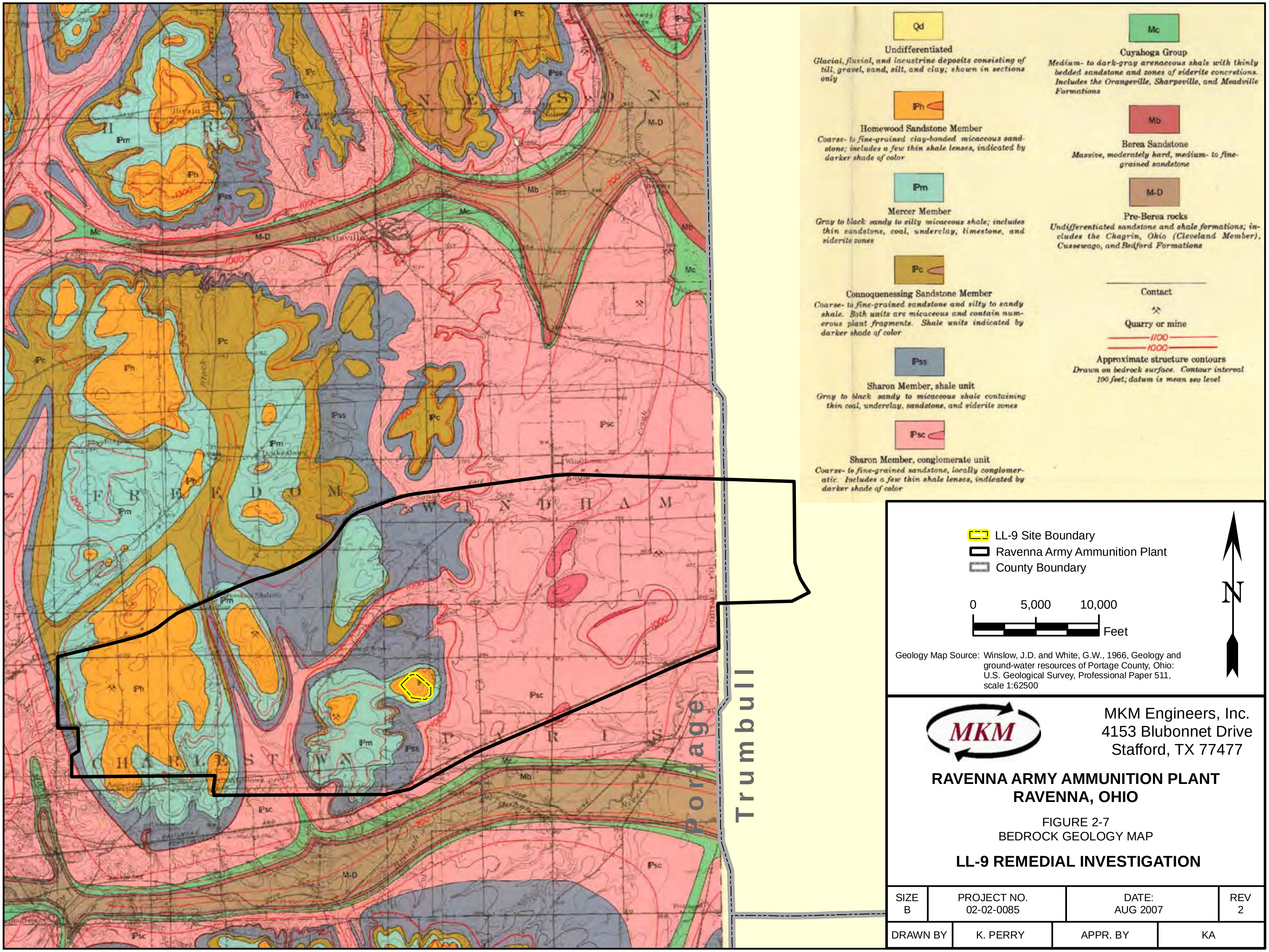
FIGURE 2-6
LOAD LINE 9 REMEDIAL INVESTIGATION
GEOLOGIC CROSS SECTION D-D'
RAVENNA ARMY AMMUNITION PLANT, RAVENNA OHIO

| | | | |
|---|---|---|---|
| SIZE<br>D | PROJECT NO.<br>02-02-0085 | DWG NO. | REV<br>2 |
| DRAWN BY | ST | APPR. BY | SRL |



- 🟨 LL-9 Site Boundary
- ☐ Ravenna Army Ammunition Plant
- ☐ County Boundary

0 5,000 10,000
Feet

Geology Map Source: Winslow, J.D. and White, G.W., 1966, Geology and ground-water resources of Portage County, Ohio: U.S. Geological Survey, Professional Paper 511, scale 1:62500

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**RAVENNA ARMY AMMUNITION PLANT**
**RAVENNA, OHIO**

FIGURE 2-7
BEDROCK GEOLOGY MAP

**LL-9 REMEDIAL INVESTIGATION**

| SIZE | PROJECT NO. | DATE: | REV |
|---|---|---|---|
| B | 02-02-0085 | AUG 2007 | 2 |

| DRAWN BY | K. PERRY | APPR. BY | KA |
|---|---|---|---|

H:\MKM_Ravenna\Ravenna_OH\Task1\MXD\BedrockGeology.mxd H:\MKM_Ravenna\Ravenna_OH\Task1\Export\BedrockGeology.pdf August 17, 2007 DWN: KMP CHKD: AP

The Connoquenessing Sandstone Member of the Pottsville Formation unconformably overlies the Sharon Member and is a medium to coarse-grained, gray-white sandstone with more feldspar and clay than the Sharon Conglomerate. Thin interbeds and partings of sandy shale also are common in the Connoquenessing. The Mercer Member of the Pottsville Formation overlies the Connoquenessing and consists of silty to carbonaceous shale with abundant thin, discontinuous sandstone lenses in the upper portion. Regionally, the Mercer also has been noted to contain interbeds of coal. The Homewood Member of the Pottsville Formation unconformably overlies the Mercer Member and consists of coarse-grained cross-bedded sandstones that contain discontinuous shale lenses. The Connoquenessing, Mercer, and Homewood Members are present only in the western half of the RVAAP facility. The Sharon Conglomerate unit is the upper bedrock surface in most of the eastern half of the facility. The regional dip of the Pottsville Formation strata is between 1.5 and 3.5 m per 1.6 km (5 and 10 ft per mi.) to the south.

#### *2.4.2.2 LL-9 Sedimentary Bedrock*

The Homewood Member of the Pottsville Formation is the upper bedrock surface present beneath the glacial/soils cover at LL 9. At LL–9 weathered bedrock (Homewood Member Sandstone) was encountered in seven locations, at depths from 2 to 16 ft, during the advancement of soil borings for monitoring well construction at LL–9. In addition, weathered bedrock was found in 21 additional locations at depths from 2 to 13 ft during the advancement of soil borings (not for monitoring well construction) at LL–9. The cored bedrock was described as a generally weathered coarse to fine grained well cemented sandstone with some interbedded siltstone. Sandstone colors included brown, orange, and gray. Depositional features included bedding plains, laminations, rip-up clasts, and weathered contacts. Structural features included horizontal and vertical fractures and clay-filled fractures. Structural features included horizontal and vertical fractures and clay-filled fractures.

## 2.5 Soils

According to the *Soil Survey of Portage County, Ohio* (USDASCS, 1978) and *Soil Survey of Trumbull County, Ohio* (USDASCS, 1982), RVAAP soils, which formed in glacial tills, are described as being nearly level to gently sloping and range from poorly drained to moderately well drained. Three soil types are found at LL–9: Dekalb channery loam, 2–6% slopes and 6–12% slopes; Loudonville silt loam, 2–6% slopes; and Mahoning silt loam, 2–6% slopes. Dekalb channery loam soils formed in residuum weathered from the underlying sandstone bedrock. Loudonville silt loam soils formed from a combination of residuum weathered from the underlying sandstone bedrock and glacial till. Mahoning silt loam soils formed in silty clay loam or clay loam glacial till.

Dekalb channery loam (2–6%) is found in the north and east portion of LL–9. Dekalb channery loam (2–6%) is gently sloping, well drained soil with medium runoff and is usually found on the upper part of hillsides. Dekalb channery loam (6–12%) is found adjacent to the Dekalb channery loam (2–6%) further to the north and east of LL–9. Dekalb channery loam (6–12%) is sloping, well drained soil with medium to rapid runoff and is found in elongated areas on the upper part of hillsides. Loudonville silt loam (2–6%) is found in the central and southern portion of LL–9 and consist of gently sloping soil commonly found on the upper part of hillsides adjacent to Dekalb series soils. Mahoning silt loam (2–6%) is found in the northernmost and westernmost portions of LL–9. Mahoning silt loam is gently sloping, poorly drained soil with medium to rapid runoff, severe seasonal wetness, and slow permeability.

## 2.6 Hydrogeology

This section describes the unconsolidated sediments, bedrock, and groundwater utilization found at RVAAP and LL–9.

### 2.6.1 Unconsolidated Sediments

Limited subsurface information indicates that a buried bedrock valley may be present to the west and north of the area known as “Fuze and Booster Hill”. However, the glacial deposits that fill this valley have not been utilized for groundwater production at RVAAP. The water-bearing characteristics for the sand and gravel aquifers in the vicinity of the RVAAP installation are poorly documented. Wells that penetrate these aquifers can yield up to 6,080 liters per minute (LPM) [1,600 gallons per minute (GPM)]. However, yields from wells penetrating silty or clay till materials are significantly lower. In general, the Lavery and Hiram Tills are too thin and impermeable to produce useful quantities of water.

### 2.6.2 Bedrock

The Sharon Conglomerate and Connoquenessing Sandstone bedrock were the primary sources of potable groundwater at RVAAP during its active phase. Many facility production wells were completed in either the Sharon Conglomerate or the Connoquenessing Sandstone. Some wells were completed so that water was produced from both the Sharon Conglomerate and the Connoquenessing Sandstone, as well as the intervening Sharon Shale (to the extent that the Sharon Shale could produce water). The highest yields were determined to come from the quartzite-pebble conglomerate facies and from jointed and fractured zones. Weathered bedrock (Homewood Member Sandstone of the Pottsville Formation) was encountered in seven locations, at depths from 5 to 16 ft, during the advancement of soil borings for monitoring well construction at LL–9. In addition, weathered bedrock was found in 21 locations at depths from 2 to 13 ft during the advancement of soil borings (not for monitoring well construction) at LL–9.

The most important bedrock sources of groundwater in the vicinity of the RVAAP facility are the sandstone/conglomerate members of the Pottsville Formation. These aquifers, together with two other deeper Mississippian/Devonian sandstone aquifers, represent the most important bedrock sources of groundwater in Northeastern Ohio. The Sharon Conglomerate is the primary source of groundwater at RVAAP and maintains the most significant well yields of the Pottsville Formation Members with hydraulic conductivity values of 19 to 7,600 liters per day per meter (LPD/m) [from 5 to 2,000 gallons per day per foot (GPD/ft)]. Past studies of the Sharon Conglomerate indicate that the highest yields are associated with the true conglomerate phase (coarse-grained sandstone with abundant quartzite pebbles) and with joints and fractures in the bedrock; however, there is no facility-specific information available regarding variations in aquifer properties resulting from these factors. Where present, the overlying Sharon Shale acts as a relatively impermeable confining layer for the Sharon Conglomerate.

Several flowing artesian production wells have been noted at the facility. The Connoquenessing Sandstone and the Homewood Sandstone are the remaining aquifers of the Pottsville Formation and exhibit hydraulic conductivities of from 19 to 1,140 LPD/m (from 5 to 300 GPD/ft) and from 19 to 760 LPD/m (from 5 to 200 GPD/ft), respectively. Well yields in the Connoquenessing and Homewood sandstones, although lower than the Sharon Conglomerate, are high enough to provide significant quantities of water. Several wells at the RVAAP facility have penetrated both the Sharon Conglomerate and the Connoquenessing Sandstone and reportedly produced water from both units. In general, hydraulic conductivities in the shales of the Sharon and Mercer Members of the Pottsville Formation are low and result in insignificant groundwater yields. The primary porosity of the shales is likely secondary, owing to joints and fractures in the bedrock; however, there is no facility-specific information available regarding the occurrence of joints and fractures in these units.

There are no records documenting the use of groundwater from LL-9. However, since the underlying Sharon Conglomerate was extensively pumped as a source of groundwater in the vicinity of LL-9 (Kammer, 1982), consideration should be given to the potential for historical contaminant migration from the AOC via groundwater draw down through the Homewood Sandstone. This phenomenon (downward migration between sandstone units) while possible would only be a migratory possibility if the Homewood Sandstone was impacted from LL-9 operations and sufficient downward permeability was present.

### 2.6.3 Groundwater Utilization

This section describes the unconsolidated sediments, bedrock, and groundwater utilization found at RVAAP and LL–9. Production wells scattered throughout the facility provided necessary sanitary and process water for RVAAP operations. The remaining process production wells, except for the well at former Building T–5301 (not currently in use), were permanently abandoned in 1992. Currently, only two groundwater production wells remain in operation. These wells, located in the central portion of the facility, provide sanitary water to the remaining site personnel. Residential groundwater use in the surrounding area is similar to that for RVAAP, with the Sharon Sandstone acting as the major producing aquifer in the area. The Connoquenessing Sandstone and the Homewood Sandstone also provide limited groundwater resources, primarily near the western half of the RVAAP facility. Many of the local residential wells surrounding RVAAP are completed in the unconsolidated glacial material.

## 2.7 Demography and Land Use

As of February 2006, a total of 20,403 acres of the former 21,683–acre RVAAP have been transferred to the United States Property and Fiscal Officer (USP&FO) for Ohio for use as an OHARNG training site. Currently, RVAAP consists of 1,280 acres in several distinct parcels scattered throughout the confines of the OHARNG's Ravenna Training and Logistics Site (RTLS). RVAAP's remaining parcels of land are located completely within the RTLS, and are completely enclosed by the RTLS perimeter fence.

The RTLS is located in northeastern Ohio within Portage and Trumbull counties, approximately 4.8 kilometers (km) (3 miles) east/northeast of the City of Ravenna and approximately 1.6 km (1 mile) northwest of the City of Newton Falls. The RVAAP portions of the property are completely located within Portage County. The RTLS (inclusive of RVAAP) is a parcel of property approximately 17.7 km (11 miles) long and 5.6 km (3.5 Miles) wide. The facility is bounded by State Route 5, the Michael J. Kirwan Reservoir, and the CSX System Railroad on the south; Garrett, McCormick, and Berry Roads on the west; the Norfolk Southern Corporation railroad on the north; and State Route 534 on the east.

The RTLS is surrounded by several communities: Windham on the north, Garrettsville 9.6 km (6 miles) to the northwest; City of Newton Falls 1.6 km (1 mile) to the southeast; Charlestown to the southwest, and Wayland 4.8 km (3 miles) to the south. RTLS did not exist when the RVAAP was operational, and the entire 21,683–acre parcel was a GOCO industrial facility.

The RVAAP facility is located in a rural area, not close to any major industrial or other developed areas. Based on data from the United States Census Bureau (1992) and the *Portage County Soil and Water Conservation District Resources Inventory* (1985), approximately 55% of Portage County, in which a majority of installation acreage is located, consists of either woodland or farmland acreage. 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.

## 2.8 Ecology

Before the government acquired the property in the 1940s, much of the land at RVAAP was cleared for agricultural use. Over 80% of RVAAP is now forest. The limited field cover growth in the remaining 20% of RVAAP is the result of earlier agricultural practices that left these sites with poor topsoil that still limits forest growth. Several thousand acres of agricultural fields were planted with trees during the 1950s and 1960s, but these plantings did not grow well in areas with poor topsoil. Some fields, leased for cattle grazing during the same period, were subsequently delayed in their reversion to forest. A few fields have undergone periodic brush removal to maintain them as open fields.

Portions of the RVAAP facility satisfy the regulatory definition of a jurisdictional wetland. Wetland areas at RVAAP include seasonally saturated wetlands, wet fields, and forested wetlands. Some wetland areas are associated with anthropogenic settling ponds and drainage areas. Some of the wetland areas are the result of natural drainage or beaver (*Castor canadensis*) activity. Some wetland areas may have been impacted by former operations due to effluent discharged to settling ponds and the natural drainage of the area in the past. However, many wetlands on the facility are of high quality.

The flora and fauna present at RVAAP are varied and widespread. The following 12 plant species listed as Ohio State Potentially Threatened have been identified at RVAAP:

1. Gray birch (*Betula populifolia*),
2. Butternut (*Juglans cinera*),
3. Northern rose azalea (*Rhododendron nudiflorum* var. *roseum*),
4. Hobblebush (*Viburnum alnifolium*),
5. Long beech fern (*Phegopteris connectilius*),
6. Straw sedge (*Carex straminea*),
7. Water avens (*Geum rivale*),
8. Tall St. John’s wort (*Hypercium majus*),
9. Swamp oats (*Sphenopholis pensylvanica*),
10. Shining ladies’-tresses (*Spiranthes lucida*),
11. Arbor vitae (*Thuja occidentalis*), and
12. American chestnut (*Castanea dentate*).

In addition to being a State Potentially Threatened Plant species, butternut also is listed as a Federal Candidate (Category 2) species. A complete list of rare species (plant and animal) found at RVAAP is provided in Appendix B.

The following nine plant and animal species listed as Ohio State Threatened have been identified at RVAAP:

1. Barn owl (*Tyto alba*),
2. Dark-eyed junco (*Junco hyemlais*)(migrant),
3. Hermit thrush (*Catharus guttatus*)(migrant),
4. Least bittern (*Ixobrychus exilis*),
5. Least flycatcher (*Empidonax minimus*),
6. *Psilotreta indecisa* (caddis fly),
7. Simple willow-herb (*Epilobium strictum*),
8. Woodland horsetail (*Equisetum sylvaticum*), and
9. Pale sedge (*Carex pallescens*).

Animals and plants listed as Ohio State Endangered include the sandhill crane (*Grus canadensis*), American bittern (*Botaurus lentiginosus)*, northern harrier (C*ircus cyaneus*), yellow-bellied sapsucker (*Sphyrapicus varius)*, golden-winged warbler (*Vermivora chrysoptera*), osprey (*Pandion haliaetus*), trumpeter swan (*Cygnus buccinator*), mountain brook lamprey (Ichthyomyzon greeleyi), graceful underwing (Catocala gracilis), ovate spikerush (*Eleocharis ovata*), tufted moisture-loving moss (*Philonotis fontana* var. *caespitosa*), narrow-necked Pohl's moss (*Pohlia elongata* var. *elongata*) and bobcat (*Lynx rufus*). Twenty-one animal species present at RVAAP are also listed as Ohio State Species of Concern:

1. Pygmy shrew (*Sorex hovi*),
2. Star-nosed mole (*Condylura cristata*),
3. Woodland jumping mouse (*Napaeozapus insignis*),
4. Sharp-shinned hawk (*Accipiter striatus*),
5. Marsh wren (*Cistothorus palustris*),
6. Henslow's sparrow (*Ammodramus henslowii*),
7. Cerulean warbler (*Dendroica cerulean*),
8. Prothonotary warbler (*Protonotaria citrea*),

9. Bobolink (*Dolichonyx oryzivorus*),
10. Northern bobwhite (*Colinus virginianus*),
11. Common moorhen (*Gallinula chloropus*),
12. Great egret (*Casmerodius albus*),
13. Sora (*Porzana Carolina*),
14. Virginia rail (*Rallus limicola*),
15. Creek heelsplitter (*Lasmigona compressa*),
16. Sedge wren (*Cistothorus platensis*)
17. Eastern box turtle (*Terrapene carolina*),
18. Four-toed salamander (*Hemidactylium scutatum*),
19. Mayfly (*Stenonema ithica),*
20. Moth (*Apamea mixta)*, and
21. Moth (*Brachylomia algens)*.

The OHARNG currently manages the Integrated Natural Resource Management Plan for the majority of the facility except for the property that is still maintained by the U.S. Army (as referenced in Section 1.2.1). Restricted land use and forest management practices have preserved and enabled large forest tracts to mature. Habitat conversion at RVAAP has focused on restoration of the forests that covered the area before it was 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 increasing forest cover enhances the area for use by both plant and animal forest species.

Future IRP activities will require consideration of these species to ensure detrimental effects on Ohio threatened or endangered flora and fauna at RVAAP do not occur. This will be discussed in the Ecological Risk Assessment presented in Section 7.0. There are currently no Federally listed species or critical habitat on the RTLS property. There are a few species currently under federal observation for listing but none listed.

# 3.0 LOAD LINE 9 INVESTIGATIONS

This section describes field activities, sample collection, and sample analyses conducted during the investigation of LL–9. The field and analytical programs were performed in accordance with the RVAAP FWSAP (USACE, 2001a) and the FWSAP Addendum for the Remedial Investigation at LL 9 (MKM, 2003a). Investigation objectives, rationale for sampling locations, sampling methods, and sample locations are discussed in this section. Deviations to the FWSAP (USACE, 2001a) or FWSAP Addendum for LL–9 (MKM, 2003a) are also documented in this section.

## 3.1 Field Activities

An initial screening field effort for lead azide was conducted in March 2002. RI-related field activities were conducted from October to December 2003 and included:

- Conducting a munitions and explosives of concern (MEC) avoidance screen before field activities were initiated;
- Mowing/clearing sampling areas and access routes;
- Excavation of test pits;
- Establishing work zones;
- Establishing temporary decontamination areas;
- Collecting surface soil samples;
- Collecting subsurface soil samples;
- Collecting sediment samples;
- Collecting surface water samples;
- Installing and developing monitoring wells;
- Collecting geotechnical samples from the borings (Shelby tubes);
- Collecting groundwater samples from monitoring wells;
- Conducting in-situ permeability testing (slug tests);
- Collecting water level measurements;
- Conducting a sample location and monitoring well survey; and
- Packing and shipping samples.

The following sections summarize the LL–9 RI activities including pre-mobilization, mobilization, and project-related field activities. A photographic log of the characterization activities is provided in Appendix C.

### 3.1.1 MEC Avoidance

MEC activities were conducted as specified in the MEC Avoidance Plan found in the FWSAP Addendum for Load Line 9 (MKM, 2003a). The UXO Avoidance Report is provided in Appendix D. A MEC survey was conducted to ensure worker safety during the RI investigation before initiating field activities. An unexploded ordnance (UXO)-qualified technician surveyed areas where personnel or equipment might traverse. Anomalies were noted, and safe pathways were established. The surface of the point to be penetrated was cleared, and an anomaly-free area was established before intrusive activities were initiated. Down-hole surveys were conducted at 2 ft intervals to a depth of 4 ft, where MEC avoidance was terminated.

### 3.1.2 Mowing/Clearing of Sample Locations

Ground-level vegetation was mowed using a hydro axe, brush hog, and/or hand clearing with chainsaw, machete, and weed eater. The vegetation was cut or cleared to allow personnel and equipment to access designated sampling locations.

### 3.1.3 Test Pits

Two test pits were excavated before installation of the monitoring wells to investigate the depth to bedrock and soil profile. The test pits were completed in accordance with Section 4.4.2.4.2 of the FWSAP (USACE, 2001a) as outlined below. The test pit excavations provided information for drilling and installation of monitoring wells; however, no samples were collected during the trenching operations.

### 3.1.4 Work Zones

MKM established work zones during drilling and trenching operations. The work zone (exclusion zone) was delineated by yellow DO NOT ENTER caution tape and road cones. To ensure site control during sample collection, the access gate to the AOC was closed and padlocked. A site sign-in log was maintained at the access gate for field personnel and site visitors.

### 3.1.5 Temporary Decontamination Area

A temporary field decontamination area was constructed to facilitate decontamination of the drilling rig, augers, rods and other associated equipment and personnel. The field decontamination area was located outside the main gate of LL 6 in the parking area (the RI field program at LL 6 (located close to LL–9) was performed concurrently with the LL–9 RI field program). A lined decontamination pad was constructed to capture decontamination fluids. In addition, several investigation-derived waste (IDW) water and clean water above-ground storage tanks (ASTs) were staged at this location. Sampling and drilling equipment was decontaminated in accordance with the procedures outlined in Sections 4.4.2.8 and 4.3.8 of the FWSAP (USACE, 2001a).

### 3.1.6 Soil Samples

#### *3.1.6.1 Azide Screening Soil Samples*

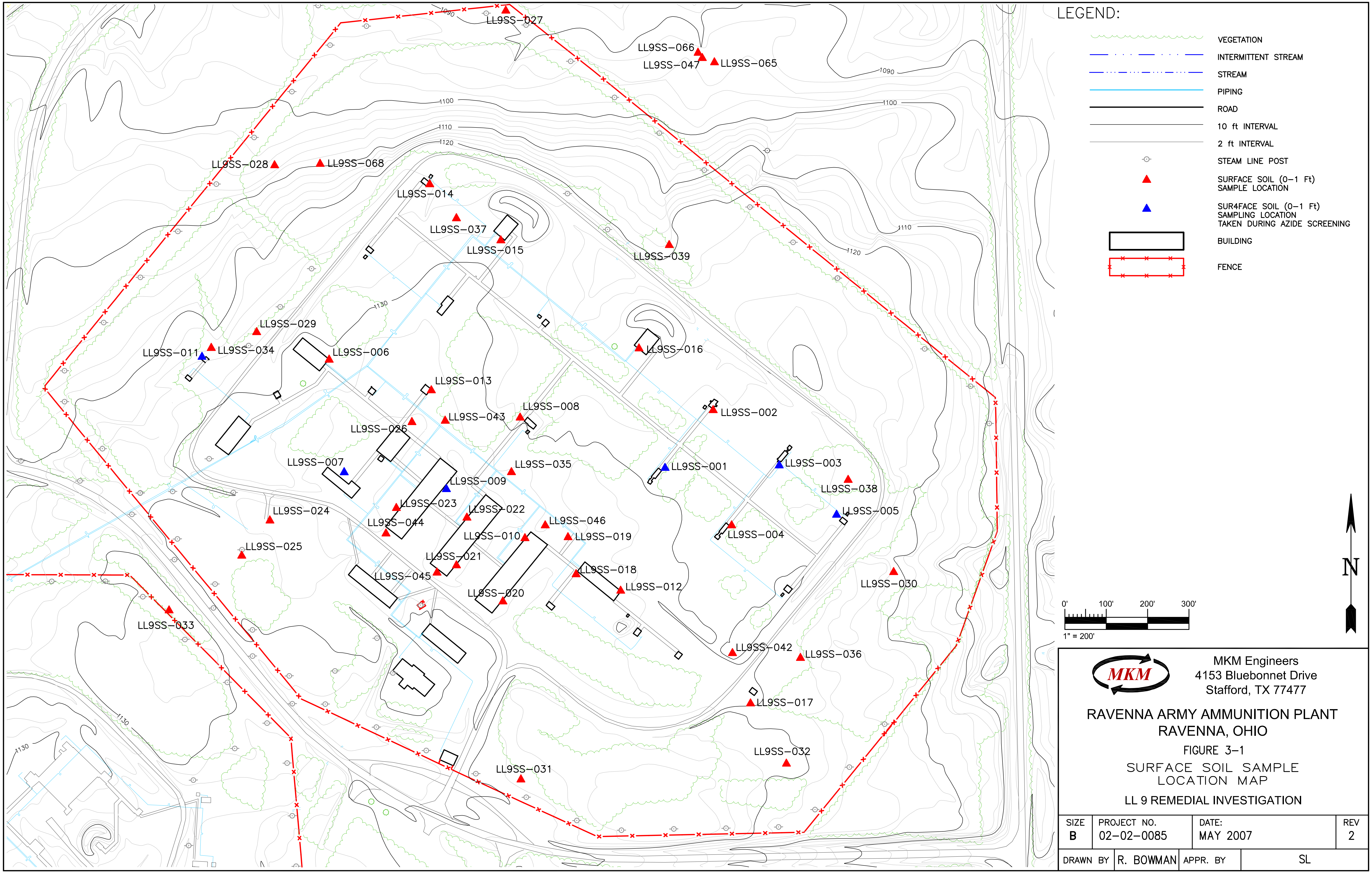
Eleven surface soil samples (LL9SS–001–0001–SO through LL9SS–011–0001–SO) were collected at LL–9 during the March 2002 azide screening event. The 11 soil samples were field analyzed for lead azide, and each was field tested for TNT and RDX using the Jenkins method. Additionally, 6 of the soil samples (LL9SS–001–0001–S), LL9SS–003–0001–SO, LL9SS–005–0001–SO, LL9SS–007–0001–SO, LL9SS–009–0001–SO, and LL9SS–011–0001–SO) were submitted to Severn Trent Laboratories, Inc. (STL) for explosives and metals analysis and split samples were sent to General Physics Laboratories (GPL) to evaluate the accuracy of the new GPL screening method for explosives (modified 8330). In addition, one additional split sample was collected for USACE and submitted for explosives analysis.

Soil samples were collected using a bucket hand auger (stainless steel) during the azide screening. Soil samples were collected from the shallow 0 to 1 ft interval. The surface soil samples were collected in and around bulk handling and process buildings and from locations within the load line. Figure 3–1 shows the location of the surface soil samples. Surface soil samples collected during the azide screening were documented on the field sampling forms included in Appendix E. Results of the surface soil screening and samples analyzed by GPL and STL laboratories are included in Appendix F.

#### *3.1.6.2 RI Soil Samples*

Soil sampling during the LL–9 RI was conducted using a combination of hollow-stem auger/split-spoon, direct push (Geoprobe), and hand auger methods. Soil samples were collected from surface (0 to 1 ft interval) and at-depth (1 to 3 ft interval or deeper) soils. The types of soil samples collected, the sampling intervals (if applicable), and the rationale for the depth of sample collection are listed in Table 3–1.

After a soil sample was collected, it was immediately labeled and placed into a plastic bag inside a cooler containing ice. Each cooler shipped to the laboratory was accompanied by a completed chain-of-custody form.



MKM

MKM Engineers
4153 Bluebonnet Drive
Stafford, TX 77477

RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO

FIGURE 3–1

SURFACE SOIL SAMPLE
LOCATION MAP

LL 9 REMEDIAL INVESTIGATION

| SIZE | PROJECT NO. | DATE: | REV |
|---|---|---|---|
| B | 02–02–0085 | MAY 2007 | 2 |

DRAWN BY R. BOWMAN APPR. BY SL

## Table 3–1

## Rationale for Selection of Soil Sampling Intervals

| Sample Type | Sampling Intervals | Rationale for Actual Depth |
|---|---|---|
| Surface Soil | 0 to 1 ft | Predetermined depths specified in the work plan |
| Subsurface Soil | 1 to 3 ft | Predetermined depths specified in the work plan |
| Monitoring Well Boreholes | 1st interval: 0 to 1 ft<br>2nd interval: None | Visual observation and/or headspace reading<br>No sample collected from rock cores |
| Subfloor | NA | Floor/soil interface in five LL–9 buildings |
| Sump/Dry Well | 1st interval: 0 to 1 ft<br>2nd interval: Varied | Visual observations<br>Depth of the bottom of the sump/dry well |
| Sewer | 1st interval: 0 to 1 ft<br>2nd interval: Varied | Visual observations<br>Depth of the bottom of the sewer manholes |
| VOC Screening (Grid) | Varied | Highest headspace reading or strongest VOC odors |

### *3.1.6.3 Surface Soils*

Surface soil samples were collected at predetermined depths specified in the work plan to:

- Assess the potential impact of LL–9 activities on surrounding soil,
- Evaluate condition of soil outside the production area,
- Determine the nature and extent of contamination, and
- Determine whether chemical releases had occurred from LL–9 infrastructure.

Figure 3–1 shows the location of the surface soil samples. Forty surface soil samples were collected by hand auger within the LL–9 AOC. These samples included 27 surface soil samples, two adjacent sewers, four adjacent to dry wells, and seven monitoring well locations (LL9SS–033–0001–SO through LL9SS–039–0001–SO). In addition, seven split samples were collected for USACE and submitted for analysis.

Table 3–2 lists the sample numbers and the method used to collect each sample. The soil/floor interface samples were collected after the buildings were demolished. The samples were collected using a hand auger from 0 to 1 ft bgs. One discrete soil sample was collected from each location using a clean, decontaminated, stainless steel hand auger.

## Table 3-2
## Summary of Samples and Analysis

| Sample Type | Collection Method | Sample Numbers[1] | Sample Depth | Activity | Date of Field Work | Laboratory Parameters |
|---|---|---|---|---|---|---|
| Surface Soil (40) | | | | | | |
| Surface Soil | Hand Auger | Azide Field Screening SS001 - SS010<br>Lab Analysis SS001, SS003, SS005, SS007, and SS009 | 0-1 ft | Azide Screening | March 2002 | Azide Field Screening, TAL Metals and Explosives (STL) and 10 % Explosives Screening Modified Method 8330 (USACE Comparitive Study) |
| Surface Soil | Hand Auger | SS002, SS004, SS006, SS008, SS010<br>SS012 - SS032 | 0-1 ft | R.I | Nov - Dec 2003 | TAL Metals<br>and 10% Full Suite |
| Monitoring Well | Hand Auger | SS033-SS039 | 0-1 ft | R.I | Nov - Dec 2003 | TAL Metals and Explosives with 10% Full Suite Analysis |
| Sewer | Geoprobe | SS042 and SS043 | 0-1 ft | R.I | Nov - Dec 2003 | TAL Metals |
| Sump / Dry Wells | Hand Auger | SS044, SS045, SS046, and SS047 | 0-1 ft | R.I | Nov - Dec 2003 | TAL Metals |
| Sub-floor | Hand Auger | SS011 | 1-3 ft | Azide Screening | March 2002 | Explosives and TAL Metals |
| **Subsurface Soil** | | | | | | |
| Subsurface Soil | Hand Auger | SB001-SB010, SB012-SB032 | 1-3 ft | R.I | Nov - Dec 2003 | TAL Metals and 10% Full Suite |
| Monitoring Well | Drill Rig / Split Spoon | Lithologic Samples only | NA | | | |
| Sewer | Geoprobe | SB042-SB043 | 8-11 ft | R.I | Nov - Dec 2003 | TAL Metals (SB042) and Full Suite (SB043) |
| Sump | Hand Auger | SB040-SB041 | ~ 7 ft | R.I | Nov - Dec 2003 | TAL Metals, Explosives, VOCs, SVOCs, PCBs, Pesticides, and Cyanide |
| Dry Wells | | SB044-SB047 | > 3 ft | R.I | Nov - Dec 2003 | TAL Metals |
| Sub-floor | Hand Auger | SB048 - SB053 | 1-3 ft | R.I | Nov - Dec 2003 | TAL Metals and 10% Full Suite |
| VOC Grid | Geoprobe | SB055, SB056, SS061, SS065, SS066 | > 1 ft | R.I | Nov - Dec 2003 | VOCs, SVOCs, TPH (GRO & DRO) |
| **Groundwater** | | | | | | |
| Groundwater | Bailer / Low Flow Micropurge | MW001-MW007 | Varied | R.I | Nov - Dec 2003 | TAL Metals, Explosives, Propellants, VOCs, SVOCs, PCBs, Pesticides and Cyanide |
| **Surface Water** | | | | | | |
| Surface Water | Submersion | SW001, SW005, SW007 and SW008 | Surface | Azide Screening | March 2002 | TAL Metals and Explosives |
| Surface Water | Submersion | SW002, SW003, SW004, and SW012 | Surface | R.I | Nov - Dec 2003 | TAL Metals and 10% (1 sample - SW012) Full Suite |
| Sump / Sewer Water | Scoop | SW009 and SW010 | > 1 ft | R.I | Nov - Dec 2003 | TAL Metals |
| **Sediment** | | | | | | |
| Sediment (6 Ditch and 2 Sump samples) | Hand Core | SD001 - SD008 | > 1 ft | Azide Screening | March 2002 | TAL Metals and Explosives |
| Ditch Sediment | Scoop | SD002, SD004, SD006 and SD011 - SD017 | 0-0.5 ft | R.I | Nov - Dec 2003 | TAL Metals and 10% Full Suite |
| Sump / Sewer Sediment | Scoop | SD009 and SD010 | > 1 ft | R.I | Nov - Dec 2003 | TAL Metals and 10% Full Suite |
| **Contingency** | | | | | | |
| Surface Soil | Hand Auger | SS068 | 0-1 ft | R.I | Nov - Dec 2003 | TAL Metals, Explosives, Propellants, VOCs, SVOCs, PCBs, Pesticides and Cyanide |
| Subsurface Soil (Next to Sumps) | Hand Auger | SB069, SS070 | ~ 7 ft | R.I | Nov - Dec 2003 | TAL Metals |

1 - Full Suite = TAL Metals, Explosives, Propellants, VOCs, SVOCs, PCBs, Pesticides and Cyanide

2 - Sample nomenclature was shortened for inclusion in this table. The full sample numbers are used throughout the remainder of this document

Surface soil sample information was documented on the field sampling forms included in Appendix G. Surface soil sampling results are included in Appendix F.

#### *3.1.6.4 Subsurface Soil Samples*

Subsurface soil samples were collected at 53 locations, as shown on Figure 3–2. These samples included 31 subsurface soil sampling locations; 6 subfloor locations (see subsection 3.1.10.3); 2 locations at depths equivalent to the bottom of the sewer manholes; 8 locations at depths equivalent to the bottom of the sump/dry wells; and at 6 locations in the VOC screening grid established east of the solvent building at LL–9 (DT–33). Soil samples were collected from predetermined depths to:

- Assess the potential impact of LL–9 activities on the surrounding soil,
- Determine the nature and horizontal and vertical extent of potential contamination,
- Evaluate the geotechnical characteristics of the LL–9 soils, and
- Determine whether releases had occurred from LL–9 infrastructure.

**Subsurface Soil Samples Adjacent to Sewers**

Two samples (LL9SB–042–0001–SO and LL9SB–043–0001–SO) were collected at LL–9 sewer manholes. The samples were located at manholes and stress points where sewer integrity was potentially suspect (see Figure 3–2). From each boring, two discrete samples were collected from the 0 to 1 ft bgs interval (surface soil sample), and at a second interval starting at the elevation equal to the total manhole depth and extending to 2 ft below the total depth (subsurface soil sample). The samples were field tested for VOCs using a hand-held photoionization detector (PID) before laboratory analysis.

**Subsurface Soil Samples Adjacent to Sumps**

Two discrete soil samples (LL9SB–040–0001–SO and LL9SB–041–0001–SO) were collected from each boring at locations adjacent to the LL–9 sumps. The sumps were excavated during the demolition operations conducted before the RI activities began. The samples (LL9SB–040–0001–SO and LL9SB–041–0001–SO) were collected from approximately 7 ft depth, the bottom elevation of the sumps (LL9SB–040–0001–SO [6.5 ft], LL9SB–041–0001–SO [7.0 ft]). Visual observations were used to determine the final depth.

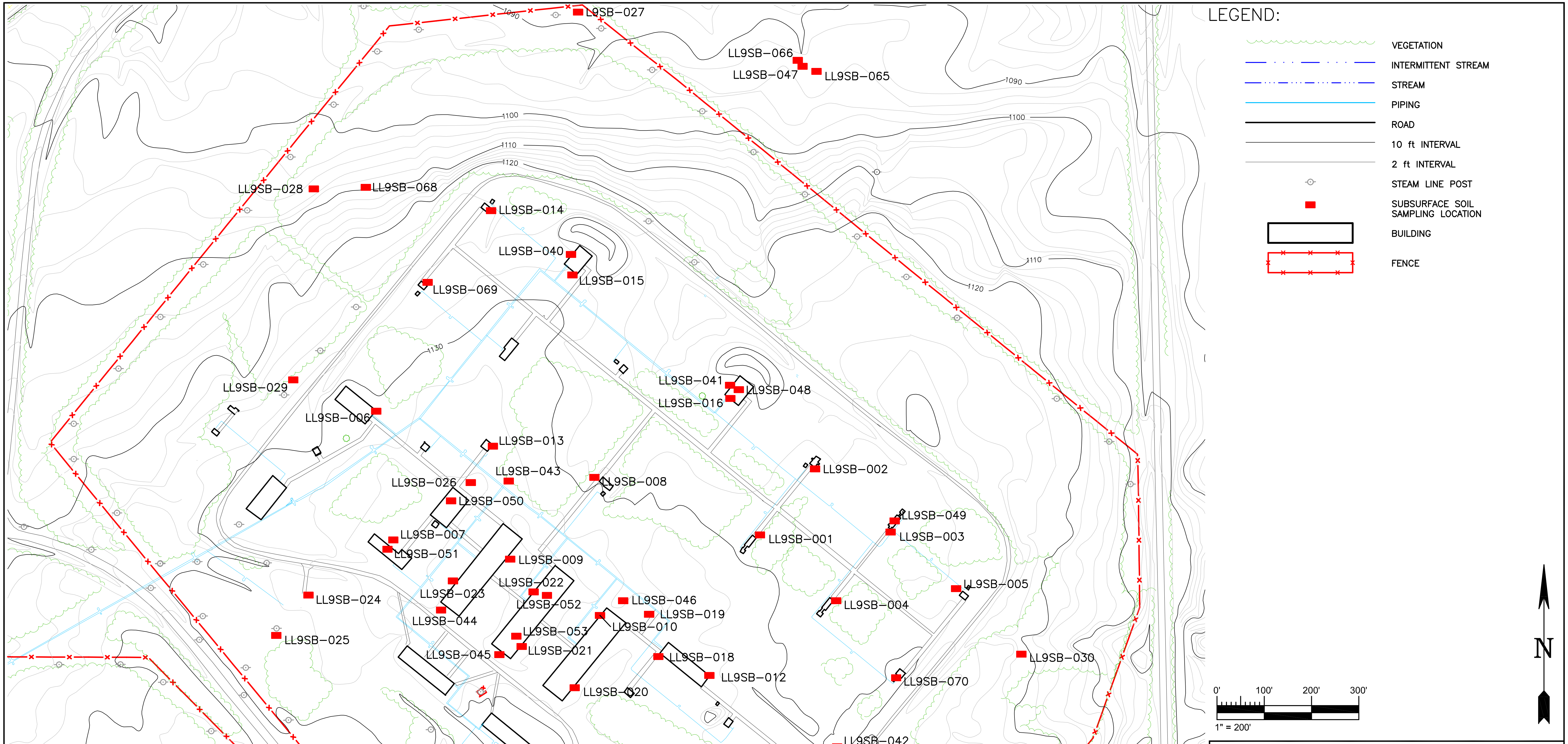


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FIGURE 3–2

SUBSURFACE SOIL SAMPLE LOCATION MAP

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**Direct-Push Subsurface Soil Samples (VOC Screening Grid)**

Of the 14 direct-push soil borings (LL9SB–054–0001–SO through LL9SB–067–0001–SO), six subsurface soil samples (LL9SB–055–0001–SO, LL9SB–056–0001–SO, LL9SB–059–0001–SO, LL9SB–061–0001–SO, LL9SB–064–0001–SO, and LL9SB–067–0001–SO) were collected at a VOC screening grid established east of the solvent building at LL–9 (Bldg DT–33). The VOC screening grid was established and sampled to determine whether releases from the solvent building had occurred. Samples from the soil borings exhibiting the highest headspace readings were selected for analysis.

Table 3–2 lists the sample numbers and the method used to collect each sample. In addition, three split samples (LL9SB–005–0001–DUP, LL9SB–043–0001–DUP, and LL9SB–053–0001–DUP) were collected for the USACE and submitted for analysis. After collection, the samples were placed into a cooler containing ice and submitted to the laboratory with completed chain-of-custody forms. The soil boring logs for the direct-push soil samples are included in Appendix A. The subsurface soil samples were documented on the field sampling forms included in Appendix H and the analytical results are included in Appendix I.

### 3.1.7 Groundwater Activities

During the RI, seven monitoring wells were installed in the shallow consolidated water table zone at LL–9 (see Figure 3–3), slug tests were conducted, and groundwater samples were collected. These groundwater activities were conducted to:

- Determine whether the production activities had adversely affected groundwater quality downgradient from the process buildings,
- Evaluate the quality of groundwater upgradient of LL–9, and
- Collect data about the LL–9 groundwater flow regime.

Monitoring wells were sited to evaluate potential subsurface contamination. Six wells were located downgradient from the areas most likely affected by production activities.

#### *3.1.7.1 Monitoring Well Installation*

The installation, development, and sampling of monitoring wells was conducted in accordance with Section 4.3.2 of the FWSAP (USACE, 2001a) and the FWSAP Addendum for the Remedial Investigation at LL 9 (RVAAP 42) (MKM, 2003a).

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FIGURE 3–3

GROUNDWATER MONITORING WELL LOCATION MAP

LL 9 REMEDIAL INVESTIGATION

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The monitoring wells were installed using hollow stem auger (HSA) drilling methods under the direct supervision of a qualified geologist. A 15.9 cm (6.25 inch) inside-diameter, hollow-stem auger was used to advance the borehole through unconsolidated material to an average depth of 21.04 ft bgs.

Monitoring wells were constructed in each borehole, following termination of drilling at the appropriate depth. A 3.05 m (10 ft) section of new, precleaned 5.0 cm (2.0 inch) schedule 40 polyvinyl chloride (PVC) with a 0.010 slot screen was set to straddle the static water level determined during drilling activities. Schedule 40 PVC riser was used to complete the well. The screen and riser were placed into the borehole through the drill stem augers during well construction. A clean sand filter pack was tremied in place from the bottom of the boring to approximately 0.6 m (2 ft) above the top of the well screen. The filter pack was sealed with 0.6 m (2 ft) of bentonite pellets. Type 1 Portland cement with 7% bentonite grout was tremied to fill the remainder of annular space to the surface. Each well was finished at the surface with protective steel surface casing or surface flush mount. At most locations (where depth to water was 12 ft or greater), the wells were finished at the surface with a protective steel surface casing (pro-casing). Surface (flush) mounts were used where depth to water was less than 12 ft and pro-casings would not fit (refer to Technical Change Letter 12 Nov 03 located in Appendix J). Three steel posts were installed around each well. Monitoring well installation procedures are provided in Section 4.3.2 of the FWSAP for RVAAP (USACE, 2001a). Well construction diagrams are included in Appendix K.

Each monitoring well was developed at least 48 hours (and no longer than 7 days) after completion. Static water level and total well depth were recorded. At least five borehole volumes were removed from each well using a submersible pump. Wells were surged with surge blocks, tubing, pumps, check valves, and bailers to remove sediment from screens. For several wells a turbidity of ≤5 Nephelometric Turbidity Unit (NTU) could not be reached given the nature of the unconsolidated water bearing zone. Low-yield wells with turbidity >5 NTU were stopped after 7 borehole volumes were removed or after 48 hours of development. Each well was allowed 48 hours to recover before resampling. All of the issues/procedures were discussed with Ohio EPA during the field investigations. Sediment volume in some of the monitoring wells necessitated the use of alternative development methods to remove the sediment. These methods included tubing and check valve surging. Well development and purging records are included in Appendix K.

#### *3.1.7.2 In-Situ Permeability Testing*

Slug tests were performed at the seven LL–9 wells to estimate the hydraulic conductivity of the consolidated bedrock material surrounding each well screen. A transducer was used to collect the falling and rising head permeability data. First, the rising head test was conducted by inserting a stainless steel slug into the well and recording water levels until the groundwater returned to static levels. After it was determined that the groundwater elevations had stabilized, the falling head test was conducted by removing the slug and collecting data until static conditions were achieved. The slug testing of monitoring wells was conducted in accordance with the FWSAP (USACE, 2001a) and the FWSAP Addendum for LL–9 (MKM, 2003a). Slug test data records are provided in Appendix L. Results of the slug tests are discussed in Section 4.2.1.

#### *3.1.7.3 Groundwater Sampling*

Low-flow micropurge sampling technology was used to collect groundwater samples at LL–9. Before samples were collected, the well condition was evaluated and documented on the field form. The casing headspace was analyzed using a hand-held PID and the depth to water and depth to the bottom of the well casing were measured and recorded. Each well was purged using micropurge technology. Purging continued until water quality indicators such as pH, temperature, dissolved oxygen, and conductivity were stabilized (three consecutive readings within 10% of each other). Samples were collected within 24 hours of purging and placed into pre-cleaned bottles provided by STL. All parameters, except VOCs, were collected using low-flow sampling technology. VOC samples were collected with a 2 inch bailer so that potential VOCs were not volatilized or bypassed if light non-aqueous phase liquids were present.

Groundwater sampling was conducted in December 2003 in accordance with the FWSAP (USACE, 2001a). Characteristics of the materials in which the wells are set include abundant mobile fines. Historically, turbidity readings are > 5 NTU have been prevalent at the conclusion of purging. Only bedrock wells have achieved turbidity < 5 NTU. Groundwater samples that were analyzed for TAL dissolved metals were field-filtered immediately after sample collection. Samples were placed into a cooler containing ice and submitted to the lab with completed chain-of-custody forms. Table 3–2 lists the analyses completed for the groundwater samples. Figure 3–3 shows the locations of the monitoring wells. Well purging and sampling forms are provided in Appendix K. Groundwater analytical results are included in Appendix M.

#### *3.1.7.4 Water Level Measurements*

Static groundwater levels and total depth measurements were taken and recorded at each monitoring well on three separate occasions to provide LL–9 groundwater flow data. The groundwater elevation data were collected during December 2003 (twice) and June 2004 and are shown in Table 3–3. Additional groundwater elevation data are included in Appendix K. Well survey information is included in Appendix N.

## Table 3–3

## LL–9 Groundwater Elevations

| Easting | Northing | Well ID | TOC | Depth To Water (ft) | | | GW Elevation (ft MSL) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Dec-03 | Dec-03 | Jun-04 | Dec-03 | Dec-03 | Jun-04 |
| 2355817.04 | 556125.81 | LL9MW–001 | 1134.62 | 14.22 | 13.75 | 14.50 | 1120.40 | 1120.87 | 1120.12 |
| 2355907.76 | 556755.11 | LL9MW–002 | 1127.30 | 10.10 | 9.75 | 9.50 | 1117.20 | 1117.55 | 1117.80 |
| 2356635.21 | 556445.31 | LL9MW–003 | 1135.76 | 11.43 | 11.82 | 11.37 | 1124.33 | 1123.94 | 1124.39 |
| 2357338.76 | 556002.00 | LL9MW–004 | 1131.83 | 18.69 | 18.23 | 18.27 | 1113.14 | 1113.60 | 1113.56 |
| 2356505.95 | 557063.36 | LL9MW–005 | 1130.93 | 14.42 | 14.30 | 16.93 | 1116.51 | 1116.63 | 1114.00 |
| 2357446.67 | 556434.79 | LL9MW–006 | 1129.88 | 17.04 | 17.87 | 14.32 | 1112.84 | 1112.01 | 1115.56 |
| 2357024.34 | 557000.56 | LL9MW–007 | 1119.99 | 7.97 | 7.85 | 8.00 | 1112.02 | 1112.14 | 1111.99 |

**Notes:**

| | |
|---|---|
| ft | Feet |
| GW | groundwater |
| MSL | mean sea level |
| TOC | top of casing |

## 3.1.8 Surface Water

### *3.1.8.1 Azide Screening Surface Water Sample*

Four surface water samples (LL9SW–001–0001–SW, LL9SW–005–0001–SW, LL9SW–007–0001–SW, and LL9SW–008–0001–SW) were collected from LL–9 during the March 2002 azide screening event. In addition, one split sample was collected for the USACE and submitted for analysis. Three locations (LL9SW–002–0001–SW, LL9SW–004–0001–SW, and LL9SW–006–0001–SW) had no surface water present for sample collection. The surface water samples were collected using direct fill of hand-held bottles. Four surface water samples (LL9SW–001–0001–SW, LL9SW–005–0001–SW, LL9SW–007–0001–SW, and LL9SW–008–0001–SW) were submitted to STL for explosives and metals analysis. Figure 3–4 shows the locations of the surface water samples. Surface water sampling forms are included in Appendix O and analytical results from the samples are included in Appendix P.

### *3.1.8.2 RI Surface Water Samples*

Surface water samples were collected from the main drainage ways at the LL–9 to:

- Evaluate whether surface water is being affected by runoff from the former production area

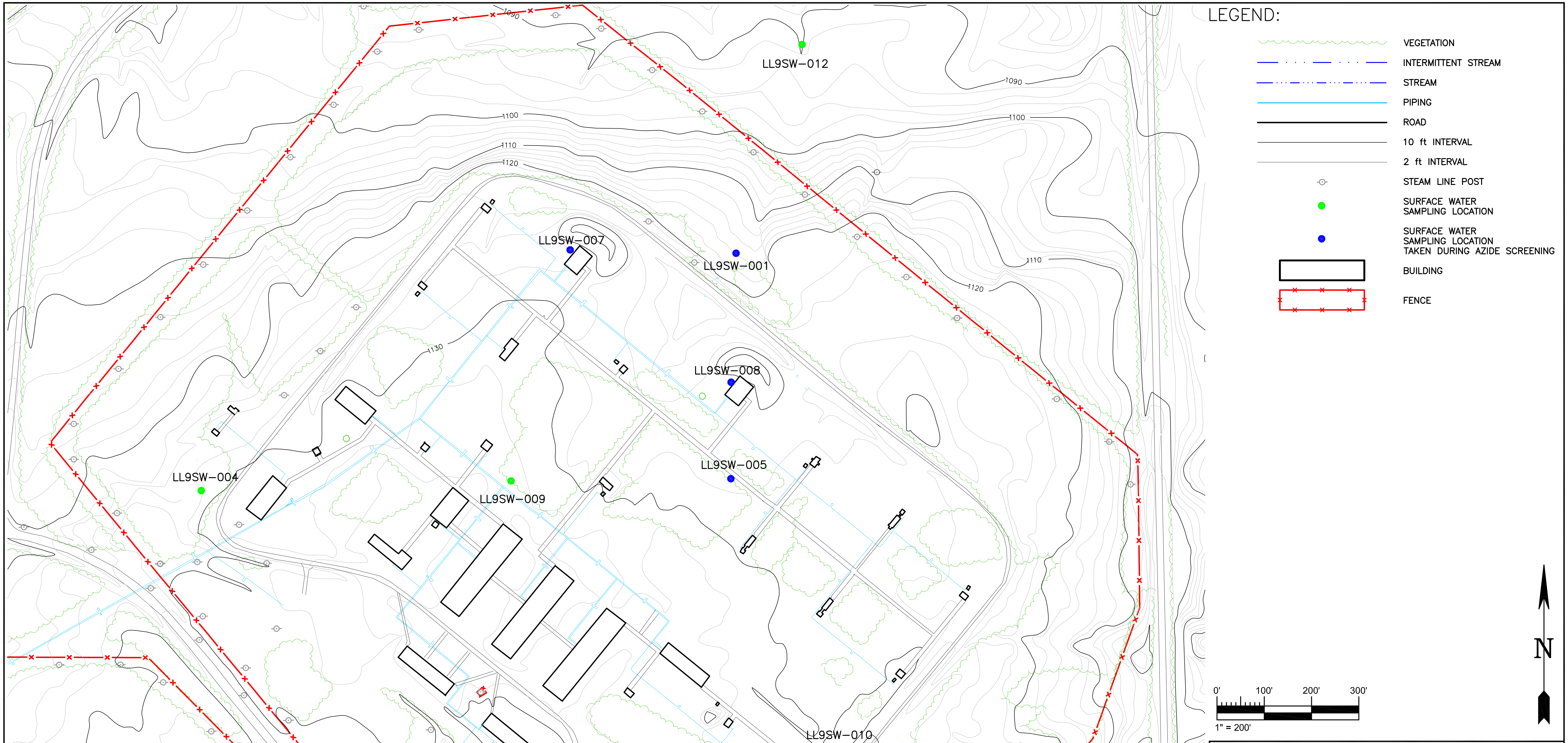

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FIGURE 3–4

SURFACE WATER SAMPLE LOCATION MAP

LL 9 REMEDIAL INVESTIGATION

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- Identify the migration pathways for potentially contaminated runoff (if any) from the process area, and
- Evaluate whether contaminants migrate beyond the site boundary via LL–9 drainage ditches.

Four locations (LL9SW–002–0001–SW to LL9SW–004–0001SW, and LL9SW–012–0001–SW) were selected to evaluate whether contaminants could be affecting surface water within the AOC boundary (Figure 3–4). Samples LL9SW–009–0001–SW and LL9SW–010–0001–SW were collected from sewer manholes (see subsection 3.1.10.1). In addition, one split sample (LL9SW–012–0001–DUP) was collected for the USACE and submitted for analysis.

At each location, surface water sample collection began at the furthest downstream point and moved upstream, thus minimizing disturbance of the sediment and the turbidity of the collected sample. The surface water was collected as described in Section 4.6.2.1.1 of the FWSAP (USACE, 2001a) and the FWSAP Addendum for LL–9 (MKM, 2003a). Direct fill of hand-held bottles was used to sample water in the drainage ditches. 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. Water quality measurements (pH, conductivity, dissolved oxygen content, and temperature) were recorded just before to sample collection. Samples were immediately placed into a cooler containing ice, and the cooler was submitted to the laboratory with completed chain-of-custody forms. Table 3–1 lists the surface water samples and analyses. Field sampling forms are provided in Appendix O, and analytical results are included in Appendix P.

### 3.1.9 Sediment

#### *3.1.9.1 Azide Screening Sediment Sample*

Eight sediment samples (LL9SD–001–0001–SD thru LL9SD–008–0001–SD) were collected from LL–9 during the March 2002 azide screening event. Six were ditch sediment samples, and two were sump sediment samples. The sediment samples were co-located with the surface water sample locations. The sediment samples were collected using a 0.61–m (2–ft) hand-core sampler. Four samples (LL9SD–001–0001–SD, LL9SD–003–0001–SD, W–24S, and LL9SD–005–0001–SD) were submitted to STL for explosives and metals analysis. Figure 3–5 shows the locations of the sediment samples. Field sampling forms are included in Appendix Q, and analytical results from the samples are included in Appendix R.

#### *3.1.9.2 RI Sediment Samples*

Sediment samples were collected from the main drainage ways at the LL–9 to:

- Evaluate whether sediments are being affected via surface water runoff at the LL–9,
- Identify the migration pathway for potential contaminants that may have been suspended in surface water runoff, and
- Evaluate whether contaminants may have migrated beyond the AOC boundaries.

Ten locations (LL9SD–002–0001–SD, LL9SD–004–0001–SD, LL9SD–006–0001–SDS, and LL9SD–011–0001–SD through LL9SD–017–0001–SD) were selected to evaluate whether the drainage system at LL–9 allowed contaminants to migrate beyond the site boundary (Figure 3–5). Two samples (LL9SD–009–0001–SD and LL9D0–10–0001–SD) were collected from sewer manholes. In addition, two split samples (LL9SD–015–0001–DUP and LL9SD–016–0001–DUP) were collected and submitted for analysis. Three of the sediment samples (LL9SD–002–0001–SD, LL9SD–004–0001–SD, and LL9SD–012–0001–SD) were co-located with the surface water sample locations.

The sediment samples were collected from 0 to 0.15 m (0 to 0.5 ft) below the sediment-water interface along the drainage ditches. Sediment samples were collected using a scoop or trowel. Sampling procedures were in accordance with the FWSAP (USACE, 2001a), Section 4.5.2.1, and the FWSAP Addendum for LL–9 (MKM, 2003a). Sediment samples from LL–9 were homogenized and placed into sample containers. Samples were immediately placed into a cooler containing ice and submitted to the laboratory with completed chain-of-custody forms.

Table 3–1 lists the analyses completed on the sediment samples. Field sampling forms are included in Appendix Q, and analytical results from the samples are included in Appendix R.

### 3.1.10 Other RI Samples

Environmental samples were collected from sewers and from the soil/sub-base interface beneath the buildings located at LL 9. In addition, 28 samples were collected from two monitoring well borehole locations and from the sediment sample locations. These samples are discussed in Subsections 3.1.10.1 through 3.1.10.4.

No water or sediment sample was collected from the sumps at LL–9 during the RI because the sumps sampled during the azide sediment screening effort were excavated during the demolition operations, which were conducted before the RI activities began. If a sample was not obtained, it was noted on a field sampling report.

Environmental samples were also collected from the soil/sub-base interface beneath the buildings located at LL–9. Geotechnical samples were collected from two of the monitoring well borehole locations and from sediment sample locations.

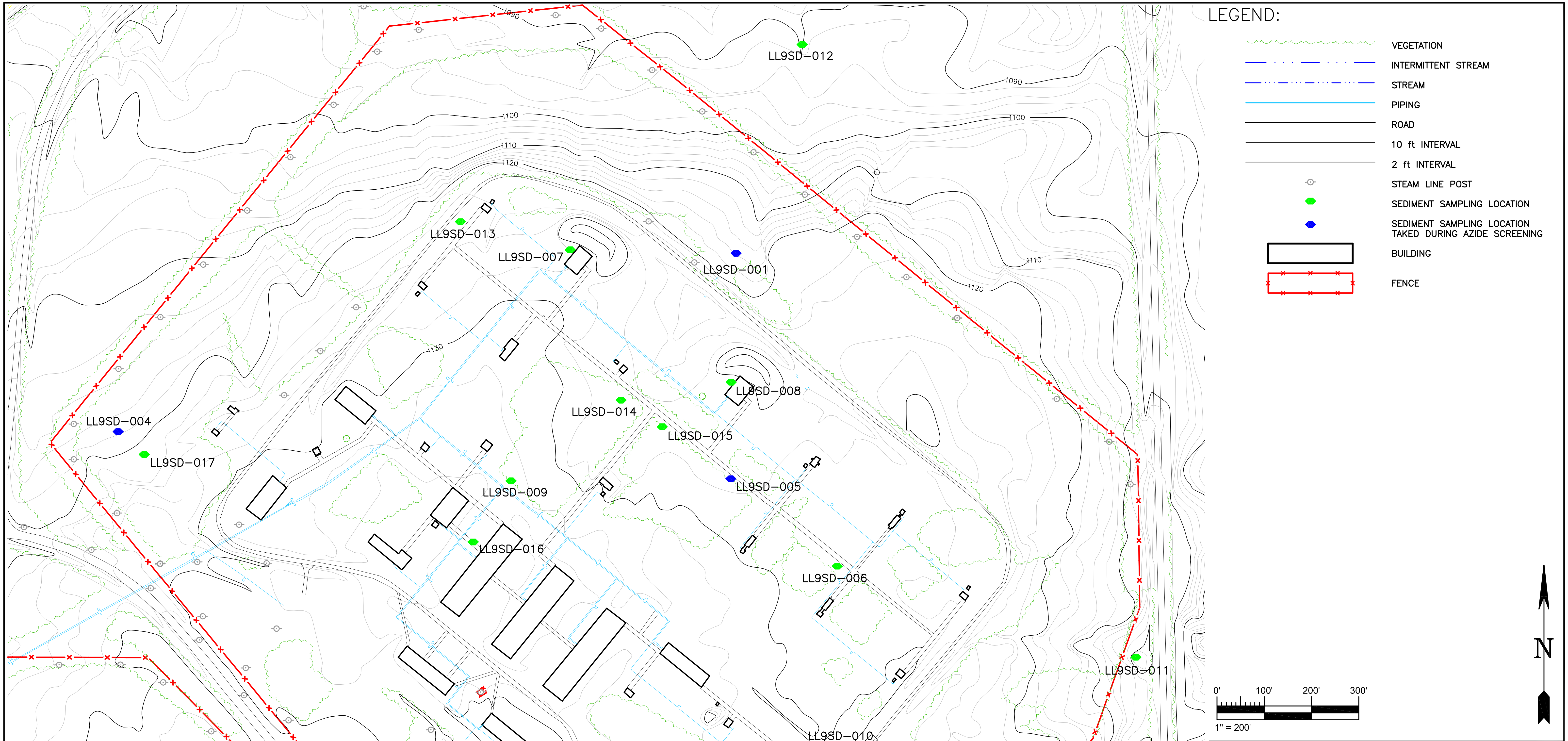

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FIGURE 3–5

SEDIMENT SAMPLE
LOCATION MAP

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#### *3.1.10.1 Sewer Manhole Water Sample*

Water samples were collected from sewer manholes, near the center of the site (LL9SW–009–0001–SW) and the eastern boundary (LL9SW–010–0001–SW) of the LL–9 site. The samples were collected to evaluate whether process operations had affected the sewer manholes. When sewer manhole samples were collected, no personnel entered the structures. A disposable Teflon® bailer was lowered into the manhole to collect the standing water sample. Water samples were immediately placed into a cooler containing ice and submitted to the laboratory with completed chain-of-custody forms. Water samples were not collected from the sewers and sumps located elsewhere at LL–9 because they contained insufficient water for sample collection. Table 3–1 lists the sewer water samples and analyses.

The field sampling forms for the sewer water samples are provided in Appendix O. The analytical results for the sewer water are included in Appendix P.

#### *3.1.10.2 Sewer Manhole Sediment Sample*

Sediment samples were collected from sewer manholes near the center of the site (LL9SD–009–0001–SD) and the eastern boundary (LL9SD–010–0001–SD) of the LL–9 site. Sediment samples were not collected from the sewers and sumps located elsewhere at LL–9 because they contained insufficient sediment for sample collection. Table 3–1 lists the sewer sediment samples and analyses.

The field sampling forms for the sewer sediment samples are provided in Appendix Q. The analytical results for the sewer sediment samples are included in Appendix R.

#### *3.1.10.3 Subfloor Samples*

Subfloor samples (LL9SB–048–0001–SO through LL9SB–053–0001–SO) at Buildings DT–6, DT–16, DT–18A, DT–21, and DT–55 were collected at the soil/sub-base interface to assess potential impact on the underlying soils from historic activities at LL–9. The location of the subfloor samples are shown in the approved FWSAP Addendum for LL–9 (MKM, 2003a). Although these samples were originally scoped to be collected by boring through the concrete slabs into the undisturbed soil in the 0–1 ft interval, demolition activities were conducted at LL–9 before the RI sampling. The heavy equipment (excavators, bulldozers, and loaders) tracked within the footprint of the buildings, and the subfloor soil was disturbed to depths sometimes greater than 1 ft below the subfloor base. Therefore, subfloor soil in the 0–1 ft interval was not representative of the pre-demolition conditions and samples were collected from the 1–3 ft interval below the disturbed soil. Two samples were collected from Building DT–21 and one each from Buildings DT–6, DT–16, DT–18A, and DT–55 (Figure 3–2).

The soil borings were hand augered from 1 to 3 ft bgs. One discrete soil sample was then collected from each boring location using a clean, decontaminated, stainless steel hand auger. Samples were immediately placed into a cooler containing ice and submitted to the laboratory with completed chain-of-custody forms. Field sampling forms are provided in Appendix H, and analytical results from the samples are included in Appendix I.

#### *3.1.10.4 Geotechnical Samples*

Geotechnical samples were collected from two of the seven monitoring well borehole locations in accordance with the scoping meeting held before field operations began. The sample borings were selected in the field by the geologist based upon site knowledge and field conditions encountered during the installation of the borings. The selection of the depth interval was limited because of the shallow occurrence of bedrock (unconsolidated between 0–6 ft bgs). Geotechnical analysis included grain size distribution, moisture content, TOC, hydraulic conductivity, and Atterberg limits. The analytical results match the typical distributions and qualities anticipated for the till/soils types at LLC9. The samples were collected using direct-push Shelby tubes and submitted to a geotechnical laboratory for analysis. Samples were collected from:

- LL9SB–033–0001–SO (MW–001) from 3–ft depth, and
- LL9SB–035–0001–SO (MW–003) from 4–ft depth.

These samples were sent to Prime Engineering & Architecture, Inc., for grain size, hydraulic conductivity, and other geotechnical analyses.

Geotechnical samples for grain size were also obtained from sediment sample locations: LL9SD–002–0001–SD, LL9SD–004–0001–SD, LL9SD–006–0001–SD, LL9SD–009–0001–SD, LL9SD–010–0001–SD, LL9SD–011–0001–SD, LL9SD–012–0001–SDS, LL9SD–013–0001SD, LL9SD–014–0001–SD, LL9SD–015–0001–SD (and duplicate), LL9SD–016–0001–SD (and duplicate), and LL9SD–017–0001–SD. These samples were sent to STL for grain size analysis.

Geotechnical results are included in Appendix S.

### 3.1.11 Sampling Location Survey

Each newly installed monitoring well, soil, surface water, and sediment sampling location was surveyed as specified in subsection 4.3.2.3.12 of the FWSAP (USACE, 2001a). The soil, surface water, sediment, and monitoring well location survey data can be found in Appendix N.

### 3.1.12 Investigation-Derived Waste

The IDW (soil and water) generated during the field activities was characterized and disposed. Representative composite samples of the waste soil and water were collected and analyzed per the requirements of the disposal facility. The LL–9 waste management disposition operations are summarized as follows:

- Excess soil cuttings generated from shallow soil sampling, drilling operations, and sediment sampling were containerized in covered roll off boxes and stored until disposition. Based on the composite sampling and analyses, the soil was determined to be non-hazardous. These materials were disposed at the Countywide R & D Landfill regional disposal facility (RDF) landfill in East Sparta, Ohio.
- Monitoring well development/purging and equipment decontamination generated wastewater. Based on laboratory analytical results, the wastewater was determined to be non-hazardous and transported to McCutcheon Enterprises Inc., a bio-solids treatment facility in Cleveland, Ohio, for disposal.

Representative composite samples from each waste stream were collected and analyzed per requirements of the disposal facility. The wastes generated during the LL–9 RI were managed and disposed in accordance with the applicable federal, state and local rules, laws, and regulations. Appendix T contains copies of the composite sample field sampling forms, chain-of-custody forms for composite samples, analytical reports, and manifests used to track the IDW.

### 3.1.13 Sample Packaging and Shipping

The samples were packaged and shipped per Section 6.0 of the FWSAP (USACE, 2001a) and Section 7.0 of the FWSAP Addendum (MKM, 2003a). Samples were properly packaged for shipment and dispatched to STL and GPL for analysis with completed chain-of-custody forms. When transferring samples, the individual relinquishing custody and the individual receiving the samples signed their names and noted the date and time of transfer on the record. The shipments complied with applicable Department of Transportation regulations for environmental samples.

## 3.2 Data Analyses and Quality

This section briefly describes the data quality procedures that were followed, and then discusses the quality of the data collected. Supporting quality documentation and relevant records, reports, logs, field notebooks, pictures, subcontractor reports, correspondence, analytical data, and chain-of-custody forms will be maintained in the MKM project files. These files will remain in the custody of the MKM Program Manager until they are transferred to JMC and OHARNG RTLS.

### 3.2.1 Field Laboratory Program

Surface soil samples collected during the azide screening were analyzed for lead azide and TNT and RDX using the Jenkins field screening method. QA procedures were completed in accordance with manufacturer requirements, including calibration of the instrument to achieve proper wave length readings and analysis of a control sample.

### 3.2.2 Laboratory Analysis

Analytical laboratory procedures were completed in accordance with applicable professional standards, USEPA requirements, government regulations and guidelines, and specific project goals and requirements. Samples collected during the investigation were analyzed by STL's facility in Chicago, Illinois, a USACE Center of Excellence-validated laboratory under contract for the investigation. The RI analyses were performed at the STL Chicago site with the exception of the propellant analyses (nitroglycerin, nitrocellulose, and nitroguanidine). STL completed these analyses at their West Sacramento, California, facility. Quality assurance (QA) samples (soil, sediment, surface water, and groundwater) were submitted to GPL in Gaithersburg, Maryland, for analysis.

Samples were analyzed in accordance with the *FWSAP* (USACE, 2001a) and the *FWSAP* Addendum for LL–9 (MKM, 2003a). The data quality objectives (DQOs) established for the LL–9 RI comply with USEPA Region V guidance. The LL–9 requirements for sample collection, handling, analysis criteria, target analytes, laboratory criteria, and data validation criteria are consistent with USEPA requirements for National Priority List sites. DQOs for this project included analytical precision, accuracy, representativeness, completeness, comparability, and sensitivity for the measurement data.

The analytical laboratory was required to strictly adhere to the FWSAP (USACE, 2001a) to ensure the quality and usability of the analytical data. The laboratory was required to perform analyses in compliance with USEPA SW–846 (USEPA, 1990), *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* analytical protocols. The laboratory used USEPA SW–846 analytical methods to analyze the samples for metals, VOCs, SVOCs, pesticides, PCBs, explosives, and cyanide. Laboratories were required to comply with the methods as written; recommended procedures suggested in the methods were considered to be requirements.

Quality control (QC) samples were obtained during the LL–9 RI following the requirements of Section 3.2 of the Facility-Wide Quality Assurance Project Plan (SAIC, 2001). 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 duplicates were collected at a frequency of 10%.
- Field equipment rinseates were collected at a frequency of 10% for samples collected with non-dedicated equipment.
- Trip blanks were included with each shipment containing aqueous VOC samples.
- A field blank was collected at the beginning of RI sampling activities.
- Split samples (soil, sediment, surface water, and groundwater) were collected at a frequency of 10% of the environmental samples, and were submitted to GPL in Gaithersburg, Maryland, for analysis.
- MS/MSDs were collected at a frequency of 5%.
- 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 sample results provided information about the effect of the sample matrix on the measurement methodology.
- Laboratory sample duplicates and MSD results were used to determine the analytical reproducibility and precision of the analyses for the samples of interest.

Field blanks, consisting of potable water used in the decontamination process, equipment rinseate blanks, and trip blanks, were submitted for analysis along with field duplicate (co-located) samples to provide a means to assess the quality of the data resulting from the field sampling program.

- Field blank samples were analyzed to determine whether field procedures contributed to sample contamination.
- Equipment rinseate blanks were used to assess the adequacy of equipment decontamination processes for groundwater sample collection.
- Trip blanks were used to assess the potential for VOC contamination of samples during sample shipment and storage.
- Field duplicate samples were analyzed to determine sample heterogeneity and sampling methodology reproducibility.

Analytical data reports from STL were forwarded to Purves Environmental, an independent third party validator, for QA review, comparison, and validation. The QC results were evaluated and summarized in the LL–9 Quality Control Summary Report (QCSR), which is included in Appendix U.

### 3.2.3 Data Review, Validation, and Quality Assessment

Data were produced, reviewed, and reported by the laboratory in accordance with specifications outlined in the FWSAP Addendum for LL–9 (MKM, 2003a) and the laboratory's QA manual. Laboratory reports included documentation verifying compliance with sample log-in procedures, analytical holding times, and QC procedures for analyses. The laboratory reports also provided information about the percent of recovery attained in laboratory spike samples, calibration curves (initial and continuing), dilutions, and detection limits. The laboratory flagged data if results warranted.

STL performed in-house analytical data reduction under the direction of STL's Project Manager and QA Officer. These individuals were responsible for assessing data quality and informing MKM about any data that were considered to be unacceptable or that required caution on the part of the data user in terms of its reliability. This notification allowed MKM to determine whether recollection or reanalysis was required to achieve the project data quality objectives. Data reduction, review, and reporting by the laboratory were conducted as follows:

- Raw data produced by the analyst were given to the analyst's area supervisor.
- The area supervisor reviewed the data to determine whether they attained the 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 STL's Laboratory Project Manager.
- STL's Project Manager reviewed the reports and, based on that review, generated final reports.
- The final data were delivered to MKM, who forwarded the packages to Purves Environmental for data validation.

STL prepared and retained full analytical and QC documentation for the project in both hard (paper) copy and electronic storage media (e.g., magnetic tape) as directed by the analytical methodologies employed. An electronic data deliverable (EDD) was prepared in the format specified in the FWSAP (USACE, 2001a). STL provided the following information to MKM in each analytical data package submitted:

- Cover sheets listing the samples included in the report and narrative comments describing problems encountered (if any) during analysis;
- Tabulated results of inorganic and organic compounds identified and quantified; and

- Analytical results for QC sample spikes, sample duplicates, and initial and continuing calibration verifications of standards and blanks, method blanks, and laboratory control sample information.

MKM compared the data packages to the chain-of-custody forms to ensure that the requested analyses had been conducted and results provided. Purves Environmental systematically verified and validated the data. This process was conducted to ensure that the precision and accuracy of the analytical data were adequate for their intended use. The validation process minimized the potential of using false or negative results in the decision-making process and ensured that detected and non-detected compounds were accurately identified. This approach was consistent with the DQOs for the project and with the analytical methods, and appropriate for determining contaminants of concern and calculating risk.

The data validation determined that the data were 100% complete and usable and satisfied the DQOs for this project. Data validation reports are included in Appendix U.

## 3.3 Deviations from the Work Plan

Every effort was made to complete the field activities in accordance with the approved work plan. However, in some instances, circumstances or field conditions necessitated a modification. Those changes are noted below.

- Minor adjustments to surface soil sampling locations were made as a consequence of refusal.
- No surface water samples (LL9SW–002–0001–SW, LL9SW–004–0001–SW, and LL9SW–006–0001–SW) were collected from the sumps at LL–9 during the azide sampling because of insufficient sample media.
- Turbidity measured during well development, purging, and sampling did not achieve <5 NTU owing to the highly abundant and mobile fines in the formation.
- The MS/MSD frequency required by the SAP was achieved for Method 8330 analyses; however, the laboratory did not select project samples for MS/MSD analyses for all other methods. Therefore, the overall MS/MSD frequency did not meet the SAP requirements.

Although these deviations reflected unanticipated field conditions, they were discussed with Ohio EPA and the objectives of the RI were still achieved. The technical field change memos are located in Appendix J.

# 4.0 NATURE AND EXTENT OF CONTAMINATION

This section summarizes the soil (surface and subsurface), groundwater, surface water, sediment, and other analytical results. The results are organized by media or type of sample: soil (surface and subsurface), groundwater, surface water, and sediment, including samples such as standing water and residue found in the sumps and sewer manholes, and geotechnical data results. A table is provided at the end of this section that lists the analytical results that exceeded either the RVAAP installation background criteria (USACE, 2001b) criteria or Region 9 residential soil or tap water PRGs which were used to screen the initial results.

The RVAAP installation background concentrations were calculated from data obtained in the Winklepeck Burning Ground (WBG) Phase II RI (USACE, 2001b). The background criteria are based on concentrations of selected naturally occurring metals in soil, sediment, surface water, and groundwater. Background values were not established for explosives, propellants, VOCs, SVOCs, and TOC; therefore, the background value assigned to these compounds, for the purpose of this RI, is zero. For metals that were "non-detect" in the background study, the background value was established as zero (USACE, 2001b). Some metals (including cyanide and cadmium) are reported as greater than installation background criteria (USACE, 2001b) exceedances even though the reported concentrations are extremely low, compared to their respective PRGs. The Region 9 residential PRGs were obtained from the USEPA website. The Region 9 PRGs for non-carcinogenic (nc) concentrations are reported as one-tenth of the published Region 9 PRG value for soil and sediment media. This procedure takes into account the additive issues with multiple COPCs. The data tables found at the end of Section 4.0 include a column that lists the installation background criteria (USACE, 2001b) concentrations that were established for each analyte/matrix. No background criteria were established for RVAAP soils that exceed 3 ft in depth. Therefore, results for samples collected at depths greater than 3 ft were compared to the background values established for metals found in the 1–3 ft interval.

The significance of the contaminants detected in LL–9 media is discussed in the Human Health and Ecological Risk Assessments (Sections 5 and 6, respectively) of this document. QC sample results (equipment rinseate samples, trip blanks, and field duplicates) are included in Appendix U.

## 4.1 Soils

This section summarizes the physical and chemical data from the analysis of surface and subsurface soil samples collected during the LL–9 RI.

### 4.1.1 Azide Screening Surface Soil Results

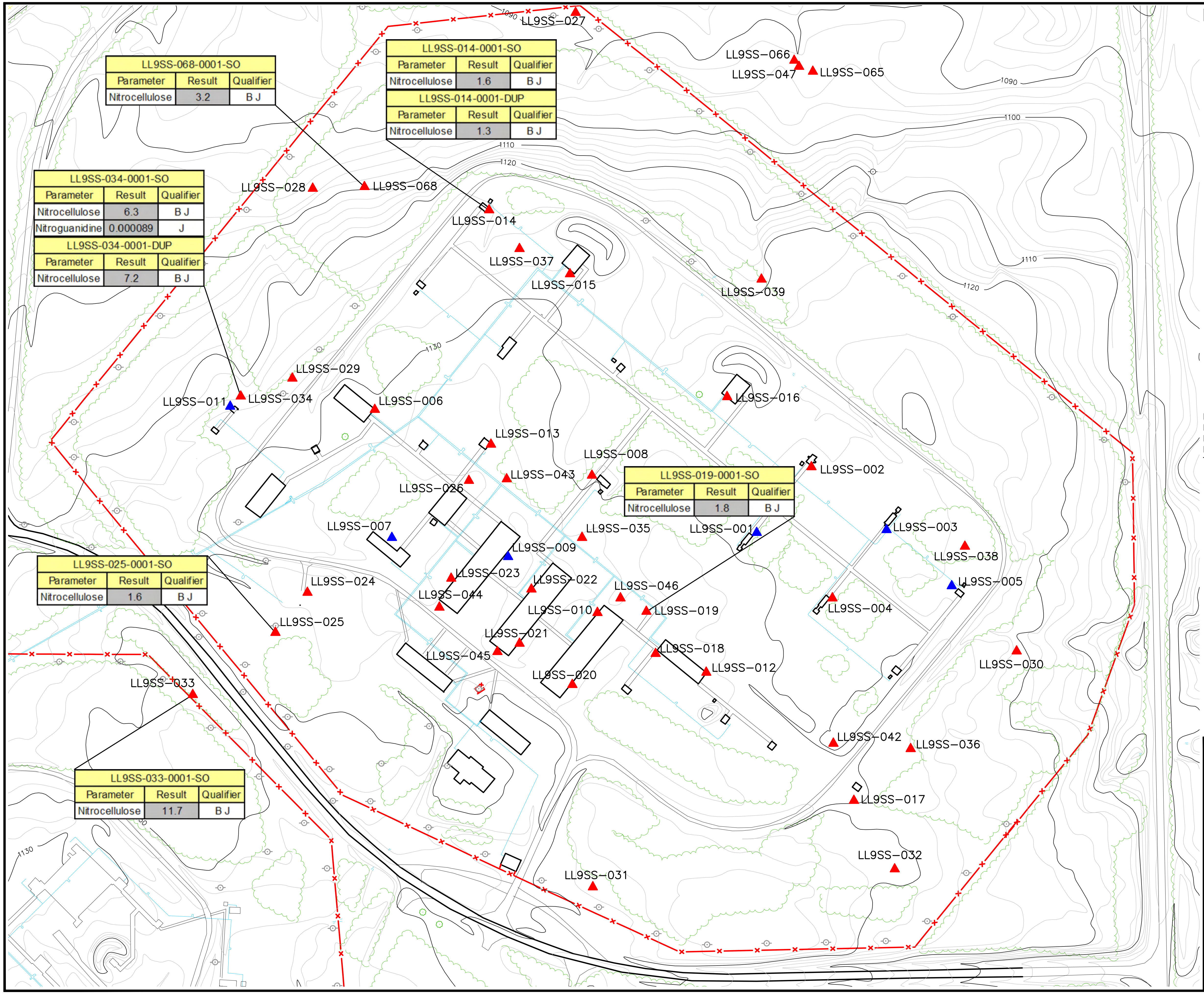
Five surface soil samples were collected and analyzed for explosives and metals during the March 2002 azide screening event; (LL9SS–001–0001–SO, LL9SS–003–0001–SO, LL9SS–005–0001–SO, LL9SS–007–0001–SO, and LL9SS–009–0001–SO). Analytical results are included in Appendix E and summarized in Table 4–1, Summary of Azide Screening Surface Soil Results (0–1 ft) (included at the end of Section 4.0). There were no explosives detected above the reporting limit. Metals exceeded the RVAAP-specific surface soil background values established by USACE (USACE, 2001b) and/or Region 9 residential soil PRG in five samples: LL9SS–001–0001–SO, LL9SS–003–0001–SO, LL9SS–005–0001–SO, LL9SS–007–0001–SO, and LL9SS–009–0001–SO. These exceedances are summarized in Table 4–2 Summary of Surface Soil Exceedences (0–1 ft bgs) (included at the end of Section 4.0).

### 4.1.2 RI Surface Soil Results

Forty surface soil samples and seven duplicates were collected at various locations at LL–9 during the RI. Each sample was collected from the surface to a depth of 1 ft (0–1ft) bgs. Soils collected at depths greater than 1 ft were considered subsurface soil samples and are discussed in Subsection 4.1.4. The surface soil samples were analyzed for TAL metals. In addition to TAL metals, 10% of the samples collected were analyzed for explosives, cyanides, VOCs, SVOCs, PCBs, pesticides, and propellants. Surface sample analytical results are included in Appendix F and summarized in Table 4-3, Summary of Surface Soil Results (0–1 ft) (included at the end of Section 4.0).

Propellants (nitrocellulose and nitroguanidine), SVOCs (benzo[a]pyrene and dibenzo[a,h]anthracene) and metals (aluminum, arsenic, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, vanadium, and zinc) were detected in surface soils at concentrations greater than RVAAP installation background (USACE, 2001b) concentrations, Region 9 residential soil preliminary remediation goals (PRGs), or both. Therefore, the lateral and vertical extent of explosives, propellants, SVOCs, and metals were not fully delineated during this Phase I RI. The lateral extent of surface soil contamination at LL–9 (as determined by this Phase I RI) is shown on Figures 4–1 through 4–3. The distribution of selected site related contaminants (aluminum, arsenic, chromium, copper, lead, manganese, and mercury) identified as COPCs in Section 6.2.3 of this document, are shown in Figures 4–4 through 4–11. The distribution and exposure pathways for SRCs are further discussed in the conceptual site model included in Section 5.4.

Exceedances for the 47 surface soil samples (including duplicates) and 5 surface soil samples collected during the azide sampling event are summarized in Table 4-2. Specific exceedences for each analytical parameter are discussed in the following subsections.



| LL9SS-068-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Nitrocellulose | 3.2 | B J |

| LL9SS-014-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Nitrocellulose | 1.6 | B J |
| **LL9SS-014-0001-DUP** | | |
| Parameter | Result | Qualifier |
| Nitrocellulose | 1.3 | B J |

| LL9SS-034-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Nitrocellulose | 6.3 | B J |
| Nitroguanidine | 0.000089 | J |
| **LL9SS-034-0001-DUP** | | |
| Parameter | Result | Qualifier |
| Nitrocellulose | 7.2 | B J |

| LL9SS-019-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Nitrocellulose | 1.8 | B J |

| LL9SS-025-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Nitrocellulose | 1.6 | B J |

| LL9SS-033-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Nitrocellulose | 11.7 | B J |

## LEGEND:

VEGETATION
INTERMITTENT STREAM
STREAM
PIPING
ROAD
10 ft INTERVAL
2 ft INTERVAL
STEAM LINE POST
SURFACE SOIL SAMPLE LOCATION
SURFACE SOIL SAMPLING LOCATION TAKEN DURING AZIDE SCREENING
BUILDING
FENCE

## NOTES:

UNITS = mg/kg
IF RESULT ≥ BACKGROUND, THEN THE VALUE IS SHADED
IF RESULT ≥ THE PRG THEN THE VALUE IS LISTED IN BOLD TEXT
IF RESULT ≥ BACKGROUND AND THE PRG THE VALUE IS BOLD + SHADED
IF RESULT < BACKGROUND AND PRG THEN THE VALUE IS LISTED IN NORMAL TEXT

ORGANIC QUALIFIERS
U – ANALYTE WAS NOT DETECTED AT OR ABOVE THE STATED LIMIT
J – RESULT IS AN ESTIMATED VALUE BELOW THE RL

ORGANIC FLAGS
B – METHOD BLANK: BATCH QC IS GREATER THAN RL
* – BATCH QC EXCEEDS THE UPPER OR LOWER CONTROL LIMIT
^ – BATCH QC IS GREATER THAN RL
A – CONCENTRATION IS BELOW THE METHOD REPORTING LIMIT (RL)
H – ALTERNATE PEAK SELECTION UPON ANALYTICAL REVIEW

0' 100' 200' 300'
1" = 200'

N

**MKM Engineers**
**4153 Bluebonnet Drive**
**Stafford, TX 77477**

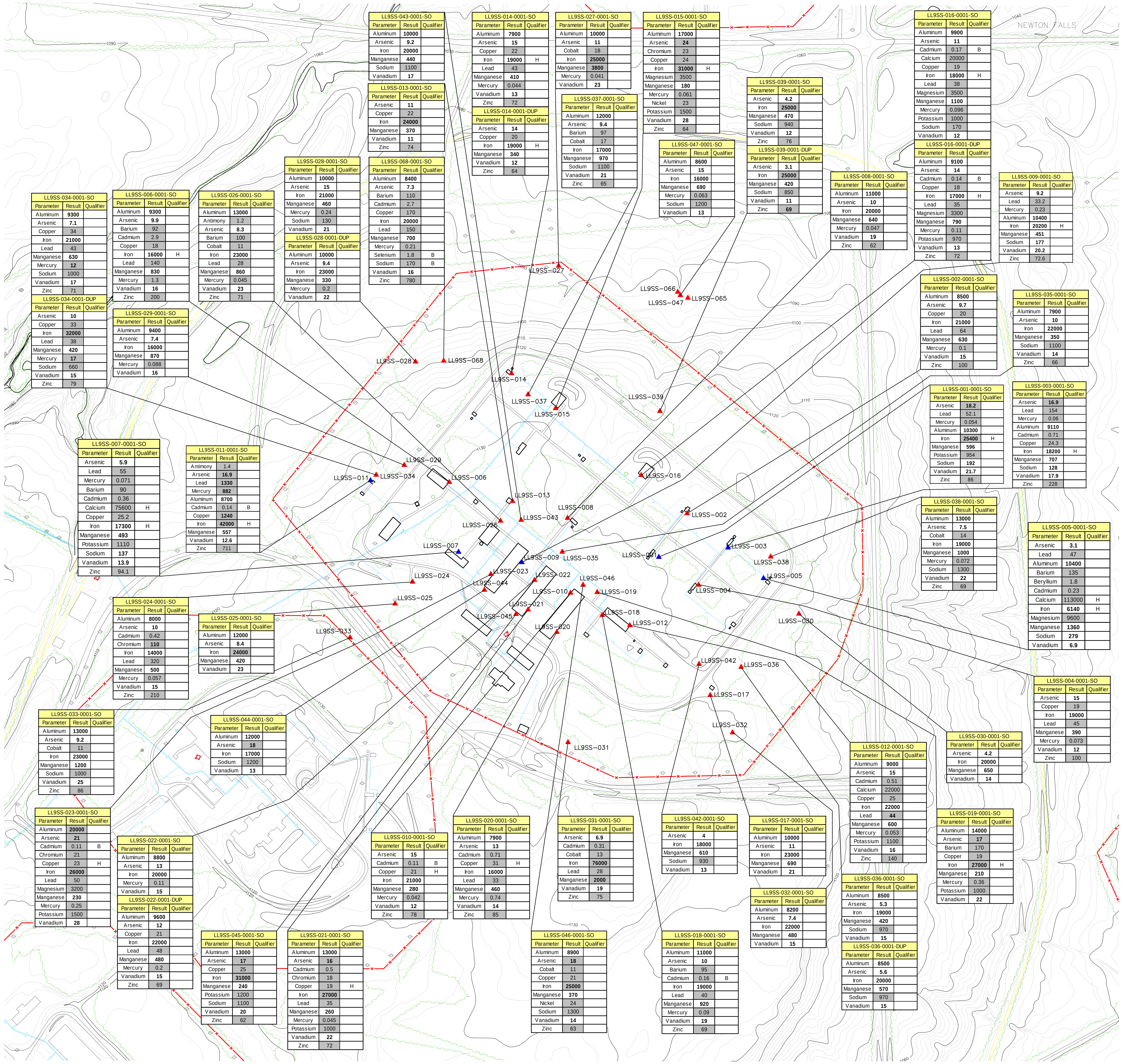
**RAVENNA ARMY AMMUNITION PLANT**
**RAVENNA, OHIO**

FIGURE 4–1

SURFACE SOIL SAMPLE (0–1Ft)
EXCEEDANCES EXPLOSIVE/PROPELLANTS

**LL 9 REMEDIAL INVESTIGATION**

| SIZE | PROJECT NO. | DATE: | REV |
|---|---|---|---|
| B | 02–02–0085 | MAY 2007 | 2 |
| DRAWN BY | R. BOWMAN | APPR. BY | SL |



LL9SS-034-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **9300** | |
| Arsenic | **7.1** | |
| Copper | 34 | |
| Iron | **21000** | |
| Lead | 43 | |
| Manganese | **630** | |
| Mercury | **12** | |
| Sodium | 1000 | |
| Vanadium | **17** | |
| Zinc | 71 | |

LL9SS-034-0001-DUP

| Parameter | Result | Qualifier |
|---|---|---|
| Arsenic | **10** | |
| Copper | 33 | |
| Iron | **32000** | |
| Lead | 38 | |
| Manganese | **420** | |
| Mercury | **17** | |
| Sodium | 660 | |
| Vanadium | **15** | |
| Zinc | 79 | |

LL9SS-006-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **9300** | |
| Arsenic | **9.9** | |
| Barium | 92 | |
| Cadmium | 2.9 | |
| Copper | 18 | |
| Iron | **16000** | H |
| Lead | 140 | |
| Manganese | **830** | |
| Mercury | 1.3 | |
| Vanadium | **16** | |
| Zinc | 200 | |

LL9SS-029-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **9400** | |
| Arsenic | **7.4** | |
| Iron | **16000** | |
| Manganese | **870** | |
| Mercury | 0.088 | |
| Vanadium | **16** | |

LL9SS-026-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **13000** | |
| Antimony | 1.2 | |
| Arsenic | **8.3** | |
| Barium | 100 | |
| Cobalt | 11 | |
| Iron | **23000** | |
| Lead | 28 | |
| Manganese | **860** | |
| Mercury | 0.045 | |
| Vanadium | **23** | |
| Zinc | 71 | |

LL9SS-028-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **10000** | |
| Arsenic | **15** | |
| Iron | **21000** | |
| Manganese | **460** | |
| Mercury | 0.24 | |
| Sodium | 130 | |
| Vanadium | **21** | |

LL9SS-028-0001-DUP

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **10000** | |
| Arsenic | **9.4** | |
| Iron | **23000** | |
| Manganese | **330** | |
| Mercury | 0.2 | |
| Vanadium | **22** | |

LL9SS-043-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **10000** | |
| Arsenic | **9.2** | |
| Iron | **20000** | |
| Manganese | **440** | |
| Sodium | 1100 | |
| Vanadium | **17** | |

LL9SS-013-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Arsenic | **11** | |
| Copper | 22 | |
| Iron | **24000** | |
| Manganese | **370** | |
| Vanadium | **11** | |
| Zinc | 74 | |

LL9SS-068-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **8400** | |
| Arsenic | **7.3** | |
| Barium | 110 | |
| Cadmium | 2.7 | |
| Copper | 170 | |
| Iron | **20000** | |
| Lead | 150 | |
| Manganese | **700** | |
| Mercury | 0.21 | |
| Selenium | 1.8 | B |
| Sodium | 170 | B |
| Vanadium | **16** | |
| Zinc | 780 | |

LL9SS-014-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **7900** | |
| Arsenic | **15** | |
| Copper | 22 | |
| Iron | **19000** | H |
| Lead | 43 | |
| Manganese | **410** | |
| Mercury | 0.044 | |
| Vanadium | **13** | |
| Zinc | 72 | |

LL9SS-014-0001-DUP

| Parameter | Result | Qualifier |
|---|---|---|
| Arsenic | **14** | |
| Copper | 20 | |
| Iron | **19000** | H |
| Manganese | **340** | |
| Vanadium | **12** | |
| Zinc | 64 | |

LL9SS-027-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **10000** | |
| Arsenic | **11** | |
| Cobalt | 18 | |
| Iron | **25000** | |
| Manganese | **3800** | |
| Mercury | 0.041 | |
| Vanadium | **23** | |

LL9SS-037-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **12000** | |
| Arsenic | **9.4** | |
| Barium | 97 | |
| Cobalt | 17 | |
| Iron | **17000** | |
| Manganese | **970** | |
| Sodium | 1100 | |
| Vanadium | **21** | |
| Zinc | 65 | |

LL9SS-015-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **17000** | |
| Arsenic | **24** | |
| Chromium | 23 | |
| Copper | 24 | |
| Iron | **31000** | H |
| Magnesium | 3500 | |
| Manganese | **180** | |
| Mercury | 0.061 | |
| Nickel | 23 | |
| Potassium | 1500 | |
| Vanadium | **28** | |
| Zinc | 64 | |

LL9SS-047-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **8600** | |
| Arsenic | **15** | |
| Iron | **16000** | |
| Manganese | **690** | |
| Mercury | 0.063 | |
| Sodium | 1200 | |
| Vanadium | **13** | |

LL9SS-039-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Arsenic | **4.2** | |
| Iron | **25000** | |
| Manganese | **470** | |
| Sodium | 940 | |
| Vanadium | **12** | |
| Zinc | 76 | |

LL9SS-039-0001-DUP

| Parameter | Result | Qualifier |
|---|---|---|
| Arsenic | **3.1** | |
| Iron | **25000** | |
| Manganese | **420** | |
| Sodium | 850 | |
| Vanadium | **11** | |
| Zinc | **69** | |

LL9SS-008-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **11000** | |
| Arsenic | **10** | |
| Iron | **20000** | |
| Manganese | **640** | |
| Mercury | 0.047 | |
| Vanadium | **19** | |
| Zinc | 62 | |

LL9SS-016-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **9900** | |
| Arsenic | **11** | |
| Cadmium | 0.17 | B |
| Calcium | 20000 | |
| Copper | 19 | |
| Iron | **18000** | H |
| Lead | 38 | |
| Magnesium | 3500 | |
| Manganese | **1100** | |
| Mercury | 0.096 | |
| Potassium | 1000 | |
| Sodium | 170 | |
| Vanadium | **12** | |

LL9SS-016-0001-DUP

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **9100** | |
| Arsenic | **14** | |
| Cadmium | 0.14 | B |
| Copper | 18 | |
| Iron | **17000** | H |
| Lead | 35 | |
| Magnesium | 3300 | |
| Manganese | **790** | |
| Mercury | 0.11 | |
| Potassium | 970 | |
| Vanadium | **13** | |
| Zinc | 72 | |

LL9SS-009-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Arsenic | **9.2** | |
| Lead | 33.2 | |
| Mercury | 0.23 | |
| Aluminum | **10400** | |
| Iron | **20200** | H |
| Manganese | **451** | |
| Sodium | **177** | |
| Vanadium | **20.2** | |
| Zinc | 72.6 | |

LL9SS-002-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **8500** | |
| Arsenic | **9.7** | |
| Copper | 20 | |
| Iron | **21000** | |
| Lead | 64 | |
| Manganese | **630** | |
| Mercury | 0.1 | |
| Vanadium | **15** | |
| Zinc | 100 | |

LL9SS-035-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **7900** | |
| Arsenic | **10** | |
| Iron | **22000** | |
| Manganese | **350** | |
| Sodium | 1100 | |
| Vanadium | **14** | |
| Zinc | 66 | |

LL9SS-001-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Arsenic | **18.2** | |
| Lead | 52.1 | |
| Mercury | 0.054 | |
| Aluminum | **10300** | |
| Iron | **25400** | H |
| Manganese | **596** | |
| Potassium | 954 | |
| Sodium | **192** | |
| Vanadium | **21.7** | |
| Zinc | 86 | |

LL9SS-003-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Arsenic | **16.9** | |
| Lead | 154 | |
| Mercury | 0.06 | |
| Aluminum | **9110** | |
| Cadmium | 0.71 | |
| Copper | 24.3 | |
| Iron | **18200** | H |
| Manganese | **707** | |
| Sodium | **128** | |
| Vanadium | **17.9** | |
| Zinc | 228 | |

LL9SS-038-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **13000** | |
| Arsenic | **7.5** | |
| Cobalt | 14 | |
| Iron | **19000** | |
| Manganese | **1000** | |
| Mercury | 0.072 | |
| Sodium | 1300 | |
| Vanadium | **22** | |
| Zinc | 69 | |

LL9SS-005-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Arsenic | **3.1** | |
| Lead | 47 | |
| Aluminum | **10400** | |
| Barium | 135 | |
| Beryllium | 1.8 | |
| Cadmium | 0.23 | |
| Calcium | 113000 | H |
| Iron | **6140** | H |
| Magnesium | 9600 | |
| Manganese | **1360** | |
| Sodium | **279** | |
| Vanadium | **6.9** | |

LL9SS-004-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Arsenic | **15** | |
| Copper | 19 | |
| Iron | **19000** | |
| Lead | 45 | |
| Manganese | **390** | |
| Mercury | 0.073 | |
| Vanadium | **12** | |
| Zinc | 100 | |

LL9SS-030-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Arsenic | **4.2** | |
| Iron | **20000** | |
| Manganese | **650** | |
| Vanadium | **14** | |

LL9SS-007-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Arsenic | **5.9** | |
| Lead | 55 | |
| Mercury | 0.071 | |
| Barium | 90 | |
| Cadmium | 0.36 | |
| Calcium | 75600 | H |
| Copper | 25.2 | |
| Iron | **17300** | H |
| Manganese | **493** | |
| Potassium | 1110 | |
| Sodium | **137** | |
| Vanadium | **13.9** | |
| Zinc | 94.1 | |

LL9SS-011-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Antimony | 1.4 | |
| Arsenic | **16.9** | |
| Lead | **1330** | |
| Mercury | **882** | |
| Aluminum | **8700** | |
| Cadmium | 0.14 | B |
| Copper | **1240** | |
| Iron | **42000** | H |
| Manganese | **557** | |
| Vanadium | **12.6** | |
| Zinc | 711 | |

LL9SS-024-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **8000** | |
| Arsenic | **10** | |
| Cadmium | 0.42 | |
| Chromium | **110** | |
| Iron | **14000** | |
| Lead | 320 | |
| Manganese | **500** | |
| Mercury | 0.057 | |
| Vanadium | **15** | |
| Zinc | 210 | |

LL9SS-025-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **12000** | |
| Arsenic | **8.4** | |
| Iron | **24000** | |
| Manganese | **420** | |
| Vanadium | **23** | |

LL9SS-033-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **13000** | |
| Arsenic | **9.2** | |
| Cobalt | 11 | |
| Iron | **23000** | |
| Manganese | **1200** | |
| Sodium | 1000 | |
| Vanadium | **25** | |
| Zinc | 86 | |

LL9SS-044-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **12000** | |
| Arsenic | **18** | |
| Iron | **17000** | |
| Sodium | 1200 | |
| Vanadium | **13** | |

LL9SS-023-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **20000** | |
| Arsenic | **21** | |
| Cadmium | 0.11 | B |
| Chromium | 21 | |
| Copper | 23 | H |
| Iron | **26000** | |
| Lead | 50 | |
| Magnesium | 3200 | |
| Manganese | **230** | |
| Mercury | 0.25 | |
| Potassium | 1500 | |
| Vanadium | **28** | |

LL9SS-022-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **8800** | |
| Arsenic | **13** | |
| Iron | **20000** | |
| Mercury | 0.11 | |
| Vanadium | **15** | |

LL9SS-022-0001-DUP

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **9600** | |
| Arsenic | **12** | |
| Copper | 21 | |
| Iron | **22000** | |
| Lead | 48 | |
| Manganese | **480** | |
| Mercury | 0.2 | |
| Vanadium | **15** | |
| Zinc | 69 | |

LL9SS-045-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **13000** | |
| Arsenic | **17** | |
| Copper | 25 | |
| Iron | **31000** | |
| Manganese | **240** | |
| Potassium | 1200 | |
| Sodium | 1100 | |
| Vanadium | **20** | |
| Zinc | 62 | |

LL9SS-021-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **13000** | |
| Arsenic | **16** | |
| Cadmium | 0.5 | |
| Chromium | 18 | |
| Copper | 19 | H |
| Iron | **27000** | |
| Lead | 35 | |
| Manganese | **260** | |
| Mercury | 0.045 | |
| Potassium | 1000 | |
| Vanadium | **22** | |
| Zinc | 72 | |

LL9SS-010-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Arsenic | **15** | |
| Cadmium | 0.11 | B |
| Copper | 21 | H |
| Iron | **21000** | |
| Manganese | **280** | |
| Mercury | 0.042 | |
| Vanadium | **12** | |
| Zinc | 78 | |

LL9SS-020-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **7900** | |
| Arsenic | **13** | |
| Cadmium | 0.71 | |
| Copper | 31 | H |
| Iron | **16000** | |
| Lead | 33 | |
| Manganese | **460** | |
| Mercury | 0.74 | |
| Vanadium | **14** | |
| Zinc | 85 | |

LL9SS-031-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Arsenic | **6.9** | |
| Cadmium | 0.31 | |
| Cobalt | 13 | |
| Iron | **76000** | |
| Lead | 28 | |
| Manganese | **2000** | |
| Vanadium | **19** | |
| Zinc | 75 | |

LL9SS-046-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **8900** | |
| Arsenic | **18** | |
| Cobalt | 11 | |
| Copper | 21 | |
| Iron | **25000** | |
| Manganese | **370** | |
| Nickel | 24 | |
| Sodium | 1300 | |
| Vanadium | **14** | |
| Zinc | 63 | |

LL9SS-042-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Arsenic | **4** | |
| Iron | **18000** | |
| Manganese | **610** | |
| Sodium | 930 | |
| Vanadium | **13** | |

LL9SS-018-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **11000** | |
| Arsenic | **10** | |
| Barium | 95 | |
| Cadmium | 0.16 | B |
| Iron | **19000** | |
| Lead | 40 | |
| Manganese | **920** | |
| Mercury | 0.09 | |
| Vanadium | **19** | |
| Zinc | 69 | |

LL9SS-017-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **10000** | |
| Arsenic | **11** | |
| Iron | **23000** | |
| Manganese | **690** | |
| Vanadium | **21** | |

LL9SS-032-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **8200** | |
| Arsenic | **7.4** | |
| Iron | **22000** | |
| Manganese | **480** | |
| Vanadium | **15** | |

LL9SS-012-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **9000** | |
| Arsenic | **15** | |
| Cadmium | 0.51 | |
| Calcium | 22000 | |
| Copper | 25 | |
| Iron | **22000** | |
| Lead | **44** | |
| Manganese | **600** | |
| Mercury | 0.053 | |
| Potassium | 1100 | |
| Vanadium | **16** | |
| Zinc | 140 | |

LL9SS-036-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **8500** | |
| Arsenic | **5.3** | |
| Iron | **19000** | |
| Manganese | **420** | |
| Sodium | 970 | |
| Vanadium | **15** | |

LL9SS-036-0001-DUP

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **8500** | |
| Arsenic | **5.6** | |
| Iron | **20000** | |
| Manganese | **570** | |
| Sodium | 970 | |
| Vanadium | **15** | |

LL9SS-019-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Aluminum | **14000** | |
| Arsenic | **17** | |
| Barium | 170 | |
| Copper | 19 | |
| Iron | **27000** | H |
| Manganese | **210** | |
| Mercury | 0.36 | |
| Potassium | 1000 | |
| Vanadium | **22** | |

LEGEND:

| | |
|---|---|
| 〰 | VEGETATION |
| — · · · — | INTERMITTENT STREAM |
| —···—···— | STREAM |
| — | PIPING |
| — | ROAD |
| — | 10 ft INTERVAL |
| — | 2 ft INTERVAL |
| ⊙ | STEAM LINE POST |
| ▲ | SURFACE SOIL SAMPLE LOCATION |
| ▲ | SURFACE SOIL SAMPLING LOCATION TAKEN DURING AZIDE SCREENING |
| ▭ | BUILDING |
| ▭ | FENCE |

NOTES:

RESULTS SHOWN IN mk/kg

IF RESULT ≥ BACKGROUND, THEN THE VALUE IS SHADED
IF RESULT ≥ THE PRG THEN THE VALUE IS LISTED IN BOLD TEXT
IF RESULT ≥ BACKGROUND AND THE PRG THE VALUE IS BOLD + SHADED
IF RESULT < BACKGROUND AND PRG THEN THE VALUE IS LISTED IN NORMAL TEXT

INORGANIC QUALIFIERS
U – ANALYTE WAS NOT DETECTED AT OR ABOVE THE STATED LIMIT
J – RESULT IS LESS THAN THE RL, BUT GREATER THAN OR EQUAL TO THE MDL
B – RESULT IS LESS THAN THE CRDL/RL, BUT GREATER THAN OR EQUAL TO THE IDL/MDL

INORGANIC FLAGS
^ – INSTRUMENT RELATED QC EXCEED THE UPPER OR LOWER CONTROL LIMITS
* – BATCH QC EXCEEDS THE UPPER OR LOWER CONTROL LIMIT
H – BATCH QC IS GREATER THAN RL

N

0' 100' 200' 300'
1" = 200'

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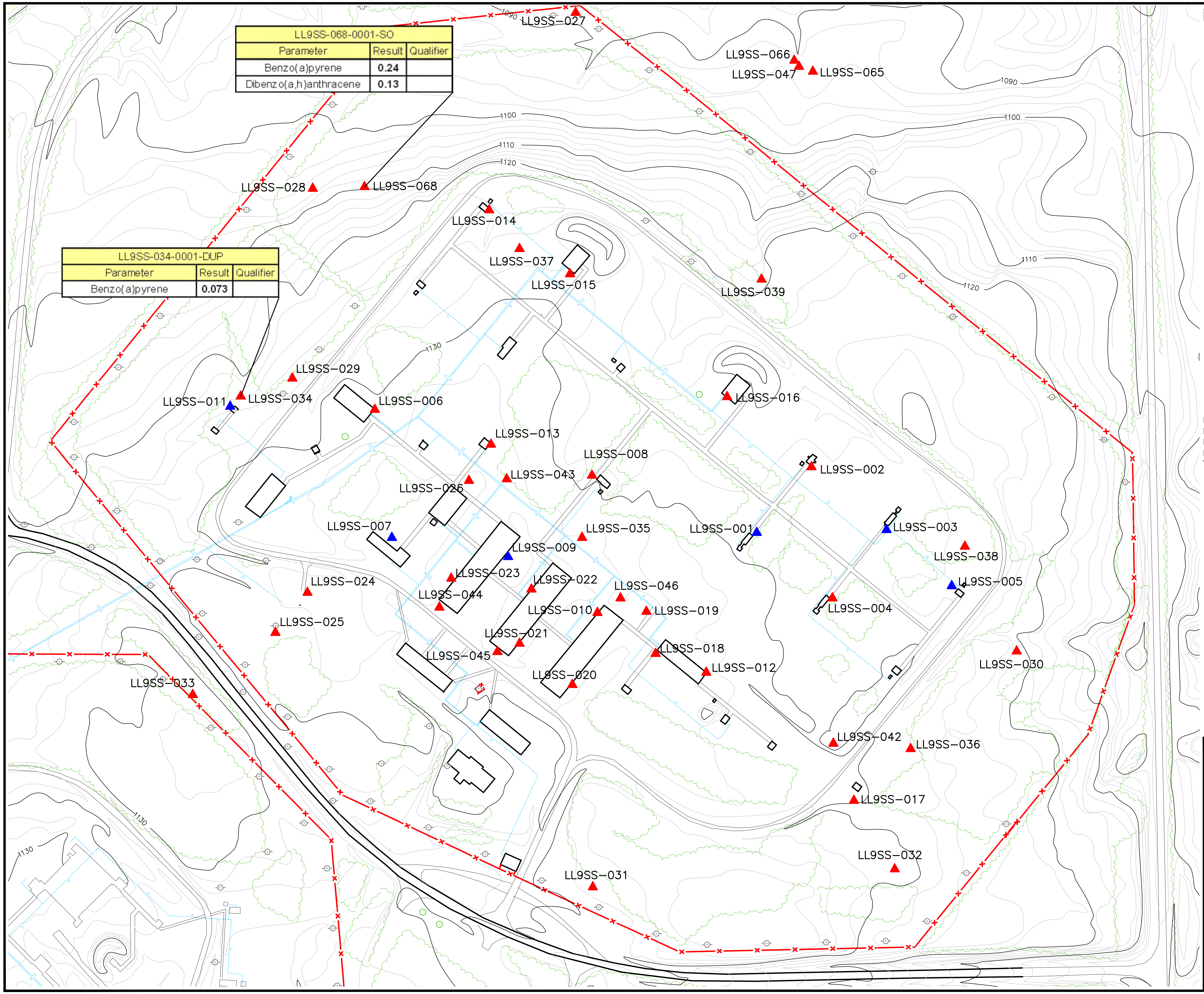
RAVENNA, OHIO

FIGURE 4–2

SURFACE SOIL SAMPLE (0–1Ft)
EXCEEDANCES TAL METALS/CYANIDE

LL 9 REMEDIAL INVESTIGATION

| SIZE | PROJECT NO. | DATE: | REV |
|---|---|---|---|
| D | 02–02–0085 | MAY 2007 | 2 |
| DRAWN BY | R. BOWMAN | APPR. BY | SL |



| LL9SS-068-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Benzo(a)pyrene | **0.24** | |
| Dibenzo(a,h)anthracene | **0.13** | |

| LL9SS-034-0001-DUP | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Benzo(a)pyrene | **0.073** | |

LEGEND:

| | |
|---|---|
| | VEGETATION |
| | INTERMITTENT STREAM |
| | STREAM |
| | PIPING |
| | ROAD |
| | 10 ft INTERVAL |
| | 2 ft INTERVAL |
| | STEAM LINE POST |
| ▲ | SURFACE SOIL SAMPLE LOCATION |
| ▲ | SURFACE SOIL SAMPLING LOCATION TAKE DURING AZIDE SCREENING |
| ☐ | BUILDING |
| | FENCE |

NOTES:

RESULTS SHOWN IN mg/kg
IF RESULT ≥ BACKGROUND, THEN THE VALUE IS SHADED
IF RESULT ≥ THE PRG THEN THE VALUE IS LISTED IN BOLD TEXT
IF RESULT ≥ BACKGROUND AND THE PRG THE VALUE IS BOLD + SHADED
IF RESULT < BACKGROUND AND PRG THEN THE VALUE IS LISTED IN NORMAL TEXT

ORGANIC QUALIFIERS
U – ANALYTE WAS NOT DETECTED AT OR ABOVE THE STATED LIMIT
J – RESULT IS AN ESTIMATED VALUE BELOW THE RL

ORGANIC FLAGS
B – METHOD BLANK: BATCH QC IS GREATER THAN RL
* – BATCH QC EXCEEDS THE UPPER OR LOWER CONTROL LIMIT
^ – BATCH QC IS GREATER THAN RL
A – CONCENTRATION IS BELOW THE METHOD REPORTING LIMIT (RL)
H – ALTERNATE PEAK SELECTION UPON ANALYTICAL REVIEW

N

0' 100' 200' 300'
1" = 200'

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## RAVENNA ARMY AMMUNITION PLANT
## RAVENNA, OHIO

FIGURE 4–3

SURFACE SOIL SAMPLE (0–1Ft)
EXCEEDANCES VOCs/SVOCs

**LL 9 REMEDIAL INVESTIGATION**

| SIZE | PROJECT NO. | DATE: | REV |
|---|---|---|---|
| B | 02–02–0085 | MAY 2007 | 2 |
| DRAWN BY | K. PERRY | APPR. BY | SL |

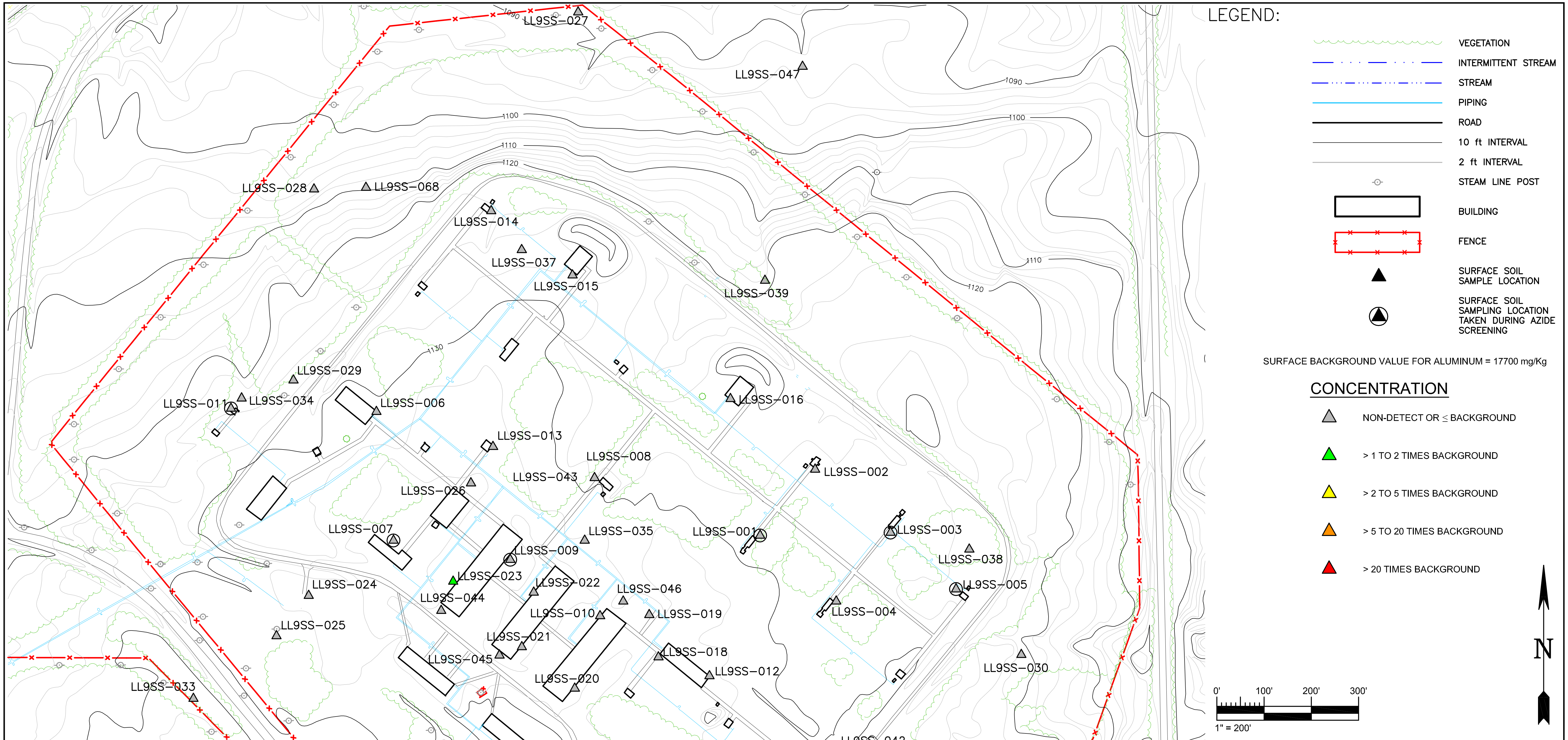

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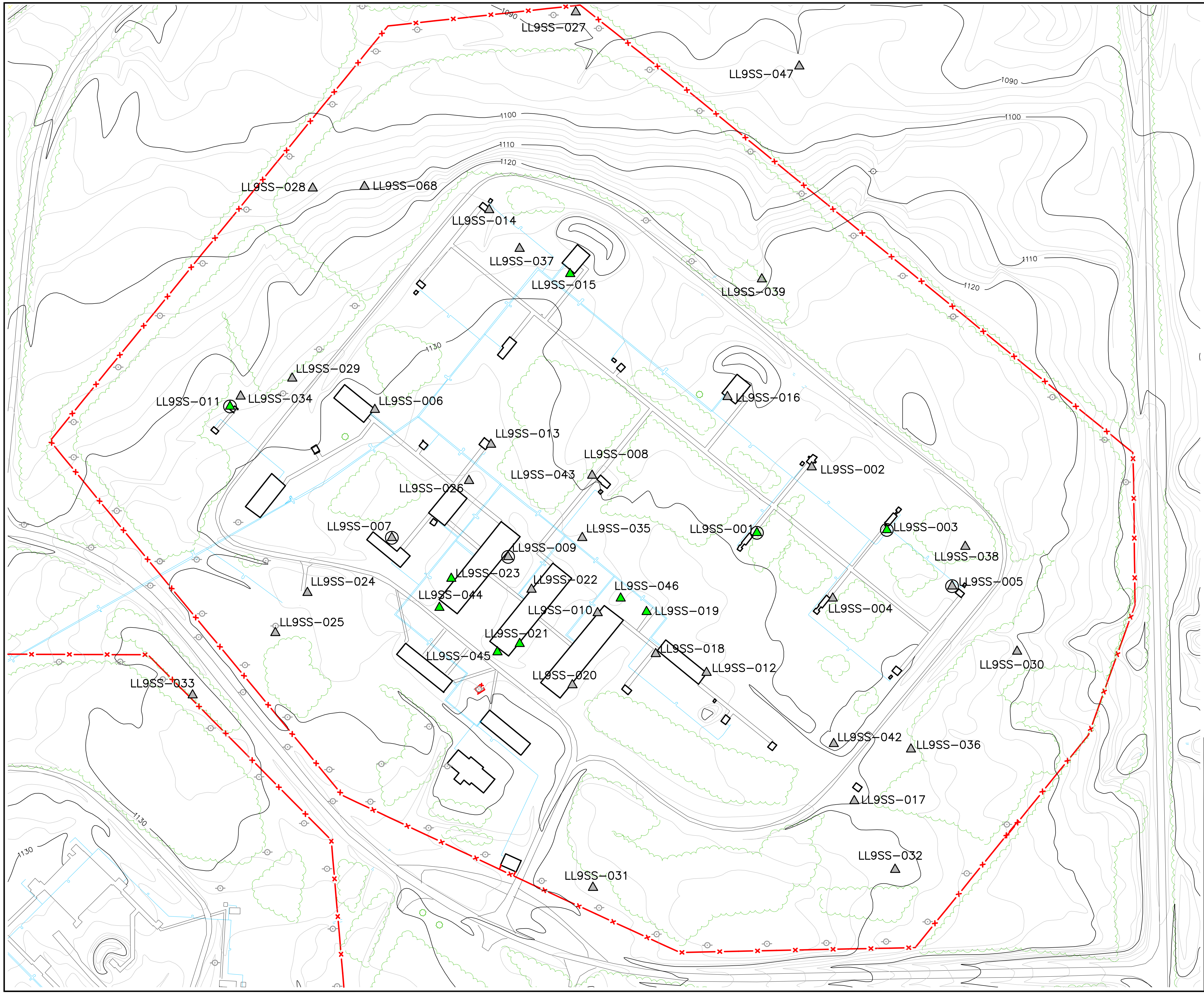
FIGURE 4-4

SURFACE SOIL SAMPLE (0-1Ft)
DISTRIBUTION OF ALUMINUM

LL 9 REMEDIAL INVESTIGATION

| SIZE | PROJECT NO. | DATE: | REV |
|---|---|---|---|
| B | 02-02-0085 | MAY 2007 | 2 |

| DRAWN BY | K. PERRY | APPR. BY | SL |
|---|---|---|---|



LEGEND:

| | |
|---|---|
| | VEGETATION |
| | INTERMITTENT STREAM |
| | STREAM |
| | PIPING |
| | ROAD |
| | 10 ft INTERVAL |
| | 2 ft INTERVAL |
| | STEAM LINE POST |
| | BUILDING |
| | FENCE |
| ▲ | SURFACE SOIL SAMPLE LOCATION |
| ▲ | SURFACE SOIL SAMPLING LOCATION TAKEN DURING AZIDE SCREENING |

SURFACE BACKGROUND VALUE FOR ARSENIC = 15.4 mg/Kg

CONCENTRATION

| | |
|---|---|
| ▲ | NON-DETECT OR ≤ BACKGROUND |
| ▲ | > 1 TO 2 TIMES BACKGROUND |
| ▲ | > 2 TO 5 TIMES BACKGROUND |
| ▲ | > 5 TO 20 TIMES BACKGROUND |
| ▲ | > 20 TIMES BACKGROUND |

N

0' 100' 200' 300'

1" = 200'

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FIGURE 4–5

SURFACE SOIL SAMPLE (0–1Ft)
DISTRIBUTION OF ARSENIC

LL 9 REMEDIAL INVESTIGATION

| SIZE | PROJECT NO. | DATE: | REV |
|---|---|---|---|
| B | 02–02–0085 | MAY 2007 | 2 |

| DRAWN BY | K. PERRY | APPR. BY | SL |
|---|---|---|---|

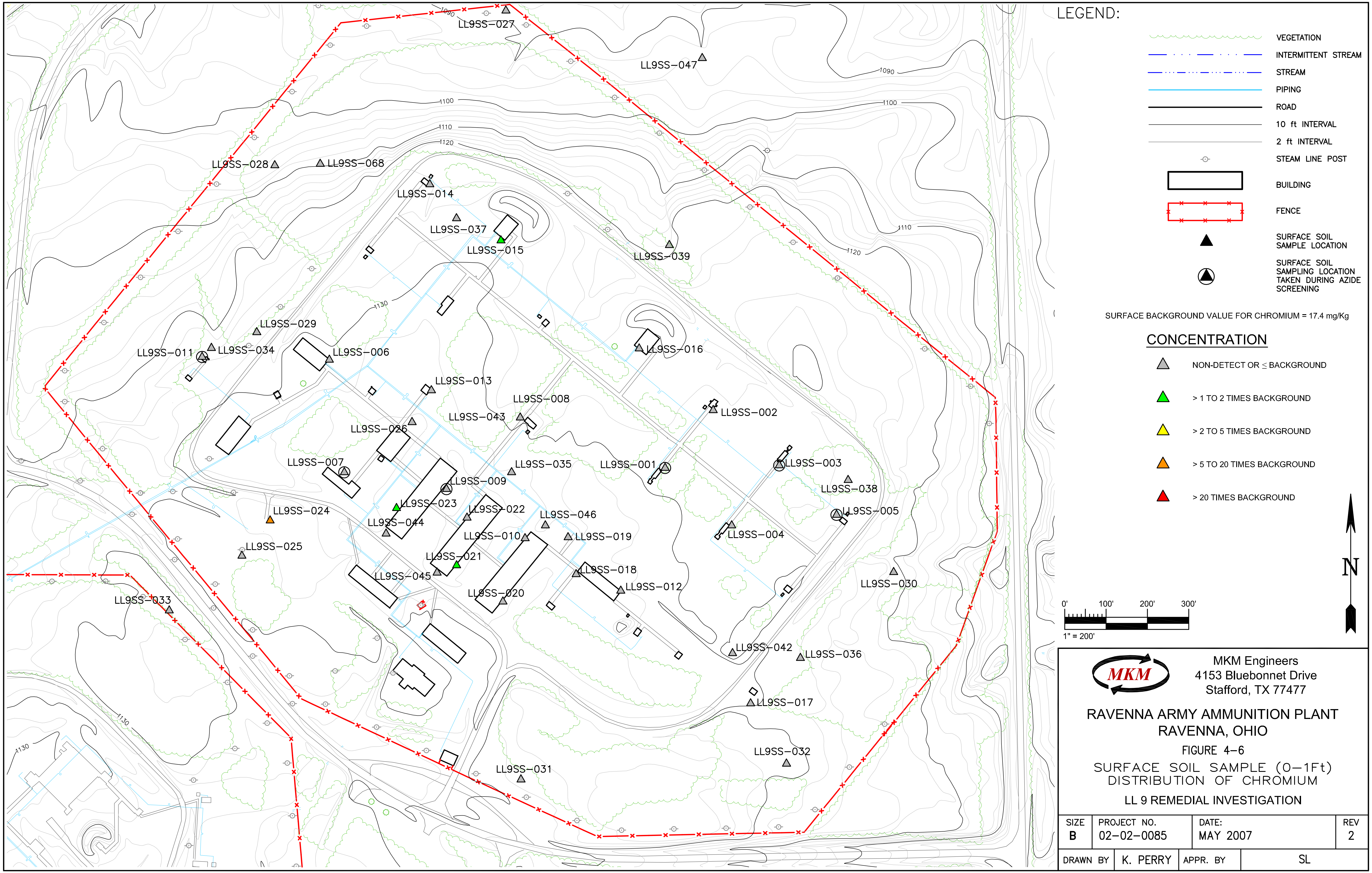

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FIGURE 4–6

SURFACE SOIL SAMPLE (0–1Ft)
DISTRIBUTION OF CHROMIUM

LL 9 REMEDIAL INVESTIGATION

| SIZE | PROJECT NO. | DATE: | REV |
|---|---|---|---|
| B | 02–02–0085 | MAY 2007 | 2 |

| DRAWN BY | K. PERRY | APPR. BY | SL |
|---|---|---|---|

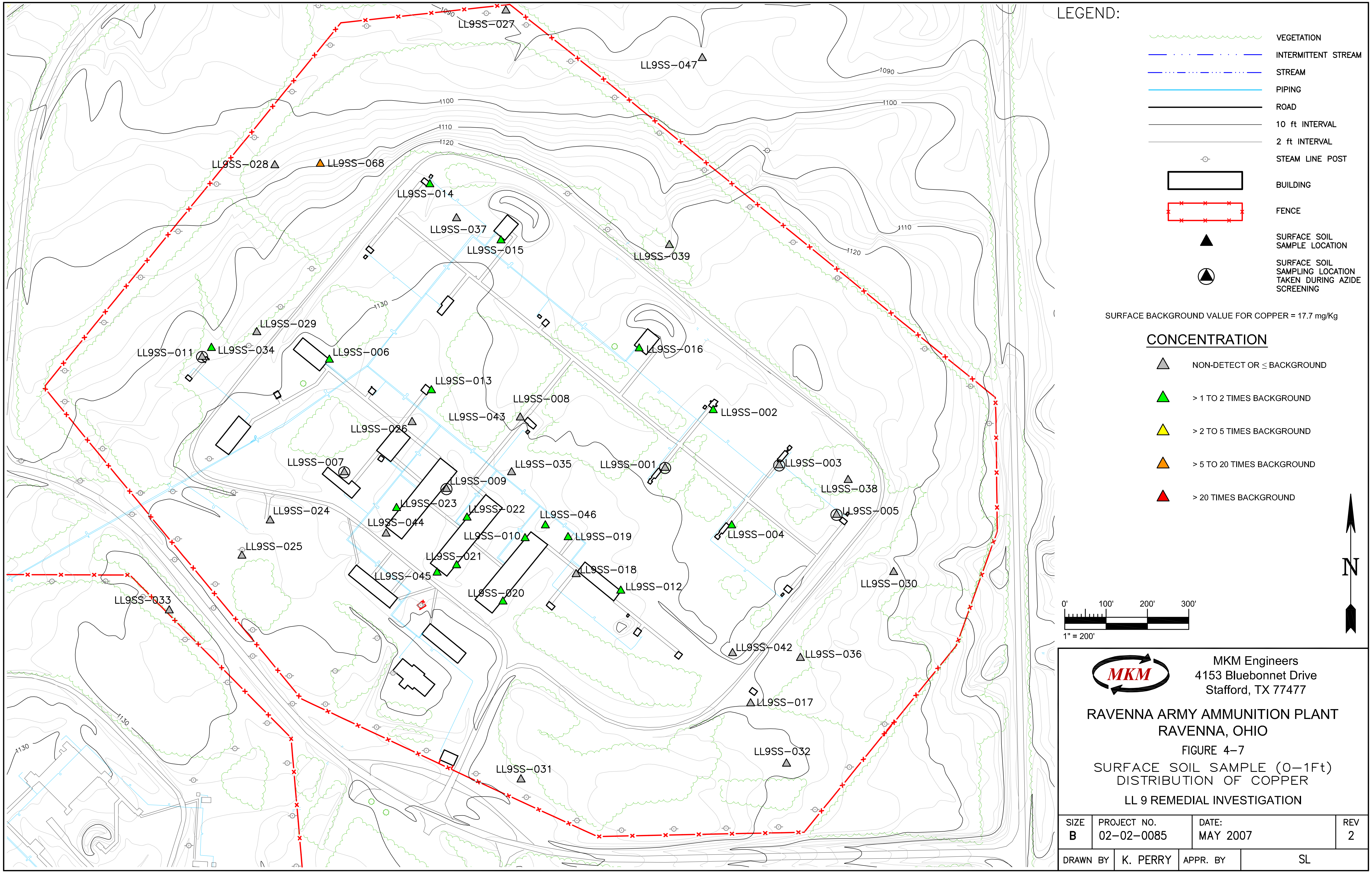

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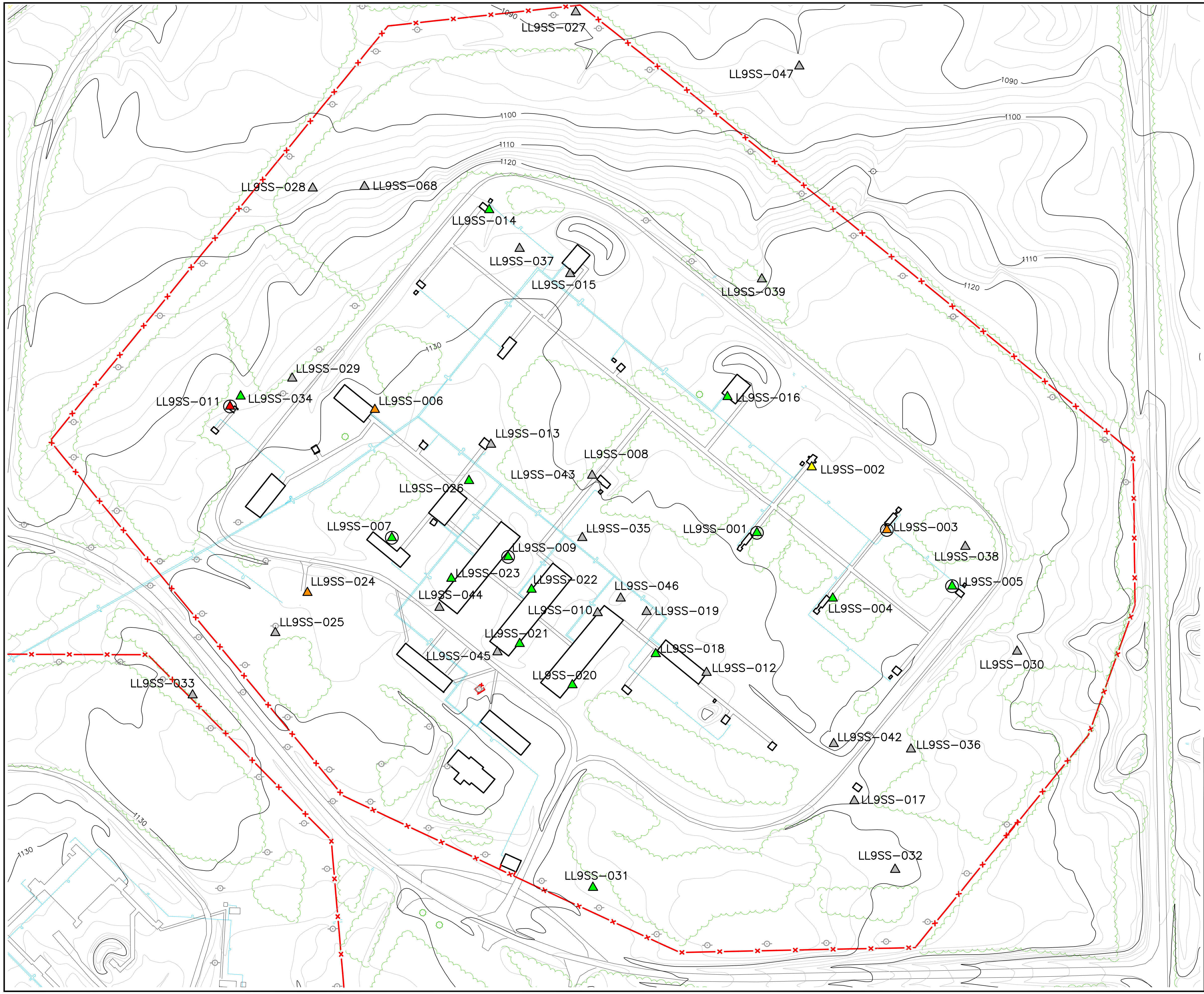
FIGURE 4–7

SURFACE SOIL SAMPLE (0–1Ft)
DISTRIBUTION OF COPPER

LL 9 REMEDIAL INVESTIGATION

| SIZE | PROJECT NO. | DATE: | REV |
|---|---|---|---|
| B | 02–02–0085 | MAY 2007 | 2 |

DRAWN BY K. PERRY APPR. BY SL



LEGEND:

VEGETATION
INTERMITTENT STREAM
STREAM
PIPING
ROAD
10 ft INTERVAL
2 ft INTERVAL
STEAM LINE POST
BUILDING
FENCE
▲ SURFACE SOIL SAMPLE LOCATION
SURFACE SOIL SAMPLING LOCATION TAKEN DURING AZIDE SCREENING

SURFACE BACKGROUND VALUE FOR LEAD = 26.1 mg/Kg

CONCENTRATION

△ NON-DETECT OR ≤ BACKGROUND
▲ > 1 TO 2 TIMES BACKGROUND
▲ > 2 TO 5 TIMES BACKGROUND
▲ > 5 TO 20 TIMES BACKGROUND
▲ > 20 TIMES BACKGROUND

0' 100' 200' 300'
1" = 200'

N

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FIGURE 4–8

SURFACE SOIL SAMPLE (0–1Ft)
DISTRIBUTION OF LEAD

LL 9 REMEDIAL INVESTIGATION

| SIZE | PROJECT NO. | DATE: | REV |
|---|---|---|---|
| B | 02–02–0085 | MAY 2007 | 2 |

| DRAWN BY | K. PERRY | APPR. BY | SL |
|---|---|---|---|

LEGEND:

- VEGETATION
- INTERMITTENT STREAM
- STREAM
- PIPING
- ROAD
- 10 ft INTERVAL
- 2 ft INTERVAL
- STEAM LINE POST
- BUILDING
- FENCE
- ▲ SURFACE SOIL SAMPLE LOCATION
- ◉ SURFACE SOIL SAMPLING LOCATION TAKEN DURING AZIDE SCREENING

SURFACE BACKGROUND VALUE FOR MANGANESE = 1450 mg/Kg

CONCENTRATION

- △ NON-DETECT OR ≤ BACKGROUND
- ▲ > 1 TO 2 TIMES BACKGROUND
- ▲ > 2 TO 5 TIMES BACKGROUND
- ▲ > 5 TO 20 TIMES BACKGROUND
- ▲ > 20 TIMES BACKGROUND

0' 100' 200' 300'
1" = 200'

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RAVENNA, OHIO

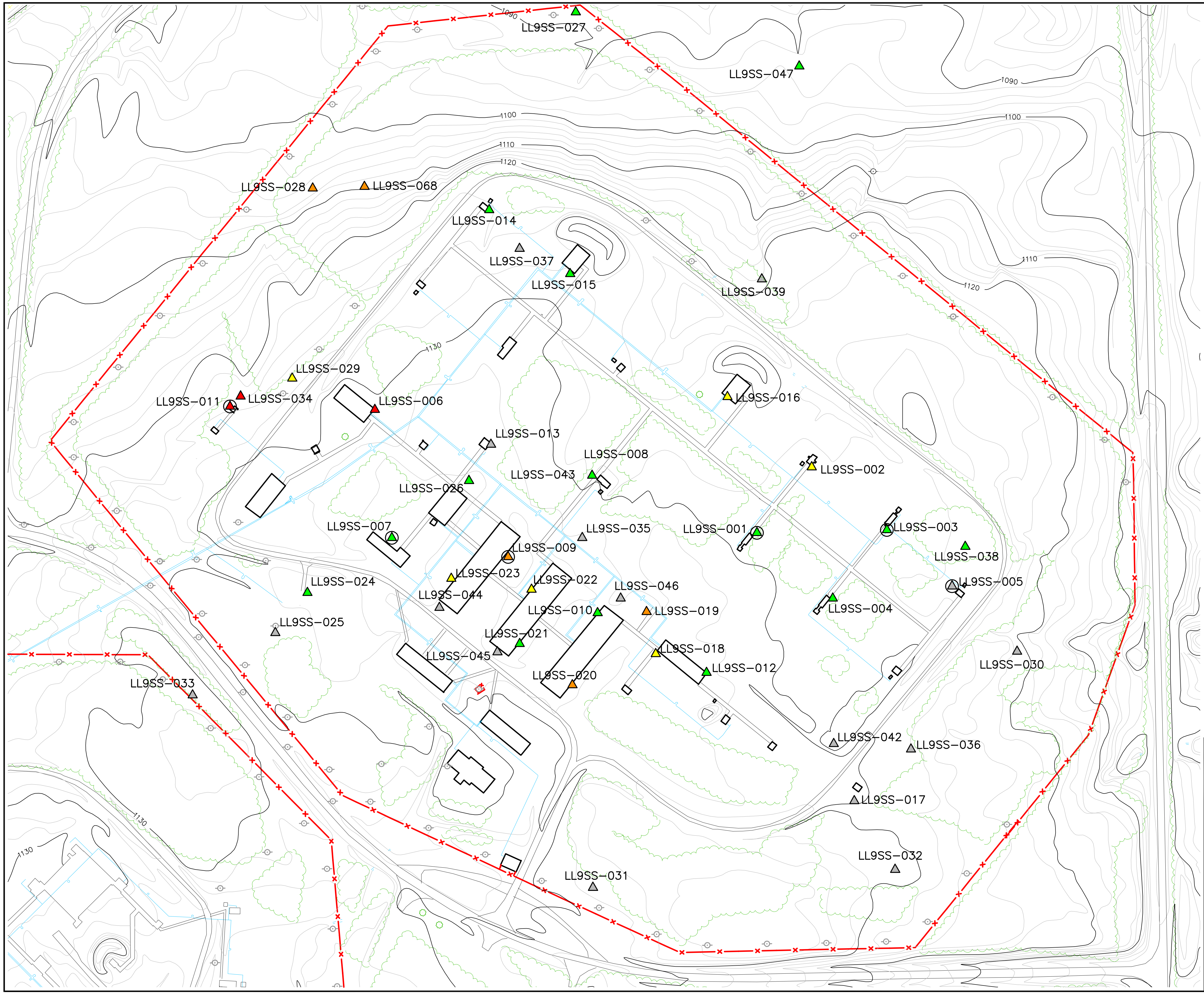
FIGURE 4-9

SURFACE SOIL SAMPLE (0-1Ft)
DISTRIBUTION OF MANGANESE

LL 9 REMEDIAL INVESTIGATION

| SIZE | PROJECT NO. | DATE: | REV |
|---|---|---|---|
| B | 02-02-0085 | MAY 2007 | 2 |

| DRAWN BY | K. PERRY | APPR. BY | SL |
|---|---|---|---|



LEGEND:

VEGETATION
INTERMITTENT STREAM
STREAM
PIPING
ROAD
10 ft INTERVAL
2 ft INTERVAL
STEAM LINE POST
BUILDING
FENCE
▲ SURFACE SOIL SAMPLE LOCATION
SURFACE SOIL SAMPLING LOCATION TAKEN DURING AZIDE SCREENING

SURFACE BACKGROUND VALUE FOR MERCURY = 0.04 mg/Kg

CONCENTRATION

NON-DETECT OR ≤ BACKGROUND
> 1 TO 2 TIMES BACKGROUND
> 2 TO 5 TIMES BACKGROUND
> 5 TO 20 TIMES BACKGROUND
> 20 TIMES BACKGROUND

0' 100' 200' 300'
1" = 200'

N

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FIGURE 4-10

SURFACE SOIL SAMPLE (0-1Ft) DISTRIBUTION OF MERCURY

LL 9 REMEDIAL INVESTIGATION

| SIZE | PROJECT NO. | DATE: | REV |
|---|---|---|---|
| B | 02-02-0085 | MAY 2007 | 2 |

| DRAWN BY | K. PERRY | APPR. BY | SL |
|---|---|---|---|

#### *4.1.2.1 Explosives and Propellants*

Explosives were not detected in the surface soil samples collected during the RI. Nitrocellulose was detected above the RVAAP installation background criteria (USACE, 2001b) in 6 samples and one duplicate. The maximum concentration of 3.2 (B)(J) mg/kg was detected in sample LL9SS–068–0001–SO. However, the maximum result was qualified as estimated (J) because the concentration of nitrocellulose in the method blank was detected above the reporting limit (B). A second propellant, nitroguanidine, was detected in sample LL9SS–034–0001–SO with an estimated concentration of 0. 089 (J) mg/kg. Figure 4–1 shows surface soil exceedances for explosives and propellants at LL–9.

#### *4.1.2.2 TAL Metals and Cyanide*

Metals were detected in surface samples collected throughout the site. Figure 4–2 shows surface soil exceedances for TAL metals and cyanide at LL–9. Cyanide was not detected in any of the surface soil samples. The following metals were detected above RVAAP installation background criteria (USACE, 2001b) or Region 9 residential soil PRGs for surface soil (0–1 ft bgs):

- Aluminum was detected above the Region 9 residential soil PRG (7,614 mg/kg) in 36 samples, 4 of which were duplicates. Aluminum was also detected above the RVAAP installation background criterion (17,700 mg/kg) and Region 9 residential soil PRG in 1 sample. The maximum aluminum concentration of 20,000 mg/kg was detected in sample LL9SS–023–0001–SO.
- Arsenic was detected above the Region 9 residential soil PRG (0.39 mg/kg) in 40 sample locations, 7 of which were duplicates. Arsenic was also detected above the RVAAP installation background (15.4 mg/kg) and Region 9 residential soil PRG in 7 samples. The maximum arsenic concentration of 24 mg/kg was detected in sample LL9SS–015–0001–SO.
- Barium was detected above the RVAAP installation background criterion (88.4 mg/kg) in 6 samples with the maximum concentration of 170 mg/kg detected in sample LL9SS–019–0001–SO.
- Cadmium was detected above the RVAAP installation background criterion (0.0 m/kg) in 11 samples, 1 of which was a duplicate. The maximum concentration of 2.9 mg/kg was detected in sample LL9SS–006–0001–SO.
- Calcium was detected above the RVAAP installation background criterion (15,800 mg/kg) in 2 samples. The maximum concentration of 22,000 mg/kg was detected in sample LL9SS–012–0001–SO.
- Chromium was detected above the RVAAP installation background criterion (17.4 mg/kg) at 3 sample locations. Chromium was also detected above the RVAAP installation background and Region 9 residential soil PRG (30 mg/kg) in 1 sample.

The maximum concentration of 110 mg/kg was detected in sample LL9SS–024–0001–SO.

- Cobalt was detected above the RVAAP installation background criterion (10.4 mg/kg) in 7 samples and the maximum concentration of 18 mg/kg was detected in sample LL9SS–027–0001–SO.
- Copper was detected above the RVAAP installation background criterion (17.7 mg/kg) at 21 sample locations, 4 of which were duplicates. The maximum concentration of 170 mg/kg was detected in sample LL9SS–068–0001–SO.
- Iron was detected above the Region 9 residential soil PRG (2,346 mg/kg) in 34 samples, 5 of which were duplicates. Iron was also detected above the RVAAP installation background criterion (23,100 mg/kg) and Region 9 residential soil PRG in 13 samples, 2 of which were duplicates. The maximum concentration of 76,000 mg/kg was detected in sample LL9SS–031–0001–SO.
- Lead was detected above the RVAAP installation background criterion (26.1 mg/kg) in 18 samples, 3 of which were duplicates. The maximum concentration of 320 mg/kg was detected in sample LL9SS–024–0001–SO.
- Magnesium was detected above the RVAAP installation background criterion (3,030 mg/kg) in 4 samples, 1 of which was a duplicate. The maximum concentration of 3,500 mg/kg was detected in samples LL9SS–015–0001–SO and LL9SS–016–0001–SO.
- Manganese was detected above the Region 9 residential soil PRG (176 mg/kg) in 39 samples, 7 of which were duplicates. Manganese was also detected above the RVAAP installation background criterion (1,450 mg/kg) and Region 9 residential soil PRG in 2 samples. The maximum concentration of 3,800 mg/kg was detected in sample LL9SS–027–0001–SO.
- Mercury was detected above the RVAAP installation background criterion (0.04 mg/kg) in 26 samples, 3 of which were duplicates. Mercury was also detected above the RVAAP installation background criterion and Region 9 residential soil PRG (2.3 mg/kg) in 2 samples, 1 of which was a duplicate. The maximum concentration of 17 mg/kg was detected in sample LL9SS–034–0001–DUP.
- Nickel was detected above the RVAAP installation background criterion (21.1 mg/kg) in 2 samples. The maximum concentration of 24 mg/kg was detected in sample LL9SS–046–0001–SO.
- Potassium was detected above the RVAAP installation background criterion (927 mg/kg) in 8 samples, one of which was a duplicate. The maximum concentration of 1,500 mg/kg was detected in samples LL9SS–015–0001–SO and LL9SS–023–0001–SO.
- Selenium was detected above the RVAAP installation background criterion (1.4 mg/kg) in 1 sample with a concentration of 1.8 mg/kg in sample LL9SS–068–0001–SO.

- Sodium was detected above RVAAP installation background criterion (123 mg/kg) in 19 samples, 3 of which were duplicates. The maximum concentration of 1,300 mg/kg was detected in samples LL9SS–038–0001–SO and LL 9SS–046–0001–SO.
- Vanadium was detected above the Region 9 residential soil PRG (7.8 mg/kg) in 47 samples, 7 of which were duplicates. The maximum concentration of 28 mg/kg was detected in samples LL9SS–015–001–SO and LL9SS–023–0001–SO.
- Zinc was detected above the RVAAP installation background criterion (61.8 mg/kg) in 30 samples, 5 of which were duplicates. The maximum concentration of 780 mg/kg was detected in sample LL9SS–068–0001–SO.

#### *4.1.2.3 Pesticides and PCBs*

No pesticides or PCBs were reported above the laboratory detection limits in the surface soil samples.

#### *4.1.2.4 Volatiles and Semi–volatiles*

Figure 4–3 shows surface soil exceedances for SVOCs and VOCs at LL–9. No VOCs were detected above Region 9 residential soil PRGs. Two SVOCs, benzo(a)pyrene and dibenzo(a,h)anthracene, were detected above the Region 9 residential soil PRG. Benzo(a)pyrene, was detected above the Region 9 residential soil PRG (0.062 mg/kg) in 2 samples, 1 of which was a duplicate not associated with the other exceedance. Benzo(a)pyrene was detected in sample LL9SS–034–0001–DUP at a concentration of 0.073 mg/kg and in sample LL9SS–068–0001–SO at a concentration of 0.240 mg/kg. Dibenzo(a,h)anthracene was detected above the Region 9 residential soil PRG (0.062 mg/kg) in 1 sample at a concentration of 0.130 mg/kg in sample LL9SS–068–0001–SO.

### 4.1.3 RI Subsurface Soil Samples

Fifty–three (53) subsurface soil samples and 3 duplicates were collected at various locations at LL–9 during the RI. Six of the 53 subsurface soil samples were subfloor subsurface soil samples (initially designated as a subfloor surface soil samples). The samples were re-classified in the field because the subfloor soils in the 0–1 ft interval were not representative of the surface soil conditions because of demolition activities. Therefore, the samples were collected as a subfloor subsurface soil samples from the 1–3 ft interval. Most samples were collected from a depth of 1–3 ft bgs. The depths of subsurface soil samples are listed in Table 4–4 (included at the end of Section 4.0). The samples were submitted for analysis of TAL metals. In addition, 10% of the samples collected were analyzed for explosives, cyanides, VOCs, SVOCs, PCBs, pesticides, and propellants. Subsurface soil sample results are summarized in Table 4–4 (included at the end of Section 4.0) and included in Appendix I.

Aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, iron, lead, manganese, mercury, vanadium, and zinc were detected at concentrations greater than the RVAAP installation background concentrations, Region 9 residential soil PRGs, or both. In addition, one propellant (nitrocellulose) and one explosive (RDX) were detected in subsurface soils. However, only 10% of the suburface samples collected were analyzed for explosives and propellants. Therefore, the lateral and vertical extent of explosives, propellants and TAL metals has not been fully delineated during this Phase I RI. The lateral extent of subsurface soil contamination at LL–9 (as determined by this Phase I RI) is shown on Figures 4–12 and 4–13. The distribution of selected site related contaminants (arsenic, chromium, copper, and mercury) identified as subsurface COPCs in Section 6.2.3 of this document, are shown in Figures 4–14 through 4–16. The distribution and exposure pathways for SRCs are further discussed in the conceptual site model included in Section 5.4.

Exceedances for the fifty–three subsurface soil samples, one subfloor subsurface sample and 3 duplicate samples are summarized in Table 4–5 (included at the end of Section 4.0). Specific exceedences for each analytical parameter are discussed in the following subsections.

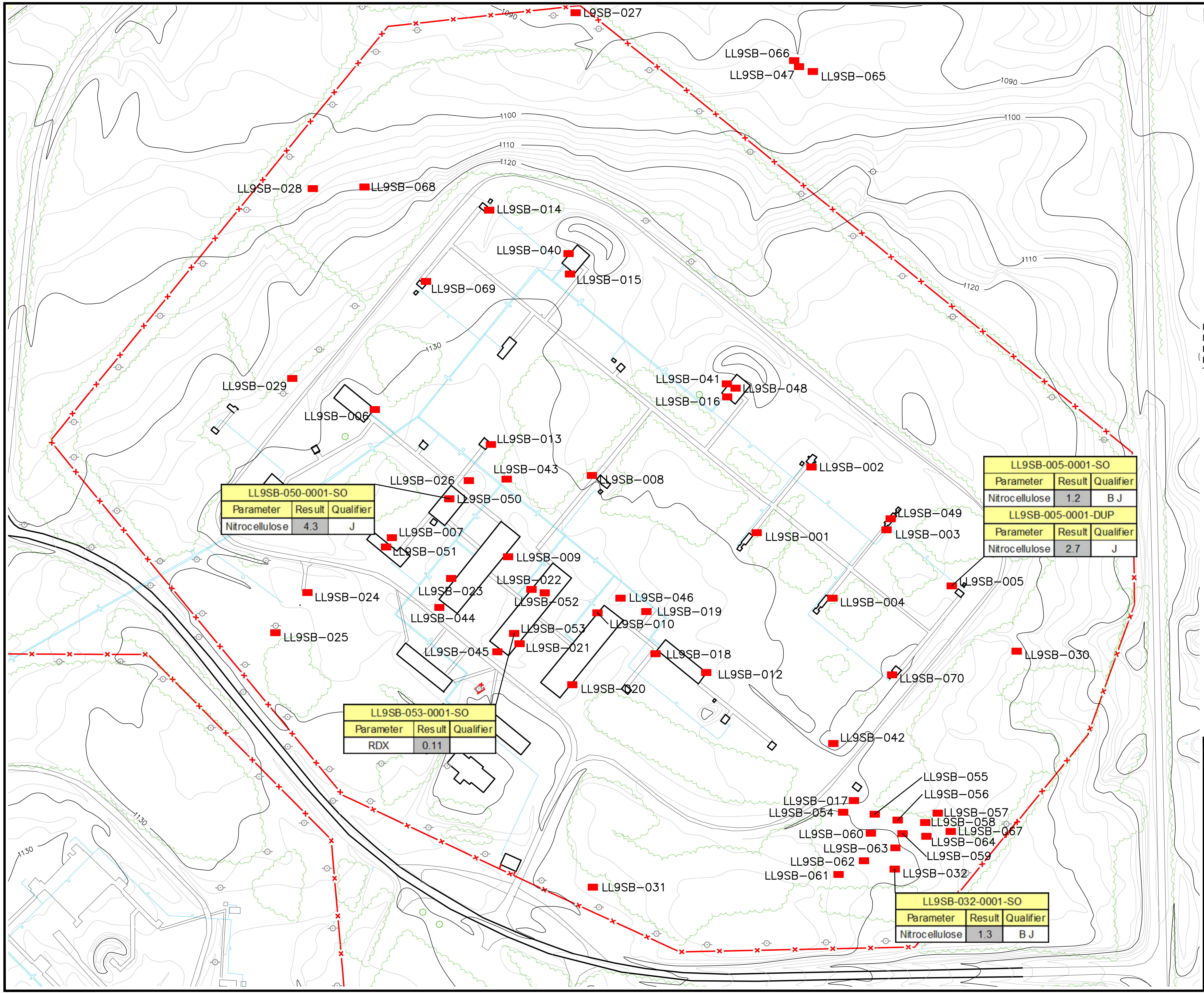
#### *4.1.3.1 Explosives and Propellants*

RDX was detected above the RVAAP background criterion (0.0 mg/kg) at a concentration of 0.11 mg/kg in sample, LL9SB–053–0001–SO. Nitrocellulose was detected at concentrations above the background criterion (0.0 mg/kg) in sample LL9SB–005–0001–SO at a concentration of 1.2 (B) (J) mg/kg; sample LL9SB–005–0001–DUP at a concentration of 2.7 (J) mg/kg; sample, LL9SB–032–0001–SO at a concentration of 1.3 (B) (J) mg/kg; and sample LL9SB–050–0001–SO at a concentration of 4.3 (J) mg/kg. However, the results were qualified as (J), or (B) the concentration of nitrocellulose in the method blank was detected above the reporting limit, or both (B) (J). In addition, one of the detections was a duplicate sample. Based on the qualified analytical results, a determination of vertical extent of explosive and propellant contamination cannot be made. Figure 4–4 shows subsurface soil exceedances for explosives and propellants at LL–9.

#### *4.1.3.2 TAL Metals and Cyanide*

Figure 4–5 shows subsurface soil exceedances for TAL metals and cyanide at LL–9. The following metals were detected above comparable RVAAP installation background criteria (USACE, 2001b), Region 9 residential soil PRGs for subsurface soil (>1 ft bgs), or both:

- Aluminum was detected above the Region 9 residential soil PRG (7,614mg/kg) in 39 samples, 1 of which was a duplicate. The maximum concentration of 18,000 mg/kg was detected in sample LL9SB–024–0001–SO and LL9SB–025–0001–SO.
- Antimony was detected above the RVAAP installation background criterion (0.96 mg/kg) in 2 samples. The maximum concentration of 1 mg/kg was detected in samples LL9SB–015–0001–SO and LL9SB–024–0001–SO.



LL9SB-050-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Nitrocellulose | 4.3 | J |

LL9SB-053-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| RDX | 0.11 | |

LL9SB-032-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Nitrocellulose | 1.3 | B J |

LL9SB-005-0001-SO

| Parameter | Result | Qualifier |
|---|---|---|
| Nitrocellulose | 1.2 | B J |

LL9SB-005-0001-DUP

| Parameter | Result | Qualifier |
|---|---|---|
| Nitrocellulose | 2.7 | J |

## LEGEND:

VEGETATION
INTERMITTENT STREAM
STREAM
PIPING
ROAD
10 ft INTERVAL
2 ft INTERVAL
STEAM LINE POST
SUBSURFACE SOIL SAMPLE LOCATION
BUILDING
FENCE

## NOTES:

RESULTS SHOWN IN mg/kg

IF RESULT ≥ BACKGROUND, THEN THE VALUE IS SHADED
IF RESULT ≥ THE PRG THEN THE VALUE IS LISTED IN BOLD TEXT
IF RESULT ≥ BACKGROUND AND THE PRG THE VALUE IS BOLD + SHADED
IF RESULT < BACKGROUND AND PRG THEN THE VALUE IS LISTED IN NORMAL TEXT

INORGANIC QUALIFIERS
U – ANALYTE WAS NOT DETECTED AT OR ABOVE THE STATED LIMIT
J – RESULT IS LESS THAN THE RL, BUT GREATER THAN OR EQUAL TO THE MDL
B – RESULT IS LESS THAN THE CRDL/RL, BUT GREATER THAN OR EQUAL TO THE IDL/MDL

INORGANIC FLAGS
^ – INSTRUMENT RELATED QC EXCEED THE UPPER OR LOWER CONTROL LIMITS
* – BATCH QC EXCEEDS THE UPPER OR LOWER CONTROL LIMIT
H – BATCH QC IS GREATER THAN RL

0' 100' 200' 300'
1" = 200'

N

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**RAVENNA ARMY AMMUNITION PLANT**
**RAVENNA, OHIO**

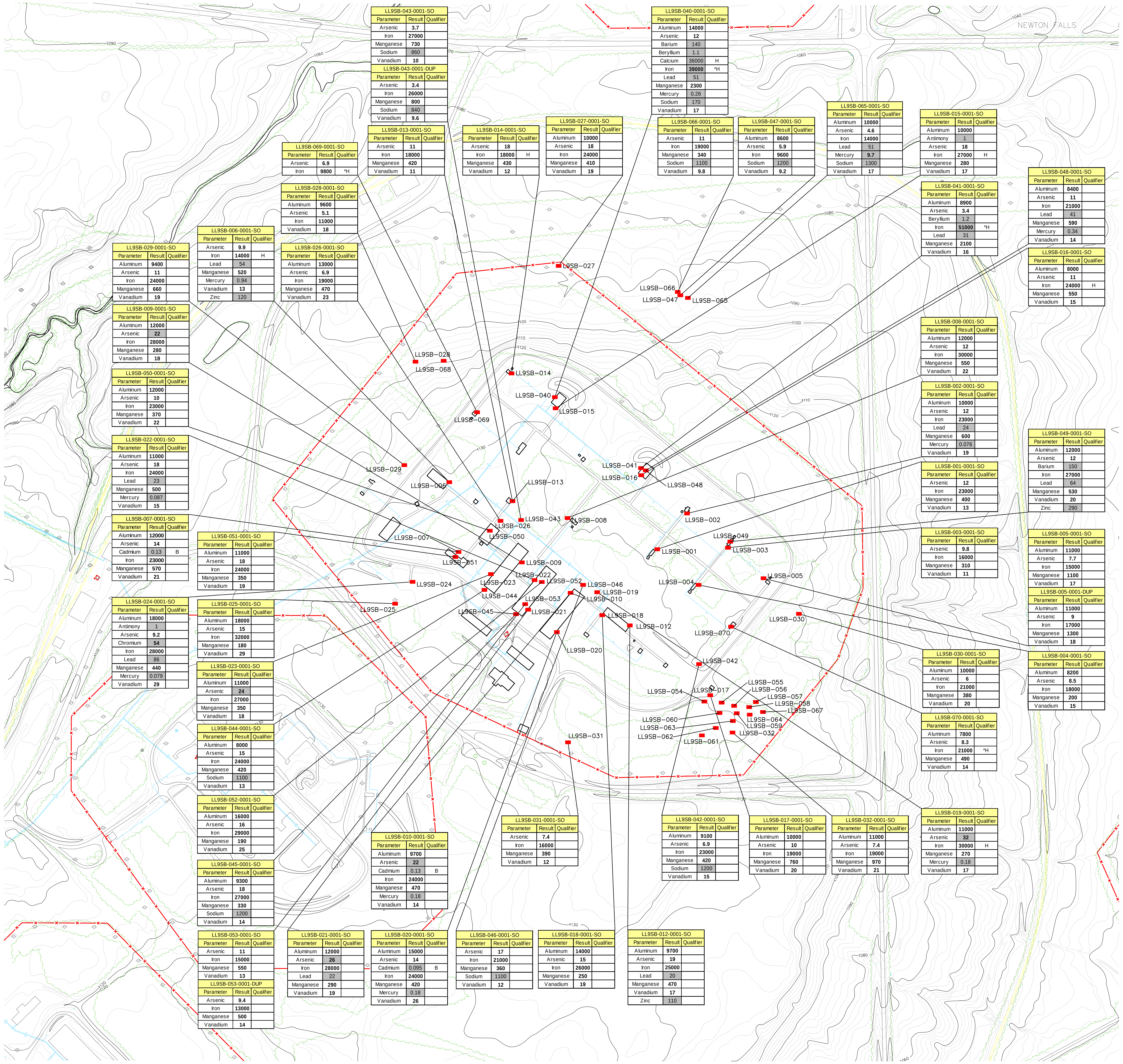
FIGURE 4–11

SUBSURFACE SOIL SAMPLE (>1Ft)
EXCEEDANCES EXPLOSIVES/PROPELLANTS

**LL 9 REMEDIAL INVESTIGATION**

| SIZE | PROJECT NO. | DATE: | REV |
|---|---|---|---|
| B | 02–02–0085 | MAY 2007 | 2 |

DRAWN BY K. PERRY APPR. BY SL



| LL9SB-043-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Arsenic | **3.7** | |
| Iron | **27000** | |
| Manganese | **730** | |
| Sodium | 860 | |
| Vanadium | **10** | |

| LL9SB-043-0001-DUP | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Arsenic | **3.4** | |
| Iron | **26000** | |
| Manganese | **800** | |
| Sodium | 840 | |
| Vanadium | **9.6** | |

| LL9SB-040-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **14000** | |
| Arsenic | **12** | |
| Barium | 140 | |
| Beryllium | 1.1 | |
| Calcium | 36000 | H |
| Iron | **39000** | *H |
| Lead | 51 | |
| Manganese | **2300** | |
| Mercury | 0.26 | |
| Sodium | 170 | |
| Vanadium | **17** | |

| LL9SB-069-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Arsenic | **6.9** | |
| Iron | **9800** | *H |

| LL9SB-013-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Arsenic | **11** | |
| Iron | **18000** | |
| Manganese | **420** | |
| Vanadium | **11** | |

| LL9SB-014-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Arsenic | **18** | |
| Iron | **18000** | H |
| Manganese | **430** | |
| Vanadium | **12** | |

| LL9SB-027-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **10000** | |
| Arsenic | **18** | |
| Iron | **24000** | |
| Manganese | **410** | |
| Vanadium | **19** | |

| LL9SB-066-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Arsenic | **11** | |
| Iron | **19000** | |
| Manganese | **340** | |
| Sodium | 1100 | |
| Vanadium | **9.8** | |

| LL9SB-047-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **8600** | |
| Arsenic | **5.9** | |
| Iron | **9600** | |
| Sodium | 1200 | |
| Vanadium | **9.2** | |

| LL9SB-065-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **10000** | |
| Arsenic | **4.6** | |
| Iron | **14000** | |
| Lead | 51 | |
| Mercury | **9.7** | |
| Sodium | 1300 | |
| Vanadium | **17** | |

| LL9SB-015-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **10000** | |
| Antimony | 1 | |
| Arsenic | **18** | |
| Iron | **27000** | H |
| Manganese | **280** | |
| Vanadium | **17** | |

| LL9SB-028-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **9600** | |
| Arsenic | **5.1** | |
| Iron | **11000** | |
| Vanadium | **18** | |

| LL9SB-048-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **8400** | |
| Arsenic | **11** | |
| Iron | **21000** | |
| Lead | 41 | |
| Manganese | **590** | |
| Mercury | 0.34 | |
| Vanadium | **14** | |

| LL9SB-041-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **8900** | |
| Arsenic | **3.4** | |
| Beryllium | 1.2 | |
| Iron | **51000** | *H |
| Lead | 31 | |
| Manganese | **2100** | |
| Vanadium | **16** | |

| LL9SB-006-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Arsenic | **9.9** | |
| Iron | **14000** | H |
| Lead | 54 | |
| Manganese | **520** | |
| Mercury | 0.94 | |
| Vanadium | **13** | |
| Zinc | 120 | |

| LL9SB-029-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **9400** | |
| Arsenic | **11** | |
| Iron | **24000** | |
| Manganese | **660** | |
| Vanadium | **19** | |

| LL9SB-026-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **13000** | |
| Arsenic | **6.9** | |
| Iron | **19000** | |
| Manganese | **470** | |
| Vanadium | **23** | |

| LL9SB-016-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **8000** | |
| Arsenic | **11** | |
| Iron | **24000** | H |
| Manganese | **550** | |
| Vanadium | **15** | |

| LL9SB-009-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **12000** | |
| Arsenic | **22** | |
| Iron | **28000** | |
| Manganese | **280** | |
| Vanadium | **18** | |

| LL9SB-008-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **12000** | |
| Arsenic | **12** | |
| Iron | **30000** | |
| Manganese | **550** | |
| Vanadium | **22** | |

| LL9SB-050-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **12000** | |
| Arsenic | **10** | |
| Iron | **23000** | |
| Manganese | **370** | |
| Vanadium | **22** | |

| LL9SB-002-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **10000** | |
| Arsenic | **12** | |
| Iron | **23000** | |
| Lead | 24 | |
| Manganese | **600** | |
| Mercury | 0.076 | |
| Vanadium | **19** | |

| LL9SB-049-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **12000** | |
| Arsenic | **12** | |
| Barium | 150 | |
| Iron | **27000** | |
| Lead | 64 | |
| Manganese | **530** | |
| Vanadium | **20** | |
| Zinc | 290 | |

| LL9SB-022-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **11000** | |
| Arsenic | **18** | |
| Iron | **24000** | |
| Lead | 23 | |
| Manganese | **500** | |
| Mercury | 0.087 | |
| Vanadium | **15** | |

| LL9SB-001-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Arsenic | **12** | |
| Iron | **23000** | |
| Manganese | **400** | |
| Vanadium | **13** | |

| LL9SB-007-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **12000** | |
| Arsenic | **14** | |
| Cadmium | 0.13 | B |
| Iron | **23000** | |
| Manganese | **570** | |
| Vanadium | **21** | |

| LL9SB-051-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **11000** | |
| Arsenic | **18** | |
| Iron | **24000** | |
| Manganese | **350** | |
| Vanadium | **19** | |

| LL9SB-003-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Arsenic | **9.8** | |
| Iron | **16000** | |
| Manganese | **310** | |
| Vanadium | **11** | |

| LL9SB-005-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **11000** | |
| Arsenic | **7.7** | |
| Iron | **15000** | |
| Manganese | **1100** | |
| Vanadium | **17** | |

| LL9SB-005-0001-DUP | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **11000** | |
| Arsenic | **9** | |
| Iron | **17000** | |
| Manganese | **1300** | |
| Vanadium | **18** | |

| LL9SB-024-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **18000** | |
| Antimony | 1 | |
| Arsenic | **9.2** | |
| Chromium | **54** | |
| Iron | **28000** | |
| Lead | 86 | |
| Manganese | **440** | |
| Mercury | 0.079 | |
| Vanadium | **29** | |

| LL9SB-025-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **18000** | |
| Arsenic | **15** | |
| Iron | **32000** | |
| Manganese | **180** | |
| Vanadium | **29** | |

| LL9SB-030-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **10000** | |
| Arsenic | **6** | |
| Iron | **21000** | |
| Manganese | **380** | |
| Vanadium | **20** | |

| LL9SB-004-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **8200** | |
| Arsenic | **8.5** | |
| Iron | **18000** | |
| Manganese | **200** | |
| Vanadium | **15** | |

| LL9SB-023-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **11000** | |
| Arsenic | **24** | |
| Iron | **27000** | |
| Manganese | **350** | |
| Vanadium | **18** | |

| LL9SB-070-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **7800** | |
| Arsenic | **8.3** | |
| Iron | **21000** | *H |
| Manganese | **490** | |
| Vanadium | **14** | |

| LL9SB-044-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **8000** | |
| Arsenic | **15** | |
| Iron | **24000** | |
| Manganese | **420** | |
| Sodium | 1100 | |
| Vanadium | **13** | |

| LL9SB-052-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **16000** | |
| Arsenic | **16** | |
| Iron | **29000** | |
| Manganese | **190** | |
| Vanadium | **25** | |

| LL9SB-019-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **11000** | |
| Arsenic | **32** | |
| Iron | **30000** | H |
| Manganese | **270** | |
| Mercury | 0.18 | |
| Vanadium | **17** | |

| LL9SB-031-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Arsenic | **7.4** | |
| Iron | **16000** | |
| Manganese | **390** | |
| Vanadium | **12** | |

| LL9SB-042-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **9100** | |
| Arsenic | **6.9** | |
| Iron | **23000** | |
| Manganese | **420** | |
| Sodium | 1200 | |
| Vanadium | **15** | |

| LL9SB-017-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **10000** | |
| Arsenic | **10** | |
| Iron | **19000** | |
| Manganese | **760** | |
| Vanadium | **20** | |

| LL9SB-032-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **11000** | |
| Arsenic | **7.4** | |
| Iron | **19000** | |
| Manganese | **970** | |
| Vanadium | **21** | |

| LL9SB-010-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **9700** | |
| Arsenic | **22** | |
| Cadmium | 0.13 | B |
| Iron | **24000** | |
| Manganese | **470** | |
| Mercury | 0.18 | |
| Vanadium | **14** | |

| LL9SB-045-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **9300** | |
| Arsenic | **18** | |
| Iron | **27000** | |
| Manganese | **330** | |
| Sodium | 1200 | |
| Vanadium | **14** | |

| LL9SB-053-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Arsenic | **11** | |
| Iron | **15000** | |
| Manganese | **550** | |
| Vanadium | **13** | |

| LL9SB-053-0001-DUP | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Arsenic | **9.4** | |
| Iron | **13000** | |
| Manganese | **500** | |
| Vanadium | **14** | |

| LL9SB-021-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **12000** | |
| Arsenic | **26** | |
| Iron | **28000** | |
| Lead | 22 | |
| Manganese | **290** | |
| Vanadium | **19** | |

| LL9SB-020-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **15000** | |
| Arsenic | **14** | |
| Cadmium | 0.095 | B |
| Iron | **24000** | |
| Manganese | **420** | |
| Mercury | 0.18 | |
| Vanadium | **26** | |

| LL9SB-046-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Arsenic | **17** | |
| Iron | **21000** | |
| Manganese | **360** | |
| Sodium | 1100 | |
| Vanadium | **12** | |

| LL9SB-018-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **14000** | |
| Arsenic | **15** | |
| Iron | **26000** | |
| Manganese | **250** | |
| Vanadium | **19** | |

| LL9SB-012-0001-SO | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **9700** | |
| Arsenic | **19** | |
| Iron | **25000** | |
| Lead | 20 | |
| Manganese | **470** | |
| Vanadium | **17** | |
| Zinc | 110 | |

LEGEND:

| | |
|---|---|
| 〰 | VEGETATION |
| — · · · — | INTERMITTENT STREAM |
| —···—···— | STREAM |
| — | PIPING |
| — | ROAD |
| — | 10 ft INTERVAL |
| — | 2 ft INTERVAL |
| ⊙ | STEAM LINE POST |
| 🟥 | SUBSURFACE SOIL SAMPLE LOCATION |
| ▭ | BUILDING |
| ×—× | FENCE |

NOTES:

RESULTS SHOWN IN mk/kg

IF RESULT ≥ BACKGROUND, THEN THE VALUE IS SHADED
IF RESULT ≥ THE PRG THEN THE VALUE IS LISTED IN BOLD TEXT
IF RESULT ≥ BACKGROUND AND THE PRG THE VALUE IS BOLD + SHADED
IF RESULT < BACKGROUND AND PRG THEN THE VALUE IS LISTED IN NORMAL TEXT

INORGANIC QUALIFIERS
U – ANALYTE WAS NOT DETECTED AT OR ABOVE THE STATED LIMIT
J – RESULT IS LESS THAN THE RL, BUT GREATER THAN OR EQUAL TO THE MDL
B – RESULT IS LESS THAN THE CRDL/RL, BUT GREATER THAN OR EQUAL TO THE IDL/MDL

INORGANIC FLAGS
^ – INSTRUMENT RELATED QC EXCEED THE UPPER OR LOWER CONTROL LIMITS
* – BATCH QC EXCEEDS THE UPPER OR LOWER CONTROL LIMIT
H – BATCH QC IS GREATER THAN RL

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## RAVENNA ARMY AMMUNITION PLANT
## RAVENNA, OHIO

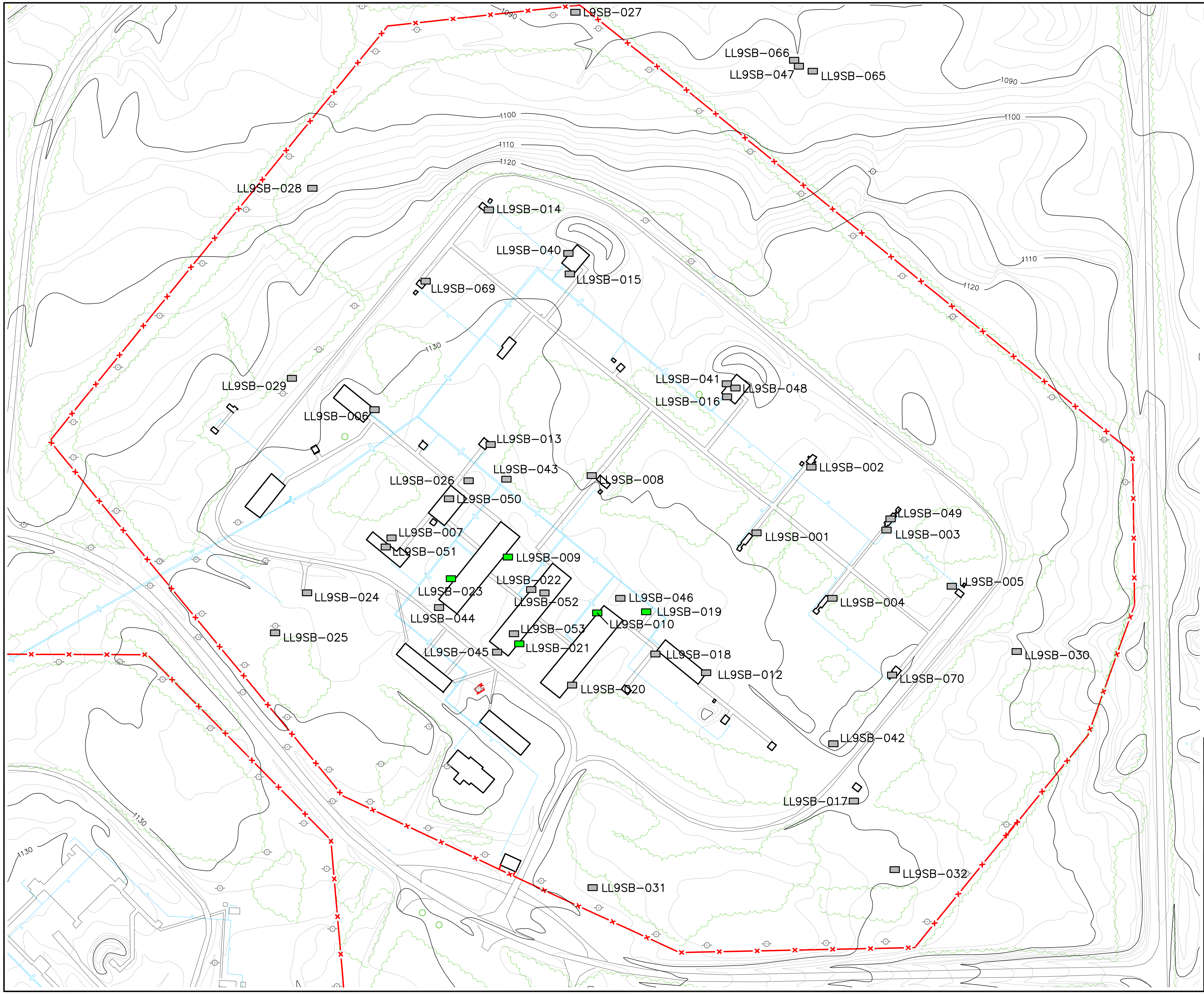
FIGURE 4-12

SUBSURFACE SOIL SAMPLE (>1Ft)
EXCEEDANCES TAL METALS AND CYANIDE

LL 9 REMEDIAL INVESTIGATION

| SIZE | PROJECT NO. | DATE: | REV |
|---|---|---|---|
| D | 02-02-0085 | MAY 2007 | 2 |

| DRAWN BY | R. BOWMAN | APPR. BY | SL |
|---|---|---|---|



LEGEND:

| | |
|---|---|
| | VEGETATION |
| | INTERMITTENT STREAM |
| | STREAM |
| | PIPING |
| | ROAD |
| | 10 ft INTERVAL |
| | 2 ft INTERVAL |
| | STEAM LINE POST |
| ▭ | BUILDING |
| | FENCE |
| ■ | SURFACE SOIL SAMPLE LOCATION |

SURFACE BACKGROUND VALUE FOR ARSENIC = 19.8 mg/Kg

CONCENTRATION

| | |
|---|---|
| ⬜ | NON-DETECT OR ≤ BACKGROUND |
| 🟩 | > 1 TO 2 TIMES BACKGROUND |
| 🟨 | > 2 TO 5 TIMES BACKGROUND |
| 🟧 | > 5 TO 20 TIMES BACKGROUND |
| 🟥 | > 20 TIMES BACKGROUND |

0' 100' 200' 300'

1" = 200'

N

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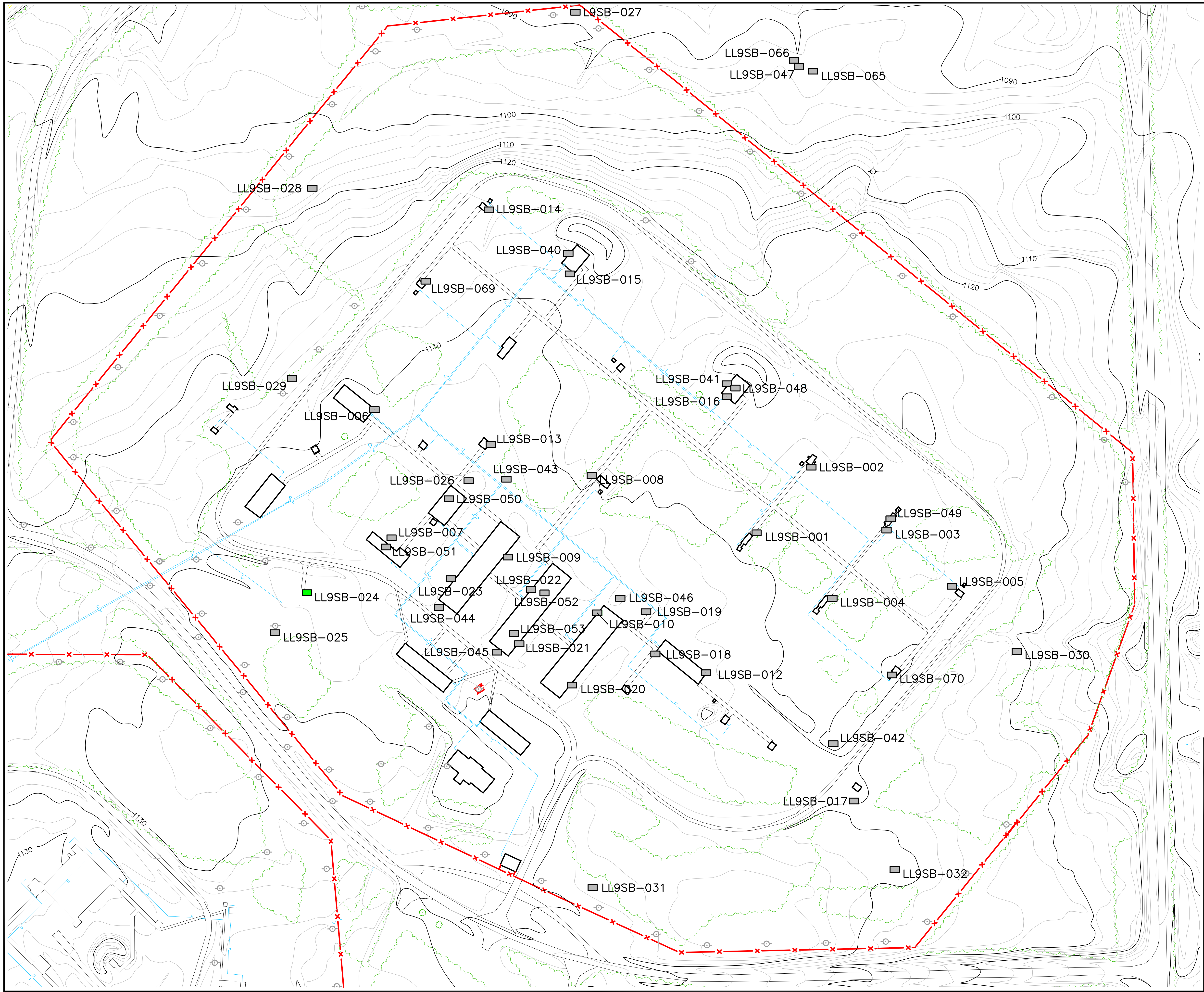
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO

FIGURE 4-13

SUBSURFACE SOIL SAMPLE (>1Ft)
DISTRIBUTION OF ARSENIC

LL 9 REMEDIAL INVESTIGATION

| SIZE | PROJECT NO. | DATE: | REV |
|---|---|---|---|
| B | 02-02-0085 | MAY 2007 | 2 |
| DRAWN BY | K. PERRY | APPR. BY | SL |



LEGEND:

| | |
|---|---|
| | VEGETATION |
| | INTERMITTENT STREAM |
| | STREAM |
| | PIPING |
| | ROAD |
| | 10 ft INTERVAL |
| | 2 ft INTERVAL |
| | STEAM LINE POST |
| | BUILDING |
| | FENCE |
| ■ | SURFACE SOIL SAMPLE LOCATION |

SURFACE BACKGROUND VALUE FOR CHROMIUM = 27.2 mg/Kg

CONCENTRATION

| | |
|---|---|
| ▨ | NON-DETECT OR ≤ BACKGROUND |
| 🟩 | > 1 TO 2 TIMES BACKGROUND |
| 🟨 | > 2 TO 5 TIMES BACKGROUND |
| 🟧 | > 5 TO 20 TIMES BACKGROUND |
| 🟥 | > 20 TIMES BACKGROUND |

0' 100' 200' 300'

1" = 200'

N

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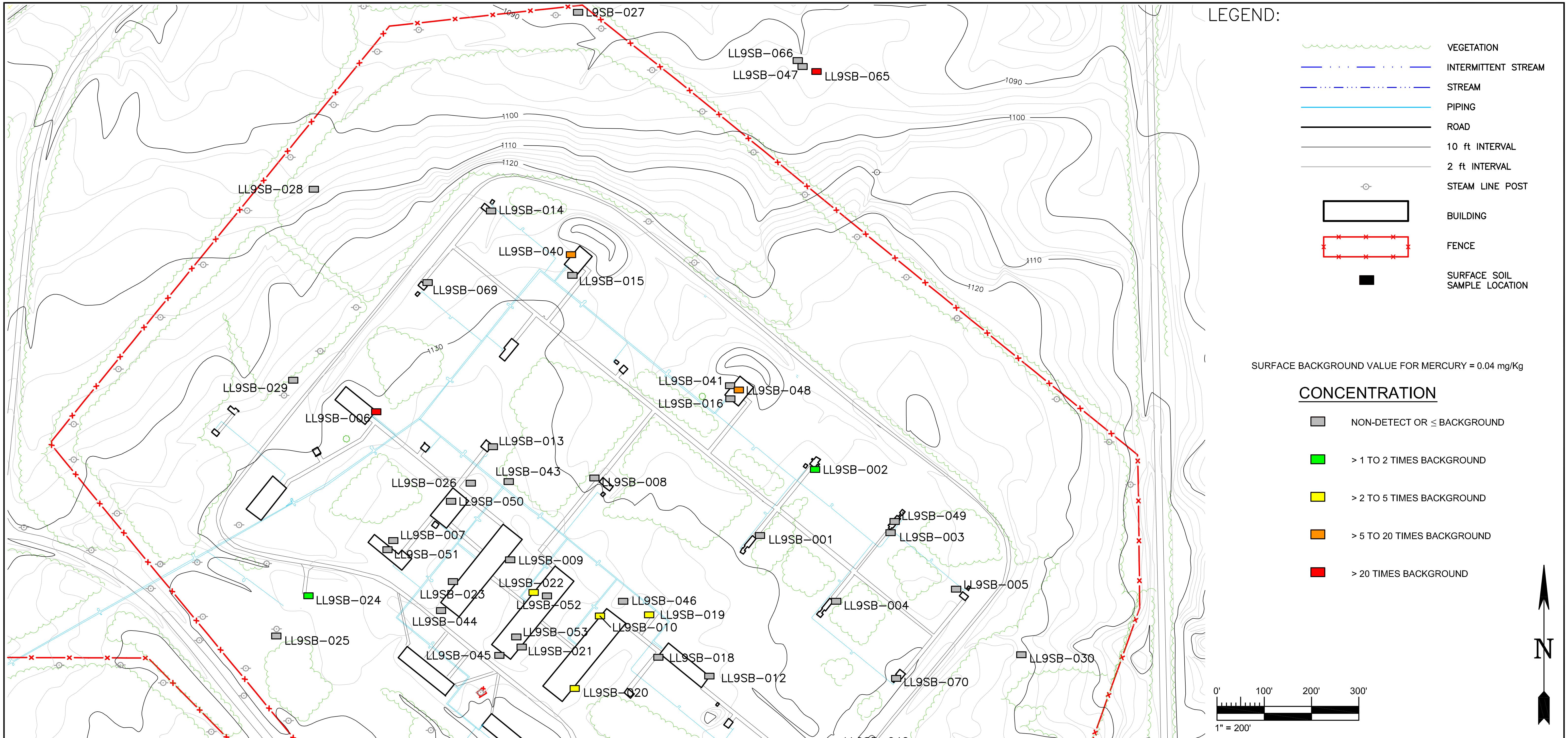
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO

FIGURE 4–14

SUBSURFACE SOIL SAMPLE (>1Ft)
DISTRIBUTION OF CHROMIUM

LL 9 REMEDIAL INVESTIGATION

| SIZE | PROJECT NO. | DATE: | REV |
|---|---|---|---|
| B | 02–02–0085 | MAY 2007 | 2 |
| DRAWN BY | K. PERRY | APPR. BY | SL |



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RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO

FIGURE 4–15

SUBSURFACE SOIL SAMPLE (>1Ft)
DISTRIBUTION OF MERCURY

LL 9 REMEDIAL INVESTIGATION

| SIZE | PROJECT NO. | DATE: | REV |
|---|---|---|---|
| B | 02–02–0085 | MAY 2007 | 2 |

| DRAWN BY | K. PERRY | APPR. BY | SL |
|---|---|---|---|

- Arsenic was detected above the Region 9 residential soil PRG (0.39 mg/kg) in 47 samples, 3 of which were duplicates. Arsenic was also detected above the RVAAP installation background criterion (19.8 mg/kg) and Region 9 residential soil PRG in 5 sample locations. The maximum concentration of 26 mg/kg was detected in sample LL9SB–021–0001–SO.

- Barium was detected above the RVAAP installation background criterion (124 mg/kg) in 2 samples. The maximum concentration of 150 mg/kg was detected in sample LL9SB–049–0001–SO.
- Beryllium was detected above the RVAAP installation background criterion (0.88 mg/kg) in 2 samples. The maximum concentration of 1.2 mg/kg was detected in sample LL9SB–041–0001–SO.
- Cadmium was detected above the RVAAP installation background criterion (0.00 mg/kg) in 3 samples. The maximum concentration of 0.13 mg/kg in samples LL9SB–007–0001–SO and LL9SB–010–001–SO.
- Calcium was detected above the RVAAP installation background criterion (35,500 mg/kg) in 1 sample. The concentration of 36,000 mg/kg was detected in sample LL9SB–040–0001–SO.
- Chromium was detected above the RVAAP installation background criterion (27.2 mg/kg) and Region 9 residential soil PRG (30 mg/kg) in 1 sample. The maximum concentration of 54 mg/kg was detected in sample LL9SB–024–0001–SO.
- Iron was detected above the Region 9 residential soil PRG (2,346 mg/kg) in 48 samples, 3 of which were duplicates. Iron was also detected above the RVAAP installation background criterion (35,200 mg/k) and Region 9 residential soil PRG in 2 samples. The maximum concentration of 51,000 mg/kg was detected in sample LL9SB–041–0001–SO.
- Lead was detected above the RVAAP installation background criterion (19.1 mg/kg) in 11 samples. The maximum concentration of 86 mg/kg was detected in sample LL9SB–024–0001–SO.
- Manganese was detected above the Region 9 residential soil PRG (0.39 mg/kg) in 48 samples, 3 of which were duplicates. The maximum concentration of 2,300 mg/kg was detected in sample LL9SB–040–0001–SO.
- Mercury was detected above the RVAAP installation background criterion (0.04 mg/kg) in 9 samples and above the Region 9 residential soil PRG (2.3 mg/kg) and the RVAAP installation background in 1 sample. The maximum concentration of 9.7 mg/kg was detected in sample LL9SB–065–0001–SO.
- Sodium was detected above the RVAAP installation background criterion (145 mg/kg) in 10 samples, 1 of which was a duplicate. The maximum concentration of 1,300 mg/kg was detected in sample LL9SB–065–0001–SO.

- Vanadium was detected above the Region 9 residential soil PRG (7.8 mg/kg) in 51 samples, 3 of which were duplicates. The maximum concentration of 29 mg/kg was detected in samples LL9SB–024–0001–SO and LL9SB–025–0001–SO.
- Zinc was detected above the RVAAP installation background criterion (93.9 mg/kg) in 3 samples. The maximum concentration of 290 mg/kg was detected in sample LL9SB–049–0001–SO.

#### *4.1.3.3 Pesticides and PCBs*

No pesticides or PCBs were reported above laboratory detection limits in the subsurface soil samples.

#### *4.1.3.4 Volatiles and Semi–volatiles*

No VOCs were reported above laboratory detection limits in subsurface soil samples. Although some SVOCs were detected, no SVOCs exceeded the Region 9 residential soil PRGs in the subsurface soil samples.

## 4.2 Groundwater

This section summarizes the physical and chemical data collected from the LL–9 groundwater monitoring wells during the RI field effort. Groundwater samples were not collected during the azide screening in March 2002.

### 4.2.1 Hydraulic Conductivity and Water Level Measurements

In June 2004, slug tests were performed on the 7 newly installed bedrock wells at LL–9. Slug test data are found in Appendix L. As shown in Table 4–6, hydraulic conductivities ranged from 2.11 x $10^{-4}$ to 7.92 x $10^{-4}$ centimeters/second (cm/s) in the screened materials underlying LL–9. The average hydraulic conductivity at LL–9 is 3.99 x $10^{-4}$ cm/s (see Appendix L). Slug tests performed on wells located at other RVAAP areas indicate average hydraulic conductivities that range between 1.45E-03 cm/s to 6.09E-06 cm/s for unconsolidated soils and bedrock. The hydraulic conductivities measured at LL–9 are consistent with bedrock conductivities measured at other locations in the RVAAP. Groundwater levels were measured on three occasions: December 8, 2003; December 17, 2003; and June 25, 2004 (see Appendix K). Data from those three rounds of well gauging were used to produce potentiometric surface maps for LL–9. These maps are shown on Figures 4–16, 4–17, and 4–18.

## Table 4–6

## Hydraulic Conductivity and Water Level Measurements

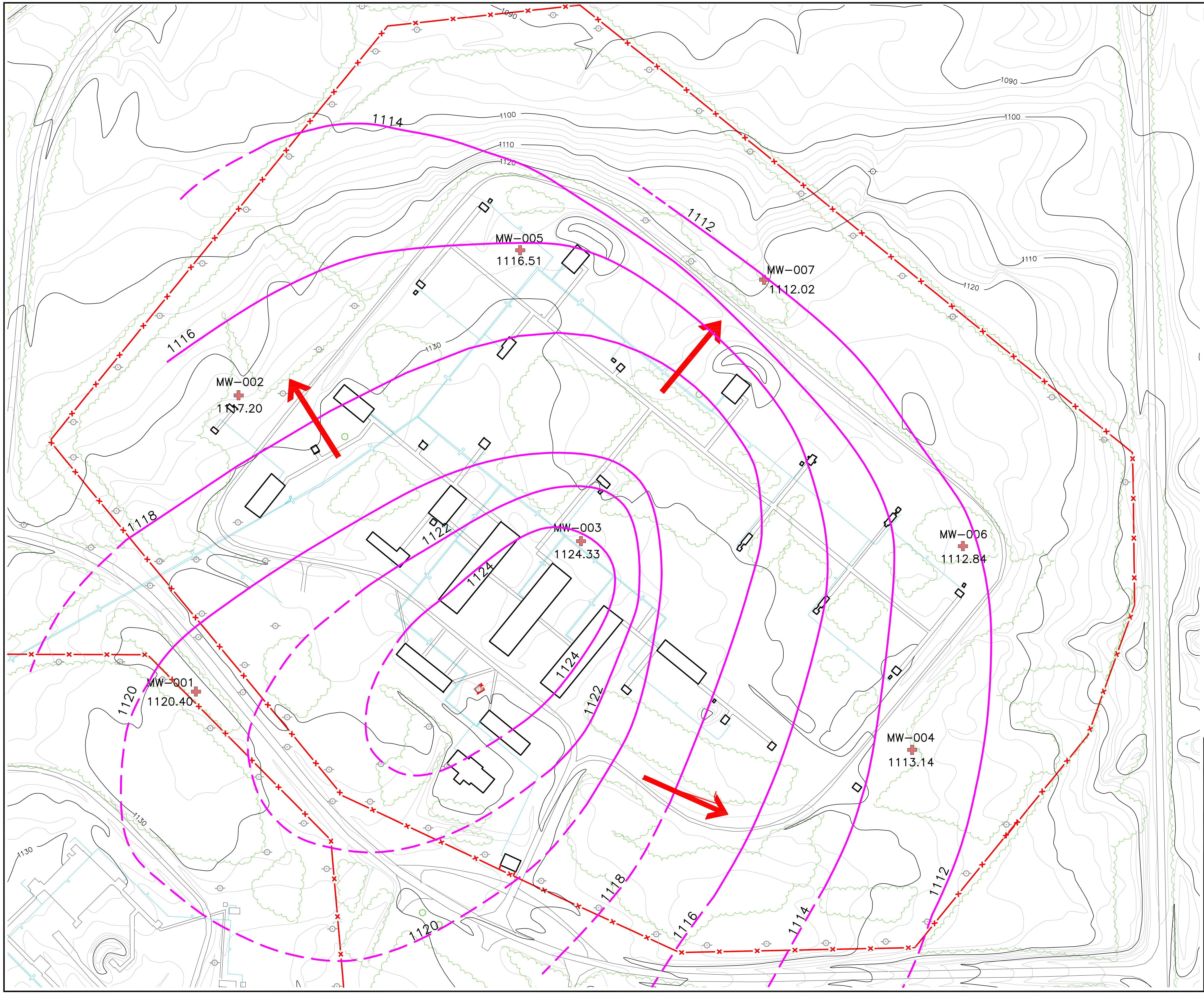
| Monitoring Well | Screened Interval Depth (bgs) | Total Depth (ft) | Geologic Material Adjacent to Screen | Hydraulic Conductivity (cm/s) |
|---|---|---|---|---|
| MW–001 | 11–21 | 23.15 | Brown sand/sandstone | $2.57 \times 10^{-4}$ |
| MW–002 | 10–20 | 22.40 | Reddish brown sandstone | $3.21 \times 10^{-4}$ |
| MW–003 | 11.5–21.5 | 24.03 | Weathered red sandstone/brown sandstone | $2.90 \times 10^{-4}$ |
| MW–004 | 22–32 | 34.49 | Grey sandstone/siltstone | $7.92 \times 10^{-4}$ |
| MW–005 | 10–20 | 23.32 | Brown sandstone | $2.11 \times 10^{-4}$ |
| MW–006 | 16–26 | 28.63 | Grey sandstone | $2.31 \times 10^{-4}$ |
| MW–007 | 8.5–18.5 | 17.95 | Sandstone | $4.61 \times 10^{-4}$ |

### 4.2.2 Groundwater Results

Groundwater samples were collected from each of the 7 newly installed monitoring wells (MW–001 through MW–007) and analyzed for TAL metals, cyanide, explosives, propellants, VOCs, SVOCs, pesticides and PCBs. The results of the groundwater are summarized in Table 4–7 (included at the end of Section 4.0) and included in Appendix M.

Nitrocellulose and five metals (antimony, cobalt, copper, iron, and manganese) were detected in seven groundwater samples (and 1 duplicate) at concentrations exceeding the RVAAP-specific consolidated bedrock background criteria, the Region 9 tap water PRG or both. However, the nitrocellulose concentrations results were qualified as estimated (J), or (B) the concentration of nitrocellulose in the method blank was detected above the reporting limit, or both (B) (J).

Exceedances for groundwater at LL–9 are summarized in Table 4–8 (included at the end of Section 4.0). Figures 4–19 and 4–20 show the analytical exceedances above installation consolidated aquifer background criteria (USACE, 2001b) levels (if available), Region 9 tap water PRGs (if available) for explosives/propellants, TAL metals/cyanide, pesticides/PCBs, VOCs, and SVOCs, or both. The results were compared to Region 9 tap water PRGs and consolidated aquifer background values for screening purposes. Purging and field sampling forms are provided in Appendix K; tabulated analytical results and laboratory reports are provided in Appendix M.



LEGEND:

| | |
|---|---|
| 〰 | VEGETATION |
| — · · · — · · · — | INTERMITTENT STREAM |
| —··—··— | STREAM |
| — | PIPING |
| — | ROAD |
| — | 10 ft INTERVAL |
| — | 2 ft INTERVAL |
| — | POTENTIOMETRIC LINE |
| – – – | POTENTIOMETRIC LINE (inferred) |
| ⊙ | STEAM LINE POST |
| ✚ | MONITORING WELL SAMPLE LOCATION |
| ▭ | BUILDING |
| ×—×—× | FENCE |
| → | GROUNDWATER FLOW DIRECTION |

0' 100' 200' 300'

1" = 200'

N

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RAVENNA, OHIO

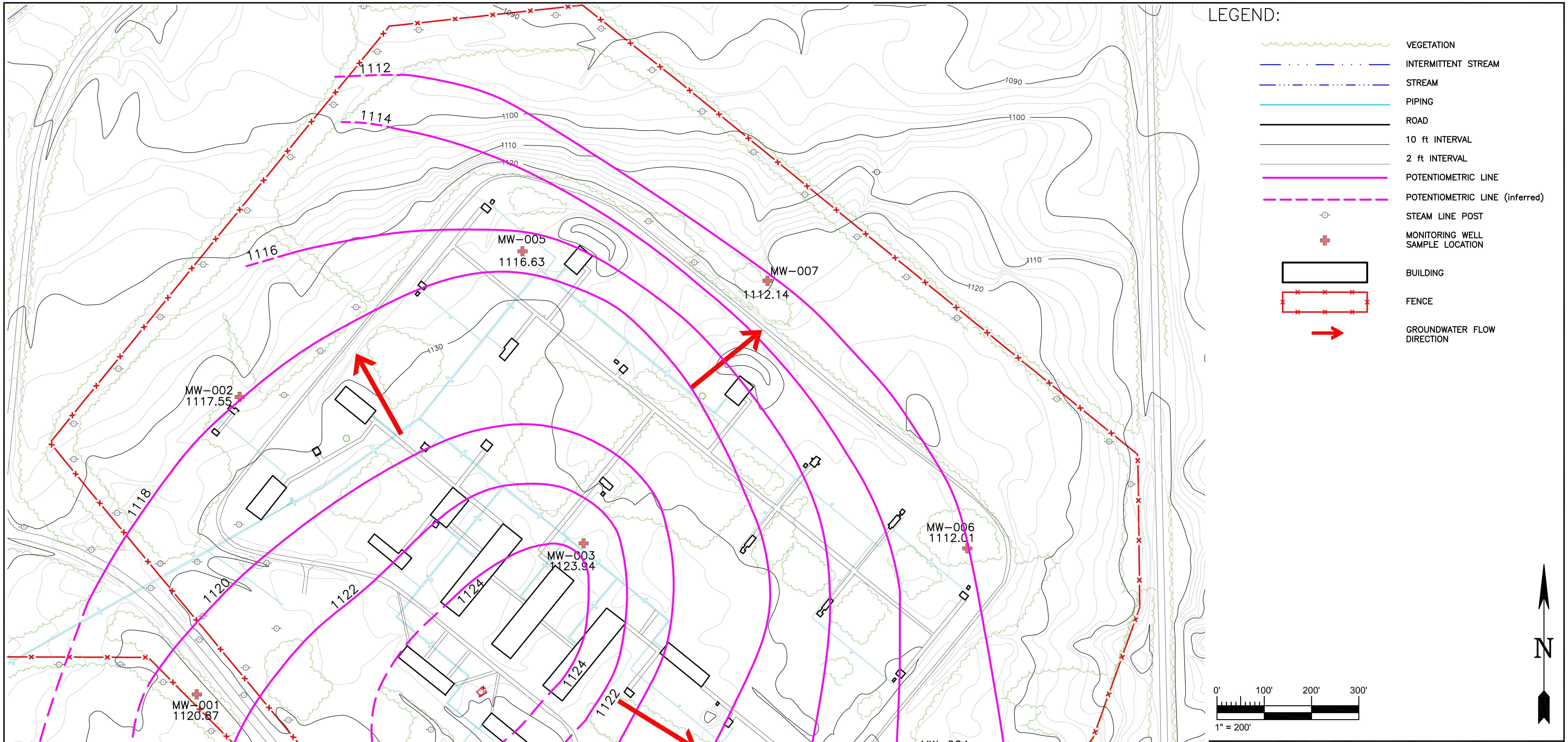
FIGURE 4-16

POTENTIOMETRIC SURFACE MAP
DECEMBER 8, 2003

LL 9 REMEDIAL INVESTIGATION

| SIZE | PROJECT NO. | DATE: | REV |
|---|---|---|---|
| B | 02-02-0085 | MAY 2007 | 2 |

| DRAWN BY | R. BOWMAN | APPR. BY | SL |
|---|---|---|---|



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RAVENNA, OHIO

FIGURE 4-17

POTENTIOMETRIC SURFACE MAP
DECEMBER 17, 2003

LL 9 REMEDIAL INVESTIGATION

| SIZE | PROJECT NO. | DATE: | REV |
|---|---|---|---|
| B | 02-02-0085 | MAY 2007 | 2 |

| DRAWN BY | R. BOWMAN | APPR. BY | SL |
|---|---|---|---|

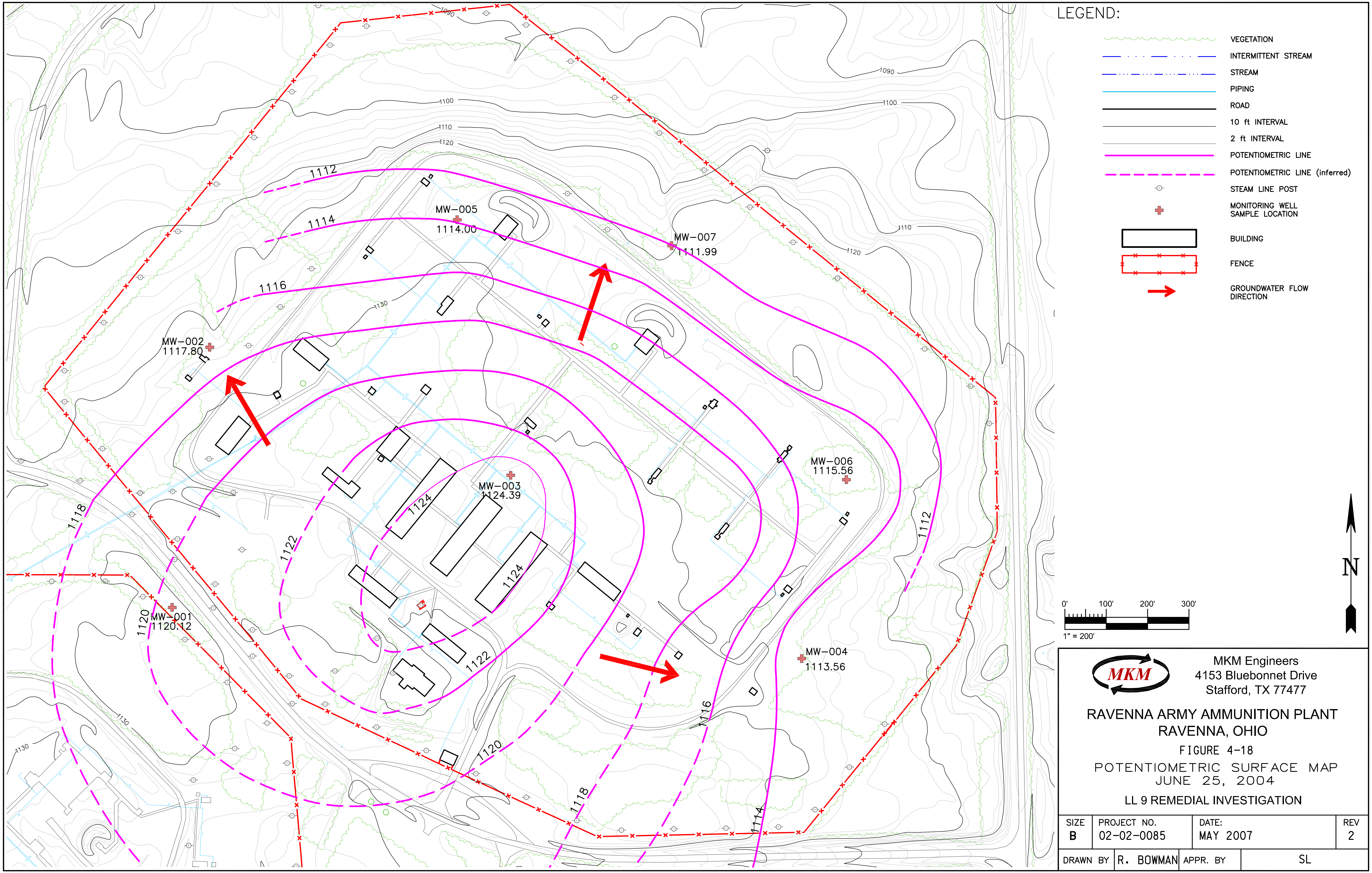

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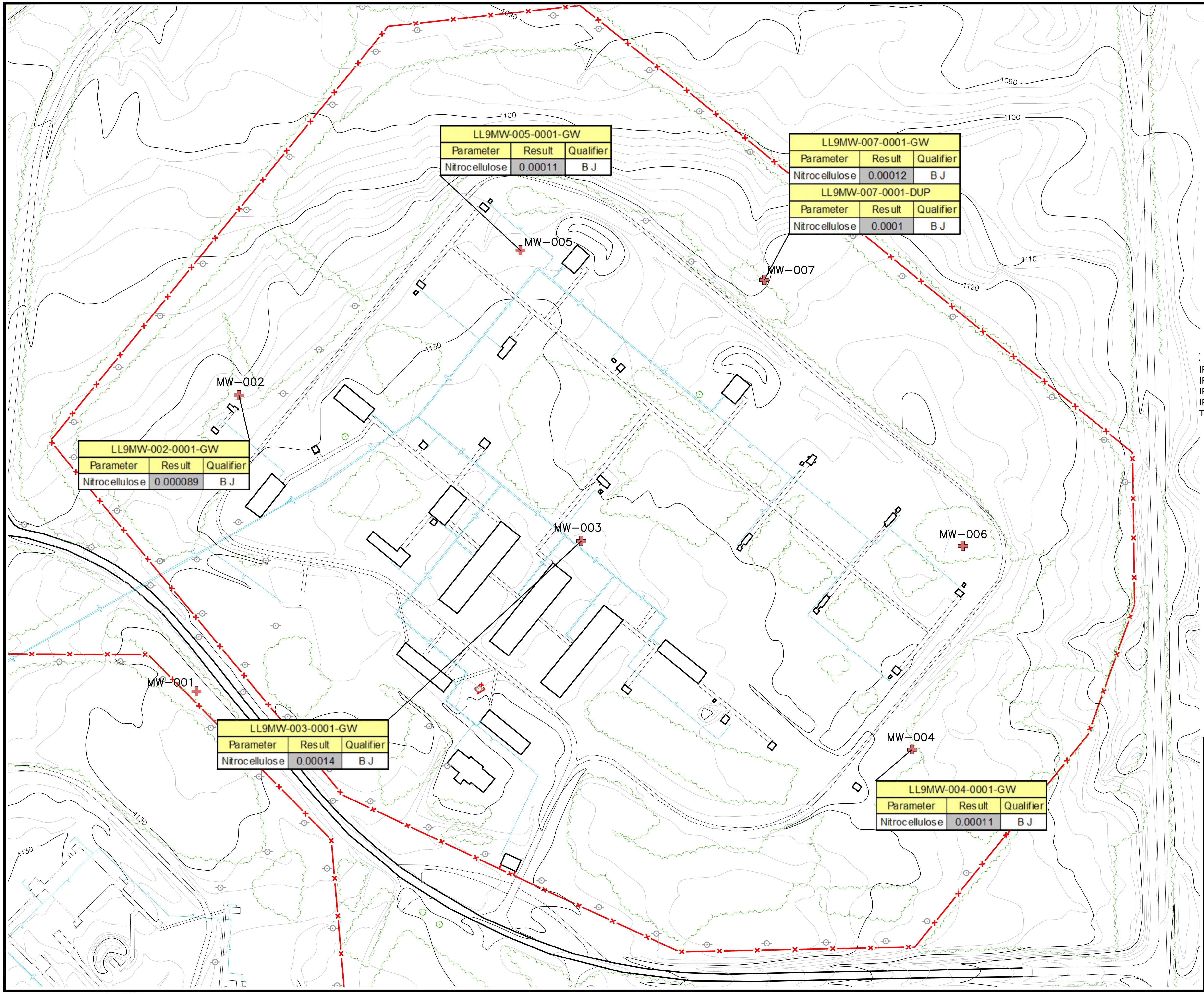
FIGURE 4-18

POTENTIOMETRIC SURFACE MAP
JUNE 25, 2004

LL 9 REMEDIAL INVESTIGATION

| SIZE | PROJECT NO. | DATE: | REV |
|---|---|---|---|
| B | 02-02-0085 | MAY 2007 | 2 |

DRAWN BY R. BOWMAN APPR. BY SL



**LL9MW-005-0001-GW**

| Parameter | Result | Qualifier |
|---|---|---|
| Nitrocellulose | 0.00011 | B J |

**LL9MW-007-0001-GW**

| Parameter | Result | Qualifier |
|---|---|---|
| Nitrocellulose | 0.00012 | B J |

**LL9MW-007-0001-DUP**

| Parameter | Result | Qualifier |
|---|---|---|
| Nitrocellulose | 0.0001 | B J |

**LL9MW-002-0001-GW**

| Parameter | Result | Qualifier |
|---|---|---|
| Nitrocellulose | 0.000089 | B J |

**LL9MW-003-0001-GW**

| Parameter | Result | Qualifier |
|---|---|---|
| Nitrocellulose | 0.00014 | B J |

**LL9MW-004-0001-GW**

| Parameter | Result | Qualifier |
|---|---|---|
| Nitrocellulose | 0.00011 | B J |

## LEGEND:

VEGETATION
INTERMITTENT STREAM
STREAM
PIPING
ROAD
10 ft INTERVAL
2 ft INTERVAL
STEAM LINE POST
MONITORING WELL SAMPLE LOCATION
BUILDING
FENCE

## NOTES:

RESULTS SHOWN IN ug/L
IF RESULT ≥ BACKGROUND, THEN THE VALUE IS SHADED
IF RESULT ≥ THE PRG THEN THE VALUE IS LISTED IN BOLD TEXT
IF RESULT ≥ BACKGROUND AND THE PRG THE VALUE IS BOLD + SHADED
IF RESULT < BACKGROUND AND PRG THEN THE VALUE IS LISTED IN NORMAL TEXT

ORGANIC QUALIFIERS
U – ANALYTE WAS NOT DETECTED AT OR ABOVE THE STATED LIMIT
J – RESULT IS AN ESTIMATED VALUE BELOW THE RL

ORGANIC FLAGS
B – METHOD BLANK: BATCH QC IS GREATER THAN RL
* – BATCH QC EXCEEDS THE UPPER OR LOWER CONTROL LIMIT
^ – BATCH QC IS GREATER THAN RL
A – CONCENTRATION IS BELOW THE METHOD REPORTING LIMIT (RL)
H – ALTERNATE PEAK SELECTION UPON ANALYTICAL REVIEW

0' 100' 200' 300'
1" = 200'

N

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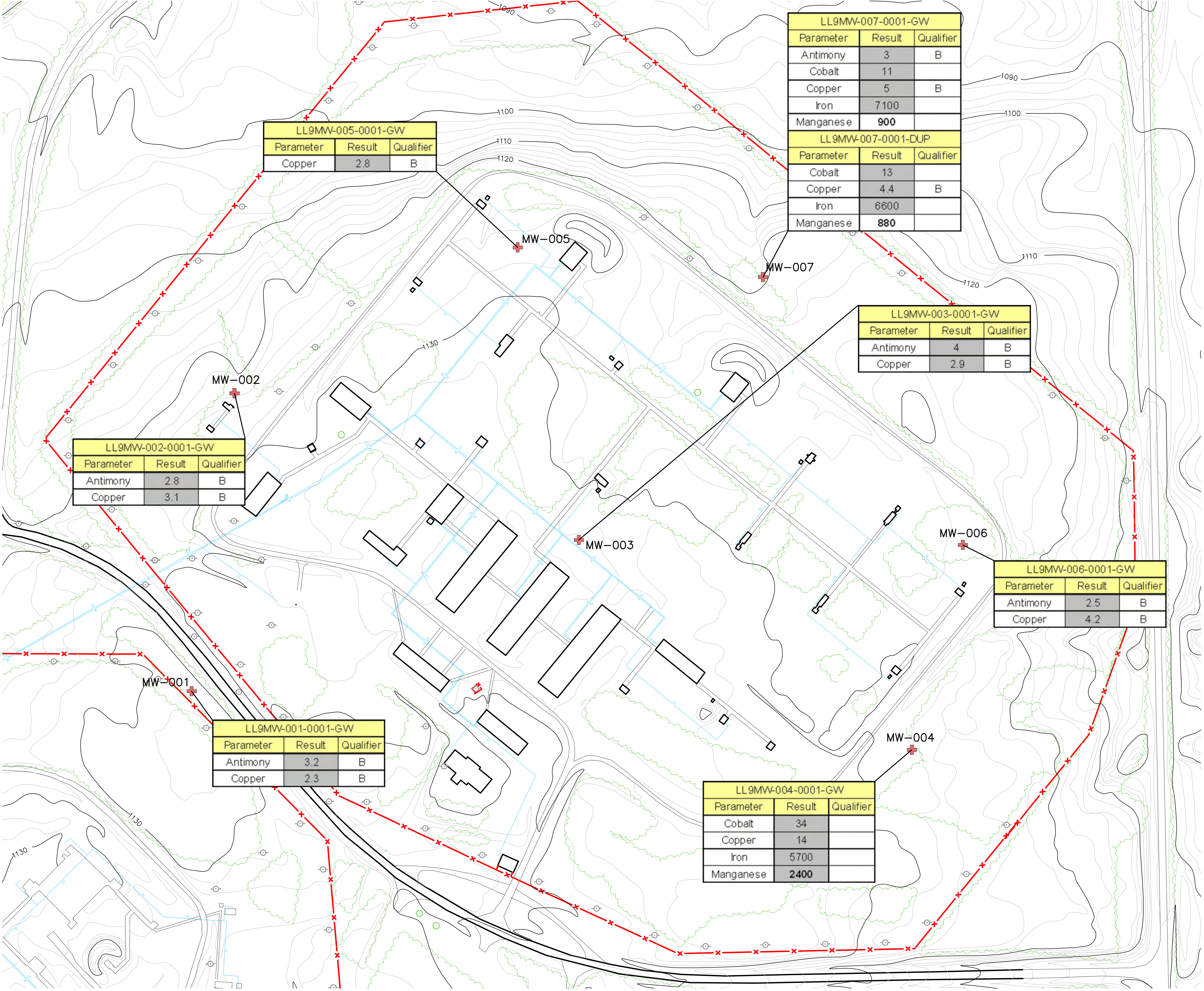
FIGURE 4-19
GROUNDWATER SAMPLE EXCEEDANCES
EXPLOSIVES/PROPELLANTS

**LL 9 REMEDIAL INVESTIGATION**

| SIZE | PROJECT NO. | DATE: | REV |
|---|---|---|---|
| B | 02-02-0085 | AUG 2007 | 3 |
| DRAWN BY | K. PERRY | APPR. BY | MT |



LL9MW-007-0001-GW

| Parameter | Result | Qualifier |
|---|---|---|
| Antimony | 3 | B |
| Cobalt | 11 | |
| Copper | 5 | B |
| Iron | 7100 | |
| Manganese | **900** | |

LL9MW-007-0001-DUP

| Parameter | Result | Qualifier |
|---|---|---|
| Cobalt | 13 | |
| Copper | 4.4 | B |
| Iron | 6600 | |
| Manganese | **880** | |

LL9MW-005-0001-GW

| Parameter | Result | Qualifier |
|---|---|---|
| Copper | 2.8 | B |

LL9MW-003-0001-GW

| Parameter | Result | Qualifier |
|---|---|---|
| Antimony | 4 | B |
| Copper | 2.9 | B |

LL9MW-002-0001-GW

| Parameter | Result | Qualifier |
|---|---|---|
| Antimony | 2.8 | B |
| Copper | 3.1 | B |

LL9MW-006-0001-GW

| Parameter | Result | Qualifier |
|---|---|---|
| Antimony | 2.5 | B |
| Copper | 4.2 | B |

LL9MW-001-0001-GW

| Parameter | Result | Qualifier |
|---|---|---|
| Antimony | 3.2 | B |
| Copper | 2.3 | B |

LL9MW-004-0001-GW

| Parameter | Result | Qualifier |
|---|---|---|
| Cobalt | 34 | |
| Copper | 14 | |
| Iron | 5700 | |
| Manganese | **2400** | |

## LEGEND:

- VEGETATION
- INTERMITTENT STREAM
- STREAM
- PIPING
- ROAD
- 10 ft INTERVAL
- 2 ft INTERVAL
- STEAM LINE POST
- MONITORING WELL SAMPLE LOCATION
- BUILDING
- FENCE

## NOTES:

RESULTS SHOWN IN ug/L
IF RESULT ≥ BACKGROUND, THEN THE VALUE IS SHADED
IF RESULT ≥ THE PRG THEN THE VALUE IS LISTED IN BOLD TEXT
IF RESULT ≥ BACKGROUND AND THE PRG THE VALUE IS BOLD + SHADED
IF RESULT < BACKGROUND AND PRG THEN THE VALUE IS LISTED IN NORMAL TEXT

INORGANIC QUALIFIERS
U – ANALYTE WAS NOT DETECTED AT OR ABOVE THE STATED LIMIT
J – RESULT IS LESS THAN THE RL, BUT GREATER THAN OR EQUAL TO THE MDL
B – RESULT IS LESS THAN THE CRDL/RL, BUT GREATER THAN OR EQUAL TO THE IDL/MDL

INORGANIC FLAGS
^ – INSTRUMENT RELATED QC EXCEED THE UPPER OR LOWER CONTROL LIMITS
* – BATCH QC EXCEEDS THE UPPER OR LOWER CONTROL LIMIT
H – BATCH QC IS GREATER THAN RL

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FIGURE 4–20

GROUNDWATER SAMPLES EXCEEDANCES
TAL METALS AND CYANIDE

**LL 9 REMEDIAL INVESTIGATION**

| SIZE | PROJECT NO. | DATE: | REV |
|---|---|---|---|
| B | 02–02–0085 | MAY 2007 | 2 |

DRAWN BY K. PERRY APPR. BY SL

#### *4.2.2.1 Explosives and Propellants*

Nitrocellulose was detected above the RVAAP-specific consolidated bedrock background criterion (0.0 mg/kg) in 6 samples, 1 of which was a duplicate. The maximum concentration of 0.00014 (B)(J) µg/L was detected in sample LL9GW–003–0001–GW. Detections refer to individual samples (six samples total), one of which was a duplicate. Figure 4–19 shows groundwater exceedances for explosives and propellants at LL–9.

#### *4.2.2.2 TAL Metals and Cyanide*

When the RVAAP-specific consolidated bedrock background criteria for groundwater were established, no background criteria were established for antimony, cobalt or copper. Therefore, the background criteria assigned to these metals, for the purpose of this RI, was zero. Figure 4–20 shows groundwater exceedances for TAL metals and cyanide at LL–9. Thirteen inorganic compounds were detected in the 7 groundwater samples (and 1 duplicate) collected as part of the LL–9 RI. Only 5 of the 13 metals detected exceeded the RVAAP-specific consolidated bedrock background criteria, the Region 9 tap water PRG or both. The exceedences are summarized as follows:

- Antimony was detected above the RVAAP-specific consolidated bedrock background criterion (0.0 µg/L) in 5 samples. The maximum concentration of 4 (B) µg/L was detected in sample LL9GW–003–0001–GW.
- Cobalt was detected above the RVAAP-specific consolidated bedrock background criterion (0.0 µg/L) in 3 samples, 1 of which was a duplicate. The maximum concentration of 34 µg/L was detected in sample LL9GW–004–0001–GW.
- Copper was detected above the RVAAP-specific consolidated bedrock background criterion (0.0 µg/L) in 8 samples, 1 of which was a duplicate. The maximum concentration of 14 µg/L was detected in sample LL9GW–004–0001–GW.
- Iron was detected above the RVAAP-specific consolidated bedrock background criterion (1,430 µg/L) in 3 samples, 1 of which was a duplicate. The maximum concentration of 7,100 µg/L was detected in sample LL9GW–007–0001–GW.
- Manganese was detected above the Region 9 tap water PRG (876 µg/L) in 2 samples, 1 of which was a duplicate. Manganese was also detected above the RVAAP-specific consolidated bedrock background criterion (1,340 µg/L) and the Region 9 tap water PRG in 1 sample. The maximum concentration of 2,400 µg/L was detected in sample LL9GW–004–0001–GW.

#### *4.2.2.3 Pesticides and PCBs*

No pesticides or PCBs were reported above laboratory detection limits in the groundwater samples.

#### *4.2.2.4 Volatiles and Semi–volatiles*

No VOCs or SVOCs were reported above laboratory detection limits in the groundwater samples

## 4.3 Surface Water

This section summarizes the physical and chemical data from the LL–9 surface water collected during the RI field program.

### 4.3.1 Azide Screening Results

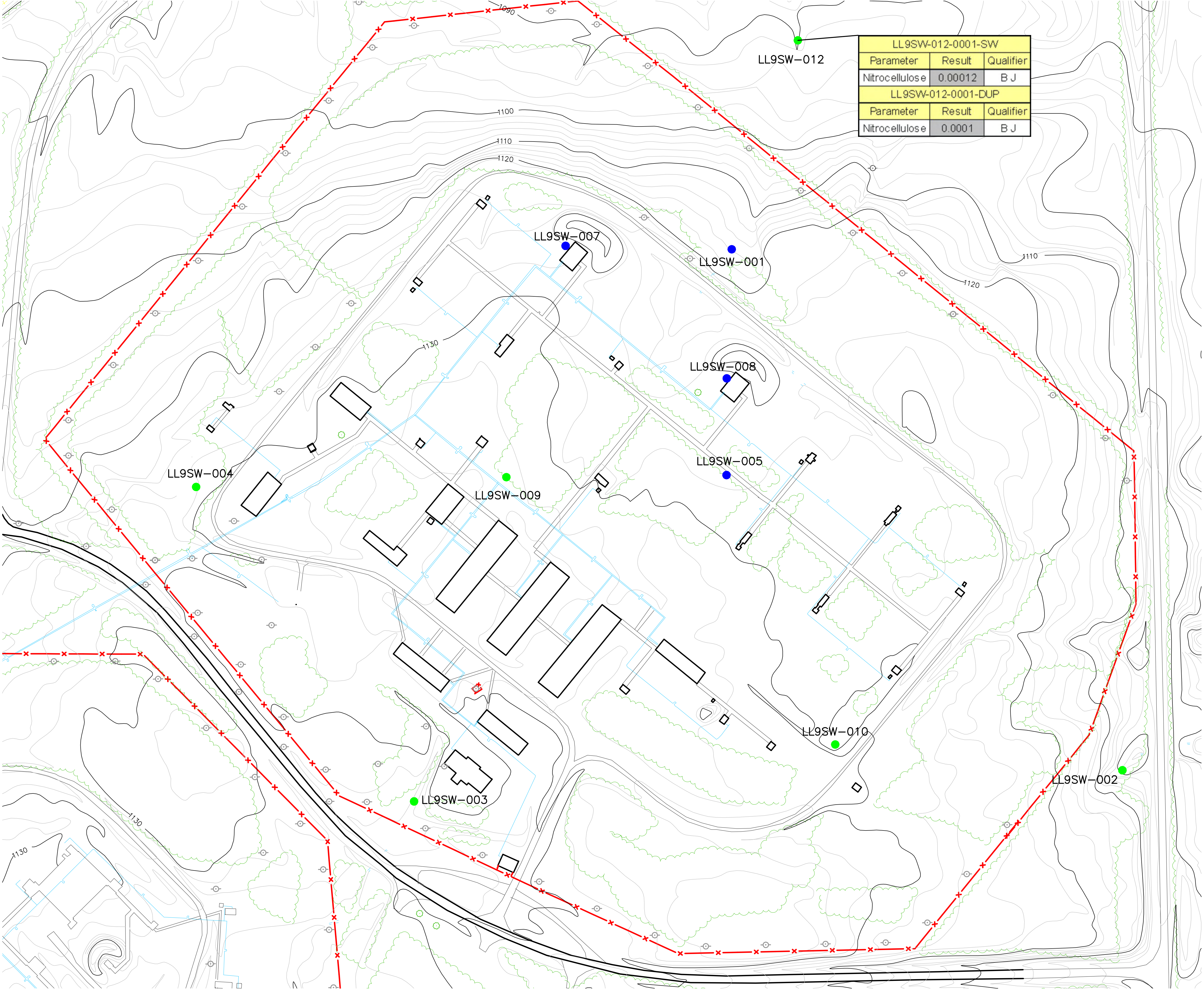
Four surface water samples and one duplicate were collected and analyzed for explosives in accordance with SW846 Method 8330 and TAL metals during the azide screening field program in March 2002. Analytical results are included in Appendix P and summarized in Table 4–9. There were no explosives detected above the reporting limit. Metals exceeded the RVAAP-specific surface water installation background values established by USACE (2000), the Region 9 tap water PRGs, or both in three of the samples and the duplicate; LL9SW–005–0001–SW, LL9SW–007–0001–SW, LL9SW–008–0001–SW, and LL9SW–008–0001–SW (FD). These exceedances are included in the surface water exceedances tabulation at the end of this subsection.

### 4.3.2 RI Results

Four ditch surface water samples, two sewer manhole samples, and one duplicate were collected and analyzed for TAL metals, explosives and cyanide. Figure 4–21 and 4–22 shows the analytical exceedances above RVAAP-specific surface water background values established by USACE (2000) (if available) and/or Region 9 tap water PRGs (if available) for explosives/propellants, TAL metals/cyanide, pesticides/PCBs, VOCs, and SVOCs.

Metals including aluminum, arsenic, barium, beryllium, chromium, cobalt, copper, lead, manganese, mercury, nickel, vanadium, and zinc were detected in surface water at concentration exceeding the RVAAP-specific surface water installation background values established by USACE (2000), the Region 9 tap water PRGs, or both. Nitrocellulose was detected in two samples at concentrations above the method detection limit but below the reporting limit. However, the nitrocellulose concentrations results were qualified as estimated (J), or (B) the concentration of nitrocellulose in the method blank was detected above the reporting limit, or both (B) (J).

The surface water sampling locations are shown on Figure 3–4. Table 4–10 (included at the end of Section 4.0) lists each surface water sample that exceeded an installation background concentration or Region 9 tap water PRG and the associated analytical result.



| LL9SW-012-0001-SW | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Nitrocellulose | 0.00012 | B J |
| **LL9SW-012-0001-DUP** | | |
| Parameter | Result | Qualifier |
| Nitrocellulose | 0.0001 | B J |

## LEGEND:

- VEGETATION
- INTERMITTENT STREAM
- STREAM
- PIPING
- ROAD
- 10 ft INTERVAL
- 2 ft INTERVAL
- STEAM LINE POST
- ● SURFACE WATER SAMPLING LOCATION
- ● SURFACE WATER SAMPLING LOCATION TAKEN DURING AZIDE SCREENING
- BUILDING
- FENCE

## NOTES:

RESULTS SHOWN IN ug/L
IF RESULT ≥ BACKGROUND, THEN THE VALUE IS SHADED
IF RESULT ≥ THE PRG THEN THE VALUE IS LISTED IN BOLD TEXT
IF RESULT ≥ BACKGROUND AND THE PRG THE VALUE IS BOLD + SHADED
IF RESULT < BACKGROUND AND PRG THEN THE VALUE IS LISTED IN NORMAL TEXT

ORGANIC QUALIFIERS
U – ANALYTE WAS NOT DETECTED AT OR ABOVE THE STATED LIMIT
J – RESULT IS AN ESTIMATED VALUE BELOW THE RL

ORGANIC FLAGS
B – METHOD BLANK: BATCH QC IS GREATER THAN RL
* – BATCH QC EXCEEDS THE UPPER OR LOWER CONTROL LIMIT
^ – BATCH QC IS GREATER THAN RL
A – CONCENTRATION IS BELOW THE METHOD REPORTING LIMIT (RL)
H – ALTERNATE PEAK SELECTION UPON ANALYTICAL REVIEW

0' 100' 200' 300'
1" = 200'

N

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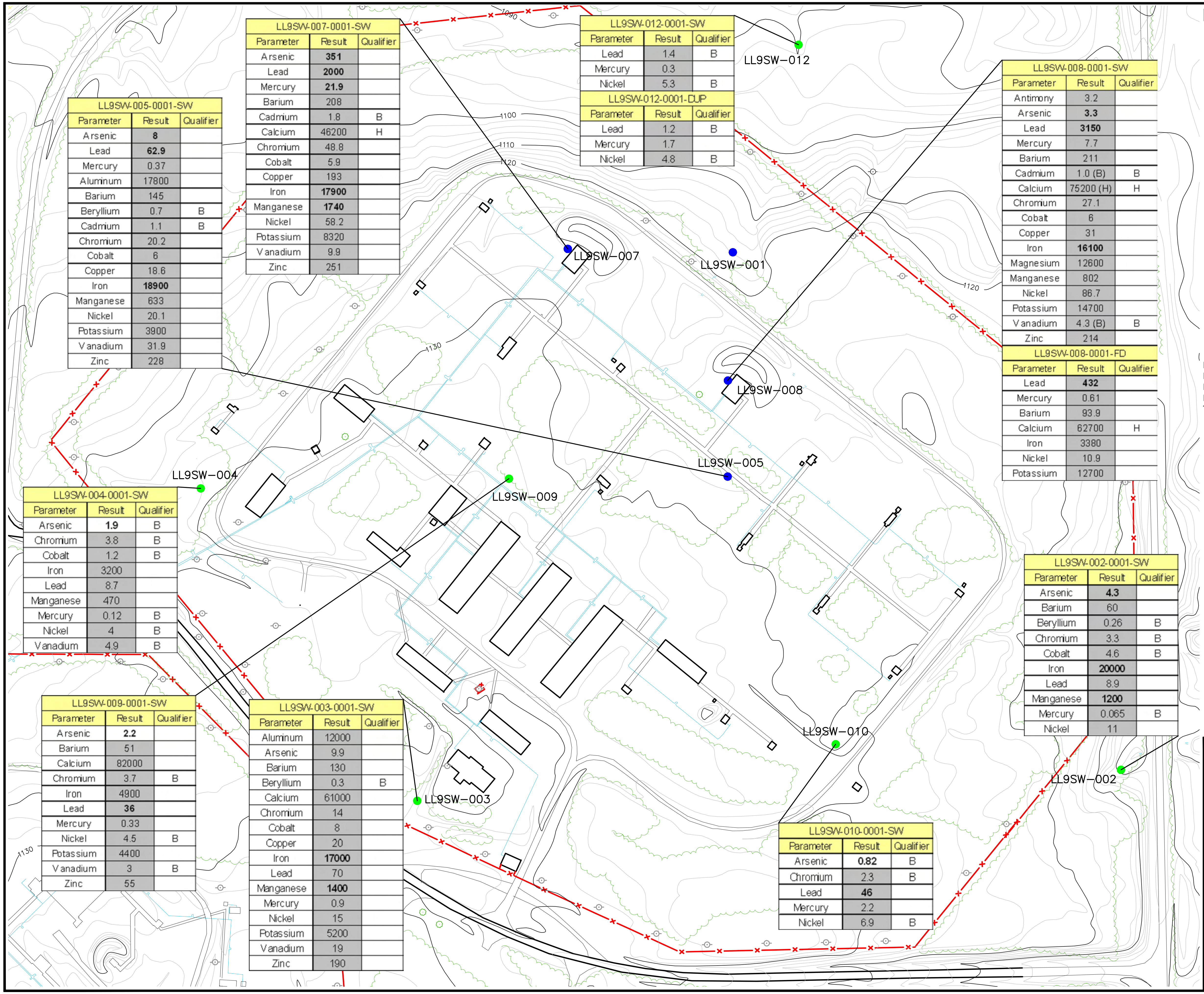
FIGURE 4–21

SURFACE WATER EXCEEDANCES
EXPLOSIVES/PROPELLANTS

**LL 9 REMEDIAL INVESTIGATION**

| SIZE | PROJECT NO. | DATE: | REV |
|---|---|---|---|
| B | 02–02–0085 | MAY 2007 | 2 |
| DRAWN BY | K. PERRY | APPR. BY | SL |



| LL9SW-005-0001-SW | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Arsenic | **8** | |
| Lead | **62.9** | |
| Mercury | 0.37 | |
| Aluminum | 17800 | |
| Barium | 145 | |
| Beryllium | 0.7 | B |
| Cadmium | 1.1 | B |
| Chromium | 20.2 | |
| Cobalt | 6 | |
| Copper | 18.6 | |
| Iron | **18900** | |
| Manganese | 633 | |
| Nickel | 20.1 | |
| Potassium | 3900 | |
| Vanadium | 31.9 | |
| Zinc | 228 | |

| LL9SW-007-0001-SW | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Arsenic | **351** | |
| Lead | **2000** | |
| Mercury | **21.9** | |
| Barium | 208 | |
| Cadmium | 1.8 | B |
| Calcium | 46200 | H |
| Chromium | 48.8 | |
| Cobalt | 5.9 | |
| Copper | 193 | |
| Iron | **17900** | |
| Manganese | **1740** | |
| Nickel | 58.2 | |
| Potassium | 8320 | |
| Vanadium | 9.9 | |
| Zinc | 251 | |

| LL9SW-012-0001-SW | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Lead | 1.4 | B |
| Mercury | 0.3 | |
| Nickel | 5.3 | B |

| LL9SW-012-0001-DUP | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Lead | 1.2 | B |
| Mercury | 1.7 | |
| Nickel | 4.8 | B |

| LL9SW-008-0001-SW | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Antimony | 3.2 | |
| Arsenic | **3.3** | |
| Lead | **3150** | |
| Mercury | 7.7 | |
| Barium | 211 | |
| Cadmium | 1.0 (B) | B |
| Calcium | 75200 (H) | H |
| Chromium | 27.1 | |
| Cobalt | 6 | |
| Copper | 31 | |
| Iron | **16100** | |
| Magnesium | 12600 | |
| Manganese | 802 | |
| Nickel | 86.7 | |
| Potassium | 14700 | |
| Vanadium | 4.3 (B) | B |
| Zinc | 214 | |

| LL9SW-008-0001-FD | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Lead | **432** | |
| Mercury | 0.61 | |
| Barium | 93.9 | |
| Calcium | 62700 | H |
| Iron | 3380 | |
| Nickel | 10.9 | |
| Potassium | 12700 | |

| LL9SW-004-0001-SW | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Arsenic | **1.9** | B |
| Chromium | 3.8 | B |
| Cobalt | 1.2 | B |
| Iron | 3200 | |
| Lead | 8.7 | |
| Manganese | 470 | |
| Mercury | 0.12 | B |
| Nickel | 4 | B |
| Vanadium | 4.9 | B |

| LL9SW-009-0001-SW | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Arsenic | **2.2** | |
| Barium | 51 | |
| Calcium | 82000 | |
| Chromium | 3.7 | B |
| Iron | 4900 | |
| Lead | **36** | |
| Mercury | 0.33 | |
| Nickel | 4.5 | B |
| Potassium | 4400 | |
| Vanadium | 3 | B |
| Zinc | 55 | |

| LL9SW-003-0001-SW | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | 12000 | |
| Arsenic | 9.9 | |
| Barium | 130 | |
| Beryllium | 0.3 | B |
| Calcium | 61000 | |
| Chromium | 14 | |
| Cobalt | 8 | |
| Copper | 20 | |
| Iron | **17000** | |
| Lead | 70 | |
| Manganese | **1400** | |
| Mercury | 0.9 | |
| Nickel | 15 | |
| Potassium | 5200 | |
| Vanadium | 19 | |
| Zinc | 190 | |

| LL9SW-010-0001-SW | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Arsenic | **0.82** | B |
| Chromium | 2.3 | B |
| Lead | **46** | |
| Mercury | 2.2 | |
| Nickel | 6.9 | B |

| LL9SW-002-0001-SW | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Arsenic | **4.3** | |
| Barium | 60 | |
| Beryllium | 0.26 | B |
| Chromium | 3.3 | B |
| Cobalt | 4.6 | B |
| Iron | **20000** | |
| Lead | 8.9 | |
| Manganese | **1200** | |
| Mercury | 0.065 | B |
| Nickel | 11 | |

## LEGEND:

| | |
|---|---|
| | VEGETATION |
| | INTERMITTENT STREAM |
| | STREAM |
| | PIPING |
| | ROAD |
| | 10 ft INTERVAL |
| | 2 ft INTERVAL |
| | STEAM LINE POST |
| ● | SURFACE WATER SAMPLING LOCATION |
| ● | SURFACE WATER SAMPLING LOCATION TAKEN DURING AZIDE SCREENING |
| ▭ | BUILDING |
| | FENCE |

## NOTES:

RESULTS SHOWN IN ug/L
IF RESULT ≥ BACKGROUND, THEN THE VALUE IS SHADED
IF RESULT ≥ THE PRG THEN THE VALUE IS LISTED IN BOLD TEXT
IF RESULT ≥ BACKGROUND AND THE PRG THE VALUE IS BOLD + SHADED
IF RESULT < BACKGROUND AND PRG THEN THE VALUE IS LISTED IN NORMAL TEXT

INORGANIC QUALIFIERS
U – ANALYTE WAS NOT DETECTED AT OR ABOVE THE STATED LIMIT
J – RESULT IS LESS THAN THE RL, BUT GREATER THAN OR EQUAL TO THE MDL
B – RESULT IS LESS THAN THE CRDL/RL, BUT GREATER THAN OR EQUAL TO THE IDL/MDL

INORGANIC FLAGS
^ – INSTRUMENT RELATED QC EXCEED THE UPPER OR LOWER CONTROL LIMITS
* – BATCH QC EXCEEDS THE UPPER OR LOWER CONTROL LIMIT
H – BATCH QC IS GREATER THAN RL

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FIGURE 4–22
SURFACE WATER EXCEEDANCES
TAL METALS AND CYANIDE
**LL 9 REMEDIAL INVESTIGATION**

| SIZE | PROJECT NO. | DATE: | REV |
|---|---|---|---|
| B | 02–02–0085 | MAY 2007 | 2 |
| DRAWN BY | K. PERRY | APPR. BY | SL |

Surface water sampling forms are found in Appendix O. Analytical results are tabulated and laboratory reports are provided in Appendix P and summarized in Table 4–11 (included at the end of Section 4.0).

#### *4.3.2.1 Explosives and Propellants*

No explosives were detected above the method detection limit. Nitrocellulose was detected above the RVAAP installation background criterion (0.0 mg/kg) in 2 samples, 1 of which was a duplicate. Nitrocellulose was detected above the method detection limit but below the reporting limit in sample LL9SW–012–0001–SW at a concentration of 0.00012 (B) (J) µg/L and LL9SW–012–0001–DUP at a concentration of 0.0001 (B) (J) µg/L. However, the nitrocellulose concentrations results were qualified as estimated (J), or (B) the concentration of nitrocellulose in the method blank was detected above the reporting limit, or both (B) (J). Figure 4–21 shows surface water exceedances for explosives and propellants at LL–9.

#### *4.3.2.2 TAL Metals and Cyanide*

When the RVAAP installation background criteria for surface water were established, no background criteria were established for beryllium, chromium, cobalt, lead, mercury, nickel or vanadium; therefore, the background criteria assigned to these metals, for the purpose of this RI, was zero. Figure 4–22 shows groundwater exceedances for TAL metals and cyanide at LL–9. The surface water metals and cyanide samples collected from LL–9 ditches were not filtered, so the results represent total concentrations. The following metals were detected above comparable RVAAP installation background criteria (USACE, 2001b), Region 9 tap water PRGs, or both:

- Aluminum was detected above the RVAAP installation background criterion (3,370 µg/L) in 1 sample. The concentration of 12000 µg/L was detected in sample LL9SW–003–0001–SW.
- Arsenic was detected above the Region 9 tap water PRG (0.045 µg/L) in 3 samples and was detected above RVAAP installation background criterion (3.2 µg/L) and the Region 9 tap water PRG in 2 samples. The maximum concentration of 9.9 µg/L was detected in sample LL9SW–003–0001–SW.
- Barium was detected above the RVAAP installation background criterion (47.5 µg/L) in 3 samples. The maximum concentration of 130 µg/L was detected in sample LL9SW–003–0001–SW.
- Beryllium was detected above the RVAAP installation background criterion (0.0 µg/L) in 2 samples. The maximum concentration of 0.3 µg/L was detected in sample LL9SW–003–0001–SW.
- Calcium was detected above the RVAAP installation background criterion (41,400 µg/L) in 2 samples. The maximum concentration of 82,000µg/L was detected in sample LL9SW–009–0001–SW.

- Chromium was detected above the RVAAP installation background criterion (0.0 µg/L) in 5 samples. The maximum concentration of 14 µg/L was detected in sample LL9SW–003–0001–SW.
- Cobalt was detected above the RVAAP installation background criterion (0.0 µg/L) in 3 samples. The maximum concentration of 8 µg/L in sample LL9SW–003–0001–SW.
- Copper was detected above the RVAAP installation background criterion (7.9 µg/L) in 1 sample with a concentration of 20 µg/L was detected in sample LL9SW–003–0001–SW.
- Iron was detected above the RVAAP installation background criterion (2,560 µg/L) in 2 samples and was detected above the Region 9 tap water PRG (10,950 µg/L) and RVAAP installation background criterion in 2 samples. The maximum concentration of 20,000 µg/L was detected in sample LL9SW–002–0001–SW.
- Lead was detected above RVAAP installation background criterion (0.0 µg/L) in 4 samples, 1 of which was a duplicate. Lead also was detected above the Region 9 tap water PRG (15 µg/L) and the RVAAP installation background criterion in 3 samples. The maximum concentration of 70 µg/L was detected in sample LL9SW–003–0001–SW.
- Manganese was detected above the RVAAP installation background criterion (391 µg/L) in 1 sample and was detected above the Region 9 tap water PRG (876 µg/L) and the RVAAP installation background criterion in 2 samples. The maximum concentration of 1,400 µg/L was detected in sample LL9SW–003–0001–SW.
- Mercury was detected above the RVAAP installation background criterion (0.0 µg/L) in 7 samples, 1 of which was a duplicate. The maximum concentration of 2.2 µg/L was detected in sample LL9SW–003–0001–SW.
- Nickel was detected above the RVAAP installation background criterion (0.0 µg/L) in 7 samples, 1 of which was a duplicate. The maximum concentration of 15 µg/L was detected in sample LL9SW–003–0001–SW.
- Potassium was detected above the RVAAP installation background criterion (3,170 µg/L) in 2 samples. The maximum concentration of 5,200 µg/L was detected in sample LL9SW–003–0001–SW.
- Vanadium was detected above the RVAAP installation background criterion (0.0 µg/L) in 3 samples. The maximum concentration of 19 µg/L was detected in sample LL9SW–003–0001–SW.
- Zinc was detected above the RVAAP installation background criterion (42 µg/L) in 2 samples. The maximum concentration of 190 µg/L was detected in sample LL9SW–003–0001–SW.

#### *4.3.2.3 Pesticides and PCBs*

No pesticides or PCBs were reported above laboratory detection limits in the surface water samples.

#### *4.3.2.4 Volatiles and Semi–volatiles*

No VOCs or SVOCs were reported above laboratory detection limits in the surface water samples.

## 4.4 Sediment

This section summarizes the physical and chemical data from the LL–9 sediment collected during the RI field program.

### 4.4.1 Azide Screening Results

Five sediment samples were collected and analyzed for explosives in accordance with SW846 Method 8330, TAL metals and lead azide during the azide screening field program in March 2002. Analytical results are included in Appendix R. There no explosives were detected above the method detection limits in any of the samples. Metals exceeded the RVAAP-specific sediment background values established by USACE (2000), Region 9 residential soil PRGs, or both, in the 4 samples analyzed for metals: LL9SD001–001–SD, LL9SD–003–0001–SD, LL9SD–005–0001–SD, and W–24S. These exceedances are included in the sediment exceedances tabulation at the end of this subsection.

### 4.4.2 RI Results

Twelve sediment samples (and 2 duplicates) were collected from LL–9; 11 from the drainage ways and 1 sewer sediment sample. The samples were analyzed for TAL metals, TOC and grain size. Ten percent of the sediment samples were analyzed for PCBs, pesticides, VOCs and SVOCs. No sump sediment samples were collected during the RI sampling effort. Section 3.3, Deviations from the Work Plan, lists the locations where samples were not collected. The analytical results for the sediment samples that exceeded RVAAP installation background or Region 9 residential soil PRG values are summarized in Table 4-12 (included at the end of Section 4.0). These results include the 5 sediment samples collected and analyzed for explosives, TAL metals and lead azide during the azide screening field program in March 2002.

Propellants (nitrocellulose and nitroguanidine), SVOCs (benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3–cd)pyrene) and metals (aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium and vanadium) were detected in sediment samples at concentrations exceeding the RVAAP-specific sediment background values established by

USACE (2000), Region 9 residential soil PRGs, or both. Therefore, the lateral and vertical extent of propellants, SVOCs, and metals were not fully delineated during this Phase I RI. Figures 4–23 through 4–25 show the analytical exceedances above installation background criteria (USACE, 2001b) levels (if available) and/or Region 9 residential soil PRGs (if available) for explosives/propellants, TAL metals/cyanide, pesticides/PCBs, VOCs, and SVOCs. Figures 4–23 through 4–25 also show the lateral extent, as determined by this Phase I RI, of sediment contamination at LL–9. Summary analytical reports are provided in Appendix R and summarized in Table 4-13 (included at the end of Section 4.0). The distribution and exposure pathways for SRCs are further discussed in the conceptual site model included in Section 5.4.

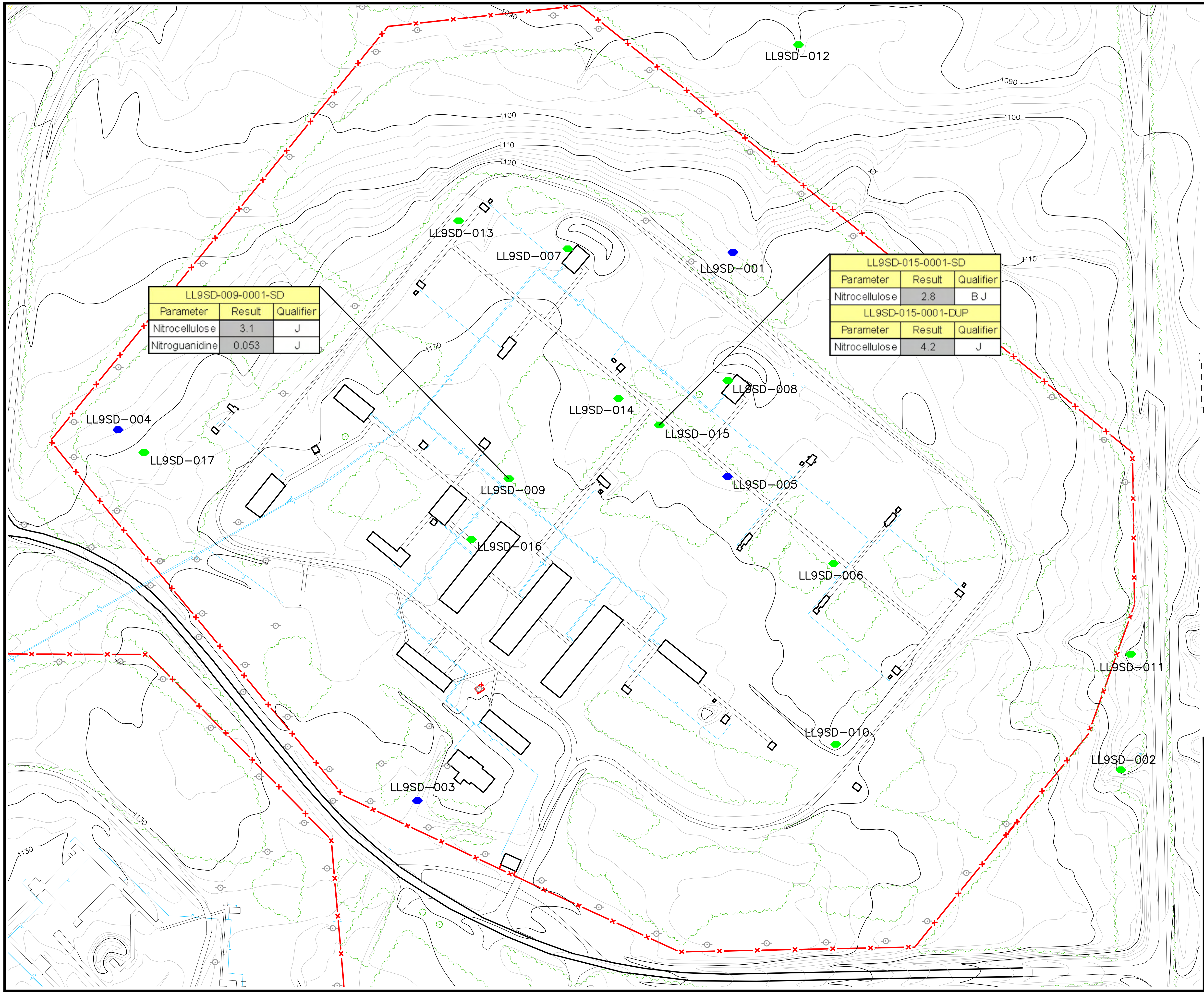
### *4.4.2.1 Explosives and Propellants*

Nitrocellulose was detected above the RVAAP installation background criterion in 3 samples, 1 of which was a duplicate. Nitrocellulose was detected in sample LL9SD–009–0001–SD at a concentration of 3.1 (J) mg/kg; LL9SD–015–0001–SD at a concentration of 2.8 (B) (J) mg/kg; and LL9SD–015–0001–DUP at a concentration of 4.2 (J) mg/kg. Nitroguanidine was detected above the RVAAP installation background criterion in 1 sample at a concentration of 0.053 (J) mg/kg in sample LL9SD–009–0001–SD. Based on the qualified analytical results, a determination of vertical extent of propellants cannot be made. Figure 4–23 shows sediment exceedances for explosives and propellants at LL–9.

### *4.4.2.2 TAL Metals and Cyanide*

When the RVAAP installation background criteria for surface water were established, no background criteria were established for antimony or cadmium; therefore, the background criteria assigned to these metals, for the purpose of this RI, was zero. Figure 4–24 shows sediment exceedances for TAL metals and cyanide at LL–9. The following metals were detected above comparable RVAAP installation background criteria (USACE, 2001b) and/or Region 9 residential soil PRGs:

- Aluminum was detected above the Region 9 residential soil PRG (7,614 mg/kg) in 11 samples, 2 of which were duplicates. Aluminum was also detected above the RVAAP installation background criterion (13,900 mg/kg) and the Region 9 residential soil PRG in 1 sample. The maximum concentration of 14,000 mg/kg was detected in sample LL9SD–004–0001–SD.
- Antimony was detected above the installation background criterion (0.0 mg/kg) in 1 sample. The concentration of 0.81 mg/kg was detected in sample LL9SD–002–0001–SD.



| LL9SD-009-0001-SD | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Nitrocellulose | 3.1 | J |
| Nitroguanidine | 0.053 | J |

| LL9SD-015-0001-SD | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Nitrocellulose | 2.8 | B J |

| LL9SD-015-0001-DUP | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Nitrocellulose | 4.2 | J |

## NOTES:

RESULTS SHOWN IN mg/kg

IF RESULT ≥ BACKGROUND, THEN THE VALUE IS SHADED
IF RESULT ≥ THE PRG THEN THE VALUE IS LISTED IN BOLD TEXT
IF RESULT ≥ BACKGROUND AND THE PRG THE VALUE IS BOLD + SHADED
IF RESULT < BACKGROUND AND PRG THEN THE VALUE IS LISTED IN NORMAL TEXT

ORGANIC QUALIFIERS
U – ANALYTE WAS NOT DETECTED AT OR ABOVE THE STATED LIMIT
J – RESULT IS AN ESTIMATED VALUE BELOW THE RL

ORGANIC FLAGS
B – METHOD BLANK: BATCH QC IS GREATER THAN RL
* – BATCH QC EXCEEDS THE UPPER OR LOWER CONTROL LIMIT
^ – BATCH QC IS GREATER THAN RL
A – CONCENTRATION IS BELOW THE METHOD REPORTING LIMIT (RL)
H – ALTERNATE PEAK SELECTION UPON ANALYTICAL REVIEW

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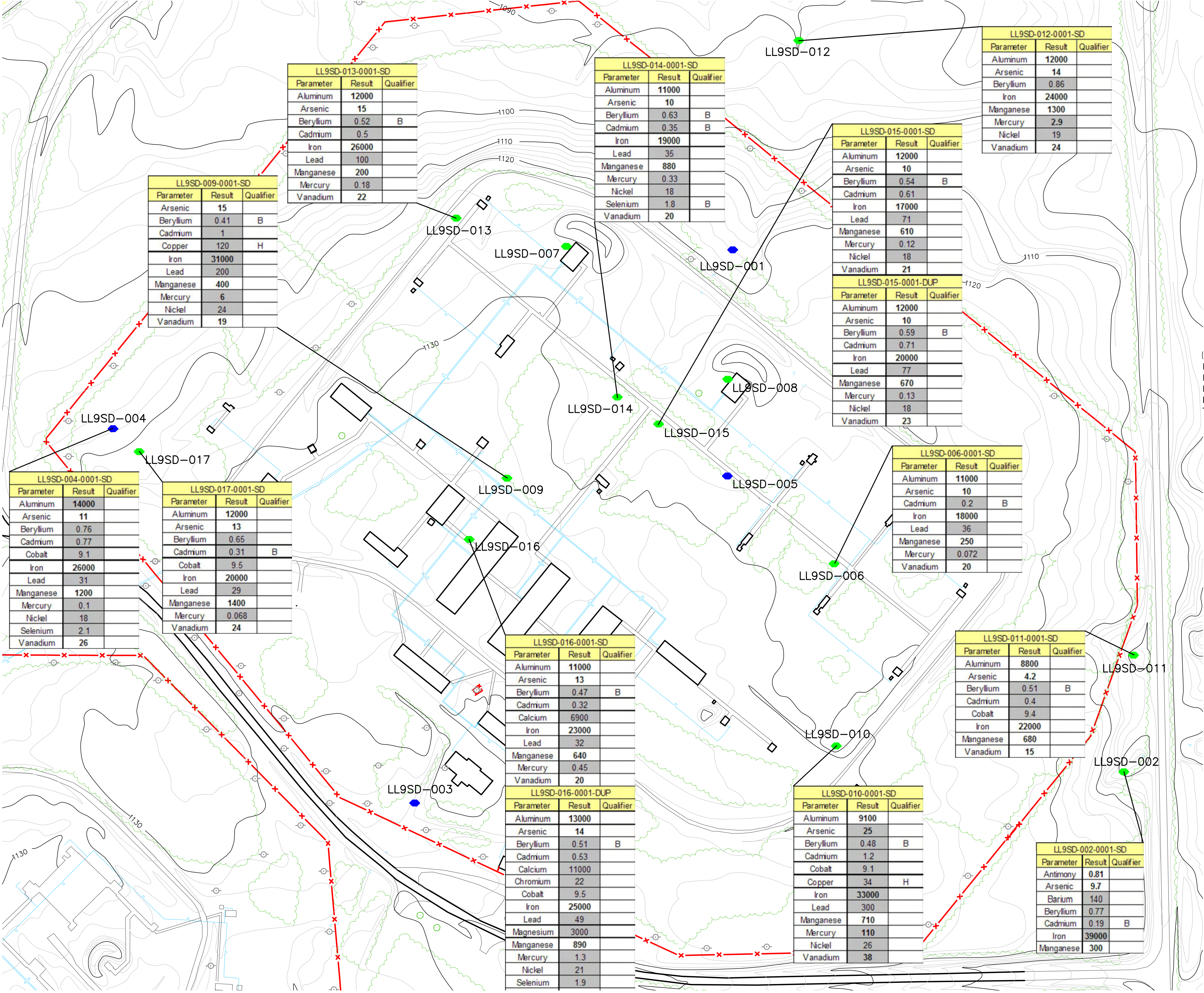
FIGURE 4–23

SEDIMENT EXCEEDANCES
EXPLOSIVES/PROPELLANTS

**LL 9 REMEDIAL INVESTIGATION**

| SIZE | PROJECT NO. | DATE: | REV |
|---|---|---|---|
| B | 02–02–0085 | MAY 2007 | 2 |

| DRAWN BY | K. PERRY | APPR. BY | SL |
|---|---|---|---|



| LL9SD-013-0001-SD | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **12000** | |
| Arsenic | **15** | |
| Beryllium | 0.52 | B |
| Cadmium | 0.5 | |
| Iron | **26000** | |
| Lead | 100 | |
| Manganese | **200** | |
| Mercury | 0.18 | |
| Vanadium | **22** | |

| LL9SD-014-0001-SD | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **11000** | |
| Arsenic | **10** | |
| Beryllium | 0.63 | B |
| Cadmium | 0.35 | B |
| Iron | **19000** | |
| Lead | 35 | |
| Manganese | **880** | |
| Mercury | 0.33 | |
| Nickel | 18 | |
| Selenium | 1.8 | B |
| Vanadium | **20** | |

| LL9SD-012-0001-SD | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **12000** | |
| Arsenic | **14** | |
| Beryllium | 0.86 | |
| Iron | **24000** | |
| Manganese | **1300** | |
| Mercury | **2.9** | |
| Nickel | 19 | |
| Vanadium | **24** | |

| LL9SD-009-0001-SD | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Arsenic | **15** | |
| Beryllium | 0.41 | B |
| Cadmium | 1 | |
| Copper | 120 | H |
| Iron | **31000** | |
| Lead | 200 | |
| Manganese | **400** | |
| Mercury | **6** | |
| Nickel | 24 | |
| Vanadium | **19** | |

| LL9SD-015-0001-SD | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **12000** | |
| Arsenic | **10** | |
| Beryllium | 0.54 | B |
| Cadmium | 0.61 | |
| Iron | **17000** | |
| Lead | 71 | |
| Manganese | **610** | |
| Mercury | 0.12 | |
| Nickel | 18 | |
| Vanadium | **21** | |

| LL9SD-015-0001-DUP | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **12000** | |
| Arsenic | **10** | |
| Beryllium | 0.59 | B |
| Cadmium | 0.71 | |
| Iron | **20000** | |
| Lead | 77 | |
| Manganese | **670** | |
| Mercury | 0.13 | |
| Nickel | 18 | |
| Vanadium | **23** | |

| LL9SD-004-0001-SD | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **14000** | |
| Arsenic | **11** | |
| Beryllium | 0.76 | |
| Cadmium | 0.77 | |
| Cobalt | 9.1 | |
| Iron | **26000** | |
| Lead | 31 | |
| Manganese | **1200** | |
| Mercury | 0.1 | |
| Nickel | 18 | |
| Selenium | 2.1 | |
| Vanadium | **26** | |

| LL9SD-017-0001-SD | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **12000** | |
| Arsenic | **13** | |
| Beryllium | 0.65 | |
| Cadmium | 0.31 | B |
| Cobalt | 9.5 | |
| Iron | **20000** | |
| Lead | 29 | |
| Manganese | **1400** | |
| Mercury | 0.068 | |
| Vanadium | **24** | |

| LL9SD-006-0001-SD | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **11000** | |
| Arsenic | **10** | |
| Cadmium | 0.2 | B |
| Iron | **18000** | |
| Lead | 36 | |
| Manganese | **250** | |
| Mercury | 0.072 | |
| Vanadium | **20** | |

| LL9SD-011-0001-SD | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **8800** | |
| Arsenic | **4.2** | |
| Beryllium | 0.51 | B |
| Cadmium | 0.4 | |
| Cobalt | 9.4 | |
| Iron | **22000** | |
| Manganese | **680** | |
| Vanadium | **15** | |

| LL9SD-016-0001-SD | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **11000** | |
| Arsenic | **13** | |
| Beryllium | 0.47 | B |
| Cadmium | 0.32 | |
| Calcium | 6900 | |
| Iron | **23000** | |
| Lead | 32 | |
| Manganese | **640** | |
| Mercury | 0.45 | |
| Vanadium | **20** | |

| LL9SD-016-0001-DUP | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **13000** | |
| Arsenic | **14** | |
| Beryllium | 0.51 | B |
| Cadmium | 0.53 | |
| Calcium | 11000 | |
| Chromium | 22 | |
| Cobalt | 9.5 | |
| Iron | **25000** | |
| Lead | 49 | |
| Magnesium | 3000 | |
| Manganese | **890** | |
| Mercury | 1.3 | |
| Nickel | 21 | |
| Selenium | 1.9 | |

| LL9SD-010-0001-SD | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Aluminum | **9100** | |
| Arsenic | **25** | |
| Beryllium | 0.48 | B |
| Cadmium | 1.2 | |
| Cobalt | 9.1 | |
| Copper | 34 | H |
| Iron | **33000** | |
| Lead | 300 | |
| Manganese | **710** | |
| Mercury | **110** | |
| Nickel | 26 | |
| Vanadium | **38** | |

| LL9SD-002-0001-SD | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Antimony | **0.81** | |
| Arsenic | **9.7** | |
| Barium | 140 | |
| Beryllium | 0.77 | |
| Cadmium | 0.19 | B |
| Iron | **39000** | |
| Manganese | **300** | |

## LEGEND:

VEGETATION
INTERMITTENT STREAM
STREAM
PIPING
ROAD
10 ft INTERVAL
2 ft INTERVAL
STEAM LINE POST
SEDIMENT SAMPLING LOCATION
SEDIMENT SAMPLING LOCATION TAKEN DURING AZIDE SCREENING
BUILDING
FENCE

## NOTES:

RESULTS SHOWN IN mg/kg

IF RESULT ≥ BACKGROUND, THEN THE VALUE IS SHADED
IF RESULT ≥ THE PRG THEN THE VALUE IS LISTED IN BOLD TEXT
IF RESULT ≥ BACKGROUND AND THE PRG THE VALUE IS BOLD + SHADED
IF RESULT < BACKGROUND AND PRG THEN THE VALUE IS LISTED IN NORMAL TEXT

INORGANIC QUALIFIERS
U – ANALYTE WAS NOT DETECTED AT OR ABOVE THE STATED LIMIT
J – RESULT IS LESS THAN THE RL, BUT GREATER THAN OR EQUAL TO THE MDL
B – RESULT IS LESS THAN THE CRDL/RL, BUT GREATER THAN OR EQUAL TO THE IDL/MDL

INORGANIC FLAGS
^ – INSTRUMENT RELATED QC EXCEED THE UPPER OR LOWER CONTROL LIMITS
* – BATCH QC EXCEEDS THE UPPER OR LOWER CONTROL LIMIT
H – BATCH QC IS GREATER THAN RL

0' 100' 200' 300'
1" = 200'

N

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**RAVENNA, OHIO**

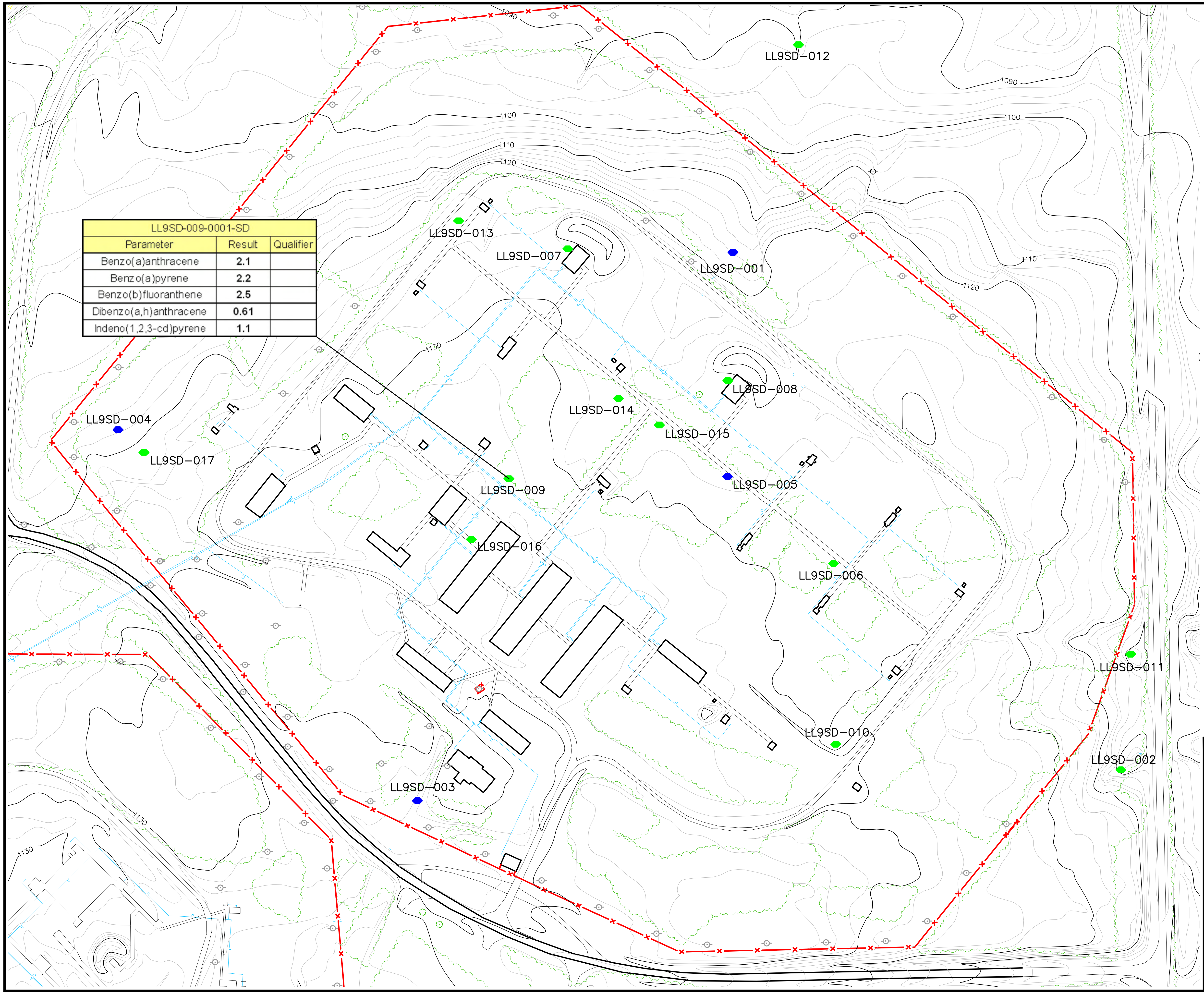
FIGURE 4-24

SEDIMENT EXCEEDANCES
TAL METALS AND CYANIDE

**LL 9 REMEDIAL INVESTIGATION**

| SIZE | PROJECT NO. | DATE: | REV |
|---|---|---|---|
| B | 02-02-0085 | MAY 2007 | 2 |

| DRAWN BY | K. PERRY | APPR. BY | SL |
|---|---|---|---|



| LL9SD-009-0001-SD | | |
|---|---|---|
| Parameter | Result | Qualifier |
| Benzo(a)anthracene | **2.1** | |
| Benzo(a)pyrene | **2.2** | |
| Benzo(b)fluoranthene | **2.5** | |
| Dibenzo(a,h)anthracene | **0.61** | |
| Indeno(1,2,3-cd)pyrene | **1.1** | |

## LEGEND:

| | |
|---|---|
| | VEGETATION |
| | INTERMITTENT STREAM |
| | STREAM |
| | PIPING |
| | ROAD |
| | 10 ft INTERVAL |
| | 2 ft INTERVAL |
| -○- | STEAM LINE POST |
| ● | SEDIMENT SAMPLING LOCATION |
| ● | SEDIMENT SAMPLING LOCATION TAKEN DURING AZIDE SCREENING |
| ☐ | BUILDING |
| ×—×—× | FENCE |

## NOTES:

RESULTS SHOWN IN mg/kg
IF RESULT ≥ BACKGROUND, THEN THE VALUE IS SHADED
IF RESULT ≥ THE PRG THEN THE VALUE IS LISTED IN BOLD TEXT
IF RESULT ≥ BACKGROUND AND THE PRG THE VALUE IS BOLD + SHADED
IF RESULT < BACKGROUND AND PRG THEN THE VALUE IS LISTED IN NORMAL TEXT

INORGANIC QUALIFIERS
U – ANALYTE WAS NOT DETECTED AT OR ABOVE THE STATED LIMIT
J – RESULT IS LESS THAN THE RL, BUT GREATER THAN OR EQUAL TO THE MDL
B – RESULT IS LESS THAN THE CRDL/RL, BUT GREATER THAN OR EQUAL TO THE IDL/MDL

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FIGURE 4−25

SEDIMENT EXCEEDANCES
VOCs AND SVOCs

**LL 9 REMEDIAL INVESTIGATION**

| SIZE | PROJECT NO. | DATE: | REV |
|---|---|---|---|
| B | 02−02−0085 | MAY 2007 | 2 |

| DRAWN BY | K. PERRY | APPR. BY | SL |
|---|---|---|---|

- Arsenic was detected above the Region 9 residential soil PRG (0.39 mg/kg) in 13 samples, 2 of which were duplicates. Arsenic was also detected above the RVAAP installation background criterion (19.5 mg/kg) and the Region 9 residential soil PRG in 1 sample. The maximum concentration of 25 mg/kg was detected in sample LL9SD–010–0001–SD.
- Barium was detected above the installation background criterion (123 mg/kg) in 1 sample with a concentration of 140 mg/kg in sample LL9SD–002–0001–SD.
- Beryllium was detected above the RVAAP installation background criterion (0.38 mg/kg) in 13 samples, 2 of which were duplicates. The maximum concentration of 0.86 mg/kg was detected in sample LL9SD–012–0001–SD.
- Cadmium was detected above the RVAAP installation background criterion (0.0 mg/kg) in 13 samples, 2 of which were duplicates. The maximum concentration of 0.77 mg/kg was detected in sample LL9SD–004–0001–SD.
- Calcium was detected above the RVAAP installation background criterion (5,510 mg/kg) in 2 samples, 1 of which was a duplicate. The maximum concentration of 11,000 mg/kg was detected in sample LL9SD–016–0001–DUP.
- Chromium was detected above the RVAAP installation background criterion (18.1 mg/kg) in 1 sample which was a duplicate. The maximum concentration of 22 mg/kg was detected in sample LL9SD–016–0001–DUP. Chromium was detected in sample LL9SD–016–0001–SD but the concentration was below the RVAAP installation background criterion with a concentration of 16 mg/kg.
- Cobalt was detected above the RVAAP installation background criterion (9.1 mg/kg) in 5 samples, 1 of which was a duplicate. The maximum concentration of 9.5 mg/kg was detected in sample LL9SD–016–0001–DUP and LL9SD–017–0001–SD. Sample LL9SD–016–0001–SD was detected but was below the RVAAP installation background criterion with a concentration of 8.2 mg/kg.
- Copper was detected above the RVAAP installation background criterion (27.6 mg/kg) in 2 samples. The maximum concentration of 120 mg/kg was detected in sample LL9SD–009–0001–SD.
- Iron was detected above the Region 9 residential soil PRG (2,346 mg/kg) in 11 samples, 2 of which were duplicates. Iron was also detected above the RVAAP installation background criterion (28,200 mg/kg) and the Region 9 residential soil PRG in 3 samples. The maximum concentration of 39,000 mg/kg was detected in sample LL9SD–002–0001–SD.
- Lead was detected above the RVAAP installation background criterion (27.4 mg/kg) in 11 samples, 2 of which were duplicates. The maximum concentration of 0.86 mg/kg was detected in sample LL9SD–012–0001–SD.
- Magnesium was detected above the RVAAP installation background criterion (2,760 mg/kg) in 1 sample which was a duplicate. The maximum concentration of 3,000 mg/kg was detected in sample LL9SD–016–0001–DUP. Sample LL9SD–016–0001–SD was detected but was below the RVAAP installation background criterion with a concentration of 2,700 mg/kg.

- Manganese was detected above the Region 9 residential soil PRG (176 mg/kg) in 14 samples, 2 of which were duplicates. The maximum concentration of 1400 mg/kg was detected in sample LL9SD–017–0001–SD.
- Mercury was detected above the RVAAP installation background criterion (0.06 mg/kg) in 9 samples, 2 of which were duplicates. Mercury was also detected above the Region 9 residential soil PRG (2.3 mg/kg) and the RVAAP installation background criterion in 3 samples. The maximum concentration of 110 mg/kg was detected in sample LL9SD–010–0001–SD.
- Nickel was detected above the RVAAP installation background criterion (17.7 mg/kg) in 8 samples, 2 of which were duplicates. The maximum concentration of 26 mg/kg was detected in sample LL9SD–010–0001–SD.
- Selenium was detected above the RVAAP installation background criterion (1.7 mg/kg) in 3 samples, 1 of which was a duplicate. The maximum concentration of 2.1 mg/kg was detected in sample LL9SD–004–0001–SD.
- Vanadium was detected above the Region 9 residential soil PRG (7.8 mg/kg) in 12 samples, 2 of which were duplicates. Vanadium was also detected above the RVAAP installation background criterion (26.1 mg/kg) in 1 sample. The maximum concentration of 38 mg/kg was detected in sample LL9SD–010–0001–SD.

#### *4.4.2.3 Pesticides and PCBs*

No pesticides or PCBs were reported above method detection limits in the subsurface soil samples.

#### *4.4.2.4 Volatiles and Semi–volatiles*

Figure 4–25 shows sediment exceedances for SVOCs at LL–9. No VOCs were reported above method detection limits in subsurface soil samples. Twenty-two SVOCs were reported above method detection limits in the sediment samples, however only 5 of the 22 SVOCs exceeded the Region 9 residential soil PRG. The following SVOCs were detected above the Region 9 residential soil PRGs:

- Benzo(a)anthracene was detected above the Region 9 PRG (0.62 mg/kg) in 1 sample. The concentration of 2.1 mg/kg was detected in sample LL9SD–009–0001–SD.
- Benzo(a)pyrene was detected above the Region 9 PRG (0.62 mg/kg) in 1 sample. The concentration of 2.5 mg/kg was detected in sample LL9SD–009–0001–SD.
- Benzo(b)fluoranthene was detected above the Region 9 PRG (0.062 mg/kg) in 1 sample. The concentration of 2.2 mg/kg was detected in sample LL9SD–009–0001–SD.
- Dibenzo(a,h)anthracene was detected above the Region 9 PRG (0.062 mg/kg) in 1 sample. The concentration of 0.61 mg/kg was detected in sample LL9SD–009–0001–SD.

- Indeno(1,2,3–cd)pyrene was detected above the Region 9 PRG (0.62 mg/kg) in 1 sample. The concentration of 1.1 mg/kg was detected in sample LL9SD–009–0001–SD.

#### *4.4.2.5 TOC and Grain Size Analyses*

TOC was measured in the sediment samples, with a maximum concentration of 24,000 mg/kg (LL9SD–013–0001–SD) and a minimum concentration of 3,500 mg/kg (LL9SD–012–0001SD).

Samples were also analyzed for grain size in accordance with ASTM D–422–63. Results for grain size analyses are included in are included in Appendix S.

## 4.5 Other Analyses

This section summarizes the physical and chemical data from the LL–9 sumps, sewers, subfloor and geotechnical samples collected during the RI field program.

### 4.5.1 Sump and Sewer Manhole Water and Residue

LL–9 sump and sewer manholes sampling results are included and discussed with surface water (Section 4.3) and sediment (Section 4.4) sampling results.

### 4.5.2 Subfloor

Subsurface soil samples LL9SB–048–0001–SO, LL9SB–049–0001–SO, LL9SB–050–0001–SO, LL9SB–051–0001–SO, LL9SB–052–0001–SO, and LL9SB–053–0001–SO were collected from the subfloor locations of selected buildings at LL–9. LL–9 subfloor sampling results are included and discussed with subsurface soil (Section 4.1.3) sampling results.

### 4.5.3 Geotechnical Samples

Geotechnical samples were obtained from some subsurface and sediment sampling locations. Two geotechnical samples were obtained from the borings that were advanced to install monitoring wells (MW–001 [sample LL9SB–033–0001–SO], and MW–003 [sample LL9SB–035–0001–SO]). Geotechnical samples were also obtained from 12 sampling and 2 duplicate sampling locations. Results obtained included grain size analysis (from all samples) and hydraulic conductivity (from the boring samples). Geotechnical sampling results are included in Appendix S.

Grain size analysis from the Shelby tube samples included 19.8% to 40% clay, 38% to 40% silt, and 18% to 30% sand. Average hydraulic conductivities ranged from 3.4E–08 to 1.1E–06. The conductivity results for LL9SB–033–0001–SO/MW–001 (3.4E–08) match the visual description of mostly lean clay. The conductivity results for LL9SB–035–0001–SO/MW–003 match the anticipated values based upon a visual description of sandy silty clay. Since these samples represent the range of visually described soil samples at the AOC, the hydraulic conductivity results can be used as a reference to similarly described soils.

## Table 4-1
## Summary of Azide Screening Surface Soil Results (0-1 ft)

| ANALYTE, UNITS, METHOD NO. | Ravenna Soil Background Criteria (0-1 ft) mg/kg | Region 9 PRG Data (Residential Soil) | D-14S | LL9SS-001-0001-SO | LL9SS-003-0001-SO | LL9SS-005-0001-SO | LL9SS-007-0001-SO | LL9SS-009-0001-SO | LL9SS-011-0001-SO |
|---|---|---|---|---|---|---|---|---|---|
| **Sample Date** | | **ppm** | 3/15/2002 | 3/11/2002 | 3/11/2002 | 3/11/2002 | 3/11/2002 | 3/11/2002 | 3/11/2002 |
| **Explosives 8330 mg/kg** | | | | | | | | | |
| **HMX** | 0.0 | 306 nc | 200 (J) (a) | 0.250 U | 0.250 U | 0.250 U | 0.250 U | 0.250 U | 0.250 U |
| **RDX** | 0.0 | 4.4 ca | BRL | 0.100 U | 0.100 U | 0.100 U | 0.100 U | 0.099 U | 0.098 U |
| **1,3,5-Trinitrotoluene** | 0.0 | 183 nc | BRL | 0.100 U | 0.100 U | 0.100 U | 0.100 U | 0.099 U | 0.098 U |
| **1,3-Dinitrobenzene** | 0.0 | 0.61 nc | BRL | 0.100 U | 0.100 U | 0.100 U | 0.100 U | 0.099 U | 0.098 U |
| **Nitrobenzene** | 0.0 | 2 nc | BRL | 0.100 U | 0.100 U | 0.100 U | 0.100 U | 0.099 U | 0.098 U |
| **2,4,6-Trinitrotoluene** | 0.0 | 16 ca | BRL | 0.100 U | 0.100 U | 0.100 U | 0.100 U | 0.099 U | 0.098 U |
| **Tetryl** | 0.0 | 61 nc | BRL | 0.200 U | 0.200 U | 0.200 U | 0.200 U | 0.200 U | 0.200 U |
| **2,4-Dinitrotoluene** | 0.0 | 12 nc | BRL | 0.100 U | 0.100 U | 0.100 U | 0.100 U | 0.099 U | 0.098 U |
| **2,6-Dinitrotoluene** | 0.0 | 6.1 nc | BRL | 0.200 U | 0.200 U | 0.200 U | 0.200 U | 0.200 U | 0.200 U |
| **2-Nitrotoluene** | 0.0 | 0.88 ca | BRL | 0.200 U | 0.200 U | 0.200 U | 0.200 U | 0.200 U | 0.200 U |
| **4-Nitrotoluene** | 0.0 | 12 ca | BRL | 0.500 U | 0.500 U | 0.500 U | 0.500 U | 0.500 U | 0.490 U |
| **3-Nitrotoluene** | 0.0 | 73 nc | BRL | 0.200 U | 0.200 U | 0.200 U | 0.200 U | 0.200 U | 0.200 U |
| | | | | | | | | | |
| **Metals 6010B mg/kg (ppm)** | | | | | | | | | |
| **Antimony** | 0.96 | 3.1 nc | NT | 0.20 (B) | 0.46 | 0.19 (B) | 0.33 U | 0.33 | 1.4 |
| **Arsenic** | 15.4 | 0.39 ca | NT | **18.2** | **16.9** | **3.1** | **5.9** | **9.2** | **16.9** |
| **Lead** | 26.1 | 400 pbk | NT | 52.1 | 154 | 47.0 | 55.0 | 33.2 | **1330** |
| **Thallium** | 0.0 | 0.52 nc | NT | 0.19 U | 0.25 U | 0.19 U | 0.22 U | 0.20 U | 0.19 U |
| **Mercury** | 0.04 | 2.3 nc | NT | 0.054 | 0.060 | 0.017 (B) | 0.071 | 0.23 | **882** |
| **Aluminum** | 17700 | 7614 nc | NT | **10300** | **9110** | **10400** | 7200 | **10400** | **8700** |
| **Barium** | 88.4 | 538 nc | NT | 64.9 | 87.3 | 135 | 90.0 | 58.6 | 40.2 |
| **Beryllium** | 0.88 | 15 nc | NT | 0.61 | 0.50 | 1.8 | 0.48 | 0.49 | 0.34 (B) |
| **Cadmium** | 0.0 | 3.7 nc | NT | 0.24 U | 0.71 | 0.23 | 0.36 | 0.22 U | 0.14 (B) |
| **Calcium** | 15800 | -- [n] | NT | 1380 | 1230 | 113000 (H) | 75600 (H) | 1780 | 5090 |
| **Chromium** | 17.4 | 30 ca | NT | 15.0 | 12.6 | 12.0 | 11.8 | 14.2 | 16.1 |
| **Cobalt** | 10.4 | 902 ca | NT | 8.7 | 8.3 | 1.7 | 6.2 | 7.7 | 9.8 |
| **Copper** | 17.7 | 313 nc | NT | 15.9 | 24.3 | 9.6 | 25.2 | 14.9 | **1240** |
| **Iron** | 23100 | 2346 nc | NT | **25400 (H)** | **18200 (H)** | **6140 (H)** | **17300 (H)** | **20200 (H)** | **42000 (H)** |
| **Magnesium** | 3030 | -- [n] | NT | 2040 | 1630 | 9600 | 2470 | 1990 | 2230 |
| **Manganese** | 1450 | 176 nc | NT | **596** | **707** | **1360** | **493** | **451** | **557** |

## Table 4-1
## Summary of Azide Screening Surface Soil Results (0-1 ft)

| ANALYTE, UNITS, METHOD NO. | Ravenna Soil Background Criteria (0-1 ft) mg/kg | Region 9 PRG Data (Residential Soil) | D-14S | LL9SS-001-0001-SO | LL9SS-003-0001-SO | LL9SS-005-0001-SO | LL9SS-007-0001-SO | LL9SS-009-0001-SO | LL9SS-011-0001-SO |
|---|---|---|---|---|---|---|---|---|---|
| **Sample Date** | | **ppm** | 3/15/2002 | 3/11/2002 | 3/11/2002 | 3/11/2002 | 3/11/2002 | 3/11/2002 | 3/11/2002 |
| **Nickel** | 21.1 | 156 nc | NT | 15.6 | 13.7 | 5.7 | 16.6 | 13.9 | 17.3 |
| **Potassium** | 927 | -- [n] | NT | 954 | 756.0 | 903 | 1110 | 771 | 815 |
| **Selenium** | 1.4 | 39 nc | NT | 1.2 U | 1.1 U | 1.1 U | 1.0 U | 1.1 U | 0.91 U |
| **Silver** | 0.0 | 39 nc | NT | 0.59 U | 0.55 U | 0.53 U | 0.52 U | 0.54 U | 0.46 U |
| **Sodium** | 123 | -- [n] | NT | 192 | 128 | 279 | 137 | 177 | 94.3 |
| **Vanadium** | 31.1 | 7.8 nc | NT | **21.7** | **17.9** | **6.9** | **13.9** | **20.2** | **12.6** |
| **Zinc** | 61.8 | 2346 nc | NT | 86.0 | 228 | 46.6 | 94.1 | 72.6 | 711 |

PRGs - Preliminary Remediation Goals
nc - non-cancer basis, value is 1/10 the published PRG
ca - cancer basis
pbk - based on PBK modeling
[n] - nutrient
U - analyte not detected
NT - not tested
If Result = or > Background, then the value is presented with a shaded/highlighted style
If Result = or > Background & PRG, then the value is presented with a bold + shaded/highlighted style
If Result = or > PRG, then the value is presented with a bold style
If Result < PRG & Background, then the value is presented with a normal style
-- -no background/PRG value available for this analyte

**INORGANIC FLAGS/QUALIFIERS**
B - result is < CRDL/RL, but ≥ IDL/MDL
H - MB, EB1, EB2, EB3: Batch QC is > RL or had a negative instrument reading lower than the absolute value of the RL

**ORGANIC FLAGS/QUALIFIERS**
J - Result is an estimated value below the RL or a TIC
a - Concentration is below the method RL

## Table 4-2
## Summary of Surface Soil Exceedances (0-1 ft bgs)

| Sample Number | Sample Date | Sample Depth | Analyte | Result (mg/kg) | Qualifier | Surface Soil Background Criteria | Surface Soil Region 9 Criteria | SS PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| LL9SS-001-0001-SO | 3/11/02 | 0-1 ft | Aluminum | 10300 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-001-0001-SO | 3/11/02 | 0-1 ft | Arsenic | 18.2 | | 15.4 | 0.39 | ca | YES | YES |
| LL9SS-001-0001-SO | 3/11/02 | 0-1 ft | Calcium | 1380 | | 15800 | | [n] | NO | YES |
| LL9SS-001-0001-SO | 3/11/02 | 0-1 ft | Iron | 25400 | H | 23100 | 2346 | nc | YES | YES |
| LL9SS-001-0001-SO | 3/11/02 | 0-1 ft | Lead | 52.1 | | 26.1 | 400 | pbk | YES | NO |
| LL9SS-001-0001-SO | 3/11/02 | 0-1 ft | Magnesium | 2040 | | 3030 | | [n] | NO | YES |
| LL9SS-001-0001-SO | 3/11/02 | 0-1 ft | Manganese | 596 | | 1450 | 176 | nc | NO | YES |
| LL9SS-001-0001-SO | 3/11/02 | 0-1 ft | Mercury | 0.054 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SS-001-0001-SO | 3/11/02 | 0-1 ft | Potassium | 954 | | 927 | | [n] | YES | YES |
| LL9SS-001-0001-SO | 3/11/02 | 0-1 ft | Sodium | 192 | | 123 | | [n] | YES | YES |
| LL9SS-001-0001-SO | 3/11/02 | 0-1 ft | Vanadium | 21.7 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-001-0001-SO | 3/11/02 | 0-1 ft | Zinc | 86 | | 61.8 | 2346 | nc | YES | NO |
| LL9SS-002-0001-SO | 12/04/03 | 0-1 ft | Aluminum | 8500 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-002-0001-SO | 12/04/03 | 0-1 ft | Arsenic | 9.7 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-002-0001-SO | 12/04/03 | 0-1 ft | Copper | 20 | | 17.7 | 313 | nc | YES | NO |
| LL9SS-002-0001-SO | 12/04/03 | 0-1 ft | Iron | 21000 | | 23100 | 2346 | nc | NO | YES |
| LL9SS-002-0001-SO | 12/04/03 | 0-1 ft | Lead | 64 | | 26.1 | 400 | pbk | YES | NO |
| LL9SS-002-0001-SO | 12/04/03 | 0-1 ft | Manganese | 630 | | 1450 | 176 | nc | NO | YES |
| LL9SS-002-0001-SO | 12/04/03 | 0-1 ft | Mercury | 0.1 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SS-002-0001-SO | 12/04/03 | 0-1 ft | Vanadium | 15 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-002-0001-SO | 12/04/03 | 0-1 ft | Zinc | 100 | | 61.8 | 2346 | nc | YES | NO |
| LL9SS-003-0001-SO | 3/11/02 | 0-1 ft | Aluminum | 9110 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-003-0001-SO | 3/11/02 | 0-1 ft | Arsenic | 16.9 | | 15.4 | 0.39 | ca | YES | YES |
| LL9SS-003-0001-SO | 3/11/02 | 0-1 ft | Cadmium | 0.71 | | 0 | 3.7 | nc | YES | NO |
| LL9SS-003-0001-SO | 3/11/02 | 0-1 ft | Calcium | 1230 | | 15800 | | [n] | NO | YES |
| LL9SS-003-0001-SO | 3/11/02 | 0-1 ft | Copper | 24.3 | | 17.7 | 313 | nc | YES | NO |
| LL9SS-003-0001-SO | 3/11/02 | 0-1 ft | Iron | 18200 | H | 23100 | 2346 | nc | NO | YES |
| LL9SS-003-0001-SO | 3/11/02 | 0-1 ft | Lead | 154 | | 26.1 | 400 | pbk | YES | NO |
| LL9SS-003-0001-SO | 3/11/02 | 0-1 ft | Magnesium | 1630 | | 3030 | | [n] | NO | YES |
| LL9SS-003-0001-SO | 3/11/02 | 0-1 ft | Manganese | 707 | | 1450 | 176 | nc | NO | YES |
| LL9SS-003-0001-SO | 3/11/02 | 0-1 ft | Mercury | 0.06 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SS-003-0001-SO | 3/11/02 | 0-1 ft | Potassium | 756 | | 927 | | [n] | NO | YES |
| LL9SS-003-0001-SO | 3/11/02 | 0-1 ft | Sodium | 128 | | 123 | | [n] | YES | YES |
| LL9SS-003-0001-SO | 3/11/02 | 0-1 ft | Vanadium | 17.9 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-003-0001-SO | 3/11/02 | 0-1 ft | Zinc | 228 | | 61.8 | 2346 | nc | YES | NO |

## Table 4-2
## Summary of Surface Soil Exceedances (0-1 ft bgs)

| Sample Number | Sample Date | Sample Depth | Analyte | Result (mg/kg) | Qualifier | Surface Soil Background Criteria | Surface Soil Region 9 Criteria | SS PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| LL9SS-004-0001-SO | 12/04/03 | 0-1 ft | Arsenic | 15 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-004-0001-SO | 12/04/03 | 0-1 ft | Copper | 19 | | 17.7 | 313 | nc | YES | NO |
| LL9SS-004-0001-SO | 12/04/03 | 0-1 ft | Iron | 19000 | | 23100 | 2346 | nc | NO | YES |
| LL9SS-004-0001-SO | 12/04/03 | 0-1 ft | Lead | 45 | | 26.1 | 400 | pbk | YES | NO |
| LL9SS-004-0001-SO | 12/04/03 | 0-1 ft | Manganese | 390 | | 1450 | 176 | nc | NO | YES |
| LL9SS-004-0001-SO | 12/04/03 | 0-1 ft | Mercury | 0.073 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SS-004-0001-SO | 12/04/03 | 0-1 ft | Vanadium | 12 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-004-0001-SO | 12/04/03 | 0-1 ft | Zinc | 100 | | 61.8 | 2346 | nc | YES | NO |
| LL9SS-005-0001-SO | 3/11/02 | 0-1 ft | Aluminum | 10400 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-005-0001-SO | 3/11/02 | 0-1 ft | Arsenic | 3.1 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-005-0001-SO | 3/11/02 | 0-1 ft | Barium | 135 | | 88.4 | 538 | nc | YES | NO |
| LL9SS-005-0001-SO | 3/11/02 | 0-1 ft | Beryllium | 1.8 | | 0.88 | 15 | nc | YES | NO |
| LL9SS-005-0001-SO | 3/11/02 | 0-1 ft | Cadmium | 0.23 | | 0 | 3.7 | nc | YES | NO |
| LL9SS-005-0001-SO | 3/11/02 | 0-1 ft | Calcium | 113000 | H | 15800 | | [n] | YES | YES |
| LL9SS-005-0001-SO | 3/11/02 | 0-1 ft | Iron | 6140 | H | 23100 | 2346 | nc | NO | YES |
| LL9SS-005-0001-SO | 3/11/02 | 0-1 ft | Lead | 47 | | 26.1 | 400 | pbk | YES | NO |
| LL9SS-005-0001-SO | 3/11/02 | 0-1 ft | Magnesium | 9600 | | 3030 | | [n] | YES | YES |
| LL9SS-005-0001-SO | 3/11/02 | 0-1 ft | Manganese | 1360 | | 1450 | 176 | nc | NO | YES |
| LL9SS-005-0001-SO | 3/11/02 | 0-1 ft | Potassium | 903 | | 927 | | [n] | NO | YES |
| LL9SS-005-0001-SO | 3/11/02 | 0-1 ft | Sodium | 279 | | 123 | | [n] | YES | YES |
| LL9SS-006-0001-SO | 12/11/03 | 0-1 ft | Aluminum | 9300 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-006-0001-SO | 12/11/03 | 0-1 ft | Arsenic | 9.9 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-006-0001-SO | 12/11/03 | 0-1 ft | Barium | 92 | | 88.4 | 538 | nc | YES | NO |
| LL9SS-006-0001-SO | 12/11/03 | 0-1 ft | Cadmium | 2.9 | | 0 | 3.7 | nc | YES | NO |
| LL9SS-006-0001-SO | 12/11/03 | 0-1 ft | Copper | 18 | | 17.7 | 313 | nc | YES | NO |
| LL9SS-006-0001-SO | 12/11/03 | 0-1 ft | Iron | 16000 | H | 23100 | 2346 | nc | NO | YES |
| LL9SS-006-0001-SO | 12/11/03 | 0-1 ft | Lead | 140 | | 26.1 | 400 | pbk | YES | NO |
| LL9SS-006-0001-SO | 12/11/03 | 0-1 ft | Manganese | 830 | | 1450 | 176 | nc | NO | YES |
| LL9SS-006-0001-SO | 12/11/03 | 0-1 ft | Mercury | 1.3 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SS-006-0001-SO | 12/11/03 | 0-1 ft | Vanadium | 16 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-006-0001-SO | 12/11/03 | 0-1 ft | Zinc | 200 | | 61.8 | 2346 | nc | YES | NO |
| LL9SS-007-0001-SO | 3/11/02 | 0-1 ft | Arsenic | 5.9 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-007-0001-SO | 3/11/02 | 0-1 ft | Barium | 90 | | 88.4 | 538 | nc | YES | NO |
| LL9SS-007-0001-SO | 3/11/02 | 0-1 ft | Cadmium | 0.36 | | 0 | 3.7 | nc | YES | NO |
| LL9SS-007-0001-SO | 3/11/02 | 0-1 ft | Calcium | 75600 | H | 15800 | | [n] | YES | YES |

## Table 4-2
## Summary of Surface Soil Exceedances (0-1 ft bgs)

| Sample Number | Sample Date | Sample Depth | Analyte | Result (mg/kg) | Qualifier | Surface Soil Background Criteria | Surface Soil Region 9 Criteria | SS PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| LL9SS-007-0001-SO | 3/11/02 | 0-1 ft | Copper | 25.2 | | 17.7 | 313 | nc | YES | NO |
| LL9SS-007-0001-SO | 3/11/02 | 0-1 ft | Iron | 17300 | H | 23100 | 2346 | nc | NO | YES |
| LL9SS-007-0001-SO | 3/11/02 | 0-1 ft | Lead | 55 | | 26.1 | 400 | pbk | YES | NO |
| LL9SS-007-0001-SO | 3/11/02 | 0-1 ft | Magnesium | 2470 | | 3030 | | [n] | NO | YES |
| LL9SS-007-0001-SO | 3/11/02 | 0-1 ft | Manganese | 493 | | 1450 | 176 | nc | NO | YES |
| LL9SS-007-0001-SO | 3/11/02 | 0-1 ft | Mercury | 0.071 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SS-007-0001-SO | 3/11/02 | 0-1 ft | Potassium | 1110 | | 927 | | [n] | YES | YES |
| LL9SS-007-0001-SO | 3/11/02 | 0-1 ft | Sodium | 137 | | 123 | | [n] | YES | YES |
| LL9SS-007-0001-SO | 3/11/02 | 0-1 ft | Vanadium | 13.9 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-007-0001-SO | 3/11/02 | 0-1 ft | Zinc | 94.1 | | 61.8 | 2346 | nc | YES | NO |
| LL9SS-008-0001-SO | 12/10/03 | 0-1 ft | Aluminum | 11000 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-008-0001-SO | 12/10/03 | 0-1 ft | Arsenic | 10 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-008-0001-SO | 12/10/03 | 0-1 ft | Iron | 20000 | | 23100 | 2346 | nc | NO | YES |
| LL9SS-008-0001-SO | 12/10/03 | 0-1 ft | Manganese | 640 | | 1450 | 176 | nc | NO | YES |
| LL9SS-008-0001-SO | 12/10/03 | 0-1 ft | Mercury | 0.047 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SS-008-0001-SO | 12/10/03 | 0-1 ft | Vanadium | 19 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-008-0001-SO | 12/10/03 | 0-1 ft | Zinc | 62 | | 61.8 | 2346 | nc | YES | NO |
| LL9SS-009-0001-SO | 3/11/02 | 0-1 ft | Aluminum | 10400 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-009-0001-SO | 3/11/02 | 0-1 ft | Arsenic | 9.2 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-009-0001-SO | 3/11/02 | 0-1 ft | Calcium | 1780 | | 15800 | | [n] | NO | YES |
| LL9SS-009-0001-SO | 3/11/02 | 0-1 ft | Iron | 20200 | H | 23100 | 2346 | nc | NO | YES |
| LL9SS-009-0001-SO | 3/11/02 | 0-1 ft | Lead | 33.2 | | 26.1 | 400 | pbk | YES | NO |
| LL9SS-009-0001-SO | 3/11/02 | 0-1 ft | Magnesium | 1990 | | 3030 | | [n] | NO | YES |
| LL9SS-009-0001-SO | 3/11/02 | 0-1 ft | Manganese | 451 | | 1450 | 176 | nc | NO | YES |
| LL9SS-009-0001-SO | 3/11/02 | 0-1 ft | Mercury | 0.23 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SS-009-0001-SO | 3/11/02 | 0-1 ft | Potassium | 771 | | 927 | | [n] | NO | YES |
| LL9SS-009-0001-SO | 3/11/02 | 0-1 ft | Sodium | 177 | | 123 | | [n] | YES | YES |
| LL9SS-009-0001-SO | 3/11/02 | 0-1 ft | Vanadium | 20.2 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-009-0001-SO | 3/11/02 | 0-1 ft | Zinc | 72.6 | | 61.8 | 2346 | nc | YES | NO |
| LL9SS-010-0001-SO | 12/08/03 | 0-1 ft | Arsenic | 15 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-010-0001-SO | 12/08/03 | 0-1 ft | Cadmium | 0.11 | B | 0 | 3.7 | nc | YES | NO |
| LL9SS-010-0001-SO | 12/08/03 | 0-1 ft | Copper | 21 | H | 17.7 | 313 | nc | YES | NO |
| LL9SS-010-0001-SO | 12/08/03 | 0-1 ft | Iron | 21000 | | 23100 | 2346 | nc | NO | YES |
| LL9SS-010-0001-SO | 12/08/03 | 0-1 ft | Manganese | 280 | | 1450 | 176 | nc | NO | YES |
| LL9SS-010-0001-SO | 12/08/03 | 0-1 ft | Mercury | 0.042 | | 0.04 | 2.3 | nc | YES | NO |

## Table 4-2
## Summary of Surface Soil Exceedances (0-1 ft bgs)

| Sample Number | Sample Date | Sample Depth | Analyte | Result (mg/kg) | Qualifier | Surface Soil Background Criteria | Surface Soil Region 9 Criteria | SS PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| LL9SS-010-0001-SO | 12/08/03 | 0-1 ft | Vanadium | 12 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-010-0001-SO | 12/08/03 | 0-1 ft | Zinc | 78 | | 61.8 | 2346 | nc | YES | NO |
| LL9SS-011-0001-SO | 3/11/02 | 0-1 ft | Aluminum | 8700 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-011-0001-SO | 3/11/02 | 0-1 ft | Antimony | 1.4 | | 0.96 | 3.1 | nc | YES | NO |
| LL9SS-011-0001-SO | 3/11/02 | 0-1 ft | Arsenic | 16.9 | | 15.4 | 0.39 | ca | YES | YES |
| LL9SS-011-0001-SO | 3/11/02 | 0-1 ft | Cadmium | 0.14 | B | 0 | 3.7 | nc | YES | NO |
| LL9SS-011-0001-SO | 3/11/02 | 0-1 ft | Calcium | 5090 | | 15800 | | [n] | NO | YES |
| LL9SS-011-0001-SO | 3/11/02 | 0-1 ft | Copper | 1240 | | 17.7 | 313 | nc | YES | YES |
| LL9SS-011-0001-SO | 3/11/02 | 0-1 ft | Iron | 42000 | H | 23100 | 2346 | nc | YES | YES |
| LL9SS-011-0001-SO | 3/11/02 | 0-1 ft | Lead | 1330 | | 26.1 | 400 | pbk | YES | YES |
| LL9SS-011-0001-SO | 3/11/02 | 0-1 ft | Magnesium | 2230 | | 3030 | | [n] | NO | YES |
| LL9SS-011-0001-SO | 3/11/02 | 0-1 ft | Manganese | 557 | | 1450 | 176 | nc | NO | YES |
| LL9SS-011-0001-SO | 3/11/02 | 0-1 ft | Mercury | 882 | | 0.04 | 2.3 | nc | YES | YES |
| LL9SS-011-0001-SO | 3/11/02 | 0-1 ft | Potassium | 815 | | 927 | | [n] | NO | YES |
| LL9SS-011-0001-SO | 3/11/02 | 0-1 ft | Sodium | 94.3 | | 123 | | [n] | NO | YES |
| LL9SS-011-0001-SO | 3/11/02 | 0-1 ft | Vanadium | 12.6 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-011-0001-SO | 3/11/02 | 0-1 ft | Zinc | 711 | | 61.8 | 2346 | nc | YES | NO |
| LL9SS-012-0001-SO | 12/10/03 | 0-1 ft | Aluminum | 9000 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-012-0001-SO | 12/10/03 | 0-1 ft | Arsenic | 15 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-012-0001-SO | 12/10/03 | 0-1 ft | Cadmium | 0.51 | | 0 | 3.7 | nc | YES | NO |
| LL9SS-012-0001-SO | 12/10/03 | 0-1 ft | Calcium | 22000 | | 15800 | --[n] | 0 | YES | NO |
| LL9SS-012-0001-SO | 12/10/03 | 0-1 ft | Copper | 25 | | 17.7 | 313 | nc | YES | NO |
| LL9SS-012-0001-SO | 12/10/03 | 0-1 ft | Iron | 22000 | | 23100 | 2346 | nc | NO | YES |
| LL9SS-012-0001-SO | 12/10/03 | 0-1 ft | Lead | 44 | | 26.1 | 400 | pbk | YES | NO |
| LL9SS-012-0001-SO | 12/10/03 | 0-1 ft | Manganese | 600 | | 1450 | 176 | nc | NO | YES |
| LL9SS-012-0001-SO | 12/10/03 | 0-1 ft | Mercury | 0.053 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SS-012-0001-SO | 12/10/03 | 0-1 ft | Potassium | 1100 | | 927 | --[n] | 0 | YES | NO |
| LL9SS-012-0001-SO | 12/10/03 | 0-1 ft | Vanadium | 16 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-012-0001-SO | 12/10/03 | 0-1 ft | Zinc | 140 | | 61.8 | 2346 | nc | YES | NO |
| LL9SS-013-0001-SO | 12/10/03 | 0-1 ft | Arsenic | 11 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-013-0001-SO | 12/10/03 | 0-1 ft | Copper | 22 | | 17.7 | 313 | nc | YES | NO |
| LL9SS-013-0001-SO | 12/10/03 | 0-1 ft | Iron | 24000 | | 23100 | 2346 | nc | YES | YES |
| LL9SS-013-0001-SO | 12/10/03 | 0-1 ft | Manganese | 370 | | 1450 | 176 | nc | NO | YES |
| LL9SS-013-0001-SO | 12/10/03 | 0-1 ft | Vanadium | 11 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-013-0001-SO | 12/10/03 | 0-1 ft | Zinc | 74 | | 61.8 | 2346 | nc | YES | NO |

## Table 4-2
## Summary of Surface Soil Exceedances (0-1 ft bgs)

| Sample Number | Sample Date | Sample Depth | Analyte | Result (mg/kg) | Qualifier | Surface Soil Background Criteria | Surface Soil Region 9 Criteria | SS PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| LL9SS-014-0001-DUP | 12/11/03 | 0-1 ft | Arsenic | 14 |  | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-014-0001-DUP | 12/11/03 | 0-1 ft | Copper | 20 |  | 17.7 | 313 | nc | YES | NO |
| LL9SS-014-0001-DUP | 12/11/03 | 0-1 ft | Iron | 19000 | H | 23100 | 2346 | nc | NO | YES |
| LL9SS-014-0001-DUP | 12/11/03 | 0-1 ft | Manganese | 340 |  | 1450 | 176 | nc | NO | YES |
| LL9SS-014-0001-DUP | 12/11/03 | 0-1 ft | Nitrocellulose | 1.3 | B J | 0 | -- | 0 | YES | NO |
| LL9SS-014-0001-DUP | 12/11/03 | 0-1 ft | Vanadium | 12 |  | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-014-0001-DUP | 12/11/03 | 0-1 ft | Zinc | 64 |  | 61.8 | 2346 | nc | YES | NO |
| LL9SS-014-0001-SO | 12/11/03 | 0-1 ft | Aluminum | 7900 |  | 17700 | 7614 | nc | NO | YES |
| LL9SS-014-0001-SO | 12/11/03 | 0-1 ft | Arsenic | 15 |  | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-014-0001-SO | 12/11/03 | 0-1 ft | Copper | 22 |  | 17.7 | 313 | nc | YES | NO |
| LL9SS-014-0001-SO | 12/11/03 | 0-1 ft | Iron | 19000 | H | 23100 | 2346 | nc | NO | YES |
| LL9SS-014-0001-SO | 12/11/03 | 0-1 ft | Lead | 43 |  | 26.1 | 400 | pbk | YES | NO |
| LL9SS-014-0001-SO | 12/11/03 | 0-1 ft | Manganese | 410 |  | 1450 | 176 | nc | NO | YES |
| LL9SS-014-0001-SO | 12/11/03 | 0-1 ft | Mercury | 0.044 |  | 0.04 | 2.3 | nc | YES | NO |
| LL9SS-014-0001-SO | 12/11/03 | 0-1 ft | Nitrocellulose | 1.6 | B J | 0 | -- | 0 | YES | NO |
| LL9SS-014-0001-SO | 12/11/03 | 0-1 ft | Nitroguanidine | 0.965 |  | 0 | 611 | nc | YES | NO |
| LL9SS-014-0001-SO | 12/11/03 | 0-1 ft | Nitroguanidine | 1 |  | 0 | 611 | nc | YES | NO |
| LL9SS-014-0001-SO | 12/11/03 | 0-1 ft | Vanadium | 13 |  | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-014-0001-SO | 12/11/03 | 0-1 ft | Zinc | 72 |  | 61.8 | 2346 | nc | YES | NO |
| LL9SS-015-0001-SO | 12/11/03 | 0-1 ft | Aluminum | 17000 |  | 17700 | 7614 | nc | NO | YES |
| LL9SS-015-0001-SO | 12/11/03 | 0-1 ft | Arsenic | 24 |  | 15.4 | 0.39 | ca | YES | YES |
| LL9SS-015-0001-SO | 12/11/03 | 0-1 ft | Chromium | 23 |  | 17.4 | 30 | ca | YES | NO |
| LL9SS-015-0001-SO | 12/11/03 | 0-1 ft | Copper | 24 |  | 17.7 | 313 | nc | YES | NO |
| LL9SS-015-0001-SO | 12/11/03 | 0-1 ft | Iron | 31000 | H | 23100 | 2346 | nc | YES | YES |
| LL9SS-015-0001-SO | 12/11/03 | 0-1 ft | Magnesium | 3500 |  | 3030 | --[n] | 0 | YES | NO |
| LL9SS-015-0001-SO | 12/11/03 | 0-1 ft | Manganese | 180 |  | 1450 | 176 | nc | NO | YES |
| LL9SS-015-0001-SO | 12/11/03 | 0-1 ft | Mercury | 0.061 |  | 0.04 | 2.3 | nc | YES | NO |
| LL9SS-015-0001-SO | 12/11/03 | 0-1 ft | Nickel | 23 |  | 21.1 | 156 | nc | YES | NO |
| LL9SS-015-0001-SO | 12/11/03 | 0-1 ft | Potassium | 1500 |  | 927 | --[n] | 0 | YES | NO |
| LL9SS-015-0001-SO | 12/11/03 | 0-1 ft | Vanadium | 28 |  | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-015-0001-SO | 12/11/03 | 0-1 ft | Zinc | 64 |  | 61.8 | 2346 | nc | YES | NO |
| LL9SS-016-0001-DUP | 12/11/03 | 0-1 ft | Aluminum | 9100 |  | 17700 | 7614 | nc | NO | YES |
| LL9SS-016-0001-DUP | 12/11/03 | 0-1 ft | Arsenic | 14 |  | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-016-0001-DUP | 12/11/03 | 0-1 ft | Cadmium | 0.14 | B | 0 | 3.7 | nc | YES | NO |
| LL9SS-016-0001-DUP | 12/11/03 | 0-1 ft | Copper | 18 |  | 17.7 | 313 | nc | YES | NO |

# Table 4-2
# Summary of Surface Soil Exceedances (0-1 ft bgs)

| Sample Number | Sample Date | Sample Depth | Analyte | Result (mg/kg) | Qualifier | Surface Soil Background Criteria | Surface Soil Region 9 Criteria | SS PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| LL9SS-016-0001-DUP | 12/11/03 | 0-1 ft | Iron | 17000 | H | 23100 | 2346 | nc | NO | YES |
| LL9SS-016-0001-DUP | 12/11/03 | 0-1 ft | Lead | 35 | | 26.1 | 400 | pbk | YES | NO |
| LL9SS-016-0001-DUP | 12/11/03 | 0-1 ft | Magnesium | 3300 | | 3030 | --[n] | 0 | YES | NO |
| LL9SS-016-0001-DUP | 12/11/03 | 0-1 ft | Manganese | 790 | | 1450 | 176 | nc | NO | YES |
| LL9SS-016-0001-DUP | 12/11/03 | 0-1 ft | Mercury | 0.11 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SS-016-0001-DUP | 12/11/03 | 0-1 ft | Potassium | 970 | | 927 | --[n] | 0 | YES | NO |
| LL9SS-016-0001-DUP | 12/11/03 | 0-1 ft | Vanadium | 13 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-016-0001-DUP | 12/11/03 | 0-1 ft | Zinc | 72 | | 61.8 | 2346 | nc | YES | NO |
| LL9SS-016-0001-SO | 12/11/03 | 0-1 ft | Aluminum | 9900 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-016-0001-SO | 12/11/03 | 0-1 ft | Arsenic | 11 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-016-0001-SO | 12/11/03 | 0-1 ft | Cadmium | 0.17 | B | 0 | 3.7 | nc | YES | NO |
| LL9SS-016-0001-SO | 12/11/03 | 0-1 ft | Calcium | 20000 | | 15800 | --[n] | 0 | YES | NO |
| LL9SS-016-0001-SO | 12/11/03 | 0-1 ft | Chromium | 19.33 | * | 17.4 | 30 | ca | YES | NO |
| LL9SS-016-0001-SO | 12/11/03 | 0-1 ft | Copper | 19 | | 17.7 | 313 | nc | YES | NO |
| LL9SS-016-0001-SO | 12/11/03 | 0-1 ft | Iron | 18000 | H | 23100 | 2346 | nc | NO | YES |
| LL9SS-016-0001-SO | 12/11/03 | 0-1 ft | Lead | 38 | | 26.1 | 400 | pbk | YES | NO |
| LL9SS-016-0001-SO | 12/11/03 | 0-1 ft | Magnesium | 3500 | | 3030 | --[n] | 0 | YES | NO |
| LL9SS-016-0001-SO | 12/11/03 | 0-1 ft | Manganese | 577.68 | * | 1450 | 176 | nc | NO | YES |
| LL9SS-016-0001-SO | 12/11/03 | 0-1 ft | Manganese | 1100 | | 1450 | 176 | nc | NO | YES |
| LL9SS-016-0001-SO | 12/11/03 | 0-1 ft | Mercury | 0.096 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SS-016-0001-SO | 12/11/03 | 0-1 ft | Potassium | 1000 | | 927 | --[n] | 0 | YES | NO |
| LL9SS-016-0001-SO | 12/11/03 | 0-1 ft | Sodium | 170 | | 123 | --[n] | 0 | YES | NO |
| LL9SS-016-0001-SO | 12/11/03 | 0-1 ft | Vanadium | 12 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-016-0001-SO | 12/11/03 | 0-1 ft | Zinc | 70 | | 61.8 | 2346 | nc | YES | NO |
| LL9SS-017-0001-SO | 12/04/03 | 0-1 ft | Aluminum | 10000 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-017-0001-SO | 12/04/03 | 0-1 ft | Arsenic | 11 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-017-0001-SO | 12/04/03 | 0-1 ft | Iron | 23000 | | 23100 | 2346 | nc | NO | YES |
| LL9SS-017-0001-SO | 12/04/03 | 0-1 ft | Manganese | 690 | | 1450 | 176 | nc | NO | YES |
| LL9SS-017-0001-SO | 12/04/03 | 0-1 ft | Vanadium | 21 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-018-0001-SO | 12/10/03 | 0-1 ft | Aluminum | 11000 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-018-0001-SO | 12/10/03 | 0-1 ft | Arsenic | 10 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-018-0001-SO | 12/10/03 | 0-1 ft | Barium | 95 | | 88.4 | 538 | nc | YES | NO |
| LL9SS-018-0001-SO | 12/10/03 | 0-1 ft | Cadmium | 0.16 | B | 0 | 3.7 | nc | YES | NO |
| LL9SS-018-0001-SO | 12/10/03 | 0-1 ft | Iron | 19000 | | 23100 | 2346 | nc | NO | YES |
| LL9SS-018-0001-SO | 12/10/03 | 0-1 ft | Lead | 40 | | 26.1 | 400 | pbk | YES | NO |

## Table 4-2
## Summary of Surface Soil Exceedances (0-1 ft bgs)

| Sample Number | Sample Date | Sample Depth | Analyte | Result (mg/kg) | Qualifier | Surface Soil Background Criteria | Surface Soil Region 9 Criteria | SS PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| LL9SS-018-0001-SO | 12/10/03 | 0-1 ft | Manganese | 920 | | 1450 | 176 | nc | NO | YES |
| LL9SS-018-0001-SO | 12/10/03 | 0-1 ft | Mercury | 0.09 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SS-018-0001-SO | 12/10/03 | 0-1 ft | Vanadium | 19 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-018-0001-SO | 12/10/03 | 0-1 ft | Zinc | 69 | | 61.8 | 2346 | nc | YES | NO |
| LL9SS-019-0001-SO | 12/11/03 | 0-1 ft | Aluminum | 14000 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-019-0001-SO | 12/11/03 | 0-1 ft | Arsenic | 17 | | 15.4 | 0.39 | ca | YES | YES |
| LL9SS-019-0001-SO | 12/11/03 | 0-1 ft | Barium | 170 | | 88.4 | 538 | nc | YES | NO |
| LL9SS-019-0001-SO | 12/11/03 | 0-1 ft | Copper | 19 | | 17.7 | 313 | nc | YES | NO |
| LL9SS-019-0001-SO | 12/11/03 | 0-1 ft | Iron | 27000 | H | 23100 | 2346 | nc | YES | YES |
| LL9SS-019-0001-SO | 12/11/03 | 0-1 ft | Manganese | 210 | | 1450 | 176 | nc | NO | YES |
| LL9SS-019-0001-SO | 12/11/03 | 0-1 ft | Mercury | 0.36 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SS-019-0001-SO | 12/11/03 | 0-1 ft | Nitrocellulose | 1.8 | B J | 0 | -- | 0 | YES | NO |
| LL9SS-019-0001-SO | 12/11/03 | 0-1 ft | Potassium | 1000 | | 927 | --[n] | 0 | YES | NO |
| LL9SS-019-0001-SO | 12/11/03 | 0-1 ft | Vanadium | 22 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-020-0001-SO | 12/08/03 | 0-1 ft | Aluminum | 7900 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-020-0001-SO | 12/08/03 | 0-1 ft | Arsenic | 13 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-020-0001-SO | 12/08/03 | 0-1 ft | Cadmium | 0.71 | | 0 | 3.7 | nc | YES | NO |
| LL9SS-020-0001-SO | 12/08/03 | 0-1 ft | Copper | 31 | H | 17.7 | 313 | nc | YES | NO |
| LL9SS-020-0001-SO | 12/08/03 | 0-1 ft | Iron | 16000 | | 23100 | 2346 | nc | NO | YES |
| LL9SS-020-0001-SO | 12/08/03 | 0-1 ft | Lead | 33 | | 26.1 | 400 | pbk | YES | NO |
| LL9SS-020-0001-SO | 12/08/03 | 0-1 ft | Manganese | 460 | | 1450 | 176 | nc | NO | YES |
| LL9SS-020-0001-SO | 12/08/03 | 0-1 ft | Mercury | 0.74 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SS-020-0001-SO | 12/08/03 | 0-1 ft | Vanadium | 14 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-020-0001-SO | 12/08/03 | 0-1 ft | Zinc | 85 | | 61.8 | 2346 | nc | YES | NO |
| LL9SS-021-0001-SO | 12/08/03 | 0-1 ft | Aluminum | 13000 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-021-0001-SO | 12/08/03 | 0-1 ft | Arsenic | 16 | | 15.4 | 0.39 | ca | YES | YES |
| LL9SS-021-0001-SO | 12/08/03 | 0-1 ft | Cadmium | 0.5 | | 0 | 3.7 | nc | YES | NO |
| LL9SS-021-0001-SO | 12/08/03 | 0-1 ft | Chromium | 18 | | 17.4 | 30 | ca | YES | NO |
| LL9SS-021-0001-SO | 12/08/03 | 0-1 ft | Copper | 19 | H | 17.7 | 313 | nc | YES | NO |
| LL9SS-021-0001-SO | 12/08/03 | 0-1 ft | Iron | 27000 | | 23100 | 2346 | nc | YES | YES |
| LL9SS-021-0001-SO | 12/08/03 | 0-1 ft | Lead | 35 | | 26.1 | 400 | pbk | YES | NO |
| LL9SS-021-0001-SO | 12/08/03 | 0-1 ft | Manganese | 260 | | 1450 | 176 | nc | NO | YES |
| LL9SS-021-0001-SO | 12/08/03 | 0-1 ft | Mercury | 0.045 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SS-021-0001-SO | 12/08/03 | 0-1 ft | Potassium | 1000 | | 927 | --[n] | 0 | YES | NO |
| LL9SS-021-0001-SO | 12/08/03 | 0-1 ft | Vanadium | 22 | | 31.1 | 7.8 | nc | NO | YES |

## Table 4-2
## Summary of Surface Soil Exceedances (0-1 ft bgs)

| Sample Number | Sample Date | Sample Depth | Analyte | Result (mg/kg) | Qualifier | Surface Soil Background Criteria | Surface Soil Region 9 Criteria | SS PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| LL9SS-021-0001-SO | 12/08/03 | 0-1 ft | Zinc | 72 | | 61.8 | 2346 | nc | YES | NO |
| LL9SS-022-0001-DUP | 12/10/03 | 0-1 ft | Aluminum | 9600 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-022-0001-DUP | 12/10/03 | 0-1 ft | Arsenic | 12 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-022-0001-DUP | 12/10/03 | 0-1 ft | Copper | 21 | | 17.7 | 313 | nc | YES | NO |
| LL9SS-022-0001-DUP | 12/10/03 | 0-1 ft | Iron | 22000 | | 23100 | 2346 | nc | NO | YES |
| LL9SS-022-0001-DUP | 12/10/03 | 0-1 ft | Lead | 48 | | 26.1 | 400 | pbk | YES | NO |
| LL9SS-022-0001-DUP | 12/10/03 | 0-1 ft | Manganese | 480 | | 1450 | 176 | nc | NO | YES |
| LL9SS-022-0001-DUP | 12/10/03 | 0-1 ft | Mercury | 0.2 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SS-022-0001-DUP | 12/10/03 | 0-1 ft | Vanadium | 15 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-022-0001-DUP | 12/10/03 | 0-1 ft | Zinc | 69 | | 61.8 | 2346 | nc | YES | NO |
| LL9SS-022-0001-SO | 12/10/03 | 0-1 ft | Aluminum | 8800 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-022-0001-SO | 12/10/03 | 0-1 ft | Arsenic | 13 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-022-0001-SO | 12/10/03 | 0-1 ft | Iron | 20000 | | 23100 | 2346 | nc | NO | YES |
| LL9SS-022-0001-SO | 12/10/03 | 0-1 ft | Mercury | 0.11 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SS-022-0001-SO | 12/10/03 | 0-1 ft | Vanadium | 15 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-023-0001-SO | 12/08/03 | 0-1 ft | Aluminum | 20000 | | 17700 | 7614 | nc | YES | YES |
| LL9SS-023-0001-SO | 12/08/03 | 0-1 ft | Arsenic | 21 | | 15.4 | 0.39 | ca | YES | YES |
| LL9SS-023-0001-SO | 12/08/03 | 0-1 ft | Cadmium | 0.11 | B | 0 | 3.7 | nc | YES | NO |
| LL9SS-023-0001-SO | 12/08/03 | 0-1 ft | Chromium | 21 | | 17.4 | 30 | ca | YES | NO |
| LL9SS-023-0001-SO | 12/08/03 | 0-1 ft | Copper | 23 | H | 17.7 | 313 | nc | YES | NO |
| LL9SS-023-0001-SO | 12/08/03 | 0-1 ft | Iron | 26000 | | 23100 | 2346 | nc | YES | YES |
| LL9SS-023-0001-SO | 12/08/03 | 0-1 ft | Lead | 50 | | 26.1 | 400 | pbk | YES | NO |
| LL9SS-023-0001-SO | 12/08/03 | 0-1 ft | Magnesium | 3200 | | 3030 | --[n] | 0 | YES | NO |
| LL9SS-023-0001-SO | 12/08/03 | 0-1 ft | Manganese | 230 | | 1450 | 176 | nc | NO | YES |
| LL9SS-023-0001-SO | 12/08/03 | 0-1 ft | Mercury | 0.25 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SS-023-0001-SO | 12/08/03 | 0-1 ft | Potassium | 1500 | | 927 | --[n] | 0 | YES | NO |
| LL9SS-023-0001-SO | 12/08/03 | 0-1 ft | Vanadium | 28 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-024-0001-SO | 12/10/03 | 0-1 ft | Aluminum | 8000 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-024-0001-SO | 12/10/03 | 0-1 ft | Arsenic | 10 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-024-0001-SO | 12/10/03 | 0-1 ft | Cadmium | 0.42 | | 0 | 3.7 | nc | YES | NO |
| LL9SS-024-0001-SO | 12/10/03 | 0-1 ft | Chromium | 110 | | 17.4 | 30 | ca | YES | YES |
| LL9SS-024-0001-SO | 12/10/03 | 0-1 ft | Iron | 14000 | | 23100 | 2346 | nc | NO | YES |
| LL9SS-024-0001-SO | 12/10/03 | 0-1 ft | Lead | 320 | | 26.1 | 400 | pbk | YES | NO |
| LL9SS-024-0001-SO | 12/10/03 | 0-1 ft | Manganese | 500 | | 1450 | 176 | nc | NO | YES |
| LL9SS-024-0001-SO | 12/10/03 | 0-1 ft | Mercury | 0.057 | | 0.04 | 2.3 | nc | YES | NO |

## Table 4-2
## Summary of Surface Soil Exceedances (0-1 ft bgs)

| Sample Number | Sample Date | Sample Depth | Analyte | Result (mg/kg) | Qualifier | Surface Soil Background Criteria | Surface Soil Region 9 Criteria | SS PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| LL9SS-024-0001-SO | 12/10/03 | 0-1 ft | Vanadium | 15 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-024-0001-SO | 12/10/03 | 0-1 ft | Zinc | 210 | | 61.8 | 2346 | nc | YES | NO |
| LL9SS-025-0001-SO | 12/10/03 | 0-1 ft | Aluminum | 12000 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-025-0001-SO | 12/10/03 | 0-1 ft | Arsenic | 8.4 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-025-0001-SO | 12/10/03 | 0-1 ft | Iron | 24000 | | 23100 | 2346 | nc | YES | YES |
| LL9SS-025-0001-SO | 12/10/03 | 0-1 ft | Manganese | 420 | | 1450 | 176 | nc | NO | YES |
| LL9SS-025-0001-SO | 12/10/03 | 0-1 ft | Nitrocellulose | 1.6 | B J | 0 | -- | 0 | YES | NO |
| LL9SS-025-0001-SO | 12/10/03 | 0-1 ft | Vanadium | 23 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-026-0001-SO | 12/10/03 | 0-1 ft | Aluminum | 13000 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-026-0001-SO | 12/10/03 | 0-1 ft | Antimony | 1.2 | | 0.96 | 3.1 | nc | YES | NO |
| LL9SS-026-0001-SO | 12/10/03 | 0-1 ft | Arsenic | 8.3 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-026-0001-SO | 12/10/03 | 0-1 ft | Barium | 100 | | 88.4 | 538 | nc | YES | NO |
| LL9SS-026-0001-SO | 12/10/03 | 0-1 ft | Cobalt | 11 | | 10.4 | 30 | ca | YES | NO |
| LL9SS-026-0001-SO | 12/10/03 | 0-1 ft | Iron | 23000 | | 23100 | 2346 | nc | NO | YES |
| LL9SS-026-0001-SO | 12/10/03 | 0-1 ft | Lead | 28 | | 26.1 | 400 | pbk | YES | NO |
| LL9SS-026-0001-SO | 12/10/03 | 0-1 ft | Manganese | 860 | | 1450 | 176 | nc | NO | YES |
| LL9SS-026-0001-SO | 12/10/03 | 0-1 ft | Mercury | 0.045 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SS-026-0001-SO | 12/10/03 | 0-1 ft | Thallium | 0.26 | | 0 | 0.52 | nc | YES | NO |
| LL9SS-026-0001-SO | 12/10/03 | 0-1 ft | Vanadium | 23 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-026-0001-SO | 12/10/03 | 0-1 ft | Zinc | 71 | | 61.8 | 2346 | nc | YES | NO |
| LL9SS-027-0001-SO | 12/04/03 | 0-1 ft | Aluminum | 10000 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-027-0001-SO | 12/04/03 | 0-1 ft | Arsenic | 11 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-027-0001-SO | 12/04/03 | 0-1 ft | Cobalt | 18 | | 10.4 | 30 | ca | YES | NO |
| LL9SS-027-0001-SO | 12/04/03 | 0-1 ft | Iron | 25000 | | 23100 | 2346 | nc | YES | YES |
| LL9SS-027-0001-SO | 12/04/03 | 0-1 ft | Manganese | 3800 | | 1450 | 176 | nc | YES | YES |
| LL9SS-027-0001-SO | 12/04/03 | 0-1 ft | Mercury | 0.041 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SS-027-0001-SO | 12/04/03 | 0-1 ft | Vanadium | 23 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-028-0001-DUP | 12/04/03 | 0-1 ft | Aluminum | 10000 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-028-0001-DUP | 12/04/03 | 0-1 ft | Arsenic | 9.4 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-028-0001-DUP | 12/04/03 | 0-1 ft | Iron | 23000 | | 23100 | 2346 | nc | NO | YES |
| LL9SS-028-0001-DUP | 12/04/03 | 0-1 ft | Manganese | 330 | | 1450 | 176 | nc | NO | YES |
| LL9SS-028-0001-DUP | 12/04/03 | 0-1 ft | Mercury | 0.2 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SS-028-0001-DUP | 12/04/03 | 0-1 ft | Vanadium | 22 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-028-0001-SO | 12/04/03 | 0-1 ft | Aluminum | 10000 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-028-0001-SO | 12/04/03 | 0-1 ft | Arsenic | 15 | | 15.4 | 0.39 | ca | NO | YES |

## Table 4-2
## Summary of Surface Soil Exceedances (0-1 ft bgs)

| Sample Number | Sample Date | Sample Depth | Analyte | Result (mg/kg) | Qualifier | Surface Soil Background Criteria | Surface Soil Region 9 Criteria | SS PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| LL9SS-028-0001-SO | 12/04/03 | 0-1 ft | Iron | 21000 | | 23100 | 2346 | nc | NO | YES |
| LL9SS-028-0001-SO | 12/04/03 | 0-1 ft | Manganese | 460 | | 1450 | 176 | nc | NO | YES |
| LL9SS-028-0001-SO | 12/04/03 | 0-1 ft | Mercury | 0.24 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SS-028-0001-SO | 12/04/03 | 0-1 ft | Vanadium | 21 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-029-0001-SO | 12/04/03 | 0-1 ft | Aluminum | 9400 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-029-0001-SO | 12/04/03 | 0-1 ft | Arsenic | 7.4 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-029-0001-SO | 12/04/03 | 0-1 ft | Iron | 16000 | | 23100 | 2346 | nc | NO | YES |
| LL9SS-029-0001-SO | 12/04/03 | 0-1 ft | Manganese | 870 | | 1450 | 176 | nc | NO | YES |
| LL9SS-029-0001-SO | 12/04/03 | 0-1 ft | Mercury | 0.088 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SS-029-0001-SO | 12/04/03 | 0-1 ft | Vanadium | 16 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-030-0001-SO | 12/04/03 | 0-1 ft | Arsenic | 4.2 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-030-0001-SO | 12/04/03 | 0-1 ft | Iron | 20000 | | 23100 | 2346 | nc | NO | YES |
| LL9SS-030-0001-SO | 12/04/03 | 0-1 ft | Manganese | 650 | | 1450 | 176 | nc | NO | YES |
| LL9SS-030-0001-SO | 12/04/03 | 0-1 ft | Vanadium | 14 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-031-0001-SO | 12/04/03 | 0-1 ft | Arsenic | 6.9 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-031-0001-SO | 12/04/03 | 0-1 ft | Cadmium | 0.31 | | 0 | 3.7 | nc | YES | NO |
| LL9SS-031-0001-SO | 12/04/03 | 0-1 ft | Cobalt | 13 | | 10.4 | 30 | ca | YES | NO |
| LL9SS-031-0001-SO | 12/04/03 | 0-1 ft | Iron | 76000 | | 23100 | 2346 | nc | YES | YES |
| LL9SS-031-0001-SO | 12/04/03 | 0-1 ft | Lead | 28 | | 26.1 | 400 | pbk | YES | NO |
| LL9SS-031-0001-SO | 12/04/03 | 0-1 ft | Manganese | 2000 | | 1450 | 176 | nc | YES | YES |
| LL9SS-031-0001-SO | 12/04/03 | 0-1 ft | Vanadium | 19 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-031-0001-SO | 12/04/03 | 0-1 ft | Zinc | 75 | | 61.8 | 2346 | nc | YES | NO |
| LL9SS-032-0001-SO | 12/04/03 | 0-1 ft | Aluminum | 8200 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-032-0001-SO | 12/04/03 | 0-1 ft | Arsenic | 7.4 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-032-0001-SO | 12/04/03 | 0-1 ft | Iron | 22000 | | 23100 | 2346 | nc | NO | YES |
| LL9SS-032-0001-SO | 12/04/03 | 0-1 ft | Manganese | 480 | | 1450 | 176 | nc | NO | YES |
| LL9SS-032-0001-SO | 12/04/03 | 0-1 ft | Vanadium | 15 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-033-0001-SO | 11/11/03 | 0-1 ft | Aluminum | 13000 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-033-0001-SO | 11/11/03 | 0-1 ft | Arsenic | 9.2 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-033-0001-SO | 11/11/03 | 0-1 ft | Cobalt | 11 | | 10.4 | 30 | ca | YES | NO |
| LL9SS-033-0001-SO | 11/11/03 | 0-1 ft | Iron | 23000 | | 23100 | 2346 | nc | NO | YES |
| LL9SS-033-0001-SO | 11/11/03 | 0-1 ft | Manganese | 1200 | | 1450 | 176 | nc | NO | YES |
| LL9SS-033-0001-SO | 11/11/03 | 0-1 ft | Nitrocellulose | 1.4 | B | 0 | -- | 0 | YES | NO |
| LL9SS-033-0001-SO | 11/11/03 | 0-1 ft | Sodium | 1000 | | 123 | --[n] | 0 | YES | NO |
| LL9SS-033-0001-SO | 11/11/03 | 0-1 ft | Vanadium | 25 | | 31.1 | 7.8 | nc | NO | YES |

# Table 4-2
# Summary of Surface Soil Exceedances (0-1 ft bgs)

| Sample Number | Sample Date | Sample Depth | Analyte | Result (mg/kg) | Qualifier | Surface Soil Background Criteria | Surface Soil Region 9 Criteria | SS PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| LL9SS-033-0001-SO | 11/11/03 | 0-1 ft | Zinc | 86 | | 61.8 | 2346 | nc | YES | NO |
| LL9SS-034-0001-DUP | 11/11/03 | 0-1 ft | Arsenic | 10 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-034-0001-DUP | 11/11/03 | 0-1 ft | Benzo(a)pyrene | 0.073 | | -- | 0.062 | ca | NO | YES |
| LL9SS-034-0001-DUP | 11/11/03 | 0-1 ft | Copper | 33 | | 17.7 | 313 | nc | YES | NO |
| LL9SS-034-0001-DUP | 11/11/03 | 0-1 ft | Iron | 32000 | | 23100 | 2346 | nc | YES | YES |
| LL9SS-034-0001-DUP | 11/11/03 | 0-1 ft | Lead | 38 | | 26.1 | 400 | pbk | YES | NO |
| LL9SS-034-0001-DUP | 11/11/03 | 0-1 ft | Manganese | 420 | | 1450 | 176 | nc | NO | YES |
| LL9SS-034-0001-DUP | 11/11/03 | 0-1 ft | Mercury | 17 | | 0.04 | 2.3 | nc | YES | YES |
| LL9SS-034-0001-DUP | 11/11/03 | 0-1 ft | Sodium | 660 | | 123 | --[n] | 0 | YES | NO |
| LL9SS-034-0001-DUP | 11/11/03 | 0-1 ft | Vanadium | 15 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-034-0001-DUP | 11/11/03 | 0-1 ft | Zinc | 79 | | 61.8 | 2346 | nc | YES | NO |
| LL9SS-034-0001-SO | 11/11/03 | 0-1 ft | Aluminum | 9300 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-034-0001-SO | 11/11/03 | 0-1 ft | Arsenic | 7.61 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-034-0001-SO | 11/11/03 | 0-1 ft | Copper | 34 | | 17.7 | 313 | nc | YES | NO |
| LL9SS-034-0001-SO | 11/11/03 | 0-1 ft | Iron | 21000 | | 23100 | 2346 | nc | NO | YES |
| LL9SS-034-0001-SO | 11/11/03 | 0-1 ft | Lead | 43 | | 26.1 | 400 | pbk | YES | NO |
| LL9SS-034-0001-SO | 11/11/03 | 0-1 ft | Manganese | 630 | | 1450 | 176 | nc | NO | YES |
| LL9SS-034-0001-SO | 11/11/03 | 0-1 ft | Mercury | 12 | | 0.04 | 2.3 | nc | YES | YES |
| LL9SS-034-0001-SO | 11/11/03 | 0-1 ft | Nitrocellulose | 1.1 | B | 0 | -- | 0 | YES | NO |
| LL9SS-034-0001-SO | 11/11/03 | 0-1 ft | Nitroglycerin | 4.84 | | 0 | -- | 0 | YES | NO |
| LL9SS-034-0001-SO | 11/11/03 | 0-1 ft | Nitroguanidine | 0.089 | J | 0 | 611 | nc | YES | NO |
| LL9SS-034-0001-SO | 11/11/03 | 0-1 ft | Sodium | 1000 | | 123 | --[n] | 0 | YES | NO |
| LL9SS-034-0001-SO | 11/11/03 | 0-1 ft | Vanadium | 17 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-034-0001-SO | 11/11/03 | 0-1 ft | Zinc | 71 | | 61.8 | 2346 | nc | YES | NO |
| LL9SS-035-0001-SO | 11/11/03 | 0-1 ft | Aluminum | 7900 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-035-0001-SO | 11/11/03 | 0-1 ft | Arsenic | 10 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-035-0001-SO | 11/11/03 | 0-1 ft | Iron | 22000 | | 23100 | 2346 | nc | NO | YES |
| LL9SS-035-0001-SO | 11/11/03 | 0-1 ft | Manganese | 350 | | 1450 | 176 | nc | NO | YES |
| LL9SS-035-0001-SO | 11/11/03 | 0-1 ft | Sodium | 1100 | | 123 | --[n] | 0 | YES | NO |
| LL9SS-035-0001-SO | 11/11/03 | 0-1 ft | Vanadium | 14 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-035-0001-SO | 11/11/03 | 0-1 ft | Zinc | 66 | | 61.8 | 2346 | nc | YES | NO |
| LL9SS-036-0001-DUP | 11/11/03 | 0-1 ft | Aluminum | 8500 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-036-0001-DUP | 11/11/03 | 0-1 ft | Arsenic | 5.6 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-036-0001-DUP | 11/11/03 | 0-1 ft | Iron | 20000 | | 23100 | 2346 | nc | NO | YES |
| LL9SS-036-0001-DUP | 11/11/03 | 0-1 ft | Manganese | 570 | | 1450 | 176 | nc | NO | YES |

## Table 4-2
## Summary of Surface Soil Exceedances (0-1 ft bgs)

| Sample Number | Sample Date | Sample Depth | Analyte | Result (mg/kg) | Qualifier | Surface Soil Background Criteria | Surface Soil Region 9 Criteria | SS PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| LL9SS-036-0001-DUP | 11/11/03 | 0-1 ft | Sodium | 970 | | 123 | --[n] | 0 | YES | NO |
| LL9SS-036-0001-DUP | 11/11/03 | 0-1 ft | Vanadium | 15 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-036-0001-SO | 11/11/03 | 0-1 ft | Aluminum | 8500 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-036-0001-SO | 11/11/03 | 0-1 ft | Arsenic | 5.3 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-036-0001-SO | 11/11/03 | 0-1 ft | Iron | 19000 | | 23100 | 2346 | nc | NO | YES |
| LL9SS-036-0001-SO | 11/11/03 | 0-1 ft | Manganese | 420 | | 1450 | 176 | nc | NO | YES |
| LL9SS-036-0001-SO | 11/11/03 | 0-1 ft | Sodium | 970 | | 123 | --[n] | 0 | YES | NO |
| LL9SS-036-0001-SO | 11/11/03 | 0-1 ft | Vanadium | 15 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-037-0001-SO | 11/11/03 | 0-1 ft | Aluminum | 12000 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-037-0001-SO | 11/11/03 | 0-1 ft | Arsenic | 9.4 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-037-0001-SO | 11/11/03 | 0-1 ft | Barium | 97 | | 88.4 | 538 | nc | YES | NO |
| LL9SS-037-0001-SO | 11/11/03 | 0-1 ft | Cobalt | 17 | | 10.4 | 30 | ca | YES | NO |
| LL9SS-037-0001-SO | 11/11/03 | 0-1 ft | Iron | 17000 | | 23100 | 2346 | nc | NO | YES |
| LL9SS-037-0001-SO | 11/11/03 | 0-1 ft | Manganese | 970 | | 1450 | 176 | nc | NO | YES |
| LL9SS-037-0001-SO | 11/11/03 | 0-1 ft | Sodium | 1100 | | 123 | --[n] | 0 | YES | NO |
| LL9SS-037-0001-SO | 11/11/03 | 0-1 ft | Vanadium | 21 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-037-0001-SO | 11/11/03 | 0-1 ft | Zinc | 65 | | 61.8 | 2346 | nc | YES | NO |
| LL9SS-038-0001-SO | 11/11/03 | 0-1 ft | Aluminum | 13000 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-038-0001-SO | 11/11/03 | 0-1 ft | Arsenic | 7.5 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-038-0001-SO | 11/11/03 | 0-1 ft | Cobalt | 14 | | 10.4 | 30 | ca | YES | NO |
| LL9SS-038-0001-SO | 11/11/03 | 0-1 ft | Iron | 19000 | | 23100 | 2346 | nc | NO | YES |
| LL9SS-038-0001-SO | 11/11/03 | 0-1 ft | Manganese | 1000 | | 1450 | 176 | nc | NO | YES |
| LL9SS-038-0001-SO | 11/11/03 | 0-1 ft | Mercury | 0.072 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SS-038-0001-SO | 11/11/03 | 0-1 ft | Sodium | 1300 | | 123 | --[n] | 0 | YES | NO |
| LL9SS-038-0001-SO | 11/11/03 | 0-1 ft | Vanadium | 22 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-038-0001-SO | 11/11/03 | 0-1 ft | Zinc | 69 | | 61.8 | 2346 | nc | YES | NO |
| LL9SS-039-0001-DUP | 11/11/03 | 0-1 ft | Arsenic | 3.1 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-039-0001-DUP | 11/11/03 | 0-1 ft | Iron | 25000 | | 23100 | 2346 | nc | YES | YES |
| LL9SS-039-0001-DUP | 11/11/03 | 0-1 ft | Manganese | 420 | | 1450 | 176 | nc | NO | YES |
| LL9SS-039-0001-DUP | 11/11/03 | 0-1 ft | Sodium | 850 | | 123 | --[n] | 0 | YES | NO |
| LL9SS-039-0001-DUP | 11/11/03 | 0-1 ft | Vanadium | 11 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-039-0001-DUP | 11/11/03 | 0-1 ft | Zinc | 69 | | 61.8 | 2346 | nc | YES | NO |
| LL9SS-039-0001-SO | 11/11/03 | 0-1 ft | Arsenic | 4.2 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-039-0001-SO | 11/11/03 | 0-1 ft | Iron | 25000 | | 23100 | 2346 | nc | YES | YES |
| LL9SS-039-0001-SO | 11/11/03 | 0-1 ft | Manganese | 470 | | 1450 | 176 | nc | NO | YES |

## Table 4-2
## Summary of Surface Soil Exceedances (0-1 ft bgs)

| Sample Number | Sample Date | Sample Depth | Analyte | Result (mg/kg) | Qualifier | Surface Soil Background Criteria | Surface Soil Region 9 Criteria | SS PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| LL9SS-039-0001-SO | 11/11/03 | 0-1 ft | Mercury | 0.05 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SS-039-0001-SO | 11/11/03 | 0-1 ft | Sodium | 940 | | 123 | --[n] | 0 | YES | NO |
| LL9SS-039-0001-SO | 11/11/03 | 0-1 ft | Vanadium | 12 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-039-0001-SO | 11/11/03 | 0-1 ft | Zinc | 76 | | 61.8 | 2346 | nc | YES | NO |
| LL9SS-042-0001-SO | 11/06/03 | 0-1 ft | Arsenic | 4 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-042-0001-SO | 11/06/03 | 0-1 ft | Iron | 18000 | | 23100 | 2346 | nc | NO | YES |
| LL9SS-042-0001-SO | 11/06/03 | 0-1 ft | Manganese | 610 | | 1450 | 176 | nc | NO | YES |
| LL9SS-042-0001-SO | 11/06/03 | 0-1 ft | Sodium | 930 | | 123 | --[n] | 0 | YES | NO |
| LL9SS-042-0001-SO | 11/06/03 | 0-1 ft | Vanadium | 13 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-043-0001-SO | 11/06/03 | 0-1 ft | Aluminum | 10000 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-043-0001-SO | 11/06/03 | 0-1 ft | Arsenic | 9.2 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-043-0001-SO | 11/06/03 | 0-1 ft | Iron | 20000 | | 23100 | 2346 | nc | NO | YES |
| LL9SS-043-0001-SO | 11/06/03 | 0-1 ft | Manganese | 440 | | 1450 | 176 | nc | NO | YES |
| LL9SS-043-0001-SO | 11/06/03 | 0-1 ft | Sodium | 1100 | | 123 | --[n] | 0 | YES | NO |
| LL9SS-043-0001-SO | 11/06/03 | 0-1 ft | Vanadium | 17 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-044-0001-SO | 11/06/03 | 0-1 ft | Aluminum | 12000 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-044-0001-SO | 11/06/03 | 0-1 ft | Arsenic | 18 | | 15.4 | 0.39 | ca | YES | YES |
| LL9SS-044-0001-SO | 11/06/03 | 0-1 ft | Barium | 92.39 | | 88.4 | 538 | nc | YES | NO |
| LL9SS-044-0001-SO | 11/06/03 | 0-1 ft | Iron | 17000 | | 23100 | 2346 | nc | NO | YES |
| LL9SS-044-0001-SO | 11/06/03 | 0-1 ft | Sodium | 1200 | | 123 | --[n] | 0 | YES | NO |
| LL9SS-044-0001-SO | 11/06/03 | 0-1 ft | Vanadium | 13 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-045-0001-SO | 11/06/03 | 0-1 ft | Aluminum | 13000 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-045-0001-SO | 11/06/03 | 0-1 ft | Arsenic | 17 | | 15.4 | 0.39 | ca | YES | YES |
| LL9SS-045-0001-SO | 11/06/03 | 0-1 ft | Copper | 25 | | 17.7 | 313 | nc | YES | NO |
| LL9SS-045-0001-SO | 11/06/03 | 0-1 ft | Iron | 31000 | | 23100 | 2346 | nc | YES | YES |
| LL9SS-045-0001-SO | 11/06/03 | 0-1 ft | Manganese | 240 | | 1450 | 176 | nc | NO | YES |
| LL9SS-045-0001-SO | 11/06/03 | 0-1 ft | Potassium | 1200 | | 927 | --[n] | 0 | YES | NO |
| LL9SS-045-0001-SO | 11/06/03 | 0-1 ft | Sodium | 1100 | | 123 | --[n] | 0 | YES | NO |
| LL9SS-045-0001-SO | 11/06/03 | 0-1 ft | Vanadium | 20 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-045-0001-SO | 11/06/03 | 0-1 ft | Zinc | 62 | | 61.8 | 2346 | nc | YES | NO |

## Table 4-2
## Summary of Surface Soil Exceedances (0-1 ft bgs)

| Sample Number | Sample Date | Sample Depth | Analyte | Result (mg/kg) | Qualifier | Surface Soil Background Criteria | Surface Soil Region 9 Criteria | SS PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| LL9SS-046-0001-SO | 11/06/03 | 0-1 ft | Aluminum | 8900 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-046-0001-SO | 11/06/03 | 0-1 ft | Arsenic | 18 | | 15.4 | 0.39 | ca | YES | YES |
| LL9SS-046-0001-SO | 11/06/03 | 0-1 ft | Cobalt | 11 | | 10.4 | 30 | ca | YES | NO |
| LL9SS-046-0001-SO | 11/06/03 | 0-1 ft | Copper | 21 | | 17.7 | 313 | nc | YES | NO |
| LL9SS-046-0001-SO | 11/06/03 | 0-1 ft | Iron | 25000 | | 23100 | 2346 | nc | YES | YES |
| LL9SS-046-0001-SO | 11/06/03 | 0-1 ft | Manganese | 370 | | 1450 | 176 | nc | NO | YES |
| LL9SS-046-0001-SO | 11/06/03 | 0-1 ft | Nickel | 24 | | 21.1 | 156 | nc | YES | NO |
| LL9SS-046-0001-SO | 11/06/03 | 0-1 ft | Sodium | 1300 | | 123 | --[n] | 0 | YES | NO |
| LL9SS-046-0001-SO | 11/06/03 | 0-1 ft | Vanadium | 14 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-046-0001-SO | 11/06/03 | 0-1 ft | Zinc | 63 | | 61.8 | 2346 | nc | YES | NO |
| LL9SS-047-0001-SO | 11/06/03 | 0-1 ft | Aluminum | 8600 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-047-0001-SO | 11/06/03 | 0-1 ft | Arsenic | 15 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-047-0001-SO | 11/06/03 | 0-1 ft | Iron | 16000 | | 23100 | 2346 | nc | NO | YES |
| LL9SS-047-0001-SO | 11/06/03 | 0-1 ft | Manganese | 690 | | 1450 | 176 | nc | NO | YES |
| LL9SS-047-0001-SO | 11/06/03 | 0-1 ft | Mercury | 0.063 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SS-047-0001-SO | 11/06/03 | 0-1 ft | Sodium | 1200 | | 123 | --[n] | 0 | YES | NO |
| LL9SS-047-0001-SO | 11/06/03 | 0-1 ft | Vanadium | 13 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-068-0001-SO | 12/12/03 | 0-1 ft | Aluminum | 8400 | | 17700 | 7614 | nc | NO | YES |
| LL9SS-068-0001-SO | 12/12/03 | 0-1 ft | Arsenic | 7.3 | | 15.4 | 0.39 | ca | NO | YES |
| LL9SS-068-0001-SO | 12/12/03 | 0-1 ft | Barium | 110 | | 88.4 | 538 | nc | YES | NO |
| LL9SS-068-0001-SO | 12/12/03 | 0-1 ft | Benzo(a)pyrene | 0.24 | | -- | 0.062 | ca | NO | YES |
| LL9SS-068-0001-SO | 12/12/03 | 0-1 ft | Cadmium | 2.7 | | 0 | 3.7 | nc | YES | NO |
| LL9SS-068-0001-SO | 12/12/03 | 0-1 ft | Copper | 170 | | 17.7 | 313 | nc | YES | NO |
| LL9SS-068-0001-SO | 12/12/03 | 0-1 ft | Dibenzo(a,h)anthracene | 0.13 | | -- | 0.062 | ca | NO | YES |
| LL9SS-068-0001-SO | 12/12/03 | 0-1 ft | Iron | 20000 | | 23100 | 2346 | nc | NO | YES |
| LL9SS-068-0001-SO | 12/12/03 | 0-1 ft | Lead | 150 | | 26.1 | 400 | pbk | YES | NO |
| LL9SS-068-0001-SO | 12/12/03 | 0-1 ft | Manganese | 700 | | 1450 | 176 | nc | NO | YES |
| LL9SS-068-0001-SO | 12/12/03 | 0-1 ft | Mercury | 0.21 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SS-068-0001-SO | 12/12/03 | 0-1 ft | Nitrocellulose | 3.2 | B J | 0 | -- | 0 | YES | NO |
| LL9SS-068-0001-SO | 12/12/03 | 0-1 ft | Selenium | 1.8 | B | 1.4 | 39 | nc | YES | NO |
| LL9SS-068-0001-SO | 12/12/03 | 0-1 ft | Sodium | 170 | B | 123 | --[n] | 0 | YES | NO |

## Table 4-2
## Summary of Surface Soil Exceedances (0-1 ft bgs)

| Sample Number | Sample Date | Sample Depth | Analyte | Result (mg/kg) | Qualifier | Surface Soil Background Criteria | Surface Soil Region 9 Criteria | SS PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| LL9SS-068-0001-SO | 12/12/03 | 0-1 ft | Vanadium | 16 | | 31.1 | 7.8 | nc | NO | YES |
| LL9SS-068-0001-SO | 12/12/03 | 0-1 ft | Zinc | 780 | | 61.8 | 2346 | nc | YES | NO |

**Notes:**
-- - no background/PRG value is available for this analyte
blank cell indicates that the analyte was a non-detect (with a "U" qualifier) or analysis was not performed
PRG - preliminary remediation goals (The PRG for lead is the Maximum Contaminant Level (MCL)
nc - non-cancer basis
ca - cancer basis
pbk - based on PBK modeling
mcl - based on CWA maximum contaminant level
max - ceiling limit
sat - soil saturation
[n] - nutrient
UC - unconsolidated
**Inorganic Qualifiers**
U - analyte was not detected at or above the stated limit
J - result is less than the RL, but greater than or equal to the MDL
B - result is less than the CRDL/RL, but greater than or equal to the IDL/MDL
**InOrganic Flags**
^ - instrument related QC exceed the upper or lower control limits
* - batch QC exceeds the upper or lower control limit
H - batch QC is greater than RL
**Organic Qualifiers**
U - analyte was not detected at or above the stated limit
J - result is an estimated value below the RL
**Organic Flags**
B - Method Blank: batch QC is greater than RL
* - batch QC exceeds the upper or lower control limit
^ - batch QC is greater than RL
a - concentration is below the method Reporting Limit (RL)
H - alternate peak selection upon analytical review

## Table 4-3
## Summary of Surface Soil Results (0-1 ft bgs)

| | | | | | | | LL9SS-002-0001-SO | | LL9SS-004-0001-SO | | LL9SS-006-0001-SO | | LL9SS-008-0001-SO | | LL9SS-010-0001-SO | | LL9SS-012-0001-SO | | LL9SS-013-0001-SO | | LL9SS-014-0001-DU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/04/03 | | 12/04/03 | | 12/11/03 | | 12/10/03 | | 12/08/03 | | 12/10/03 | | 12/10/03 | | 12/11/03 | |
| | | | | | | **Sample Depth** | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Surface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SS PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| Cyanide 9012A | 9014/9010B | Cyanide, Total | mg/Kg | 0.00 | 122 | nc | | | | | | | | | | | | | | | 0.13 | U |
| Explosives 8330 | 8330 | 1,3,5-Trinitrobenzene | mg/Kg | 0 | 183 | nc | | | | | | | | | | | | | | | 0.017 | U |
| | | 1,3-Dinitrobenzene | mg/Kg | 0 | 0.61 | nc | | | | | | | | | | | | | | | 0.017 | U |
| | | 2,4,6-TNT | mg/Kg | 0 | 16 | ca | | | | | | | | | | | | | | | 0.033 | U |
| | | 2,4-Dinitrotoluene | mg/Kg | 0 | 12 | nc | | | | | | | | | | | | | | | 0.035 | U |
| | | 2,6-Dinitrotoluene | mg/Kg | 0 | 6.1 | nc | | | | | | | | | | | | | | | 0.046 | U |
| | | 2-Nitrotoluene | mg/Kg | 0 | 0.88 | ca | | | | | | | | | | | | | | | 0.032 | U |
| | | 3-Nitrotoluene | mg/Kg | 0 | 73 | nc | | | | | | | | | | | | | | | 0.049 | U |
| | | 4-Nitrotoluene | mg/Kg | 0 | 12 | ca | | | | | | | | | | | | | | | 0.045 | U |
| | | HMX | mg/Kg | 0 | 306 | nc | | | | | | | | | | | | | | | 0.11 | U |
| | | Nitrobenzene | mg/Kg | 0 | 2 | nc | | | | | | | | | | | | | | | 0.022 | U |
| | | RDX | mg/Kg | 0 | 4.4 | ca | | | | | | | | | | | | | | | 0.057 | U |
| | | Tetryl | mg/Kg | 0 | 61 | nc | | | | | | | | | | | | | | | 0.042 | U |
| PCB TCL 8082 | 8082 | Aroclor 1016 | mg/Kg | -- | 0.39 | nc | | | | | | | | | | | | | | | 0.0021 | U |
| | | Aroclor 1221 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | 0.0022 | U |
| | | Aroclor 1232 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | 0.0022 | U |
| | | Aroclor 1242 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | 0.0022 | U |
| | | Aroclor 1248 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | 0.0022 | U |
| | | Aroclor 1254 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | 0.0022 | U |
| | | Aroclor 1260 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | 0.0015 | U |
| Pesticides 8081A | 8081A | 4,4'-DDD | mg/Kg | -- | 2.4 | ca | | | | | | | | | | | | | | | 0.0004 | U |
| | | 4,4'-DDE | mg/Kg | -- | 1.7 | ca | | | | | | | | | | | | | | | 0.00072 | U |
| | | 4,4'-DDT | mg/Kg | -- | 1.7 | ca | | | | | | | | | | | | | | | 0.00041 | U |
| | | Aldrin | mg/Kg | -- | 0.029 | ca | | | | | | | | | | | | | | | 0.00014 | U |
| | | alpha-BHC | mg/Kg | -- | 0.09 | sat | | | | | | | | | | | | | | | 0.00018 | U |
| | | alpha-Chlordane | mg/Kg | -- | 1.6 | ca | | | | | | | | | | | | | | | 0.00013 | U |
| | | beta-BHC | mg/Kg | -- | 0.32 | ca | | | | | | | | | | | | | | | 0.00017 | U |
| | | delta-BHC | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | 0.00012 | U |
| | | Dieldrin | mg/Kg | -- | 0.030 | ca | | | | | | | | | | | | | | | 0.00038 | U |
| | | Endosulfan I | mg/Kg | -- | 37 | nc | | | | | | | | | | | | | | | 0.0003 | U |
| | | Endosulfan II | mg/Kg | -- | 37 | nc | | | | | | | | | | | | | | | 0.00031 | U |
| | | Endosulfan sulfate | mg/Kg | -- | 37 | nc | | | | | | | | | | | | | | | 0.00032 | U |
| | | Endrin | mg/Kg | -- | 1.8 | nc | | | | | | | | | | | | | | | 0.00048 | U |
| | | Endrin aldehyde | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | 0.00036 | U |
| | | Endrin ketone | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | 0.00032 | U |
| | | gamma-BHC (Lindane) | mg/Kg | -- | 0.44 | ca | | | | | | | | | | | | | | | 0.00025 | U |
| | | gamma-Chlordane | mg/Kg | -- | 1.6 | ca | | | | | | | | | | | | | | | 0.00017 | U |
| | | Heptachlor | mg/Kg | -- | 0.11 | ca | | | | | | | | | | | | | | | 0.0002 | U |
| | | Heptachlor epoxide | mg/Kg | -- | 0.053 | ca | | | | | | | | | | | | | | | 0.00015 | U |
| | | Methoxychlor | mg/Kg | -- | 31 | nc | | | | | | | | | | | | | | | 0.0025 | U |
| | | Toxaphene | mg/Kg | -- | 0 | 0 | | | | | | | | | | | | | | | 0.0051 | U |

### Table 4-3
### Summary of Surface Soil Results (0-1 ft bgs)

| | | | | | | | LL9SS-002-0001-SO | | LL9SS-004-0001-SO | | LL9SS-006-0001-SO | | LL9SS-008-0001-SO | | LL9SS-010-0001-SO | | LL9SS-012-0001-SO | | LL9SS-013-0001-SO | | LL9SS-014-0001-DU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/04/03 | | 12/04/03 | | 12/11/03 | | 12/10/03 | | 12/08/03 | | 12/10/03 | | 12/10/03 | | 12/11/03 | |
| | | | | | | **Sample Depth** | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Surface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SS PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| Propellants 8330 | 353.2 | Nitrocellulose | mg/Kg | 0 | -- | 0 | | | | | | | | | | | | | | | 1.3 | B J |
| | 8330 | Nitroglycerin | mg/Kg | 0 | -- | 0 | | | | | | | | | | | | | | | 0.5 | U |
| | UV/HPLC per SOP | Nitroguanidine | mg/Kg | 0 | 611 | nc | | | | | | | | | | | | | | | 0.25 | U |
| SVOCs TCL 8270 C | 8270C | 1,2,4-Trichlorobenzene | mg/Kg | -- | 6.2 | nc | | | | | | | | | | | | | | | 0.065 | U |
| | | 1,2-Dichlorobenzene | mg/Kg | -- | 600 | sat | | | | | | | | | | | | | | | 0.088 | U |
| | | 1,3-Dichlorobenzene | mg/Kg | -- | 53 | nc | | | | | | | | | | | | | | | 0.088 | U |
| | | 1,4-Dichlorobenzene | mg/Kg | -- | 3.4 | ca | | | | | | | | | | | | | | | 0.079 | U |
| | | 2,2-oxybis (1-chloropropane) | mg/Kg | -- | 2.9 | ca | | | | | | | | | | | | | | | 0.083 | U |
| | | 2,4,5-Trichlorophenol | mg/Kg | -- | 611 | nc | | | | | | | | | | | | | | | 0.042 | U |
| | | 2,4,6-Trichlorophenol | mg/Kg | -- | 0.61 | nc | | | | | | | | | | | | | | | 0.052 | U |
| | | 2,4-Dichlorophenol | mg/Kg | -- | 18 | nc | | | | | | | | | | | | | | | 0.053 | U |
| | | 2,4-Dimethylphenol | mg/Kg | -- | 122 | nc | | | | | | | | | | | | | | | 0.067 | U |
| | | 2,4-Dinitrophenol | mg/Kg | -- | 12 | nc | | | | | | | | | | | | | | | 0.13 | U |
| | | 2-Chloronaphthalene | mg/Kg | -- | 494 | nc | | | | | | | | | | | | | | | 0.053 | U |
| | | 2-Chlorophenol | mg/Kg | -- | 6.3 | nc | | | | | | | | | | | | | | | 0.065 | U |
| | | 2-Methylnaphthalene | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | 0.0017 | U |
| | | 2-Methylphenol (o-cresol) | mg/Kg | -- | 306 | nc | | | | | | | | | | | | | | | 0.0093 | U |
| | | 2-Nitroaniline | mg/Kg | -- | 18.3 | nc | | | | | | | | | | | | | | | 0.038 | U |
| | | 2-Nitrophenol | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | 0.07 | U |
| | | 3,3-Dichlorobenzidine | mg/Kg | -- | 1.1 | ca | | | | | | | | | | | | | | | 0.02 | U |
| | | 3-Nitroaniline | mg/Kg | -- | 1.8 | nc | | | | | | | | | | | | | | | 0.12 | U |
| | | 4,6-Dinitro-2-methylphenol | mg/Kg | -- | 0.61 | nc | | | | | | | | | | | | | | | 0.11 | U |
| | | 4-Bromophenyl phenyl ether | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | 0.0034 | U |
| | | 4-Chloro-3-methylphenol | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | 0.042 | U |
| | | 4-Chloroaniline | mg/Kg | -- | 24 | nc | | | | | | | | | | | | | | | 0.11 | U |
| | | 4-Chlorophenyl phenyl ether | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | 0.004 | U |
| | | 4-Methylphenol (m/p-cresol) | mg/Kg | -- | 31 | nc | | | | | | | | | | | | | | | 0.0064 | U |
| | | 4-Nitroaniline | mg/Kg | -- | 23 | ca | | | | | | | | | | | | | | | 0.043 | U |
| | | 4-Nitrophenol | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | 0.091 | U |
| | | Acenaphthene | mg/Kg | -- | 368 | nc | | | | | | | | | | | | | | | 0.0016 | U |
| | | Acenaphthylene | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | 0.001 | U |
| | | Anthracene | mg/Kg | -- | 2189 | nc | | | | | | | | | | | | | | | 0.00095 | U |
| | | Benzo(a)anthracene | mg/Kg | -- | 0.62 | ca | | | | | | | | | | | | | | | 0.0012 | U |
| | | Benzo(a)pyrene | mg/Kg | -- | 0.062 | ca | | | | | | | | | | | | | | | 0.0024 | U |
| | | Benzo(b)fluoranthene | mg/Kg | -- | 0.62 | ca | | | | | | | | | | | | | | | 0.0023 | U |
| | | Benzo(ghi)perylene | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | 0.0021 | U |
| | | Benzo(k)fluoranthene | mg/Kg | -- | 6.2 | ca | | | | | | | | | | | | | | | 0.0031 | U |
| | | Bis(2-chloroethoxy)methane | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | 0.0032 | U |
| | | Bis(2-chloroethyl)ether | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | 0.0022 | U |
| | | Bis(2-ethylhexyl)phthalate | mg/Kg | -- | 35 | ca | | | | | | | | | | | | | | | 0.047 | J |
| | | Butyl benzyl phthalate | mg/Kg | -- | 1222 | nc | | | | | | | | | | | | | | | 0.0046 | U |
| | | Carbazole | mg/Kg | -- | 24 | ca | | | | | | | | | | | | | | | 0.039 | U |
| | | Chrysene | mg/Kg | -- | 62 | ca | | | | | | | | | | | | | | | 0.002 | U |
| | | Dibenzo(a,h)anthracene | mg/Kg | -- | 0.062 | ca | | | | | | | | | | | | | | | 0.0024 | U |

# Table 4-3
## Summary of Surface Soil Results (0-1 ft bgs)

| | | | | | | | LL9SS-002-0001-SO | | LL9SS-004-0001-SO | | LL9SS-006-0001-SO | | LL9SS-008-0001-SO | | LL9SS-010-0001-SO | | LL9SS-012-0001-SO | | LL9SS-013-0001-SO | | LL9SS-014-0001-DUP | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/04/03 | | 12/04/03 | | 12/11/03 | | 12/10/03 | | 12/08/03 | | 12/10/03 | | 12/10/03 | | 12/11/03 | |
| | | | | | | **Sample Depth** | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Surface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SS PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| | | Dibenzofuran | mg/Kg | -- | 15 | nc | | | | | | | | | | | | | | | 0.003 | U |
| | | Diethyl phthalate | mg/Kg | -- | 4888 | nc | | | | | | | | | | | | | | | 0.0041 | U |
| | | Dimethyl phthalate | mg/Kg | -- | 100000 | max | | | | | | | | | | | | | | | 0.004 | U |
| | | Di-n-butyl phthalate | mg/Kg | -- | 611 | nc | | | | | | | | | | | | | | | 0.022 | U |
| | | Di-n-octyl phthalate | mg/Kg | -- | 244 | nc | | | | | | | | | | | | | | | 0.0097 | U |
| | | Fluoranthene | mg/Kg | -- | 229 | nc | | | | | | | | | | | | | | | 0.0012 | U |
| | | Fluorene | mg/Kg | -- | 275 | nc | | | | | | | | | | | | | | | 0.0018 | U |
| | | Hexachlorobenzene | mg/Kg | -- | 0.30 | ca | | | | | | | | | | | | | | | 0.002 | U |
| | | Hexachlorobutadiene | mg/Kg | -- | 6.2 | ca | | | | | | | | | | | | | | | 0.0037 | U |
| | | Hexachlorocyclopentadiene | mg/Kg | -- | 37 | nc | | | | | | | | | | | | | | | 0.06 | U |
| | | Hexachloroethane | mg/Kg | -- | 35 | ca | | | | | | | | | | | | | | | 0.0037 | U |
| | | Indeno(1,2,3-cd)pyrene | mg/Kg | -- | 0.62 | ca | | | | | | | | | | | | | | | 0.0023 | U |
| | | Isophorone | mg/Kg | -- | 512 | ca | | | | | | | | | | | | | | | 0.0027 | U |
| | | Naphthalene | mg/Kg | -- | 5.6 | nc | | | | | | | | | | | | | | | 0.0019 | U |
| | | n-Nitroso-di-n-propylamine | mg/Kg | -- | 0.069 | ca | | | | | | | | | | | | | | | 0.0026 | U |
| | | n-Nitrosodiphenylamine | mg/Kg | -- | 99 | ca | | | | | | | | | | | | | | | 0.0032 | U |
| | | Pentachlorophenol | mg/Kg | -- | 3.0 | ca | | | | | | | | | | | | | | | 0.11 | U |
| | | Phenanthrene | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | 0.0011 | U |
| | | Phenol | mg/Kg | -- | 1833 | nc | | | | | | | | | | | | | | | 0.0018 | U |
| | | Pyrene | mg/Kg | -- | 232 | nc | | | | | | | | | | | | | | | 0.0022 | U |
| TAL Metals 6010B | 6010B | Aluminum | mg/Kg | 17700 | 7614 | nc | **8500** | | 7100 | | **9300** | | **11000** | | 7200 | | **9000** | | 6000 | | 6800 | |
| | | Barium | mg/Kg | 88.4 | 538 | nc | 65 | | 44 | | 92 | | 60 | | 27 | | 71 | | 29 | | 35 | |
| | | Beryllium | mg/Kg | 0.88 | 15 | nc | 0.62 | | 0.41 | B | 0.49 | | 0.46 | | 0.27 | B | 0.5 | | 0.31 | B | 0.23 | B |
| | | Cadmium | mg/Kg | 0.00 | 3.7 | nc | 0.084 | U | 0.091 | U | 2.9 | | 0.091 | U | 0.11 | B | 0.51 | | 0.08 | U | 0.08 | U |
| | | Calcium | mg/Kg | 15800 | -- | 0 | 2100 | | 1200 | | 4900 | | 1200 | | 1100 | | 22000 | | 2500 | | 1200 | |
| | | Chromium | mg/Kg | 17.4 | 30 | ca | 13 | | 10 | | 14 | | 14 | | 10 | | 13 | | 8.4 | | 8.9 | |
| | | Cobalt | mg/Kg | 10.4 | 902 | ca | 8.7 | | 6.2 | | 9.2 | | 8.5 | | 6 | | 7.1 | | 7.9 | | 5.7 | |
| | | Copper | mg/Kg | 17.7 | 313 | nc | 20 | | 19 | | 18 | | 13 | | 21 | H | 25 | | 22 | | 20 | |
| | | Iron | mg/Kg | 23100 | 2346 | nc | **21000** | | **19000** | | **16000** | H | **20000** | | **21000** | | **22000** | | **24000** | | **19000** | H |
| | | Magnesium | mg/Kg | 3030 | -- | 0 | 1900 | | 1800 | | 2000 | | 2000 | | 1800 | | 3000 | | 2400 | | 1700 | |
| | | Manganese | mg/Kg | 1450 | 176 | nc | **630** | | **390** | | **830** | | **640** | | **280** | | **600** | | **370** | | **340** | |
| | | Nickel | mg/Kg | 21.1 | 156 | nc | 16 | | 15 | | 15 | | 16 | | 15 | | 17 | | 16 | | 13 | |
| | | Potassium | mg/Kg | 927 | -- | 0 | 670 | | 620 | | 700 | | 790 | | 790 | | 1100 | | 610 | | 560 | |
| | | Selenium | mg/Kg | 1.4 | 39 | nc | 0.54 | B | 0.63 | B | 0.45 | B | 0.46 | U | 0.47 | B | 0.45 | U | 0.4 | U | 0.31 | B |
| | | Silver | mg/Kg | 0.00 | 39 | nc | 0.33 | U | 0.35 | U | 0.37 | U | 0.35 | U | 0.33 | U | 0.35 | U | 0.31 | U | 0.31 | U |
| | | Sodium | mg/Kg | 123 | -- | 0 | 92 | U | 99 | U | 100 | U | 99 | U | 92 | U | 97 | U | 87 | U | 87 | U |
| | | Vanadium | mg/Kg | 31.1 | 7.8 | nc | **15** | | **12** | | **16** | | **19** | | **12** | | **16** | | **11** | | **12** | |
| | | Zinc | mg/Kg | 61.8 | 2346 | nc | 100 | | 100 | | 200 | | 62 | | 78 | | 140 | | 74 | | 64 | |
| | 7041 | Antimony | mg/Kg | 0.96 | 3.1 | nc | 0.49 | U | 0.41 | U | 0.51 | U | 0.5 | U | 0.46 | U | 0.95 | | 0.47 | U | 0.45 | U |
| | 7060A | Arsenic | mg/Kg | 15.4 | 0.39 | ca | **9.7** | | **15** | | **9.9** | | **10** | | **15** | | **15** | | **11** | | **14** | |
| | 7421 | Lead | mg/Kg | 26.1 | 400 | pbk | 64 | | 45 | | 140 | | 18 | | 11 | | 44 | | 15 | | 15 | |
| | 7471A | Mercury | mg/Kg | 0.04 | 2.3 | nc | 0.1 | | 0.073 | | 1.3 | | 0.047 | | 0.042 | | 0.053 | | 0.024 | | 0.024 | |
| | 7841 | Thallium | mg/Kg | 0.00 | 0.52 | nc | 0.21 | U | 0.36 | U | 0.22 | U | 0.22 | U | 0.2 | U | 0.21 | U | 0.2 | U | 0.2 | U |

## Table 4-3
## Summary of Surface Soil Results (0-1 ft bgs)

| | | | | | | | LL9SS-002-0001-SO | | LL9SS-004-0001-SO | | LL9SS-006-0001-SO | | LL9SS-008-0001-SO | | LL9SS-010-0001-SO | | LL9SS-012-0001-SO | | LL9SS-013-0001-SO | | LL9SS-014-0001-DU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/04/03 | | 12/04/03 | | 12/11/03 | | 12/10/03 | | 12/08/03 | | 12/10/03 | | 12/10/03 | | 12/11/03 | |
| | | | | | | **Sample Depth** | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Surface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SS PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| VOCs TCL 8260B | 8260B | 1,1,1-Trichloroethane | mg/Kg | -- | 1200 | sat | | | | | | | | | | | | | | | 0.0012 | U |
| | | 1,1,2,2-Tetrachloroethane | mg/Kg | -- | 0.41 | ca | | | | | | | | | | | | | | | 0.0011 | U |
| | | 1,1,2-Trichloroethane | mg/Kg | -- | 0.73 | ca | | | | | | | | | | | | | | | 0.0012 | U |
| | | 1,1-Dichloroethane | mg/Kg | -- | 51 | nc | | | | | | | | | | | | | | | 0.0011 | U |
| | | 1,1-Dichloroethene | mg/Kg | -- | 12 | nc | | | | | | | | | | | | | | | 0.0015 | U |
| | | 1,2-Dichloroethane | mg/Kg | -- | 0.28 | ca | | | | | | | | | | | | | | | 0.0011 | U |
| | | 1,2-Dichloroethene (total) | mg/Kg | -- | 6.9 | nc | | | | | | | | | | | | | | | 0.0024 | U |
| | | 1,2-Dichloropropane | mg/Kg | -- | 0.34 | ca | | | | | | | | | | | | | | | 0.0011 | U |
| | | 2-Butanone (MEK) | mg/Kg | -- | 2231 | nc | | | | | | | | | | | | | | | 0.0044 | U |
| | | 2-Hexanone | mg/Kg | -- | 530 | nc | | | | | | | | | | | | | | | 0.0012 | U |
| | | 4-Methyl-2-pentanone (MIBK) | mg/Kg | -- | 528 | nc | | | | | | | | | | | | | | | 0.0011 | U |
| | | Acetone | mg/Kg | -- | 1412 | nc | | | | | | | | | | | | | | | 0.0052 | U |
| | | Benzene | mg/Kg | -- | 0.64 | ca | | | | | | | | | | | | | | | 0.0012 | U |
| | | Bromodichloromethane | mg/Kg | -- | 0.82 | ca | | | | | | | | | | | | | | | 0.0011 | U |
| | | Bromoform | mg/Kg | -- | 62 | ca | | | | | | | | | | | | | | | 0.00084 | U |
| | | Bromomethane | mg/Kg | -- | 0.39 | nc | | | | | | | | | | | | | | | 0.0015 | U |
| | | Carbon disulfide | mg/Kg | -- | 36 | nc | | | | | | | | | | | | | | | 0.0013 | U |
| | | Carbon tetrachloride | mg/Kg | -- | 0.25 | ca | | | | | | | | | | | | | | | 0.0012 | U |
| | | Chlorobenzene | mg/Kg | -- | 15 | nc | | | | | | | | | | | | | | | 0.0012 | U |
| | | Chloroethane | mg/Kg | -- | 3.0 | ca | | | | | | | | | | | | | | | 0.0011 | U |
| | | Chloroform | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | 0.0012 | U |
| | | Chloromethane | mg/Kg | -- | 4.7 | nc | | | | | | | | | | | | | | | 0.0012 | U |
| | | cis-1,3-Dichloropropene | mg/Kg | -- | 0.78 | ca | | | | | | | | | | | | | | | 0.001 | U |
| | | Dibromochloromethane | mg/Kg | -- | 1.1 | ca | | | | | | | | | | | | | | | 0.00089 | U |
| | | Ethylbenzene | mg/Kg | -- | 395 | sat | | | | | | | | | | | | | | | 0.0012 | U |
| | | Methylene chloride | mg/Kg | -- | 9.1 | ca | | | | | | | | | | | | | | | 0.0033 | U |
| | | Styrene | mg/Kg | -- | 1700 | sat | | | | | | | | | | | | | | | 0.0012 | U |
| | | Tetrachloroethene | mg/Kg | -- | 0.48 | ca | | | | | | | | | | | | | | | 0.0013 | U |
| | | Toluene | mg/Kg | -- | 520 | sat | | | | | | | | | | | | | | | 0.0012 | U |
| | | trans-1,3-Dichloropropene | mg/Kg | -- | 0.78 | ca | | | | | | | | | | | | | | | 0.00089 | U |
| | | Trichloroethene | mg/Kg | -- | 0.053 | ca | | | | | | | | | | | | | | | 0.0012 | U |
| | | Vinyl chloride | mg/Kg | -- | 0.079 | ca | | | | | | | | | | | | | | | 0.0012 | U |
| | | Xylenes (total) | mg/Kg | -- | 0.079 | ca | | | | | | | | | | | | | | | 0.0038 | U |

## Table 4-3
## Summary of Surface Soil Results (0-1 ft bgs)

| | | | | | | | LL9SS-014-0001-SO | | LL9SS-015-0001-SO | | LL9SS-016-0001-DU | | LL9SS-016-0001-SO | | LL9SS-017-0001-SO | | LL9SS-018-0001-SO | | LL9SS-019-0001-SO | | LL9SS-020-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/11/03 | | 12/11/03 | | 12/11/03 | | 12/11/03 | | 12/04/03 | | 12/10/03 | | 12/11/03 | | 12/08/03 | |
| | | | | | | **Sample Depth** | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Surface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SS PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| Cyanide 9012A | 9014/9010B | Cyanide, Total | mg/Kg | 0.00 | 122 | nc | 0.18 | U | | | | | | | | | | | 0.18 | U | | |
| Explosives 8330 | 8330 | 1,3,5-Trinitrobenzene | mg/Kg | 0 | 183 | nc | 0.017 | U | | | | | | | | | | | 0.017 | U | | |
| | | 1,3-Dinitrobenzene | mg/Kg | 0 | 0.61 | nc | 0.018 | U | | | | | | | | | | | 0.018 | U | | |
| | | 2,4,6-TNT | mg/Kg | 0 | 16 | ca | 0.033 | U | | | | | | | | | | | 0.033 | U | | |
| | | 2,4-Dinitrotoluene | mg/Kg | 0 | 12 | nc | 0.035 | U | | | | | | | | | | | 0.035 | U | | |
| | | 2,6-Dinitrotoluene | mg/Kg | 0 | 6.1 | nc | 0.047 | U | | | | | | | | | | | 0.047 | U | | |
| | | 2-Nitrotoluene | mg/Kg | 0 | 0.88 | ca | 0.033 | U | | | | | | | | | | | 0.033 | U | | |
| | | 3-Nitrotoluene | mg/Kg | 0 | 73 | nc | 0.049 | U | | | | | | | | | | | 0.05 | U | | |
| | | 4-Nitrotoluene | mg/Kg | 0 | 12 | ca | 0.046 | U | | | | | | | | | | | 0.046 | U | | |
| | | HMX | mg/Kg | 0 | 306 | nc | 0.11 | U | | | | | | | | | | | 0.11 | U | | |
| | | Nitrobenzene | mg/Kg | 0 | 2 | nc | 0.022 | U | | | | | | | | | | | 0.022 | U | | |
| | | RDX | mg/Kg | 0 | 4.4 | ca | 0.058 | U | | | | | | | | | | | 0.058 | U | | |
| | | Tetryl | mg/Kg | 0 | 61 | nc | 0.043 | U | | | | | | | | | | | 0.043 | U | | |
| PCB TCL 8082 | 8082 | Aroclor 1016 | mg/Kg | -- | 0.39 | nc | 0.002 | U | | | | | | | | | | | 0.0023 | U | | |
| | | Aroclor 1221 | mg/Kg | -- | 0.22 | ca | 0.0021 | U | | | | | | | | | | | 0.0025 | U | | |
| | | Aroclor 1232 | mg/Kg | -- | 0.22 | ca | 0.0021 | U | | | | | | | | | | | 0.0025 | U | | |
| | | Aroclor 1242 | mg/Kg | -- | 0.22 | ca | 0.0021 | U | | | | | | | | | | | 0.0025 | U | | |
| | | Aroclor 1248 | mg/Kg | -- | 0.22 | ca | 0.0021 | U | | | | | | | | | | | 0.0025 | U | | |
| | | Aroclor 1254 | mg/Kg | -- | 0.22 | ca | 0.0021 | U | | | | | | | | | | | 0.0025 | U | | |
| | | Aroclor 1260 | mg/Kg | -- | 0.22 | ca | 0.0015 | U | | | | | | | | | | | 0.0017 | U | | |
| Pesticides 8081A | 8081A | 4,4'-DDD | mg/Kg | -- | 2.4 | ca | 0.00038 | U | | | | | | | | | | | 0.00044 | U | | |
| | | 4,4'-DDE | mg/Kg | -- | 1.7 | ca | 0.00069 | U | | | | | | | | | | | 0.0008 | U | | |
| | | 4,4'-DDT | mg/Kg | -- | 1.7 | ca | 0.00039 | U | | | | | | | | | | | 0.00046 | U | | |
| | | Aldrin | mg/Kg | -- | 0.029 | ca | 0.00014 | U | | | | | | | | | | | 0.00016 | U | | |
| | | alpha-BHC | mg/Kg | -- | 0.09 | sat | 0.00017 | U | | | | | | | | | | | 0.0002 | U | | |
| | | alpha-Chlordane | mg/Kg | -- | 1.6 | ca | 0.00013 | U | | | | | | | | | | | 0.00015 | U | | |
| | | beta-BHC | mg/Kg | -- | 0.32 | ca | 0.00016 | U | | | | | | | | | | | 0.00018 | U | | |
| | | delta-BHC | mg/Kg | -- | -- | 0 | 0.00012 | U | | | | | | | | | | | 0.00014 | U | | |
| | | Dieldrin | mg/Kg | -- | 0.030 | ca | 0.00036 | U | | | | | | | | | | | 0.00042 | U | | |
| | | Endosulfan I | mg/Kg | -- | 37 | nc | 0.00029 | U | | | | | | | | | | | 0.00033 | U | | |
| | | Endosulfan II | mg/Kg | -- | 37 | nc | 0.0003 | U | | | | | | | | | | | 0.00034 | U | | |
| | | Endosulfan sulfate | mg/Kg | -- | 37 | nc | 0.00031 | U | | | | | | | | | | | 0.00036 | U | | |
| | | Endrin | mg/Kg | -- | 1.8 | nc | 0.00046 | U | | | | | | | | | | | 0.00053 | U | | |
| | | Endrin aldehyde | mg/Kg | -- | -- | 0 | 0.00035 | U | | | | | | | | | | | 0.00041 | U | | |
| | | Endrin ketone | mg/Kg | -- | -- | 0 | 0.00031 | U | | | | | | | | | | | 0.00036 | U | | |
| | | gamma-BHC (Lindane) | mg/Kg | -- | 0.44 | ca | 0.00024 | U | | | | | | | | | | | 0.00028 | U | | |
| | | gamma-Chlordane | mg/Kg | -- | 1.6 | ca | 0.00016 | U | | | | | | | | | | | 0.00018 | U | | |
| | | Heptachlor | mg/Kg | -- | 0.11 | ca | 0.00019 | U | | | | | | | | | | | 0.00022 | U | | |
| | | Heptachlor epoxide | mg/Kg | -- | 0.053 | ca | 0.00015 | U | | | | | | | | | | | 0.00017 | U | | |
| | | Methoxychlor | mg/Kg | -- | 31 | nc | 0.0024 | U | | | | | | | | | | | 0.0028 | U | | |
| | | Toxaphene | mg/Kg | -- | 0 | 0 | 0.0049 | U | | | | | | | | | | | 0.0057 | U | | |

# Table 4-3
## Summary of Surface Soil Results (0-1 ft bgs)

| | | | | | | | LL9SS-014-0001-SO | | LL9SS-015-0001-SO | | LL9SS-016-0001-DU | | LL9SS-016-0001-SO | | LL9SS-017-0001-SO | | LL9SS-018-0001-SO | | LL9SS-019-0001-SO | | LL9SS-020-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/11/03 | | 12/11/03 | | 12/11/03 | | 12/11/03 | | 12/04/03 | | 12/10/03 | | 12/11/03 | | 12/08/03 | |
| | | | | | | **Sample Depth** | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Surface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SS PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| Propellants 8330 | 353.2 | Nitrocellulose | mg/Kg | 0 | -- | 0 | 1.6 | B J | | | | | | | | | | | 1.8 | B J | | |
| | 8330 | Nitroglycerin | mg/Kg | 0 | -- | 0 | 0.5 | U | | | | | | | | | | | 0.5 | U | | |
| | UV/HPLC per SOP | Nitroguanidine | mg/Kg | 0 | 611 | nc | 0.25 | U | | | | | | | | | | | 0.25 | U | | |
| SVOCs TCL 8270 C | 8270C | 1,2,4-Trichlorobenzene | mg/Kg | -- | 6.2 | nc | 0.065 | U | | | | | | | | | | | 0.073 | U | | |
| | | 1,2-Dichlorobenzene | mg/Kg | -- | 600 | sat | 0.087 | U | | | | | | | | | | | 0.098 | U | | |
| | | 1,3-Dichlorobenzene | mg/Kg | -- | 53 | nc | 0.087 | U | | | | | | | | | | | 0.098 | U | | |
| | | 1,4-Dichlorobenzene | mg/Kg | -- | 3.4 | ca | 0.078 | U | | | | | | | | | | | 0.088 | U | | |
| | | 2,2-oxybis (1-chloropropane) | mg/Kg | -- | 2.9 | ca | 0.083 | U | | | | | | | | | | | 0.093 | U | | |
| | | 2,4,5-Trichlorophenol | mg/Kg | -- | 611 | nc | 0.042 | U | | | | | | | | | | | 0.047 | U | | |
| | | 2,4,6-Trichlorophenol | mg/Kg | -- | 0.61 | nc | 0.052 | U | | | | | | | | | | | 0.058 | U | | |
| | | 2,4-Dichlorophenol | mg/Kg | -- | 18 | nc | 0.053 | U | | | | | | | | | | | 0.059 | U | | |
| | | 2,4-Dimethylphenol | mg/Kg | -- | 122 | nc | 0.066 | U | | | | | | | | | | | 0.074 | U | | |
| | | 2,4-Dinitrophenol | mg/Kg | -- | 12 | nc | 0.13 | U | | | | | | | | | | | 0.14 | U | | |
| | | 2-Chloronaphthalene | mg/Kg | -- | 494 | nc | 0.053 | U | | | | | | | | | | | 0.059 | U | | |
| | | 2-Chlorophenol | mg/Kg | -- | 6.3 | nc | 0.065 | U | | | | | | | | | | | 0.073 | U | | |
| | | 2-Methylnaphthalene | mg/Kg | -- | -- | 0 | 0.0017 | U | | | | | | | | | | | 0.0019 | U | | |
| | | 2-Methylphenol (o-cresol) | mg/Kg | -- | 306 | nc | 0.0093 | U | | | | | | | | | | | 0.01 | U | | |
| | | 2-Nitroaniline | mg/Kg | -- | 18.3 | nc | 0.038 | U | | | | | | | | | | | 0.042 | U | | |
| | | 2-Nitrophenol | mg/Kg | -- | -- | 0 | 0.07 | U | | | | | | | | | | | 0.078 | U | | |
| | | 3,3-Dichlorobenzidine | mg/Kg | -- | 1.1 | ca | 0.02 | U | | | | | | | | | | | 0.022 | U | | |
| | | 3-Nitroaniline | mg/Kg | -- | 1.8 | nc | 0.12 | U | | | | | | | | | | | 0.14 | U | | |
| | | 4,6-Dinitro-2-methylphenol | mg/Kg | -- | 0.61 | nc | 0.1 | U | | | | | | | | | | | 0.12 | U | | |
| | | 4-Bromophenyl phenyl ether | mg/Kg | -- | -- | 0 | 0.0034 | U | | | | | | | | | | | 0.0038 | U | | |
| | | 4-Chloro-3-methylphenol | mg/Kg | -- | -- | 0 | 0.042 | U | | | | | | | | | | | 0.047 | U | | |
| | | 4-Chloroaniline | mg/Kg | -- | 24 | nc | 0.11 | U | | | | | | | | | | | 0.12 | U | | |
| | | 4-Chlorophenyl phenyl ether | mg/Kg | -- | -- | 0 | 0.004 | U | | | | | | | | | | | 0.0045 | U | | |
| | | 4-Methylphenol (m/p-cresol) | mg/Kg | -- | 31 | nc | 0.0064 | U | | | | | | | | | | | 0.0072 | U | | |
| | | 4-Nitroaniline | mg/Kg | -- | 23 | ca | 0.043 | U | | | | | | | | | | | 0.048 | U | | |
| | | 4-Nitrophenol | mg/Kg | -- | -- | 0 | 0.091 | U | | | | | | | | | | | 0.1 | U | | |
| | | Acenaphthene | mg/Kg | -- | 368 | nc | 0.0015 | U | | | | | | | | | | | 0.0017 | U | | |
| | | Acenaphthylene | mg/Kg | -- | -- | 0 | 0.001 | U | | | | | | | | | | | 0.0011 | U | | |
| | | Anthracene | mg/Kg | -- | 2189 | nc | 0.00095 | U | | | | | | | | | | | 0.0011 | U | | |
| | | Benzo(a)anthracene | mg/Kg | -- | 0.62 | ca | 0.0012 | U | | | | | | | | | | | 0.0072 | J | | |
| | | Benzo(a)pyrene | mg/Kg | -- | 0.062 | ca | 0.0024 | U | | | | | | | | | | | 0.0068 | J | | |
| | | Benzo(b)fluoranthene | mg/Kg | -- | 0.62 | ca | 0.0023 | U | | | | | | | | | | | 0.0073 | J | | |
| | | Benzo(ghi)perylene | mg/Kg | -- | -- | 0 | 0.0021 | U | | | | | | | | | | | 0.0053 | J | | |
| | | Benzo(k)fluoranthene | mg/Kg | -- | 6.2 | ca | 0.0031 | U | | | | | | | | | | | 0.0049 | J | | |
| | | Bis(2-chloroethoxy)methane | mg/Kg | -- | -- | 0 | 0.0032 | U | | | | | | | | | | | 0.0036 | U | | |
| | | Bis(2-chloroethyl)ether | mg/Kg | -- | 0.22 | ca | 0.0022 | U | | | | | | | | | | | 0.0025 | U | | |
| | | Bis(2-ethylhexyl)phthalate | mg/Kg | -- | 35 | ca | 0.15 | J | | | | | | | | | | | 0.061 | J | | |
| | | Butyl benzyl phthalate | mg/Kg | -- | 1222 | nc | 0.0045 | U | | | | | | | | | | | 0.0051 | U | | |
| | | Carbazole | mg/Kg | -- | 24 | ca | 0.039 | U | | | | | | | | | | | 0.043 | U | | |
| | | Chrysene | mg/Kg | -- | 62 | ca | 0.002 | U | | | | | | | | | | | 0.0052 | J | | |
| | | Dibenzo(a,h)anthracene | mg/Kg | -- | 0.062 | ca | 0.0024 | U | | | | | | | | | | | 0.0027 | U | | |

## Table 4-3
## Summary of Surface Soil Results (0-1 ft bgs)

| | | | | | | | LL9SS-014-0001-SO | | LL9SS-015-0001-SO | | LL9SS-016-0001-DU | | LL9SS-016-0001-SO | | LL9SS-017-0001-SO | | LL9SS-018-0001-SO | | LL9SS-019-0001-SO | | LL9SS-020-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/11/03 | | 12/11/03 | | 12/11/03 | | 12/11/03 | | 12/04/03 | | 12/10/03 | | 12/11/03 | | 12/08/03 | |
| | | | | | | **Sample Depth** | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Surface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SS PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| | | Dibenzofuran | mg/Kg | -- | 15 | nc | 0.003 | U | | | | | | | | | | | 0.0033 | U | | |
| | | Diethyl phthalate | mg/Kg | -- | 4888 | nc | 0.0041 | U | | | | | | | | | | | 0.0046 | U | | |
| | | Dimethyl phthalate | mg/Kg | -- | 100000 | max | 0.004 | U | | | | | | | | | | | 0.0045 | U | | |
| | | Di-n-butyl phthalate | mg/Kg | -- | 611 | nc | 0.022 | U | | | | | | | | | | | 0.025 | U | | |
| | | Di-n-octyl phthalate | mg/Kg | -- | 244 | nc | 0.0096 | U | | | | | | | | | | | 0.011 | U | | |
| | | Fluoranthene | mg/Kg | -- | 229 | nc | 0.0012 | U | | | | | | | | | | | 0.01 | J | | |
| | | Fluorene | mg/Kg | -- | 275 | nc | 0.0018 | U | | | | | | | | | | | 0.002 | U | | |
| | | Hexachlorobenzene | mg/Kg | -- | 0.30 | ca | 0.002 | U | | | | | | | | | | | 0.0022 | U | | |
| | | Hexachlorobutadiene | mg/Kg | -- | 6.2 | ca | 0.0036 | U | | | | | | | | | | | 0.0041 | U | | |
| | | Hexachlorocyclopentadiene | mg/Kg | -- | 37 | nc | 0.06 | U | | | | | | | | | | | 0.067 | U | | |
| | | Hexachloroethane | mg/Kg | -- | 35 | ca | 0.0036 | U | | | | | | | | | | | 0.0041 | U | | |
| | | Indeno(1,2,3-cd)pyrene | mg/Kg | -- | 0.62 | ca | 0.0023 | U | | | | | | | | | | | 0.0026 | U | | |
| | | Isophorone | mg/Kg | -- | 512 | ca | 0.0027 | U | | | | | | | | | | | 0.003 | U | | |
| | | Naphthalene | mg/Kg | -- | 5.6 | nc | 0.0019 | U | | | | | | | | | | | 0.0021 | U | | |
| | | n-Nitroso-di-n-propylamine | mg/Kg | -- | 0.069 | ca | 0.0025 | U | | | | | | | | | | | 0.0028 | U | | |
| | | n-Nitrosodiphenylamine | mg/Kg | -- | 99 | ca | 0.0032 | U | | | | | | | | | | | 0.0036 | U | | |
| | | Pentachlorophenol | mg/Kg | -- | 3.0 | ca | 0.11 | U | | | | | | | | | | | 0.12 | U | | |
| | | Phenanthrene | mg/Kg | -- | -- | 0 | 0.0011 | U | | | | | | | | | | | 0.0051 | J | | |
| | | Phenol | mg/Kg | -- | 1833 | nc | 0.0018 | U | | | | | | | | | | | 0.002 | U | | |
| | | Pyrene | mg/Kg | -- | 232 | nc | 0.0022 | U | | | | | | | | | | | 0.01 | J | | |
| TAL Metals 6010B | 6010B | Aluminum | mg/Kg | 17700 | 7614 | nc | **7900** | | **17000** | | **9100** | | **9900** | | **10000** | | **11000** | | **14000** | | **7900** | |
| | | Barium | mg/Kg | 88.4 | 538 | nc | 39 | | 62 | | 67 | | 82 | | 65 | | 95 | | 170 | | 47 | |
| | | Beryllium | mg/Kg | 0.88 | 15 | nc | 0.22 | B | 0.51 | | 0.54 | | 0.72 | | 0.69 | | 0.49 | | 0.41 | B | 0.32 | B |
| | | Cadmium | mg/Kg | 0.00 | 3.7 | nc | 0.083 | U | 0.093 | U | 0.14 | B | 0.17 | B | 0.09 | U | 0.16 | B | 0.085 | U | 0.71 | |
| | | Calcium | mg/Kg | 15800 | -- | 0 | 1100 | | 2200 | | 12000 | | 20000 | | 650 | | 1200 | | 900 | | 1600 | |
| | | Chromium | mg/Kg | 17.4 | 30 | ca | 11 | | 23 | | 12 | | 10 | | 14 | | 14 | | 17 | | 11 | |
| | | Cobalt | mg/Kg | 10.4 | 902 | ca | 7.2 | | 8.3 | | 6.1 | | 7 | | 8 | | 10 | | 8 | | 7 | |
| | | Copper | mg/Kg | 17.7 | 313 | nc | 22 | | 24 | | 18 | | 19 | | 12 | | 12 | | 19 | | 31 | H |
| | | Iron | mg/Kg | 23100 | 2346 | nc | **19000** | H | **31000** | H | **17000** | H | **18000** | H | **23000** | | **19000** | | **27000** | H | **16000** | |
| | | Magnesium | mg/Kg | 3030 | -- | 0 | 2000 | | 3500 | | 3300 | | 3500 | | 1800 | | 2000 | | 2600 | | 1800 | |
| | | Manganese | mg/Kg | 1450 | 176 | nc | **410** | | **180** | | **790** | | **1100** | | **690** | | **920** | | **210** | | **460** | |
| | | Nickel | mg/Kg | 21.1 | 156 | nc | 16 | | 23 | | 15 | | 17 | | 14 | | 16 | | 17 | | 14 | |
| | | Potassium | mg/Kg | 927 | -- | 0 | 620 | | 1500 | | 970 | | 1000 | | 660 | | 700 | | 1000 | | 660 | |
| | | Selenium | mg/Kg | 1.4 | 39 | nc | 0.42 | B | 0.56 | B | 0.67 | B | 0.66 | B | 0.45 | U | 0.45 | U | 0.43 | B | 0.52 | B |
| | | Silver | mg/Kg | 0.00 | 39 | nc | 0.32 | U | 0.36 | U | 0.32 | U | 0.31 | U | 0.35 | U | 0.35 | U | 0.33 | U | 0.33 | U |
| | | Sodium | mg/Kg | 123 | -- | 0 | 90 | U | 100 | U | 100 | | 170 | | 97 | U | 98 | U | 93 | U | 92 | U |
| | | Vanadium | mg/Kg | 31.1 | 7.8 | nc | **13** | | **28** | | **13** | | **12** | | **21** | | **19** | | **22** | | **14** | |
| | | Zinc | mg/Kg | 61.8 | 2346 | nc | 72 | | 64 | | 72 | | 70 | | 52 | | 69 | | 51 | | 85 | |
| | 7041 | Antimony | mg/Kg | 0.96 | 3.1 | nc | 0.46 | U | 0.7 | B | 0.45 | U | 0.49 | U | 0.46 | U | 0.54 | B | 0.52 | U | 0.48 | U |
| | 7060A | Arsenic | mg/Kg | 15.4 | 0.39 | ca | **15** | | **24** | | **14** | | **11** | | **11** | | **10** | | **17** | | **13** | |
| | 7421 | Lead | mg/Kg | 26.1 | 400 | pbk | 43 | | 18 | | 35 | | 38 | | 16 | | 40 | | 20 | | 33 | |
| | 7471A | Mercury | mg/Kg | 0.04 | 2.3 | nc | 0.044 | | 0.061 | | 0.11 | | 0.096 | | 0.037 | | 0.09 | | 0.36 | | 0.74 | |
| | 7841 | Thallium | mg/Kg | 0.00 | 0.52 | nc | 0.2 | U | 0.23 | U | 0.2 | U | 0.21 | U | 1 | U | 0.22 | U | 0.23 | U | 0.21 | U |

# Table 4-3
## Summary of Surface Soil Results (0-1 ft bgs)

| | | | | | | | LL9SS-014-0001-SO | | LL9SS-015-0001-SO | | LL9SS-016-0001-DU | | LL9SS-016-0001-SO | | LL9SS-017-0001-SO | | LL9SS-018-0001-SO | | LL9SS-019-0001-SO | | LL9SS-020-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/11/03 | | 12/11/03 | | 12/11/03 | | 12/11/03 | | 12/04/03 | | 12/10/03 | | 12/11/03 | | 12/08/03 | |
| | | | | | | **Sample Depth** | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Surface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SS PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| VOCs TCL 8260B | 8260B | 1,1,1-Trichloroethane | mg/Kg | -- | 1200 | sat | 0.0012 | U | | | | | | | | | | | 0.0014 | U | | |
| | | 1,1,2,2-Tetrachloroethane | mg/Kg | -- | 0.41 | ca | 0.0011 | U | | | | | | | | | | | 0.0012 | U | | |
| | | 1,1,2-Trichloroethane | mg/Kg | -- | 0.73 | ca | 0.0012 | U | | | | | | | | | | | 0.0014 | U | | |
| | | 1,1-Dichloroethane | mg/Kg | -- | 51 | nc | 0.0011 | U | | | | | | | | | | | 0.0012 | U | | |
| | | 1,1-Dichloroethene | mg/Kg | -- | 12 | nc | 0.0015 | U | | | | | | | | | | | 0.0016 | U | | |
| | | 1,2-Dichloroethane | mg/Kg | -- | 0.28 | ca | 0.0011 | U | | | | | | | | | | | 0.0012 | U | | |
| | | 1,2-Dichloroethene (total) | mg/Kg | -- | 6.9 | nc | 0.0023 | U | | | | | | | | | | | 0.0026 | U | | |
| | | 1,2-Dichloropropane | mg/Kg | -- | 0.34 | ca | 0.0011 | U | | | | | | | | | | | 0.0012 | U | | |
| | | 2-Butanone (MEK) | mg/Kg | -- | 2231 | nc | 0.0044 | U | | | | | | | | | | | 0.0049 | U | | |
| | | 2-Hexanone | mg/Kg | -- | 530 | nc | 0.0012 | U | | | | | | | | | | | 0.0014 | U | | |
| | | 4-Methyl-2-pentanone (MIBK) | mg/Kg | -- | 528 | nc | 0.0011 | U | | | | | | | | | | | 0.0012 | U | | |
| | | Acetone | mg/Kg | -- | 1412 | nc | 0.0051 | U | | | | | | | | | | | 0.0058 | U | | |
| | | Benzene | mg/Kg | -- | 0.64 | ca | 0.0012 | U | | | | | | | | | | | 0.0014 | U | | |
| | | Bromodichloromethane | mg/Kg | -- | 0.82 | ca | 0.0011 | U | | | | | | | | | | | 0.0012 | U | | |
| | | Bromoform | mg/Kg | -- | 62 | ca | 0.00084 | U | | | | | | | | | | | 0.00094 | U | | |
| | | Bromomethane | mg/Kg | -- | 0.39 | nc | 0.0015 | U* | | | | | | | | | | | 0.0016 | U* | | |
| | | Carbon disulfide | mg/Kg | -- | 36 | nc | 0.0013 | U | | | | | | | | | | | 0.0015 | U | | |
| | | Carbon tetrachloride | mg/Kg | -- | 0.25 | ca | 0.0012 | UM | | | | | | | | | | | 0.0014 | U | | |
| | | Chlorobenzene | mg/Kg | -- | 15 | nc | 0.0012 | U | | | | | | | | | | | 0.0014 | U | | |
| | | Chloroethane | mg/Kg | -- | 3.0 | ca | 0.0011 | U | | | | | | | | | | | 0.0012 | U | | |
| | | Chloroform | mg/Kg | -- | 0.22 | ca | 0.0012 | U | | | | | | | | | | | 0.0014 | U | | |
| | | Chloromethane | mg/Kg | -- | 4.7 | nc | 0.0012 | U | | | | | | | | | | | 0.0014 | U | | |
| | | cis-1,3-Dichloropropene | mg/Kg | -- | 0.78 | ca | 0.001 | U | | | | | | | | | | | 0.0012 | U | | |
| | | Dibromochloromethane | mg/Kg | -- | 1.1 | ca | 0.00088 | U | | | | | | | | | | | 0.00099 | U | | |
| | | Ethylbenzene | mg/Kg | -- | 395 | sat | 0.0012 | U | | | | | | | | | | | 0.0014 | U | | |
| | | Methylene chloride | mg/Kg | -- | 9.1 | ca | 0.0032 | U | | | | | | | | | | | 0.0036 | U | | |
| | | Styrene | mg/Kg | -- | 1700 | sat | 0.0012 | U | | | | | | | | | | | 0.0014 | U | | |
| | | Tetrachloroethene | mg/Kg | -- | 0.48 | ca | 0.0013 | U | | | | | | | | | | | 0.0015 | U | | |
| | | Toluene | mg/Kg | -- | 520 | sat | 0.0012 | U | | | | | | | | | | | 0.0014 | U | | |
| | | trans-1,3-Dichloropropene | mg/Kg | -- | 0.78 | ca | 0.00088 | U | | | | | | | | | | | 0.00099 | U | | |
| | | Trichloroethene | mg/Kg | -- | 0.053 | ca | 0.0012 | U | | | | | | | | | | | 0.0014 | U | | |
| | | Vinyl chloride | mg/Kg | -- | 0.079 | ca | 0.0012 | U | | | | | | | | | | | 0.0014 | U | | |
| | | Xylenes (total) | mg/Kg | -- | 0.079 | ca | 0.0038 | U | | | | | | | | | | | 0.0042 | U | | |

## Table 4-3
## Summary of Surface Soil Results (0-1 ft bgs)

| | | | | | | | LL9SS-021-0001-SO | | LL9SS-022-0001-DU | | LL9SS-022-0001-SO | | LL9SS-023-0001-SO | | LL9SS-024-0001-SO | | LL9SS-025-0001-SO | | LL9SS-026-0001-SO | | LL9SS-027-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/08/03 | | 12/10/03 | | 12/10/03 | | 12/08/03 | | 12/10/03 | | 12/10/03 | | 12/10/03 | | 12/04/03 | |
| | | | | | | **Sample Depth** | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Surface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SS PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| Cyanide 9012A | 9014/9010B | Cyanide, Total | mg/Kg | 0.00 | 122 | nc | | | | | | | | | | | 0.24 | U | | | | |
| Explosives 8330 | 8330 | 1,3,5-Trinitrobenzene | mg/Kg | 0 | 183 | nc | | | | | | | | | | | 0.017 | U | | | | |
| | | 1,3-Dinitrobenzene | mg/Kg | 0 | 0.61 | nc | | | | | | | | | | | 0.018 | U | | | | |
| | | 2,4,6-TNT | mg/Kg | 0 | 16 | ca | | | | | | | | | | | 0.033 | U | | | | |
| | | 2,4-Dinitrotoluene | mg/Kg | 0 | 12 | nc | | | | | | | | | | | 0.035 | U | | | | |
| | | 2,6-Dinitrotoluene | mg/Kg | 0 | 6.1 | nc | | | | | | | | | | | 0.047 | U | | | | |
| | | 2-Nitrotoluene | mg/Kg | 0 | 0.88 | ca | | | | | | | | | | | 0.033 | U | | | | |
| | | 3-Nitrotoluene | mg/Kg | 0 | 73 | nc | | | | | | | | | | | 0.049 | U | | | | |
| | | 4-Nitrotoluene | mg/Kg | 0 | 12 | ca | | | | | | | | | | | 0.046 | U | | | | |
| | | HMX | mg/Kg | 0 | 306 | nc | | | | | | | | | | | 0.11 | U | | | | |
| | | Nitrobenzene | mg/Kg | 0 | 2 | nc | | | | | | | | | | | 0.022 | U | | | | |
| | | RDX | mg/Kg | 0 | 4.4 | ca | | | | | | | | | | | 0.058 | U | | | | |
| | | Tetryl | mg/Kg | 0 | 61 | nc | | | | | | | | | | | 0.043 | U | | | | |
| PCB TCL 8082 | 8082 | Aroclor 1016 | mg/Kg | -- | 0.39 | nc | | | | | | | | | | | 0.0024 | U | | | | |
| | | Aroclor 1221 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | 0.0025 | U | | | | |
| | | Aroclor 1232 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | 0.0025 | U | | | | |
| | | Aroclor 1242 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | 0.0025 | U | | | | |
| | | Aroclor 1248 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | 0.0025 | U | | | | |
| | | Aroclor 1254 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | 0.0025 | U | | | | |
| | | Aroclor 1260 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | 0.0017 | U | | | | |
| Pesticides 8081A | 8081A | 4,4'-DDD | mg/Kg | -- | 2.4 | ca | | | | | | | | | | | 0.0022 | U | | | | |
| | | 4,4'-DDE | mg/Kg | -- | 1.7 | ca | | | | | | | | | | | 0.0041 | U | | | | |
| | | 4,4'-DDT | mg/Kg | -- | 1.7 | ca | | | | | | | | | | | 0.0023 | U | | | | |
| | | Aldrin | mg/Kg | -- | 0.029 | ca | | | | | | | | | | | 0.00081 | U | | | | |
| | | alpha-BHC | mg/Kg | -- | 0.09 | sat | | | | | | | | | | | 0.001 | U | | | | |
| | | alpha-Chlordane | mg/Kg | -- | 1.6 | ca | | | | | | | | | | | 0.00075 | U | | | | |
| | | beta-BHC | mg/Kg | -- | 0.32 | ca | | | | | | | | | | | 0.00094 | U | | | | |
| | | delta-BHC | mg/Kg | -- | -- | 0 | | | | | | | | | | | 0.00069 | U | | | | |
| | | Dieldrin | mg/Kg | -- | 0.030 | ca | | | | | | | | | | | 0.0021 | U | | | | |
| | | Endosulfan I | mg/Kg | -- | 37 | nc | | | | | | | | | | | 0.0017 | U | | | | |
| | | Endosulfan II | mg/Kg | -- | 37 | nc | | | | | | | | | | | 0.0017 | U | | | | |
| | | Endosulfan sulfate | mg/Kg | -- | 37 | nc | | | | | | | | | | | 0.0018 | U | | | | |
| | | Endrin | mg/Kg | -- | 1.8 | nc | | | | | | | | | | | 0.0027 | U | | | | |
| | | Endrin aldehyde | mg/Kg | -- | -- | 0 | | | | | | | | | | | 0.0021 | U | | | | |
| | | Endrin ketone | mg/Kg | -- | -- | 0 | | | | | | | | | | | 0.0018 | U | | | | |
| | | gamma-BHC (Lindane) | mg/Kg | -- | 0.44 | ca | | | | | | | | | | | 0.0014 | U | | | | |
| | | gamma-Chlordane | mg/Kg | -- | 1.6 | ca | | | | | | | | | | | 0.00094 | U | | | | |
| | | Heptachlor | mg/Kg | -- | 0.11 | ca | | | | | | | | | | | 0.0011 | U | | | | |
| | | Heptachlor epoxide | mg/Kg | -- | 0.053 | ca | | | | | | | | | | | 0.00087 | U | | | | |
| | | Methoxychlor | mg/Kg | -- | 31 | nc | | | | | | | | | | | 0.014 | U | | | | |
| | | Toxaphene | mg/Kg | -- | 0 | 0 | | | | | | | | | | | 0.029 | U | | | | |

# Table 4-3
## Summary of Surface Soil Results (0-1 ft bgs)

| | | | | | | | LL9SS-021-0001-SO | | LL9SS-022-0001-DU | | LL9SS-022-0001-SO | | LL9SS-023-0001-SO | | LL9SS-024-0001-SO | | LL9SS-025-0001-SO | | LL9SS-026-0001-SO | | LL9SS-027-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/08/03 | | 12/10/03 | | 12/10/03 | | 12/08/03 | | 12/10/03 | | 12/10/03 | | 12/10/03 | | 12/04/03 | |
| | | | | | | **Sample Depth** | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Surface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SS PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| Propellants 8330 | 353.2 | Nitrocellulose | mg/Kg | 0 | -- | 0 | | | | | | | | | | | 1.6 | B J | | | | |
| | 8330 | Nitroglycerin | mg/Kg | 0 | -- | 0 | | | | | | | | | | | 0.5 | U | | | | |
| | UV/HPLC per SOP | Nitroguanidine | mg/Kg | 0 | 611 | nc | | | | | | | | | | | 0.25 | U | | | | |
| SVOCs TCL 8270 C | 8270C | 1,2,4-Trichlorobenzene | mg/Kg | -- | 6.2 | nc | | | | | | | | | | | 0.073 | U | | | | |
| | | 1,2-Dichlorobenzene | mg/Kg | -- | 600 | sat | | | | | | | | | | | 0.097 | U | | | | |
| | | 1,3-Dichlorobenzene | mg/Kg | -- | 53 | nc | | | | | | | | | | | 0.097 | U | | | | |
| | | 1,4-Dichlorobenzene | mg/Kg | -- | 3.4 | ca | | | | | | | | | | | 0.087 | U | | | | |
| | | 2,2-oxybis (1-chloropropane) | mg/Kg | -- | 2.9 | ca | | | | | | | | | | | 0.092 | U | | | | |
| | | 2,4,5-Trichlorophenol | mg/Kg | -- | 611 | nc | | | | | | | | | | | 0.047 | U | | | | |
| | | 2,4,6-Trichlorophenol | mg/Kg | -- | 0.61 | nc | | | | | | | | | | | 0.058 | U | | | | |
| | | 2,4-Dichlorophenol | mg/Kg | -- | 18 | nc | | | | | | | | | | | 0.059 | U | | | | |
| | | 2,4-Dimethylphenol | mg/Kg | -- | 122 | nc | | | | | | | | | | | 0.074 | U | | | | |
| | | 2,4-Dinitrophenol | mg/Kg | -- | 12 | nc | | | | | | | | | | | 0.14 | U | | | | |
| | | 2-Chloronaphthalene | mg/Kg | -- | 494 | nc | | | | | | | | | | | 0.059 | U | | | | |
| | | 2-Chlorophenol | mg/Kg | -- | 6.3 | nc | | | | | | | | | | | 0.073 | U | | | | |
| | | 2-Methylnaphthalene | mg/Kg | -- | -- | 0 | | | | | | | | | | | 0.0018 | U | | | | |
| | | 2-Methylphenol (o-cresol) | mg/Kg | -- | 306 | nc | | | | | | | | | | | 0.01 | U | | | | |
| | | 2-Nitroaniline | mg/Kg | -- | 18.3 | nc | | | | | | | | | | | 0.042 | U | | | | |
| | | 2-Nitrophenol | mg/Kg | -- | -- | 0 | | | | | | | | | | | 0.077 | U | | | | |
| | | 3,3-Dichlorobenzidine | mg/Kg | -- | 1.1 | ca | | | | | | | | | | | 0.022 | U | | | | |
| | | 3-Nitroaniline | mg/Kg | -- | 1.8 | nc | | | | | | | | | | | 0.14 | U | | | | |
| | | 4,6-Dinitro-2-methylphenol | mg/Kg | -- | 0.61 | nc | | | | | | | | | | | 0.12 | U | | | | |
| | | 4-Bromophenyl phenyl ether | mg/Kg | -- | -- | 0 | | | | | | | | | | | 0.0038 | U | | | | |
| | | 4-Chloro-3-methylphenol | mg/Kg | -- | -- | 0 | | | | | | | | | | | 0.047 | U | | | | |
| | | 4-Chloroaniline | mg/Kg | -- | 24 | nc | | | | | | | | | | | 0.12 | U | | | | |
| | | 4-Chlorophenyl phenyl ether | mg/Kg | -- | -- | 0 | | | | | | | | | | | 0.0044 | U | | | | |
| | | 4-Methylphenol (m/p-cresol) | mg/Kg | -- | 31 | nc | | | | | | | | | | | 0.0071 | U | | | | |
| | | 4-Nitroaniline | mg/Kg | -- | 23 | ca | | | | | | | | | | | 0.048 | U | | | | |
| | | 4-Nitrophenol | mg/Kg | -- | -- | 0 | | | | | | | | | | | 0.1 | U | | | | |
| | | Acenaphthene | mg/Kg | -- | 368 | nc | | | | | | | | | | | 0.0017 | U | | | | |
| | | Acenaphthylene | mg/Kg | -- | -- | 0 | | | | | | | | | | | 0.0011 | U | | | | |
| | | Anthracene | mg/Kg | -- | 2189 | nc | | | | | | | | | | | 0.0011 | U | | | | |
| | | Benzo(a)anthracene | mg/Kg | -- | 0.62 | ca | | | | | | | | | | | 0.012 | Ja | | | | |
| | | Benzo(a)pyrene | mg/Kg | -- | 0.062 | ca | | | | | | | | | | | 0.012 | Ja | | | | |
| | | Benzo(b)fluoranthene | mg/Kg | -- | 0.62 | ca | | | | | | | | | | | 0.011 | Ja | | | | |
| | | Benzo(ghi)perylene | mg/Kg | -- | -- | 0 | | | | | | | | | | | 0.011 | Ja | | | | |
| | | Benzo(k)fluoranthene | mg/Kg | -- | 6.2 | ca | | | | | | | | | | | 0.01 | Ja | | | | |
| | | Bis(2-chloroethoxy)methane | mg/Kg | -- | -- | 0 | | | | | | | | | | | 0.0036 | U | | | | |
| | | Bis(2-chloroethyl)ether | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | 0.0025 | U | | | | |
| | | Bis(2-ethylhexyl)phthalate | mg/Kg | -- | 35 | ca | | | | | | | | | | | 0.012 | U | | | | |
| | | Butyl benzyl phthalate | mg/Kg | -- | 1222 | nc | | | | | | | | | | | 0.005 | U | | | | |
| | | Carbazole | mg/Kg | -- | 24 | ca | | | | | | | | | | | 0.043 | U | | | | |
| | | Chrysene | mg/Kg | -- | 62 | ca | | | | | | | | | | | 0.012 | Ja | | | | |
| | | Dibenzo(a,h)anthracene | mg/Kg | -- | 0.062 | ca | | | | | | | | | | | 0.03 | Ja | | | | |

## Table 4-3
## Summary of Surface Soil Results (0-1 ft bgs)

| | | | | | | | LL9SS-021-0001-SO | | LL9SS-022-0001-DUP | | LL9SS-022-0001-SO | | LL9SS-023-0001-SO | | LL9SS-024-0001-SO | | LL9SS-025-0001-SO | | LL9SS-026-0001-SO | | LL9SS-027-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/08/03 | | 12/10/03 | | 12/10/03 | | 12/08/03 | | 12/10/03 | | 12/10/03 | | 12/10/03 | | 12/04/03 | |
| | | | | | | **Sample Depth** | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Surface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SS PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| | | Dibenzofuran | mg/Kg | -- | 15 | nc | | | | | | | | | | | 0.0033 | U | | | | |
| | | Diethyl phthalate | mg/Kg | -- | 4888 | nc | | | | | | | | | | | 0.0046 | U | | | | |
| | | Dimethyl phthalate | mg/Kg | -- | 100000 | max | | | | | | | | | | | 0.0044 | U | | | | |
| | | Di-n-butyl phthalate | mg/Kg | -- | 611 | nc | | | | | | | | | | | 0.025 | U | | | | |
| | | Di-n-octyl phthalate | mg/Kg | -- | 244 | nc | | | | | | | | | | | 0.011 | U | | | | |
| | | Fluoranthene | mg/Kg | -- | 229 | nc | | | | | | | | | | | 0.019 | Ja | | | | |
| | | Fluorene | mg/Kg | -- | 275 | nc | | | | | | | | | | | 0.002 | U | | | | |
| | | Hexachlorobenzene | mg/Kg | -- | 0.30 | ca | | | | | | | | | | | 0.0022 | U | | | | |
| | | Hexachlorobutadiene | mg/Kg | -- | 6.2 | ca | | | | | | | | | | | 0.0041 | U | | | | |
| | | Hexachlorocyclopentadiene | mg/Kg | -- | 37 | nc | | | | | | | | | | | 0.066 | U | | | | |
| | | Hexachloroethane | mg/Kg | -- | 35 | ca | | | | | | | | | | | 0.0041 | U | | | | |
| | | Indeno(1,2,3-cd)pyrene | mg/Kg | -- | 0.62 | ca | | | | | | | | | | | 0.024 | Ja | | | | |
| | | Isophorone | mg/Kg | -- | 512 | ca | | | | | | | | | | | 0.003 | U | | | | |
| | | Naphthalene | mg/Kg | -- | 5.6 | nc | | | | | | | | | | | 0.0021 | U | | | | |
| | | n-Nitroso-di-n-propylamine | mg/Kg | -- | 0.069 | ca | | | | | | | | | | | 0.0028 | U | | | | |
| | | n-Nitrosodiphenylamine | mg/Kg | -- | 99 | ca | | | | | | | | | | | 0.0036 | U | | | | |
| | | Pentachlorophenol | mg/Kg | -- | 3.0 | ca | | | | | | | | | | | 0.12 | U | | | | |
| | | Phenanthrene | mg/Kg | -- | -- | 0 | | | | | | | | | | | 0.01 | Ja | | | | |
| | | Phenol | mg/Kg | -- | 1833 | nc | | | | | | | | | | | 0.002 | U | | | | |
| | | Pyrene | mg/Kg | -- | 232 | nc | | | | | | | | | | | 0.019 | Ja | | | | |
| TAL Metals 6010B | 6010B | Aluminum | mg/Kg | 17700 | 7614 | nc | **13000** | | **9600** | | **8800** | | **20000** | | **8000** | | **12000** | | **13000** | | **10000** | |
| | | Barium | mg/Kg | 88.4 | 538 | nc | 55 | | 55 | | 38 | | 66 | | 49 | | 57 | | 100 | | 81 | |
| | | Beryllium | mg/Kg | 0.88 | 15 | nc | 0.37 | B | 0.49 | | 0.36 | B | 0.43 | B | 0.31 | B | 0.35 | B | 0.6 | | 0.84 | |
| | | Cadmium | mg/Kg | 0.00 | 3.7 | nc | 0.5 | | 0.09 | U | 0.086 | U | 0.11 | B | 0.42 | | 0.096 | U | 0.095 | U | 0.1 | U |
| | | Calcium | mg/Kg | 15800 | -- | 0 | 2700 | | 4300 | | 1300 | | 5300 | | 1100 | | 1100 | | 1200 | | 430 | |
| | | Chromium | mg/Kg | 17.4 | 30 | ca | 18 | | 12 | | 12 | | 21 | | **110** | | 16 | | 17 | | 11 | |
| | | Cobalt | mg/Kg | 10.4 | 902 | ca | 6 | | 6.9 | | 8.6 | | 6.5 | | 6.6 | | 8 | | 11 | | 18 | |
| | | Copper | mg/Kg | 17.7 | 313 | nc | 19 | H | 21 | | 17 | | 23 | H | 13 | | 9.9 | | 12 | | 7.1 | |
| | | Iron | mg/Kg | 23100 | 2346 | nc | **27000** | | **22000** | | **20000** | | **26000** | | **14000** | | **24000** | | **23000** | | **25000** | |
| | | Magnesium | mg/Kg | 3030 | -- | 0 | 2200 | | 2300 | | 1900 | | 3200 | | 1500 | | 2300 | | 2300 | | 1300 | |
| | | Manganese | mg/Kg | 1450 | 176 | nc | **260** | | **480** | | 150 | | **230** | | **500** | | **420** | | **860** | | **3800** | |
| | | Nickel | mg/Kg | 21.1 | 156 | nc | 13 | | 15 | | 15 | | 16 | | 9.9 | | 12 | | 16 | | 12 | |
| | | Potassium | mg/Kg | 927 | -- | 0 | 1000 | | 750 | | 750 | | 1500 | | 560 | | 790 | | 860 | | 540 | |
| | | Selenium | mg/Kg | 1.4 | 39 | nc | 0.44 | U | 0.45 | U | 0.43 | U | 0.89 | B | 0.5 | U | 0.48 | U | 0.48 | U | 0.71 | B |
| | | Silver | mg/Kg | 0.00 | 39 | nc | 0.34 | U | 0.35 | U | 0.33 | U | 0.38 | U | 0.39 | U | 0.37 | U | 0.37 | U | 0.39 | U |
| | | Sodium | mg/Kg | 123 | -- | 0 | 94 | U | 98 | U | 93 | U | 110 | U | 110 | U | 100 | U | 100 | U | 110 | U |
| | | Vanadium | mg/Kg | 31.1 | 7.8 | nc | **22** | | **15** | | **15** | | **28** | | **15** | | **23** | | **23** | | **23** | |
| | | Zinc | mg/Kg | 61.8 | 2346 | nc | 72 | | 69 | | 48 | | 57 | | 210 | | 46 | | 71 | | 47 | |
| | 7041 | Antimony | mg/Kg | 0.96 | 3.1 | nc | 0.5 | U | 0.52 | U | 0.49 | U | 0.55 | U | 0.85 | | 0.54 | U | 1.2 | | 0.55 | U |
| | 7060A | Arsenic | mg/Kg | 15.4 | 0.39 | ca | **16** | | **12** | | **13** | | **21** | | **10** | | **8.4** | | **8.3** | | **11** | |
| | 7421 | Lead | mg/Kg | 26.1 | 400 | pbk | 35 | | 48 | | 20 | | 50 | | 320 | | 25 | | 28 | | 16 | |
| | 7471A | Mercury | mg/Kg | 0.04 | 2.3 | nc | 0.045 | | 0.2 | | 0.11 | | 0.25 | | 0.057 | | 0.032 | | 0.045 | | 0.041 | |
| | 7841 | Thallium | mg/Kg | 0.00 | 0.52 | nc | 0.22 | U | 0.23 | U | 0.21 | U | 0.24 | U | 0.23 | U | 0.23 | U | 0.23 | U | 0.24 | U |

## Table 4-3
## Summary of Surface Soil Results (0-1 ft bgs)

| | | | | | | | LL9SS-021-0001-SO | | LL9SS-022-0001-DU | | LL9SS-022-0001-SO | | LL9SS-023-0001-SO | | LL9SS-024-0001-SO | | LL9SS-025-0001-SO | | LL9SS-026-0001-SO | | LL9SS-027-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/08/03 | | 12/10/03 | | 12/10/03 | | 12/08/03 | | 12/10/03 | | 12/10/03 | | 12/10/03 | | 12/04/03 | |
| | | | | | | **Sample Depth** | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Surface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SS PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| VOCs TCL 8260B | 8260B | 1,1,1-Trichloroethane | mg/Kg | -- | 1200 | sat | | | | | | | | | | | 0.0014 | U | | | | |
| | | 1,1,2,2-Tetrachloroethane | mg/Kg | -- | 0.41 | ca | | | | | | | | | | | 0.0012 | U | | | | |
| | | 1,1,2-Trichloroethane | mg/Kg | -- | 0.73 | ca | | | | | | | | | | | 0.0014 | U | | | | |
| | | 1,1-Dichloroethane | mg/Kg | -- | 51 | nc | | | | | | | | | | | 0.0013 | U | | | | |
| | | 1,1-Dichloroethene | mg/Kg | -- | 12 | nc | | | | | | | | | | | 0.0016 | U | | | | |
| | | 1,2-Dichloroethane | mg/Kg | -- | 0.28 | ca | | | | | | | | | | | 0.0012 | U | | | | |
| | | 1,2-Dichloroethene (total) | mg/Kg | -- | 6.9 | nc | | | | | | | | | | | 0.0026 | U | | | | |
| | | 1,2-Dichloropropane | mg/Kg | -- | 0.34 | ca | | | | | | | | | | | 0.0013 | U | | | | |
| | | 2-Butanone (MEK) | mg/Kg | -- | 2231 | nc | | | | | | | | | | | 0.0049 | U | | | | |
| | | 2-Hexanone | mg/Kg | -- | 530 | nc | | | | | | | | | | | 0.0014 | U | | | | |
| | | 4-Methyl-2-pentanone (MIBK) | mg/Kg | -- | 528 | nc | | | | | | | | | | | 0.0013 | U | | | | |
| | | Acetone | mg/Kg | -- | 1412 | nc | | | | | | | | | | | 0.0058 | U | | | | |
| | | Benzene | mg/Kg | -- | 0.64 | ca | | | | | | | | | | | 0.0014 | U | | | | |
| | | Bromodichloromethane | mg/Kg | -- | 0.82 | ca | | | | | | | | | | | 0.0012 | U | | | | |
| | | Bromoform | mg/Kg | -- | 62 | ca | | | | | | | | | | | 0.00094 | U | | | | |
| | | Bromomethane | mg/Kg | -- | 0.39 | nc | | | | | | | | | | | 0.0016 | U | | | | |
| | | Carbon disulfide | mg/Kg | -- | 36 | nc | | | | | | | | | | | 0.0015 | U | | | | |
| | | Carbon tetrachloride | mg/Kg | -- | 0.25 | ca | | | | | | | | | | | 0.0014 | U | | | | |
| | | Chlorobenzene | mg/Kg | -- | 15 | nc | | | | | | | | | | | 0.0014 | U | | | | |
| | | Chloroethane | mg/Kg | -- | 3.0 | ca | | | | | | | | | | | 0.0013 | U | | | | |
| | | Chloroform | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | 0.0014 | U | | | | |
| | | Chloromethane | mg/Kg | -- | 4.7 | nc | | | | | | | | | | | 0.0014 | U | | | | |
| | | cis-1,3-Dichloropropene | mg/Kg | -- | 0.78 | ca | | | | | | | | | | | 0.0012 | U | | | | |
| | | Dibromochloromethane | mg/Kg | -- | 1.1 | ca | | | | | | | | | | | 0.00099 | U | | | | |
| | | Ethylbenzene | mg/Kg | -- | 395 | sat | | | | | | | | | | | 0.0014 | U | | | | |
| | | Methylene chloride | mg/Kg | -- | 9.1 | ca | | | | | | | | | | | 0.0036 | U | | | | |
| | | Styrene | mg/Kg | -- | 1700 | sat | | | | | | | | | | | 0.0014 | U | | | | |
| | | Tetrachloroethene | mg/Kg | -- | 0.48 | ca | | | | | | | | | | | 0.0015 | U | | | | |
| | | Toluene | mg/Kg | -- | 520 | sat | | | | | | | | | | | 0.0014 | U | | | | |
| | | trans-1,3-Dichloropropene | mg/Kg | -- | 0.78 | ca | | | | | | | | | | | 0.00099 | U | | | | |
| | | Trichloroethene | mg/Kg | -- | 0.053 | ca | | | | | | | | | | | 0.0014 | U | | | | |
| | | Vinyl chloride | mg/Kg | -- | 0.079 | ca | | | | | | | | | | | 0.0014 | U | | | | |
| | | Xylenes (total) | mg/Kg | -- | 0.079 | ca | | | | | | | | | | | 0.0043 | U | | | | |

## Table 4-3
## Summary of Surface Soil Results (0-1 ft bgs)

| | | | | | | | LL9SS-028-0001-DUP | | LL9SS-028-0001-SO | | LL9SS-029-0001-SO | | LL9SS-030-0001-SO | | LL9SS-031-0001-SO | | LL9SS-032-0001-SO | | LL9SS-033-0001-SO | | LL9SS-034-0001-DUP | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 11/11/03 | | 11/11/03 | |
| | | | | | | **Sample Depth** | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Surface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SS PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| Cyanide 9012A | 9014/9010B | Cyanide, Total | mg/Kg | 0.00 | 122 | nc | | | | | | | | | | | | | 0.16 | U | 0.17 | U |
| Explosives 8330 | 8330 | 1,3,5-Trinitrobenzene | mg/Kg | 0 | 183 | nc | | | | | | | | | | | | | 0.017 | U | 0.017 | U |
| | | 1,3-Dinitrobenzene | mg/Kg | 0 | 0.61 | nc | | | | | | | | | | | | | 0.018 | U | 0.018 | U |
| | | 2,4,6-TNT | mg/Kg | 0 | 16 | ca | | | | | | | | | | | | | 0.034 | U | 0.034 | U |
| | | 2,4-Dinitrotoluene | mg/Kg | 0 | 12 | nc | | | | | | | | | | | | | 0.035 | U | 0.035 | U |
| | | 2,6-Dinitrotoluene | mg/Kg | 0 | 6.1 | nc | | | | | | | | | | | | | 0.047 | U* | 0.047 | U* |
| | | 2-Nitrotoluene | mg/Kg | 0 | 0.88 | ca | | | | | | | | | | | | | 0.033 | U | 0.033 | U |
| | | 3-Nitrotoluene | mg/Kg | 0 | 73 | nc | | | | | | | | | | | | | 0.05 | U | 0.05 | U |
| | | 4-Nitrotoluene | mg/Kg | 0 | 12 | ca | | | | | | | | | | | | | 0.046 | U | 0.046 | U |
| | | HMX | mg/Kg | 0 | 306 | nc | | | | | | | | | | | | | 0.11 | U | 0.11 | U |
| | | Nitrobenzene | mg/Kg | 0 | 2 | nc | | | | | | | | | | | | | 0.022 | U | 0.022 | U |
| | | RDX | mg/Kg | 0 | 4.4 | ca | | | | | | | | | | | | | 0.058 | U | 0.058 | U |
| | | Tetryl | mg/Kg | 0 | 61 | nc | | | | | | | | | | | | | 0.043 | U | 0.043 | U |
| PCB TCL 8082 | 8082 | Aroclor 1016 | mg/Kg | -- | 0.39 | nc | | | | | | | | | | | | | 0.0026 | U | 0.0023 | U |
| | | Aroclor 1221 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | 0.0027 | U | 0.0024 | U |
| | | Aroclor 1232 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | 0.0027 | U | 0.0024 | U |
| | | Aroclor 1242 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | 0.0027 | U | 0.0024 | U |
| | | Aroclor 1248 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | 0.0027 | U | 0.0024 | U |
| | | Aroclor 1254 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | 0.0027 | U | 0.0024 | U |
| | | Aroclor 1260 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | 0.0019 | U | 0.0017 | U |
| Pesticides 8081A | 8081A | 4,4'-DDD | mg/Kg | -- | 2.4 | ca | | | | | | | | | | | | | 0.00049 | U | 0.00043 | U |
| | | 4,4'-DDE | mg/Kg | -- | 1.7 | ca | | | | | | | | | | | | | 0.00089 | U | 0.00077 | U |
| | | 4,4'-DDT | mg/Kg | -- | 1.7 | ca | | | | | | | | | | | | | 0.00051 | U | 0.00044 | U |
| | | Aldrin | mg/Kg | -- | 0.029 | ca | | | | | | | | | | | | | 0.00018 | U | 0.00015 | U |
| | | alpha-BHC | mg/Kg | -- | 0.09 | sat | | | | | | | | | | | | | 0.00022 | U | 0.00019 | U |
| | | alpha-Chlordane | mg/Kg | -- | 1.6 | ca | | | | | | | | | | | | | 0.00016 | U | 0.00014 | U |
| | | beta-BHC | mg/Kg | -- | 0.32 | ca | | | | | | | | | | | | | 0.00021 | U | 0.00018 | U |
| | | delta-BHC | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | 0.00015 | U | 0.00013 | U |
| | | Dieldrin | mg/Kg | -- | 0.030 | ca | | | | | | | | | | | | | 0.00047 | U | 0.0004 | U |
| | | Endosulfan I | mg/Kg | -- | 37 | nc | | | | | | | | | | | | | 0.00037 | U | 0.00032 | U |
| | | Endosulfan II | mg/Kg | -- | 37 | nc | | | | | | | | | | | | | 0.00038 | U | 0.00033 | U |
| | | Endosulfan sulfate | mg/Kg | -- | 37 | nc | | | | | | | | | | | | | 0.0004 | U | 0.00035 | U |
| | | Endrin | mg/Kg | -- | 1.8 | nc | | | | | | | | | | | | | 0.00059 | U | 0.00051 | U |
| | | Endrin aldehyde | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | 0.00045 | U | 0.00039 | U |
| | | Endrin ketone | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | 0.0004 | U | 0.00035 | U |
| | | gamma-BHC (Lindane) | mg/Kg | -- | 0.44 | ca | | | | | | | | | | | | | 0.00032 | U | 0.00027 | U |
| | | gamma-Chlordane | mg/Kg | -- | 1.6 | ca | | | | | | | | | | | | | 0.00021 | U | 0.00018 | U |
| | | Heptachlor | mg/Kg | -- | 0.11 | ca | | | | | | | | | | | | | 0.00025 | U | 0.00021 | U |
| | | Heptachlor epoxide | mg/Kg | -- | 0.053 | ca | | | | | | | | | | | | | 0.00019 | U | 0.00017 | U |
| | | Methoxychlor | mg/Kg | -- | 31 | nc | | | | | | | | | | | | | 0.0032 | U | 0.0027 | U |
| | | Toxaphene | mg/Kg | -- | 0 | 0 | | | | | | | | | | | | | 0.0063 | U | 0.0055 | U |

## Table 4-3
## Summary of Surface Soil Results (0-1 ft bgs)

| | | | | | | | LL9SS-028-0001-DU | | LL9SS-028-0001-SO | | LL9SS-029-0001-SO | | LL9SS-030-0001-SO | | LL9SS-031-0001-SO | | LL9SS-032-0001-SO | | LL9SS-033-0001-SO | | LL9SS-034-0001-DU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 11/11/03 | | 11/11/03 | |
| | | | | | | **Sample Depth** | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Surface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SS PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| Propellants 8330 | 353.2 | Nitrocellulose | mg/Kg | 0 | -- | 0 | | | | | | | | | | | | | 1.4 | B J | 2.5 | U |
| | 8330 | Nitroglycerin | mg/Kg | 0 | -- | 0 | | | | | | | | | | | | | 0.5 | U | 0.5 | U |
| | UV/HPLC per SOP | Nitroguanidine | mg/Kg | 0 | 611 | nc | | | | | | | | | | | | | 0.25 | U | 0.25 | U |
| SVOCs TCL 8270 C | 8270C | 1,2,4-Trichlorobenzene | mg/Kg | -- | 6.2 | nc | | | | | | | | | | | | | 0.08 | U | 0.071 | U |
| | | 1,2-Dichlorobenzene | mg/Kg | -- | 600 | sat | | | | | | | | | | | | | 0.11 | U | 0.095 | U |
| | | 1,3-Dichlorobenzene | mg/Kg | -- | 53 | nc | | | | | | | | | | | | | 0.11 | U | 0.095 | U |
| | | 1,4-Dichlorobenzene | mg/Kg | -- | 3.4 | ca | | | | | | | | | | | | | 0.096 | U | 0.085 | U |
| | | 2,2-oxybis (1-chloropropane) | mg/Kg | -- | 2.9 | ca | | | | | | | | | | | | | 0.1 | U | 0.09 | U |
| | | 2,4,5-Trichlorophenol | mg/Kg | -- | 611 | nc | | | | | | | | | | | | | 0.051 | U | 0.046 | U |
| | | 2,4,6-Trichlorophenol | mg/Kg | -- | 0.61 | nc | | | | | | | | | | | | | 0.064 | U | 0.057 | U |
| | | 2,4-Dichlorophenol | mg/Kg | -- | 18 | nc | | | | | | | | | | | | | 0.065 | U | 0.058 | U |
| | | 2,4-Dimethylphenol | mg/Kg | -- | 122 | nc | | | | | | | | | | | | | 0.081 | U | 0.072 | U |
| | | 2,4-Dinitrophenol | mg/Kg | -- | 12 | nc | | | | | | | | | | | | | 0.15 | U | 0.14 | U |
| | | 2-Chloronaphthalene | mg/Kg | -- | 494 | nc | | | | | | | | | | | | | 0.065 | U | 0.058 | U |
| | | 2-Chlorophenol | mg/Kg | -- | 6.3 | nc | | | | | | | | | | | | | 0.08 | U | 0.071 | U |
| | | 2-Methylnaphthalene | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | 0.002 | U | 0.0018 | U |
| | | 2-Methylphenol (o-cresol) | mg/Kg | -- | 306 | nc | | | | | | | | | | | | | 0.011 | U | 0.01 | U |
| | | 2-Nitroaniline | mg/Kg | -- | 18.3 | nc | | | | | | | | | | | | | 0.046 | U | 0.041 | U |
| | | 2-Nitrophenol | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | 0.085 | U | 0.076 | U |
| | | 3,3-Dichlorobenzidine | mg/Kg | -- | 1.1 | ca | | | | | | | | | | | | | 0.024 | U | 0.022 | U |
| | | 3-Nitroaniline | mg/Kg | -- | 1.8 | nc | | | | | | | | | | | | | 0.15 | U | 0.13 | U |
| | | 4,6-Dinitro-2-methylphenol | mg/Kg | -- | 0.61 | nc | | | | | | | | | | | | | 0.13 | U* | 0.11 | U* |
| | | 4-Bromophenyl phenyl ether | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | 0.0042 | U | 0.0037 | U |
| | | 4-Chloro-3-methylphenol | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | 0.051 | U | 0.046 | U |
| | | 4-Chloroaniline | mg/Kg | -- | 24 | nc | | | | | | | | | | | | | 0.14 | U | 0.12 | U |
| | | 4-Chlorophenyl phenyl ether | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | 0.0049 | U | 0.0043 | U |
| | | 4-Methylphenol (m/p-cresol) | mg/Kg | -- | 31 | nc | | | | | | | | | | | | | 0.0078 | U | 0.007 | U |
| | | 4-Nitroaniline | mg/Kg | -- | 23 | ca | | | | | | | | | | | | | 0.053 | U | 0.047 | U |
| | | 4-Nitrophenol | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | 0.11 | U | 0.099 | U |
| | | Acenaphthene | mg/Kg | -- | 368 | nc | | | | | | | | | | | | | 0.0019 | U | 0.011 | Ja |
| | | Acenaphthylene | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | 0.0012 | U | 0.0011 | U |
| | | Anthracene | mg/Kg | -- | 2189 | nc | | | | | | | | | | | | | 0.0012 | U | 0.022 | Ja |
| | | Benzo(a)anthracene | mg/Kg | -- | 0.62 | ca | | | | | | | | | | | | | 0.017 | Ja | 0.079 | |
| | | Benzo(a)pyrene | mg/Kg | -- | 0.062 | ca | | | | | | | | | | | | | 0.025 | Ja | **0.073** | |
| | | Benzo(b)fluoranthene | mg/Kg | -- | 0.62 | ca | | | | | | | | | | | | | 0.031 | Ja | 0.098 | |
| | | Benzo(ghi)perylene | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | 0.02 | Ja | 0.056 | |
| | | Benzo(k)fluoranthene | mg/Kg | -- | 6.2 | ca | | | | | | | | | | | | | 0.018 | Ja | 0.058 | M |
| | | Bis(2-chloroethoxy)methane | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | 0.0039 | U | 0.0035 | U |
| | | Bis(2-chloroethyl)ether | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | 0.0027 | U | 0.0024 | U |
| | | Bis(2-ethylhexyl)phthalate | mg/Kg | -- | 35 | ca | | | | | | | | | | | | | 0.013 | U | 0.014 | Ja |
| | | Butyl benzyl phthalate | mg/Kg | -- | 1222 | nc | | | | | | | | | | | | | 0.0055 | U | 0.0049 | U |
| | | Carbazole | mg/Kg | -- | 24 | ca | | | | | | | | | | | | | 0.047 | U | 0.042 | U |
| | | Chrysene | mg/Kg | -- | 62 | ca | | | | | | | | | | | | | 0.025 | Ja | 0.12 | |
| | | Dibenzo(a,h)anthracene | mg/Kg | -- | 0.062 | ca | | | | | | | | | | | | | 0.01 | Ja | 0.027 | Ja |

## Table 4-3
## Summary of Surface Soil Results (0-1 ft bgs)

| | | | | | | | LL9SS-028-0001-DUP | | LL9SS-028-0001-SO | | LL9SS-029-0001-SO | | LL9SS-030-0001-SO | | LL9SS-031-0001-SO | | LL9SS-032-0001-SO | | LL9SS-033-0001-SO | | LL9SS-034-0001-DUP | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 11/11/03 | | 11/11/03 | |
| | | | | | | **Sample Depth** | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Surface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SS PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| | | Dibenzofuran | mg/Kg | -- | 15 | nc | | | | | | | | | | | | | 0.0036 | U | 0.0032 | U |
| | | Diethyl phthalate | mg/Kg | -- | 4888 | nc | | | | | | | | | | | | | 0.005 | U | 0.0044 | U |
| | | Dimethyl phthalate | mg/Kg | -- | 100000 | max | | | | | | | | | | | | | 0.0049 | U | 0.0043 | U |
| | | Di-n-butyl phthalate | mg/Kg | -- | 611 | nc | | | | | | | | | | | | | 0.027 | U | 0.024 | U |
| | | Di-n-octyl phthalate | mg/Kg | -- | 244 | nc | | | | | | | | | | | | | 0.012 | U | 0.01 | U |
| | | Fluoranthene | mg/Kg | -- | 229 | nc | | | | | | | | | | | | | 0.035 | Ja | 0.2 | |
| | | Fluorene | mg/Kg | -- | 275 | nc | | | | | | | | | | | | | 0.0022 | U | 0.0085 | Ja |
| | | Hexachlorobenzene | mg/Kg | -- | 0.30 | ca | | | | | | | | | | | | | 0.0024 | U | 0.0022 | U |
| | | Hexachlorobutadiene | mg/Kg | -- | 6.2 | ca | | | | | | | | | | | | | 0.0045 | U | 0.004 | U |
| | | Hexachlorocyclopentadiene | mg/Kg | -- | 37 | nc | | | | | | | | | | | | | 0.073 | U | 0.065 | U |
| | | Hexachloroethane | mg/Kg | -- | 35 | ca | | | | | | | | | | | | | 0.0045 | U | 0.004 | U |
| | | Indeno(1,2,3-cd)pyrene | mg/Kg | -- | 0.62 | ca | | | | | | | | | | | | | 0.018 | Ja | 0.056 | |
| | | Isophorone | mg/Kg | -- | 512 | ca | | | | | | | | | | | | | 0.0032 | U | 0.0029 | U |
| | | Naphthalene | mg/Kg | -- | 5.6 | nc | | | | | | | | | | | | | 0.0023 | U | 0.002 | U |
| | | n-Nitroso-di-n-propylamine | mg/Kg | -- | 0.069 | ca | | | | | | | | | | | | | 0.0031 | U | 0.0028 | U |
| | | n-Nitrosodiphenylamine | mg/Kg | -- | 99 | ca | | | | | | | | | | | | | 0.0039 | U* | 0.0035 | U* |
| | | Pentachlorophenol | mg/Kg | -- | 3.0 | ca | | | | | | | | | | | | | 0.14 | U | 0.12 | U |
| | | Phenanthrene | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | 0.02 | Ja | 0.1 | |
| | | Phenol | mg/Kg | -- | 1833 | nc | | | | | | | | | | | | | 0.0022 | U | 0.0019 | U |
| | | Pyrene | mg/Kg | -- | 232 | nc | | | | | | | | | | | | | 0.039 | Ja | 0.16 | |
| TAL Metals 6010B | 6010B | Aluminum | mg/Kg | 17700 | 7614 | nc | **10000** | | **10000** | | **9400** | | 6800 | | 6400 | | **8200** | | **13000** | | 7000 | |
| | | Barium | mg/Kg | 88.4 | 538 | nc | 52 | | 64 | | 80 | | 52 | | 72 | | 45 | | 77 | | 41 | |
| | | Beryllium | mg/Kg | 0.88 | 15 | nc | 0.51 | | 0.57 | B | 0.75 | | 0.61 | | 0.74 | | 0.58 | | 0.55 | | 0.46 | |
| | | Cadmium | mg/Kg | 0.00 | 3.7 | nc | 0.09 | U | 0.12 | U | 0.1 | U | 0.096 | U | 0.31 | | 0.088 | U | 0.11 | U | 0.086 | U |
| | | Calcium | mg/Kg | 15800 | -- | 0 | 730 | | 1100 | | 530 | | 530 | | 2600 | | 600 | | 990 | | 900 | |
| | | Chromium | mg/Kg | 17.4 | 30 | ca | 12 | | 12 | | 11 | | 9.2 | | 11 | | 12 | | 15 | | 12 | |
| | | Cobalt | mg/Kg | 10.4 | 902 | ca | 5.1 | | 5.3 | | 8.1 | | 5.6 | | 13 | | 7.5 | | 11 | | 6.1 | |
| | | Copper | mg/Kg | 17.7 | 313 | nc | 6.4 | | 7.2 | | 8.9 | | 8.1 | | 8.5 | | 13 | | 9.3 | | 33 | |
| | | Iron | mg/Kg | 23100 | 2346 | nc | **23000** | | **21000** | | **16000** | | **20000** | | **76000** | | **22000** | | **23000** | | **32000** | |
| | | Magnesium | mg/Kg | 3030 | -- | 0 | 1300 | | 1400 | | 1600 | | 1200 | | 1300 | | 1700 | | 1900 | | 1500 | |
| | | Manganese | mg/Kg | 1450 | 176 | nc | **330** | | **460** | | **870** | | **650** | | **2000** | | **480** | | **1200** | | **420** | |
| | | Nickel | mg/Kg | 21.1 | 156 | nc | 7.9 | | 8.9 | | 13 | | 10 | | 18 | | 13 | | 12 | | 16 | |
| | | Potassium | mg/Kg | 927 | -- | 0 | 570 | | 580 | | 600 | | 450 | | 540 | | 660 | | 770 | | 550 | |
| | | Selenium | mg/Kg | 1.4 | 39 | nc | 0.51 | B | 0.92 | B | 0.79 | B | 0.48 | U | 0.45 | U | 0.52 | B | 1 | B | 0.61 | B |
| | | Silver | mg/Kg | 0.00 | 39 | nc | 0.35 | U | 0.45 | U | 0.4 | U | 0.37 | U | 0.35 | U | 0.34 | U | 0.41 | U | 0.33 | U |
| | | Sodium | mg/Kg | 123 | -- | 0 | 98 | U | 130 | U | 110 | U | 100 | U | 97 | U | 95 | U | 1000 | | 660 | |
| | | Vanadium | mg/Kg | 31.1 | 7.8 | nc | **22** | | **21** | | **16** | | **14** | | **19** | | **15** | | **25** | | **15** | |
| | | Zinc | mg/Kg | 61.8 | 2346 | nc | 36 | | 43 | | 56 | | 48 | | 75 | | 47 | | 86 | | 79 | |
| | 7041 | Antimony | mg/Kg | 0.96 | 3.1 | nc | 0.53 | U | 0.62 | U | 0.54 | U | 0.52 | U | 0.48 | U | 0.49 | U | 0.54 | U | 0.49 | U |
| | 7060A | Arsenic | mg/Kg | 15.4 | 0.39 | ca | **9.4** | | **15** | | **7.4** | | **4.2** | | **6.9** | | **7.4** | | **9.2** | | **10** | |
| | 7421 | Lead | mg/Kg | 26.1 | 400 | pbk | 13 | | 13 | | 17 | | 13 | | 28 | | 12 | | 25 | | 38 | |
| | 7471A | Mercury | mg/Kg | 0.04 | 2.3 | nc | 0.2 | | 0.24 | | 0.088 | | 0.034 | | 0.032 | | 0.028 | | 0.033 | | **17** | |
| | 7841 | Thallium | mg/Kg | 0.00 | 0.52 | nc | 0.23 | U | 0.27 | U | 0.23 | U | 0.22 | U | 1 | U | 0.21 | U | 1.2 | U | 0.21 | U |

# Table 4-3
## Summary of Surface Soil Results (0-1 ft bgs)

| | | | | | | | LL9SS-028-0001-DUI | | LL9SS-028-0001-SO | | LL9SS-029-0001-SO | | LL9SS-030-0001-SO | | LL9SS-031-0001-SO | | LL9SS-032-0001-SO | | LL9SS-033-0001-SO | | LL9SS-034-0001-DUI | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 11/11/03 | | 11/11/03 | |
| | | | | | | **Sample Depth** | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Surface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SS PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| VOCs TCL 8260B | 8260B | 1,1,1-Trichloroethane | mg/Kg | -- | 1200 | sat | | | | | | | | | | | | | 0.00084 | U* | 0.00073 | U* |
| | | 1,1,2,2-Tetrachloroethane | mg/Kg | -- | 0.41 | ca | | | | | | | | | | | | | 0.00088 | U | 0.00077 | U |
| | | 1,1,2-Trichloroethane | mg/Kg | -- | 0.73 | ca | | | | | | | | | | | | | 0.00098 | U | 0.00086 | U |
| | | 1,1-Dichloroethane | mg/Kg | -- | 51 | nc | | | | | | | | | | | | | 0.0012 | U | 0.0011 | U |
| | | 1,1-Dichloroethene | mg/Kg | -- | 12 | nc | | | | | | | | | | | | | 0.0014 | U | 0.0012 | U |
| | | 1,2-Dichloroethane | mg/Kg | -- | 0.28 | ca | | | | | | | | | | | | | 0.0008 | U | 0.0007 | U |
| | | 1,2-Dichloroethene (total) | mg/Kg | -- | 6.9 | nc | | | | | | | | | | | | | 0.0026 | U | 0.0023 | U |
| | | 1,2-Dichloropropane | mg/Kg | -- | 0.34 | ca | | | | | | | | | | | | | 0.0013 | U | 0.0012 | U |
| | | 2-Butanone (MEK) | mg/Kg | -- | 2231 | nc | | | | | | | | | | | | | 0.0058 | U | 0.0051 | U |
| | | 2-Hexanone | mg/Kg | -- | 530 | nc | | | | | | | | | | | | | 0.0023 | U | 0.002 | U |
| | | 4-Methyl-2-pentanone (MIBK) | mg/Kg | -- | 528 | nc | | | | | | | | | | | | | 0.0041 | U | 0.0036 | U |
| | | Acetone | mg/Kg | -- | 1412 | nc | | | | | | | | | | | | | 0.0056 | U* | 0.0049 | U* |
| | | Benzene | mg/Kg | -- | 0.64 | ca | | | | | | | | | | | | | 0.00091 | U | 0.0008 | U |
| | | Bromodichloromethane | mg/Kg | -- | 0.82 | ca | | | | | | | | | | | | | 0.00093 | U | 0.00082 | U |
| | | Bromoform | mg/Kg | -- | 62 | ca | | | | | | | | | | | | | 0.0012 | U | 0.0011 | U |
| | | Bromomethane | mg/Kg | -- | 0.39 | nc | | | | | | | | | | | | | 0.004 | U* | 0.0035 | U* |
| | | Carbon disulfide | mg/Kg | -- | 36 | nc | | | | | | | | | | | | | 0.0027 | U | 0.0024 | U |
| | | Carbon tetrachloride | mg/Kg | -- | 0.25 | ca | | | | | | | | | | | | | 0.0011 | U | 0.001 | U |
| | | Chlorobenzene | mg/Kg | -- | 15 | nc | | | | | | | | | | | | | 0.0012 | U | 0.0011 | U |
| | | Chloroethane | mg/Kg | -- | 3.0 | ca | | | | | | | | | | | | | 0.0022 | U | 0.0019 | U |
| | | Chloroform | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | 0.00085 | U | 0.00075 | U |
| | | Chloromethane | mg/Kg | -- | 4.7 | nc | | | | | | | | | | | | | 0.0013 | U | 0.0011 | U |
| | | cis-1,3-Dichloropropene | mg/Kg | -- | 0.78 | ca | | | | | | | | | | | | | 0.0011 | U | 0.00095 | U |
| | | Dibromochloromethane | mg/Kg | -- | 1.1 | ca | | | | | | | | | | | | | 0.00095 | U | 0.00083 | U |
| | | Ethylbenzene | mg/Kg | -- | 395 | sat | | | | | | | | | | | | | 0.0015 | U | 0.0013 | U |
| | | Methylene chloride | mg/Kg | -- | 9.1 | ca | | | | | | | | | | | | | 0.0025 | U | 0.0022 | U |
| | | Styrene | mg/Kg | -- | 1700 | sat | | | | | | | | | | | | | 0.0014 | U | 0.0012 | U |
| | | Tetrachloroethene | mg/Kg | -- | 0.48 | ca | | | | | | | | | | | | | 0.00092 | U | 0.00081 | U |
| | | Toluene | mg/Kg | -- | 520 | sat | | | | | | | | | | | | | 0.0014 | U | 0.0012 | U |
| | | trans-1,3-Dichloropropene | mg/Kg | -- | 0.78 | ca | | | | | | | | | | | | | 0.0012 | U | 0.001 | U |
| | | Trichloroethene | mg/Kg | -- | 0.053 | ca | | | | | | | | | | | | | 0.00081 | U | 0.00071 | U |
| | | Vinyl chloride | mg/Kg | -- | 0.079 | ca | | | | | | | | | | | | | 0.001 | U | 0.00089 | U |
| | | Xylenes (total) | mg/Kg | -- | 0.079 | ca | | | | | | | | | | | | | 0.004 | U | 0.0035 | U |

## Table 4-3
## Summary of Surface Soil Results (0-1 ft bgs)

| | | | | | | | LL9SS-034-0001-SO | | LL9SS-035-0001-SO | | LL9SS-036-0001-DU | | LL9SS-036-0001-SO | | LL9SS-037-0001-SO | | LL9SS-038-0001-SO | | LL9SS-039-0001-DU | | LL9SS-039-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 11/11/03 | | 11/11/03 | | 11/11/03 | | 11/11/03 | | 11/11/03 | | 11/11/03 | | 11/11/03 | | 11/11/03 | |
| | | | | | | **Sample Depth** | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Surface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SS PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| Cyanide 9012A | 9014/9010B | Cyanide, Total | mg/Kg | 0.00 | 122 | nc | 0.1 | U | | | | | | | | | | | | | | |
| Explosives 8330 | 8330 | 1,3,5-Trinitrobenzene | mg/Kg | 0 | 183 | nc | 0.017 | U | 0.017 | U | | | | | 0.018 | U | | | 0.018 | U | 0.018 | U |
| | | 1,3-Dinitrobenzene | mg/Kg | 0 | 0.61 | nc | 0.018 | U | 0.018 | U | | | | | 0.018 | U | | | 0.018 | U | 0.018 | U |
| | | 2,4,6-TNT | mg/Kg | 0 | 16 | ca | 0.033 | U | 0.034 | U | | | | | 0.034 | U | | | 0.034 | U | 0.034 | U |
| | | 2,4-Dinitrotoluene | mg/Kg | 0 | 12 | nc | 0.035 | U | 0.035 | U | | | | | 0.036 | U | | | 0.036 | U | 0.036 | U |
| | | 2,6-Dinitrotoluene | mg/Kg | 0 | 6.1 | nc | 0.047 | U* | 0.047 | U* | | | | | 0.048 | U* | | | 0.048 | U* | 0.048 | U* |
| | | 2-Nitrotoluene | mg/Kg | 0 | 0.88 | ca | 0.033 | U | 0.033 | U | | | | | 0.033 | U | | | 0.033 | U | 0.033 | U |
| | | 3-Nitrotoluene | mg/Kg | 0 | 73 | nc | 0.05 | U | 0.05 | U | | | | | 0.05 | U | | | 0.05 | U | 0.05 | U |
| | | 4-Nitrotoluene | mg/Kg | 0 | 12 | ca | 0.046 | U | 0.046 | U | | | | | 0.047 | U | | | 0.047 | U | 0.047 | U |
| | | HMX | mg/Kg | 0 | 306 | nc | 0.11 | U | 0.11 | U | | | | | 0.11 | U | | | 0.11 | U | 0.11 | U |
| | | Nitrobenzene | mg/Kg | 0 | 2 | nc | 0.022 | U | 0.022 | U | | | | | 0.022 | U | | | 0.022 | U | 0.022 | U |
| | | RDX | mg/Kg | 0 | 4.4 | ca | 0.058 | U | 0.058 | U | | | | | 0.059 | U | | | 0.059 | U | 0.059 | U |
| | | Tetryl | mg/Kg | 0 | 61 | nc | 0.043 | U | 0.043 | U | | | | | 0.043 | U | | | 0.043 | U | 0.043 | U |
| PCB TCL 8082 | 8082 | Aroclor 1016 | mg/Kg | -- | 0.39 | nc | 0.0023 | U | | | | | | | | | | | | | | |
| | | Aroclor 1221 | mg/Kg | -- | 0.22 | ca | 0.0024 | U | | | | | | | | | | | | | | |
| | | Aroclor 1232 | mg/Kg | -- | 0.22 | ca | 0.0024 | U | | | | | | | | | | | | | | |
| | | Aroclor 1242 | mg/Kg | -- | 0.22 | ca | 0.0024 | U | | | | | | | | | | | | | | |
| | | Aroclor 1248 | mg/Kg | -- | 0.22 | ca | 0.0024 | U | | | | | | | | | | | | | | |
| | | Aroclor 1254 | mg/Kg | -- | 0.22 | ca | 0.0024 | U | | | | | | | | | | | | | | |
| | | Aroclor 1260 | mg/Kg | -- | 0.22 | ca | 0.0017 | U | | | | | | | | | | | | | | |
| Pesticides 8081A | 8081A | 4,4'-DDD | mg/Kg | -- | 2.4 | ca | 0.00043 | U | | | | | | | | | | | | | | |
| | | 4,4'-DDE | mg/Kg | -- | 1.7 | ca | 0.00077 | U | | | | | | | | | | | | | | |
| | | 4,4'-DDT | mg/Kg | -- | 1.7 | ca | 0.00044 | U | | | | | | | | | | | | | | |
| | | Aldrin | mg/Kg | -- | 0.029 | ca | 0.00015 | U | | | | | | | | | | | | | | |
| | | alpha-BHC | mg/Kg | -- | 0.09 | sat | 0.00019 | U | | | | | | | | | | | | | | |
| | | alpha-Chlordane | mg/Kg | -- | 1.6 | ca | 0.00014 | U | | | | | | | | | | | | | | |
| | | beta-BHC | mg/Kg | -- | 0.32 | ca | 0.00018 | U | | | | | | | | | | | | | | |
| | | delta-BHC | mg/Kg | -- | -- | 0 | 0.00013 | U | | | | | | | | | | | | | | |
| | | Dieldrin | mg/Kg | -- | 0.030 | ca | 0.0004 | U | | | | | | | | | | | | | | |
| | | Endosulfan I | mg/Kg | -- | 37 | nc | 0.00032 | U | | | | | | | | | | | | | | |
| | | Endosulfan II | mg/Kg | -- | 37 | nc | 0.00033 | U | | | | | | | | | | | | | | |
| | | Endosulfan sulfate | mg/Kg | -- | 37 | nc | 0.00034 | U | | | | | | | | | | | | | | |
| | | Endrin | mg/Kg | -- | 1.8 | nc | 0.00051 | U | | | | | | | | | | | | | | |
| | | Endrin aldehyde | mg/Kg | -- | -- | 0 | 0.00039 | U | | | | | | | | | | | | | | |
| | | Endrin ketone | mg/Kg | -- | -- | 0 | 0.00034 | U | | | | | | | | | | | | | | |
| | | gamma-BHC (Lindane) | mg/Kg | -- | 0.44 | ca | 0.00027 | U | | | | | | | | | | | | | | |
| | | gamma-Chlordane | mg/Kg | -- | 1.6 | ca | 0.00018 | U | | | | | | | | | | | | | | |
| | | Heptachlor | mg/Kg | -- | 0.11 | ca | 0.00021 | U | | | | | | | | | | | | | | |
| | | Heptachlor epoxide | mg/Kg | -- | 0.053 | ca | 0.00017 | U | | | | | | | | | | | | | | |
| | | Methoxychlor | mg/Kg | -- | 31 | nc | 0.0027 | U | | | | | | | | | | | | | | |
| | | Toxaphene | mg/Kg | -- | 0 | 0 | 0.0055 | U | | | | | | | | | | | | | | |

# Table 4-3
## Summary of Surface Soil Results (0-1 ft bgs)

| | | | | | | | LL9SS-034-0001-SO | | LL9SS-035-0001-SO | | LL9SS-036-0001-DU | | LL9SS-036-0001-SO | | LL9SS-037-0001-SO | | LL9SS-038-0001-SO | | LL9SS-039-0001-DU | | LL9SS-039-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 11/11/03 | | 11/11/03 | | 11/11/03 | | 11/11/03 | | 11/11/03 | | 11/11/03 | | 11/11/03 | | 11/11/03 | |
| | | | | | | **Sample Depth** | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Surface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SS PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| Propellants 8330 | 353.2 | Nitrocellulose | mg/Kg | 0 | -- | 0 | 1.1 | B | | | | | | | | | | | | | | |
| | 8330 | Nitroglycerin | mg/Kg | 0 | -- | 0 | 0.5 | U | | | | | | | | | | | | | | |
| | UV/HPLC per SOP | Nitroguanidine | mg/Kg | 0 | 611 | nc | 0.089 | J | | | | | | | | | | | | | | |
| SVOCs TCL 8270 C | 8270C | 1,2,4-Trichlorobenzene | mg/Kg | -- | 6.2 | nc | 0.071 | U | | | | | | | | | | | | | | |
| | | 1,2-Dichlorobenzene | mg/Kg | -- | 600 | sat | 0.094 | U | | | | | | | | | | | | | | |
| | | 1,3-Dichlorobenzene | mg/Kg | -- | 53 | nc | 0.094 | U | | | | | | | | | | | | | | |
| | | 1,4-Dichlorobenzene | mg/Kg | -- | 3.4 | ca | 0.085 | U | | | | | | | | | | | | | | |
| | | 2,2-oxybis (1-chloropropane) | mg/Kg | -- | 2.9 | ca | 0.09 | U | | | | | | | | | | | | | | |
| | | 2,4,5-Trichlorophenol | mg/Kg | -- | 611 | nc | 0.045 | U | | | | | | | | | | | | | | |
| | | 2,4,6-Trichlorophenol | mg/Kg | -- | 0.61 | nc | 0.056 | U | | | | | | | | | | | | | | |
| | | 2,4-Dichlorophenol | mg/Kg | -- | 18 | nc | 0.057 | U | | | | | | | | | | | | | | |
| | | 2,4-Dimethylphenol | mg/Kg | -- | 122 | nc | 0.072 | U | | | | | | | | | | | | | | |
| | | 2,4-Dinitrophenol | mg/Kg | -- | 12 | nc | 0.14 | U | | | | | | | | | | | | | | |
| | | 2-Chloronaphthalene | mg/Kg | -- | 494 | nc | 0.057 | U | | | | | | | | | | | | | | |
| | | 2-Chlorophenol | mg/Kg | -- | 6.3 | nc | 0.071 | U | | | | | | | | | | | | | | |
| | | 2-Methylnaphthalene | mg/Kg | -- | -- | 0 | 0.0018 | U | | | | | | | | | | | | | | |
| | | 2-Methylphenol (o-cresol) | mg/Kg | -- | 306 | nc | 0.01 | U | | | | | | | | | | | | | | |
| | | 2-Nitroaniline | mg/Kg | -- | 18.3 | nc | 0.041 | U | | | | | | | | | | | | | | |
| | | 2-Nitrophenol | mg/Kg | -- | -- | 0 | 0.075 | U | | | | | | | | | | | | | | |
| | | 3,3-Dichlorobenzidine | mg/Kg | -- | 1.1 | ca | 0.022 | U | | | | | | | | | | | | | | |
| | | 3-Nitroaniline | mg/Kg | -- | 1.8 | nc | 0.13 | U | | | | | | | | | | | | | | |
| | | 4,6-Dinitro-2-methylphenol | mg/Kg | -- | 0.61 | nc | 0.11 | U* | | | | | | | | | | | | | | |
| | | 4-Bromophenyl phenyl ether | mg/Kg | -- | -- | 0 | 0.0037 | U | | | | | | | | | | | | | | |
| | | 4-Chloro-3-methylphenol | mg/Kg | -- | -- | 0 | 0.045 | U | | | | | | | | | | | | | | |
| | | 4-Chloroaniline | mg/Kg | -- | 24 | nc | 0.12 | U | | | | | | | | | | | | | | |
| | | 4-Chlorophenyl phenyl ether | mg/Kg | -- | -- | 0 | 0.0043 | U | | | | | | | | | | | | | | |
| | | 4-Methylphenol (m/p-cresol) | mg/Kg | -- | 31 | nc | 0.0069 | U | | | | | | | | | | | | | | |
| | | 4-Nitroaniline | mg/Kg | -- | 23 | ca | 0.047 | U | | | | | | | | | | | | | | |
| | | 4-Nitrophenol | mg/Kg | -- | -- | 0 | 0.098 | U | | | | | | | | | | | | | | |
| | | Acenaphthene | mg/Kg | -- | 368 | nc | 0.0017 | U | | | | | | | | | | | | | | |
| | | Acenaphthylene | mg/Kg | -- | -- | 0 | 0.0011 | U | | | | | | | | | | | | | | |
| | | Anthracene | mg/Kg | -- | 2189 | nc | 0.001 | U | | | | | | | | | | | | | | |
| | | Benzo(a)anthracene | mg/Kg | -- | 0.62 | ca | 0.026 | Ja | | | | | | | | | | | | | | |
| | | Benzo(a)pyrene | mg/Kg | -- | 0.062 | ca | 0.023 | Ja | | | | | | | | | | | | | | |
| | | Benzo(b)fluoranthene | mg/Kg | -- | 0.62 | ca | 0.032 | Ja | | | | | | | | | | | | | | |
| | | Benzo(ghi)perylene | mg/Kg | -- | -- | 0 | 0.017 | Ja | | | | | | | | | | | | | | |
| | | Benzo(k)fluoranthene | mg/Kg | -- | 6.2 | ca | 0.025 | Ja | | | | | | | | | | | | | | |
| | | Bis(2-chloroethoxy)methane | mg/Kg | -- | -- | 0 | 0.0035 | U | | | | | | | | | | | | | | |
| | | Bis(2-chloroethyl)ether | mg/Kg | -- | 0.22 | ca | 0.0024 | U | | | | | | | | | | | | | | |
| | | Bis(2-ethylhexyl)phthalate | mg/Kg | -- | 35 | ca | 0.011 | U | | | | | | | | | | | | | | |
| | | Butyl benzyl phthalate | mg/Kg | -- | 1222 | nc | 0.0049 | U | | | | | | | | | | | | | | |
| | | Carbazole | mg/Kg | -- | 24 | ca | 0.042 | U | | | | | | | | | | | | | | |
| | | Chrysene | mg/Kg | -- | 62 | ca | 0.03 | Ja | | | | | | | | | | | | | | |
| | | Dibenzo(a,h)anthracene | mg/Kg | -- | 0.062 | ca | 0.0026 | U | | | | | | | | | | | | | | |

## Table 4-3
## Summary of Surface Soil Results (0-1 ft bgs)

| | | | | | | | LL9SS-034-0001-SO | | LL9SS-035-0001-SO | | LL9SS-036-0001-DUP | | LL9SS-036-0001-SO | | LL9SS-037-0001-SO | | LL9SS-038-0001-SO | | LL9SS-039-0001-DUP | | LL9SS-039-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 11/11/03 | | 11/11/03 | | 11/11/03 | | 11/11/03 | | 11/11/03 | | 11/11/03 | | 11/11/03 | | 11/11/03 | |
| | | | | | | **Sample Depth** | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Surface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SS PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| | | Dibenzofuran | mg/Kg | -- | 15 | nc | 0.0032 | U | | | | | | | | | | | | | | |
| | | Diethyl phthalate | mg/Kg | -- | 4888 | nc | 0.0044 | U | | | | | | | | | | | | | | |
| | | Dimethyl phthalate | mg/Kg | -- | 100000 | max | 0.0043 | U | | | | | | | | | | | | | | |
| | | Di-n-butyl phthalate | mg/Kg | -- | 611 | nc | 0.024 | U | | | | | | | | | | | | | | |
| | | Di-n-octyl phthalate | mg/Kg | -- | 244 | nc | 0.01 | U | | | | | | | | | | | | | | |
| | | Fluoranthene | mg/Kg | -- | 229 | nc | 0.058 | | | | | | | | | | | | | | | |
| | | Fluorene | mg/Kg | -- | 275 | nc | 0.0019 | U | | | | | | | | | | | | | | |
| | | Hexachlorobenzene | mg/Kg | -- | 0.30 | ca | 0.0022 | U | | | | | | | | | | | | | | |
| | | Hexachlorobutadiene | mg/Kg | -- | 6.2 | ca | 0.0039 | U | | | | | | | | | | | | | | |
| | | Hexachlorocyclopentadiene | mg/Kg | -- | 37 | nc | 0.065 | U | | | | | | | | | | | | | | |
| | | Hexachloroethane | mg/Kg | -- | 35 | ca | 0.0039 | U | | | | | | | | | | | | | | |
| | | Indeno(1,2,3-cd)pyrene | mg/Kg | -- | 0.62 | ca | 0.0025 | U | | | | | | | | | | | | | | |
| | | Isophorone | mg/Kg | -- | 512 | ca | 0.0029 | U | | | | | | | | | | | | | | |
| | | Naphthalene | mg/Kg | -- | 5.6 | nc | 0.002 | U | | | | | | | | | | | | | | |
| | | n-Nitroso-di-n-propylamine | mg/Kg | -- | 0.069 | ca | 0.0028 | U | | | | | | | | | | | | | | |
| | | n-Nitrosodiphenylamine | mg/Kg | -- | 99 | ca | 0.0035 | U* | | | | | | | | | | | | | | |
| | | Pentachlorophenol | mg/Kg | -- | 3.0 | ca | 0.12 | U | | | | | | | | | | | | | | |
| | | Phenanthrene | mg/Kg | -- | -- | 0 | 0.021 | Ja | | | | | | | | | | | | | | |
| | | Phenol | mg/Kg | -- | 1833 | nc | 0.0019 | U | | | | | | | | | | | | | | |
| | | Pyrene | mg/Kg | -- | 232 | nc | 0.045 | | | | | | | | | | | | | | | |
| TAL Metals 6010B | 6010B | Aluminum | mg/Kg | 17700 | 7614 | nc | **9300** | | **7900** | | **8500** | | **8500** | | **12000** | | **13000** | | 5700 | | 6000 | |
| | | Barium | mg/Kg | 88.4 | 538 | nc | 57 | | 38 | | 47 | | 44 | | 97 | | 81 | | 34 | | 37 | |
| | | Beryllium | mg/Kg | 0.88 | 15 | nc | 0.42 | B | 0.41 | B | 0.39 | B | 0.36 | B | 0.58 | | 0.59 | | 0.49 | | 0.51 | |
| | | Cadmium | mg/Kg | 0.00 | 3.7 | nc | 0.087 | U | 0.092 | U | 0.092 | U | 0.09 | U | 0.092 | U | 0.11 | U | 0.091 | U | 0.099 | U |
| | | Calcium | mg/Kg | 15800 | -- | 0 | 1300 | | 4100 | | 370 | | 320 | | 610 | | 210 | | 2000 | | 1600 | |
| | | Chromium | mg/Kg | 17.4 | 30 | ca | 14 | | 13 | | 14 | | 14 | | 16 | | 15 | | 9.8 | | 9.7 | |
| | | Cobalt | mg/Kg | 10.4 | 902 | ca | 8.7 | | 7.5 | | 8.1 | | 7 | | 17 | | 14 | | 4.5 | | 4.8 | |
| | | Copper | mg/Kg | 17.7 | 313 | nc | 34 | | 14 | | 9.1 | | 8.8 | | 9.2 | | 11 | | 7.1 | | 7.8 | |
| | | Iron | mg/Kg | 23100 | 2346 | nc | **21000** | | **22000** | | **20000** | | **19000** | | **17000** | | **19000** | | **25000** | | **25000** | |
| | | Magnesium | mg/Kg | 3030 | -- | 0 | 1900 | | 2100 | | 1500 | | 1600 | | 1800 | | 1700 | | 1100 | | 1100 | |
| | | Manganese | mg/Kg | 1450 | 176 | nc | **630** | | **350** | | **570** | | **420** | | **970** | | **1000** | | **420** | | **470** | |
| | | Nickel | mg/Kg | 21.1 | 156 | nc | 15 | | 14 | | 12 | | 12 | | 15 | | 14 | | 9.4 | | 10 | |
| | | Potassium | mg/Kg | 927 | -- | 0 | 760 | | 820 | | 660 | | 650 | | 680 | | 720 | | 520 | | 550 | |
| | | Selenium | mg/Kg | 1.4 | 39 | nc | 0.66 | B | 0.84 | B | 1.1 | B | 0.56 | B | 0.99 | B | 1.1 | B | 1.1 | B | 1.2 | B |
| | | Silver | mg/Kg | 0.00 | 39 | nc | 0.34 | U | 0.35 | U | 0.36 | U | 0.35 | U | 0.36 | U | 0.44 | U | 0.35 | U | 0.38 | U |
| | | Sodium | mg/Kg | 123 | -- | 0 | 1000 | | 1100 | | 970 | | 970 | | 1100 | | 1300 | | 850 | | 940 | |
| | | Vanadium | mg/Kg | 31.1 | 7.8 | nc | **17** | | **14** | | **15** | | **15** | | **21** | | **22** | | **11** | | **12** | |
| | | Zinc | mg/Kg | 61.8 | 2346 | nc | 71 | | 66 | | 49 | | 48 | | 65 | | 69 | | 69 | | 76 | |
| | 7041 | Antimony | mg/Kg | 0.96 | 3.1 | nc | 0.5 | U | 0.47 | U | 0.52 | U | 0.52 | U | 0.5 | U | 0.54 | U | 0.48 | U | 0.55 | U |
| | 7060A | Arsenic | mg/Kg | 15.4 | 0.39 | ca | **7.1** | | **10** | | **5.6** | | **5.3** | | **9.4** | | **7.5** | | **3.1** | | **4.2** | |
| | 7421 | Lead | mg/Kg | 26.1 | 400 | pbk | 43 | | 21 | | 13 | | 13 | | 21 | | 21 | | 19 | | 22 | |
| | 7471A | Mercury | mg/Kg | 0.04 | 2.3 | nc | **12** | | 0.033 | | 0.031 | | 0.026 | | 0.03 | | 0.072 | | 0.032 | | 0.039 | |
| | 7841 | Thallium | mg/Kg | 0.00 | 0.52 | nc | 0.22 | U | 0.2 | U | 1.1 | U | 1.1 | U | 0.22 | U | 0.24 | U | 1 | U | 0.24 | U |

## Table 4-3
## Summary of Surface Soil Results (0-1 ft bgs)

| | | | | | | | LL9SS-034-0001-SO | | LL9SS-035-0001-SO | | LL9SS-036-0001-DU | | LL9SS-036-0001-SO | | LL9SS-037-0001-SO | | LL9SS-038-0001-SO | | LL9SS-039-0001-DU | | LL9SS-039-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Sample Date | 11/11/03 | | 11/11/03 | | 11/11/03 | | 11/11/03 | | 11/11/03 | | 11/11/03 | | 11/11/03 | | 11/11/03 | |
| | | | | | | Sample Depth | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Surface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SS PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| VOCs TCL 8260B | 8260B | 1,1,1-Trichloroethane | mg/Kg | -- | 1200 | sat | 0.00074 | U* | | | | | | | | | | | | | | |
| | | 1,1,2,2-Tetrachloroethane | mg/Kg | -- | 0.41 | ca | 0.00077 | U | | | | | | | | | | | | | | |
| | | 1,1,2-Trichloroethane | mg/Kg | -- | 0.73 | ca | 0.00086 | U | | | | | | | | | | | | | | |
| | | 1,1-Dichloroethane | mg/Kg | -- | 51 | nc | 0.0011 | U | | | | | | | | | | | | | | |
| | | 1,1-Dichloroethene | mg/Kg | -- | 12 | nc | 0.0012 | U | | | | | | | | | | | | | | |
| | | 1,2-Dichloroethane | mg/Kg | -- | 0.28 | ca | 0.0007 | U | | | | | | | | | | | | | | |
| | | 1,2-Dichloroethene (total) | mg/Kg | -- | 6.9 | nc | 0.0023 | U | | | | | | | | | | | | | | |
| | | 1,2-Dichloropropane | mg/Kg | -- | 0.34 | ca | 0.0012 | U | | | | | | | | | | | | | | |
| | | 2-Butanone (MEK) | mg/Kg | -- | 2231 | nc | 0.0051 | U | | | | | | | | | | | | | | |
| | | 2-Hexanone | mg/Kg | -- | 530 | nc | 0.0021 | U | | | | | | | | | | | | | | |
| | | 4-Methyl-2-pentanone (MIBK) | mg/Kg | -- | 528 | nc | 0.0036 | U | | | | | | | | | | | | | | |
| | | Acetone | mg/Kg | -- | 1412 | nc | 0.005 | U* | | | | | | | | | | | | | | |
| | | Benzene | mg/Kg | -- | 0.64 | ca | 0.0008 | U | | | | | | | | | | | | | | |
| | | Bromodichloromethane | mg/Kg | -- | 0.82 | ca | 0.00082 | U | | | | | | | | | | | | | | |
| | | Bromoform | mg/Kg | -- | 62 | ca | 0.0011 | U | | | | | | | | | | | | | | |
| | | Bromomethane | mg/Kg | -- | 0.39 | nc | 0.0035 | U* | | | | | | | | | | | | | | |
| | | Carbon disulfide | mg/Kg | -- | 36 | nc | 0.0024 | U | | | | | | | | | | | | | | |
| | | Carbon tetrachloride | mg/Kg | -- | 0.25 | ca | 0.001 | U | | | | | | | | | | | | | | |
| | | Chlorobenzene | mg/Kg | -- | 15 | nc | 0.0011 | U | | | | | | | | | | | | | | |
| | | Chloroethane | mg/Kg | -- | 3.0 | ca | 0.0019 | U | | | | | | | | | | | | | | |
| | | Chloroform | mg/Kg | -- | 0.22 | ca | 0.00075 | U | | | | | | | | | | | | | | |
| | | Chloromethane | mg/Kg | -- | 4.7 | nc | 0.0011 | U | | | | | | | | | | | | | | |
| | | cis-1,3-Dichloropropene | mg/Kg | -- | 0.78 | ca | 0.00096 | U | | | | | | | | | | | | | | |
| | | Dibromochloromethane | mg/Kg | -- | 1.1 | ca | 0.00083 | U | | | | | | | | | | | | | | |
| | | Ethylbenzene | mg/Kg | -- | 395 | sat | 0.0013 | U | | | | | | | | | | | | | | |
| | | Methylene chloride | mg/Kg | -- | 9.1 | ca | 0.0022 | U | | | | | | | | | | | | | | |
| | | Styrene | mg/Kg | -- | 1700 | sat | 0.0012 | U | | | | | | | | | | | | | | |
| | | Tetrachloroethene | mg/Kg | -- | 0.48 | ca | 0.00081 | U | | | | | | | | | | | | | | |
| | | Toluene | mg/Kg | -- | 520 | sat | 0.0012 | U | | | | | | | | | | | | | | |
| | | trans-1,3-Dichloropropene | mg/Kg | -- | 0.78 | ca | 0.001 | U | | | | | | | | | | | | | | |
| | | Trichloroethene | mg/Kg | -- | 0.053 | ca | 0.00071 | U | | | | | | | | | | | | | | |
| | | Vinyl chloride | mg/Kg | -- | 0.079 | ca | 0.00089 | U | | | | | | | | | | | | | | |
| | | Xylenes (total) | mg/Kg | -- | 0.079 | ca | 0.0035 | U | | | | | | | | | | | | | | |

## Table 4-3
## Summary of Surface Soil Results (0-1 ft bgs)

| | | | | | | | LL9SS-042-0001-SO | | LL9SS-043-0001-SO | | LL9SS-044-0001-SO | | LL9SS-045-0001-SO | | LL9SS-046-0001-SO | | LL9SS-047-0001-SO | | LL9SS-068-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 11/06/03 | | 11/06/03 | | 11/06/03 | | 11/06/03 | | 11/06/03 | | 11/06/03 | | 12/12/03 | |
| | | | | | | **Sample Depth** | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 0.3 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Surface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SS PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| Cyanide 9012A | 9014/9010B | Cyanide, Total | mg/Kg | 0.00 | 122 | nc | | | | | | | | | | | | | 0.26 | U |
| Explosives 8330 | 8330 | 1,3,5-Trinitrobenzene | mg/Kg | 0 | 183 | nc | | | | | | | | | | | | | 0.018 | U |
| | | 1,3-Dinitrobenzene | mg/Kg | 0 | 0.61 | nc | | | | | | | | | | | | | 0.018 | U |
| | | 2,4,6-TNT | mg/Kg | 0 | 16 | ca | | | | | | | | | | | | | 0.034 | U |
| | | 2,4-Dinitrotoluene | mg/Kg | 0 | 12 | nc | | | | | | | | | | | | | 0.036 | U |
| | | 2,6-Dinitrotoluene | mg/Kg | 0 | 6.1 | nc | | | | | | | | | | | | | 0.048 | U |
| | | 2-Nitrotoluene | mg/Kg | 0 | 0.88 | ca | | | | | | | | | | | | | 0.033 | U |
| | | 3-Nitrotoluene | mg/Kg | 0 | 73 | nc | | | | | | | | | | | | | 0.05 | U |
| | | 4-Nitrotoluene | mg/Kg | 0 | 12 | ca | | | | | | | | | | | | | 0.047 | U |
| | | HMX | mg/Kg | 0 | 306 | nc | | | | | | | | | | | | | 0.11 | U |
| | | Nitrobenzene | mg/Kg | 0 | 2 | nc | | | | | | | | | | | | | 0.022 | U |
| | | RDX | mg/Kg | 0 | 4.4 | ca | | | | | | | | | | | | | 0.059 | U |
| | | Tetryl | mg/Kg | 0 | 61 | nc | | | | | | | | | | | | | 0.043 | U |
| PCB TCL 8082 | 8082 | Aroclor 1016 | mg/Kg | -- | 0.39 | nc | | | | | | | | | | | | | 0.0036 | U |
| | | Aroclor 1221 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | 0.0038 | U |
| | | Aroclor 1232 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | 0.0038 | U |
| | | Aroclor 1242 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | 0.0038 | U |
| | | Aroclor 1248 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | 0.0038 | U |
| | | Aroclor 1254 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | 0.0038 | U |
| | | Aroclor 1260 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | 0.0026 | U |
| Pesticides 8081A | 8081A | 4,4'-DDD | mg/Kg | -- | 2.4 | ca | | | | | | | | | | | | | 0.00068 | U |
| | | 4,4'-DDE | mg/Kg | -- | 1.7 | ca | | | | | | | | | | | | | 0.0012 | U |
| | | 4,4'-DDT | mg/Kg | -- | 1.7 | ca | | | | | | | | | | | | | 0.0007 | U |
| | | Aldrin | mg/Kg | -- | 0.029 | ca | | | | | | | | | | | | | 0.00025 | U |
| | | alpha-BHC | mg/Kg | -- | 0.09 | sat | | | | | | | | | | | | | 0.0003 | U |
| | | alpha-Chlordane | mg/Kg | -- | 1.6 | ca | | | | | | | | | | | | | 0.00023 | U |
| | | beta-BHC | mg/Kg | -- | 0.32 | ca | | | | | | | | | | | | | 0.00028 | U |
| | | delta-BHC | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | 0.00021 | U |
| | | Dieldrin | mg/Kg | -- | 0.030 | ca | | | | | | | | | | | | | 0.00064 | U |
| | | Endosulfan I | mg/Kg | -- | 37 | nc | | | | | | | | | | | | | 0.00051 | U |
| | | Endosulfan II | mg/Kg | -- | 37 | nc | | | | | | | | | | | | | 0.00053 | U |
| | | Endosulfan sulfate | mg/Kg | -- | 37 | nc | | | | | | | | | | | | | 0.00055 | U |
| | | Endrin | mg/Kg | -- | 1.8 | nc | | | | | | | | | | | | | 0.00081 | U |
| | | Endrin aldehyde | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | 0.00062 | U |
| | | Endrin ketone | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | 0.00055 | U |
| | | gamma-BHC (Lindane) | mg/Kg | -- | 0.44 | ca | | | | | | | | | | | | | 0.00043 | U |
| | | gamma-Chlordane | mg/Kg | -- | 1.6 | ca | | | | | | | | | | | | | 0.00028 | U |
| | | Heptachlor | mg/Kg | -- | 0.11 | ca | | | | | | | | | | | | | 0.00034 | U |
| | | Heptachlor epoxide | mg/Kg | -- | 0.053 | ca | | | | | | | | | | | | | 0.00026 | U |
| | | Methoxychlor | mg/Kg | -- | 31 | nc | | | | | | | | | | | | | 0.0043 | U |
| | | Toxaphene | mg/Kg | -- | 0 | 0 | | | | | | | | | | | | | 0.0087 | U |

## Table 4-3
## Summary of Surface Soil Results (0-1 ft bgs)

| | | | | | | | LL9SS-042-0001-SO | | LL9SS-043-0001-SO | | LL9SS-044-0001-SO | | LL9SS-045-0001-SO | | LL9SS-046-0001-SO | | LL9SS-047-0001-SO | | LL9SS-068-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Sample Date | 11/06/03 | | 11/06/03 | | 11/06/03 | | 11/06/03 | | 11/06/03 | | 11/06/03 | | 12/12/03 | |
| | | | | | | Sample Depth | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 0.3 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Surface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SS PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| Propellants 8330 | 353.2 | Nitrocellulose | mg/Kg | 0 | -- | 0 | | | | | | | | | | | | | 3.2 | B J |
| | 8330 | Nitroglycerin | mg/Kg | 0 | -- | 0 | | | | | | | | | | | | | 0.5 | U |
| | UV/HPLC per SOP | Nitroguanidine | mg/Kg | 0 | 611 | nc | | | | | | | | | | | | | 0.25 | U |
| SVOCs TCL 8270 C | 8270C | 1,2,4-Trichlorobenzene | mg/Kg | -- | 6.2 | nc | | | | | | | | | | | | | 0.11 | U |
| | | 1,2-Dichlorobenzene | mg/Kg | -- | 600 | sat | | | | | | | | | | | | | 0.15 | U |
| | | 1,3-Dichlorobenzene | mg/Kg | -- | 53 | nc | | | | | | | | | | | | | 0.15 | U |
| | | 1,4-Dichlorobenzene | mg/Kg | -- | 3.4 | ca | | | | | | | | | | | | | 0.13 | U |
| | | 2,2-oxybis (1-chloropropane) | mg/Kg | -- | 2.9 | ca | | | | | | | | | | | | | 0.14 | U |
| | | 2,4,5-Trichlorophenol | mg/Kg | -- | 611 | nc | | | | | | | | | | | | | 0.07 | U |
| | | 2,4,6-Trichlorophenol | mg/Kg | -- | 0.61 | nc | | | | | | | | | | | | | 0.087 | U |
| | | 2,4-Dichlorophenol | mg/Kg | -- | 18 | nc | | | | | | | | | | | | | 0.089 | U |
| | | 2,4-Dimethylphenol | mg/Kg | -- | 122 | nc | | | | | | | | | | | | | 0.11 | U |
| | | 2,4-Dinitrophenol | mg/Kg | -- | 12 | nc | | | | | | | | | | | | | 0.21 | U |
| | | 2-Chloronaphthalene | mg/Kg | -- | 494 | nc | | | | | | | | | | | | | 0.089 | U |
| | | 2-Chlorophenol | mg/Kg | -- | 6.3 | nc | | | | | | | | | | | | | 0.11 | U |
| | | 2-Methylnaphthalene | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | 0.015 | J |
| | | 2-Methylphenol (o-cresol) | mg/Kg | -- | 306 | nc | | | | | | | | | | | | | 0.016 | U |
| | | 2-Nitroaniline | mg/Kg | -- | 18.3 | nc | | | | | | | | | | | | | 0.063 | U |
| | | 2-Nitrophenol | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | 0.12 | U |
| | | 3,3-Dichlorobenzidine | mg/Kg | -- | 1.1 | ca | | | | | | | | | | | | | 0.033 | U |
| | | 3-Nitroaniline | mg/Kg | -- | 1.8 | nc | | | | | | | | | | | | | 0.21 | U |
| | | 4,6-Dinitro-2-methylphenol | mg/Kg | -- | 0.61 | nc | | | | | | | | | | | | | 0.18 | U |
| | | 4-Bromophenyl phenyl ether | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | 0.0057 | U |
| | | 4-Chloro-3-methylphenol | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | 0.07 | U |
| | | 4-Chloroaniline | mg/Kg | -- | 24 | nc | | | | | | | | | | | | | 0.18 | U |
| | | 4-Chlorophenyl phenyl ether | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | 0.0067 | U |
| | | 4-Methylphenol (m/p-cresol) | mg/Kg | -- | 31 | nc | | | | | | | | | | | | | 0.011 | U |
| | | 4-Nitroaniline | mg/Kg | -- | 23 | ca | | | | | | | | | | | | | 0.072 | U |
| | | 4-Nitrophenol | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | 0.15 | U |
| | | Acenaphthene | mg/Kg | -- | 368 | nc | | | | | | | | | | | | | 0.011 | J |
| | | Acenaphthylene | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | 0.05 | J |
| | | Anthracene | mg/Kg | -- | 2189 | nc | | | | | | | | | | | | | 0.048 | J |
| | | Benzo(a)anthracene | mg/Kg | -- | 0.62 | ca | | | | | | | | | | | | | 0.23 | |
| | | Benzo(a)pyrene | mg/Kg | -- | 0.062 | ca | | | | | | | | | | | | | **0.24** | |
| | | Benzo(b)fluoranthene | mg/Kg | -- | 0.62 | ca | | | | | | | | | | | | | 0.24 | M |
| | | Benzo(ghi)perylene | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | 0.17 | |
| | | Benzo(k)fluoranthene | mg/Kg | -- | 6.2 | ca | | | | | | | | | | | | | 0.2 | M |
| | | Bis(2-chloroethoxy)methane | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | 0.0054 | U |
| | | Bis(2-chloroethyl)ether | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | 0.0037 | U |
| | | Bis(2-ethylhexyl)phthalate | mg/Kg | -- | 35 | ca | | | | | | | | | | | | | 0.03 | J |
| | | Butyl benzyl phthalate | mg/Kg | -- | 1222 | nc | | | | | | | | | | | | | 0.0076 | U |
| | | Carbazole | mg/Kg | -- | 24 | ca | | | | | | | | | | | | | 0.065 | U |
| | | Chrysene | mg/Kg | -- | 62 | ca | | | | | | | | | | | | | 0.25 | |
| | | Dibenzo(a,h)anthracene | mg/Kg | -- | 0.062 | ca | | | | | | | | | | | | | **0.13** | |

## Table 4-3
## Summary of Surface Soil Results (0-1 ft bgs)

| | | | | | | | LL9SS-042-0001-SO | | LL9SS-043-0001-SO | | LL9SS-044-0001-SO | | LL9SS-045-0001-SO | | LL9SS-046-0001-SO | | LL9SS-047-0001-SO | | LL9SS-068-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 11/06/03 | | 11/06/03 | | 11/06/03 | | 11/06/03 | | 11/06/03 | | 11/06/03 | | 12/12/03 | |
| | | | | | | **Sample Depth** | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 0.3 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Surface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SS PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| | | Dibenzofuran | mg/Kg | -- | 15 | nc | | | | | | | | | | | | | 0.013 | J |
| | | Diethyl phthalate | mg/Kg | -- | 4888 | nc | | | | | | | | | | | | | 0.0068 | U |
| | | Dimethyl phthalate | mg/Kg | -- | 100000 | max | | | | | | | | | | | | | 0.0067 | U |
| | | Di-n-butyl phthalate | mg/Kg | -- | 611 | nc | | | | | | | | | | | | | 0.037 | U |
| | | Di-n-octyl phthalate | mg/Kg | -- | 244 | nc | | | | | | | | | | | | | 0.016 | U |
| | | Fluoranthene | mg/Kg | -- | 229 | nc | | | | | | | | | | | | | 0.36 | |
| | | Fluorene | mg/Kg | -- | 275 | nc | | | | | | | | | | | | | 0.025 | J |
| | | Hexachlorobenzene | mg/Kg | -- | 0.30 | ca | | | | | | | | | | | | | 0.0033 | U |
| | | Hexachlorobutadiene | mg/Kg | -- | 6.2 | ca | | | | | | | | | | | | | 0.0061 | U |
| | | Hexachlorocyclopentadiene | mg/Kg | -- | 37 | nc | | | | | | | | | | | | | 0.1 | U |
| | | Hexachloroethane | mg/Kg | -- | 35 | ca | | | | | | | | | | | | | 0.0061 | U |
| | | Indeno(1,2,3-cd)pyrene | mg/Kg | -- | 0.62 | ca | | | | | | | | | | | | | 0.17 | |
| | | Isophorone | mg/Kg | -- | 512 | ca | | | | | | | | | | | | | 0.0044 | U |
| | | Naphthalene | mg/Kg | -- | 5.6 | nc | | | | | | | | | | | | | 0.019 | J |
| | | n-Nitroso-di-n-propylamine | mg/Kg | -- | 0.069 | ca | | | | | | | | | | | | | 0.0043 | U |
| | | n-Nitrosodiphenylamine | mg/Kg | -- | 99 | ca | | | | | | | | | | | | | 0.0054 | U |
| | | Pentachlorophenol | mg/Kg | -- | 3.0 | ca | | | | | | | | | | | | | 0.18 | U |
| | | Phenanthrene | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | 0.28 | |
| | | Phenol | mg/Kg | -- | 1833 | nc | | | | | | | | | | | | | 0.003 | U |
| | | Pyrene | mg/Kg | -- | 232 | nc | | | | | | | | | | | | | 0.4 | |
| TAL Metals 6010B | 6010B | Aluminum | mg/Kg | 17700 | 7614 | nc | 7200 | | **10000** | | **12000** | | **13000** | | **8900** | | **8600** | | **8400** | |
| | | Barium | mg/Kg | 88.4 | 538 | nc | 41 | | 57 | | 85 | | 40 | | 53 | | 61 | | 110 | |
| | | Beryllium | mg/Kg | 0.88 | 15 | nc | 0.47 | | 0.47 | | 0.27 | B | 0.48 | | 0.42 | B | 0.26 | B | 0.54 | B |
| | | Cadmium | mg/Kg | 0.00 | 3.7 | nc | 0.078 | U | 0.086 | U | 0.09 | U | 0.082 | U | 0.09 | U | 0.088 | U | 2.7 | |
| | | Calcium | mg/Kg | 15800 | -- | 0 | 470 | | 630 | | 2800 | | 750 | | 890 | | 770 | | 1900 | |
| | | Chromium | mg/Kg | 17.4 | 30 | ca | 10 | | 13 | | 16 | | 17 | | 13 | | 12 | | 15 | |
| | | Cobalt | mg/Kg | 10.4 | 902 | ca | 9.2 | | 9.3 | | 4.2 | | 8.6 | | 11 | | 6.4 | | 6.8 | |
| | | Copper | mg/Kg | 17.7 | 313 | nc | 11 | | 13 | | 9.7 | | 25 | | 21 | | 15 | | 170 | |
| | | Iron | mg/Kg | 23100 | 2346 | nc | **18000** | | **20000** | | **17000** | | **31000** | | **25000** | | **16000** | | **20000** | |
| | | Magnesium | mg/Kg | 3030 | -- | 0 | 1700 | | 2400 | | 2200 | | 2900 | | 3000 | | 2000 | | 1200 | |
| | | Manganese | mg/Kg | 1450 | 176 | nc | **610** | | **440** | | 150 | | **240** | | **370** | | **690** | | **700** | |
| | | Nickel | mg/Kg | 21.1 | 156 | nc | 13 | | 17 | | 19 | | 21 | | 24 | | 13 | | 15 | |
| | | Potassium | mg/Kg | 927 | -- | 0 | 710 | | 860 | | 770 | | 1200 | | 900 | | 890 | | 680 | |
| | | Selenium | mg/Kg | 1.4 | 39 | nc | 0.39 | B | 0.62 | B | 0.45 | U | 0.41 | U | 0.45 | U | 0.45 | B | 1.8 | B |
| | | Silver | mg/Kg | 0.00 | 39 | nc | 0.3 | U | 0.33 | U | 0.35 | U | 0.32 | U | 0.35 | U | 0.34 | U | 0.57 | U |
| | | Sodium | mg/Kg | 123 | -- | 0 | 930 | | 1100 | | 1200 | | 1100 | | 1300 | | 1200 | | 170 | B |
| | | Vanadium | mg/Kg | 31.1 | 7.8 | nc | **13** | | **17** | | **13** | | **20** | | **14** | | **13** | | **16** | |
| | | Zinc | mg/Kg | 61.8 | 2346 | nc | 46 | | 50 | | 40 | | 62 | | 63 | | 45 | | 780 | |
| | 7041 | Antimony | mg/Kg | 0.96 | 3.1 | nc | 0.41 | U | 0.49 | U | 0.47 | U | 0.49 | U | 0.54 | B | 0.52 | U | 0.79 | U |
| | 7060A | Arsenic | mg/Kg | 15.4 | 0.39 | ca | **4** | | **9.2** | | **18** | | **17** | | **18** | | **15** | | **7.3** | |
| | 7421 | Lead | mg/Kg | 26.1 | 400 | pbk | 9.2 | | 14 | | 10 | | 16 | | 13 | | 12 | | 150 | |
| | 7471A | Mercury | mg/Kg | 0.04 | 2.3 | nc | 0.0076 | B | 0.026 | | 0.0057 | B | 0.0081 | B | 0.016 | B | 0.063 | | 0.21 | |
| | 7841 | Thallium | mg/Kg | 0.00 | 0.52 | nc | 0.89 | U | 0.21 | U | 1 | U | 0.21 | U | 1 | U | 1.1 | U | 0.34 | U |

## Table 4-3
## Summary of Surface Soil Results (0-1 ft bgs)

| | | | | | | | LL9SS-042-0001-SO | | LL9SS-043-0001-SO | | LL9SS-044-0001-SO | | LL9SS-045-0001-SO | | LL9SS-046-0001-SO | | LL9SS-047-0001-SO | | LL9SS-068-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 11/06/03 | | 11/06/03 | | 11/06/03 | | 11/06/03 | | 11/06/03 | | 11/06/03 | | 12/12/03 | |
| | | | | | | **Sample Depth** | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 1 ft | | 0 - 0.3 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Surface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SS PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| VOCs TCL 8260B | 8260B | 1,1,1-Trichloroethane | mg/Kg | -- | 1200 | sat | | | | | | | | | | | | | 0.0021 | U |
| | | 1,1,2,2-Tetrachloroethane | mg/Kg | -- | 0.41 | ca | | | | | | | | | | | | | 0.0018 | U |
| | | 1,1,2-Trichloroethane | mg/Kg | -- | 0.73 | ca | | | | | | | | | | | | | 0.0021 | U |
| | | 1,1-Dichloroethane | mg/Kg | -- | 51 | nc | | | | | | | | | | | | | 0.0019 | U |
| | | 1,1-Dichloroethene | mg/Kg | -- | 12 | nc | | | | | | | | | | | | | 0.0025 | U |
| | | 1,2-Dichloroethane | mg/Kg | -- | 0.28 | ca | | | | | | | | | | | | | 0.0018 | U |
| | | 1,2-Dichloroethene (total) | mg/Kg | -- | 6.9 | nc | | | | | | | | | | | | | 0.004 | U |
| | | 1,2-Dichloropropane | mg/Kg | -- | 0.34 | ca | | | | | | | | | | | | | 0.0019 | U |
| | | 2-Butanone (MEK) | mg/Kg | -- | 2231 | nc | | | | | | | | | | | | | 0.0074 | U |
| | | 2-Hexanone | mg/Kg | -- | 530 | nc | | | | | | | | | | | | | 0.0021 | U |
| | | 4-Methyl-2-pentanone (MIBK) | mg/Kg | -- | 528 | nc | | | | | | | | | | | | | 0.0019 | U* |
| | | Acetone | mg/Kg | -- | 1412 | nc | | | | | | | | | | | | | 0.0087 | U |
| | | Benzene | mg/Kg | -- | 0.64 | ca | | | | | | | | | | | | | 0.0021 | U |
| | | Bromodichloromethane | mg/Kg | -- | 0.82 | ca | | | | | | | | | | | | | 0.0018 | U |
| | | Bromoform | mg/Kg | -- | 62 | ca | | | | | | | | | | | | | 0.0014 | U |
| | | Bromomethane | mg/Kg | -- | 0.39 | nc | | | | | | | | | | | | | 0.0025 | U |
| | | Carbon disulfide | mg/Kg | -- | 36 | nc | | | | | | | | | | | | | 0.0023 | U |
| | | Carbon tetrachloride | mg/Kg | -- | 0.25 | ca | | | | | | | | | | | | | 0.0021 | U |
| | | Chlorobenzene | mg/Kg | -- | 15 | nc | | | | | | | | | | | | | 0.0021 | U |
| | | Chloroethane | mg/Kg | -- | 3.0 | ca | | | | | | | | | | | | | 0.0019 | U |
| | | Chloroform | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | 0.0021 | U |
| | | Chloromethane | mg/Kg | -- | 4.7 | nc | | | | | | | | | | | | | 0.0021 | U |
| | | cis-1,3-Dichloropropene | mg/Kg | -- | 0.78 | ca | | | | | | | | | | | | | 0.0018 | U |
| | | Dibromochloromethane | mg/Kg | -- | 1.1 | ca | | | | | | | | | | | | | 0.0015 | U |
| | | Ethylbenzene | mg/Kg | -- | 395 | sat | | | | | | | | | | | | | 0.0021 | U |
| | | Methylene chloride | mg/Kg | -- | 9.1 | ca | | | | | | | | | | | | | 0.0055 | U |
| | | Styrene | mg/Kg | -- | 1700 | sat | | | | | | | | | | | | | 0.0021 | U |
| | | Tetrachloroethene | mg/Kg | -- | 0.48 | ca | | | | | | | | | | | | | 0.0023 | U |
| | | Toluene | mg/Kg | -- | 520 | sat | | | | | | | | | | | | | 0.0021 | U |
| | | trans-1,3-Dichloropropene | mg/Kg | -- | 0.78 | ca | | | | | | | | | | | | | 0.0015 | U |
| | | Trichloroethene | mg/Kg | -- | 0.053 | ca | | | | | | | | | | | | | 0.0021 | U |
| | | Vinyl chloride | mg/Kg | -- | 0.079 | ca | | | | | | | | | | | | | 0.0021 | U |
| | | Xylenes (total) | mg/Kg | -- | 0.079 | ca | | | | | | | | | | | | | 0.0064 | U |

## Table 4-3
## Summary of Surface Soil Results (0-1 ft bgs)

**Notes:**

-- - no background/PRG value is available for this analyte
blank cell indicates that the analysis was not performed
PRG - preliminary remediation goals
(The PRG for lead is the Maximum Contaminant Level (MCL)
nc - non-cancer basis
ca - cancer basis
pbk - based on PBK modeling
mcl - based on CWA maximum contaminant level
max - ceiling limit
sat - soil saturation
[n] - nutrient
UC - unconsolidated
If Result = or > Background, then the value is presented with a shaded/highlighted style
If Result = or > Background and PRG, then the value is presented
with a bold + shaded/highlighted style
If Result = or > PRG, then the value is presented with a bold style
If Result < PRG and Background, then the value is presented with a normal style

**Inorganic Qualifiers**
U - analyte was not detected at or above the stated limit
J - result is less than the RL, but greater than or equal to the MDL
B - result is less than the CRDL/RL, but greater than or equal to the IDL/MDL

**InOrganic Flags**
^ - instrument related QC exceed the upper or lower control limits
* - batch QC exceeds the upper or lower control limit
H - batch QC is greater than RL

**Organic Qualifiers**
U - analyte was not detected at or above the stated limit
J - result is an estimated value below the RL

**Organic Flags**
B - Method Blank: batch QC is greater than R
* - batch QC exceeds the upper or lower control limit
^ - batch QC is greater than RL
a - concentration is below the method Reporting Limit (RL)
H - alternate peak selection upon analytical review

## Table 4-4
## Summary of Subsurface Soil Results (>1 ft bgs)

| | | | | | | | LL9SB-001-0001-SO | | LL9SB-002-0001-SO | | LL9SB-003-0001-SO | | LL9SB-004-0001-SO | | LL9SB-005-0001-DUP | | LL9SB-005-0001-SO | | LL9SB-006-0001-SO | | LL9SB-007-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/11/03 | | 12/08/03 | |
| | | | | | | **Sample Depth** | 1 - 3 ft | | 1 - 3 ft | | 1 - 2 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 2 ft | | 1 - 3 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Subsurface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SB PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| Cyanide 9012A | 9014/9010B | Cyanide, Total | mg/Kg | 0.00 | 122 | nc | | | | | | | | | 0.17 | U | 0.25 | U | | | | |
| Explosives 8330 | 8330 | 1,3,5-Trinitrobenzene | mg/Kg | 0 | 183 | nc | 0.017 | U | | | | | | | 0.017 | U | 0.018 | U | | | | |
| | | 1,3-Dinitrobenzene | mg/Kg | 0 | 0.61 | nc | 0.017 | U | | | | | | | 0.018 | U | 0.018 | U | | | | |
| | | 2,4,6-TNT | mg/Kg | 0 | 16 | ca | 0.033 | U | | | | | | | 0.034 | U | 0.034 | U | | | | |
| | | 2,4-Dinitrotoluene | mg/Kg | 0 | 12 | nc | 0.035 | U | | | | | | | 0.035 | U | 0.036 | U | | | | |
| | | 2,6-Dinitrotoluene | mg/Kg | 0 | 6.1 | nc | 0.047 | U* | | | | | | | 0.047 | U* | 0.048 | U* | | | | |
| | | 2-Nitrotoluene | mg/Kg | 0 | 0.88 | ca | 0.033 | U | | | | | | | 0.033 | U | 0.033 | U | | | | |
| | | 3-Nitrotoluene | mg/Kg | 0 | 73 | nc | 0.049 | U | | | | | | | 0.05 | U | 0.05 | U | | | | |
| | | 4-Nitrotoluene | mg/Kg | 0 | 12 | ca | 0.046 | U | | | | | | | 0.046 | U | 0.047 | U | | | | |
| | | HMX | mg/Kg | 0 | 306 | nc | 0.11 | U | | | | | | | 0.11 | U | 0.11 | U | | | | |
| | | Nitrobenzene | mg/Kg | 0 | 2 | nc | 0.022 | U | | | | | | | 0.022 | U | 0.022 | U | | | | |
| | | RDX | mg/Kg | 0 | 4.4 | ca | 0.057 | U | | | | | | | 0.058 | U | 0.059 | U | | | | |
| | | Tetryl | mg/Kg | 0 | 61 | nc | 0.043 | U | | | | | | | 0.043 | U | 0.043 | U | | | | |
| Others | 8015B MDRO | Diesel Range Organics (DRO) | mg/Kg | -- | -- | -- | | | | | | | | | | | | | | | | |
| | 8015B MGRO | Gasoline Range Organics (GRO) | mg/Kg | -- | -- | -- | | | | | | | | | | | | | | | | |
| PCB TCL 8082 | 8082 | Aroclor 1016 | mg/Kg | -- | 0.39 | nc | | | | | | | | | 0.0023 | U | 0.0022 | U | | | | |
| | | Aroclor 1221 | mg/Kg | -- | 0.22 | ca | | | | | | | | | 0.0024 | U | 0.0023 | U | | | | |
| | | Aroclor 1232 | mg/Kg | -- | 0.22 | ca | | | | | | | | | 0.0024 | U | 0.0023 | U | | | | |
| | | Aroclor 1242 | mg/Kg | -- | 0.22 | ca | | | | | | | | | 0.0024 | U | 0.0023 | U | | | | |
| | | Aroclor 1248 | mg/Kg | -- | 0.22 | ca | | | | | | | | | 0.0024 | U | 0.0023 | U | | | | |
| | | Aroclor 1254 | mg/Kg | -- | 0.22 | ca | | | | | | | | | 0.0024 | U | 0.0023 | U | | | | |
| | | Aroclor 1260 | mg/Kg | -- | 0.22 | ca | | | | | | | | | 0.0017 | U | 0.0016 | U | | | | |
| Pesticides 8081A | 8081A | 4,4'-DDD | mg/Kg | -- | 2.4 | ca | | | | | | | | | 0.00043 | U | 0.00041 | U | | | | |
| | | 4,4'-DDE | mg/Kg | -- | 1.7 | ca | | | | | | | | | 0.00078 | U | 0.00075 | U | | | | |
| | | 4,4'-DDT | mg/Kg | -- | 1.7 | ca | | | | | | | | | 0.00044 | U | 0.00043 | U | | | | |
| | | Aldrin | mg/Kg | -- | 0.029 | ca | | | | | | | | | 0.00016 | U | 0.00015 | U | | | | |
| | | alpha-BHC | mg/Kg | -- | 0.09 | sat | | | | | | | | | 0.00019 | U | 0.00018 | U | | | | |
| | | alpha-Chlordane | mg/Kg | -- | 1.6 | ca | | | | | | | | | 0.00014 | U | 0.00014 | U | | | | |
| | | beta-BHC | mg/Kg | -- | 0.32 | ca | | | | | | | | | 0.00018 | U | 0.00017 | U | | | | |
| | | delta-BHC | mg/Kg | -- | -- | 0 | | | | | | | | | 0.00013 | U | 0.00013 | U | | | | |
| | | Dieldrin | mg/Kg | -- | 0.030 | ca | | | | | | | | | 0.00041 | U | 0.00039 | U | | | | |
| | | Endosulfan I | mg/Kg | -- | 37 | nc | | | | | | | | | 0.00032 | U | 0.00031 | U | | | | |
| | | Endosulfan II | mg/Kg | -- | 37 | nc | | | | | | | | | 0.00034 | U | 0.00032 | U | | | | |
| | | Endosulfan sulfate | mg/Kg | -- | 37 | nc | | | | | | | | | 0.00035 | U | 0.00033 | U | | | | |
| | | Endrin | mg/Kg | -- | 1.8 | nc | | | | | | | | | 0.00052 | U | 0.0005 | U | | | | |
| | | Endrin aldehyde | mg/Kg | -- | -- | 0 | | | | | | | | | 0.0004 | U | 0.00038 | U | | | | |
| | | Endrin ketone | mg/Kg | -- | -- | 0 | | | | | | | | | 0.00035 | U | 0.00033 | U | | | | |
| | | gamma-BHC (Lindane) | mg/Kg | -- | 0.44 | ca | | | | | | | | | 0.00028 | U | 0.00027 | U | | | | |
| | | gamma-Chlordane | mg/Kg | -- | 1.6 | ca | | | | | | | | | 0.00018 | U | 0.00017 | U | | | | |
| | | Heptachlor | mg/Kg | -- | 0.11 | ca | | | | | | | | | 0.00022 | U | 0.00021 | U | | | | |
| | | Heptachlor epoxide | mg/Kg | -- | 0.053 | ca | | | | | | | | | 0.00017 | U | 0.00016 | U | | | | |
| | | Methoxychlor | mg/Kg | -- | 31 | nc | | | | | | | | | 0.0028 | U | 0.0027 | U | | | | |
| | | Toxaphene | mg/Kg | -- | 0 | 0 | | | | | | | | | 0.0055 | U | 0.0053 | U | | | | |

## Table 4-4
## Summary of Subsurface Soil Results (>1 ft bgs)

| | | | | | | | LL9SB-001-0001-SO | | LL9SB-002-0001-SO | | LL9SB-003-0001-SO | | LL9SB-004-0001-SO | | LL9SB-005-0001-DUP | | LL9SB-005-0001-SO | | LL9SB-006-0001-SO | | LL9SB-007-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/11/03 | | 12/08/03 | |
| | | | | | | **Sample Depth** | 1 - 3 ft | | 1 - 3 ft | | 1 - 2 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 2 ft | | 1 - 3 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Subsurface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SB PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| Propellants 8330 | 353.2 | Nitrocellulose | mg/Kg | 0 | -- | 0 | | | | | | | | | 2.7 | J | 1.2 | B J | | | | |
| | 8330 | Nitroglycerin | mg/Kg | 0 | -- | 0 | | | | | | | | | 0.5 | U | 0.5 | U | | | | |
| | UV/HPLC per SOP | Nitroguanidine | mg/Kg | 0 | 611 | nc | | | | | | | | | 0.25 | U | 0.25 | U | | | | |
| SVOCs TCL 8270 C | 8270C | 1,2,4-Trichlorobenzene | mg/Kg | -- | 6.2 | nc | | | | | | | | | 0.073 | U | 0.07 | U | | | | |
| | | 1,2-Dichlorobenzene | mg/Kg | -- | 600 | sat | | | | | | | | | 0.097 | U | 0.094 | U | | | | |
| | | 1,3-Dichlorobenzene | mg/Kg | -- | 53 | nc | | | | | | | | | 0.097 | U | 0.094 | U | | | | |
| | | 1,4-Dichlorobenzene | mg/Kg | -- | 3.4 | ca | | | | | | | | | 0.087 | U | 0.085 | U | | | | |
| | | 2,2-oxybis (1-chloropropane) | mg/Kg | -- | 2.9 | ca | | | | | | | | | 0.092 | U | 0.089 | U | | | | |
| | | 2,4,5-Trichlorophenol | mg/Kg | -- | 611 | nc | | | | | | | | | 0.047 | U | 0.045 | U | | | | |
| | | 2,4,6-Trichlorophenol | mg/Kg | -- | 0.61 | nc | | | | | | | | | 0.058 | U | 0.056 | U | | | | |
| | | 2,4-Dichlorophenol | mg/Kg | -- | 18 | nc | | | | | | | | | 0.059 | U | 0.057 | U | | | | |
| | | 2,4-Dimethylphenol | mg/Kg | -- | 122 | nc | | | | | | | | | 0.074 | U | 0.071 | U | | | | |
| | | 2,4-Dinitrophenol | mg/Kg | -- | 12 | nc | | | | | | | | | 0.14 | U | 0.14 | U | | | | |
| | | 2-Chloronaphthalene | mg/Kg | -- | 494 | nc | | | | | | | | | 0.059 | U | 0.057 | U | | | | |
| | | 2-Chlorophenol | mg/Kg | -- | 6.3 | nc | | | | | | | | | 0.073 | U | 0.07 | U | | | | |
| | | 2-Methylnaphthalene | mg/Kg | -- | -- | 0 | | | | | | | | | 0.0018 | U | 0.0018 | U | | | | |
| | | 2-Methylphenol (o-cresol) | mg/Kg | -- | 306 | nc | | | | | | | | | 0.01 | U | 0.01 | U | | | | |
| | | 2-Nitroaniline | mg/Kg | -- | 18.3 | nc | | | | | | | | | 0.042 | U | 0.04 | U | | | | |
| | | 2-Nitrophenol | mg/Kg | -- | -- | 0 | | | | | | | | | 0.078 | U | 0.075 | U | | | | |
| | | 3,3-Dichlorobenzidine | mg/Kg | -- | 1.1 | ca | | | | | | | | | 0.022 | U | 0.021 | U | | | | |
| | | 3-Nitroaniline | mg/Kg | -- | 1.8 | nc | | | | | | | | | 0.14 | U | 0.13 | U | | | | |
| | | 4,6-Dinitro-2-methylphenol | mg/Kg | -- | 0.61 | nc | | | | | | | | | 0.12 | U* | 0.11 | U* | | | | |
| | | 4-Bromophenyl phenyl ether | mg/Kg | -- | -- | 0 | | | | | | | | | 0.0038 | U | 0.0037 | U | | | | |
| | | 4-Chloro-3-methylphenol | mg/Kg | -- | -- | 0 | | | | | | | | | 0.047 | U | 0.045 | U | | | | |
| | | 4-Chloroaniline | mg/Kg | -- | 24 | nc | | | | | | | | | 0.12 | U | 0.12 | U | | | | |
| | | 4-Chlorophenyl phenyl ether | mg/Kg | -- | -- | 0 | | | | | | | | | 0.0044 | U | 0.0043 | U | | | | |
| | | 4-Methylphenol (m/p-cresol) | mg/Kg | -- | 31 | nc | | | | | | | | | 0.0071 | U | 0.0069 | U | | | | |
| | | 4-Nitroaniline | mg/Kg | -- | 23 | ca | | | | | | | | | 0.048 | U | 0.046 | U | | | | |
| | | 4-Nitrophenol | mg/Kg | -- | -- | 0 | | | | | | | | | 0.1 | U | 0.098 | U | | | | |
| | | Acenaphthene | mg/Kg | -- | 368 | nc | | | | | | | | | 0.0017 | U | 0.0017 | U | | | | |
| | | Acenaphthylene | mg/Kg | -- | -- | 0 | | | | | | | | | 0.0011 | U | 0.0011 | U | | | | |
| | | Anthracene | mg/Kg | -- | 2189 | nc | | | | | | | | | 0.0011 | U | 0.001 | U | | | | |
| | | Benzo(a)anthracene | mg/Kg | -- | 0.62 | ca | | | | | | | | | 0.0014 | U | 0.0013 | U | | | | |
| | | Benzo(a)pyrene | mg/Kg | -- | 0.062 | ca | | | | | | | | | 0.0027 | U | 0.0026 | U | | | | |
| | | Benzo(b)fluoranthene | mg/Kg | -- | 0.62 | ca | | | | | | | | | 0.0026 | U | 0.0025 | U | | | | |
| | | Benzo(ghi)perylene | mg/Kg | -- | -- | 0 | | | | | | | | | 0.0038 | J | 0.0023 | U | | | | |
| | | Benzo(k)fluoranthene | mg/Kg | -- | 6.2 | ca | | | | | | | | | 0.0034 | U | 0.0033 | U | | | | |
| | | Bis(2-chloroethoxy)methane | mg/Kg | -- | -- | 0 | | | | | | | | | 0.0036 | U | 0.0035 | U | | | | |
| | | Bis(2-chloroethyl)ether | mg/Kg | -- | 0.22 | ca | | | | | | | | | 0.0025 | U | 0.0024 | U | | | | |
| | | Bis(2-ethylhexyl)phthalate | mg/Kg | -- | 35 | ca | | | | | | | | | 0.012 | U | 0.011 | U | | | | |

## Table 4-4
## Summary of Subsurface Soil Results (>1 ft bgs)

| | | | | | | | LL9SB-001-0001-SO | | LL9SB-002-0001-SO | | LL9SB-003-0001-SO | | LL9SB-004-0001-SO | | LL9SB-005-0001-DUP | | LL9SB-005-0001-SO | | LL9SB-006-0001-SO | | LL9SB-007-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/11/03 | | 12/08/03 | |
| | | | | | | **Sample Depth** | 1 - 3 ft | | 1 - 3 ft | | 1 - 2 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 2 ft | | 1 - 3 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Subsurface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SB PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| | | Butyl benzyl phthalate | mg/Kg | -- | 1222 | nc | | | | | | | | | 0.005 | U | 0.0049 | U | | | | |
| | | Carbazole | mg/Kg | -- | 24 | ca | | | | | | | | | 0.043 | U | 0.042 | U | | | | |
| | | Chrysene | mg/Kg | -- | 62 | ca | | | | | | | | | 0.0022 | U | 0.0021 | U | | | | |
| | | Dibenzo(a,h)anthracene | mg/Kg | -- | 0.062 | ca | | | | | | | | | 0.0027 | U | 0.0026 | U | | | | |
| | | Dibenzofuran | mg/Kg | -- | 15 | nc | | | | | | | | | 0.0033 | U | 0.0032 | U | | | | |
| | | Diethyl phthalate | mg/Kg | -- | 4888 | nc | | | | | | | | | 0.0046 | U | 0.0044 | U | | | | |
| | | Dimethyl phthalate | mg/Kg | -- | 100000 | max | | | | | | | | | 0.0044 | U | 0.0043 | U | | | | |
| | | Di-n-butyl phthalate | mg/Kg | -- | 611 | nc | | | | | | | | | 0.025 | U | 0.024 | U | | | | |
| | | Di-n-octyl phthalate | mg/Kg | -- | 244 | nc | | | | | | | | | 0.011 | U | 0.01 | U | | | | |
| | | Fluoranthene | mg/Kg | -- | 229 | nc | | | | | | | | | 0.0014 | U | 0.0013 | U | | | | |
| | | Fluorene | mg/Kg | -- | 275 | nc | | | | | | | | | 0.002 | U | 0.0019 | U | | | | |
| | | Hexachlorobenzene | mg/Kg | -- | 0.30 | ca | | | | | | | | | 0.0022 | U | 0.0021 | U | | | | |
| | | Hexachlorobutadiene | mg/Kg | -- | 6.2 | ca | | | | | | | | | 0.0041 | U | 0.0039 | U | | | | |
| | | Hexachlorocyclopentadiene | mg/Kg | -- | 37 | nc | | | | | | | | | 0.066 | U | 0.064 | U | | | | |
| | | Hexachloroethane | mg/Kg | -- | 35 | ca | | | | | | | | | 0.0041 | U | 0.0039 | U | | | | |
| | | Indeno(1,2,3-cd)pyrene | mg/Kg | -- | 0.62 | ca | | | | | | | | | 0.018 | J | 0.017 | J | | | | |
| | | Isophorone | mg/Kg | -- | 512 | ca | | | | | | | | | 0.003 | U | 0.0029 | U | | | | |
| | | Naphthalene | mg/Kg | -- | 5.6 | nc | | | | | | | | | 0.0021 | U | 0.002 | U | | | | |
| | | n-Nitroso-di-n-propylamine | mg/Kg | -- | 0.069 | ca | | | | | | | | | 0.0028 | U | 0.0027 | U | | | | |
| | | n-Nitrosodiphenylamine | mg/Kg | -- | 99 | ca | | | | | | | | | 0.0036 | U | 0.0035 | U | | | | |
| | | Pentachlorophenol | mg/Kg | -- | 3.0 | ca | | | | | | | | | 0.12 | U | 0.12 | U | | | | |
| | | Phenanthrene | mg/Kg | -- | -- | 0 | | | | | | | | | 0.0012 | U | 0.0012 | U | | | | |
| | | Phenol | mg/Kg | -- | 1833 | nc | | | | | | | | | 0.002 | U | 0.0019 | U | | | | |
| | | Pyrene | mg/Kg | -- | 232 | nc | | | | | | | | | 0.0025 | U | 0.0024 | U | | | | |
| TAL Metals 6010B | 6010B | Aluminum | mg/Kg | 19500 | 7614 | nc | 7500 | | **10000** | | 6600 | | **8200** | | **11000** | | **11000** | | 7000 | | **12000** | |
| | | Barium | mg/Kg | 124 | 538 | nc | 30 | | 64 | | 26 | | 50 | | 80 | | 70 | | 66 | | 75 | |
| | | Beryllium | mg/Kg | 0.88 | 15 | nc | 0.33 | B | 0.44 | B | 0.38 | B | 0.43 | | 0.8 | | 0.63 | | 0.31 | B | 0.55 | |
| | | Cadmium | mg/Kg | 0.00 | 3.7 | nc | 0.091 | U | 0.092 | U | 0.085 | U | 0.084 | U | 0.091 | U | 0.09 | U | 2 | | 0.13 | B |
| | | Calcium | mg/Kg | 35500 | -- | 0 | 800 | | 4300 | | 530 | | 1100 | | 360 | | 330 | | 2700 | | 1900 | |
| | | Chromium | mg/Kg | 27.2 | 30 | ca | 10 | | 16 | | 8.4 | | 10 | | 13 | | 13 | | 11 | | 16 | |
| | | Cobalt | mg/Kg | 23.2 | 902 | ca | 6.8 | | 8 | | 5.5 | | 3.8 | | 11 | | 11 | | 6.2 | | 10 | |
| | | Copper | mg/Kg | 32.3 | 313 | nc | 27 | | 19 | | 17 | | 6.5 | | 9.3 | | 9.1 | | 15 | | 21 | H |
| | | Iron | mg/Kg | 35200 | 2346 | nc | **23000** | | **23000** | | **16000** | | **18000** | | **17000** | | **15000** | | **14000** | H | **23000** | |
| | | Magnesium | mg/Kg | 8790 | -- | 0 | 2100 | | 2200 | | 1600 | | 1200 | | 1700 | | 1600 | | 1500 | | 2700 | |
| | | Manganese | mg/Kg | 3030 | 176 | nc | **400** | | **600** | | **310** | | **200** | | **1300** | | **1100** | | **520** | | **570** | |
| | | Nickel | mg/Kg | 60.7 | 156 | nc | 18 | | 17 | | 13 | | 7.1 | | 16 | | 14 | | 12 | | 21 | |
| | | Potassium | mg/Kg | 3350 | -- | 0 | 630 | | 660 | | 480 | | 490 | | 560 | | 550 | | 550 | | 1100 | |
| | | Selenium | mg/Kg | 1.5 | 39 | nc | 0.45 | U | 0.77 | B | 0.43 | U | 0.42 | U | 0.91 | B | 0.69 | B | 0.38 | B | 0.46 | U |
| | | Silver | mg/Kg | 0.00 | 39 | nc | 0.35 | U | 0.36 | U | 0.33 | U | 0.32 | U | 0.35 | U | 0.35 | U | 0.34 | U | 0.36 | U |
| | | Sodium | mg/Kg | 145 | -- | 0 | 98 | U | 99 | U | 93 | U | 91 | U | 99 | U | 97 | U | 95 | U | 100 | U |
| | | Vanadium | mg/Kg | 37.6 | 7.8 | nc | **13** | | **19** | | **11** | | **15** | | **18** | | **17** | | **13** | | **21** | |
| | | Zinc | mg/Kg | 93.3 | 2346 | nc | 60 | | 68 | | 48 | | 37 | | 49 | | 45 | | 120 | | 62 | |

## Table 4-4
## Summary of Subsurface Soil Results (>1 ft bgs)

| | | | | | | | LL9SB-001-0001-SO | | LL9SB-002-0001-SO | | LL9SB-003-0001-SO | | LL9SB-004-0001-SO | | LL9SB-005-0001-DUP | | LL9SB-005-0001-SO | | LL9SB-006-0001-SO | | LL9SB-007-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/11/03 | | 12/08/03 | |
| | | | | | | **Sample Depth** | 1 - 3 ft | | 1 - 3 ft | | 1 - 2 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 2 ft | | 1 - 3 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Subsurface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SB PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| | 7041 | Antimony | mg/Kg | 0.96 | 3.1 | nc | 0.52 | U | 0.48 | U | 0.48 | U | 0.5 | U | 0.53 | U | 0.48 | U | 0.48 | U | 0.5 | U |
| | 7060A | Arsenic | mg/Kg | 19.8 | 0.39 | ca | **12** | | **12** | | **9.8** | | **8.5** | | **9** | | **7.7** | | **9.9** | | **14** | |
| | 7421 | Lead | mg/Kg | 19.1 | 400 | pbk | 9.2 | | 24 | | 10 | | 9.9 | | 12 | | 11 | | 54 | | 19 | |
| | 7471A | Mercury | mg/Kg | 0.04 | 2.3 | nc | 0.021 | | 0.076 | | 0.022 | | 0.019 | B | 0.039 | | 0.034 | | 0.94 | | 0.025 | |
| | 7841 | Thallium | mg/Kg | 0.91 | 0.52 | nc | 0.23 | U | 0.21 | U | 0.21 | U | 0.22 | U | 0.23 | U | 0.21 | U | 0.21 | U | 0.22 | U |
| VOCs TCL 8260B | 8260B | 1,1,1-Trichloroethane | mg/Kg | -- | 1200 | sat | | | | | | | | | 0.0014 | U | 0.0013 | U | | | | |
| | | 1,1,2,2-Tetrachloroethane | mg/Kg | -- | 0.41 | ca | | | | | | | | | 0.0012 | U | 0.0012 | U | | | | |
| | | 1,1,2-Trichloroethane | mg/Kg | -- | 0.73 | ca | | | | | | | | | 0.0014 | U | 0.0013 | U | | | | |
| | | 1,1-Dichloroethane | mg/Kg | -- | 51 | nc | | | | | | | | | 0.0012 | U | 0.0012 | U | | | | |
| | | 1,1-Dichloroethene | mg/Kg | -- | 12 | nc | | | | | | | | | 0.0016 | U | 0.0016 | U | | | | |
| | | 1,2-Dichloroethane | mg/Kg | -- | 0.28 | ca | | | | | | | | | 0.0012 | U | 0.0011 | U | | | | |
| | | 1,2-Dichloroethene (total) | mg/Kg | -- | 6.9 | nc | | | | | | | | | 0.0026 | U | 0.0025 | U | | | | |
| | | 1,2-Dichloropropane | mg/Kg | -- | 0.34 | ca | | | | | | | | | 0.0012 | U | 0.0012 | U | | | | |
| | | 2-Butanone (MEK) | mg/Kg | -- | 2231 | nc | | | | | | | | | 0.0048 | U | 0.0047 | U | | | | |
| | | 2-Hexanone | mg/Kg | -- | 530 | nc | | | | | | | | | 0.0014 | U | 0.0013 | U | | | | |
| | | 4-Methyl-2-pentanone (MIBK) | mg/Kg | -- | 528 | nc | | | | | | | | | 0.0012 | U | 0.0012 | U | | | | |
| | | Acetone | mg/Kg | -- | 1412 | nc | | | | | | | | | 0.0057 | U | 0.0055 | U | | | | |
| | | Benzene | mg/Kg | -- | 0.64 | ca | | | | | | | | | 0.0014 | U | 0.0013 | U | | | | |
| | | Bromodichloromethane | mg/Kg | -- | 0.82 | ca | | | | | | | | | 0.0012 | U | 0.0012 | U | | | | |
| | | Bromoform | mg/Kg | -- | 62 | ca | | | | | | | | | 0.00093 | U | 0.0009 | U | | | | |
| | | Bromomethane | mg/Kg | -- | 0.39 | nc | | | | | | | | | 0.0016 | U* | 0.0016 | U* | | | | |
| | | Carbon disulfide | mg/Kg | -- | 36 | nc | | | | | | | | | 0.0015 | U | 0.0014 | U | | | | |
| | | Carbon tetrachloride | mg/Kg | -- | 0.25 | ca | | | | | | | | | 0.0014 | U | 0.0013 | U | | | | |
| | | Chlorobenzene | mg/Kg | -- | 15 | nc | | | | | | | | | 0.0014 | U | 0.0013 | U | | | | |
| | | Chloroethane | mg/Kg | -- | 3.0 | ca | | | | | | | | | 0.0012 | U | 0.0012 | U | | | | |
| | | Chloroform | mg/Kg | -- | 0.22 | ca | | | | | | | | | 0.0014 | U | 0.0013 | U | | | | |
| | | Chloromethane | mg/Kg | -- | 4.7 | nc | | | | | | | | | 0.0014 | U | 0.0013 | U | | | | |
| | | cis-1,3-Dichloropropene | mg/Kg | -- | 0.78 | ca | | | | | | | | | 0.0012 | U | 0.0011 | U | | | | |
| | | Dibromochloromethane | mg/Kg | -- | 1.1 | ca | | | | | | | | | 0.00098 | U | 0.00095 | U | | | | |
| | | Ethylbenzene | mg/Kg | -- | 395 | sat | | | | | | | | | 0.0014 | U | 0.0013 | U | | | | |
| | | Methylene chloride | mg/Kg | -- | 9.1 | ca | | | | | | | | | 0.0036 | U | 0.0035 | U | | | | |
| | | Styrene | mg/Kg | -- | 1700 | sat | | | | | | | | | 0.0014 | U | 0.0013 | U | | | | |
| | | Tetrachloroethene | mg/Kg | -- | 0.48 | ca | | | | | | | | | 0.0015 | U | 0.0014 | U | | | | |
| | | Toluene | mg/Kg | -- | 520 | sat | | | | | | | | | 0.0014 | U | 0.0013 | U | | | | |
| | | trans-1,3-Dichloropropene | mg/Kg | -- | 0.78 | ca | | | | | | | | | 0.00098 | U | 0.00095 | U | | | | |
| | | Trichloroethene | mg/Kg | -- | 0.053 | ca | | | | | | | | | 0.0014 | U | 0.0013 | U | | | | |
| | | Vinyl chloride | mg/Kg | -- | 0.079 | ca | | | | | | | | | 0.0014 | U | 0.0013 | U | | | | |
| | | Xylenes (total) | mg/Kg | -- | 0.079 | ca | | | | | | | | | 0.0042 | U | 0.0041 | U | | | | |

## Table 4-4
## Summary of Subsurface Soil Results (>1 ft bgs)

| | | | | | | | LL9SB-008-0001-SO | | LL9SB-009-0001-SO | | LL9SB-010-0001-SO | | LL9SB-012-0001-SO | | LL9SB-013-0001-SO | | LL9SB-014-0001-SO | | LL9SB-015-0001-SO | | LL9SB-016-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Sample Date | 12/10/03 | | 12/08/03 | | 12/08/03 | | 12/10/03 | | 12/10/03 | | 12/11/03 | | 12/11/03 | | 12/11/03 | |
| | | | | | | Sample Depth | 1 - 3 ft | | 1 - 3 ft | | 2.5 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | |
| Group | Method | Analyte | Units | RVAAP Subsurface Soil Background Criteria | Region 9 (Residential Soil) PRGs | SB PRG Basis | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| Cyanide 9012A | 9014/9010B | Cyanide, Total | mg/Kg | 0.00 | 122 | nc | | | | | | | | | | | | | | | | |
| Explosives 8330 | 8330 | 1,3,5-Trinitrobenzene | mg/Kg | 0 | 183 | nc | | | | | | | | | | | | | | | | |
| | | 1,3-Dinitrobenzene | mg/Kg | 0 | 0.61 | nc | | | | | | | | | | | | | | | | |
| | | 2,4,6-TNT | mg/Kg | 0 | 16 | ca | | | | | | | | | | | | | | | | |
| | | 2,4-Dinitrotoluene | mg/Kg | 0 | 12 | nc | | | | | | | | | | | | | | | | |
| | | 2,6-Dinitrotoluene | mg/Kg | 0 | 6.1 | nc | | | | | | | | | | | | | | | | |
| | | 2-Nitrotoluene | mg/Kg | 0 | 0.88 | ca | | | | | | | | | | | | | | | | |
| | | 3-Nitrotoluene | mg/Kg | 0 | 73 | nc | | | | | | | | | | | | | | | | |
| | | 4-Nitrotoluene | mg/Kg | 0 | 12 | ca | | | | | | | | | | | | | | | | |
| | | HMX | mg/Kg | 0 | 306 | nc | | | | | | | | | | | | | | | | |
| | | Nitrobenzene | mg/Kg | 0 | 2 | nc | | | | | | | | | | | | | | | | |
| | | RDX | mg/Kg | 0 | 4.4 | ca | | | | | | | | | | | | | | | | |
| | | Tetryl | mg/Kg | 0 | 61 | nc | | | | | | | | | | | | | | | | |
| Others | 8015B MDRO | Diesel Range Organics (DRO) | mg/Kg | -- | -- | -- | | | | | | | | | | | | | | | | |
| | 8015B MGRO | Gasoline Range Organics (GRO) | mg/Kg | -- | -- | -- | | | | | | | | | | | | | | | | |
| PCB TCL 8082 | 8082 | Aroclor 1016 | mg/Kg | -- | 0.39 | nc | | | | | | | | | | | | | | | | |
| | | Aroclor 1221 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | | |
| | | Aroclor 1232 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | | |
| | | Aroclor 1242 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | | |
| | | Aroclor 1248 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | | |
| | | Aroclor 1254 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | | |
| | | Aroclor 1260 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | | |
| Pesticides 8081A | 8081A | 4,4'-DDD | mg/Kg | -- | 2.4 | ca | | | | | | | | | | | | | | | | |
| | | 4,4'-DDE | mg/Kg | -- | 1.7 | ca | | | | | | | | | | | | | | | | |
| | | 4,4'-DDT | mg/Kg | -- | 1.7 | ca | | | | | | | | | | | | | | | | |
| | | Aldrin | mg/Kg | -- | 0.029 | ca | | | | | | | | | | | | | | | | |
| | | alpha-BHC | mg/Kg | -- | 0.09 | sat | | | | | | | | | | | | | | | | |
| | | alpha-Chlordane | mg/Kg | -- | 1.6 | ca | | | | | | | | | | | | | | | | |
| | | beta-BHC | mg/Kg | -- | 0.32 | ca | | | | | | | | | | | | | | | | |
| | | delta-BHC | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | | |
| | | Dieldrin | mg/Kg | -- | 0.030 | ca | | | | | | | | | | | | | | | | |
| | | Endosulfan I | mg/Kg | -- | 37 | nc | | | | | | | | | | | | | | | | |
| | | Endosulfan II | mg/Kg | -- | 37 | nc | | | | | | | | | | | | | | | | |
| | | Endosulfan sulfate | mg/Kg | -- | 37 | nc | | | | | | | | | | | | | | | | |
| | | Endrin | mg/Kg | -- | 1.8 | nc | | | | | | | | | | | | | | | | |
| | | Endrin aldehyde | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | | |
| | | Endrin ketone | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | | |
| | | gamma-BHC (Lindane) | mg/Kg | -- | 0.44 | ca | | | | | | | | | | | | | | | | |
| | | gamma-Chlordane | mg/Kg | -- | 1.6 | ca | | | | | | | | | | | | | | | | |
| | | Heptachlor | mg/Kg | -- | 0.11 | ca | | | | | | | | | | | | | | | | |
| | | Heptachlor epoxide | mg/Kg | -- | 0.053 | ca | | | | | | | | | | | | | | | | |
| | | Methoxychlor | mg/Kg | -- | 31 | nc | | | | | | | | | | | | | | | | |
| | | Toxaphene | mg/Kg | -- | 0 | 0 | | | | | | | | | | | | | | | | |

## Table 4-4
## Summary of Subsurface Soil Results (>1 ft bgs)

| | | | | | | | LL9SB-008-0001-SO | | LL9SB-009-0001-SO | | LL9SB-010-0001-SO | | LL9SB-012-0001-SO | | LL9SB-013-0001-SO | | LL9SB-014-0001-SO | | LL9SB-015-0001-SO | | LL9SB-016-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/10/03 | | 12/08/03 | | 12/08/03 | | 12/10/03 | | 12/10/03 | | 12/11/03 | | 12/11/03 | | 12/11/03 | |
| | | | | | | **Sample Depth** | 1 - 3 ft | | 1 - 3 ft | | 2.5 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Subsurface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SB PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| Propellants 8330 | 353.2 | Nitrocellulose | mg/Kg | 0 | -- | 0 | | | | | | | | | | | | | | | | |
| | 8330 | Nitroglycerin | mg/Kg | 0 | -- | 0 | | | | | | | | | | | | | | | | |
| | UV/HPLC per SOP | Nitroguanidine | mg/Kg | 0 | 611 | nc | | | | | | | | | | | | | | | | |
| SVOCs TCL 8270 C | 8270C | 1,2,4-Trichlorobenzene | mg/Kg | -- | 6.2 | nc | | | | | | | | | | | | | | | | |
| | | 1,2-Dichlorobenzene | mg/Kg | -- | 600 | sat | | | | | | | | | | | | | | | | |
| | | 1,3-Dichlorobenzene | mg/Kg | -- | 53 | nc | | | | | | | | | | | | | | | | |
| | | 1,4-Dichlorobenzene | mg/Kg | -- | 3.4 | ca | | | | | | | | | | | | | | | | |
| | | 2,2-oxybis (1-chloropropane) | mg/Kg | -- | 2.9 | ca | | | | | | | | | | | | | | | | |
| | | 2,4,5-Trichlorophenol | mg/Kg | -- | 611 | nc | | | | | | | | | | | | | | | | |
| | | 2,4,6-Trichlorophenol | mg/Kg | -- | 0.61 | nc | | | | | | | | | | | | | | | | |
| | | 2,4-Dichlorophenol | mg/Kg | -- | 18 | nc | | | | | | | | | | | | | | | | |
| | | 2,4-Dimethylphenol | mg/Kg | -- | 122 | nc | | | | | | | | | | | | | | | | |
| | | 2,4-Dinitrophenol | mg/Kg | -- | 12 | nc | | | | | | | | | | | | | | | | |
| | | 2-Chloronaphthalene | mg/Kg | -- | 494 | nc | | | | | | | | | | | | | | | | |
| | | 2-Chlorophenol | mg/Kg | -- | 6.3 | nc | | | | | | | | | | | | | | | | |
| | | 2-Methylnaphthalene | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | | |
| | | 2-Methylphenol (o-cresol) | mg/Kg | -- | 306 | nc | | | | | | | | | | | | | | | | |
| | | 2-Nitroaniline | mg/Kg | -- | 18.3 | nc | | | | | | | | | | | | | | | | |
| | | 2-Nitrophenol | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | | |
| | | 3,3-Dichlorobenzidine | mg/Kg | -- | 1.1 | ca | | | | | | | | | | | | | | | | |
| | | 3-Nitroaniline | mg/Kg | -- | 1.8 | nc | | | | | | | | | | | | | | | | |
| | | 4,6-Dinitro-2-methylphenol | mg/Kg | -- | 0.61 | nc | | | | | | | | | | | | | | | | |
| | | 4-Bromophenyl phenyl ether | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | | |
| | | 4-Chloro-3-methylphenol | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | | |
| | | 4-Chloroaniline | mg/Kg | -- | 24 | nc | | | | | | | | | | | | | | | | |
| | | 4-Chlorophenyl phenyl ether | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | | |
| | | 4-Methylphenol (m/p-cresol) | mg/Kg | -- | 31 | nc | | | | | | | | | | | | | | | | |
| | | 4-Nitroaniline | mg/Kg | -- | 23 | ca | | | | | | | | | | | | | | | | |
| | | 4-Nitrophenol | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | | |
| | | Acenaphthene | mg/Kg | -- | 368 | nc | | | | | | | | | | | | | | | | |
| | | Acenaphthylene | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | | |
| | | Anthracene | mg/Kg | -- | 2189 | nc | | | | | | | | | | | | | | | | |
| | | Benzo(a)anthracene | mg/Kg | -- | 0.62 | ca | | | | | | | | | | | | | | | | |
| | | Benzo(a)pyrene | mg/Kg | -- | 0.062 | ca | | | | | | | | | | | | | | | | |
| | | Benzo(b)fluoranthene | mg/Kg | -- | 0.62 | ca | | | | | | | | | | | | | | | | |
| | | Benzo(ghi)perylene | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | | |
| | | Benzo(k)fluoranthene | mg/Kg | -- | 6.2 | ca | | | | | | | | | | | | | | | | |
| | | Bis(2-chloroethoxy)methane | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | | |
| | | Bis(2-chloroethyl)ether | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | | |
| | | Bis(2-ethylhexyl)phthalate | mg/Kg | -- | 35 | ca | | | | | | | | | | | | | | | | |

## Table 4-4
## Summary of Subsurface Soil Results (>1 ft bgs)

| | | | | | | | LL9SB-008-0001-SO | | LL9SB-009-0001-SO | | LL9SB-010-0001-SO | | LL9SB-012-0001-SO | | LL9SB-013-0001-SO | | LL9SB-014-0001-SO | | LL9SB-015-0001-SO | | LL9SB-016-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/10/03 | | 12/08/03 | | 12/08/03 | | 12/10/03 | | 12/10/03 | | 12/11/03 | | 12/11/03 | | 12/11/03 | |
| | | | | | | **Sample Depth** | 1 - 3 ft | | 1 - 3 ft | | 2.5 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Subsurface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SB PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| | | Butyl benzyl phthalate | mg/Kg | -- | 1222 | nc | | | | | | | | | | | | | | | | |
| | | Carbazole | mg/Kg | -- | 24 | ca | | | | | | | | | | | | | | | | |
| | | Chrysene | mg/Kg | -- | 62 | ca | | | | | | | | | | | | | | | | |
| | | Dibenzo(a,h)anthracene | mg/Kg | -- | 0.062 | ca | | | | | | | | | | | | | | | | |
| | | Dibenzofuran | mg/Kg | -- | 15 | nc | | | | | | | | | | | | | | | | |
| | | Diethyl phthalate | mg/Kg | -- | 4888 | nc | | | | | | | | | | | | | | | | |
| | | Dimethyl phthalate | mg/Kg | -- | 100000 | max | | | | | | | | | | | | | | | | |
| | | Di-n-butyl phthalate | mg/Kg | -- | 611 | nc | | | | | | | | | | | | | | | | |
| | | Di-n-octyl phthalate | mg/Kg | -- | 244 | nc | | | | | | | | | | | | | | | | |
| | | Fluoranthene | mg/Kg | -- | 229 | nc | | | | | | | | | | | | | | | | |
| | | Fluorene | mg/Kg | -- | 275 | nc | | | | | | | | | | | | | | | | |
| | | Hexachlorobenzene | mg/Kg | -- | 0.30 | ca | | | | | | | | | | | | | | | | |
| | | Hexachlorobutadiene | mg/Kg | -- | 6.2 | ca | | | | | | | | | | | | | | | | |
| | | Hexachlorocyclopentadiene | mg/Kg | -- | 37 | nc | | | | | | | | | | | | | | | | |
| | | Hexachloroethane | mg/Kg | -- | 35 | ca | | | | | | | | | | | | | | | | |
| | | Indeno(1,2,3-cd)pyrene | mg/Kg | -- | 0.62 | ca | | | | | | | | | | | | | | | | |
| | | Isophorone | mg/Kg | -- | 512 | ca | | | | | | | | | | | | | | | | |
| | | Naphthalene | mg/Kg | -- | 5.6 | nc | | | | | | | | | | | | | | | | |
| | | n-Nitroso-di-n-propylamine | mg/Kg | -- | 0.069 | ca | | | | | | | | | | | | | | | | |
| | | n-Nitrosodiphenylamine | mg/Kg | -- | 99 | ca | | | | | | | | | | | | | | | | |
| | | Pentachlorophenol | mg/Kg | -- | 3.0 | ca | | | | | | | | | | | | | | | | |
| | | Phenanthrene | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | | |
| | | Phenol | mg/Kg | -- | 1833 | nc | | | | | | | | | | | | | | | | |
| | | Pyrene | mg/Kg | -- | 232 | nc | | | | | | | | | | | | | | | | |
| TAL Metals 6010B | 6010B | Aluminum | mg/Kg | 19500 | 7614 | nc | **12000** | | **12000** | | **9700** | | **9700** | | 6700 | | 7100 | | **10000** | | **8000** | |
| | | Barium | mg/Kg | 124 | 538 | nc | 71 | | 51 | | 57 | | 55 | | 29 | | 34 | | 60 | | 47 | |
| | | Beryllium | mg/Kg | 0.88 | 15 | nc | 0.58 | | 0.52 | | 0.55 | | 0.34 | B | 0.25 | B | 0.23 | B | 0.54 | | 0.43 | |
| | | Cadmium | mg/Kg | 0.00 | 3.7 | nc | 0.095 | U | 0.091 | U | 0.13 | B | 0.091 | U | 0.084 | U | 0.081 | U | 0.079 | U | 0.077 | U |
| | | Calcium | mg/Kg | 35500 | -- | 0 | 1100 | | 420 | | 4900 | | 2600 | | 4400 | | 900 | | 750 | | 2200 | |
| | | Chromium | mg/Kg | 27.2 | 30 | ca | 15 | | 17 | | 14 | | 13 | | 9 | | 12 | | 15 | | 12 | |
| | | Cobalt | mg/Kg | 23.2 | 902 | ca | 10 | | 11 | | 9.3 | | 8.8 | | 6 | | 7.2 | | 11 | | 7.1 | |
| | | Copper | mg/Kg | 32.3 | 313 | nc | 19 | | 21 | H | 21 | H | 26 | | 24 | | 20 | | 22 | | 19 | |
| | | Iron | mg/Kg | 35200 | 2346 | nc | **30000** | | **28000** | | **24000** | | **25000** | | **18000** | | **18000** | H | **27000** | H | **24000** | H |
| | | Magnesium | mg/Kg | 8790 | -- | 0 | 2100 | | 3000 | | 3200 | | 2500 | | 2600 | | 1800 | | 3200 | | 2100 | |
| | | Manganese | mg/Kg | 3030 | 176 | nc | **550** | | **280** | | **470** | | **470** | | **420** | | **430** | | **280** | | **550** | |
| | | Nickel | mg/Kg | 60.7 | 156 | nc | 17 | | 24 | | 25 | | 19 | | 15 | | 16 | | 32 | | 17 | |
| | | Potassium | mg/Kg | 3350 | -- | 0 | 780 | | 1300 | | 1200 | | 900 | | 640 | | 620 | | 1300 | | 760 | |
| | | Selenium | mg/Kg | 1.5 | 39 | nc | 0.47 | U | 0.46 | U | 0.44 | U | 0.46 | U | 0.42 | U | 0.32 | B | 0.15 | B | 0.3 | B |
| | | Silver | mg/Kg | 0.00 | 39 | nc | 0.37 | U | 0.35 | U | 0.34 | U | 0.35 | U | 0.32 | U | 0.31 | U | 0.31 | U | 0.3 | U |
| | | Sodium | mg/Kg | 145 | -- | 0 | 100 | U | 99 | U | 96 | U | 99 | U | 91 | U | 87 | U | 85 | U | 83 | U |
| | | Vanadium | mg/Kg | 37.6 | 7.8 | nc | **22** | | **18** | | **14** | | **17** | | **11** | | **12** | | **17** | | **15** | |
| | | Zinc | mg/Kg | 93.3 | 2346 | nc | 64 | | 62 | | 72 | | 110 | | 64 | | 65 | | 62 | | 82 | |

## Table 4-4
## Summary of Subsurface Soil Results (>1 ft bgs)

| | | | | | | | LL9SB-008-0001-SO | | LL9SB-009-0001-SO | | LL9SB-010-0001-SO | | LL9SB-012-0001-SO | | LL9SB-013-0001-SO | | LL9SB-014-0001-SO | | LL9SB-015-0001-SO | | LL9SB-016-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/10/03 | | 12/08/03 | | 12/08/03 | | 12/10/03 | | 12/10/03 | | 12/11/03 | | 12/11/03 | | 12/11/03 | |
| | | | | | | **Sample Depth** | 1 - 3 ft | | 1 - 3 ft | | 2.5 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Subsurface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SB PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| | 7041 | Antimony | mg/Kg | 0.96 | 3.1 | nc | 0.53 | U | 0.47 | U | 0.49 | U | 0.8 | | 0.46 | U | 0.48 | U | 1 | | 0.47 | U |
| | 7060A | Arsenic | mg/Kg | 19.8 | 0.39 | ca | **12** | | **22** | | **22** | | **19** | | **11** | | **18** | | **18** | | **11** | |
| | 7421 | Lead | mg/Kg | 19.1 | 400 | pbk | 14 | | 13 | | 19 | | 20 | | 11 | | 15 | | 14 | | 17 | |
| | 7471A | Mercury | mg/Kg | 0.04 | 2.3 | nc | 0.037 | | 0.014 | B | 0.18 | | 0.033 | | 0.016 | B | 0.02 | | 0.015 | B | 0.029 | |
| | 7841 | Thallium | mg/Kg | 0.91 | 0.52 | nc | 0.23 | U | 0.2 | U | 0.21 | U | 0.2 | U | 0.2 | U | 0.21 | U | 0.19 | U | 0.2 | U |
| VOCs TCL 8260B | 8260B | 1,1,1-Trichloroethane | mg/Kg | -- | 1200 | sat | | | | | | | | | | | | | | | | |
| | | 1,1,2,2-Tetrachloroethane | mg/Kg | -- | 0.41 | ca | | | | | | | | | | | | | | | | |
| | | 1,1,2-Trichloroethane | mg/Kg | -- | 0.73 | ca | | | | | | | | | | | | | | | | |
| | | 1,1-Dichloroethane | mg/Kg | -- | 51 | nc | | | | | | | | | | | | | | | | |
| | | 1,1-Dichloroethene | mg/Kg | -- | 12 | nc | | | | | | | | | | | | | | | | |
| | | 1,2-Dichloroethane | mg/Kg | -- | 0.28 | ca | | | | | | | | | | | | | | | | |
| | | 1,2-Dichloroethene (total) | mg/Kg | -- | 6.9 | nc | | | | | | | | | | | | | | | | |
| | | 1,2-Dichloropropane | mg/Kg | -- | 0.34 | ca | | | | | | | | | | | | | | | | |
| | | 2-Butanone (MEK) | mg/Kg | -- | 2231 | nc | | | | | | | | | | | | | | | | |
| | | 2-Hexanone | mg/Kg | -- | 530 | nc | | | | | | | | | | | | | | | | |
| | | 4-Methyl-2-pentanone (MIBK) | mg/Kg | -- | 528 | nc | | | | | | | | | | | | | | | | |
| | | Acetone | mg/Kg | -- | 1412 | nc | | | | | | | | | | | | | | | | |
| | | Benzene | mg/Kg | -- | 0.64 | ca | | | | | | | | | | | | | | | | |
| | | Bromodichloromethane | mg/Kg | -- | 0.82 | ca | | | | | | | | | | | | | | | | |
| | | Bromoform | mg/Kg | -- | 62 | ca | | | | | | | | | | | | | | | | |
| | | Bromomethane | mg/Kg | -- | 0.39 | nc | | | | | | | | | | | | | | | | |
| | | Carbon disulfide | mg/Kg | -- | 36 | nc | | | | | | | | | | | | | | | | |
| | | Carbon tetrachloride | mg/Kg | -- | 0.25 | ca | | | | | | | | | | | | | | | | |
| | | Chlorobenzene | mg/Kg | -- | 15 | nc | | | | | | | | | | | | | | | | |
| | | Chloroethane | mg/Kg | -- | 3.0 | ca | | | | | | | | | | | | | | | | |
| | | Chloroform | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | | |
| | | Chloromethane | mg/Kg | -- | 4.7 | nc | | | | | | | | | | | | | | | | |
| | | cis-1,3-Dichloropropene | mg/Kg | -- | 0.78 | ca | | | | | | | | | | | | | | | | |
| | | Dibromochloromethane | mg/Kg | -- | 1.1 | ca | | | | | | | | | | | | | | | | |
| | | Ethylbenzene | mg/Kg | -- | 395 | sat | | | | | | | | | | | | | | | | |
| | | Methylene chloride | mg/Kg | -- | 9.1 | ca | | | | | | | | | | | | | | | | |
| | | Styrene | mg/Kg | -- | 1700 | sat | | | | | | | | | | | | | | | | |
| | | Tetrachloroethene | mg/Kg | -- | 0.48 | ca | | | | | | | | | | | | | | | | |
| | | Toluene | mg/Kg | -- | 520 | sat | | | | | | | | | | | | | | | | |
| | | trans-1,3-Dichloropropene | mg/Kg | -- | 0.78 | ca | | | | | | | | | | | | | | | | |
| | | Trichloroethene | mg/Kg | -- | 0.053 | ca | | | | | | | | | | | | | | | | |
| | | Vinyl chloride | mg/Kg | -- | 0.079 | ca | | | | | | | | | | | | | | | | |
| | | Xylenes (total) | mg/Kg | -- | 0.079 | ca | | | | | | | | | | | | | | | | |

## Table 4-4
## Summary of Subsurface Soil Results (>1 ft bgs)

| | | | | | | | LL9SB-017-0001-SO | | LL9SB-018-0001-SO | | LL9SB-019-0001-SO | | LL9SB-020-0001-SO | | LL9SB-021-0001-SO | | LL9SB-022-0001-SO | | LL9SB-023-0001-SO | | LL9SB-024-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/04/03 | | 12/10/03 | | 12/11/03 | | 12/08/03 | | 12/08/03 | | 12/10/03 | | 12/08/03 | | 12/10/03 | |
| | | | | | | **Sample Depth** | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 2.5 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Subsurface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SB PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| Cyanide 9012A | 9014/9010B | Cyanide, Total | mg/Kg | 0.00 | 122 | nc | | | | | | | | | | | | | | | | |
| Explosives 8330 | 8330 | 1,3,5-Trinitrobenzene | mg/Kg | 0 | 183 | nc | | | | | | | | | | | | | | | | |
| | | 1,3-Dinitrobenzene | mg/Kg | 0 | 0.61 | nc | | | | | | | | | | | | | | | | |
| | | 2,4,6-TNT | mg/Kg | 0 | 16 | ca | | | | | | | | | | | | | | | | |
| | | 2,4-Dinitrotoluene | mg/Kg | 0 | 12 | nc | | | | | | | | | | | | | | | | |
| | | 2,6-Dinitrotoluene | mg/Kg | 0 | 6.1 | nc | | | | | | | | | | | | | | | | |
| | | 2-Nitrotoluene | mg/Kg | 0 | 0.88 | ca | | | | | | | | | | | | | | | | |
| | | 3-Nitrotoluene | mg/Kg | 0 | 73 | nc | | | | | | | | | | | | | | | | |
| | | 4-Nitrotoluene | mg/Kg | 0 | 12 | ca | | | | | | | | | | | | | | | | |
| | | HMX | mg/Kg | 0 | 306 | nc | | | | | | | | | | | | | | | | |
| | | Nitrobenzene | mg/Kg | 0 | 2 | nc | | | | | | | | | | | | | | | | |
| | | RDX | mg/Kg | 0 | 4.4 | ca | | | | | | | | | | | | | | | | |
| | | Tetryl | mg/Kg | 0 | 61 | nc | | | | | | | | | | | | | | | | |
| Others | 8015B MDRO | Diesel Range Organics (DRO) | mg/Kg | -- | -- | -- | | | | | | | | | | | | | | | | |
| | 8015B MGRO | Gasoline Range Organics (GRO) | mg/Kg | -- | -- | -- | | | | | | | | | | | | | | | | |
| PCB TCL 8082 | 8082 | Aroclor 1016 | mg/Kg | -- | 0.39 | nc | | | | | | | | | | | | | | | | |
| | | Aroclor 1221 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | | |
| | | Aroclor 1232 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | | |
| | | Aroclor 1242 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | | |
| | | Aroclor 1248 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | | |
| | | Aroclor 1254 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | | |
| | | Aroclor 1260 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | | |
| Pesticides 8081A | 8081A | 4,4'-DDD | mg/Kg | -- | 2.4 | ca | | | | | | | | | | | | | | | | |
| | | 4,4'-DDE | mg/Kg | -- | 1.7 | ca | | | | | | | | | | | | | | | | |
| | | 4,4'-DDT | mg/Kg | -- | 1.7 | ca | | | | | | | | | | | | | | | | |
| | | Aldrin | mg/Kg | -- | 0.029 | ca | | | | | | | | | | | | | | | | |
| | | alpha-BHC | mg/Kg | -- | 0.09 | sat | | | | | | | | | | | | | | | | |
| | | alpha-Chlordane | mg/Kg | -- | 1.6 | ca | | | | | | | | | | | | | | | | |
| | | beta-BHC | mg/Kg | -- | 0.32 | ca | | | | | | | | | | | | | | | | |
| | | delta-BHC | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | | |
| | | Dieldrin | mg/Kg | -- | 0.030 | ca | | | | | | | | | | | | | | | | |
| | | Endosulfan I | mg/Kg | -- | 37 | nc | | | | | | | | | | | | | | | | |
| | | Endosulfan II | mg/Kg | -- | 37 | nc | | | | | | | | | | | | | | | | |
| | | Endosulfan sulfate | mg/Kg | -- | 37 | nc | | | | | | | | | | | | | | | | |
| | | Endrin | mg/Kg | -- | 1.8 | nc | | | | | | | | | | | | | | | | |
| | | Endrin aldehyde | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | | |
| | | Endrin ketone | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | | |
| | | gamma-BHC (Lindane) | mg/Kg | -- | 0.44 | ca | | | | | | | | | | | | | | | | |
| | | gamma-Chlordane | mg/Kg | -- | 1.6 | ca | | | | | | | | | | | | | | | | |
| | | Heptachlor | mg/Kg | -- | 0.11 | ca | | | | | | | | | | | | | | | | |
| | | Heptachlor epoxide | mg/Kg | -- | 0.053 | ca | | | | | | | | | | | | | | | | |
| | | Methoxychlor | mg/Kg | -- | 31 | nc | | | | | | | | | | | | | | | | |
| | | Toxaphene | mg/Kg | -- | 0 | 0 | | | | | | | | | | | | | | | | |

# Table 4-4
## Summary of Subsurface Soil Results (>1 ft bgs)

| | | | | | | | LL9SB-017-0001-SO | | LL9SB-018-0001-SO | | LL9SB-019-0001-SO | | LL9SB-020-0001-SO | | LL9SB-021-0001-SO | | LL9SB-022-0001-SO | | LL9SB-023-0001-SO | | LL9SB-024-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/04/03 | | 12/10/03 | | 12/11/03 | | 12/08/03 | | 12/08/03 | | 12/10/03 | | 12/08/03 | | 12/10/03 | |
| | | | | | | **Sample Depth** | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 2.5 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Subsurface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SB PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| Propellants 8330 | 353.2 | Nitrocellulose | mg/Kg | 0 | -- | 0 | | | | | | | | | | | | | | | | |
| | 8330 | Nitroglycerin | mg/Kg | 0 | -- | 0 | | | | | | | | | | | | | | | | |
| | UV/HPLC per SOP | Nitroguanidine | mg/Kg | 0 | 611 | nc | | | | | | | | | | | | | | | | |
| SVOCs TCL 8270 C | 8270C | 1,2,4-Trichlorobenzene | mg/Kg | -- | 6.2 | nc | | | | | | | | | | | | | | | | |
| | | 1,2-Dichlorobenzene | mg/Kg | -- | 600 | sat | | | | | | | | | | | | | | | | |
| | | 1,3-Dichlorobenzene | mg/Kg | -- | 53 | nc | | | | | | | | | | | | | | | | |
| | | 1,4-Dichlorobenzene | mg/Kg | -- | 3.4 | ca | | | | | | | | | | | | | | | | |
| | | 2,2-oxybis (1-chloropropane) | mg/Kg | -- | 2.9 | ca | | | | | | | | | | | | | | | | |
| | | 2,4,5-Trichlorophenol | mg/Kg | -- | 611 | nc | | | | | | | | | | | | | | | | |
| | | 2,4,6-Trichlorophenol | mg/Kg | -- | 0.61 | nc | | | | | | | | | | | | | | | | |
| | | 2,4-Dichlorophenol | mg/Kg | -- | 18 | nc | | | | | | | | | | | | | | | | |
| | | 2,4-Dimethylphenol | mg/Kg | -- | 122 | nc | | | | | | | | | | | | | | | | |
| | | 2,4-Dinitrophenol | mg/Kg | -- | 12 | nc | | | | | | | | | | | | | | | | |
| | | 2-Chloronaphthalene | mg/Kg | -- | 494 | nc | | | | | | | | | | | | | | | | |
| | | 2-Chlorophenol | mg/Kg | -- | 6.3 | nc | | | | | | | | | | | | | | | | |
| | | 2-Methylnaphthalene | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | | |
| | | 2-Methylphenol (o-cresol) | mg/Kg | -- | 306 | nc | | | | | | | | | | | | | | | | |
| | | 2-Nitroaniline | mg/Kg | -- | 18.3 | nc | | | | | | | | | | | | | | | | |
| | | 2-Nitrophenol | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | | |
| | | 3,3-Dichlorobenzidine | mg/Kg | -- | 1.1 | ca | | | | | | | | | | | | | | | | |
| | | 3-Nitroaniline | mg/Kg | -- | 1.8 | nc | | | | | | | | | | | | | | | | |
| | | 4,6-Dinitro-2-methylphenol | mg/Kg | -- | 0.61 | nc | | | | | | | | | | | | | | | | |
| | | 4-Bromophenyl phenyl ether | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | | |
| | | 4-Chloro-3-methylphenol | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | | |
| | | 4-Chloroaniline | mg/Kg | -- | 24 | nc | | | | | | | | | | | | | | | | |
| | | 4-Chlorophenyl phenyl ether | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | | |
| | | 4-Methylphenol (m/p-cresol) | mg/Kg | -- | 31 | nc | | | | | | | | | | | | | | | | |
| | | 4-Nitroaniline | mg/Kg | -- | 23 | ca | | | | | | | | | | | | | | | | |
| | | 4-Nitrophenol | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | | |
| | | Acenaphthene | mg/Kg | -- | 368 | nc | | | | | | | | | | | | | | | | |
| | | Acenaphthylene | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | | |
| | | Anthracene | mg/Kg | -- | 2189 | nc | | | | | | | | | | | | | | | | |
| | | Benzo(a)anthracene | mg/Kg | -- | 0.62 | ca | | | | | | | | | | | | | | | | |
| | | Benzo(a)pyrene | mg/Kg | -- | 0.062 | ca | | | | | | | | | | | | | | | | |
| | | Benzo(b)fluoranthene | mg/Kg | -- | 0.62 | ca | | | | | | | | | | | | | | | | |
| | | Benzo(ghi)perylene | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | | |
| | | Benzo(k)fluoranthene | mg/Kg | -- | 6.2 | ca | | | | | | | | | | | | | | | | |
| | | Bis(2-chloroethoxy)methane | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | | |
| | | Bis(2-chloroethyl)ether | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | | |
| | | Bis(2-ethylhexyl)phthalate | mg/Kg | -- | 35 | ca | | | | | | | | | | | | | | | | |

## Table 4-4
## Summary of Subsurface Soil Results (>1 ft bgs)

| | | | | | | | LL9SB-017-0001-SO | | LL9SB-018-0001-SO | | LL9SB-019-0001-SO | | LL9SB-020-0001-SO | | LL9SB-021-0001-SO | | LL9SB-022-0001-SO | | LL9SB-023-0001-SO | | LL9SB-024-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/04/03 | | 12/10/03 | | 12/11/03 | | 12/08/03 | | 12/08/03 | | 12/10/03 | | 12/08/03 | | 12/10/03 | |
| | | | | | | **Sample Depth** | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 2.5 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Subsurface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SB PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| | | Butyl benzyl phthalate | mg/Kg | -- | 1222 | nc | | | | | | | | | | | | | | | | |
| | | Carbazole | mg/Kg | -- | 24 | ca | | | | | | | | | | | | | | | | |
| | | Chrysene | mg/Kg | -- | 62 | ca | | | | | | | | | | | | | | | | |
| | | Dibenzo(a,h)anthracene | mg/Kg | -- | 0.062 | ca | | | | | | | | | | | | | | | | |
| | | Dibenzofuran | mg/Kg | -- | 15 | nc | | | | | | | | | | | | | | | | |
| | | Diethyl phthalate | mg/Kg | -- | 4888 | nc | | | | | | | | | | | | | | | | |
| | | Dimethyl phthalate | mg/Kg | -- | 100000 | max | | | | | | | | | | | | | | | | |
| | | Di-n-butyl phthalate | mg/Kg | -- | 611 | nc | | | | | | | | | | | | | | | | |
| | | Di-n-octyl phthalate | mg/Kg | -- | 244 | nc | | | | | | | | | | | | | | | | |
| | | Fluoranthene | mg/Kg | -- | 229 | nc | | | | | | | | | | | | | | | | |
| | | Fluorene | mg/Kg | -- | 275 | nc | | | | | | | | | | | | | | | | |
| | | Hexachlorobenzene | mg/Kg | -- | 0.30 | ca | | | | | | | | | | | | | | | | |
| | | Hexachlorobutadiene | mg/Kg | -- | 6.2 | ca | | | | | | | | | | | | | | | | |
| | | Hexachlorocyclopentadiene | mg/Kg | -- | 37 | nc | | | | | | | | | | | | | | | | |
| | | Hexachloroethane | mg/Kg | -- | 35 | ca | | | | | | | | | | | | | | | | |
| | | Indeno(1,2,3-cd)pyrene | mg/Kg | -- | 0.62 | ca | | | | | | | | | | | | | | | | |
| | | Isophorone | mg/Kg | -- | 512 | ca | | | | | | | | | | | | | | | | |
| | | Naphthalene | mg/Kg | -- | 5.6 | nc | | | | | | | | | | | | | | | | |
| | | n-Nitroso-di-n-propylamine | mg/Kg | -- | 0.069 | ca | | | | | | | | | | | | | | | | |
| | | n-Nitrosodiphenylamine | mg/Kg | -- | 99 | ca | | | | | | | | | | | | | | | | |
| | | Pentachlorophenol | mg/Kg | -- | 3.0 | ca | | | | | | | | | | | | | | | | |
| | | Phenanthrene | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | | |
| | | Phenol | mg/Kg | -- | 1833 | nc | | | | | | | | | | | | | | | | |
| | | Pyrene | mg/Kg | -- | 232 | nc | | | | | | | | | | | | | | | | |
| TAL Metals 6010B | 6010B | Aluminum | mg/Kg | 19500 | 7614 | nc | **10000** | | **14000** | | **11000** | | **15000** | | **12000** | | **11000** | | **11000** | | **18000** | |
| | | Barium | mg/Kg | 124 | 538 | nc | 71 | | 58 | | 95 | | 65 | | 43 | | 73 | | 69 | | 78 | |
| | | Beryllium | mg/Kg | 0.88 | 15 | nc | 0.6 | | 0.53 | | 0.65 | | 0.36 | B | 0.56 | | 0.69 | | 0.63 | | 0.52 | |
| | | Cadmium | mg/Kg | 0.00 | 3.7 | nc | 0.083 | U | 0.09 | U | 0.092 | U | 0.095 | B | 0.085 | U | 0.094 | U | 0.089 | U | 0.099 | U |
| | | Calcium | mg/Kg | 35500 | -- | 0 | 410 | | 580 | | 870 | | 1700 | | 970 | | 6700 | | 1200 | | 650 | |
| | | Chromium | mg/Kg | 27.2 | 30 | ca | 14 | | 18 | | 16 | | 19 | | 17 | | 15 | | 16 | | **54** | |
| | | Cobalt | mg/Kg | 23.2 | 902 | ca | 6.7 | | 9.1 | | 12 | | 6.4 | | 11 | | 10 | | 13 | | 14 | |
| | | Copper | mg/Kg | 32.3 | 313 | nc | 9.4 | | 20 | | 25 | | 20 | H | 22 | H | 25 | | 21 | H | 24 | |
| | | Iron | mg/Kg | 35200 | 2346 | nc | **19000** | | **26000** | | **30000** | H | **24000** | | **28000** | | **24000** | | **27000** | | **28000** | |
| | | Magnesium | mg/Kg | 8790 | -- | 0 | 1600 | | 3000 | | 3200 | | 2500 | | 2700 | | 3600 | | 3300 | | 4700 | |
| | | Manganese | mg/Kg | 3030 | 176 | nc | **760** | | **250** | | **270** | | **420** | | **290** | | **500** | | **350** | | **440** | |
| | | Nickel | mg/Kg | 60.7 | 156 | nc | 12 | | 24 | | 29 | | 15 | | 23 | | 25 | | 29 | | 31 | |
| | | Potassium | mg/Kg | 3350 | -- | 0 | 570 | | 1200 | | 1100 | | 1200 | | 1200 | | 950 | | 1300 | | 1600 | |
| | | Selenium | mg/Kg | 1.5 | 39 | nc | 0.67 | B | 0.45 | U | 0.3 | B | 0.45 | U | 0.63 | B | 0.47 | U | 0.45 | U | 0.5 | U |
| | | Silver | mg/Kg | 0.00 | 39 | nc | 0.32 | U | 0.35 | U | 0.36 | U | 0.35 | U | 0.33 | U | 0.36 | U | 0.35 | U | 0.39 | U |
| | | Sodium | mg/Kg | 145 | -- | 0 | 90 | U | 97 | U | 100 | U | 98 | U | 93 | U | 100 | U | 97 | U | 110 | U |
| | | Vanadium | mg/Kg | 37.6 | 7.8 | nc | **20** | | **19** | | **17** | | **26** | | **19** | | **15** | | **18** | | **29** | |
| | | Zinc | mg/Kg | 93.3 | 2346 | nc | 36 | | 63 | | 75 | | 53 | | 78 | | 85 | | 58 | | 83 | |

## Table 4-4
## Summary of Subsurface Soil Results (>1 ft bgs)

| | | | | | | | LL9SB-017-0001-SO | | LL9SB-018-0001-SO | | LL9SB-019-0001-SO | | LL9SB-020-0001-SO | | LL9SB-021-0001-SO | | LL9SB-022-0001-SO | | LL9SB-023-0001-SO | | LL9SB-024-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/04/03 | | 12/10/03 | | 12/11/03 | | 12/08/03 | | 12/08/03 | | 12/10/03 | | 12/08/03 | | 12/10/03 | |
| | | | | | | **Sample Depth** | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 2.5 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Subsurface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SB PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| | 7041 | Antimony | mg/Kg | 0.96 | 3.1 | nc | 0.85 | | 0.82 | | 0.49 | U | 0.85 | | 0.52 | B | 0.53 | U | 0.49 | U | 1 | |
| | 7060A | Arsenic | mg/Kg | 19.8 | 0.39 | ca | **10** | | **15** | | **32** | | **14** | | **26** | | **18** | | **24** | | **9.2** | |
| | 7421 | Lead | mg/Kg | 19.1 | 400 | pbk | 10 | | 12 | | 19 | | 12 | | 22 | | 23 | | 12 | | 86 | |
| | 7471A | Mercury | mg/Kg | 0.04 | 2.3 | nc | 0.029 | | 0.035 | | 0.18 | | 0.18 | | 0.021 | | 0.087 | | 0.018 | B | 0.079 | |
| | 7841 | Thallium | mg/Kg | 0.91 | 0.52 | nc | 0.2 | U | 0.21 | U | 0.21 | U | 0.21 | U | 0.33 | | 0.23 | U | 0.21 | U | 0.24 | U |
| VOCs TCL 8260B | 8260B | 1,1,1-Trichloroethane | mg/Kg | -- | 1200 | sat | | | | | | | | | | | | | | | | |
| | | 1,1,2,2-Tetrachloroethane | mg/Kg | -- | 0.41 | ca | | | | | | | | | | | | | | | | |
| | | 1,1,2-Trichloroethane | mg/Kg | -- | 0.73 | ca | | | | | | | | | | | | | | | | |
| | | 1,1-Dichloroethane | mg/Kg | -- | 51 | nc | | | | | | | | | | | | | | | | |
| | | 1,1-Dichloroethene | mg/Kg | -- | 12 | nc | | | | | | | | | | | | | | | | |
| | | 1,2-Dichloroethane | mg/Kg | -- | 0.28 | ca | | | | | | | | | | | | | | | | |
| | | 1,2-Dichloroethene (total) | mg/Kg | -- | 6.9 | nc | | | | | | | | | | | | | | | | |
| | | 1,2-Dichloropropane | mg/Kg | -- | 0.34 | ca | | | | | | | | | | | | | | | | |
| | | 2-Butanone (MEK) | mg/Kg | -- | 2231 | nc | | | | | | | | | | | | | | | | |
| | | 2-Hexanone | mg/Kg | -- | 530 | nc | | | | | | | | | | | | | | | | |
| | | 4-Methyl-2-pentanone (MIBK) | mg/Kg | -- | 528 | nc | | | | | | | | | | | | | | | | |
| | | Acetone | mg/Kg | -- | 1412 | nc | | | | | | | | | | | | | | | | |
| | | Benzene | mg/Kg | -- | 0.64 | ca | | | | | | | | | | | | | | | | |
| | | Bromodichloromethane | mg/Kg | -- | 0.82 | ca | | | | | | | | | | | | | | | | |
| | | Bromoform | mg/Kg | -- | 62 | ca | | | | | | | | | | | | | | | | |
| | | Bromomethane | mg/Kg | -- | 0.39 | nc | | | | | | | | | | | | | | | | |
| | | Carbon disulfide | mg/Kg | -- | 36 | nc | | | | | | | | | | | | | | | | |
| | | Carbon tetrachloride | mg/Kg | -- | 0.25 | ca | | | | | | | | | | | | | | | | |
| | | Chlorobenzene | mg/Kg | -- | 15 | nc | | | | | | | | | | | | | | | | |
| | | Chloroethane | mg/Kg | -- | 3.0 | ca | | | | | | | | | | | | | | | | |
| | | Chloroform | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | | |
| | | Chloromethane | mg/Kg | -- | 4.7 | nc | | | | | | | | | | | | | | | | |
| | | cis-1,3-Dichloropropene | mg/Kg | -- | 0.78 | ca | | | | | | | | | | | | | | | | |
| | | Dibromochloromethane | mg/Kg | -- | 1.1 | ca | | | | | | | | | | | | | | | | |
| | | Ethylbenzene | mg/Kg | -- | 395 | sat | | | | | | | | | | | | | | | | |
| | | Methylene chloride | mg/Kg | -- | 9.1 | ca | | | | | | | | | | | | | | | | |
| | | Styrene | mg/Kg | -- | 1700 | sat | | | | | | | | | | | | | | | | |
| | | Tetrachloroethene | mg/Kg | -- | 0.48 | ca | | | | | | | | | | | | | | | | |
| | | Toluene | mg/Kg | -- | 520 | sat | | | | | | | | | | | | | | | | |
| | | trans-1,3-Dichloropropene | mg/Kg | -- | 0.78 | ca | | | | | | | | | | | | | | | | |
| | | Trichloroethene | mg/Kg | -- | 0.053 | ca | | | | | | | | | | | | | | | | |
| | | Vinyl chloride | mg/Kg | -- | 0.079 | ca | | | | | | | | | | | | | | | | |
| | | Xylenes (total) | mg/Kg | -- | 0.079 | ca | | | | | | | | | | | | | | | | |

## Table 4-4
## Summary of Subsurface Soil Results (>1 ft bgs)

| | | | | | | | LL9SB-025-0001-SO | | LL9SB-026-0001-SO | | LL9SB-027-0001-SO | | LL9SB-028-0001-SO | | LL9SB-029-0001-SO | | LL9SB-030-0001-SO | | LL9SB-031-0001-SO | | LL9SB-032-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Sample Date | 12/10/03 | | 12/10/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | |
| | | | | | | Sample Depth | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Subsurface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SB PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| Cyanide 9012A | 9014/9010B | Cyanide, Total | mg/Kg | 0.00 | 122 | nc | | | | | | | | | | | | | | | 0.21 | U |
| Explosives 8330 | 8330 | 1,3,5-Trinitrobenzene | mg/Kg | 0 | 183 | nc | | | | | | | | | | | | | 0.018 | U | 0.017 | U |
| | | 1,3-Dinitrobenzene | mg/Kg | 0 | 0.61 | nc | | | | | | | | | | | | | 0.018 | U | 0.018 | U |
| | | 2,4,6-TNT | mg/Kg | 0 | 16 | ca | | | | | | | | | | | | | 0.034 | U | 0.034 | U |
| | | 2,4-Dinitrotoluene | mg/Kg | 0 | 12 | nc | | | | | | | | | | | | | 0.036 | U | 0.035 | U |
| | | 2,6-Dinitrotoluene | mg/Kg | 0 | 6.1 | nc | | | | | | | | | | | | | 0.048 | U* | 0.047 | U* |
| | | 2-Nitrotoluene | mg/Kg | 0 | 0.88 | ca | | | | | | | | | | | | | 0.033 | U | 0.033 | U |
| | | 3-Nitrotoluene | mg/Kg | 0 | 73 | nc | | | | | | | | | | | | | 0.05 | U | 0.05 | U |
| | | 4-Nitrotoluene | mg/Kg | 0 | 12 | ca | | | | | | | | | | | | | 0.047 | U | 0.046 | U |
| | | HMX | mg/Kg | 0 | 306 | nc | | | | | | | | | | | | | 0.11 | U | 0.11 | U |
| | | Nitrobenzene | mg/Kg | 0 | 2 | nc | | | | | | | | | | | | | 0.022 | U | 0.022 | U |
| | | RDX | mg/Kg | 0 | 4.4 | ca | | | | | | | | | | | | | 0.059 | U | 0.058 | U |
| | | Tetryl | mg/Kg | 0 | 61 | nc | | | | | | | | | | | | | 0.043 | U | 0.043 | U |
| Others | 8015B MDRO | Diesel Range Organics (DRO) | mg/Kg | -- | -- | -- | | | | | | | | | | | | | | | | |
| | 8015B MGRO | Gasoline Range Organics (GRO) | mg/Kg | -- | -- | -- | | | | | | | | | | | | | | | | |
| PCB TCL 8082 | 8082 | Aroclor 1016 | mg/Kg | -- | 0.39 | nc | | | | | | | | | | | | | | | 0.0022 | U |
| | | Aroclor 1221 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | 0.0024 | U |
| | | Aroclor 1232 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | 0.0024 | U |
| | | Aroclor 1242 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | 0.0024 | U |
| | | Aroclor 1248 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | 0.0024 | U |
| | | Aroclor 1254 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | 0.0024 | U |
| | | Aroclor 1260 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | 0.0016 | U |
| Pesticides 8081A | 8081A | 4,4'-DDD | mg/Kg | -- | 2.4 | ca | | | | | | | | | | | | | | | 0.00042 | U |
| | | 4,4'-DDE | mg/Kg | -- | 1.7 | ca | | | | | | | | | | | | | | | 0.00076 | U |
| | | 4,4'-DDT | mg/Kg | -- | 1.7 | ca | | | | | | | | | | | | | | | 0.00044 | U |
| | | Aldrin | mg/Kg | -- | 0.029 | ca | | | | | | | | | | | | | | | 0.00015 | U |
| | | alpha-BHC | mg/Kg | -- | 0.09 | sat | | | | | | | | | | | | | | | 0.00019 | U |
| | | alpha-Chlordane | mg/Kg | -- | 1.6 | ca | | | | | | | | | | | | | | | 0.00014 | U |
| | | beta-BHC | mg/Kg | -- | 0.32 | ca | | | | | | | | | | | | | | | 0.00018 | U |
| | | delta-BHC | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | 0.00013 | U |
| | | Dieldrin | mg/Kg | -- | 0.030 | ca | | | | | | | | | | | | | | | 0.0004 | U |
| | | Endosulfan I | mg/Kg | -- | 37 | nc | | | | | | | | | | | | | | | 0.00032 | U |
| | | Endosulfan II | mg/Kg | -- | 37 | nc | | | | | | | | | | | | | | | 0.00033 | U |
| | | Endosulfan sulfate | mg/Kg | -- | 37 | nc | | | | | | | | | | | | | | | 0.00034 | U |
| | | Endrin | mg/Kg | -- | 1.8 | nc | | | | | | | | | | | | | | | 0.00051 | U |
| | | Endrin aldehyde | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | 0.00039 | U |
| | | Endrin ketone | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | 0.00034 | U |
| | | gamma-BHC (Lindane) | mg/Kg | -- | 0.44 | ca | | | | | | | | | | | | | | | 0.00027 | U |
| | | gamma-Chlordane | mg/Kg | -- | 1.6 | ca | | | | | | | | | | | | | | | 0.00018 | U |
| | | Heptachlor | mg/Kg | -- | 0.11 | ca | | | | | | | | | | | | | | | 0.00021 | U |
| | | Heptachlor epoxide | mg/Kg | -- | 0.053 | ca | | | | | | | | | | | | | | | 0.00016 | U |
| | | Methoxychlor | mg/Kg | -- | 31 | nc | | | | | | | | | | | | | | | 0.0027 | U |
| | | Toxaphene | mg/Kg | -- | 0 | 0 | | | | | | | | | | | | | | | 0.0054 | U |

## Table 4-4
## Summary of Subsurface Soil Results (>1 ft bgs)

| | | | | | | | LL9SB-025-0001-SO | | LL9SB-026-0001-SO | | LL9SB-027-0001-SO | | LL9SB-028-0001-SO | | LL9SB-029-0001-SO | | LL9SB-030-0001-SO | | LL9SB-031-0001-SO | | LL9SB-032-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/10/03 | | 12/10/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | |
| | | | | | | **Sample Depth** | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Subsurface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SB PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| Propellants 8330 | 353.2 | Nitrocellulose | mg/Kg | 0 | -- | 0 | | | | | | | | | | | | | | | 1.3 | B J |
| | 8330 | Nitroglycerin | mg/Kg | 0 | -- | 0 | | | | | | | | | | | | | | | 0.5 | U |
| | UV/HPLC per SOP | Nitroguanidine | mg/Kg | 0 | 611 | nc | | | | | | | | | | | | | | | 0.25 | U |
| SVOCs TCL 8270 C | 8270C | 1,2,4-Trichlorobenzene | mg/Kg | -- | 6.2 | nc | | | | | | | | | | | | | | | 0.071 | U |
| | | 1,2-Dichlorobenzene | mg/Kg | -- | 600 | sat | | | | | | | | | | | | | | | 0.095 | U |
| | | 1,3-Dichlorobenzene | mg/Kg | -- | 53 | nc | | | | | | | | | | | | | | | 0.095 | U |
| | | 1,4-Dichlorobenzene | mg/Kg | -- | 3.4 | ca | | | | | | | | | | | | | | | 0.086 | U |
| | | 2,2-oxybis (1-chloropropane) | mg/Kg | -- | 2.9 | ca | | | | | | | | | | | | | | | 0.091 | U |
| | | 2,4,5-Trichlorophenol | mg/Kg | -- | 611 | nc | | | | | | | | | | | | | | | 0.046 | U |
| | | 2,4,6-Trichlorophenol | mg/Kg | -- | 0.61 | nc | | | | | | | | | | | | | | | 0.057 | U |
| | | 2,4-Dichlorophenol | mg/Kg | -- | 18 | nc | | | | | | | | | | | | | | | 0.058 | U |
| | | 2,4-Dimethylphenol | mg/Kg | -- | 122 | nc | | | | | | | | | | | | | | | 0.072 | U |
| | | 2,4-Dinitrophenol | mg/Kg | -- | 12 | nc | | | | | | | | | | | | | | | 0.14 | U |
| | | 2-Chloronaphthalene | mg/Kg | -- | 494 | nc | | | | | | | | | | | | | | | 0.058 | U |
| | | 2-Chlorophenol | mg/Kg | -- | 6.3 | nc | | | | | | | | | | | | | | | 0.071 | U |
| | | 2-Methylnaphthalene | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | 0.0018 | U |
| | | 2-Methylphenol (o-cresol) | mg/Kg | -- | 306 | nc | | | | | | | | | | | | | | | 0.01 | U |
| | | 2-Nitroaniline | mg/Kg | -- | 18.3 | nc | | | | | | | | | | | | | | | 0.041 | U |
| | | 2-Nitrophenol | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | 0.076 | U |
| | | 3,3-Dichlorobenzidine | mg/Kg | -- | 1.1 | ca | | | | | | | | | | | | | | | 0.022 | U |
| | | 3-Nitroaniline | mg/Kg | -- | 1.8 | nc | | | | | | | | | | | | | | | 0.13 | U |
| | | 4,6-Dinitro-2-methylphenol | mg/Kg | -- | 0.61 | nc | | | | | | | | | | | | | | | 0.11 | U* |
| | | 4-Bromophenyl phenyl ether | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | 0.0037 | U |
| | | 4-Chloro-3-methylphenol | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | 0.046 | U |
| | | 4-Chloroaniline | mg/Kg | -- | 24 | nc | | | | | | | | | | | | | | | 0.12 | U |
| | | 4-Chlorophenyl phenyl ether | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | 0.0043 | U |
| | | 4-Methylphenol (m/p-cresol) | mg/Kg | -- | 31 | nc | | | | | | | | | | | | | | | 0.007 | U |
| | | 4-Nitroaniline | mg/Kg | -- | 23 | ca | | | | | | | | | | | | | | | 0.047 | U |
| | | 4-Nitrophenol | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | 0.099 | U |
| | | Acenaphthene | mg/Kg | -- | 368 | nc | | | | | | | | | | | | | | | 0.0017 | U |
| | | Acenaphthylene | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | 0.0011 | U |
| | | Anthracene | mg/Kg | -- | 2189 | nc | | | | | | | | | | | | | | | 0.001 | U |
| | | Benzo(a)anthracene | mg/Kg | -- | 0.62 | ca | | | | | | | | | | | | | | | 0.0031 | J |
| | | Benzo(a)pyrene | mg/Kg | -- | 0.062 | ca | | | | | | | | | | | | | | | 0.0027 | U |
| | | Benzo(b)fluoranthene | mg/Kg | -- | 0.62 | ca | | | | | | | | | | | | | | | 0.0045 | J |
| | | Benzo(ghi)perylene | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | 0.0033 | J |
| | | Benzo(k)fluoranthene | mg/Kg | -- | 6.2 | ca | | | | | | | | | | | | | | | 0.0034 | U |
| | | Bis(2-chloroethoxy)methane | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | 0.0035 | U |
| | | Bis(2-chloroethyl)ether | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | 0.0024 | U |
| | | Bis(2-ethylhexyl)phthalate | mg/Kg | -- | 35 | ca | | | | | | | | | | | | | | | 0.011 | U |

## Table 4-4
## Summary of Subsurface Soil Results (>1 ft bgs)

| | | | | | | | LL9SB-025-0001-SO | | LL9SB-026-0001-SO | | LL9SB-027-0001-SO | | LL9SB-028-0001-SO | | LL9SB-029-0001-SO | | LL9SB-030-0001-SO | | LL9SB-031-0001-SO | | LL9SB-032-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/10/03 | | 12/10/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | |
| | | | | | | **Sample Depth** | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Subsurface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SB PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| | | Butyl benzyl phthalate | mg/Kg | -- | 1222 | nc | | | | | | | | | | | | | | | 0.0049 | U |
| | | Carbazole | mg/Kg | -- | 24 | ca | | | | | | | | | | | | | | | 0.042 | U |
| | | Chrysene | mg/Kg | -- | 62 | ca | | | | | | | | | | | | | | | 0.0031 | J |
| | | Dibenzo(a,h)anthracene | mg/Kg | -- | 0.062 | ca | | | | | | | | | | | | | | | 0.026 | J |
| | | Dibenzofuran | mg/Kg | -- | 15 | nc | | | | | | | | | | | | | | | 0.0033 | U |
| | | Diethyl phthalate | mg/Kg | -- | 4888 | nc | | | | | | | | | | | | | | | 0.0045 | U |
| | | Dimethyl phthalate | mg/Kg | -- | 100000 | max | | | | | | | | | | | | | | | 0.0043 | U |
| | | Di-n-butyl phthalate | mg/Kg | -- | 611 | nc | | | | | | | | | | | | | | | 0.024 | U |
| | | Di-n-octyl phthalate | mg/Kg | -- | 244 | nc | | | | | | | | | | | | | | | 0.01 | U |
| | | Fluoranthene | mg/Kg | -- | 229 | nc | | | | | | | | | | | | | | | 0.0064 | J |
| | | Fluorene | mg/Kg | -- | 275 | nc | | | | | | | | | | | | | | | 0.0019 | U |
| | | Hexachlorobenzene | mg/Kg | -- | 0.30 | ca | | | | | | | | | | | | | | | 0.0022 | U |
| | | Hexachlorobutadiene | mg/Kg | -- | 6.2 | ca | | | | | | | | | | | | | | | 0.004 | U |
| | | Hexachlorocyclopentadiene | mg/Kg | -- | 37 | nc | | | | | | | | | | | | | | | 0.065 | U |
| | | Hexachloroethane | mg/Kg | -- | 35 | ca | | | | | | | | | | | | | | | 0.004 | U |
| | | Indeno(1,2,3-cd)pyrene | mg/Kg | -- | 0.62 | ca | | | | | | | | | | | | | | | 0.018 | J |
| | | Isophorone | mg/Kg | -- | 512 | ca | | | | | | | | | | | | | | | 0.0029 | U |
| | | Naphthalene | mg/Kg | -- | 5.6 | nc | | | | | | | | | | | | | | | 0.0021 | U |
| | | n-Nitroso-di-n-propylamine | mg/Kg | -- | 0.069 | ca | | | | | | | | | | | | | | | 0.0028 | U |
| | | n-Nitrosodiphenylamine | mg/Kg | -- | 99 | ca | | | | | | | | | | | | | | | 0.0035 | U |
| | | Pentachlorophenol | mg/Kg | -- | 3.0 | ca | | | | | | | | | | | | | | | 0.12 | U |
| | | Phenanthrene | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | 0.0012 | U |
| | | Phenol | mg/Kg | -- | 1833 | nc | | | | | | | | | | | | | | | 0.0019 | U |
| | | Pyrene | mg/Kg | -- | 232 | nc | | | | | | | | | | | | | | | 0.004 | J |
| TAL Metals 6010B | 6010B | Aluminum | mg/Kg | 19500 | 7614 | nc | **18000** | | **13000** | | **10000** | | **9600** | | **9400** | | **10000** | | 6400 | | **11000** | |
| | | Barium | mg/Kg | 124 | 538 | nc | 45 | | 70 | | 54 | | 37 | | 62 | | 43 | | 28 | | 100 | |
| | | Beryllium | mg/Kg | 0.88 | 15 | nc | 0.5 | | 0.36 | B | 0.61 | | 0.33 | B | 0.58 | | 0.55 | | 0.4 | B | 0.84 | |
| | | Cadmium | mg/Kg | 0.00 | 3.7 | nc | 0.094 | U | 0.093 | U | 0.087 | U | 0.092 | U | 0.08 | U | 0.094 | U | 0.087 | U | 0.086 | U |
| | | Calcium | mg/Kg | 35500 | -- | 0 | 890 | | 600 | | 630 | | 600 | | 320 | | 500 | | 470 | | 760 | |
| | | Chromium | mg/Kg | 27.2 | 30 | ca | 23 | | 15 | | 13 | | 11 | | 14 | | 13 | | 9.9 | | 13 | |
| | | Cobalt | mg/Kg | 23.2 | 902 | ca | 8.5 | | 8.1 | | 6.7 | | 2.4 | | 8.7 | | 5.9 | | 5.5 | | 11 | |
| | | Copper | mg/Kg | 32.3 | 313 | nc | 23 | | 8.1 | | 14 | | 5.2 | | 9.1 | | 11 | | 6.3 | | 12 | |
| | | Iron | mg/Kg | 35200 | 2346 | nc | **32000** | | **19000** | | **24000** | | **11000** | | **24000** | | **21000** | | **16000** | | **19000** | |
| | | Magnesium | mg/Kg | 8790 | -- | 0 | 4000 | | 2200 | | 1700 | | 1200 | | 1700 | | 1700 | | 1400 | | 1600 | |
| | | Manganese | mg/Kg | 3030 | 176 | nc | **180** | | **470** | | **410** | | 50 | | **660** | | **380** | | **390** | | **970** | |
| | | Nickel | mg/Kg | 60.7 | 156 | nc | 25 | | 14 | | 14 | | 6.6 | | 12 | | 13 | | 10 | | 13 | |
| | | Potassium | mg/Kg | 3350 | -- | 0 | 1600 | | 860 | | 670 | | 610 | | 530 | | 560 | | 440 | | 510 | |
| | | Selenium | mg/Kg | 1.5 | 39 | nc | 0.47 | U | 0.47 | U | 0.43 | U | 0.46 | U | 0.65 | B | 0.58 | B | 0.43 | U | 0.43 | U |
| | | Silver | mg/Kg | 0.00 | 39 | nc | 0.37 | U | 0.36 | U | 0.34 | U | 0.36 | U | 0.31 | U | 0.36 | U | 0.34 | U | 0.33 | U |
| | | Sodium | mg/Kg | 145 | -- | 0 | 100 | U | 100 | U | 94 | U | 100 | U | 87 | U | 100 | U | 94 | U | 93 | U |
| | | Vanadium | mg/Kg | 37.6 | 7.8 | nc | **29** | | **23** | | **19** | | **18** | | **19** | | **20** | | **12** | | **21** | |
| | | Zinc | mg/Kg | 93.3 | 2346 | nc | 61 | | 45 | | 47 | | 27 | | 42 | | 45 | | 38 | | 44 | |

## Table 4-4
## Summary of Subsurface Soil Results (>1 ft bgs)

| | | | | | | | LL9SB-025-0001-SO | | LL9SB-026-0001-SO | | LL9SB-027-0001-SO | | LL9SB-028-0001-SO | | LL9SB-029-0001-SO | | LL9SB-030-0001-SO | | LL9SB-031-0001-SO | | LL9SB-032-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/10/03 | | 12/10/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | | 12/04/03 | |
| | | | | | | **Sample Depth** | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Subsurface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SB PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| | 7041 | Antimony | mg/Kg | 0.96 | 3.1 | nc | 0.7 | B | 0.56 | B | 0.52 | U | 0.47 | U | 0.46 | U | 0.46 | U | 0.47 | U | 0.46 | U |
| | 7060A | Arsenic | mg/Kg | 19.8 | 0.39 | ca | **15** | | **6.9** | | **18** | | **5.1** | | **11** | | **6** | | **7.4** | | **7.4** | |
| | 7421 | Lead | mg/Kg | 19.1 | 400 | pbk | 11 | | 14 | | 14 | | 5.5 | | 11 | | 8.8 | | 6.5 | | 15 | |
| | 7471A | Mercury | mg/Kg | 0.04 | 2.3 | nc | 0.0095 | B | 0.024 | | 0.035 | | 0.032 | | 0.038 | | 0.038 | | 0.016 | B | 0.015 | B |
| | 7841 | Thallium | mg/Kg | 0.91 | 0.52 | nc | 0.22 | U | 0.22 | U | 1.1 | U | 0.2 | U | 0.99 | U | 0.2 | U | 1 | U | 0.2 | U |
| VOCs TCL 8260B | 8260B | 1,1,1-Trichloroethane | mg/Kg | -- | 1200 | sat | | | | | | | | | | | | | | | 0.0013 | U |
| | | 1,1,2,2-Tetrachloroethane | mg/Kg | -- | 0.41 | ca | | | | | | | | | | | | | | | 0.0012 | U |
| | | 1,1,2-Trichloroethane | mg/Kg | -- | 0.73 | ca | | | | | | | | | | | | | | | 0.0013 | U |
| | | 1,1-Dichloroethane | mg/Kg | -- | 51 | nc | | | | | | | | | | | | | | | 0.0012 | U |
| | | 1,1-Dichloroethene | mg/Kg | -- | 12 | nc | | | | | | | | | | | | | | | 0.0016 | U |
| | | 1,2-Dichloroethane | mg/Kg | -- | 0.28 | ca | | | | | | | | | | | | | | | 0.0011 | U |
| | | 1,2-Dichloroethene (total) | mg/Kg | -- | 6.9 | nc | | | | | | | | | | | | | | | 0.0026 | U |
| | | 1,2-Dichloropropane | mg/Kg | -- | 0.34 | ca | | | | | | | | | | | | | | | 0.0012 | U |
| | | 2-Butanone (MEK) | mg/Kg | -- | 2231 | nc | | | | | | | | | | | | | | | 0.0047 | U |
| | | 2-Hexanone | mg/Kg | -- | 530 | nc | | | | | | | | | | | | | | | 0.0013 | U |
| | | 4-Methyl-2-pentanone (MIBK) | mg/Kg | -- | 528 | nc | | | | | | | | | | | | | | | 0.0012 | U |
| | | Acetone | mg/Kg | -- | 1412 | nc | | | | | | | | | | | | | | | 0.0056 | U |
| | | Benzene | mg/Kg | -- | 0.64 | ca | | | | | | | | | | | | | | | 0.0013 | U |
| | | Bromodichloromethane | mg/Kg | -- | 0.82 | ca | | | | | | | | | | | | | | | 0.0012 | U |
| | | Bromoform | mg/Kg | -- | 62 | ca | | | | | | | | | | | | | | | 0.00091 | U |
| | | Bromomethane | mg/Kg | -- | 0.39 | nc | | | | | | | | | | | | | | | 0.0016 | U* |
| | | Carbon disulfide | mg/Kg | -- | 36 | nc | | | | | | | | | | | | | | | 0.0015 | U |
| | | Carbon tetrachloride | mg/Kg | -- | 0.25 | ca | | | | | | | | | | | | | | | 0.0013 | U |
| | | Chlorobenzene | mg/Kg | -- | 15 | nc | | | | | | | | | | | | | | | 0.0013 | U |
| | | Chloroethane | mg/Kg | -- | 3.0 | ca | | | | | | | | | | | | | | | 0.0012 | U |
| | | Chloroform | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | 0.0013 | U |
| | | Chloromethane | mg/Kg | -- | 4.7 | nc | | | | | | | | | | | | | | | 0.0013 | U |
| | | cis-1,3-Dichloropropene | mg/Kg | -- | 0.78 | ca | | | | | | | | | | | | | | | 0.0011 | U |
| | | Dibromochloromethane | mg/Kg | -- | 1.1 | ca | | | | | | | | | | | | | | | 0.00096 | U |
| | | Ethylbenzene | mg/Kg | -- | 395 | sat | | | | | | | | | | | | | | | 0.0013 | U |
| | | Methylene chloride | mg/Kg | -- | 9.1 | ca | | | | | | | | | | | | | | | 0.0035 | U |
| | | Styrene | mg/Kg | -- | 1700 | sat | | | | | | | | | | | | | | | 0.0013 | U |
| | | Tetrachloroethene | mg/Kg | -- | 0.48 | ca | | | | | | | | | | | | | | | 0.0015 | U |
| | | Toluene | mg/Kg | -- | 520 | sat | | | | | | | | | | | | | | | 0.0013 | U |
| | | trans-1,3-Dichloropropene | mg/Kg | -- | 0.78 | ca | | | | | | | | | | | | | | | 0.00096 | U |
| | | Trichloroethene | mg/Kg | -- | 0.053 | ca | | | | | | | | | | | | | | | 0.0013 | U |
| | | Vinyl chloride | mg/Kg | -- | 0.079 | ca | | | | | | | | | | | | | | | 0.0013 | U |
| | | Xylenes (total) | mg/Kg | -- | 0.079 | ca | | | | | | | | | | | | | | | 0.0041 | U |

## Table 4-4
## Summary of Subsurface Soil Results (>1 ft bgs)

| | | | | | | | LL9SB-040-0001-SO | | LL9SB-041-0001-SO | | LL9SB-042-0001-SO | | LL9SB-043-0001-DUP | | LL9SB-043-0001-SO | | LL9SB-044-0001-SO | | LL9SB-045-0001-SO | | LL9SB-046-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 10/27/03 | | 10/27/03 | | 11/06/03 | | 11/06/03 | | 11/06/03 | | 11/06/03 | | 11/06/03 | | 11/06/03 | |
| | | | | | | **Sample Depth** | 6.5 ft | | 7 ft | | 8 - 10 ft | | 9 - 11 ft | | 9 - 11 ft | | 8 - 10 ft | | 8 - 10 ft | | 4 - 6 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Subsurface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SB PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| Cyanide 9012A | 9014/9010B | Cyanide, Total | mg/Kg | 0.00 | 122 | nc | 0.17 | U | 0.17 | U | | | 0.077 | U^ | 0.13 | U | | | | | | |
| Explosives 8330 | 8330 | 1,3,5-Trinitrobenzene | mg/Kg | 0 | 183 | nc | 0.018 | U | 0.017 | U | | | 0.017 | U | 0.017 | U | | | | | | |
| | | 1,3-Dinitrobenzene | mg/Kg | 0 | 0.61 | nc | 0.018 | U | 0.018 | U | | | 0.018 | U | 0.018 | U | | | | | | |
| | | 2,4,6-TNT | mg/Kg | 0 | 16 | ca | 0.034 | U | 0.034 | U | | | 0.034 | U | 0.033 | U | | | | | | |
| | | 2,4-Dinitrotoluene | mg/Kg | 0 | 12 | nc | 0.036 | U | 0.035 | U | | | 0.035 | U | 0.035 | U | | | | | | |
| | | 2,6-Dinitrotoluene | mg/Kg | 0 | 6.1 | nc | 0.048 | U | 0.047 | U | | | 0.047 | U | 0.047 | U | | | | | | |
| | | 2-Nitrotoluene | mg/Kg | 0 | 0.88 | ca | 0.033 | U | 0.033 | U | | | 0.033 | U | 0.033 | U | | | | | | |
| | | 3-Nitrotoluene | mg/Kg | 0 | 73 | nc | 0.05 | U | 0.05 | U | | | 0.05 | U | 0.05 | U | | | | | | |
| | | 4-Nitrotoluene | mg/Kg | 0 | 12 | ca | 0.047 | U | 0.046 | U | | | 0.046 | U | 0.046 | U | | | | | | |
| | | HMX | mg/Kg | 0 | 306 | nc | 0.11 | U | 0.11 | U | | | 0.11 | U | 0.11 | U | | | | | | |
| | | Nitrobenzene | mg/Kg | 0 | 2 | nc | 0.022 | U | 0.022 | U | | | 0.022 | U | 0.022 | U | | | | | | |
| | | RDX | mg/Kg | 0 | 4.4 | ca | 0.059 | U | 0.058 | U | | | 0.058 | U | 0.058 | U | | | | | | |
| | | Tetryl | mg/Kg | 0 | 61 | nc | 0.043 | U | 0.043 | U | | | 0.043 | U | 0.043 | U | | | | | | |
| Others | 8015B MDRO | Diesel Range Organics (DRO) | mg/Kg | -- | -- | -- | | | | | | | | | | | | | | | | |
| | 8015B MGRO | Gasoline Range Organics (GRO) | mg/Kg | -- | -- | -- | | | | | | | | | | | | | | | | |
| PCB TCL 8082 | 8082 | Aroclor 1016 | mg/Kg | -- | 0.39 | nc | 0.0022 | U | 0.0022 | U | | | 0.018 | U | 0.019 | U | | | | | | |
| | | Aroclor 1221 | mg/Kg | -- | 0.22 | ca | 0.0023 | U | 0.0023 | U | | | 0.018 | U | 0.019 | U | | | | | | |
| | | Aroclor 1232 | mg/Kg | -- | 0.22 | ca | 0.0023 | U | 0.0023 | U | | | 0.018 | U | 0.019 | U | | | | | | |
| | | Aroclor 1242 | mg/Kg | -- | 0.22 | ca | 0.0023 | U | 0.0023 | U | | | 0.018 | U | 0.019 | U | | | | | | |
| | | Aroclor 1248 | mg/Kg | -- | 0.22 | ca | 0.0023 | U | 0.0023 | U | | | 0.018 | U | 0.019 | U | | | | | | |
| | | Aroclor 1254 | mg/Kg | -- | 0.22 | ca | 0.0023 | U | 0.0023 | U | | | 0.018 | U | 0.019 | U | | | | | | |
| | | Aroclor 1260 | mg/Kg | -- | 0.22 | ca | 0.0016 | U | 0.0016 | U | | | 0.018 | U | 0.019 | U | | | | | | |
| Pesticides 8081A | 8081A | 4,4'-DDD | mg/Kg | -- | 2.4 | ca | 0.0021 | U | 0.00042 | U | | | 0.0004 | U | 0.0004 | U | | | | | | |
| | | 4,4'-DDE | mg/Kg | -- | 1.7 | ca | 0.0038 | U | 0.00075 | U | | | 0.00072 | U | 0.00073 | U | | | | | | |
| | | 4,4'-DDT | mg/Kg | -- | 1.7 | ca | 0.0021 | U | 0.00043 | U | | | 0.00041 | U | 0.00041 | U | | | | | | |
| | | Aldrin | mg/Kg | -- | 0.029 | ca | 0.00075 | U | 0.00015 | U | | | 0.00014 | U | 0.00015 | U | | | | | | |
| | | alpha-BHC | mg/Kg | -- | 0.09 | sat | 0.00093 | U | 0.00018 | U | | | 0.00018 | U | 0.00018 | U | | | | | | |
| | | alpha-Chlordane | mg/Kg | -- | 1.6 | ca | 0.0007 | U | 0.00014 | U | | | 0.00013 | U | 0.00013 | U | | | | | | |
| | | beta-BHC | mg/Kg | -- | 0.32 | ca | 0.00087 | U | 0.00017 | U | | | 0.00017 | U | 0.00017 | U | | | | | | |
| | | delta-BHC | mg/Kg | -- | -- | 0 | 0.00064 | U | 0.00013 | U | | | 0.00012 | U | 0.00012 | U | | | | | | |
| | | Dieldrin | mg/Kg | -- | 0.030 | ca | 0.002 | U | 0.00039 | U | | | 0.00037 | U | 0.00038 | U | | | | | | |
| | | Endosulfan I | mg/Kg | -- | 37 | nc | 0.0016 | U | 0.00031 | U | | | 0.0003 | U | 0.0003 | U | | | | | | |
| | | Endosulfan II | mg/Kg | -- | 37 | nc | 0.0016 | U | 0.00032 | U | | | 0.00031 | U | 0.00031 | U | | | | | | |
| | | Endosulfan sulfate | mg/Kg | -- | 37 | nc | 0.0017 | U | 0.00034 | U | | | 0.00032 | U | 0.00032 | U | | | | | | |
| | | Endrin | mg/Kg | -- | 1.8 | nc | 0.0025 | U | 0.0005 | U | | | 0.00047 | U | 0.00048 | U | | | | | | |
| | | Endrin aldehyde | mg/Kg | -- | -- | 0 | 0.0019 | U | 0.00038 | U | | | 0.00036 | U | 0.00037 | U | | | | | | |
| | | Endrin ketone | mg/Kg | -- | -- | 0 | 0.0017 | U | 0.00034 | U | | | 0.00032 | U | 0.00032 | U | | | | | | |
| | | gamma-BHC (Lindane) | mg/Kg | -- | 0.44 | ca | 0.0013 | U | 0.00027 | U | | | 0.00025 | U | 0.00026 | U | | | | | | |
| | | gamma-Chlordane | mg/Kg | -- | 1.6 | ca | 0.00087 | U | 0.00017 | U | | | 0.00017 | U | 0.00017 | U | | | | | | |
| | | Heptachlor | mg/Kg | -- | 0.11 | ca | 0.001 | U | 0.00021 | U | | | 0.0002 | U | 0.0002 | U | | | | | | |
| | | Heptachlor epoxide | mg/Kg | -- | 0.053 | ca | 0.00081 | U | 0.00016 | U | | | 0.00015 | U | 0.00016 | U | | | | | | |
| | | Methoxychlor | mg/Kg | -- | 31 | nc | 0.013 | U | 0.0027 | U | | | 0.0025 | U | 0.0026 | U | | | | | | |
| | | Toxaphene | mg/Kg | -- | 0 | 0 | 0.027 | U | 0.0053 | U | | | 0.0051 | U | 0.0051 | U | | | | | | |

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## Table 4-4
## Summary of Subsurface Soil Results (>1 ft bgs)

| | | | | | | | LL9SB-040-0001-SO | | LL9SB-041-0001-SO | | LL9SB-042-0001-SO | | LL9SB-043-0001-DUP | | LL9SB-043-0001-SO | | LL9SB-044-0001-SO | | LL9SB-045-0001-SO | | LL9SB-046-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 10/27/03 | | 10/27/03 | | 11/06/03 | | 11/06/03 | | 11/06/03 | | 11/06/03 | | 11/06/03 | | 11/06/03 | |
| | | | | | | **Sample Depth** | 6.5 ft | | 7 ft | | 8 - 10 ft | | 9 - 11 ft | | 9 - 11 ft | | 8 - 10 ft | | 8 - 10 ft | | 4 - 6 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Subsurface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SB PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| Propellants 8330 | 353.2 | Nitrocellulose | mg/Kg | 0 | -- | 0 | | | | | | | 2.3 | U | 2.3 | U | | | | | | |
| | 8330 | Nitroglycerin | mg/Kg | 0 | -- | 0 | | | | | | | 0.5 | U | 0.5 | U | | | | | | |
| | UV/HPLC per SOP | Nitroguanidine | mg/Kg | 0 | 611 | nc | | | | | | | 0.25 | U | 0.25 | U | | | | | | |
| SVOCs TCL 8270 C | 8270C | 1,2,4-Trichlorobenzene | mg/Kg | -- | 6.2 | nc | 0.068 | U | 0.068 | U | | | 0.065 | U | 0.065 | U | | | | | | |
| | | 1,2-Dichlorobenzene | mg/Kg | -- | 600 | sat | 0.091 | U | 0.091 | U | | | 0.087 | U | 0.087 | U | | | | | | |
| | | 1,3-Dichlorobenzene | mg/Kg | -- | 53 | nc | 0.091 | U | 0.091 | U | | | 0.087 | U | 0.087 | U | | | | | | |
| | | 1,4-Dichlorobenzene | mg/Kg | -- | 3.4 | ca | 0.082 | U | 0.082 | U | | | 0.078 | U | 0.078 | U | | | | | | |
| | | 2,2-oxybis (1-chloropropane) | mg/Kg | -- | 2.9 | ca | 0.086 | U | 0.086 | U | | | 0.083 | U | 0.083 | U | | | | | | |
| | | 2,4,5-Trichlorophenol | mg/Kg | -- | 611 | nc | 0.044 | U | 0.044 | U | | | 0.042 | U | 0.042 | U | | | | | | |
| | | 2,4,6-Trichlorophenol | mg/Kg | -- | 0.61 | nc | 0.054 | U | 0.054 | U | | | 0.052 | U | 0.052 | U | | | | | | |
| | | 2,4-Dichlorophenol | mg/Kg | -- | 18 | nc | 0.055 | U | 0.055 | U | | | 0.053 | U | 0.053 | U | | | | | | |
| | | 2,4-Dimethylphenol | mg/Kg | -- | 122 | nc | 0.069 | U | 0.069 | U | | | 0.066 | U | 0.066 | U | | | | | | |
| | | 2,4-Dinitrophenol | mg/Kg | -- | 12 | nc | 0.13 | U | 0.13 | U | | | 0.13 | U | 0.13 | U | | | | | | |
| | | 2-Chloronaphthalene | mg/Kg | -- | 494 | nc | 0.055 | U | 0.055 | U | | | 0.053 | U | 0.053 | U | | | | | | |
| | | 2-Chlorophenol | mg/Kg | -- | 6.3 | nc | 0.068 | U | 0.068 | U | | | 0.065 | U | 0.065 | U | | | | | | |
| | | 2-Methylnaphthalene | mg/Kg | -- | -- | 0 | 0.0017 | U | 0.0017 | U | | | 0.0017 | U | 0.0017 | U | | | | | | |
| | | 2-Methylphenol (o-cresol) | mg/Kg | -- | 306 | nc | 0.0096 | U | 0.0097 | U | | | 0.0092 | U | 0.0093 | U | | | | | | |
| | | 2-Nitroaniline | mg/Kg | -- | 18.3 | nc | 0.039 | U | 0.039 | U | | | 0.037 | U* | 0.038 | U* | | | | | | |
| | | 2-Nitrophenol | mg/Kg | -- | -- | 0 | 0.072 | U | 0.072 | U | | | 0.069 | U | 0.07 | U | | | | | | |
| | | 3,3-Dichlorobenzidine | mg/Kg | -- | 1.1 | ca | 0.021 | U | 0.021 | U | | | 0.02 | U | 0.02 | U | | | | | | |
| | | 3-Nitroaniline | mg/Kg | -- | 1.8 | nc | 0.13 | U | 0.13 | U | | | 0.12 | U | 0.12 | U | | | | | | |
| | | 4,6-Dinitro-2-methylphenol | mg/Kg | -- | 0.61 | nc | 0.11 | U | 0.11 | U | | | 0.1 | U* | 0.1 | U* | | | | | | |
| | | 4-Bromophenyl phenyl ether | mg/Kg | -- | -- | 0 | 0.0036 | U | 0.0036 | U | | | 0.0034 | U* | 0.0034 | U* | | | | | | |
| | | 4-Chloro-3-methylphenol | mg/Kg | -- | -- | 0 | 0.044 | U | 0.044 | U | | | 0.042 | U | 0.042 | U | | | | | | |
| | | 4-Chloroaniline | mg/Kg | -- | 24 | nc | 0.11 | U | 0.12 | U | | | 0.11 | U | 0.11 | U | | | | | | |
| | | 4-Chlorophenyl phenyl ether | mg/Kg | -- | -- | 0 | 0.0041 | U | 0.0041 | U | | | 0.004 | U* | 0.004 | U* | | | | | | |
| | | 4-Methylphenol (m/p-cresol) | mg/Kg | -- | 31 | nc | 0.0067 | U | 0.0067 | U | | | 0.0064 | U | 0.0064 | U | | | | | | |
| | | 4-Nitroaniline | mg/Kg | -- | 23 | ca | 0.045 | U | 0.045 | U | | | 0.043 | U | 0.043 | U | | | | | | |
| | | 4-Nitrophenol | mg/Kg | -- | -- | 0 | 0.094 | U | 0.094 | U | | | 0.09 | U | 0.091 | U | | | | | | |
| | | Acenaphthene | mg/Kg | -- | 368 | nc | 0.0016 | U | 0.0016 | U | | | 0.0015 | U | 0.0015 | U | | | | | | |
| | | Acenaphthylene | mg/Kg | -- | -- | 0 | 0.001 | U | 0.001 | U | | | 0.001 | U* | 0.001 | U* | | | | | | |
| | | Anthracene | mg/Kg | -- | 2189 | nc | 0.00099 | U | 0.00099 | U | | | 0.00095 | U | 0.00095 | U | | | | | | |
| | | Benzo(a)anthracene | mg/Kg | -- | 0.62 | ca | 0.053 | | 0.0013 | U | | | 0.0012 | U | 0.0012 | U | | | | | | |
| | | Benzo(a)pyrene | mg/Kg | -- | 0.062 | ca | 0.052 | | 0.0025 | U | | | 0.0024 | U | 0.0024 | U | | | | | | |
| | | Benzo(b)fluoranthene | mg/Kg | -- | 0.62 | ca | 0.062 | | 0.0024 | U | | | 0.0023 | U | 0.0023 | U | | | | | | |
| | | Benzo(ghi)perylene | mg/Kg | -- | -- | 0 | 0.034 | Ja | 0.0022 | U | | | 0.0021 | U | 0.0021 | U | | | | | | |
| | | Benzo(k)fluoranthene | mg/Kg | -- | 6.2 | ca | 0.059 | M | 0.0032 | U | | | 0.0031 | U | 0.0031 | U | | | | | | |
| | | Bis(2-chloroethoxy)methane | mg/Kg | -- | -- | 0 | 0.0033 | U | 0.0033 | U | | | 0.0032 | U | 0.0032 | U | | | | | | |
| | | Bis(2-chloroethyl)ether | mg/Kg | -- | 0.22 | ca | 0.0023 | U | 0.0023 | U | | | 0.0022 | U | 0.0022 | U | | | | | | |
| | | Bis(2-ethylhexyl)phthalate | mg/Kg | -- | 35 | ca | 0.011 | U | 0.011 | U | | | 0.01 | U | 0.01 | U | | | | | | |

## Table 4-4
## Summary of Subsurface Soil Results (>1 ft bgs)

| | | | | | | | LL9SB-040-0001-SO | | LL9SB-041-0001-SO | | LL9SB-042-0001-SO | | LL9SB-043-0001-DUP | | LL9SB-043-0001-SO | | LL9SB-044-0001-SO | | LL9SB-045-0001-SO | | LL9SB-046-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 10/27/03 | | 10/27/03 | | 11/06/03 | | 11/06/03 | | 11/06/03 | | 11/06/03 | | 11/06/03 | | 11/06/03 | |
| | | | | | | **Sample Depth** | 6.5 ft | | 7 ft | | 8 - 10 ft | | 9 - 11 ft | | 9 - 11 ft | | 8 - 10 ft | | 8 - 10 ft | | 4 - 6 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Subsurface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SB PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| | | Butyl benzyl phthalate | mg/Kg | -- | 1222 | nc | 0.0047 | U | 0.0047 | U | | | 0.0045 | U | 0.0045 | U | | | | | | |
| | | Carbazole | mg/Kg | -- | 24 | ca | 0.04 | U | 0.04 | U | | | 0.039 | U | 0.039 | U | | | | | | |
| | | Chrysene | mg/Kg | -- | 62 | ca | 0.058 | | 0.0021 | U | | | 0.002 | U | 0.002 | U | | | | | | |
| | | Dibenzo(a,h)anthracene | mg/Kg | -- | 0.062 | ca | 0.018 | Ja | 0.0025 | U | | | 0.0024 | U | 0.0024 | U | | | | | | |
| | | Dibenzofuran | mg/Kg | -- | 15 | nc | 0.0031 | U | 0.0031 | U | | | 0.003 | U | 0.003 | U | | | | | | |
| | | Diethyl phthalate | mg/Kg | -- | 4888 | nc | 0.0043 | U | 0.0043 | U | | | 0.0041 | U* | 0.0041 | U* | | | | | | |
| | | Dimethyl phthalate | mg/Kg | -- | 100000 | max | 0.0041 | U | 0.0041 | U | | | 0.004 | U* | 0.004 | U* | | | | | | |
| | | Di-n-butyl phthalate | mg/Kg | -- | 611 | nc | 0.14 | Ja | 0.087 | Ja | | | 0.022 | U | 0.022 | U | | | | | | |
| | | Di-n-octyl phthalate | mg/Kg | -- | 244 | nc | 0.01 | U | 0.01 | U | | | 0.0096 | U | 0.0096 | U | | | | | | |
| | | Fluoranthene | mg/Kg | -- | 229 | nc | 0.17 | | 0.0013 | U | | | 0.0012 | U | 0.0012 | U | | | | | | |
| | | Fluorene | mg/Kg | -- | 275 | nc | 0.0018 | U | 0.0018 | U | | | 0.0018 | U | 0.0018 | U | | | | | | |
| | | Hexachlorobenzene | mg/Kg | -- | 0.30 | ca | 0.0021 | U | 0.0021 | U | | | 0.002 | U* | 0.002 | U* | | | | | | |
| | | Hexachlorobutadiene | mg/Kg | -- | 6.2 | ca | 0.0038 | U | 0.0038 | U | | | 0.0036 | U | 0.0036 | U | | | | | | |
| | | Hexachlorocyclopentadiene | mg/Kg | -- | 37 | nc | 0.062 | U | 0.062 | U | | | 0.059 | U | 0.06 | U | | | | | | |
| | | Hexachloroethane | mg/Kg | -- | 35 | ca | 0.0038 | U | 0.0038 | U | | | 0.0036 | U | 0.0036 | U | | | | | | |
| | | Indeno(1,2,3-cd)pyrene | mg/Kg | -- | 0.62 | ca | 0.034 | Ja | 0.0024 | U | | | 0.0023 | U | 0.0023 | U | | | | | | |
| | | Isophorone | mg/Kg | -- | 512 | ca | 0.0028 | U | 0.0028 | U | | | 0.0026 | U | 0.0027 | U | | | | | | |
| | | Naphthalene | mg/Kg | -- | 5.6 | nc | 0.002 | U | 0.002 | U | | | 0.0019 | U | 0.0019 | U | | | | | | |
| | | n-Nitroso-di-n-propylamine | mg/Kg | -- | 0.069 | ca | 0.0026 | U | 0.0026 | U | | | 0.0025 | U | 0.0025 | U | | | | | | |
| | | n-Nitrosodiphenylamine | mg/Kg | -- | 99 | ca | 0.0033 | U | 0.0033 | U | | | 0.0032 | U | 0.0032 | U | | | | | | |
| | | Pentachlorophenol | mg/Kg | -- | 3.0 | ca | 0.11 | U | 0.12 | U | | | 0.11 | U | 0.11 | U | | | | | | |
| | | Phenanthrene | mg/Kg | -- | -- | 0 | 0.061 | | 0.0012 | U | | | 0.0011 | U | 0.0011 | U | | | | | | |
| | | Phenol | mg/Kg | -- | 1833 | nc | 0.0018 | U | 0.0018 | U | | | 0.0018 | U | 0.0018 | U | | | | | | |
| | | Pyrene | mg/Kg | -- | 232 | nc | 0.12 | | 0.0023 | U | | | 0.0022 | U | 0.0022 | U | | | | | | |
| TAL Metals 6010B | 6010B | Aluminum | mg/Kg | 19500 | 7614 | nc | **14000** | | **8900** | | **9100** | | 4300 | | 4800 | | **8000** | | **9300** | | 6700 | |
| | | Barium | mg/Kg | 124 | 538 | nc | 140 | | 57 | | 57 | | 24 | | 26 | | 32 | | 34 | | 26 | |
| | | Beryllium | mg/Kg | 0.88 | 15 | nc | 1.1 | | 1.2 | | 0.43 | B | 0.4 | | 0.42 | | 0.35 | B | 0.43 | | 0.29 | B |
| | | Cadmium | mg/Kg | 0.00 | 3.7 | nc | 0.083 | U | 0.086 | U | 0.087 | U | 0.078 | U | 0.084 | U | 0.08 | U | 0.085 | U | 0.092 | U |
| | | Calcium | mg/Kg | 35500 | -- | 0 | 36000 | H | 6900 | H | 480 | | 420 | | 420 | | 1500 | | 700 | | 760 | |
| | | Chromium | mg/Kg | 27.2 | 30 | ca | 17 | | 18 | | 14 | | 8.8 | | 9.7 | | 13 | | 14 | | 10 | |
| | | Cobalt | mg/Kg | 23.2 | 902 | ca | 6.1 | | 19 | | 8.7 | | 6.5 | | 6.8 | | 10 | | 11 | | 7.7 | |
| | | Copper | mg/Kg | 32.3 | 313 | nc | 15 | | 20 | | 13 | | 6.7 | | 7.4 | | 19 | | 20 | | 18 | |
| | | Iron | mg/Kg | 35200 | 2346 | nc | **39000** | *H | **51000** | *H | **23000** | | **26000** | | **27000** | | **24000** | | **27000** | | **21000** | |
| | | Magnesium | mg/Kg | 8790 | -- | 0 | 5000 | | 3000 | | 2200 | | 1400 | | 1500 | | 2800 | | 3100 | | 2200 | |
| | | Manganese | mg/Kg | 3030 | 176 | nc | **2300** | | **2100** | | **420** | | **800** | | **730** | | **420** | | **330** | | **360** | |
| | | Nickel | mg/Kg | 60.7 | 156 | nc | 11 | | 37 | | 17 | | 12 | | 12 | | 25 | | 23 | | 17 | |
| | | Potassium | mg/Kg | 3350 | -- | 0 | 1200 | | 1700 | | 810 | | 520 | | 560 | | 1100 | | 900 | | 910 | |
| | | Selenium | mg/Kg | 1.5 | 39 | nc | 0.42 | U | 0.43 | U | 0.43 | U | 0.39 | U | 0.42 | U | 0.4 | U | 0.5 | B | 0.46 | U |
| | | Silver | mg/Kg | 0.00 | 39 | nc | 0.32 | U | 0.33 | U | 0.34 | U | 0.3 | U | 0.33 | U | 0.31 | U | 0.33 | U | 0.36 | U |
| | | Sodium | mg/Kg | 145 | -- | 0 | 170 | | 93 | U | 1200 | | 840 | | 860 | | 1100 | | 1200 | | 1100 | |
| | | Vanadium | mg/Kg | 37.6 | 7.8 | nc | **17** | | **16** | | **15** | | **9.6** | | **10** | | **13** | | **14** | | **12** | |
| | | Zinc | mg/Kg | 93.3 | 2346 | nc | 68 | H | 64 | H | 52 | | 51 | | 56 | | 58 | | 60 | | 55 | |

## Table 4-4
## Summary of Subsurface Soil Results (>1 ft bgs)

| | | | | | | | LL9SB-040-0001-SO | | LL9SB-041-0001-SO | | LL9SB-042-0001-SO | | LL9SB-043-0001-DUP | | LL9SB-043-0001-SO | | LL9SB-044-0001-SO | | LL9SB-045-0001-SO | | LL9SB-046-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 10/27/03 | | 10/27/03 | | 11/06/03 | | 11/06/03 | | 11/06/03 | | 11/06/03 | | 11/06/03 | | 11/06/03 | |
| | | | | | | **Sample Depth** | 6.5 ft | | 7 ft | | 8 - 10 ft | | 9 - 11 ft | | 9 - 11 ft | | 8 - 10 ft | | 8 - 10 ft | | 4 - 6 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Subsurface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SB PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| | 7041 | Antimony | mg/Kg | 0.96 | 3.1 | nc | 0.47 | U | 0.49 | U | 0.44 | U | 0.44 | U | 0.48 | U | 0.5 | B | 0.5 | U | 0.54 | B |
| | 7060A | Arsenic | mg/Kg | 19.8 | 0.39 | ca | **12** | | **3.4** | | **6.9** | | **3.4** | | **3.7** | | **15** | | **18** | | **17** | |
| | 7421 | Lead | mg/Kg | 19.1 | 400 | pbk | 51 | | 31 | | 11 | | 5.6 | | 6 | | 9.3 | | 11 | | 9 | |
| | 7471A | Mercury | mg/Kg | 0.04 | 2.3 | nc | 0.26 | | 0.017 | B | 0.02 | | 0.012 | B | 0.018 | B | 0.014 | B | 0.014 | B | 0.013 | B |
| | 7841 | Thallium | mg/Kg | 0.91 | 0.52 | nc | 0.2 | U | 0.21 | U | 0.95 | U | 0.96 | U | 1 | U | 1 | U | 1.1 | U | 0.97 | U |
| VOCs TCL 8260B | 8260B | 1,1,1-Trichloroethane | mg/Kg | -- | 1200 | sat | 0.00071 | U | 0.00072 | U | | | 0.02 | U | 0.0007 | U | | | | | | |
| | | 1,1,2,2-Tetrachloroethane | mg/Kg | -- | 0.41 | ca | 0.00075 | U | 0.00075 | U | | | 0.022 | U | 0.00073 | U | | | | | | |
| | | 1,1,2-Trichloroethane | mg/Kg | -- | 0.73 | ca | 0.00083 | U | 0.00084 | U | | | 0.038 | U | 0.00081 | U | | | | | | |
| | | 1,1-Dichloroethane | mg/Kg | -- | 51 | nc | 0.001 | U | 0.001 | U | | | 0.016 | U | 0.001 | U | | | | | | |
| | | 1,1-Dichloroethene | mg/Kg | -- | 12 | nc | 0.0012 | U | 0.0012 | U | | | 0.017 | U | 0.0011 | U | | | | | | |
| | | 1,2-Dichloroethane | mg/Kg | -- | 0.28 | ca | 0.00068 | U | 0.00068 | U | | | 0.026 | U | 0.00066 | U | | | | | | |
| | | 1,2-Dichloroethene (total) | mg/Kg | -- | 6.9 | nc | 0.0022 | U | 0.0022 | U | | | 0.035 | U | 0.0022 | U | | | | | | |
| | | 1,2-Dichloropropane | mg/Kg | -- | 0.34 | ca | 0.0011 | U | 0.0011 | U | | | 0.021 | U | 0.0011 | U | | | | | | |
| | | 2-Butanone (MEK) | mg/Kg | -- | 2231 | nc | 0.0049 | U | 0.0049 | U | | | 0.062 | U | 0.0048 | U | | | | | | |
| | | 2-Hexanone | mg/Kg | -- | 530 | nc | 0.002 | U | 0.002 | U | | | 0.063 | U | 0.0019 | U | | | | | | |
| | | 4-Methyl-2-pentanone (MIBK) | mg/Kg | -- | 528 | nc | 0.0035 | U | 0.0035 | U | | | 0.045 | U | 0.0034 | U | | | | | | |
| | | Acetone | mg/Kg | -- | 1412 | nc | 0.0048 | U | 0.0048 | U | | | 0.035 | U | 0.0047 | U | | | | | | |
| | | Benzene | mg/Kg | -- | 0.64 | ca | 0.00077 | U | 0.00078 | U | | | 0.017 | U | 0.00075 | U | | | | | | |
| | | Bromodichloromethane | mg/Kg | -- | 0.82 | ca | 0.0008 | U | 0.0008 | U | | | 0.023 | U | 0.00078 | U | | | | | | |
| | | Bromoform | mg/Kg | -- | 62 | ca | 0.0011 | U | 0.0011 | U | | | 0.022 | U | 0.001 | U | | | | | | |
| | | Bromomethane | mg/Kg | -- | 0.39 | nc | 0.0034 | U | 0.0034 | U | | | 0.013 | U | 0.0033 | U | | | | | | |
| | | Carbon disulfide | mg/Kg | -- | 36 | nc | 0.0023 | U | 0.0024 | U | | | 0.025 | U | 0.0023 | U | | | | | | |
| | | Carbon tetrachloride | mg/Kg | -- | 0.25 | ca | 0.00097 | U | 0.00098 | U | | | 0.02 | U | 0.00095 | U | | | | | | |
| | | Chlorobenzene | mg/Kg | -- | 15 | nc | 0.0011 | U | 0.0011 | U | | | 0.027 | U | 0.001 | U | | | | | | |
| | | Chloroethane | mg/Kg | -- | 3.0 | ca | 0.0019 | U | 0.0019 | U | | | 0.024 | U | 0.0018 | U | | | | | | |
| | | Chloroform | mg/Kg | -- | 0.22 | ca | 0.00073 | U | 0.00073 | U | | | 0.022 | U | 0.00071 | U | | | | | | |
| | | Chloromethane | mg/Kg | -- | 4.7 | nc | 0.0011 | U | 0.0011 | U | | | 0.028 | U | 0.0011 | U | | | | | | |
| | | cis-1,3-Dichloropropene | mg/Kg | -- | 0.78 | ca | 0.00093 | U | 0.00093 | U | | | 0.027 | U | 0.0009 | U | | | | | | |
| | | Dibromochloromethane | mg/Kg | -- | 1.1 | ca | 0.00081 | U | 0.00081 | U | | | 0.023 | U | 0.00079 | U | | | | | | |
| | | Ethylbenzene | mg/Kg | -- | 395 | sat | 0.0013 | U | 0.0013 | U | | | 0.027 | U | 0.0013 | U | | | | | | |
| | | Methylene chloride | mg/Kg | -- | 9.1 | ca | 0.0021 | U | 0.0021 | U | | | 0.024 | U | 0.0021 | U | | | | | | |
| | | Styrene | mg/Kg | -- | 1700 | sat | 0.0012 | U | 0.0012 | U | | | 0.034 | U | 0.0011 | U | | | | | | |
| | | Tetrachloroethene | mg/Kg | -- | 0.48 | ca | 0.00078 | U | 0.00079 | U | | | 0.028 | U | 0.00076 | U | | | | | | |
| | | Toluene | mg/Kg | -- | 520 | sat | 0.0012 | U | 0.0012 | U | | | 0.022 | U | 0.0011 | U | | | | | | |
| | | trans-1,3-Dichloropropene | mg/Kg | -- | 0.78 | ca | 0.00098 | U | 0.00099 | U | | | 0.024 | U | 0.00096 | U | | | | | | |
| | | Trichloroethene | mg/Kg | -- | 0.053 | ca | 0.00069 | U | 0.00069 | U | | | 0.026 | U | 0.00067 | U | | | | | | |
| | | Vinyl chloride | mg/Kg | -- | 0.079 | ca | 0.00087 | U | 0.00087 | U | | | 0.022 | U | 0.00084 | U | | | | | | |
| | | Xylenes (total) | mg/Kg | -- | 0.079 | ca | 0.0034 | U | 0.0034 | U | | | 0.06 | U | 0.0033 | U | | | | | | |

## Table 4-4
## Summary of Subsurface Soil Results (>1 ft bgs)

| | | | | | | | LL9SB-047-0001-SO | | LL9SB-048-0001-SO | | LL9SB-049-0001-SO | | LL9SB-050-0001-SO | | LL9SB-051-0001-SO | | LL9SB-052-0001-SO | | LL9SB-053-0001-DUP | | LL9SB-053-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 11/06/03 | | 12/10/03 | | 12/10/03 | | 12/10/03 | | 12/08/03 | | 12/08/03 | | 12/11/03 | | 12/11/03 | |
| | | | | | | **Sample Depth** | 3 - 5 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Subsurface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SB PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| Cyanide 9012A | 9014/9010B | Cyanide, Total | mg/Kg | 0.00 | 122 | nc | | | | | | | 0.19 | U | | | | | | | | |
| Explosives 8330 | 8330 | 1,3,5-Trinitrobenzene | mg/Kg | 0 | 183 | nc | | | | | | | 0.018 | U | | | | | 0.017 | U | 0.017 | U |
| | | 1,3-Dinitrobenzene | mg/Kg | 0 | 0.61 | nc | | | | | | | 0.018 | U | | | | | 0.018 | U | 0.017 | U |
| | | 2,4,6-TNT | mg/Kg | 0 | 16 | ca | | | | | | | 0.034 | U | | | | | 0.033 | U | 0.033 | U |
| | | 2,4-Dinitrotoluene | mg/Kg | 0 | 12 | nc | | | | | | | 0.036 | U | | | | | 0.035 | U | 0.035 | U |
| | | 2,6-Dinitrotoluene | mg/Kg | 0 | 6.1 | nc | | | | | | | 0.048 | U | | | | | 0.047 | U | 0.046 | U |
| | | 2-Nitrotoluene | mg/Kg | 0 | 0.88 | ca | | | | | | | 0.033 | U | | | | | 0.033 | U | 0.032 | U |
| | | 3-Nitrotoluene | mg/Kg | 0 | 73 | nc | | | | | | | 0.05 | U | | | | | 0.049 | U | 0.049 | U |
| | | 4-Nitrotoluene | mg/Kg | 0 | 12 | ca | | | | | | | 0.047 | U | | | | | 0.046 | U | 0.045 | U |
| | | HMX | mg/Kg | 0 | 306 | nc | | | | | | | 0.11 | U | | | | | 0.11 | U | 0.11 | U |
| | | Nitrobenzene | mg/Kg | 0 | 2 | nc | | | | | | | 0.022 | U | | | | | 0.022 | U | 0.022 | U |
| | | RDX | mg/Kg | 0 | 4.4 | ca | | | | | | | 0.059 | U | | | | | 0.058 | U | 0.11 | |
| | | Tetryl | mg/Kg | 0 | 61 | nc | | | | | | | 0.043 | U | | | | | 0.043 | U | 0.042 | U |
| Others | 8015B MDRO | Diesel Range Organics (DRO) | mg/Kg | -- | -- | -- | | | | | | | | | | | | | | | | |
| | 8015B MGRO | Gasoline Range Organics (GRO) | mg/Kg | -- | -- | -- | | | | | | | | | | | | | | | | |
| PCB TCL 8082 | 8082 | Aroclor 1016 | mg/Kg | -- | 0.39 | nc | | | | | | | 0.0022 | U | | | | | | | | |
| | | Aroclor 1221 | mg/Kg | -- | 0.22 | ca | | | | | | | 0.0023 | U | | | | | | | | |
| | | Aroclor 1232 | mg/Kg | -- | 0.22 | ca | | | | | | | 0.0023 | U | | | | | | | | |
| | | Aroclor 1242 | mg/Kg | -- | 0.22 | ca | | | | | | | 0.0023 | U | | | | | | | | |
| | | Aroclor 1248 | mg/Kg | -- | 0.22 | ca | | | | | | | 0.0023 | U | | | | | | | | |
| | | Aroclor 1254 | mg/Kg | -- | 0.22 | ca | | | | | | | 0.0023 | U | | | | | | | | |
| | | Aroclor 1260 | mg/Kg | -- | 0.22 | ca | | | | | | | 0.0016 | U | | | | | | | | |
| Pesticides 8081A | 8081A | 4,4'-DDD | mg/Kg | -- | 2.4 | ca | | | | | | | 0.00042 | U | | | | | | | | |
| | | 4,4'-DDE | mg/Kg | -- | 1.7 | ca | | | | | | | 0.00075 | U | | | | | | | | |
| | | 4,4'-DDT | mg/Kg | -- | 1.7 | ca | | | | | | | 0.00043 | U | | | | | | | | |
| | | Aldrin | mg/Kg | -- | 0.029 | ca | | | | | | | 0.00015 | U | | | | | | | | |
| | | alpha-BHC | mg/Kg | -- | 0.09 | sat | | | | | | | 0.00019 | U | | | | | | | | |
| | | alpha-Chlordane | mg/Kg | -- | 1.6 | ca | | | | | | | 0.00014 | U | | | | | | | | |
| | | beta-BHC | mg/Kg | -- | 0.32 | ca | | | | | | | 0.00017 | U | | | | | | | | |
| | | delta-BHC | mg/Kg | -- | -- | 0 | | | | | | | 0.00013 | U | | | | | | | | |
| | | Dieldrin | mg/Kg | -- | 0.030 | ca | | | | | | | 0.00039 | U | | | | | | | | |
| | | Endosulfan I | mg/Kg | -- | 37 | nc | | | | | | | 0.00031 | U | | | | | | | | |
| | | Endosulfan II | mg/Kg | -- | 37 | nc | | | | | | | 0.00033 | U | | | | | | | | |
| | | Endosulfan sulfate | mg/Kg | -- | 37 | nc | | | | | | | 0.00034 | U | | | | | | | | |
| | | Endrin | mg/Kg | -- | 1.8 | nc | | | | | | | 0.0005 | U | | | | | | | | |
| | | Endrin aldehyde | mg/Kg | -- | -- | 0 | | | | | | | 0.00038 | U | | | | | | | | |
| | | Endrin ketone | mg/Kg | -- | -- | 0 | | | | | | | 0.00034 | U | | | | | | | | |
| | | gamma-BHC (Lindane) | mg/Kg | -- | 0.44 | ca | | | | | | | 0.00027 | U | | | | | | | | |
| | | gamma-Chlordane | mg/Kg | -- | 1.6 | ca | | | | | | | 0.00017 | U | | | | | | | | |
| | | Heptachlor | mg/Kg | -- | 0.11 | ca | | | | | | | 0.00021 | U | | | | | | | | |
| | | Heptachlor epoxide | mg/Kg | -- | 0.053 | ca | | | | | | | 0.00016 | U | | | | | | | | |
| | | Methoxychlor | mg/Kg | -- | 31 | nc | | | | | | | 0.0027 | U | | | | | | | | |
| | | Toxaphene | mg/Kg | -- | 0 | 0 | | | | | | | 0.0053 | U | | | | | | | | |

## Table 4-4
## Summary of Subsurface Soil Results (>1 ft bgs)

| | | | | | | | LL9SB-047-0001-SO | | LL9SB-048-0001-SO | | LL9SB-049-0001-SO | | LL9SB-050-0001-SO | | LL9SB-051-0001-SO | | LL9SB-052-0001-SO | | LL9SB-053-0001-DUP | | LL9SB-053-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 11/06/03 | | 12/10/03 | | 12/10/03 | | 12/10/03 | | 12/08/03 | | 12/08/03 | | 12/11/03 | | 12/11/03 | |
| | | | | | | **Sample Depth** | 3 - 5 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Subsurface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SB PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| Propellants 8330 | 353.2 | Nitrocellulose | mg/Kg | 0 | -- | 0 | | | | | | | 4.3 | J | | | | | | | | |
| | 8330 | Nitroglycerin | mg/Kg | 0 | -- | 0 | | | | | | | 0.5 | U | | | | | | | | |
| | UV/HPLC per SOP | Nitroguanidine | mg/Kg | 0 | 611 | nc | | | | | | | 0.25 | U | | | | | | | | |
| SVOCs TCL 8270 C | 8270C | 1,2,4-Trichlorobenzene | mg/Kg | -- | 6.2 | nc | | | | | | | 0.07 | U | | | | | | | | |
| | | 1,2-Dichlorobenzene | mg/Kg | -- | 600 | sat | | | | | | | 0.094 | U | | | | | | | | |
| | | 1,3-Dichlorobenzene | mg/Kg | -- | 53 | nc | | | | | | | 0.094 | U | | | | | | | | |
| | | 1,4-Dichlorobenzene | mg/Kg | -- | 3.4 | ca | | | | | | | 0.084 | U | | | | | | | | |
| | | 2,2-oxybis (1-chloropropane) | mg/Kg | -- | 2.9 | ca | | | | | | | 0.089 | U | | | | | | | | |
| | | 2,4,5-Trichlorophenol | mg/Kg | -- | 611 | nc | | | | | | | 0.045 | U | | | | | | | | |
| | | 2,4,6-Trichlorophenol | mg/Kg | -- | 0.61 | nc | | | | | | | 0.056 | U | | | | | | | | |
| | | 2,4-Dichlorophenol | mg/Kg | -- | 18 | nc | | | | | | | 0.057 | U | | | | | | | | |
| | | 2,4-Dimethylphenol | mg/Kg | -- | 122 | nc | | | | | | | 0.071 | U | | | | | | | | |
| | | 2,4-Dinitrophenol | mg/Kg | -- | 12 | nc | | | | | | | 0.14 | U | | | | | | | | |
| | | 2-Chloronaphthalene | mg/Kg | -- | 494 | nc | | | | | | | 0.057 | U | | | | | | | | |
| | | 2-Chlorophenol | mg/Kg | -- | 6.3 | nc | | | | | | | 0.07 | U | | | | | | | | |
| | | 2-Methylnaphthalene | mg/Kg | -- | -- | 0 | | | | | | | 0.0018 | U | | | | | | | | |
| | | 2-Methylphenol (o-cresol) | mg/Kg | -- | 306 | nc | | | | | | | 0.01 | U | | | | | | | | |
| | | 2-Nitroaniline | mg/Kg | -- | 18.3 | nc | | | | | | | 0.04 | U | | | | | | | | |
| | | 2-Nitrophenol | mg/Kg | -- | -- | 0 | | | | | | | 0.075 | U | | | | | | | | |
| | | 3,3-Dichlorobenzidine | mg/Kg | -- | 1.1 | ca | | | | | | | 0.021 | U | | | | | | | | |
| | | 3-Nitroaniline | mg/Kg | -- | 1.8 | nc | | | | | | | 0.13 | U | | | | | | | | |
| | | 4,6-Dinitro-2-methylphenol | mg/Kg | -- | 0.61 | nc | | | | | | | 0.11 | U | | | | | | | | |
| | | 4-Bromophenyl phenyl ether | mg/Kg | -- | -- | 0 | | | | | | | 0.0037 | U | | | | | | | | |
| | | 4-Chloro-3-methylphenol | mg/Kg | -- | -- | 0 | | | | | | | 0.045 | U | | | | | | | | |
| | | 4-Chloroaniline | mg/Kg | -- | 24 | nc | | | | | | | 0.12 | U | | | | | | | | |
| | | 4-Chlorophenyl phenyl ether | mg/Kg | -- | -- | 0 | | | | | | | 0.0043 | U | | | | | | | | |
| | | 4-Methylphenol (m/p-cresol) | mg/Kg | -- | 31 | nc | | | | | | | 0.0069 | U | | | | | | | | |
| | | 4-Nitroaniline | mg/Kg | -- | 23 | ca | | | | | | | 0.046 | U | | | | | | | | |
| | | 4-Nitrophenol | mg/Kg | -- | -- | 0 | | | | | | | 0.097 | U | | | | | | | | |
| | | Acenaphthene | mg/Kg | -- | 368 | nc | | | | | | | 0.019 | Ja | | | | | | | | |
| | | Acenaphthylene | mg/Kg | -- | -- | 0 | | | | | | | 0.0011 | U | | | | | | | | |
| | | Anthracene | mg/Kg | -- | 2189 | nc | | | | | | | 0.03 | Ja | | | | | | | | |
| | | Benzo(a)anthracene | mg/Kg | -- | 0.62 | ca | | | | | | | 0.041 | | | | | | | | | |
| | | Benzo(a)pyrene | mg/Kg | -- | 0.062 | ca | | | | | | | 0.042 | | | | | | | | | |
| | | Benzo(b)fluoranthene | mg/Kg | -- | 0.62 | ca | | | | | | | 0.038 | Ja | | | | | | | | |
| | | Benzo(ghi)perylene | mg/Kg | -- | -- | 0 | | | | | | | 0.033 | Ja | | | | | | | | |
| | | Benzo(k)fluoranthene | mg/Kg | -- | 6.2 | ca | | | | | | | 0.032 | Ja | | | | | | | | |
| | | Bis(2-chloroethoxy)methane | mg/Kg | -- | -- | 0 | | | | | | | 0.0034 | U | | | | | | | | |
| | | Bis(2-chloroethyl)ether | mg/Kg | -- | 0.22 | ca | | | | | | | 0.0024 | U | | | | | | | | |
| | | Bis(2-ethylhexyl)phthalate | mg/Kg | -- | 35 | ca | | | | | | | 0.011 | U | | | | | | | | |

## Table 4-4
## Summary of Subsurface Soil Results (>1 ft bgs)

| | | | | | | | LL9SB-047-0001-SO | | LL9SB-048-0001-SO | | LL9SB-049-0001-SO | | LL9SB-050-0001-SO | | LL9SB-051-0001-SO | | LL9SB-052-0001-SO | | LL9SB-053-0001-DUP | | LL9SB-053-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 11/06/03 | | 12/10/03 | | 12/10/03 | | 12/10/03 | | 12/08/03 | | 12/08/03 | | 12/11/03 | | 12/11/03 | |
| | | | | | | **Sample Depth** | 3 - 5 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Subsurface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SB PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| | | Butyl benzyl phthalate | mg/Kg | -- | 1222 | nc | | | | | | | 0.0049 | U | | | | | | | | |
| | | Carbazole | mg/Kg | -- | 24 | ca | | | | | | | 0.042 | U | | | | | | | | |
| | | Chrysene | mg/Kg | -- | 62 | ca | | | | | | | 0.042 | | | | | | | | | |
| | | Dibenzo(a,h)anthracene | mg/Kg | -- | 0.062 | ca | | | | | | | 0.043 | | | | | | | | | |
| | | Dibenzofuran | mg/Kg | -- | 15 | nc | | | | | | | 0.0079 | Ja | | | | | | | | |
| | | Diethyl phthalate | mg/Kg | -- | 4888 | nc | | | | | | | 0.0044 | U | | | | | | | | |
| | | Dimethyl phthalate | mg/Kg | -- | 100000 | max | | | | | | | 0.0043 | U | | | | | | | | |
| | | Di-n-butyl phthalate | mg/Kg | -- | 611 | nc | | | | | | | 0.024 | U | | | | | | | | |
| | | Di-n-octyl phthalate | mg/Kg | -- | 244 | nc | | | | | | | 0.01 | U | | | | | | | | |
| | | Fluoranthene | mg/Kg | -- | 229 | nc | | | | | | | 0.13 | | | | | | | | | |
| | | Fluorene | mg/Kg | -- | 275 | nc | | | | | | | 0.015 | Ja | | | | | | | | |
| | | Hexachlorobenzene | mg/Kg | -- | 0.30 | ca | | | | | | | 0.0021 | U | | | | | | | | |
| | | Hexachlorobutadiene | mg/Kg | -- | 6.2 | ca | | | | | | | 0.0039 | U | | | | | | | | |
| | | Hexachlorocyclopentadiene | mg/Kg | -- | 37 | nc | | | | | | | 0.064 | U | | | | | | | | |
| | | Hexachloroethane | mg/Kg | -- | 35 | ca | | | | | | | 0.0039 | U | | | | | | | | |
| | | Indeno(1,2,3-cd)pyrene | mg/Kg | -- | 0.62 | ca | | | | | | | 0.044 | | | | | | | | | |
| | | Isophorone | mg/Kg | -- | 512 | ca | | | | | | | 0.0028 | U | | | | | | | | |
| | | Naphthalene | mg/Kg | -- | 5.6 | nc | | | | | | | 0.002 | U | | | | | | | | |
| | | n-Nitroso-di-n-propylamine | mg/Kg | -- | 0.069 | ca | | | | | | | 0.0027 | U | | | | | | | | |
| | | n-Nitrosodiphenylamine | mg/Kg | -- | 99 | ca | | | | | | | 0.0034 | U | | | | | | | | |
| | | Pentachlorophenol | mg/Kg | -- | 3.0 | ca | | | | | | | 0.12 | U | | | | | | | | |
| | | Phenanthrene | mg/Kg | -- | -- | 0 | | | | | | | 0.1 | | | | | | | | | |
| | | Phenol | mg/Kg | -- | 1833 | nc | | | | | | | 0.0019 | U | | | | | | | | |
| | | Pyrene | mg/Kg | -- | 232 | nc | | | | | | | 0.1 | | | | | | | | | |
| TAL Metals 6010B | 6010B | Aluminum | mg/Kg | 19500 | 7614 | nc | **8600** | | **8400** | | **12000** | | **12000** | | **11000** | | **16000** | | 6900 | | 7400 | |
| | | Barium | mg/Kg | 124 | 538 | nc | 61 | | 51 | | 150 | | 56 | | 64 | | 66 | | 54 | | 57 | |
| | | Beryllium | mg/Kg | 0.88 | 15 | nc | 0.16 | B | 0.4 | B | 0.47 | | 0.33 | B | 0.55 | | 0.55 | | 0.19 | B | 0.24 | B |
| | | Cadmium | mg/Kg | 0.00 | 3.7 | nc | 0.082 | U | 0.085 | U | 0.089 | U | 0.092 | U | 0.11 | B | 0.089 | U | 0.08 | U | 0.09 | U |
| | | Calcium | mg/Kg | 35500 | -- | 0 | 1000 | | 5100 | | 990 | | 970 | | 6800 | | 850 | | 1300 | | 790 | |
| | | Chromium | mg/Kg | 27.2 | 30 | ca | 11 | | 12 | | 24 | | 16 | | 15 | | 21 | | 8.1 | | 8.8 | |
| | | Cobalt | mg/Kg | 23.2 | 902 | ca | 1.6 | | 9 | | 9.2 | | 6.8 | | 9.6 | | 7.4 | | 5.4 | | 6.2 | |
| | | Copper | mg/Kg | 32.3 | 313 | nc | 8.7 | | 20 | | 21 | | 11 | | 21 | H | 22 | H | 11 | | 12 | |
| | | Iron | mg/Kg | 35200 | 2346 | nc | **9600** | | **21000** | | **27000** | | **23000** | | **24000** | | **29000** | | **13000** | H | **15000** | H |
| | | Magnesium | mg/Kg | 8790 | -- | 0 | 1300 | | 2500 | | 2500 | | 2200 | | 3100 | | 3600 | | 1400 | | 1500 | |
| | | Manganese | mg/Kg | 3030 | 176 | nc | 92 | | **590** | | **530** | | **370** | | **350** | | **190** | | **500** | | **550** | |
| | | Nickel | mg/Kg | 60.7 | 156 | nc | 9.6 | | 18 | | 21 | | 13 | | 22 | | 20 | | 11 | | 13 | |
| | | Potassium | mg/Kg | 3350 | -- | 0 | 740 | | 850 | | 1100 | | 1000 | | 1400 | | 1600 | | 670 | | 700 | |
| | | Selenium | mg/Kg | 1.5 | 39 | nc | 0.41 | U | 0.43 | U | 0.44 | U | 0.46 | U | 0.44 | U | 0.44 | U | 0.46 | B | 0.41 | B |
| | | Silver | mg/Kg | 0.00 | 39 | nc | 0.32 | U | 0.33 | U | 0.34 | U | 0.36 | U | 0.34 | U | 0.34 | U | 0.31 | U | 0.35 | U |
| | | Sodium | mg/Kg | 145 | -- | 0 | 1200 | | 92 | U | 96 | U | 100 | U | 95 | U | 120 | | 86 | U | 97 | U |
| | | Vanadium | mg/Kg | 37.6 | 7.8 | nc | **9.2** | | **14** | | **20** | | **22** | | **19** | | **25** | | **14** | | **13** | |
| | | Zinc | mg/Kg | 93.3 | 2346 | nc | 50 | | 82 | | 290 | | 40 | | 59 | | 53 | | 47 | | 45 | |

## Table 4-4
## Summary of Subsurface Soil Results (>1 ft bgs)

| | | | | | | | LL9SB-047-0001-SO | | LL9SB-048-0001-SO | | LL9SB-049-0001-SO | | LL9SB-050-0001-SO | | LL9SB-051-0001-SO | | LL9SB-052-0001-SO | | LL9SB-053-0001-DUP | | LL9SB-053-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 11/06/03 | | 12/10/03 | | 12/10/03 | | 12/10/03 | | 12/08/03 | | 12/08/03 | | 12/11/03 | | 12/11/03 | |
| | | | | | | **Sample Depth** | 3 - 5 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | | 1 - 3 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Subsurface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SB PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| | 7041 | Antimony | mg/Kg | 0.96 | 3.1 | nc | 0.49 | U | 0.47 | U | 0.49 | U | 0.51 | U | 0.51 | U | 0.52 | U | 0.45 | U | 0.46 | U |
| | 7060A | Arsenic | mg/Kg | 19.8 | 0.39 | ca | **5.9** | | **11** | | **12** | | **10** | | **18** | | **16** | | **9.4** | | **11** | |
| | 7421 | Lead | mg/Kg | 19.1 | 400 | pbk | 5.2 | | 41 | | 64 | | 15 | | 13 | | 9.3 | | 10 | | 12 | |
| | 7471A | Mercury | mg/Kg | 0.04 | 2.3 | nc | 0.03 | | 0.34 | | 0.036 | | 0.027 | | 0.027 | | 0.017 | B | 0.023 | | 0.024 | |
| | 7841 | Thallium | mg/Kg | 0.91 | 0.52 | nc | 1 | U | 0.2 | U | 0.21 | U | 0.22 | U | 0.22 | U | 0.22 | U | 0.19 | U | 0.2 | U |
| VOCs TCL 8260B | 8260B | 1,1,1-Trichloroethane | mg/Kg | -- | 1200 | sat | | | | | | | 0.0013 | U | | | | | | | | |
| | | 1,1,2,2-Tetrachloroethane | mg/Kg | -- | 0.41 | ca | | | | | | | 0.0012 | U | | | | | | | | |
| | | 1,1,2-Trichloroethane | mg/Kg | -- | 0.73 | ca | | | | | | | 0.0013 | U | | | | | | | | |
| | | 1,1-Dichloroethane | mg/Kg | -- | 51 | nc | | | | | | | 0.0012 | U | | | | | | | | |
| | | 1,1-Dichloroethene | mg/Kg | -- | 12 | nc | | | | | | | 0.0016 | U | | | | | | | | |
| | | 1,2-Dichloroethane | mg/Kg | -- | 0.28 | ca | | | | | | | 0.0011 | U | | | | | | | | |
| | | 1,2-Dichloroethene (total) | mg/Kg | -- | 6.9 | nc | | | | | | | 0.0025 | U | | | | | | | | |
| | | 1,2-Dichloropropane | mg/Kg | -- | 0.34 | ca | | | | | | | 0.0012 | U | | | | | | | | |
| | | 2-Butanone (MEK) | mg/Kg | -- | 2231 | nc | | | | | | | 0.0047 | U | | | | | | | | |
| | | 2-Hexanone | mg/Kg | -- | 530 | nc | | | | | | | 0.0013 | U | | | | | | | | |
| | | 4-Methyl-2-pentanone (MIBK) | mg/Kg | -- | 528 | nc | | | | | | | 0.0012 | U | | | | | | | | |
| | | Acetone | mg/Kg | -- | 1412 | nc | | | | | | | 0.0055 | U | | | | | | | | |
| | | Benzene | mg/Kg | -- | 0.64 | ca | | | | | | | 0.0013 | U | | | | | | | | |
| | | Bromodichloromethane | mg/Kg | -- | 0.82 | ca | | | | | | | 0.0012 | U | | | | | | | | |
| | | Bromoform | mg/Kg | -- | 62 | ca | | | | | | | 0.0009 | U | | | | | | | | |
| | | Bromomethane | mg/Kg | -- | 0.39 | nc | | | | | | | 0.0016 | U | | | | | | | | |
| | | Carbon disulfide | mg/Kg | -- | 36 | nc | | | | | | | 0.0014 | U | | | | | | | | |
| | | Carbon tetrachloride | mg/Kg | -- | 0.25 | ca | | | | | | | 0.0013 | U | | | | | | | | |
| | | Chlorobenzene | mg/Kg | -- | 15 | nc | | | | | | | 0.0013 | U | | | | | | | | |
| | | Chloroethane | mg/Kg | -- | 3.0 | ca | | | | | | | 0.0012 | U | | | | | | | | |
| | | Chloroform | mg/Kg | -- | 0.22 | ca | | | | | | | 0.0013 | U | | | | | | | | |
| | | Chloromethane | mg/Kg | -- | 4.7 | nc | | | | | | | 0.0013 | U | | | | | | | | |
| | | cis-1,3-Dichloropropene | mg/Kg | -- | 0.78 | ca | | | | | | | 0.0011 | U | | | | | | | | |
| | | Dibromochloromethane | mg/Kg | -- | 1.1 | ca | | | | | | | 0.00095 | U | | | | | | | | |
| | | Ethylbenzene | mg/Kg | -- | 395 | sat | | | | | | | 0.0013 | U | | | | | | | | |
| | | Methylene chloride | mg/Kg | -- | 9.1 | ca | | | | | | | 0.0035 | U | | | | | | | | |
| | | Styrene | mg/Kg | -- | 1700 | sat | | | | | | | 0.0013 | U | | | | | | | | |
| | | Tetrachloroethene | mg/Kg | -- | 0.48 | ca | | | | | | | 0.0014 | U | | | | | | | | |
| | | Toluene | mg/Kg | -- | 520 | sat | | | | | | | 0.0013 | U | | | | | | | | |
| | | trans-1,3-Dichloropropene | mg/Kg | -- | 0.78 | ca | | | | | | | 0.00095 | U | | | | | | | | |
| | | Trichloroethene | mg/Kg | -- | 0.053 | ca | | | | | | | 0.0013 | U | | | | | | | | |
| | | Vinyl chloride | mg/Kg | -- | 0.079 | ca | | | | | | | 0.0013 | U | | | | | | | | |
| | | Xylenes (total) | mg/Kg | -- | 0.079 | ca | | | | | | | 0.0041 | U | | | | | | | | |

## Table 4-4
## Summary of Subsurface Soil Results (>1 ft bgs)

| | | | | | | | LL9SB-055-0001-SO | | LL9SB-056-0001-SO | | LL9SB-059-0001-SO | | LL9SB-061-0001-SO | | LL9SB-065-0001-SO | | LL9SB-066-0001-SO | | LL9SB-069-0001-SO | | LL9SB-070-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 11/05/03 | | 11/05/03 | | 11/05/03 | | 11/05/03 | | 11/06/03 | | 11/06/03 | | 10/27/03 | | 10/27/03 | |
| | | | | | | **Sample Depth** | 1.5 - 3.5 ft | | 2 - 4 ft | | 3 - 5 ft | | 1 - 3 ft | | 3 - 5 ft | | 5 - 7 ft | | 7 ft | | 6.5 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Subsurface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SB PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| Cyanide 9012A | 9014/9010B | Cyanide, Total | mg/Kg | 0.00 | 122 | nc | | | | | | | | | | | | | | | | |
| Explosives 8330 | 8330 | 1,3,5-Trinitrobenzene | mg/Kg | 0 | 183 | nc | | | | | | | | | | | | | | | | |
| | | 1,3-Dinitrobenzene | mg/Kg | 0 | 0.61 | nc | | | | | | | | | | | | | | | | |
| | | 2,4,6-TNT | mg/Kg | 0 | 16 | ca | | | | | | | | | | | | | | | | |
| | | 2,4-Dinitrotoluene | mg/Kg | 0 | 12 | nc | | | | | | | | | | | | | | | | |
| | | 2,6-Dinitrotoluene | mg/Kg | 0 | 6.1 | nc | | | | | | | | | | | | | | | | |
| | | 2-Nitrotoluene | mg/Kg | 0 | 0.88 | ca | | | | | | | | | | | | | | | | |
| | | 3-Nitrotoluene | mg/Kg | 0 | 73 | nc | | | | | | | | | | | | | | | | |
| | | 4-Nitrotoluene | mg/Kg | 0 | 12 | ca | | | | | | | | | | | | | | | | |
| | | HMX | mg/Kg | 0 | 306 | nc | | | | | | | | | | | | | | | | |
| | | Nitrobenzene | mg/Kg | 0 | 2 | nc | | | | | | | | | | | | | | | | |
| | | RDX | mg/Kg | 0 | 4.4 | ca | | | | | | | | | | | | | | | | |
| | | Tetryl | mg/Kg | 0 | 61 | nc | | | | | | | | | | | | | | | | |
| Others | 8015B MDRO | Diesel Range Organics (DRO) | mg/Kg | -- | -- | -- | 3 | U | 2.9 | U | 3 | U | 2.9 | U | | | | | | | | |
| | 8015B MGRO | Gasoline Range Organics (GRO) | mg/Kg | -- | -- | -- | 0.012 | U | 0.011 | U | 0.011 | U | 0.011 | U | | | | | | | | |
| PCB TCL 8082 | 8082 | Aroclor 1016 | mg/Kg | -- | 0.39 | nc | | | | | | | | | | | | | | | | |
| | | Aroclor 1221 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | | |
| | | Aroclor 1232 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | | |
| | | Aroclor 1242 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | | |
| | | Aroclor 1248 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | | |
| | | Aroclor 1254 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | | |
| | | Aroclor 1260 | mg/Kg | -- | 0.22 | ca | | | | | | | | | | | | | | | | |
| Pesticides 8081A | 8081A | 4,4'-DDD | mg/Kg | -- | 2.4 | ca | | | | | | | | | | | | | | | | |
| | | 4,4'-DDE | mg/Kg | -- | 1.7 | ca | | | | | | | | | | | | | | | | |
| | | 4,4'-DDT | mg/Kg | -- | 1.7 | ca | | | | | | | | | | | | | | | | |
| | | Aldrin | mg/Kg | -- | 0.029 | ca | | | | | | | | | | | | | | | | |
| | | alpha-BHC | mg/Kg | -- | 0.09 | sat | | | | | | | | | | | | | | | | |
| | | alpha-Chlordane | mg/Kg | -- | 1.6 | ca | | | | | | | | | | | | | | | | |
| | | beta-BHC | mg/Kg | -- | 0.32 | ca | | | | | | | | | | | | | | | | |
| | | delta-BHC | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | | |
| | | Dieldrin | mg/Kg | -- | 0.030 | ca | | | | | | | | | | | | | | | | |
| | | Endosulfan I | mg/Kg | -- | 37 | nc | | | | | | | | | | | | | | | | |
| | | Endosulfan II | mg/Kg | -- | 37 | nc | | | | | | | | | | | | | | | | |
| | | Endosulfan sulfate | mg/Kg | -- | 37 | nc | | | | | | | | | | | | | | | | |
| | | Endrin | mg/Kg | -- | 1.8 | nc | | | | | | | | | | | | | | | | |
| | | Endrin aldehyde | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | | |
| | | Endrin ketone | mg/Kg | -- | -- | 0 | | | | | | | | | | | | | | | | |
| | | gamma-BHC (Lindane) | mg/Kg | -- | 0.44 | ca | | | | | | | | | | | | | | | | |
| | | gamma-Chlordane | mg/Kg | -- | 1.6 | ca | | | | | | | | | | | | | | | | |
| | | Heptachlor | mg/Kg | -- | 0.11 | ca | | | | | | | | | | | | | | | | |
| | | Heptachlor epoxide | mg/Kg | -- | 0.053 | ca | | | | | | | | | | | | | | | | |
| | | Methoxychlor | mg/Kg | -- | 31 | nc | | | | | | | | | | | | | | | | |
| | | Toxaphene | mg/Kg | -- | 0 | 0 | | | | | | | | | | | | | | | | |

## Table 4-4
## Summary of Subsurface Soil Results (>1 ft bgs)

| | | | | | | | LL9SB-055-0001-SO | | LL9SB-056-0001-SO | | LL9SB-059-0001-SO | | LL9SB-061-0001-SO | | LL9SB-065-0001-SO | | LL9SB-066-0001-SO | | LL9SB-069-0001-SO | | LL9SB-070-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 11/05/03 | | 11/05/03 | | 11/05/03 | | 11/05/03 | | 11/06/03 | | 11/06/03 | | 10/27/03 | | 10/27/03 | |
| | | | | | | **Sample Depth** | 1.5 - 3.5 ft | | 2 - 4 ft | | 3 - 5 ft | | 1 - 3 ft | | 3 - 5 ft | | 5 - 7 ft | | 7 ft | | 6.5 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Subsurface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SB PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| Propellants 8330 | 353.2 | Nitrocellulose | mg/Kg | 0 | -- | 0 | | | | | | | | | | | | | | | | |
| | 8330 | Nitroglycerin | mg/Kg | 0 | -- | 0 | | | | | | | | | | | | | | | | |
| | UV/HPLC per SOP | Nitroguanidine | mg/Kg | 0 | 611 | nc | | | | | | | | | | | | | | | | |
| SVOCs TCL 8270 C | 8270C | 1,2,4-Trichlorobenzene | mg/Kg | -- | 6.2 | nc | 0.072 | U | 0.068 | U | 0.069 | U | 0.068 | U | | | | | | | | |
| | | 1,2-Dichlorobenzene | mg/Kg | -- | 600 | sat | 0.097 | U | 0.091 | U | 0.092 | U | 0.091 | U | | | | | | | | |
| | | 1,3-Dichlorobenzene | mg/Kg | -- | 53 | nc | 0.097 | U | 0.091 | U | 0.092 | U | 0.091 | U | | | | | | | | |
| | | 1,4-Dichlorobenzene | mg/Kg | -- | 3.4 | ca | 0.087 | U | 0.081 | U | 0.083 | U | 0.082 | U | | | | | | | | |
| | | 2,2-oxybis (1-chloropropane) | mg/Kg | -- | 2.9 | ca | 0.092 | U | 0.086 | U | 0.087 | U | 0.086 | U | | | | | | | | |
| | | 2,4,5-Trichlorophenol | mg/Kg | -- | 611 | nc | 0.047 | U | 0.044 | U | 0.044 | U | 0.044 | U | | | | | | | | |
| | | 2,4,6-Trichlorophenol | mg/Kg | -- | 0.61 | nc | 0.058 | U | 0.054 | U | 0.055 | U | 0.054 | U | | | | | | | | |
| | | 2,4-Dichlorophenol | mg/Kg | -- | 18 | nc | 0.059 | U | 0.055 | U | 0.056 | U | 0.055 | U | | | | | | | | |
| | | 2,4-Dimethylphenol | mg/Kg | -- | 122 | nc | 0.073 | U | 0.069 | U | 0.07 | U | 0.069 | U | | | | | | | | |
| | | 2,4-Dinitrophenol | mg/Kg | -- | 12 | nc | 0.14 | U | 0.13 | U | 0.13 | U | 0.13 | U | | | | | | | | |
| | | 2-Chloronaphthalene | mg/Kg | -- | 494 | nc | 0.059 | U | 0.055 | U | 0.056 | U | 0.055 | U | | | | | | | | |
| | | 2-Chlorophenol | mg/Kg | -- | 6.3 | nc | 0.072 | U | 0.068 | U | 0.069 | U | 0.068 | U | | | | | | | | |
| | | 2-Methylnaphthalene | mg/Kg | -- | -- | 0 | 0.0018 | U | 0.0017 | U | 0.0017 | U | 0.0017 | U | | | | | | | | |
| | | 2-Methylphenol (o-cresol) | mg/Kg | -- | 306 | nc | 0.01 | U | 0.0096 | U | 0.0098 | U | 0.0096 | U | | | | | | | | |
| | | 2-Nitroaniline | mg/Kg | -- | 18.3 | nc | 0.042 | U* | 0.039 | U* | 0.04 | U* | 0.039 | U* | | | | | | | | |
| | | 2-Nitrophenol | mg/Kg | -- | -- | 0 | 0.077 | U | 0.072 | U | 0.073 | U | 0.072 | U | | | | | | | | |
| | | 3,3-Dichlorobenzidine | mg/Kg | -- | 1.1 | ca | 0.022 | U | 0.021 | U | 0.021 | U | 0.021 | U | | | | | | | | |
| | | 3-Nitroaniline | mg/Kg | -- | 1.8 | nc | 0.14 | U | 0.13 | U | 0.13 | U | 0.13 | U | | | | | | | | |
| | | 4,6-Dinitro-2-methylphenol | mg/Kg | -- | 0.61 | nc | 0.12 | U* | 0.11 | U* | 0.11 | U* | 0.11 | U* | | | | | | | | |
| | | 4-Bromophenyl phenyl ether | mg/Kg | -- | -- | 0 | 0.0038 | U* | 0.0036 | U* | 0.0036 | U* | 0.0036 | U* | | | | | | | | |
| | | 4-Chloro-3-methylphenol | mg/Kg | -- | -- | 0 | 0.047 | U | 0.044 | U | 0.044 | U | 0.044 | U | | | | | | | | |
| | | 4-Chloroaniline | mg/Kg | -- | 24 | nc | 0.12 | U | 0.11 | U | 0.12 | U | 0.11 | U | | | | | | | | |
| | | 4-Chlorophenyl phenyl ether | mg/Kg | -- | -- | 0 | 0.0044 | U* | 0.0041 | U* | 0.0042 | U* | 0.0041 | U* | | | | | | | | |
| | | 4-Methylphenol (m/p-cresol) | mg/Kg | -- | 31 | nc | 0.0071 | U | 0.0066 | U | 0.0068 | U | 0.0067 | U | | | | | | | | |
| | | 4-Nitroaniline | mg/Kg | -- | 23 | ca | 0.048 | U | 0.045 | U | 0.045 | U | 0.045 | U | | | | | | | | |
| | | 4-Nitrophenol | mg/Kg | -- | -- | 0 | 0.1 | U | 0.094 | U | 0.096 | U | 0.094 | U | | | | | | | | |
| | | Acenaphthene | mg/Kg | -- | 368 | nc | 0.0017 | U | 0.0016 | U | 0.006 | J | 0.0016 | U | | | | | | | | |
| | | Acenaphthylene | mg/Kg | -- | -- | 0 | 0.0011 | U* | 0.001 | U* | 0.0011 | U* | 0.001 | U* | | | | | | | | |
| | | Anthracene | mg/Kg | -- | 2189 | nc | 0.0011 | U | 0.00099 | U | 0.0063 | J | 0.00099 | U | | | | | | | | |
| | | Benzo(a)anthracene | mg/Kg | -- | 0.62 | ca | 0.0013 | U | 0.0066 | J | 0.029 | J | 0.0066 | J | | | | | | | | |
| | | Benzo(a)pyrene | mg/Kg | -- | 0.062 | ca | 0.0027 | U | 0.0061 | J | 0.027 | J | 0.0071 | J | | | | | | | | |
| | | Benzo(b)fluoranthene | mg/Kg | -- | 0.62 | ca | 0.0026 | U | 0.0072 | J | 0.032 | JH | 0.01 | J | | | | | | | | |
| | | Benzo(ghi)perylene | mg/Kg | -- | -- | 0 | 0.0023 | U | 0.0054 | J | 0.012 | J | 0.0022 | U | | | | | | | | |
| | | Benzo(k)fluoranthene | mg/Kg | -- | 6.2 | ca | 0.0034 | U | 0.0078 | JM | 0.03 | J | 0.0065 | JM | | | | | | | | |
| | | Bis(2-chloroethoxy)methane | mg/Kg | -- | -- | 0 | 0.0036 | U | 0.0033 | U | 0.0034 | U | 0.0033 | U | | | | | | | | |
| | | Bis(2-chloroethyl)ether | mg/Kg | -- | 0.22 | ca | 0.0024 | U | 0.0023 | U | 0.0023 | U | 0.0023 | U | | | | | | | | |
| | | Bis(2-ethylhexyl)phthalate | mg/Kg | -- | 35 | ca | 0.012 | U | 0.011 | U | 0.011 | U | 0.011 | U | | | | | | | | |

# Table 4-4
## Summary of Subsurface Soil Results (>1 ft bgs)

| | | | | | | | LL9SB-055-0001-SO | | LL9SB-056-0001-SO | | LL9SB-059-0001-SO | | LL9SB-061-0001-SO | | LL9SB-065-0001-SO | | LL9SB-066-0001-SO | | LL9SB-069-0001-SO | | LL9SB-070-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 11/05/03 | | 11/05/03 | | 11/05/03 | | 11/05/03 | | 11/06/03 | | 11/06/03 | | 10/27/03 | | 10/27/03 | |
| | | | | | | **Sample Depth** | 1.5 - 3.5 ft | | 2 - 4 ft | | 3 - 5 ft | | 1 - 3 ft | | 3 - 5 ft | | 5 - 7 ft | | 7 ft | | 6.5 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Subsurface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SB PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| | | Butyl benzyl phthalate | mg/Kg | -- | 1222 | nc | 0.005 | U | 0.0047 | U | 0.0048 | U | 0.0047 | U | | | | | | | | |
| | | Carbazole | mg/Kg | -- | 24 | ca | 0.043 | U | 0.04 | U | 0.041 | U | 0.04 | U | | | | | | | | |
| | | Chrysene | mg/Kg | -- | 62 | ca | 0.0022 | U | 0.007 | J | 0.026 | J | 0.0071 | J | | | | | | | | |
| | | Dibenzo(a,h)anthracene | mg/Kg | -- | 0.062 | ca | 0.0027 | U | 0.0025 | U | 0.0064 | J | 0.0025 | U | | | | | | | | |
| | | Dibenzofuran | mg/Kg | -- | 15 | nc | 0.0033 | U | 0.0031 | U | 0.0031 | U | 0.0031 | U | | | | | | | | |
| | | Diethyl phthalate | mg/Kg | -- | 4888 | nc | 0.0045 | U* | 0.0042 | U* | 0.0043 | U* | 0.0042 | U* | | | | | | | | |
| | | Dimethyl phthalate | mg/Kg | -- | 100000 | max | 0.0044 | U* | 0.0041 | U* | 0.0042 | U* | 0.0041 | U* | | | | | | | | |
| | | Di-n-butyl phthalate | mg/Kg | -- | 611 | nc | 0.024 | U | 0.023 | U | 0.023 | U | 0.023 | U | | | | | | | | |
| | | Di-n-octyl phthalate | mg/Kg | -- | 244 | nc | 0.011 | U | 0.01 | U | 0.01 | U | 0.01 | U | | | | | | | | |
| | | Fluoranthene | mg/Kg | -- | 229 | nc | 0.0013 | U | 0.015 | J | 0.071 | | 0.013 | J | | | | | | | | |
| | | Fluorene | mg/Kg | -- | 275 | nc | 0.002 | U | 0.0018 | U | 0.0019 | U | 0.0018 | U | | | | | | | | |
| | | Hexachlorobenzene | mg/Kg | -- | 0.30 | ca | 0.0022 | U* | 0.0021 | U* | 0.0021 | U* | 0.0021 | U* | | | | | | | | |
| | | Hexachlorobutadiene | mg/Kg | -- | 6.2 | ca | 0.004 | U | 0.0038 | U | 0.0038 | U | 0.0038 | U | | | | | | | | |
| | | Hexachlorocyclopentadiene | mg/Kg | -- | 37 | nc | 0.066 | U | 0.062 | U | 0.063 | U | 0.062 | U | | | | | | | | |
| | | Hexachloroethane | mg/Kg | -- | 35 | ca | 0.004 | U | 0.0038 | U | 0.0038 | U | 0.0038 | U | | | | | | | | |
| | | Indeno(1,2,3-cd)pyrene | mg/Kg | -- | 0.62 | ca | 0.0026 | U | 0.0039 | J | 0.014 | J | 0.0041 | J | | | | | | | | |
| | | Isophorone | mg/Kg | -- | 512 | ca | 0.0029 | U | 0.0028 | U | 0.0028 | U | 0.0028 | U | | | | | | | | |
| | | Naphthalene | mg/Kg | -- | 5.6 | nc | 0.0021 | U | 0.0019 | U | 0.002 | U | 0.002 | U | | | | | | | | |
| | | n-Nitroso-di-n-propylamine | mg/Kg | -- | 0.069 | ca | 0.0028 | U | 0.0026 | U | 0.0027 | U | 0.0026 | U | | | | | | | | |
| | | n-Nitrosodiphenylamine | mg/Kg | -- | 99 | ca | 0.0036 | U | 0.0033 | U | 0.0034 | U | 0.0033 | U | | | | | | | | |
| | | Pentachlorophenol | mg/Kg | -- | 3.0 | ca | 0.12 | U | 0.11 | U | 0.12 | U | 0.11 | U | | | | | | | | |
| | | Phenanthrene | mg/Kg | -- | -- | 0 | 0.0012 | U | 0.0065 | J | 0.036 | J | 0.0049 | J | | | | | | | | |
| | | Phenol | mg/Kg | -- | 1833 | nc | 0.002 | U | 0.0018 | U | 0.0019 | U | 0.0018 | U | | | | | | | | |
| | | Pyrene | mg/Kg | -- | 232 | nc | 0.0024 | U | 0.0096 | J | 0.044 | | 0.0079 | J | | | | | | | | |
| TAL Metals 6010B | 6010B | Aluminum | mg/Kg | 19500 | 7614 | nc | | | | | | | | | **10000** | | 5300 | | 2900 | | **7800** | |
| | | Barium | mg/Kg | 124 | 538 | nc | | | | | | | | | 83 | | 38 | | 13 | | 45 | |
| | | Beryllium | mg/Kg | 0.88 | 15 | nc | | | | | | | | | 0.43 | B | 0.44 | | 0.16 | B | 0.27 | B |
| | | Cadmium | mg/Kg | 0.00 | 3.7 | nc | | | | | | | | | 0.11 | U | 0.086 | U | 0.086 | U | 0.087 | U |
| | | Calcium | mg/Kg | 35500 | -- | 0 | | | | | | | | | 1100 | | 1200 | | 370 | H | 1600 | H |
| | | Chromium | mg/Kg | 27.2 | 30 | ca | | | | | | | | | 12 | | 9.8 | | 4.7 | | 11 | |
| | | Cobalt | mg/Kg | 23.2 | 902 | ca | | | | | | | | | 5.8 | | 10 | | 2.2 | | 6.6 | |
| | | Copper | mg/Kg | 32.3 | 313 | nc | | | | | | | | | 8.7 | | 18 | | 5.1 | | 18 | |
| | | Iron | mg/Kg | 35200 | 2346 | nc | | | | | | | | | **14000** | | **19000** | | **9800** | *H | **21000** | *H |
| | | Magnesium | mg/Kg | 8790 | -- | 0 | | | | | | | | | 2100 | | 1700 | | 540 | | 2000 | |
| | | Manganese | mg/Kg | 3030 | 176 | nc | | | | | | | | | 140 | | **340** | | 42 | | **490** | |
| | | Nickel | mg/Kg | 60.7 | 156 | nc | | | | | | | | | 15 | | 22 | | 4.3 | | 16 | |
| | | Potassium | mg/Kg | 3350 | -- | 0 | | | | | | | | | 790 | | 1000 | | 370 | | 740 | |
| | | Selenium | mg/Kg | 1.5 | 39 | nc | | | | | | | | | 0.58 | B | 0.43 | U | 0.43 | U | 0.43 | U |
| | | Silver | mg/Kg | 0.00 | 39 | nc | | | | | | | | | 0.42 | U | 0.33 | U | 0.33 | U | 0.34 | U |
| | | Sodium | mg/Kg | 145 | -- | 0 | | | | | | | | | 1300 | | 1100 | | 93 | U | 94 | U |
| | | Vanadium | mg/Kg | 37.6 | 7.8 | nc | | | | | | | | | **17** | | **9.8** | | 6.1 | | **14** | |
| | | Zinc | mg/Kg | 93.3 | 2346 | nc | | | | | | | | | 72 | | 54 | | 49 | H | 69 | H |

# Table 4-4
# Summary of Subsurface Soil Results (>1 ft bgs)

| | | | | | | | LL9SB-055-0001-SO | | LL9SB-056-0001-SO | | LL9SB-059-0001-SO | | LL9SB-061-0001-SO | | LL9SB-065-0001-SO | | LL9SB-066-0001-SO | | LL9SB-069-0001-SO | | LL9SB-070-0001-SO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 11/05/03 | | 11/05/03 | | 11/05/03 | | 11/05/03 | | 11/06/03 | | 11/06/03 | | 10/27/03 | | 10/27/03 | |
| | | | | | | **Sample Depth** | 1.5 - 3.5 ft | | 2 - 4 ft | | 3 - 5 ft | | 1 - 3 ft | | 3 - 5 ft | | 5 - 7 ft | | 7 ft | | 6.5 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Subsurface Soil Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SB PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| | 7041 | Antimony | mg/Kg | 0.96 | 3.1 | nc | | | | | | | | | 0.72 | B | 0.45 | U | 0.43 | U | 0.44 | U |
| | 7060A | Arsenic | mg/Kg | 19.8 | 0.39 | ca | | | | | | | | | **4.6** | | **11** | | **6.9** | | **8.3** | |
| | 7421 | Lead | mg/Kg | 19.1 | 400 | pbk | | | | | | | | | 51 | | 10 | | 9.2 | | 11 | |
| | 7471A | Mercury | mg/Kg | 0.04 | 2.3 | nc | | | | | | | | | **9.7** | | 0.016 | B | 0.025 | | 0.013 | B |
| | 7841 | Thallium | mg/Kg | 0.91 | 0.52 | nc | | | | | | | | | 1.1 | U | 0.97 | U | 0.19 | U | 0.19 | U |
| VOCs TCL 8260B | 8260B | 1,1,1-Trichloroethane | mg/Kg | -- | 1200 | sat | 0.00075 | U | 0.00071 | U | 0.019 | U | 0.019 | U | | | | | | | | |
| | | 1,1,2,2-Tetrachloroethane | mg/Kg | -- | 0.41 | ca | 0.00079 | U | 0.00074 | U | 0.022 | U | 0.022 | U | | | | | | | | |
| | | 1,1,2-Trichloroethane | mg/Kg | -- | 0.73 | ca | 0.00087 | U | 0.00082 | U | 0.037 | U | 0.037 | U | | | | | | | | |
| | | 1,1-Dichloroethane | mg/Kg | -- | 51 | nc | 0.0011 | U | 0.001 | U | 0.016 | U | 0.016 | U | | | | | | | | |
| | | 1,1-Dichloroethene | mg/Kg | -- | 12 | nc | 0.0012 | U | 0.0012 | U | 0.017 | U | 0.016 | U | | | | | | | | |
| | | 1,2-Dichloroethane | mg/Kg | -- | 0.28 | ca | 0.00071 | U | 0.00067 | U | 0.025 | U | 0.025 | U | | | | | | | | |
| | | 1,2-Dichloroethene (total) | mg/Kg | -- | 6.9 | nc | 0.0023 | U | 0.0022 | U | 0.034 | U | 0.034 | U | | | | | | | | |
| | | 1,2-Dichloropropane | mg/Kg | -- | 0.34 | ca | 0.0012 | U | 0.0011 | U | 0.021 | U | 0.021 | U | | | | | | | | |
| | | 2-Butanone (MEK) | mg/Kg | -- | 2231 | nc | 0.0052 | U | 0.0049 | U | 0.06 | U | 0.06 | U | | | | | | | | |
| | | 2-Hexanone | mg/Kg | -- | 530 | nc | 0.0021 | U | 0.002 | U | 0.061 | U | 0.061 | U | | | | | | | | |
| | | 4-Methyl-2-pentanone (MIBK) | mg/Kg | -- | 528 | nc | 0.0037 | U | 0.0035 | U | 0.044 | U | 0.044 | U | | | | | | | | |
| | | Acetone | mg/Kg | -- | 1412 | nc | 0.005 | U | 0.0048 | U | 0.034 | U | 0.034 | U | | | | | | | | |
| | | Benzene | mg/Kg | -- | 0.64 | ca | 0.00081 | U | 0.00077 | U | 0.017 | U | 0.016 | U | | | | | | | | |
| | | Bromodichloromethane | mg/Kg | -- | 0.82 | ca | 0.00083 | U | 0.00079 | U | 0.022 | U | 0.022 | U | | | | | | | | |
| | | Bromoform | mg/Kg | -- | 62 | ca | 0.0011 | U | 0.0011 | U | 0.021 | U | 0.021 | U | | | | | | | | |
| | | Bromomethane | mg/Kg | -- | 0.39 | nc | 0.0036 | U | 0.0034 | U | 0.012 | U | 0.012 | U | | | | | | | | |
| | | Carbon disulfide | mg/Kg | -- | 36 | nc | 0.0025 | U | 0.0023 | U | 0.024 | U | 0.024 | U | | | | | | | | |
| | | Carbon tetrachloride | mg/Kg | -- | 0.25 | ca | 0.001 | U | 0.00096 | U | 0.019 | U | 0.019 | U | | | | | | | | |
| | | Chlorobenzene | mg/Kg | -- | 15 | nc | 0.0011 | U | 0.0011 | U | 0.026 | U | 0.026 | U | | | | | | | | |
| | | Chloroethane | mg/Kg | -- | 3.0 | ca | 0.002 | U | 0.0019 | U | 0.024 | U | 0.024 | U | | | | | | | | |
| | | Chloroform | mg/Kg | -- | 0.22 | ca | 0.00076 | U | 0.00072 | U | 0.021 | U | 0.021 | U | | | | | | | | |
| | | Chloromethane | mg/Kg | -- | 4.7 | nc | 0.0012 | U | 0.0011 | U | 0.028 | U | 0.028 | U | | | | | | | | |
| | | cis-1,3-Dichloropropene | mg/Kg | -- | 0.78 | ca | 0.00097 | U | 0.00092 | U | 0.027 | U | 0.026 | U | | | | | | | | |
| | | Dibromochloromethane | mg/Kg | -- | 1.1 | ca | 0.00085 | U | 0.0008 | U | 0.022 | U | 0.022 | U | | | | | | | | |
| | | Ethylbenzene | mg/Kg | -- | 395 | sat | 0.0013 | U | 0.0013 | U | 0.027 | U | 0.026 | U | | | | | | | | |
| | | Methylene chloride | mg/Kg | -- | 9.1 | ca | 0.0022 | U | 0.0021 | U | 0.024 | U | 0.024 | U | | | | | | | | |
| | | Styrene | mg/Kg | -- | 1700 | sat | 0.0012 | U | 0.0012 | U | 0.034 | U | 0.033 | U | | | | | | | | |
| | | Tetrachloroethene | mg/Kg | -- | 0.48 | ca | 0.00082 | U | 0.00078 | U | 0.027 | U | 0.027 | U | | | | | | | | |
| | | Toluene | mg/Kg | -- | 520 | sat | 0.0012 | U | 0.0012 | U | 0.021 | U | 0.021 | U | | | | | | | | |
| | | trans-1,3-Dichloropropene | mg/Kg | -- | 0.78 | ca | 0.001 | U | 0.00097 | U | 0.023 | U | 0.023 | U | | | | | | | | |
| | | Trichloroethene | mg/Kg | -- | 0.053 | ca | 0.00072 | U | 0.00068 | U | 0.025 | U | 0.025 | U | | | | | | | | |
| | | Vinyl chloride | mg/Kg | -- | 0.079 | ca | 0.00091 | U | 0.00086 | U | 0.021 | U | 0.021 | U | | | | | | | | |
| | | Xylenes (total) | mg/Kg | -- | 0.079 | ca | 0.0036 | U | 0.0034 | U | 0.059 | U | 0.059 | U | | | | | | | | |

## Table 4-4
## Summary of Subsurface Soil Results (>1 ft bgs)

### Notes:

-- - no background/PRG value is available for this analyte
blank cell indicates that the analysis was not performed
PRG - preliminary remediation goals
(The PRG for lead is the Maximum Contaminant Level (MCL)
nc - non-cancer basis
ca - cancer basis
pbk - based on PBK modeling
mcl - based on CWA maximum contaminant level
max - ceiling limit
sat - soil saturation
[n] - nutrient
UC - unconsolidated
If Result = or > Background, then the value is presented with a shaded/highlighted style
If Result = or > Background and PRG, then the value is presented with a bold + shaded/highlighted style
If Result = or > PRG, then the value is presented with a bold style
If Result < PRG and Background, then the value is presented with a normal style

**Inorganic Qualifiers**
U - analyte was not detected at or above the stated limit
J - result is less than the RL, but greater than or equal to the MDL
B - result is less than the CRDL/RL, but greater than or equal to the IDL/MDL

**InOrganic Flags**
^ - instrument related QC exceed the upper or lower control limits
* - batch QC exceeds the upper or lower control limit
H - batch QC is greater than RL

**Organic Qualifiers**
U - analyte was not detected at or above the stated limit
J - result is an estimated value below the RL

**Organic Flags**
B - Method Blank: batch QC is greater than RL
* - batch QC exceeds the upper or lower control limit
^ - batch QC is greater than RL
a - concentration is below the method Reporting Limit (RL)
H - alternate peak selection upon analytical review

## Table 4-5
## Summary of Subsurface Soil Exceedances (>1 ft)

| Sample Number | Sample Date | Sample Depth | Analyte | Result (mg/kg) | Qualifier | Subsurface Soil Background Criteria | Subsurface Soil Region 9 Criteria | SB PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| LL9SB-001-0001-SO | 12/04/03 | 1-3 ft | Arsenic | 12 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-001-0001-SO | 12/04/03 | 1-3 ft | Iron | 23000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-001-0001-SO | 12/04/03 | 1-3 ft | Manganese | 400 | | 3030 | 176 | nc | NO | YES |
| LL9SB-001-0001-SO | 12/04/03 | 1-3 ft | Vanadium | 13 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-002-0001-SO | 12/04/03 | 1-3 ft | Aluminum | 10000 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-002-0001-SO | 12/04/03 | 1-3 ft | Arsenic | 12 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-002-0001-SO | 12/04/03 | 1-3 ft | Iron | 23000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-002-0001-SO | 12/04/03 | 1-3 ft | Lead | 24 | | 19.1 | 400 | pbk | YES | NO |
| LL9SB-002-0001-SO | 12/04/03 | 1-3 ft | Manganese | 600 | | 3030 | 176 | nc | NO | YES |
| LL9SB-002-0001-SO | 12/04/03 | 1-3 ft | Mercury | 0.076 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SB-002-0001-SO | 12/04/03 | 1-3 ft | Vanadium | 19 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-003-0001-SO | 12/04/03 | 1-2 ft | Arsenic | 9.8 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-003-0001-SO | 12/04/03 | 1-2 ft | Iron | 16000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-003-0001-SO | 12/04/03 | 1-2 ft | Manganese | 310 | | 3030 | 176 | nc | NO | YES |
| LL9SB-003-0001-SO | 12/04/03 | 1-2 ft | Vanadium | 11 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-004-0001-SO | 12/04/03 | 1-3 ft | Aluminum | 8200 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-004-0001-SO | 12/04/03 | 1-3 ft | Arsenic | 8.5 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-004-0001-SO | 12/04/03 | 1-3 ft | Iron | 18000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-004-0001-SO | 12/04/03 | 1-3 ft | Manganese | 200 | | 3030 | 176 | nc | NO | YES |
| LL9SB-004-0001-SO | 12/04/03 | 1-3 ft | Vanadium | 15 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-005-0001-DUP | 12/04/03 | 1-3 ft | Aluminum | 11000 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-005-0001-DUP | 12/04/03 | 1-3 ft | Arsenic | 9 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-005-0001-DUP | 12/04/03 | 1-3 ft | Iron | 17000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-005-0001-DUP | 12/04/03 | 1-3 ft | Manganese | 1300 | | 3030 | 176 | nc | NO | YES |
| LL9SB-005-0001-DUP | 12/04/03 | 1-3 ft | Nitrocellulose | 2.7 | J | 0 | -- | 0 | YES | NO |
| LL9SB-005-0001-DUP | 12/04/03 | 1-3 ft | Vanadium | 18 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-005-0001-SO | 12/04/03 | 1-3 ft | Aluminum | 11000 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-005-0001-SO | 12/04/03 | 1-3 ft | Arsenic | 7.7 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-005-0001-SO | 12/04/03 | 1-3 ft | Iron | 15000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-005-0001-SO | 12/04/03 | 1-3 ft | Manganese | 1100 | | 3030 | 176 | nc | NO | YES |
| LL9SB-005-0001-SO | 12/04/03 | 1-3 ft | Nitrocellulose | 1.2 | B J | 0 | -- | 0 | YES | NO |
| LL9SB-005-0001-SO | 12/04/03 | 1-3 ft | Nitroglycerin | 4.82 | | 0 | -- | 0 | YES | NO |

## Table 4-5
## Summary of Subsurface Soil Exceedances (>1 ft)

| Sample Number | Sample Date | Sample Depth | Analyte | Result (mg/kg) | Qualifier | Subsurface Soil Background Criteria | Subsurface Soil Region 9 Criteria | SB PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| LL9SB-005-0001-SO | 12/04/03 | 1-3 ft | Nitroglycerin | 4.9 |  | 0 | -- | 0 | YES | NO |
| LL9SB-005-0001-SO | 12/04/03 | 1-3 ft | Nitroguanidine | 0.945 |  | 0 | 611 | nc | YES | NO |
| LL9SB-005-0001-SO | 12/04/03 | 1-3 ft | Nitroguanidine | 0.912 |  | 0 | 611 | nc | YES | NO |
| LL9SB-005-0001-SO | 12/04/03 | 1-3 ft | Vanadium | 17 |  | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-006-0001-SO | 12/11/03 | 1-2 ft | Arsenic | 9.9 |  | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-006-0001-SO | 12/11/03 | 1-2 ft | Cadmium | 2 |  | 0 | 3.7 | nc | YES | NO |
| LL9SB-006-0001-SO | 12/11/03 | 1-2 ft | Iron | 14000 | H | 35200 | 2346 | nc | NO | YES |
| LL9SB-006-0001-SO | 12/11/03 | 1-2 ft | Lead | 54 |  | 19.1 | 400 | pbk | YES | NO |
| LL9SB-006-0001-SO | 12/11/03 | 1-2 ft | Manganese | 520 |  | 3030 | 176 | nc | NO | YES |
| LL9SB-006-0001-SO | 12/11/03 | 1-2 ft | Mercury | 0.94 |  | 0.04 | 2.3 | nc | YES | NO |
| LL9SB-006-0001-SO | 12/11/03 | 1-2 ft | Vanadium | 13 |  | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-006-0001-SO | 12/11/03 | 1-2 ft | Zinc | 120 |  | 93.3 | 2346 | nc | YES | NO |
| LL9SB-007-0001-SO | 12/08/03 | 1-3 ft | Aluminum | 12000 |  | 19500 | 7614 | nc | NO | YES |
| LL9SB-007-0001-SO | 12/08/03 | 1-3 ft | Arsenic | 14 |  | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-007-0001-SO | 12/08/03 | 1-3 ft | Cadmium | 0.13 | B | 0 | 3.7 | nc | YES | NO |
| LL9SB-007-0001-SO | 12/08/03 | 1-3 ft | Iron | 23000 |  | 35200 | 2346 | nc | NO | YES |
| LL9SB-007-0001-SO | 12/08/03 | 1-3 ft | Manganese | 570 |  | 3030 | 176 | nc | NO | YES |
| LL9SB-007-0001-SO | 12/08/03 | 1-3 ft | Vanadium | 21 |  | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-008-0001-SO | 12/10/03 | 1-3 ft | Aluminum | 12000 |  | 19500 | 7614 | nc | NO | YES |
| LL9SB-008-0001-SO | 12/10/03 | 1-3 ft | Arsenic | 12 |  | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-008-0001-SO | 12/10/03 | 1-3 ft | Iron | 30000 |  | 35200 | 2346 | nc | NO | YES |
| LL9SB-008-0001-SO | 12/10/03 | 1-3 ft | Manganese | 550 |  | 3030 | 176 | nc | NO | YES |
| LL9SB-008-0001-SO | 12/10/03 | 1-3 ft | Vanadium | 22 |  | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-009-0001-SO | 12/08/03 | 1-3 ft | Aluminum | 12000 |  | 19500 | 7614 | nc | NO | YES |
| LL9SB-009-0001-SO | 12/08/03 | 1-3 ft | Arsenic | 22 |  | 19.8 | 0.39 | ca | YES | YES |
| LL9SB-009-0001-SO | 12/08/03 | 1-3 ft | Iron | 28000 |  | 35200 | 2346 | nc | NO | YES |
| LL9SB-009-0001-SO | 12/08/03 | 1-3 ft | Manganese | 280 |  | 3030 | 176 | nc | NO | YES |
| LL9SB-009-0001-SO | 12/08/03 | 1-3 ft | Vanadium | 18 |  | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-010-0001-SO | 12/08/03 | 2.5 ft | Aluminum | 9700 |  | 19500 | 7614 | nc | NO | YES |
| LL9SB-010-0001-SO | 12/08/03 | 2.5 ft | Arsenic | 22 |  | 19.8 | 0.39 | ca | YES | YES |
| LL9SB-010-0001-SO | 12/08/03 | 2.5 ft | Cadmium | 0.13 | B | 0 | 3.7 | nc | YES | NO |
| LL9SB-010-0001-SO | 12/08/03 | 2.5 ft | Iron | 24000 |  | 35200 | 2346 | nc | NO | YES |

## Table 4-5
## Summary of Subsurface Soil Exceedances (>1 ft)

| Sample Number | Sample Date | Sample Depth | Analyte | Result (mg/kg) | Qualifier | Subsurface Soil Background Criteria | Subsurface Soil Region 9 Criteria | SB PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| LL9SB-010-0001-SO | 12/08/03 | 2.5 ft | Manganese | 470 | | 3030 | 176 | nc | NO | YES |
| LL9SB-010-0001-SO | 12/08/03 | 2.5 ft | Mercury | 0.18 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SB-010-0001-SO | 12/08/03 | 2.5 ft | Vanadium | 14 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-012-0001-SO | 12/10/03 | 1-3 ft | Aluminum | 9700 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-012-0001-SO | 12/10/03 | 1-3 ft | Arsenic | 19 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-012-0001-SO | 12/10/03 | 1-3 ft | Iron | 25000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-012-0001-SO | 12/10/03 | 1-3 ft | Lead | 20 | | 19.1 | 400 | pbk | YES | NO |
| LL9SB-012-0001-SO | 12/10/03 | 1-3 ft | Manganese | 470 | | 3030 | 176 | nc | NO | YES |
| LL9SB-012-0001-SO | 12/10/03 | 1-3 ft | Vanadium | 17 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-012-0001-SO | 12/10/03 | 1-3 ft | Zinc | 110 | | 93.3 | 2346 | nc | YES | NO |
| LL9SB-013-0001-SO | 12/10/03 | 1-3 ft | Arsenic | 11 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-013-0001-SO | 12/10/03 | 1-3 ft | Iron | 18000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-013-0001-SO | 12/10/03 | 1-3 ft | Manganese | 420 | | 3030 | 176 | nc | NO | YES |
| LL9SB-013-0001-SO | 12/10/03 | 1-3 ft | Vanadium | 11 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-014-0001-SO | 12/11/03 | 1-3 ft | Arsenic | 18 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-014-0001-SO | 12/11/03 | 1-3 ft | Iron | 18000 | H | 35200 | 2346 | nc | NO | YES |
| LL9SB-014-0001-SO | 12/11/03 | 1-3 ft | Manganese | 430 | | 3030 | 176 | nc | NO | YES |
| LL9SB-014-0001-SO | 12/11/03 | 1-3 ft | Vanadium | 12 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-015-0001-SO | 12/11/03 | 1-3 ft | Aluminum | 10000 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-015-0001-SO | 12/11/03 | 1-3 ft | Antimony | 1 | | 0.96 | 3.1 | nc | YES | NO |
| LL9SB-015-0001-SO | 12/11/03 | 1-3 ft | Arsenic | 18 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-015-0001-SO | 12/11/03 | 1-3 ft | Iron | 27000 | H | 35200 | 2346 | nc | NO | YES |
| LL9SB-015-0001-SO | 12/11/03 | 1-3 ft | Manganese | 280 | | 3030 | 176 | nc | NO | YES |
| LL9SB-015-0001-SO | 12/11/03 | 1-3 ft | Vanadium | 17 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-016-0001-SO | 12/11/03 | 1-3 ft | Aluminum | 8000 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-016-0001-SO | 12/11/03 | 1-3 ft | Arsenic | 11 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-016-0001-SO | 12/11/03 | 1-3 ft | Iron | 24000 | H | 35200 | 2346 | nc | NO | YES |
| LL9SB-016-0001-SO | 12/11/03 | 1-3 ft | Manganese | 550 | | 3030 | 176 | nc | NO | YES |
| LL9SB-016-0001-SO | 12/11/03 | 1-3 ft | Vanadium | 15 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-017-0001-SO | 12/04/03 | 1-3 ft | Aluminum | 10000 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-017-0001-SO | 12/04/03 | 1-3 ft | Arsenic | 10 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-017-0001-SO | 12/04/03 | 1-3 ft | Iron | 19000 | | 35200 | 2346 | nc | NO | YES |

## Table 4-5
## Summary of Subsurface Soil Exceedances (>1 ft)

| Sample Number | Sample Date | Sample Depth | Analyte | Result (mg/kg) | Qualifier | Subsurface Soil Background Criteria | Subsurface Soil Region 9 Criteria | SB PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| LL9SB-017-0001-SO | 12/04/03 | 1-3 ft | Manganese | 760 | | 3030 | 176 | nc | NO | YES |
| LL9SB-017-0001-SO | 12/04/03 | 1-3 ft | Vanadium | 20 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-018-0001-SO | 12/10/03 | 1-3 ft | Aluminum | 14000 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-018-0001-SO | 12/10/03 | 1-3 ft | Arsenic | 15 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-018-0001-SO | 12/10/03 | 1-3 ft | Iron | 26000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-018-0001-SO | 12/10/03 | 1-3 ft | Manganese | 250 | | 3030 | 176 | nc | NO | YES |
| LL9SB-018-0001-SO | 12/10/03 | 1-3 ft | Vanadium | 19 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-019-0001-SO | 12/11/03 | 1-3 ft | Aluminum | 11000 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-019-0001-SO | 12/11/03 | 1-3 ft | Arsenic | 32 | | 19.8 | 0.39 | ca | YES | YES |
| LL9SB-019-0001-SO | 12/11/03 | 1-3 ft | Iron | 30000 | H | 35200 | 2346 | nc | NO | YES |
| LL9SB-019-0001-SO | 12/11/03 | 1-3 ft | Manganese | 270 | | 3030 | 176 | nc | NO | YES |
| LL9SB-019-0001-SO | 12/11/03 | 1-3 ft | Mercury | 0.18 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SB-019-0001-SO | 12/11/03 | 1-3 ft | Vanadium | 17 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-020-0001-SO | 12/08/03 | 1-3 ft | Aluminum | 15000 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-020-0001-SO | 12/08/03 | 1-3 ft | Arsenic | 14 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-020-0001-SO | 12/08/03 | 1-3 ft | Cadmium | 0.095 | B | 0 | 3.7 | nc | YES | NO |
| LL9SB-020-0001-SO | 12/08/03 | 1-3 ft | Iron | 24000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-020-0001-SO | 12/08/03 | 1-3 ft | Manganese | 420 | | 3030 | 176 | nc | NO | YES |
| LL9SB-020-0001-SO | 12/08/03 | 1-3 ft | Mercury | 0.18 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SB-020-0001-SO | 12/08/03 | 1-3 ft | Vanadium | 26 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-021-0001-SO | 12/08/03 | 2.5 ft | Aluminum | 12000 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-021-0001-SO | 12/08/03 | 2.5 ft | Arsenic | 26 | | 19.8 | 0.39 | ca | YES | YES |
| LL9SB-021-0001-SO | 12/08/03 | 2.5 ft | Iron | 28000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-021-0001-SO | 12/08/03 | 2.5 ft | Lead | 22 | | 19.1 | 400 | pbk | YES | NO |
| LL9SB-021-0001-SO | 12/08/03 | 2.5 ft | Manganese | 290 | | 3030 | 176 | nc | NO | YES |
| LL9SB-021-0001-SO | 12/08/03 | 2.5 ft | Vanadium | 19 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-022-0001-SO | 12/10/03 | 1-3 ft | Aluminum | 11000 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-022-0001-SO | 12/10/03 | 1-3 ft | Arsenic | 18 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-022-0001-SO | 12/10/03 | 1-3 ft | Iron | 24000 | | 35200 | 2346 | nc | NO | YES |

# Table 4-5
## Summary of Subsurface Soil Exceedances (>1 ft)

| Sample Number | Sample Date | Sample Depth | Analyte | Result (mg/kg) | Qualifier | Subsurface Soil Background Criteria | Subsurface Soil Region 9 Criteria | SB PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| LL9SB-022-0001-SO | 12/10/03 | 1-3 ft | Lead | 23 | | 19.1 | 400 | pbk | YES | NO |
| LL9SB-022-0001-SO | 12/10/03 | 1-3 ft | Manganese | 500 | | 3030 | 176 | nc | NO | YES |
| LL9SB-022-0001-SO | 12/10/03 | 1-3 ft | Mercury | 0.087 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SB-022-0001-SO | 12/10/03 | 1-3 ft | Vanadium | 15 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-023-0001-SO | 12/08/03 | 1-3 ft | Aluminum | 11000 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-023-0001-SO | 12/08/03 | 1-3 ft | Arsenic | 24 | | 19.8 | 0.39 | ca | YES | YES |
| LL9SB-023-0001-SO | 12/08/03 | 1-3 ft | Iron | 27000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-023-0001-SO | 12/08/03 | 1-3 ft | Manganese | 350 | | 3030 | 176 | nc | NO | YES |
| LL9SB-023-0001-SO | 12/08/03 | 1-3 ft | Vanadium | 18 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-024-0001-SO | 12/10/03 | 1-3 ft | Aluminum | 18000 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-024-0001-SO | 12/10/03 | 1-3 ft | Antimony | 1 | | 0.96 | 3.1 | nc | YES | NO |
| LL9SB-024-0001-SO | 12/10/03 | 1-3 ft | Arsenic | 9.2 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-024-0001-SO | 12/10/03 | 1-3 ft | Chromium | 54 | | 27.2 | 30 | ca | YES | YES |
| LL9SB-024-0001-SO | 12/10/03 | 1-3 ft | Iron | 28000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-024-0001-SO | 12/10/03 | 1-3 ft | Lead | 86 | | 19.1 | 400 | pbk | YES | NO |
| LL9SB-024-0001-SO | 12/10/03 | 1-3 ft | Manganese | 440 | | 3030 | 176 | nc | NO | YES |
| LL9SB-024-0001-SO | 12/10/03 | 1-3 ft | Mercury | 0.079 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SB-024-0001-SO | 12/10/03 | 1-3 ft | Vanadium | 29 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-025-0001-SO | 12/10/03 | 1-3 ft | Aluminum | 18000 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-025-0001-SO | 12/10/03 | 1-3 ft | Arsenic | 15 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-025-0001-SO | 12/10/03 | 1-3 ft | Iron | 32000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-025-0001-SO | 12/10/03 | 1-3 ft | Manganese | 180 | | 3030 | 176 | nc | NO | YES |
| LL9SB-025-0001-SO | 12/10/03 | 1-3 ft | Vanadium | 29 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-026-0001-SO | 12/10/03 | 1-3 ft | Aluminum | 13000 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-026-0001-SO | 12/10/03 | 1-3 ft | Arsenic | 6.9 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-026-0001-SO | 12/10/03 | 1-3 ft | Iron | 19000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-026-0001-SO | 12/10/03 | 1-3 ft | Manganese | 470 | | 3030 | 176 | nc | NO | YES |

# Table 4-5
## Summary of Subsurface Soil Exceedances (>1 ft)

| Sample Number | Sample Date | Sample Depth | Analyte | Result (mg/kg) | Qualifier | Subsurface Soil Background Criteria | Subsurface Soil Region 9 Criteria | SB PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| LL9SB-026-0001-SO | 12/10/03 | 1-3 ft | Vanadium | 23 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-027-0001-SO | 12/04/03 | 1-3 ft | Aluminum | 10000 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-027-0001-SO | 12/04/03 | 1-3 ft | Arsenic | 18 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-027-0001-SO | 12/04/03 | 1-3 ft | Iron | 24000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-027-0001-SO | 12/04/03 | 1-3 ft | Manganese | 410 | | 3030 | 176 | nc | NO | YES |
| LL9SB-027-0001-SO | 12/04/03 | 1-3 ft | Vanadium | 19 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-028-0001-SO | 12/04/03 | 1-3 ft | Aluminum | 9600 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-028-0001-SO | 12/04/03 | 1-3 ft | Arsenic | 5.1 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-028-0001-SO | 12/04/03 | 1-3 ft | Iron | 11000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-028-0001-SO | 12/04/03 | 1-3 ft | Vanadium | 18 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-029-0001-SO | 12/04/03 | 1-3 ft | Aluminum | 9400 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-029-0001-SO | 12/04/03 | 1-3 ft | Arsenic | 11 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-029-0001-SO | 12/04/03 | 1-3 ft | Iron | 24000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-029-0001-SO | 12/04/03 | 1-3 ft | Manganese | 660 | | 3030 | 176 | nc | NO | YES |
| LL9SB-029-0001-SO | 12/04/03 | 1-3 ft | Vanadium | 19 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-030-0001-SO | 12/04/03 | 1-3 ft | Aluminum | 10000 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-030-0001-SO | 12/04/03 | 1-3 ft | Arsenic | 6 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-030-0001-SO | 12/04/03 | 1-3 ft | Iron | 21000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-030-0001-SO | 12/04/03 | 1-3 ft | Manganese | 380 | | 3030 | 176 | nc | NO | YES |
| LL9SB-030-0001-SO | 12/04/03 | 1-3 ft | Vanadium | 20 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-031-0001-SO | 12/04/03 | 1-3 ft | Arsenic | 7.4 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-031-0001-SO | 12/04/03 | 1-3 ft | Iron | 16000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-031-0001-SO | 12/04/03 | 1-3 ft | Manganese | 390 | | 3030 | 176 | nc | NO | YES |
| LL9SB-031-0001-SO | 12/04/03 | 1-3 ft | Vanadium | 12 | | 37.6 | 7.8 | nc | NO | YES |

## Table 4-5
## Summary of Subsurface Soil Exceedances (>1 ft)

| Sample Number | Sample Date | Sample Depth | Analyte | Result (mg/kg) | Qualifier | Subsurface Soil Background Criteria | Subsurface Soil Region 9 Criteria | SB PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| LL9SB-032-0001-SO | 12/04/03 | 1-3 ft | Aluminum | 11000 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-032-0001-SO | 12/04/03 | 1-3 ft | Arsenic | 7.4 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-032-0001-SO | 12/04/03 | 1-3 ft | Iron | 19000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-032-0001-SO | 12/04/03 | 1-3 ft | Manganese | 970 | | 3030 | 176 | nc | NO | YES |
| LL9SB-032-0001-SO | 12/04/03 | 1-3 ft | Nitrocellulose | 1.3 | B J | 0 | -- | 0 | YES | NO |
| LL9SB-032-0001-SO | 12/04/03 | 1-3 ft | Vanadium | 21 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-040-0001-SO | 10/27/03 | 6.5 ft | Aluminum | 14000 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-040-0001-SO | 10/27/03 | 6.5 ft | Arsenic | 12 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-040-0001-SO | 10/27/03 | 6.5 ft | Barium | 140 | | 124 | 538 | nc | YES | NO |
| LL9SB-040-0001-SO | 10/27/03 | 6.5 ft | Beryllium | 1.1 | | 0.88 | 15 | nc | YES | NO |
| LL9SB-040-0001-SO | 10/27/03 | 6.5 ft | Calcium | 36000 | H | 35500 | --[n] | 0 | YES | NO |
| LL9SB-040-0001-SO | 10/27/03 | 6.5 ft | Iron | 39000 | *H | 35200 | 2346 | nc | YES | YES |
| LL9SB-040-0001-SO | 10/27/03 | 6.5 ft | Lead | 51 | | 19.1 | 400 | pbk | YES | NO |
| LL9SB-040-0001-SO | 10/27/03 | 6.5 ft | Manganese | 2300 | | 3030 | 176 | nc | NO | YES |
| LL9SB-040-0001-SO | 10/27/03 | 6.5 ft | Mercury | 0.26 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SB-040-0001-SO | 10/27/03 | 6.5 ft | Sodium | 170 | | 145 | --[n] | 0 | YES | NO |
| LL9SB-040-0001-SO | 10/27/03 | 6.5 ft | Vanadium | 17 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-041-0001-SO | 10/27/03 | 7.0 ft | Aluminum | 8900 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-041-0001-SO | 10/27/03 | 7.0 ft | Arsenic | 3.4 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-041-0001-SO | 10/27/03 | 7.0 ft | Beryllium | 1.2 | | 0.88 | 15 | nc | YES | NO |
| LL9SB-041-0001-SO | 10/27/03 | 7.0 ft | Iron | 51000 | *H | 35200 | 2346 | nc | YES | YES |
| LL9SB-041-0001-SO | 10/27/03 | 7.0 ft | Lead | 31 | | 19.1 | 400 | pbk | YES | NO |
| LL9SB-041-0001-SO | 10/27/03 | 7.0 ft | Manganese | 2100 | | 3030 | 176 | nc | NO | YES |
| LL9SB-041-0001-SO | 10/27/03 | 7.0 ft | Vanadium | 16 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-042-0001-SO | 11/06/03 | 8-10 ft | Aluminum | 9100 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-042-0001-SO | 11/06/03 | 8-10 ft | Arsenic | 6.9 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-042-0001-SO | 11/06/03 | 8-10 ft | Iron | 23000 | | 35200 | 2346 | nc | NO | YES |

## Table 4-5
## Summary of Subsurface Soil Exceedances (>1 ft)

| Sample Number | Sample Date | Sample Depth | Analyte | Result (mg/kg) | Qualifier | Subsurface Soil Background Criteria | Subsurface Soil Region 9 Criteria | SB PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| LL9SB-042-0001-SO | 11/06/03 | 8-10 ft | Manganese | 420 | | 3030 | 176 | nc | NO | YES |
| LL9SB-042-0001-SO | 11/06/03 | 8-10 ft | Sodium | 1200 | | 145 | --[n] | 0 | YES | NO |
| LL9SB-042-0001-SO | 11/06/03 | 8-10 ft | Vanadium | 15 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-043-0001-DUP | 11/06/03 | 9-11 ft | Arsenic | 3.4 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-043-0001-DUP | 11/06/03 | 9-11 ft | Iron | 26000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-043-0001-DUP | 11/06/03 | 9-11 ft | Manganese | 800 | | 3030 | 176 | nc | NO | YES |
| LL9SB-043-0001-DUP | 11/06/03 | 9-11 ft | Sodium | 840 | | 145 | --[n] | 0 | YES | NO |
| LL9SB-043-0001-DUP | 11/06/03 | 9-11 ft | Vanadium | 9.6 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-043-0001-SO | 11/06/03 | 9-11 ft | Arsenic | 3.7 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-043-0001-SO | 11/06/03 | 9-11 ft | Iron | 27000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-043-0001-SO | 11/06/03 | 9-11 ft | Manganese | 730 | | 3030 | 176 | nc | NO | YES |
| LL9SB-043-0001-SO | 11/06/03 | 9-11 ft | Sodium | 860 | | 145 | --[n] | 0 | YES | NO |
| LL9SB-043-0001-SO | 11/06/03 | 9-11 ft | Vanadium | 10 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-044-0001-SO | 11/06/03 | 8-10 ft | Aluminum | 8000 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-044-0001-SO | 11/06/03 | 8-10 ft | Arsenic | 15 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-044-0001-SO | 11/06/03 | 8-10 ft | Iron | 24000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-044-0001-SO | 11/06/03 | 8-10 ft | Manganese | 420 | | 3030 | 176 | nc | NO | YES |
| LL9SB-044-0001-SO | 11/06/03 | 8-10 ft | Sodium | 1100 | | 145 | --[n] | 0 | YES | NO |
| LL9SB-044-0001-SO | 11/06/03 | 8-10 ft | Vanadium | 13 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-045-0001-SO | 11/06/03 | 8-10 ft | Aluminum | 9300 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-045-0001-SO | 11/06/03 | 8-10 ft | Arsenic | 18 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-045-0001-SO | 11/06/03 | 8-10 ft | Iron | 27000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-045-0001-SO | 11/06/03 | 8-10 ft | Manganese | 330 | | 3030 | 176 | nc | NO | YES |
| LL9SB-045-0001-SO | 11/06/03 | 8-10 ft | Sodium | 1200 | | 145 | --[n] | 0 | YES | NO |
| LL9SB-045-0001-SO | 11/06/03 | 8-10 ft | Vanadium | 14 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-046-0001-SO | 11/06/03 | 4-6 ft | Arsenic | 17 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-046-0001-SO | 11/06/03 | 4-6 ft | Iron | 21000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-046-0001-SO | 11/06/03 | 4-6 ft | Manganese | 360 | | 3030 | 176 | nc | NO | YES |
| LL9SB-046-0001-SO | 11/06/03 | 4-6 ft | Sodium | 1100 | | 145 | --[n] | 0 | YES | NO |
| LL9SB-046-0001-SO | 11/06/03 | 4-6 ft | Vanadium | 12 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-047-0001-SO | 11/06/03 | 3-5 ft | Aluminum | 8600 | | 19500 | 7614 | nc | NO | YES |

## Table 4-5
## Summary of Subsurface Soil Exceedances (>1 ft)

| Sample Number | Sample Date | Sample Depth | Analyte | Result (mg/kg) | Qualifier | Subsurface Soil Background Criteria | Subsurface Soil Region 9 Criteria | SB PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| LL9SB-047-0001-SO | 11/06/03 | 3-5 ft | Arsenic | 5.9 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-047-0001-SO | 11/06/03 | 3-5 ft | Iron | 9600 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-047-0001-SO | 11/06/03 | 3-5 ft | Sodium | 1200 | | 145 | --[n] | 0 | YES | NO |
| LL9SB-047-0001-SO | 11/06/03 | 3-5 ft | Vanadium | 9.2 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-048-0001-SO | 12/10/03 | 1-3 ft | Aluminum | 8400 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-048-0001-SO | 12/10/03 | 1-3 ft | Arsenic | 11 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-048-0001-SO | 12/10/03 | 1-3 ft | Iron | 21000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-048-0001-SO | 12/10/03 | 1-3 ft | Lead | 41 | | 19.1 | 400 | pbk | YES | NO |
| LL9SB-048-0001-SO | 12/10/03 | 1-3 ft | Manganese | 590 | | 3030 | 176 | nc | NO | YES |
| LL9SB-048-0001-SO | 12/10/03 | 1-3 ft | Mercury | 0.34 | | 0.04 | 2.3 | nc | YES | NO |
| LL9SB-048-0001-SO | 12/10/03 | 1-3 ft | Vanadium | 14 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-049-0001-SO | 12/10/03 | 1-3 ft | Aluminum | 12000 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-049-0001-SO | 12/10/03 | 1-3 ft | Arsenic | 12 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-049-0001-SO | 12/10/03 | 1-3 ft | Barium | 150 | | 124 | 538 | nc | YES | NO |
| LL9SB-049-0001-SO | 12/10/03 | 1-3 ft | Iron | 27000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-049-0001-SO | 12/10/03 | 1-3 ft | Lead | 64 | | 19.1 | 400 | pbk | YES | NO |
| LL9SB-049-0001-SO | 12/10/03 | 1-3 ft | Manganese | 530 | | 3030 | 176 | nc | NO | YES |
| LL9SB-049-0001-SO | 12/10/03 | 1-3 ft | Vanadium | 20 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-049-0001-SO | 12/10/03 | 1-3 ft | Zinc | 290 | | 93.3 | 2346 | nc | YES | NO |
| LL9SB-050-0001-SO | 12/10/03 | 1-3 ft | Aluminum | 12000 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-050-0001-SO | 12/10/03 | 1-3 ft | Arsenic | 10 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-050-0001-SO | 12/10/03 | 1-3 ft | Iron | 23000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-050-0001-SO | 12/10/03 | 1-3 ft | Manganese | 370 | | 3030 | 176 | nc | NO | YES |
| LL9SB-050-0001-SO | 12/10/03 | 1-3 ft | Nitrocellulose | 4.3 | J | 0 | -- | 0 | YES | NO |
| LL9SB-050-0001-SO | 12/10/03 | 1-3 ft | Vanadium | 22 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-051-0001-SO | 12/08/03 | 1-3 ft | Aluminum | 11000 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-051-0001-SO | 12/08/03 | 1-3 ft | Arsenic | 18 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-051-0001-SO | 12/08/03 | 1-3 ft | Cadmium | 0.11 | B | 0 | 3.7 | nc | YES | NO |
| LL9SB-051-0001-SO | 12/08/03 | 1-3 ft | Iron | 24000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-051-0001-SO | 12/08/03 | 1-3 ft | Manganese | 350 | | 3030 | 176 | nc | NO | YES |
| LL9SB-051-0001-SO | 12/08/03 | 1-3 ft | Vanadium | 19 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-052-0001-SO | 12/08/03 | 1-3 ft | Aluminum | 16000 | | 19500 | 7614 | nc | NO | YES |

## Table 4-5
## Summary of Subsurface Soil Exceedances (>1 ft)

| Sample Number | Sample Date | Sample Depth | Analyte | Result (mg/kg) | Qualifier | Subsurface Soil Background Criteria | Subsurface Soil Region 9 Criteria | SB PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| LL9SB-052-0001-SO | 12/08/03 | 1-3 ft | Arsenic | 16 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-052-0001-SO | 12/08/03 | 1-3 ft | Iron | 29000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-052-0001-SO | 12/08/03 | 1-3 ft | Manganese | 190 | | 3030 | 176 | nc | NO | YES |
| LL9SB-052-0001-SO | 12/08/03 | 1-3 ft | Vanadium | 25 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-053-0001-DUP | 12/11/03 | 1-3 ft | Arsenic | 9.4 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-053-0001-DUP | 12/11/03 | 1-3 ft | Iron | 13000 | H | 35200 | 2346 | nc | NO | YES |
| LL9SB-053-0001-DUP | 12/11/03 | 1-3 ft | Manganese | 500 | | 3030 | 176 | nc | NO | YES |
| LL9SB-053-0001-DUP | 12/11/03 | 1-3 ft | Vanadium | 14 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-053-0001-SO | 12/11/03 | 1-3 ft | Arsenic | 11 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-053-0001-SO | 12/11/03 | 1-3 ft | Iron | 15000 | H | 35200 | 2346 | nc | NO | YES |
| LL9SB-053-0001-SO | 12/11/03 | 1-3 ft | Manganese | 550 | | 3030 | 176 | nc | NO | YES |
| LL9SB-053-0001-SO | 12/11/03 | 1-3 ft | RDX | 0.11 | | 0 | 4.4 | ca | YES | NO |
| LL9SB-053-0001-SO | 12/11/03 | 1-3 ft | Vanadium | 13 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-065-0001-SO | 11/06/03 | 3-5 ft | Aluminum | 10000 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-065-0001-SO | 11/06/03 | 3-5 ft | Arsenic | 4.6 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-065-0001-SO | 11/06/03 | 3-5 ft | Iron | 14000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-065-0001-SO | 11/06/03 | 3-5 ft | Lead | 51 | | 19.1 | 400 | pbk | YES | NO |
| LL9SB-065-0001-SO | 11/06/03 | 3-5 ft | Mercury | 9.7 | | 0.04 | 2.3 | nc | YES | YES |
| LL9SB-065-0001-SO | 11/06/03 | 3-5 ft | Sodium | 1300 | | 145 | --[n] | 0 | YES | NO |
| LL9SB-065-0001-SO | 11/06/03 | 3-5 ft | Vanadium | 17 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-066-0001-SO | 11/06/03 | 5-7 ft | Arsenic | 11 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-066-0001-SO | 11/06/03 | 5-7 ft | Iron | 19000 | | 35200 | 2346 | nc | NO | YES |
| LL9SB-066-0001-SO | 11/06/03 | 5-7 ft | Manganese | 340 | | 3030 | 176 | nc | NO | YES |
| LL9SB-066-0001-SO | 11/06/03 | 5-7 ft | Sodium | 1100 | | 145 | --[n] | 0 | YES | NO |
| LL9SB-066-0001-SO | 11/06/03 | 5-7 ft | Vanadium | 9.8 | | 37.6 | 7.8 | nc | NO | YES |
| LL9SB-069-0001-SO | 10/27/03 | 7.0 ft | Arsenic | 6.9 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-069-0001-SO | 10/27/03 | 7.0 ft | Iron | 9800 | *H | 35200 | 2346 | nc | NO | YES |
| LL9SB-070-0001-SO | 10/27/03 | 6.5 ft | Aluminum | 7800 | | 19500 | 7614 | nc | NO | YES |
| LL9SB-070-0001-SO | 10/27/03 | 6.5 ft | Arsenic | 8.3 | | 19.8 | 0.39 | ca | NO | YES |
| LL9SB-070-0001-SO | 10/27/03 | 6.5 ft | Iron | 21000 | *H | 35200 | 2346 | nc | NO | YES |

# Table 4-5
## Summary of Subsurface Soil Exceedances (>1 ft)

| Sample Number | Sample Date | Sample Depth | Analyte | Result (mg/kg) | Qualifier | Subsurface Soil Background Criteria | Subsurface Soil Region 9 Criteria | SB PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| LL9SB-070-0001-SO | 10/27/03 | 6.5 ft | Manganese | 490 | | 3030 | 176 | nc | NO | YES |
| LL9SB-070-0001-SO | 10/27/03 | 6.5 ft | Vanadium | 14 | | 37.6 | 7.8 | nc | NO | YES |

**Notes:**
-- - no background/PRG value is available for this analyte
PRG - preliminary remediation goals (The PRG for lead is the Maximum Contaminant Level (MCL)
nc - non-cancer basis
ca - cancer basis
pbk - based on PBK modeling
mcl - based on CWA maximum contaminant level
max - ceiling limit
sat - soil saturation
[n] - nutrient
UC - unconsolidated

**Inorganic Qualifiers**
U - analyte was not detected at or above the stated limit
J - result is less than the RL, but greater than or equal to the MDL
B - result is less than the CRDL/RL, but greater than or equal to the IDL/MDL
**InOrganic Flags**
^ - instrument related QC exceed the upper or lower control limits
* - batch QC exceeds the upper or lower control limit
H - batch QC is greater than RL
**Organic Qualifiers**
U - analyte was not detected at or above the stated limit
J - result is an estimated value below the RL
**Organic Flags**
B - Method Blank: batch QC is greater than RL
* - batch QC exceeds the upper or lower control limit
^ - batch QC is greater than RL
a - concentration is below the method Reporting Limit (RL)
H - alternate peak selection upon analytical review

# Table 4-7
## Summary of Groundwater Results

| | | | | | | | LL9MW-001-0001-GW | | LL9MW-002-0001-GW | | LL9MW-003-0001-GW | | LL9MW-004-0001-GW | | LL9MW-005-0001-GW | | LL9MW-006-0001-GW | | LL9MW-007-0001-DUP | | LL9MW-007-0001-GW | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/17/03 | | 12/16/03 | | 12/16/03 | | 12/17/03 | | 12/17/03 | | 12/16/03 | | 12/15/03 | | 12/15/03 | |
| | | | | | | **Screened Interval** | 10.5-20.5 ft. | | 10-20 ft. | | 11.5-21.5 ft. | | 22-32 ft | | 10-20 ft | | 16-26 ft. | | 8.5-18.5 ft | | 8.5-18.5 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Consolidated Wells Background Criteria** | **Consolidated Wells Region 9 (Tap Water) PRGs** | **C-MW PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| Cyanide 9012A | 9014/9010B | Cyanide, Total | µg/L | 0.00 | 730 | nc | 4.4 | U | 4.4 | U | 4.4 | U | 4.4 | U | 4.4 | U | 4.4 | U | 4.4 | U | 4.4 | U |
| Explosives 8330 | 8330 | 1,3,5-Trinitrobenzene | µg/L | 0 | 1095 | nc | 0.11 | U | 0.1 | U | 0.08 | U | 0.11 | U | 0.096 | U | 0.08 | U | 0.084 | U | 0.12 | U |
| | | 1,3-Dinitrobenzene | µg/L | 0 | 3.6 | nc | 0.071 | U | 0.066 | U | 0.053 | U | 0.07 | U | 0.064 | U | 0.053 | U | 0.056 | U | 0.08 | U |
| | | 2,4,6-TNT | µg/L | 0 | 2.2 | ca | 0.091 | U | 0.085 | U | 0.068 | U | 0.09 | U | 0.082 | U | 0.068 | U | 0.071 | U | 0.1 | U |
| | | 2,4-Dinitrotoluene | µg/L | 0 | 73 | nc | 0.056 | U | 0.052 | U | 0.042 | U | 0.055 | U | 0.05 | U | 0.042 | U | 0.044 | U | 0.063 | U |
| | | 2,6-Dinitrotoluene | µg/L | 0 | 36 | nc | 0.28 | U | 0.26 | U | 0.21 | U | 0.27 | U | 0.25 | U | 0.21 | U | 0.22 | U | 0.31 | U |
| | | 2-Nitrotoluene | µg/L | 0 | 0.049 | ca | 0.22 | U | 0.2 | U | 0.16 | U | 0.21 | U | 0.2 | U | 0.16 | U | 0.17 | U | 0.24 | U |
| | | 3-Nitrotoluene | µg/L | 0 | 122 | nc | 0.14 | U | 0.13 | U | 0.1 | U | 0.13 | U | 0.12 | U | 0.1 | U | 0.11 | U | 0.15 | U |
| | | 4-Nitrotoluene | µg/L | 0 | 0.66 | ca | 0.45 | U | 0.42 | U | 0.34 | U | 0.44 | U | 0.4 | U | 0.34 | U | 0.35 | U | 0.51 | U |
| | | HMX | µg/L | 0 | 1825 | nc | 0.3 | U | 0.28 | U | 0.22 | U | 0.3 | U | 0.27 | U | 0.22 | U | 0.24 | U | 0.34 | U |
| | | Nitrobenzene | µg/L | 0 | 3.4 | nc | 0.12 | U | 0.12 | U | 0.092 | U | 0.12 | U | 0.11 | U | 0.092 | U | 0.097 | U | 0.14 | U |
| | | RDX | µg/L | 0 | 0.61 | ca | 0.18 | U | 0.17 | U | 0.13 | U | 0.18 | U | 0.16 | U | 0.13 | U | 0.14 | U | 0.2 | U |
| | | Tetryl | µg/L | 0 | 365 | nc | 0.29 | U | 0.27 | U | 0.22 | U | 0.29 | U | 0.26 | U | 0.22 | U | 0.23 | U | 0.33 | U |
| PCB TCL 8082 | 8082 | Aroclor 1016 | µg/L | -- | 0.96 | ca | 0.16 | U | 0.17 | U | 0.17 | U | 0.16 | U | 0.17 | U | 0.16 | U | 0.17 | U | 0.17 | U |
| | | Aroclor 1221 | µg/L | -- | 0.034 | ca | 0.44 | U | 0.46 | U | 0.45 | U | 0.44 | U | 0.46 | U | 0.43 | U | 0.47 | U | 0.46 | U |
| | | Aroclor 1232 | µg/L | -- | 0.034 | ca | 0.21 | U | 0.22 | U | 0.21 | U | 0.21 | U | 0.22 | U | 0.21 | U | 0.22 | U | 0.22 | U |
| | | Aroclor 1242 | µg/L | -- | 0.034 | ca | 0.18 | U | 0.19 | U | 0.18 | U | 0.18 | U | 0.19 | U | 0.18 | U | 0.19 | U | 0.19 | U |
| | | Aroclor 1248 | µg/L | -- | 0.034 | ca | 0.2 | U | 0.21 | U | 0.2 | U | 0.2 | U | 0.21 | U | 0.2 | U | 0.21 | U | 0.21 | U |
| | | Aroclor 1254 | µg/L | -- | 0.034 | ca | 0.12 | U | 0.13 | U | 0.13 | U | 0.12 | U | 0.13 | U | 0.12 | U | 0.13 | U | 0.13 | U |
| | | Aroclor 1260 | µg/L | -- | 0.034 | ca | 0.14 | U | 0.15 | U | 0.15 | U | 0.14 | U | 0.15 | U | 0.14 | U | 0.15 | U | 0.15 | U |
| Pesticides 8081A | 8081A | 4,4'-DDD | µg/L | -- | 0.28 | ca | 0.034 | U | 0.036 | U | 0.035 | U | 0.034 | U | 0.036 | U | 0.034 | U | 0.037 | U | 0.036 | U |
| | | 4,4'-DDE | µg/L | -- | 0.20 | ca | 0.022 | U | 0.023 | U | 0.022 | U | 0.022 | U | 0.023 | U | 0.021 | U | 0.023 | U | 0.023 | U |
| | | 4,4'-DDT | µg/L | -- | 0.20 | ca | 0.047 | U | 0.049 | U | 0.048 | U | 0.047 | U | 0.049 | U | 0.046 | U | 0.05 | U | 0.049 | U |
| | | Aldrin | µg/L | -- | 0.0040 | ca | 0.027 | U | 0.028 | U | 0.027 | U | 0.027 | U | 0.028 | U | 0.026 | U | 0.029 | U | 0.028 | U |
| | | alpha-BHC | µg/L | -- | 0.011 | nc | 0.045 | U | 0.047 | U | 0.046 | U | 0.045 | U | 0.047 | U | 0.044 | U | 0.048 | U | 0.047 | U |
| | | alpha-Chlordane | µg/L | -- | 0.19 | ca | 0.015 | U | 0.016 | U | 0.016 | U | 0.015 | U | 0.016 | U | 0.015 | U | 0.016 | U | 0.016 | U |
| | | beta-BHC | µg/L | -- | 0.037 | ca | 0.027 | U | 0.028 | U | 0.027 | U | 0.027 | U | 0.028 | U | 0.026 | U | 0.029 | U | 0.028 | U |
| | | delta-BHC | µg/L | -- | -- | 0 | 0.024 | U | 0.025 | U | 0.024 | U | 0.024 | U | 0.025 | U | 0.023 | U | 0.026 | U | 0.025 | U |
| | | Dieldrin | µg/L | -- | 0.0042 | ca | 0.017 | U | 0.018 | U | 0.017 | U | 0.017 | U | 0.018 | U | 0.017 | U | 0.018 | U | 0.018 | U |
| | | Endosulfan I | µg/L | -- | 220 | nc | 0.02 | U | 0.021 | U | 0.02 | U | 0.02 | U | 0.021 | U | 0.02 | U | 0.021 | U | 0.021 | U |
| | | Endosulfan II | µg/L | -- | 220 | nc | 0.04 | U | 0.042 | U | 0.041 | U | 0.04 | U | 0.042 | U | 0.039 | U | 0.043 | U | 0.042 | U |
| | | Endosulfan sulfate | µg/L | -- | 220 | nc | 0.042 | U | 0.044 | U | 0.043 | U | 0.042 | U | 0.044 | U | 0.041 | U | 0.045 | U | 0.044 | U |
| | | Endrin | µg/L | -- | 11 | nc | 0.016 | U | 0.017 | U | 0.017 | U | 0.016 | U | 0.017 | U | 0.016 | U | 0.017 | U | 0.017 | U |
| | | Endrin aldehyde | µg/L | -- | -- | 0 | 0.033 | U | 0.035 | U* | 0.034 | U* | 0.033 | U | 0.035 | U | 0.033 | U* | 0.036 | U | 0.035 | U |
| | | Endrin ketone | µg/L | -- | -- | 0 | 0.028 | U | 0.029 | U* | 0.028 | U* | 0.028 | U | 0.029 | U | 0.027 | U* | 0.03 | U | 0.029 | U |
| | | gamma-BHC (Lindane) | µg/L | -- | 0.052 | ca | 0.04 | U | 0.042 | U | 0.041 | U | 0.04 | U | 0.042 | U | 0.039 | U | 0.043 | U | 0.042 | U |
| | | gamma-Chlordane | µg/L | -- | 0.19 | ca | 0.016 | U | 0.017 | U | 0.017 | U | 0.016 | U | 0.017 | U | 0.016 | U | 0.017 | U | 0.017 | U |
| | | Heptachlor | µg/L | -- | 0.015 | ca | 0.039 | U | 0.041 | U | 0.04 | U | 0.039 | U | 0.041 | U | 0.038 | U | 0.042 | U | 0.041 | U |
| | | Heptachlor epoxide | µg/L | -- | 0.0074 | ca | 0.034 | U | 0.036 | U | 0.035 | U | 0.034 | U | 0.036 | U | 0.034 | U | 0.037 | U | 0.036 | U |
| | | Methoxychlor | µg/L | -- | 182 | nc | 0.16 | U | 0.17 | U | 0.17 | U | 0.16 | U | 0.17 | U | 0.16 | U | 0.17 | U | 0.17 | U |
| | | Toxaphene | µg/L | -- | 0 | 0 | 0.13 | U | 0.14 | U | 0.14 | U | 0.13 | U | 0.14 | U | 0.13 | U | 0.14 | U | 0.14 | U |

## Table 4-7
## Summary of Groundwater Results

|  |  |  |  |  |  |  | LL9MW-001-0001-GW |  | LL9MW-002-0001-GW |  | LL9MW-003-0001-GW |  | LL9MW-004-0001-GW |  | LL9MW-005-0001-GW |  | LL9MW-006-0001-GW |  | LL9MW-007-0001-DUP |  | LL9MW-007-0001-GW |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  |  | **Sample Date** | 12/17/03 |  | 12/16/03 |  | 12/16/03 |  | 12/17/03 |  | 12/17/03 |  | 12/16/03 |  | 12/15/03 |  | 12/15/03 |  |
|  |  |  |  |  |  | **Screened Interval** | 10.5-20.5 ft. |  | 10-20 ft. |  | 11.5-21.5 ft. |  | 22-32 ft |  | 10-20 ft |  | 16-26 ft. |  | 8.5-18.5 ft |  | 8.5-18.5 ft |  |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Consolidated Wells Background Criteria** | **Consolidated Wells Region 9 (Tap Water) PRGs** | **C-MW PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| Propellants 8330 | 353.2 | Nitrocellulose | µg/L | 0 | -- | 0 | 0.0005 | U | 0.000089 | B J | 0.00014 | B J | 0.00011 | B J | 0.00011 | B J | 0.0005 | U | 0.0001 | B J | 0.00012 | B J |
|  | 8330 | Nitroglycerin | µg/L | 0 | -- | 0 | 0.65 | U | 0.65 | U | 0.65 | U | 0.65 | U | 0.65 | U | 0.65 | U | 0.65 | U | 0.65 | U |
|  | UV/HPLC per SOP | Nitroguanidine | µg/L | 0 | 3650 | nc | 20 | U | 20 | U | 20 | U | 20 | U | 20 | U | 20 | U | 20 | U | 20 | U |
| SVOCs TCL 8270 C | 8270C | 1,2,4-Trichlorobenzene | µg/L | -- | 7.2 | nc | 0.33 | U | 0.35 | U | 0.33 | U | 0.33 | U | 0.35 | U | 0.34 | U | 0.33 | U | 0.32 | U |
|  |  | 1,2-Dichlorobenzene | µg/L | -- | 370 | nc | 0.34 | U | 0.36 | U | 0.34 | U | 0.34 | U | 0.36 | U | 0.35 | U | 0.34 | U | 0.33 | U |
|  |  | 1,3-Dichlorobenzene | µg/L | -- | 182 | nc | 0.41 | U | 0.44 | U | 0.41 | U | 0.41 | U | 0.44 | U | 0.43 | U | 0.42 | U | 0.41 | U |
|  |  | 1,4-Dichlorobenzene | µg/L | -- | 0.50 | ca | 0.32 | U | 0.34 | U | 0.32 | U | 0.32 | U | 0.34 | U | 0.33 | U | 0.32 | U | 0.31 | U |
|  |  | 2,2-oxybis (1-chloropropane) | µg/L | -- | 0.27 | ca | 0.27 | U | 0.29 | U | 0.27 | U | 0.27 | U | 0.29 | U | 0.28 | U | 0.27 | U | 0.26 | U |
|  |  | 2,4,5-Trichlorophenol | µg/L | -- | 3650 | nc | 1.3 | U | 1.4 | U | 1.3 | U | 1.3 | U | 1.4 | U | 1.4 | U | 1.4 | U | 1.3 | U |
|  |  | 2,4,6-Trichlorophenol | µg/L | -- | 3.6 | nc | 0.2 | U | 0.21 | U | 0.2 | U | 0.2 | U | 0.21 | U | 0.21 | U | 0.2 | U | 0.2 | U |
|  |  | 2,4-Dichlorophenol | µg/L | -- | 109 | nc | 0.87 | U | 0.93 | U | 0.87 | U | 0.87 | U | 0.93 | U | 0.9 | U | 0.88 | U | 0.86 | U |
|  |  | 2,4-Dimethylphenol | µg/L | -- | 730 | nc | 1.2 | U | 1.3 | U | 1.2 | U | 1.2 | U | 1.3 | U | 1.3 | U | 1.3 | U | 1.2 | U |
|  |  | 2,4-Dinitrophenol | µg/L | -- | 73 | nc | 3.2 | U | 3.4 | U | 3.2 | U | 3.2 | U | 3.4 | U | 3.3 | U | 3.2 | U | 3.1 | U |
|  |  | 2-Chloronaphthalene | µg/L | -- | 487 | nc | 0.25 | U | 0.27 | U | 0.25 | U | 0.25 | U | 0.27 | U | 0.26 | U | 0.25 | U | 0.25 | U |
|  |  | 2-Chlorophenol | µg/L | -- | 30 | nc | 0.12 | U | 0.12 | U | 0.12 | U | 0.12 | U | 0.12 | U | 0.12 | U | 0.12 | U | 0.11 | U |
|  |  | 2-Methylnaphthalene | µg/L | -- | -- | 0 | 0.12 | U | 0.13 | U | 0.12 | U | 0.12 | U | 0.13 | U | 0.13 | U | 0.13 | U | 0.12 | U |
|  |  | 2-Methylphenol (o-cresol) | µg/L | -- | 1825 | nc | 0.25 | U | 0.27 | U | 0.25 | U | 0.25 | U | 0.27 | U | 0.26 | U | 0.25 | U | 0.25 | U |
|  |  | 2-Nitroaniline | µg/L | -- | 109 | nc | 0.21 | U | 0.22 | U | 0.21 | U | 0.21 | U | 0.22 | U | 0.22 | U | 0.21 | U | 0.21 | U |
|  |  | 2-Nitrophenol | µg/L | -- | -- | 0 | 0.79 | U | 0.84 | U | 0.79 | U | 0.79 | U | 0.84 | U | 0.81 | U | 0.8 | U | 0.77 | U |
|  |  | 3,3-Dichlorobenzidine | µg/L | -- | 0.15 | ca | 0.69 | U | 0.73 | U | 0.69 | U | 0.69 | U | 0.73 | U | 0.71 | U | 0.7 | U | 0.68 | U |
|  |  | 3-Nitroaniline | µg/L | -- | 3.2 | ca | 2 | U | 2.1 | U | 2 | U | 2 | U | 2.1 | U | 2.1 | U | 2 | U | 2 | U |
|  |  | 4,6-Dinitro-2-methylphenol | µg/L | -- | 3.6 | nc | 2.3 | U | 2.4 | U | 2.3 | U | 2.3 | U | 2.4 | U | 2.4 | U | 2.3 | U | 2.3 | U |
|  |  | 4-Bromophenyl phenyl ether | µg/L | -- | -- | 0 | 0.18 | U | 0.19 | U | 0.18 | U | 0.18 | U | 0.19 | U | 0.19 | U | 0.18 | U | 0.18 | U |
|  |  | 4-Chloro-3-methylphenol | µg/L | -- | -- | 0 | 2.3 | U | 2.4 | U | 2.3 | U | 2.3 | U | 2.4 | U | 2.4 | U | 2.3 | U | 2.3 | U |
|  |  | 4-Chloroaniline | µg/L | -- | 146 | nc | 2.7 | U | 2.9 | U | 2.7 | U | 2.7 | U | 2.9 | U | 2.8 | U | 2.7 | U | 2.6 | U |
|  |  | 4-Chlorophenyl phenyl ether | µg/L | -- | -- | 0 | 0.72 | U | 0.77 | U | 0.72 | U | 0.72 | U | 0.77 | U | 0.74 | U | 0.73 | U | 0.71 | U |
|  |  | 4-Methylphenol (m/p-cresol) | µg/L | -- | 182 | nc | 0.096 | U | 0.1 | U | 0.096 | U | 0.096 | U | 0.1 | U | 0.099 | U | 0.097 | U | 0.094 | U |
|  |  | 4-Nitroaniline | µg/L | -- | 3.2 | ca | 2.2 | U | 2.3 | U | 2.2 | U | 2.2 | U | 2.3 | U | 2.3 | U | 2.2 | U | 2.2 | U |
|  |  | 4-Nitrophenol | µg/L | -- | -- | 0 | 3.6 | U | 3.8 | U | 3.6 | U | 3.6 | U | 3.8 | U | 3.7 | U | 3.6 | U | 3.5 | U |
|  |  | Acenaphthene | µg/L | -- | 365 | nc | 0.12 | U | 0.12 | U | 0.12 | U | 0.12 | U | 0.12 | U | 0.12 | U | 0.12 | U | 0.11 | U |
|  |  | Acenaphthylene | µg/L | -- | -- | 0 | 0.12 | U | 0.12 | U | 0.12 | U | 0.12 | U | 0.12 | U | 0.12 | U | 0.12 | U | 0.11 | U |
|  |  | Anthracene | µg/L | -- | 1825 | nc | 0.14 | U | 0.15 | U | 0.14 | U | 0.14 | U | 0.15 | U | 0.15 | U | 0.15 | U | 0.14 | U |
|  |  | Benzo(a)anthracene | µg/L | -- | 0.092 | ca | 0.047 | U | 0.05 | U | 0.047 | U | 0.047 | U | 0.05 | U | 0.049 | U | 0.048 | U | 0.046 | U |
|  |  | Benzo(a)pyrene | µg/L | -- | 0.0092 | ca | 0.081 | U | 0.086 | U | 0.081 | U | 0.081 | U | 0.086 | U | 0.083 | U | 0.082 | U | 0.079 | U |
|  |  | Benzo(b)fluoranthene | µg/L | -- | 0.092 | ca | 0.064 | U | 0.068 | U | 0.064 | U | 0.064 | U | 0.068 | U | 0.066 | U | 0.065 | U | 0.063 | U |
|  |  | Benzo(ghi)perylene | µg/L | -- | -- | 0 | 0.18 | U | 0.19 | U | 0.18 | U | 0.18 | U | 0.19 | U | 0.19 | U | 0.18 | U | 0.18 | U |
|  |  | Benzo(k)fluoranthene | µg/L | -- | 0.92 | ca | 0.069 | U | 0.073 | U | 0.069 | U | 0.069 | U | 0.073 | U | 0.071 | U | 0.07 | U | 0.068 | U |
|  |  | Bis(2-chloroethoxy)methane | µg/L | -- | -- | 0 | 0.3 | U | 0.32 | U | 0.3 | U | 0.3 | U | 0.32 | U | 0.31 | U | 0.3 | U | 0.29 | U |
|  |  | Bis(2-chloroethyl)ether | µg/L | -- | 0.010 | ca | 0.29 | U | 0.31 | U | 0.29 | U | 0.29 | U | 0.31 | U | 0.3 | U | 0.29 | U | 0.28 | U |
|  |  | Bis(2-ethylhexyl)phthalate | µg/L | -- | 4.8 | ca | 3.7 | U | 4 | U | 3.7 | U | 3.7 | U | 4 | U | 3.9 | U | 3.8 | U | 4.3 | J |
|  |  | Butyl benzyl phthalate | µg/L | -- | 7300 | nc | 0.37 | U | 0.4 | U | 0.37 | U | 0.37 | U | 0.4 | U | 0.39 | U | 0.38 | U | 0.37 | U |
|  |  | Carbazole | µg/L | -- | 3.4 | ca | 0.28 | U | 0.3 | U | 0.28 | U | 0.28 | U | 0.3 | U | 0.29 | U | 0.28 | U | 0.27 | U |
|  |  | Chrysene | µg/L | -- | 9.2 | ca | 0.043 | U | 0.046 | U | 0.043 | U | 0.043 | U | 0.046 | U | 0.045 | U | 0.044 | U | 0.042 | U |

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## Table 4-7
## Summary of Groundwater Results

| | | | | | | | LL9MW-001-0001-GW | | LL9MW-002-0001-GW | | LL9MW-003-0001-GW | | LL9MW-004-0001-GW | | LL9MW-005-0001-GW | | LL9MW-006-0001-GW | | LL9MW-007-0001-DUP | | LL9MW-007-0001-GW | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/17/03 | | 12/16/03 | | 12/16/03 | | 12/17/03 | | 12/17/03 | | 12/16/03 | | 12/15/03 | | 12/15/03 | |
| | | | | | | **Screened Interval** | 10.5-20.5 ft. | | 10-20 ft. | | 11.5-21.5 ft. | | 22-32 ft | | 10-20 ft | | 16-26 ft. | | 8.5-18.5 ft | | 8.5-18.5 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Consolidated Wells Background Criteria** | **Consolidated Wells Region 9 (Tap Water) PRGs** | **C-MW PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| | | Dibenzo(a,h)anthracene | µg/L | -- | 0.0092 | ca | 0.12 | U | 0.13 | U | 0.12 | U | 0.12 | U | 0.13 | U | 0.13 | U | 0.13 | U | 0.12 | U |
| | | Dibenzofuran | µg/L | -- | 12 | nc | 0.12 | U | 0.13 | U | 0.12 | U | 0.12 | U | 0.13 | U | 0.13 | U | 0.13 | U | 0.12 | U |
| | | Diethyl phthalate | µg/L | -- | 29199 | nc | 0.14 | U | 0.15 | U | 0.14 | U | 0.14 | U | 0.15 | U | 0.15 | U | 0.15 | U | 0.14 | U |
| | | Dimethyl phthalate | µg/L | -- | 364867 | nc | 0.2 | U | 0.21 | U | 0.2 | U | 0.2 | U | 0.21 | U | 0.21 | U | 0.2 | U | 0.2 | U |
| | | Di-n-butyl phthalate | µg/L | -- | 3650 | nc | 0.35 | U | 0.37 | U | 0.35 | U | 0.35 | U | 0.37 | U | 0.36 | U | 0.35 | U | 0.34 | U |
| | | Di-n-octyl phthalate | µg/L | -- | 1460 | nc | 2.4 | U | 2.6 | U | 2.4 | U | 2.4 | U | 2.6 | U | 2.5 | U | 2.4 | U | 2.4 | U |
| | | Fluoranthene | µg/L | -- | 1460 | nc | 0.13 | U | 0.14 | U | 0.13 | U | 0.13 | U | 0.14 | U | 0.14 | U | 0.14 | U | 0.13 | U |
| | | Fluorene | µg/L | -- | 243 | nc | 0.12 | U | 0.13 | U | 0.12 | U | 0.12 | U | 0.13 | U | 0.13 | U | 0.13 | U | 0.12 | U |
| | | Hexachlorobenzene | µg/L | -- | 0.042 | ca | 0.093 | U | 0.099 | U | 0.093 | U | 0.093 | U | 0.099 | U | 0.096 | U | 0.094 | U | 0.092 | U |
| | | Hexachlorobutadiene | µg/L | -- | 0.86 | ca | 0.62 | U | 0.65 | U | 0.62 | U | 0.62 | U | 0.65 | U | 0.63 | U | 0.62 | U | 0.6 | U |
| | | Hexachlorocyclopentadiene | µg/L | -- | 219 | nc | 0.62 | U | 0.66 | U | 0.62 | U | 0.62 | U | 0.66 | U | 0.64 | U | 0.63 | U | 0.61 | U |
| | | Hexachloroethane | µg/L | -- | 4.8 | ca | 0.59 | U | 0.62 | U | 0.59 | U | 0.59 | U | 0.62 | U | 0.6 | U | 0.59 | U | 0.58 | U |
| | | Indeno(1,2,3-cd)pyrene | µg/L | -- | 0.092 | ca | 0.083 | U | 0.088 | U | 0.083 | U | 0.083 | U | 0.088 | U | 0.085 | U | 0.083 | U | 0.081 | U |
| | | Isophorone | µg/L | -- | 71 | ca | 0.25 | U | 0.27 | U | 0.25 | U | 0.25 | U | 0.27 | U | 0.26 | U | 0.25 | U | 0.25 | U |
| | | Naphthalene | µg/L | -- | 6.2 | nc | 0.15 | U | 0.16 | U | 0.15 | U | 0.15 | U | 0.16 | U | 0.16 | U | 0.16 | U | 0.15 | U |
| | | n-Nitroso-di-n-propylamine | µg/L | -- | 0.0096 | ca | 0.078 | U | 0.083 | U | 0.078 | U | 0.078 | U | 0.083 | U | 0.08 | U | 0.079 | U | 0.076 | U |
| | | n-Nitrosodiphenylamine | µg/L | -- | 14 | ca | 0.12 | U | 0.13 | U | 0.12 | U | 0.12 | U | 0.13 | U | 0.13 | U | 0.13 | U | 0.12 | U |
| | | Pentachlorophenol | µg/L | -- | 0.56 | ca | 1.6 | U | 1.7 | U | 1.6 | U | 1.6 | U | 1.7 | U | 1.7 | U | 1.7 | U | 1.6 | U |
| | | Phenanthrene | µg/L | -- | -- | 0 | 0.13 | U | 0.14 | U | 0.13 | U | 0.13 | U | 0.14 | U | 0.14 | U | 0.14 | U | 0.13 | U |
| | | Phenol | µg/L | -- | 10950 | nc | 0.34 | U | 0.36 | U | 0.34 | U | 0.34 | U | 0.36 | U | 0.35 | U | 0.34 | U | 0.33 | U |
| | | Pyrene | µg/L | -- | 182 | nc | 0.12 | U | 0.12 | U | 0.12 | U | 0.12 | U | 0.12 | U | 0.12 | U | 0.12 | U | 0.11 | U |
| TAL Metals 6010B | 6010B | Aluminum | µg/L | -- | 36499 | nc | 24 | U | 170 | B | 31 | B | 24 | U | 25 | B | 76 | B | 24 | U | 24 | U |
| | | Barium | µg/L | 256 | 2555 | nc | 15 | | 4.7 | B | 26 | | 40 | | 6 | B | 69 | | 18 | | 18 | |
| | | Beryllium | µg/L | 0.00 | 73 | nc | 0.17 | U | 0.17 | U | 0.17 | U | 0.17 | U | 0.17 | U | 0.17 | U | 0.17 | U | 0.17 | U |
| | | Cadmium | µg/L | 0.00 | 18 | nc | 0.44 | U | 0.44 | U | 0.44 | U | 0.44 | U | 0.44 | U | 0.44 | U | 0.44 | U | 0.44 | U |
| | | Calcium | µg/L | 53100 | -- | 0 | 34000 | H | 17000 | H | 14000 | H | 13000 | H | 8800 | H | 4400 | H | 11000 | H | 12000 | H |
| | | Chromium | µg/L | 0.00 | 109 | nc | 1.5 | U | 1.5 | U | 1.5 | U | 1.5 | U | 1.5 | U | 1.5 | U | 1.5 | U | 1.5 | U |
| | | Cobalt | µg/L | 0.00 | 730 | nc | 1 | U | 1 | U | 1 | U | 34 | | 1 | U | 1 | U | 13 | | 11 | |
| | | Copper | µg/L | 0.00 | 1460 | nc | 2.3 | B | 3.1 | B | 2.9 | B | 14 | | 2.8 | B | 4.2 | B | 4.4 | B | 5 | B |
| | | Iron | µg/L | 1430 | 10950 | nc | 40 | U | 40 | U | 62 | | 5700 | | 40 | U | 40 | U | 6600 | | 7100 | |
| | | Magnesium | µg/L | 15000 | -- | 0 | 9600 | | 6800 | | 5400 | | 10000 | | 3700 | | 5000 | | 6000 | | 6400 | |
| | | Manganese | µg/L | 1340 | 876 | nc | 160 | | 190 | | 140 | | **2400** | | 15 | | 73 | | **880** | | **900** | |
| | | Nickel | µg/L | 83.4 | 730 | nc | 1.9 | U | 29 | | 5.1 | B | 45 | | 2.3 | B | 9.8 | B | 25 | | 24 | |
| | | Potassium | µg/L | 5770 | -- | 0 | 1200 | | 1200 | | 1900 | | 1200 | | 750 | | 1400 | | 1300 | | 1400 | |
| | | Selenium | µg/L | 0.00 | 182 | nc | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U |
| | | Silver | µg/L | 0.00 | 182 | nc | 3.1 | U | 3.1 | U | 3.1 | U | 3.1 | U | 3.1 | U | 3.1 | U | 3.1 | U | 3.1 | U |
| | | Sodium | µg/L | 51400 | -- | 0 | 4600 | | 2600 | | 3600 | | 5500 | | 3200 | | 2200 | | 3700 | | 3700 | |
| | | Vanadium | µg/L | 0.00 | 36 | nc | 2.1 | U | 2.1 | U | 2.1 | U | 2.1 | U | 2.1 | U | 2.1 | U | 2.1 | U | 2.1 | U |
| | | Zinc | µg/L | 52.3 | 10950 | nc | 10 | U | 13 | | 40 | | 31 | | 24 | | 21 | | 38 | | 38 | |
| | 7041 | Antimony | µg/L | 0.00 | 15 | nc | 3.2 | B | 2.8 | B | 4 | B | 2.2 | U | 2.2 | U | 2.5 | B | 2.2 | U | 3 | B |
| | 7060A | Arsenic | µg/L | 0.00 | 0.045 | ca | 0.73 | U | 0.73 | U | 0.73 | U | 0.73 | U | 0.73 | U | 0.73 | U | 0.73 | U | 0.73 | U |
| | 7421 | Lead | µg/L | 0.00 | 15 | mcl | 0.78 | U | 0.78 | U | 0.78 | U | 0.78 | U | 0.78 | U | 0.78 | U | 0.78 | U | 0.78 | U |
| | 7470A | Mercury | µg/L | 0.00 | 11 | nc | 0.049 | U | 0.049 | U | 0.049 | U | 0.049 | U | 0.049 | U | 0.049 | U | 0.049 | U | 0.049 | U |
| | 7841 | Thallium | µg/L | 0.00 | 2.4 | nc | 1.6 | U | 1.6 | U | 1.6 | U | 1.6 | U | 1.6 | U | 1.6 | U | 1.6 | U | 1.6 | U |
| VOCs TCL 8260B | 8260B | 1,1,1-Trichloroethane | µg/L | -- | 3172 | nc | 0.08 | U | 0.08 | U | 0.08 | U | 0.08 | U | 0.08 | U | 0.08 | U | 0.08 | U | 0.08 | U |
| | | 1,1,2,2-Tetrachloroethane | µg/L | -- | 0.055 | ca | 0.09 | U | 0.09 | U | 0.09 | U | 0.09 | U | 0.09 | U | 0.09 | U | 0.09 | U | 0.09 | U |
| | | 1,1,2-Trichloroethane | µg/L | -- | 0.20 | ca | 0.15 | U | 0.15 | U | 0.15 | U | 0.15 | U | 0.15 | U | 0.15 | U | 0.15 | U | 0.15 | U |
| | | 1,1-Dichloroethane | µg/L | -- | 811 | nc | 0.11 | U | 0.11 | U | 0.11 | U | 0.11 | U | 0.11 | U | 0.11 | U | 0.11 | U | 0.11 | U |
| | | 1,1-Dichloroethene | µg/L | -- | 339 | nc | 0.12 | U | 0.12 | U | 0.12 | U | 0.12 | U | 0.12 | U | 0.12 | U | 0.12 | U | 0.12 | U |

## Table 4-7
## Summary of Groundwater Results

| | | | | | | | LL9MW-001-0001-GW | | LL9MW-002-0001-GW | | LL9MW-003-0001-GW | | LL9MW-004-0001-GW | | LL9MW-005-0001-GW | | LL9MW-006-0001-GW | | LL9MW-007-0001-DUP | | LL9MW-007-0001-GW | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/17/03 | | 12/16/03 | | 12/16/03 | | 12/17/03 | | 12/17/03 | | 12/16/03 | | 12/15/03 | | 12/15/03 | |
| | | | | | | **Screened Interval** | 10.5-20.5 ft. | | 10-20 ft. | | 11.5-21.5 ft. | | 22-32 ft | | 10-20 ft | | 16-26 ft. | | 8.5-18.5 ft | | 8.5-18.5 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Consolidated Wells Background Criteria** | **Consolidated Wells Region 9 (Tap Water) PRGs** | **C-MW PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| | | 1,2-Dichloroethane | µg/L | -- | 0.12 | ca | 0.09 | U | 0.09 | U | 0.09 | U | 0.09 | U | 0.09 | U | 0.09 | U | 0.09 | U | 0.09 | U |
| | | 1,2-Dichloroethene (total) | µg/L | -- | 120 | nc | 0.23 | U | 0.23 | U | 0.23 | U | 0.23 | U | 0.23 | U | 0.23 | U | 0.23 | U | 0.23 | U |
| | | 1,2-Dichloropropane | µg/L | -- | 0.16 | ca | 0.12 | U | 0.12 | U | 0.12 | U | 0.12 | U | 0.12 | U | 0.12 | U | 0.12 | U | 0.12 | U |
| | | 2-Butanone (MEK) | µg/L | -- | 6968 | nc | 1.2 | U | 1.2 | U | 1.2 | U | 1.2 | U | 1.2 | U | 1.2 | U | 1.2 | U | 1.2 | U |
| | | 2-Hexanone | µg/L | -- | 2000 | nc | 0.53 | U | 0.53 | U | 0.53 | U | 0.53 | U | 0.53 | U | 0.53 | U | 0.53 | U | 0.53 | U |
| | | 4-Methyl-2-pentanone (MIBK) | µg/L | -- | 1993 | nc | 0.65 | U | 0.65 | U | 0.65 | U | 0.65 | U | 0.65 | U | 0.65 | U | 0.65 | U | 0.65 | U |
| | | Acetone | µg/L | -- | 5475 | nc | 1.8 | U | 1.8 | U | 1.8 | U | 1.8 | U | 1.8 | U | 1.8 | U | 1.8 | U | 1.8 | U |
| | | Benzene | µg/L | -- | 0.35 | ca | 0.09 | U | 0.09 | U | 0.09 | U | 0.09 | U | 0.09 | U | 0.09 | U | 0.09 | U | 0.09 | U |
| | | Bromodichloromethane | µg/L | -- | 0.18 | ca | 0.11 | U | 0.11 | U | 0.11 | U | 0.11 | U | 0.11 | U | 0.11 | U | 0.11 | U | 0.11 | U |
| | | Bromoform | µg/L | -- | 8.5 | ca | 0.11 | U | 0.11 | U | 0.11 | U | 0.11 | U | 0.11 | U | 0.11 | U | 0.11 | U | 0.11 | U |
| | | Bromomethane | µg/L | -- | 8.7 | nc | 0.1 | U | 0.1 | U* | 0.1 | U | 0.1 | U | 0.1 | U | 0.1 | U* | 0.1 | U* | 0.1 | U* |
| | | Carbon disulfide | µg/L | -- | 1043 | nc | 0.2 | U | 0.2 | U | 0.2 | U | 0.2 | U | 0.2 | U | 0.2 | U | 0.2 | U | 0.2 | U |
| | | Carbon tetrachloride | µg/L | -- | 0.17 | ca | 0.13 | U | 0.13 | U | 0.13 | U | 0.13 | U | 0.13 | U | 0.13 | U | 0.13 | U | 0.13 | U |
| | | Chlorobenzene | µg/L | -- | 106 | nc | 0.08 | U | 0.08 | U | 0.08 | U | 0.08 | U | 0.08 | U | 0.08 | U | 0.08 | U | 0.08 | U |
| | | Chloroethane | µg/L | -- | 4.6 | ca | 0.08 | U | 0.08 | U | 0.08 | U | 0.08 | U | 0.08 | U | 0.08 | U | 0.08 | U | 0.08 | U |
| | | Chloroform | µg/L | -- | 0.17 | ca | 0.11 | U | 0.11 | U | 0.11 | U | 0.11 | U | 0.11 | U | 0.11 | U | 0.11 | U | 0.11 | U |
| | | Chloromethane | µg/L | -- | 158 | nc | 0.08 | U | 0.08 | U* | 0.08 | U | 0.08 | U | 0.08 | U | 0.08 | U* | 0.08 | U* | 0.08 | U* |
| | | cis-1,3-Dichloropropene | µg/L | -- | 0.40 | ca | 0.12 | U | 0.12 | U | 0.12 | U | 0.12 | U | 0.12 | U | 0.12 | U | 0.12 | U | 0.12 | U |
| | | Dibromochloromethane | µg/L | -- | 0.13 | ca | 0.06 | U | 0.06 | U | 0.06 | U | 0.06 | U | 0.06 | U | 0.06 | U | 0.06 | U | 0.06 | U |
| | | Ethylbenzene | µg/L | -- | 1340 | nc | 0.07 | U | 0.07 | U | 0.07 | U | 0.07 | U | 0.07 | U | 0.07 | U | 0.07 | U | 0.07 | U |
| | | Methylene chloride | µg/L | -- | 4.3 | ca | 0.35 | U | 0.35 | U | 0.35 | U | 0.35 | U | 0.35 | U | 0.35 | U | 0.35 | U | 0.35 | U |
| | | Styrene | µg/L | -- | 1641 | nc | 0.13 | U | 0.13 | U | 0.13 | U | 0.13 | U | 0.13 | U | 0.13 | U | 0.13 | U | 0.13 | U |
| | | Tetrachloroethene | µg/L | -- | 0.10 | ca | 0.09 | U | 0.09 | U | 0.09 | U | 0.09 | U | 0.09 | U | 0.09 | U | 0.09 | U | 0.09 | U |
| | | Toluene | µg/L | -- | 723 | nc | 0.1 | U | 0.1 | U | 0.1 | U | 0.1 | U | 0.1 | U | 0.1 | U | 0.1 | U | 0.1 | U |
| | | trans-1,3-Dichloropropene | µg/L | -- | 0.40 | ca | 0.15 | U | 0.15 | U | 0.15 | U | 0.15 | U | 0.15 | U | 0.15 | U | 0.15 | U | 0.15 | U |
| | | Trichloroethene | µg/L | -- | 0.028 | ca | 0.1 | U | 0.1 | U | 0.1 | U | 0.1 | U | 0.1 | U | 0.1 | U | 0.1 | U | 0.1 | U |
| | | Vinyl chloride | µg/L | -- | 0.020 | ca | 0.08 | U | 0.08 | U | 0.08 | U | 0.08 | U | 0.08 | U | 0.08 | U | 0.08 | U | 0.08 | U |
| | | Xylenes (total) | µg/L | -- | 0.020 | ca | 0.28 | U | 0.28 | U | 0.28 | U | 0.28 | U | 0.28 | U | 0.28 | U | 0.28 | U | 0.28 | U |

**Notes:**

-- - no background/PRG value is available for this analyte
blank cell indicates that the analysis was not performed
PRG - preliminary remediation goals
(The PRG for lead is the Maximum Contaminant Level (MCL)
nc - non-cancer basis
ca - cancer basis
pbk - based on PBK modeling
mcl - based on CWA maximum contaminant level
max - ceiling limit
sat - soil saturation
[n] - nutrient
UC - unconsolidated
If Result = or > Background, then the value is presented with a shaded/highlighted style
If Result = or > Background and PRG, then the value is presented with a bold + shaded/highlighted style
If Result = or > PRG, then the value is presented with a bold style
If Result < PRG and Background, then the value is presented with a normal style

**Inorganic Qualifiers**
U - analyte was not detected at or above the stated limit
J - result is less than the RL, but greater than or equal to the MDL
B - result is less than the CRDL/RL, but greater than or equal to the IDL/MDL
**InOrganic Flags**
^ - instrument related QC exceed the upper or lower control limits
* - batch QC exceeds the upper or lower control limit
H - batch QC is greater than RL
**Organic Qualifiers**
U - analyte was not detected at or above the stated limit
J - result is an estimated value below the RL
**Organic Flags**
B - Method Blank: batch QC is greater than RL
* - batch QC exceeds the upper or lower control limit
^ - batch QC is greater than RL
a - concentration is below the method Reporting Limit (RL)
H - alternate peak selection upon analytical review

## Table 4-8
## Summary of Groundwater Exceedances

| Sample Number | Sample Date | Sample Depth | Analyte | Result | Units | Qualifier | RVAAP Consolidated Wells Background Criteria | Region 9 (Tap Water) PRGs | C-MW PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LL9MW-001-0001-GW | 12/17/2003 | 10.5-20.5 ft | Copper | 2.3 | µg/L | H | 0.00 | 1460 | nc | YES | NO |
| LL9MW-001-0001-GW | 12/17/2003 | 10.5-20.5 ft | Antimony | 3.2 | µg/L |  | 0.00 | 15 | nc | YES | NO |
| LL9MW-002-0001-GW | 12/16/2003 | 10-20 ft. | Nitrocellulose | 0.000089 | µg/L | BJ | 0 | -- | 0 | YES | NO |
| LL9MW-002-0001-GW | 12/16/2003 | 10-20 ft. | Copper | 3.1 | µg/L | B | 0.00 | 1460 | nc | YES | NO |
| LL9MW-002-0001-GW | 12/16/2003 | 10-20 ft. | Antimony | 2.8 | µg/L | B | 0.00 | 15 | nc | YES | NO |
| LL9MW-003-0001-GW | 12/16/2003 | 11.5-21.5 ft. | Nitrocellulose | 0.00014 | µg/L | BJ | 0 | -- | 0 | YES | NO |
| LL9MW-003-0001-GW | 12/16/2003 | 11.5-21.5 ft. | Copper | 2.9 | µg/L | B | 0.00 | 1460 | nc | YES | NO |
| LL9MW-003-0001-GW | 12/16/2003 | 11.5-21.5 ft. | Antimony | 4 | µg/L | B | 0.00 | 15 | nc | YES | NO |
| LL9MW-004-0001-GW | 12/17/2003 | 22-32 ft | Nitrocellulose | 0.00011 | µg/L |  | 0 | -- | 0 | YES | NO |
| LL9MW-004-0001-GW | 12/17/2003 | 22-32 ft | Cobalt | 34 | µg/L |  | 0.00 | 730 | nc | YES | NO |
| LL9MW-004-0001-GW | 12/17/2003 | 22-32 ft | Copper | 14 | µg/L |  | 0.00 | 1460 | nc | YES | NO |
| LL9MW-004-0001-GW | 12/17/2003 | 22-32 ft | Iron | 5700 | µg/L |  | 1430 | 10950 | nc | YES | NO |
| LL9MW-004-0001-GW | 12/17/2003 | 22-32 ft | Manganese | 2400 | µg/L |  | 1340 | 876 | nc | YES | YES |
| LL9MW-005-0001-GW | 12/17/2003 | 10-20 ft | Nitrocellulose | 0.00011 | µg/L | BJ | 0 | -- | 0 | YES | NO |
| LL9MW-005-0001-GW | 12/17/2003 | 10-20 ft | Copper | 2.8 | µg/L | B | 0.00 | 1460 | nc | YES | NO |
| LL9MW-006-0001-GW | 12/16/2003 | 16-26 ft. | Copper | 4.2 | µg/L | B | 0.00 | 1460 | nc | YES | NO |
| LL9MW-006-0001-GW | 12/16/2003 | 16-26 ft. | Antimony | 2.5 | µg/L | B | 0.00 | 15 | nc | YES | NO |
| LL9MW-007-0001-DUP | 12/15/2003 | 8.5-18.5 ft | Nitrocellulose | 0.0001 | µg/L | BJ | 0 | -- | 0 | YES | NO |
| LL9MW-007-0001-DUP | 12/15/2003 | 8.5-18.5 ft | Cobalt | 13 | µg/L |  | 0.00 | 730 | nc | YES | NO |
| LL9MW-007-0001-DUP | 12/15/2003 | 8.5-18.5 ft | Copper | 4.4 | µg/L | B | 0.00 | 1460 | nc | YES | NO |
| LL9MW-007-0001-DUP | 12/15/2003 | 8.5-18.5 ft | Iron | 6600 | µg/L |  | 1430 | 10950 | nc | YES | NO |
| LL9MW-007-0001-DUP | 12/15/2003 | 8.5-18.5 ft | Manganese | 880 | µg/L |  | 1340 | 876 | nc | NO | YES |
| LL9MW-007-0001-GW | 12/15/2003 | 8.5-18.5 ft | Nitrocellulose | 0.00012 | µg/L | BJ | 0 | -- | 0 | YES | NO |
| LL9MW-007-0001-GW | 12/15/2003 | 8.5-18.5 ft | Cobalt | 11 | µg/L |  | 0.00 | 730 | nc | YES | NO |
| LL9MW-007-0001-GW | 12/15/2003 | 8.5-18.5 ft | Copper | 5 | µg/L | B | 0.00 | 1460 | nc | YES | NO |
| LL9MW-007-0001-GW | 12/15/2003 | 8.5-18.5 ft | Iron | 7100 | µg/L |  | 1430 | 10950 | nc | YES | NO |
| LL9MW-007-0001-GW | 12/15/2003 | 8.5-18.5 ft | Manganese | 900 | µg/L |  | 1340 | 876 | nc | NO | YES |
| LL9MW-007-0001-GW | 12/15/2003 | 8.5-18.5 ft | Antimony | 3 | µg/L | B | 0.00 | 15 | nc | YES | NO |

**Notes:**

-- - no background/PRG value is available for this analyte
blank cell indicates that the analyte was a non-detect (with a "U" qualifier) or analysis was not performed
PRG - preliminary remediation goals (The PRG for lead is the Maximum Contaminant Level (MCL)
nc - non-cancer basis
ca - cancer basis

**Inorganic Qualifiers**
U - analyte was not detected at or above the stated limit
J - result is less than the RL, but greater than or equal to the MDL
B - result is less than the CRDL/RL, but greater than or equal to the IDL/MDL

**Organic Qualifiers**
U - analyte was not detected at or above the stated limit
J - result is an estimated value below the RL

## Table 4-9
## Azide Screening Surface Water Sample Results Summary

| ANALYTE**, UNITS, METHOD NO. | RVAAP Surface Water Background Criteria ug/L | Region 9 PRG Data (Tap Water) | LL9SW-001-0001-SW | LL9SW-005-0001-SW | LL9SW-007-0001-SW | LL9SW-008-0001-SW | LL9SW-008-0001-FD |
|---|---|---|---|---|---|---|---|
| **Sample Date** | | | 3/12/2002 | 3/13/2002 | 3/12/2002 | 3/13/2002 | 3/13/2002 |
| **Explosives 8330 ug/L** | | | | | | | |
| **HMX** | 0.0 | 1825 nc | 0.55 U | 0.65 U | 0.44 U | 0.70 U | 0.57 U |
| **RDX** | 0.0 | 0.61 ca | 0.23 U | 0.27 U | 0.18 U | 0.29 U | 0.23 U |
| **1,3,5-Trinitrotoluene** | 0.0 | 1095 nc | 0.23 U | 0.27 U | 0.18 U | 0.29 U | 0.23 U |
| **1,3-Dinitrobenzene** | 0.0 | 3.6 nc | 0.23 U | 0.27 U | 0.18 U | 0.29 U | 0.23 U |
| **Nitrobenzene** | 0.0 | 3.4 nc | 0.23 U | 0.27 U | 0.18 U | 0.29 U | 0.23 U |
| **2,4,6-Trinitrtoluene** | 0.0 | 2.2 ca | 0.23 U | 0.27 U | 0.18 U | 0.29 U | 0.23 U |
| **Tetryl** | 0.0 | 365 nc | 0.44 U | 0.52 U | 0.35 U | 0.55 U | 0.45 U |
| **2,4-Dinitrotoluene** | 0.0 | 73 nc | 0.23 U | 0.27 U | 0.18 U | 0.29 U | 0.23 U |
| **2,6-Dinitrotoluene** | 0.0 | 36 nc | 0.44 U | 0.52 U | 0.35 U | 0.55 U | 0.45 U |
| **2-Nitrotoluene** | 0.0 | 0.049 ca | 0.44 U | 0.52 U | 0.35 U | 0.55 U | 0.45 U |
| **4-Nitrtoluene** | 0.0 | 0.66 ca | 1.1 U | 1.3 U | 0.88 U | 1.4 U | 1.1 U |
| **3-Nitrotoluene** | 0.0 | 122 nc | 0.44 U | 0.52 U | 0.35 U | 0.55 U | 0.45 U |
| | | | | | | | |
| **TAL Metals 6010B ug/L** | | | | | | | |
| **Antimony** | 0.0 | 15 nc | 3.0 U | 3.0 U | 3.0 U | 3.2 | 3.0 U |
| **Arsenic** | 3.2 | 0.045 ca | 2.0 U | **8.0** | **351** | **3.3** | 2.0 U |
| **Lead** | 0.0 | 15 mcl | 2.0 U | **62.9** | **2000** | **3150** | **432.0** |
| **Thallium** | 0.0 | 2.4 nc | 2.0 U | 2.0 U | 2.0 U | 2.0 U | 2.0 U |
| **Mercury** | 0.0 | 11 nc | 0.20 U | 0.37 | **21.9** | 7.7 | 0.61 |
| **Aluminum** | 3370 | 36499 nc | 339 | 17800 | 3030 | 1610 | 243 |
| **Barium** | 47.5 | 2555 nc | 21.4 | 145 | 208.0 | 211 | 93.9 |
| **Beryllium** | 0.0 | 73 nc | 4.0 U | 0.70 (B) | 4.0 U | 4.0 U | 4.0 U |
| **Cadmium** | 0.0 | 18 nc | 2.0 U | 1.1 (B) | 1.8 (B) | 1.0 (B) | 2.0 U |
| **Calcium** | 41400 | -- [n] | 9830 (H) | 13900 (H) | 46200 (H) | 75200 (H) | 62700 (H) |
| **Chromium** | 0.0 | 109 nc | 10.0 U | 20.2 | 48.8 | 27.1 | 10.0 U |
| **Cobalt** | 0.0 | 730 nc | 5.0 U | 6.0 | 5.9 | 6.0 | 5.0 U |
| **Copper** | 7.9 | 1460 nc | 10.0 U | 18.6 | 193 | 31 | 4.4 (B) |
| **Iron** | 2560.0 | 10950 nc | 249 | **18900** | **17900** | **16100** | 3380 |
| **Magnesium** | 10800.0 | -- [n] | 2110 | 5360 | 2770 | 12600 | 3550 |
| **Manganese** | 391 | 876 nc | 10.1 | 633 | **1740** | 802 | 271 |
| **Nickel** | 0.0 | 730 nc | 10.0 U | 20.1 | 58.2 | 86.7 | 10.9 |
| **Potassium** | 3170 | -- [n] | 798 | 3900 | 8320 | 14700 | 12700 |

## Table 4-9
## Azide Screening Surface Water Sample Results Summary

| ANALYTE**, UNITS, METHOD NO. | RVAAP Surface Water Background Criteria ug/L | Region 9 PRG Data (Tap Water) | LL9SW-001-0001-SW | LL9SW-005-0001-SW | LL9SW-007-0001-SW | LL9SW-008-0001-SW | LL9SW-008-0001-FD |
|---|---|---|---|---|---|---|---|
| **Sample Date** | | | 3/12/2002 | 3/13/2002 | 3/12/2002 | 3/13/2002 | 3/13/2002 |
| **Selenium** | 0 | 182 nc | 10. 0 U | 10. 0 U | 10.0 U | 10.0 U | 10.0 U |
| **Silver** | 0 | 182 nc | 5. 0 U | 10.0 U | 5.0 U | 5.0 U | 5.0 U |
| **Sodium** | 21300 | -- [n] | 966 (B) | 1350 | 1470 | 2970 | 2410 |
| **Vanadium** | 0.0 | 36 nc | 5. 0 U | 31.9 | 9.9 | 4.3 (B) | 5.0 U |
| **Zinc** | 42 | 10950 nc | 32.4 | 228 | 251 | 214 | 33.0 |
| | | | | | | | |
| **Total Organic Carbon** | | | | | | | |
| **Organic Carbon** | | | | | | | |
| | | | | | | | |

PRGs - Preliminary Remediation Goals
nc - non-cancer basis, value is 1/10 the published PRG
ca - cancer basis
pbk - based on PBK modeling
[n] - nutrient
U - analyte not detected
NT - not tested
If Result = or > Background, then the value is presented with a shaded/highlighted style
If Result = or > Background & PRG, then the value is presented with a bold + shaded/highlighted style
If Result = or > PRG, then the value is presented with a bold style
If Result < PRG & Background, then the value is presented with a normal style
-- - no background/PRG value is available for this analyte

**INORGANIC FLAGS/QUALIFIERS**

B - result is < CRDL/RL, but ≥ IDL/MDL
H - MB, EB1, EB2, EB3: Batch QC is > RL or had a negative instrument reading lower than the absolute value of the RL

**ORGANIC FLAGS/QUALIFIERS**

J - Result is an estimated value below the RL or a TIC
a - Concentration is below the method RL

# Table 4-10
## Summary of Surface Water Exceedances

| Sample Number | Sample Date | Sample Depth | Analyte | Result (ug/l) | Units | Qualifier | Surface Water Background Criteria | Surface Water Region 9 Criteria | SW PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LL9SW-002-0001-SW | 12/05/03 | 0 | Arsenic | 4.3 | µg/L |  | 3.2 | 0.045 | ca | YES | YES |
| LL9SW-002-0001-SW | 12/05/03 | 0 | Barium | 60 | µg/L |  | 47.5 | 2555 | nc | YES | NO |
| LL9SW-002-0001-SW | 12/05/03 | 0 | Beryllium | 0.26 | µg/L | B | 0 | 73 | nc | YES | NO |
| LL9SW-002-0001-SW | 12/05/03 | 0 | Chromium | 3.3 | µg/L | B | 0 | 109 | nc | YES | NO |
| LL9SW-002-0001-SW | 12/05/03 | 0 | Cobalt | 4.6 | µg/L | B | 0 | 730 | nc | YES | NO |
| LL9SW-002-0001-SW | 12/05/03 | 0 | Iron | 20000 | µg/L |  | 2560 | 10950 | nc | YES | YES |
| LL9SW-002-0001-SW | 12/05/03 | 0 | Lead | 8.9 | µg/L |  | 0 | 15 | mcl | YES | NO |
| LL9SW-002-0001-SW | 12/05/03 | 0 | Manganese | 1200 | µg/L |  | 391 | 876 | nc | YES | YES |
| LL9SW-002-0001-SW | 12/05/03 | 0 | Mercury | 0.065 | µg/L | B | 0 | 11 | nc | YES | NO |
| LL9SW-002-0001-SW | 12/05/03 | 0 | Nickel | 11 | µg/L |  | 0 | 730 | nc | YES | NO |
| LL9SW-003-0001-SW | 12/05/03 | 0 | Aluminum | 12000 | µg/L |  | 3370 | 36499 | nc | YES | NO |
| LL9SW-003-0001-SW | 12/05/03 | 0 | Arsenic | 9.9 | µg/L |  | 3.2 | 0.045 | ca | YES | YES |
| LL9SW-003-0001-SW | 12/05/03 | 0 | Barium | 130 | µg/L |  | 47.5 | 2555 | nc | YES | NO |
| LL9SW-003-0001-SW | 12/05/03 | 0 | Beryllium | 0.3 | µg/L | B | 0 | 73 | nc | YES | NO |
| LL9SW-003-0001-SW | 12/05/03 | 0 | Calcium | 61000 | µg/L |  | 41400 | --[n] | 0 | YES | NO |
| LL9SW-003-0001-SW | 12/05/03 | 0 | Chromium | 14 | µg/L |  | 0 | 109 | nc | YES | NO |
| LL9SW-003-0001-SW | 12/05/03 | 0 | Cobalt | 8 | µg/L |  | 0 | 730 | nc | YES | NO |
| LL9SW-003-0001-SW | 12/05/03 | 0 | Copper | 20 | µg/L |  | 7.9 | 1460 | nc | YES | NO |
| LL9SW-003-0001-SW | 12/05/03 | 0 | Iron | 17000 | µg/L |  | 2560 | 10950 | nc | YES | YES |
| LL9SW-003-0001-SW | 12/05/03 | 0 | Lead | 70 | µg/L |  | 0 | 15 | mcl | YES | YES |
| LL9SW-003-0001-SW | 12/05/03 | 0 | Manganese | 1400 | µg/L |  | 391 | 876 | nc | YES | YES |
| LL9SW-003-0001-SW | 12/05/03 | 0 | Mercury | 0.39 | µg/L |  | 0 | 11 | nc | YES | NO |
| LL9SW-003-0001-SW | 12/05/03 | 0 | Nickel | 15 | µg/L |  | 0 | 730 | nc | YES | NO |
| LL9SW-003-0001-SW | 12/05/03 | 0 | Potassium | 5200 | µg/L |  | 3170 | --[n] | 0 | YES | NO |
| LL9SW-003-0001-SW | 12/05/03 | 0 | Vanadium | 19 | µg/L |  | 0 | 36 | nc | YES | NO |
| LL9SW-003-0001-SW | 12/05/03 | 0 | Zinc | 190 | µg/L |  | 42 | 10950 | nc | YES | NO |
| LL9SW-004-0001-SW | 12/05/03 | 0 | Arsenic | 1.9 | µg/L | B | 3.2 | 0.045 | ca | NO | YES |
| LL9SW-004-0001-SW | 12/05/03 | 0 | Chromium | 3.8 | µg/L | B | 0 | 109 | nc | YES | NO |
| LL9SW-004-0001-SW | 12/05/03 | 0 | Cobalt | 1.2 | µg/L | B | 0 | 730 | nc | YES | NO |
| LL9SW-004-0001-SW | 12/05/03 | 0 | Iron | 3200 | µg/L |  | 2560 | 10950 | nc | YES | NO |
| LL9SW-004-0001-SW | 12/05/03 | 0 | Lead | 8.7 | µg/L |  | 0 | 15 | mcl | YES | NO |
| LL9SW-004-0001-SW | 12/05/03 | 0 | Manganese | 470 | µg/L |  | 391 | 876 | nc | YES | NO |
| LL9SW-004-0001-SW | 12/05/03 | 0 | Mercury | 0.12 | µg/L | B | 0 | 11 | nc | YES | NO |
| LL9SW-004-0001-SW | 12/05/03 | 0 | Nickel | 4 | µg/L | B | 0 | 730 | nc | YES | NO |
| LL9SW-004-0001-SW | 12/05/03 | 0 | Vanadium | 4.9 | µg/L | B | 0 | 36 | nc | YES | NO |
| LL9SW-005-0001-SW | 3/13/2002 | 0 | Aluminum | 17800 | µg/L |  | 3370 | 36499 | NC | YES | NO |
| LL9SW-005-0001-SW | 3/13/2002 | 0 | Arsenic | 8 | µg/L |  | 3.2 | 0.045 | CA | YES | YES |
| LL9SW-005-0001-SW | 3/13/2002 | 0 | Barium | 145 | µg/L |  | 47.5 | 2555 | NC | YES | NO |
| LL9SW-005-0001-SW | 3/13/2002 | 0 | Beryllium | 0.7 | µg/L | B | 0 | 73 | NC | YES | NO |

# Table 4-10
## Summary of Surface Water Exceedances

| Sample Number | Sample Date | Sample Depth | Analyte | Result (ug/l) | Units | Qualifier | Surface Water Background Criteria | Surface Water Region 9 Criteria | SW PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LL9SW-005-0001-SW | 3/13/2002 | 0 | Cadmium | 1.1 | µg/L | B | 0 | 18 | NC | YES | NO |
| LL9SW-005-0001-SW | 3/13/2002 | 0 | Chromium | 20.2 | µg/L |  | 0 | 109 | NC | YES | NO |
| LL9SW-005-0001-SW | 3/13/2002 | 0 | Cobalt | 6 | µg/L |  | 0 | 730 | NC | YES | NO |
| LL9SW-005-0001-SW | 3/13/2002 | 0 | Copper | 18.6 | µg/L |  | 7.9 | 1460 | NC | YES | NO |
| LL9SW-005-0001-SW | 3/13/2002 | 0 | Iron | 18900 | µg/L |  | 2560 | 10950 | NC | YES | YES |
| LL9SW-005-0001-SW | 3/13/2002 | 0 | Lead | 62.9 | µg/L |  | 0 | 15 | MCL | YES | YES |
| LL9SW-005-0001-SW | 3/13/2002 | 0 | Manganese | 633 | µg/L |  | 391 | 876 | NC | YES | NO |
| LL9SW-005-0001-SW | 3/13/2002 | 0 | Mercury | 0.37 | µg/L |  | 0 | 11 | NC | YES | NO |
| LL9SW-005-0001-SW | 3/13/2002 | 0 | Nickel | 20.1 | µg/L |  | 0 | 730 | NC | YES | NO |
| LL9SW-005-0001-SW | 3/13/2002 | 0 | Potassium | 3900 | µg/L |  | 3170 | -- | [n] | YES | NO |
| LL9SW-005-0001-SW | 3/13/2002 | 0 | Vanadium | 31.9 | µg/L |  | 0 | 36 | NC | YES | NO |
| LL9SW-005-0001-SW | 3/13/2002 | 0 | Zinc | 228 | µg/L |  | 42 | 10950 | NC | YES | NO |
| LL9SW-007-0001-SW | 3/12/2002 | 0 | Arsenic | 351 | µg/L |  | 3.2 | 0.045 | CA | YES | YES |
| LL9SW-007-0001-SW | 3/12/2002 | 0 | Barium | 208 | µg/L |  | 47.5 | 2555 | NC | YES | NO |
| LL9SW-007-0001-SW | 3/12/2002 | 0 | Cadmium | 1.8 | µg/L | B | 0 | 18 | NC | YES | NO |
| LL9SW-007-0001-SW | 3/12/2002 | 0 | Calcium | 46200 | µg/L | H | 41400 | -- | [n] | YES | NO |
| LL9SW-007-0001-SW | 3/12/2002 | 0 | Chromium | 48.8 | µg/L |  | 0 | 109 | NC | YES | NO |
| LL9SW-007-0001-SW | 3/12/2002 | 0 | Cobalt | 5.9 | µg/L |  | 0 | 730 | NC | YES | NO |
| LL9SW-007-0001-SW | 3/12/2002 | 0 | Copper | 193 | µg/L |  | 7.9 | 1460 | NC | YES | NO |
| LL9SW-007-0001-SW | 3/12/2002 | 0 | Iron | 17900 | µg/L |  | 2560 | 10950 | NC | YES | YES |
| LL9SW-007-0001-SW | 3/12/2002 | 0 | Lead | 2000 | µg/L |  | 0 | 15 | MCL | YES | YES |
| LL9SW-007-0001-SW | 3/12/2002 | 0 | Manganese | 1740 | µg/L |  | 391 | 876 | NC | YES | YES |
| LL9SW-007-0001-SW | 3/12/2002 | 0 | Mercury | 21.9 | µg/L |  | 0 | 11 | NC | YES | YES |
| LL9SW-007-0001-SW | 3/12/2002 | 0 | Nickel | 58.2 | µg/L |  | 0 | 730 | NC | YES | NO |
| LL9SW-007-0001-SW | 3/12/2002 | 0 | Potassium | 8320 | µg/L |  | 3170 | -- | [n] | YES | NO |
| LL9SW-007-0001-SW | 3/12/2002 | 0 | Vanadium | 9.9 | µg/L |  | 0 | 36 | NC | YES | NO |
| LL9SW-007-0001-SW | 3/12/2002 | 0 | Zinc | 251 | µg/L |  | 42 | 10950 | NC | YES | NO |
| LL9SW-008-0001-FD | 3/13/2002 | 0 | 4-Nitrtoluene | 1.1 | µg/L |  | 0 | 0.66 | CA | YES | YES |
| LL9SW-008-0001-FD | 3/13/2002 | 0 | Barium | 93.9 | µg/L |  | 47.5 | 2555 | NC | YES | NO |
| LL9SW-008-0001-FD | 3/13/2002 | 0 | Calcium | 62700 | µg/L | H | 41400 | -- | [n] | YES | NO |
| LL9SW-008-0001-FD | 3/13/2002 | 0 | Iron | 3380 | µg/L |  | 2560 | 10950 | NC | YES | NO |
| LL9SW-008-0001-FD | 3/13/2002 | 0 | Lead | 432 | µg/L |  | 0 | 15 | MCL | YES | YES |
| LL9SW-008-0001-FD | 3/13/2002 | 0 | Mercury | 0.61 | µg/L |  | 0 | 11 | NC | YES | NO |
| LL9SW-008-0001-FD | 3/13/2002 | 0 | Nickel | 10.9 | µg/L |  | 0 | 730 | NC | YES | NO |
| LL9SW-008-0001-FD | 3/13/2002 | 0 | Potassium | 12700 | µg/L |  | 3170 | -- | [n] | YES | NO |
| LL9SW-008-0001-SW | 3/13/2002 | 0 | Antimony | 3.2 | µg/L |  | 0 | 15 | NC | YES | NO |
| LL9SW-008-0001-SW | 3/13/2002 | 0 | Arsenic | 3.3 | µg/L |  | 3.2 | 0.045 | CA | YES | YES |
| LL9SW-008-0001-SW | 3/13/2002 | 0 | Barium | 211 | µg/L |  | 47.5 | 2555 | NC | YES | NO |
| LL9SW-008-0001-SW | 3/13/2002 | 0 | Cadmium | 1 | µg/L | B | 0 | 18 | NC | YES | NO |

## Table 4-10
## Summary of Surface Water Exceedances

| Sample Number | Sample Date | Sample Depth | Analyte | Result (ug/l) | Units | Qualifier | Surface Water Background Criteria | Surface Water Region 9 Criteria | SW PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LL9SW-008-0001-SW | 3/13/2002 | 0 | Calcium | 75200 | µg/L | H | 41400 | -- | [n] | YES | NO |
| LL9SW-008-0001-SW | 3/13/2002 | 0 | Chromium | 27.1 | µg/L |  | 0 | 109 | NC | YES | NO |
| LL9SW-008-0001-SW | 3/13/2002 | 0 | Cobalt | 6 | µg/L |  | 0 | 730 | NC | YES | NO |
| LL9SW-008-0001-SW | 3/13/2002 | 0 | Copper | 31 | µg/L |  | 7.9 | 1460 | NC | YES | NO |
| LL9SW-008-0001-SW | 3/13/2002 | 0 | Iron | 16100 | µg/L |  | 2560 | 10950 | NC | YES | YES |
| LL9SW-008-0001-SW | 3/13/2002 | 0 | Lead | 3150 | µg/L |  | 0 | 15 | MCL | YES | YES |
| LL9SW-008-0001-SW | 3/13/2002 | 0 | Magnesium | 12600 | µg/L |  | 10800 | -- | [n] | YES | NO |
| LL9SW-008-0001-SW | 3/13/2002 | 0 | Manganese | 802 | µg/L |  | 391 | 876 | NC | YES | NO |
| LL9SW-008-0001-SW | 3/13/2002 | 0 | Mercury | 7.7 | µg/L |  | 0 | 11 | NC | YES | NO |
| LL9SW-008-0001-SW | 3/13/2002 | 0 | Nickel | 86.7 | µg/L |  | 0 | 730 | NC | YES | NO |
| LL9SW-008-0001-SW | 3/13/2002 | 0 | Potassium | 14700 | µg/L |  | 3170 | -- | [n] | YES | NO |
| LL9SW-008-0001-SW | 3/13/2002 | 0 | Vanadium | 4.3 | µg/L | B | 0 | 36 | NC | YES | NO |
| LL9SW-008-0001-SW | 3/13/2002 | 0 | Zinc | 214 | µg/L |  | 42 | 10950 | NC | YES | NO |
| LL9SW-009-0001-SW | 12/09/03 | 0 | Arsenic | 2.2 | µg/L |  | 3.2 | 0.045 | ca | NO | YES |
| LL9SW-009-0001-SW | 12/09/03 | 0 | Barium | 51 | µg/L |  | 47.5 | 2555 | nc | YES | NO |
| LL9SW-009-0001-SW | 12/09/03 | 0 | Calcium | 82000 | µg/L |  | 41400 | --[n] | 0 | YES | NO |
| LL9SW-009-0001-SW | 12/09/03 | 0 | Chromium | 3.7 | µg/L | B | 0 | 109 | nc | YES | NO |
| LL9SW-009-0001-SW | 12/09/03 | 0 | Iron | 4900 | µg/L |  | 2560 | 10950 | nc | YES | NO |
| LL9SW-009-0001-SW | 12/09/03 | 0 | Lead | 36 | µg/L |  | 0 | 15 | mcl | YES | YES |
| LL9SW-009-0001-SW | 12/09/03 | 0 | Mercury | 0.33 | µg/L |  | 0 | 11 | nc | YES | NO |
| LL9SW-009-0001-SW | 12/09/03 | 0 | Nickel | 4.5 | µg/L | B | 0 | 730 | nc | YES | NO |
| LL9SW-009-0001-SW | 12/09/03 | 0 | Potassium | 4400 | µg/L |  | 3170 | --[n] | 0 | YES | NO |
| LL9SW-009-0001-SW | 12/09/03 | 0 | Vanadium | 3 | µg/L | B | 0 | 36 | nc | YES | NO |
| LL9SW-009-0001-SW | 12/09/03 | 0 | Zinc | 55 | µg/L |  | 42 | 10950 | nc | YES | NO |
| LL9SW-010-0001-SW | 12/09/03 | 0 | Arsenic | 0.82 | µg/L | B | 3.2 | 0.045 | ca | NO | YES |
| LL9SW-010-0001-SW | 12/09/03 | 0 | Chromium | 2.3 | µg/L | B | 0 | 109 | nc | YES | NO |
| LL9SW-010-0001-SW | 12/09/03 | 0 | Lead | 46 | µg/L |  | 0 | 15 | mcl | YES | YES |
| LL9SW-010-0001-SW | 12/09/03 | 0 | Mercury | 2.2 | µg/L |  | 0 | 11 | nc | YES | NO |
| LL9SW-010-0001-SW | 12/09/03 | 0 | Nickel | 6.9 | µg/L | B | 0 | 730 | nc | YES | NO |
| LL9SW-012-0001-DUP | 12/09/03 | 0 | Lead | 1.2 | µg/L | B | 0 | 15 | mcl | YES | NO |
| LL9SW-012-0001-DUP | 12/09/03 | 0 | Mercury | 1.7 | µg/L |  | 0 | 11 | nc | YES | NO |
| LL9SW-012-0001-DUP | 12/09/03 | 0 | Nickel | 4.8 | µg/L | B | 0 | 730 | nc | YES | NO |
| LL9SW-012-0001-DUP | 12/09/03 | 0 | Nitrocellulose | 0.0001 | µg/L | B J | 0 | -- | 0 | YES | NO |
| LL9SW-012-0001-SW | 12/09/03 | 0 | Lead | 1.4 | µg/L | B | 0 | 15 | mcl | YES | NO |
| LL9SW-012-0001-SW | 12/09/03 | 0 | Mercury | 0.3 | µg/L |  | 0 | 11 | nc | YES | NO |
| LL9SW-012-0001-SW | 12/09/03 | 0 | Nickel | 5.3 | µg/L | B | 0 | 730 | nc | YES | NO |
| LL9SW-012-0001-SW | 12/09/03 | 0 | Nitrocellulose | 0.00012 | µg/L | B J | 0 | -- | 0 | YES | NO |
| LL9SW-012-0001-SW | 12/09/03 | 0 | Nitroglycerin | 4.9 | µg/L |  | 0 | -- | 0 | YES | NO |
| LL9SW-012-0001-SW | 12/09/03 | 0 | Nitroglycerin | 5.02 | µg/L |  | 0 | -- | 0 | YES | NO |

## Table 4-10
## Summary of Surface Water Exceedances

| Sample Number | Sample Date | Sample Depth | Analyte | Result (ug/l) | Units | Qualifier | Surface Water Background Criteria | Surface Water Region 9 Criteria | SW PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LL9SW-012-0001-SW | 12/09/03 | 0 | Nitroguanidine | 249 | µg/L | | 0 | 3650 | nc | YES | NO |
| LL9SW-012-0001-SW | 12/09/03 | 0 | Nitroguanidine | 271 | µg/L | | 0 | 3650 | nc | YES | NO |
| LL9SW-012-0001-SW | 12/09/03 | 0 | Thallium | 1.97 | µg/L | B | 0 | 2.4 | nc | YES | NO |

**Notes:**
-- - no background/PRG value is available for this analyte
PRG - preliminary remediation goals (The PRG for lead is the Maximum Contaminant Level (MCL)
nc - non-cancer basis
ca - cancer basis
mcl - based on CWA maximum contaminant level
max - ceiling limit
[n] - nutrient
**Inorganic Qualifiers**
J - result is less than the RL, but greater than or equal to the MDL
B - result is less than the CRDL/RL, but greater than or equal to the IDL/MDL
**InOrganic Flags**
^ - instrument related QC exceed the upper or lower control limits
* - batch QC exceeds the upper or lower control limit
H - batch QC is greater than RL
**Organic Qualifiers**
J - result is an estimated value below the RL
**Organic Flags**
B - Method Blank: batch QC is greater than RL
* - batch QC exceeds the upper or lower control limit
^ - batch QC is greater than RL
a - concentration is below the method Reporting Limit (RL)
H - alternate peak selection upon analytical review

## Table 4-11
## Summary of Surface Water Results

| | | | | | | | LL9SW-002-0001-SW | | LL9SW-003-0001-SW | | LL9SW-004-0001-SW | | LL9SW-009-0001-SW | | LL9SW-010-0001-SW | | LL9SW-012-0001-DUP | | LL9SW-012-0001-SW | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/05/03 | | 12/05/03 | | 12/05/03 | | 12/09/03 | | 12/09/03 | | 12/09/03 | | 12/09/03 | |
| | | | | | | **Sample Depth** | Surface | | Surface | | Surface | | Surface | | Surface | | Surface | | Surface | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Surface Water Background Criteria** | **Region 9 (Tap Water) PRGs** | **SW PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| Cyanide 9012A | 9014/9010B | Cyanide, Total | µg/L | 0.00 | 730 | nc | 4.4 | U | 4.4 | U | 4.4 | U | 4.4 | U | 4.4 | U | 4.4 | U | 4.4 | U |
| Explosives 8330 | 8330 | 1,3,5-Trinitrobenzene | µg/L | 0 | 1095 | nc | 0.11 | U | 0.087 | U | 0.087 | U | 0.08 | U | 0.08 | U | 0.11 | U | 0.12 | U |
| | | 1,3-Dinitrobenzene | µg/L | 0 | 3.6 | nc | 0.072 | U | 0.057 | U | 0.057 | U | 0.053 | U | 0.053 | U | 0.07 | U | 0.081 | U |
| | | 2,4,6-TNT | µg/L | 0 | 2.2 | ca | 0.092 | U | 0.074 | U | 0.074 | U | 0.068 | U | 0.068 | U | 0.09 | U | 0.1 | U |
| | | 2,4-Dinitrotoluene | µg/L | 0 | 73 | nc | 0.057 | U | 0.046 | U | 0.046 | U | 0.042 | U | 0.042 | U | 0.055 | U | 0.064 | U |
| | | 2,6-Dinitrotoluene | µg/L | 0 | 36 | nc | 0.28 | U | 0.22 | U | 0.22 | U | 0.21 | U | 0.21 | U | 0.27 | U | 0.32 | U |
| | | 2-Nitrotoluene | µg/L | 0 | 0.049 | ca | 0.22 | U | 0.18 | U | 0.18 | U | 0.16 | U | 0.16 | U | 0.21 | U | 0.25 | U |
| | | 3-Nitrotoluene | µg/L | 0 | 122 | nc | 0.14 | U | 0.11 | U | 0.11 | U | 0.1 | U | 0.1 | U | 0.13 | U | 0.16 | U |
| | | 4-Nitrotoluene | µg/L | 0 | 0.66 | ca | 0.45 | U | 0.37 | U | 0.37 | U | 0.34 | U | 0.34 | U | 0.44 | U | 0.52 | U |
| | | HMX | µg/L | 0 | 1825 | nc | 0.3 | U | 0.24 | U | 0.24 | U | 0.22 | U | 0.22 | U | 0.3 | U | 0.35 | U |
| | | Nitrobenzene | µg/L | 0 | 3.4 | nc | 0.12 | U | 0.1 | U | 0.1 | U | 0.092 | U | 0.092 | U | 0.12 | U | 0.14 | U |
| | | RDX | µg/L | 0 | 0.61 | ca | 0.18 | U | 0.14 | U | 0.14 | U | 0.13 | U | 0.13 | U | 0.18 | U | 0.2 | U |
| | | Tetryl | µg/L | 0 | 365 | nc | 0.29 | U | 0.24 | U | 0.24 | U | 0.22 | U | 0.22 | U | 0.29 | U | 0.33 | U |
| PCB TCL 8082 | 8082 | Aroclor 1016 | µg/L | -- | 0.96 | ca | | | | | | | | | | | 0.17 | U | 0.17 | U |
| | | Aroclor 1221 | µg/L | -- | 0.034 | ca | | | | | | | | | | | 0.45 | U | 0.45 | U |
| | | Aroclor 1232 | µg/L | -- | 0.034 | ca | | | | | | | | | | | 0.21 | U | 0.22 | U |
| | | Aroclor 1242 | µg/L | -- | 0.034 | ca | | | | | | | | | | | 0.18 | U | 0.19 | U |
| | | Aroclor 1248 | µg/L | -- | 0.034 | ca | | | | | | | | | | | 0.2 | U | 0.21 | U |
| | | Aroclor 1254 | µg/L | -- | 0.034 | ca | | | | | | | | | | | 0.13 | U | 0.13 | U |
| | | Aroclor 1260 | µg/L | -- | 0.034 | ca | | | | | | | | | | | 0.15 | U | 0.15 | U |
| Pesticides 8081A | 8081A | 4,4'-DDD | µg/L | -- | 0.28 | ca | | | | | | | | | | | 0.035 | U | 0.035 | U |
| | | 4,4'-DDE | µg/L | -- | 0.20 | ca | | | | | | | | | | | 0.022 | U | 0.023 | U |
| | | 4,4'-DDT | µg/L | -- | 0.20 | ca | | | | | | | | | | | 0.048 | U | 0.048 | U |
| | | Aldrin | µg/L | -- | 0.0040 | ca | | | | | | | | | | | 0.027 | U | 0.027 | U |
| | | alpha-BHC | µg/L | -- | 0.011 | nc | | | | | | | | | | | 0.046 | U | 0.046 | U |
| | | alpha-Chlordane | µg/L | -- | 0.19 | ca | | | | | | | | | | | 0.016 | U | 0.016 | U |
| | | beta-BHC | µg/L | -- | 0.037 | ca | | | | | | | | | | | 0.027 | U | 0.027 | U |
| | | delta-BHC | µg/L | -- | -- | 0 | | | | | | | | | | | 0.024 | U | 0.025 | U |
| | | Dieldrin | µg/L | -- | 0.0042 | ca | | | | | | | | | | | 0.017 | U | 0.018 | U |
| | | Endosulfan I | µg/L | -- | 220 | nc | | | | | | | | | | | 0.02 | U | 0.021 | U |
| | | Endosulfan II | µg/L | -- | 220 | nc | | | | | | | | | | | 0.041 | U | 0.041 | U |
| | | Endosulfan sulfate | µg/L | -- | 220 | nc | | | | | | | | | | | 0.043 | U | 0.043 | U |
| | | Endrin | µg/L | -- | 11 | nc | | | | | | | | | | | 0.017 | U | 0.017 | U |
| | | Endrin aldehyde | µg/L | -- | -- | 0 | | | | | | | | | | | 0.034 | U | 0.034 | U |
| | | Endrin ketone | µg/L | -- | -- | 0 | | | | | | | | | | | 0.028 | U | 0.028 | U |
| | | gamma-BHC (Lindane) | µg/L | -- | 0.052 | ca | | | | | | | | | | | 0.041 | U | 0.041 | U |
| | | gamma-Chlordane | µg/L | -- | 0.19 | ca | | | | | | | | | | | 0.017 | U | 0.017 | U |
| | | Heptachlor | µg/L | -- | 0.015 | ca | | | | | | | | | | | 0.04 | U | 0.04 | U |
| | | Heptachlor epoxide | µg/L | -- | 0.0074 | ca | | | | | | | | | | | 0.035 | U | 0.035 | U |
| | | Methoxychlor | µg/L | -- | 182 | nc | | | | | | | | | | | 0.17 | U | 0.17 | U |
| | | Toxaphene | µg/L | -- | 0 | 0 | | | | | | | | | | | 0.14 | U | 0.14 | U |

## Table 4-11
## Summary of Surface Water Results

|  |  |  |  |  |  |  | LL9SW-002-0001-SW |  | LL9SW-003-0001-SW |  | LL9SW-004-0001-SW |  | LL9SW-009-0001-SW |  | LL9SW-010-0001-SW |  | LL9SW-012-0001-DUP |  | LL9SW-012-0001-SW |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  |  | **Sample Date** | 12/05/03 |  | 12/05/03 |  | 12/05/03 |  | 12/09/03 |  | 12/09/03 |  | 12/09/03 |  | 12/09/03 |  |
|  |  |  |  |  |  | **Sample Depth** | Surface |  | Surface |  | Surface |  | Surface |  | Surface |  | Surface |  | Surface |  |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Surface Water Background Criteria** | **Region 9 (Tap Water) PRGs** | **SW PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| Propellants 8330 | 353.2 | Nitrocellulose | µg/L | 0 | -- | 0 |  |  |  |  |  |  |  |  |  |  | 0.0001 | B J | 0.00012 | B J |
|  | 8330 | Nitroglycerin | µg/L | 0 | -- | 0 |  |  |  |  |  |  |  |  |  |  | 0.65 | U | 0.65 | U |
|  | UV/HPLC per SOP | Nitroguanidine | µg/L | 0 | 3650 | nc |  |  |  |  |  |  |  |  |  |  | 20 | U | 20 | U |
| SVOCs TCL 8270 C | 8270C | 1,2,4-Trichlorobenzene | µg/L | -- | 7.2 | nc |  |  |  |  |  |  |  |  |  |  | 0.33 | U | 0.33 | U |
|  |  | 1,2-Dichlorobenzene | µg/L | -- | 370 | nc |  |  |  |  |  |  |  |  |  |  | 0.34 | U | 0.34 | U |
|  |  | 1,3-Dichlorobenzene | µg/L | -- | 182 | nc |  |  |  |  |  |  |  |  |  |  | 0.41 | U | 0.42 | U |
|  |  | 1,4-Dichlorobenzene | µg/L | -- | 0.50 | ca |  |  |  |  |  |  |  |  |  |  | 0.32 | U | 0.32 | U |
|  |  | 2,2-oxybis (1-chloropropane) | µg/L | -- | 0.27 | ca |  |  |  |  |  |  |  |  |  |  | 0.27 | U | 0.27 | U |
|  |  | 2,4,5-Trichlorophenol | µg/L | -- | 3650 | nc |  |  |  |  |  |  |  |  |  |  | 1.3 | U | 1.4 | U |
|  |  | 2,4,6-Trichlorophenol | µg/L | -- | 3.6 | nc |  |  |  |  |  |  |  |  |  |  | 0.2 | U | 0.21 | U |
|  |  | 2,4-Dichlorophenol | µg/L | -- | 109 | nc |  |  |  |  |  |  |  |  |  |  | 0.87 | U | 0.89 | U |
|  |  | 2,4-Dimethylphenol | µg/L | -- | 730 | nc |  |  |  |  |  |  |  |  |  |  | 1.2 | U | 1.3 | U |
|  |  | 2,4-Dinitrophenol | µg/L | -- | 73 | nc |  |  |  |  |  |  |  |  |  |  | 3.2 | U | 3.2 | U |
|  |  | 2-Chloronaphthalene | µg/L | -- | 487 | nc |  |  |  |  |  |  |  |  |  |  | 0.25 | U | 0.25 | U |
|  |  | 2-Chlorophenol | µg/L | -- | 30 | nc |  |  |  |  |  |  |  |  |  |  | 0.12 | U | 0.12 | U |
|  |  | 2-Methylnaphthalene | µg/L | -- | -- | 0 |  |  |  |  |  |  |  |  |  |  | 0.12 | U | 0.13 | U |
|  |  | 2-Methylphenol (o-cresol) | µg/L | -- | 1825 | nc |  |  |  |  |  |  |  |  |  |  | 0.25 | U | 0.25 | U |
|  |  | 2-Nitroaniline | µg/L | -- | 109 | nc |  |  |  |  |  |  |  |  |  |  | 0.21 | U | 0.22 | U |
|  |  | 2-Nitrophenol | µg/L | -- | -- | 0 |  |  |  |  |  |  |  |  |  |  | 0.79 | U | 0.8 | U |
|  |  | 3,3-Dichlorobenzidine | µg/L | -- | 0.15 | ca |  |  |  |  |  |  |  |  |  |  | 0.69 | U | 0.71 | U |
|  |  | 3-Nitroaniline | µg/L | -- | 3.2 | ca |  |  |  |  |  |  |  |  |  |  | 2 | U | 2.1 | U |
|  |  | 4,6-Dinitro-2-methylphenol | µg/L | -- | 3.6 | nc |  |  |  |  |  |  |  |  |  |  | 2.3 | U | 2.4 | U |
|  |  | 4-Bromophenyl phenyl ether | µg/L | -- | -- | 0 |  |  |  |  |  |  |  |  |  |  | 0.18 | U | 0.19 | U |
|  |  | 4-Chloro-3-methylphenol | µg/L | -- | -- | 0 |  |  |  |  |  |  |  |  |  |  | 2.3 | U | 2.4 | U |
|  |  | 4-Chloroaniline | µg/L | -- | 146 | nc |  |  |  |  |  |  |  |  |  |  | 2.7 | U | 2.7 | U |
|  |  | 4-Chlorophenyl phenyl ether | µg/L | -- | -- | 0 |  |  |  |  |  |  |  |  |  |  | 0.72 | U | 0.74 | U |
|  |  | 4-Methylphenol (m/p-cresol) | µg/L | -- | 182 | nc |  |  |  |  |  |  |  |  |  |  | 0.096 | U | 0.098 | U |
|  |  | 4-Nitroaniline | µg/L | -- | 3.2 | ca |  |  |  |  |  |  |  |  |  |  | 2.2 | U | 2.3 | U |
|  |  | 4-Nitrophenol | µg/L | -- | -- | 0 |  |  |  |  |  |  |  |  |  |  | 3.6 | U | 3.6 | U |
|  |  | Acenaphthene | µg/L | -- | 365 | nc |  |  |  |  |  |  |  |  |  |  | 0.12 | U | 0.12 | U |
|  |  | Acenaphthylene | µg/L | -- | -- | 0 |  |  |  |  |  |  |  |  |  |  | 0.12 | U | 0.12 | U |
|  |  | Anthracene | µg/L | -- | 1825 | nc |  |  |  |  |  |  |  |  |  |  | 0.14 | U | 0.15 | U |
|  |  | Benzo(a)anthracene | µg/L | -- | 0.092 | ca |  |  |  |  |  |  |  |  |  |  | 0.047 | U | 0.048 | U |
|  |  | Benzo(a)pyrene | µg/L | -- | 0.0092 | ca |  |  |  |  |  |  |  |  |  |  | 0.081 | U | 0.082 | U |
|  |  | Benzo(b)fluoranthene | µg/L | -- | 0.092 | ca |  |  |  |  |  |  |  |  |  |  | 0.064 | U | 0.066 | U |
|  |  | Benzo(ghi)perylene | µg/L | -- | -- | 0 |  |  |  |  |  |  |  |  |  |  | 0.18 | U | 0.19 | U |
|  |  | Benzo(k)fluoranthene | µg/L | -- | 0.92 | ca |  |  |  |  |  |  |  |  |  |  | 0.069 | U | 0.071 | U |
|  |  | Bis(2-chloroethoxy)methane | µg/L | -- | -- | 0 |  |  |  |  |  |  |  |  |  |  | 0.3 | U | 0.3 | U |
|  |  | Bis(2-chloroethyl)ether | µg/L | -- | 0.010 | ca |  |  |  |  |  |  |  |  |  |  | 0.29 | U | 0.29 | U |
|  |  | Bis(2-ethylhexyl)phthalate | µg/L | -- | 4.8 | ca |  |  |  |  |  |  |  |  |  |  | 3.7 | U | 3.8 | U |
|  |  | Butyl benzyl phthalate | µg/L | -- | 7300 | nc |  |  |  |  |  |  |  |  |  |  | 0.37 | U | 0.38 | U |
|  |  | Carbazole | µg/L | -- | 3.4 | ca |  |  |  |  |  |  |  |  |  |  | 0.28 | U | 0.28 | U |
|  |  | Chrysene | µg/L | -- | 9.2 | ca |  |  |  |  |  |  |  |  |  |  | 0.043 | U | 0.044 | U |
|  |  | Dibenzo(a,h)anthracene | µg/L | -- | 0.0092 | ca |  |  |  |  |  |  |  |  |  |  | 0.12 | U | 0.13 | U |

## Table 4-11
## Summary of Surface Water Results

| | | | | | | | LL9SW-002-0001-SW | | LL9SW-003-0001-SW | | LL9SW-004-0001-SW | | LL9SW-009-0001-SW | | LL9SW-010-0001-SW | | LL9SW-012-0001-DUP | | LL9SW-012-0001-SW | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/05/03 | | 12/05/03 | | 12/05/03 | | 12/09/03 | | 12/09/03 | | 12/09/03 | | 12/09/03 | |
| | | | | | | **Sample Depth** | Surface | | Surface | | Surface | | Surface | | Surface | | Surface | | Surface | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Surface Water Background Criteria** | **Region 9 (Tap Water) PRGs** | **SW PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| | | Dibenzofuran | µg/L | -- | 12 | nc | | | | | | | | | | | 0.12 | U | 0.13 | U |
| | | Diethyl phthalate | µg/L | -- | 29199 | nc | | | | | | | | | | | 0.14 | U | 0.15 | U |
| | | Dimethyl phthalate | µg/L | -- | 364867 | nc | | | | | | | | | | | 0.2 | U | 0.21 | U |
| | | Di-n-butyl phthalate | µg/L | -- | 3650 | nc | | | | | | | | | | | 0.35 | U | 0.35 | U |
| | | Di-n-octyl phthalate | µg/L | -- | 1460 | nc | | | | | | | | | | | 2.4 | U | 2.5 | U |
| | | Fluoranthene | µg/L | -- | 1460 | nc | | | | | | | | | | | 0.13 | U | 0.14 | U |
| | | Fluorene | µg/L | -- | 243 | nc | | | | | | | | | | | 0.12 | U | 0.13 | U |
| | | Hexachlorobenzene | µg/L | -- | 0.042 | ca | | | | | | | | | | | 0.093 | U | 0.095 | U |
| | | Hexachlorobutadiene | µg/L | -- | 0.86 | ca | | | | | | | | | | | 0.62 | U | 0.63 | U |
| | | Hexachlorocyclopentadiene | µg/L | -- | 219 | nc | | | | | | | | | | | 0.62 | U | 0.64 | U |
| | | Hexachloroethane | µg/L | -- | 4.8 | ca | | | | | | | | | | | 0.59 | U | 0.6 | U |
| | | Indeno(1,2,3-cd)pyrene | µg/L | -- | 0.092 | ca | | | | | | | | | | | 0.083 | U | 0.084 | U |
| | | Isophorone | µg/L | -- | 71 | ca | | | | | | | | | | | 0.25 | U | 0.25 | U |
| | | Naphthalene | µg/L | -- | 6.2 | nc | | | | | | | | | | | 0.15 | U | 0.16 | U |
| | | n-Nitroso-di-n-propylamine | µg/L | -- | 0.0096 | ca | | | | | | | | | | | 0.078 | U | 0.079 | U |
| | | n-Nitrosodiphenylamine | µg/L | -- | 14 | ca | | | | | | | | | | | 0.12 | U | 0.13 | U |
| | | Pentachlorophenol | µg/L | -- | 0.56 | ca | | | | | | | | | | | 1.6 | U | 1.7 | U |
| | | Phenanthrene | µg/L | -- | -- | 0 | | | | | | | | | | | 0.13 | U | 0.14 | U |
| | | Phenol | µg/L | -- | 10950 | nc | | | | | | | | | | | 0.34 | U | 0.34 | U |
| | | Pyrene | µg/L | -- | 182 | nc | | | | | | | | | | | 0.12 | U | 0.12 | U |
| TAL Metals 6010B | 6010B | Aluminum | µg/L | 3370 | 36499 | nc | 1800 | | 12000 | | 3200 | | 1700 | | 1200 | | 440 | | 430 | |
| | | Barium | µg/L | 47.5 | 2555 | nc | 60 | | 130 | | 43 | | 51 | | 31 | | 28 | | 28 | |
| | | Beryllium | µg/L | 0.00 | 73 | nc | 0.26 | B | 0.3 | B | 0.17 | U | 0.17 | U | 0.17 | U | 0.17 | U | 0.17 | U |
| | | Cadmium | µg/L | 0.00 | 18 | nc | 0.44 | U | 0.44 | U | 0.44 | U | 0.44 | U | 0.44 | U | 0.44 | U | 0.44 | U |
| | | Calcium | µg/L | 41400 | -- | 0 | 9900 | | 61000 | | 12000 | | 82000 | | 20000 | | 18000 | | 18000 | |
| | | Chromium | µg/L | 0.00 | 109 | nc | 3.3 | B | 14 | | 3.8 | B | 3.7 | B | 2.3 | B | 1.5 | U | 1.5 | U |
| | | Cobalt | µg/L | 0.00 | 730 | nc | 4.6 | B | 8 | | 1.2 | B | 1 | U | 1 | U | 1 | U | 1 | U |
| | | Copper | µg/L | 7.9 | 1460 | nc | 5.8 | B | 20 | | 4.4 | B | 7.3 | B | 6.6 | B | 1.6 | U | 1.6 | U |
| | | Iron | µg/L | 2560 | 10950 | nc | **20000** | | **17000** | | 3200 | | 4900 | | 1900 | | 440 | | 540 | |
| | | Magnesium | µg/L | 10800 | -- | 0 | 3000 | | 9600 | | 3000 | | 9600 | | 5400 | | 4300 | | 4500 | |
| | | Manganese | µg/L | 391 | 876 | nc | **1200** | | **1400** | | 470 | | 330 | | 160 | | 110 | | 120 | |
| | | Nickel | µg/L | 0.00 | 730 | nc | 11 | | 15 | | 4 | B | 4.5 | B | 6.9 | B | 4.8 | B | 5.3 | B |
| | | Potassium | µg/L | 3170 | -- | 0 | 1700 | | 5200 | | 1400 | | 4400 | | 1700 | | 1200 | | 1200 | |
| | | Selenium | µg/L | 0.00 | 182 | nc | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U |
| | | Silver | µg/L | 0.00 | 182 | nc | 3.1 | U | 3.1 | U | 3.1 | U | 3.1 | U | 3.1 | U | 3.1 | U | 3.1 | U |
| | | Sodium | µg/L | 21300 | -- | 0 | 2000 | | 4300 | | 2000 | | 6300 | | 11000 | | 2300 | | 2400 | |
| | | Vanadium | µg/L | 0.00 | 36 | nc | 2.1 | U | 19 | | 4.9 | B | 3 | B | 2.1 | U | 2.1 | U | 2.1 | U |
| | | Zinc | µg/L | 42 | 10950 | nc | 41 | | 190 | | 39 | | 55 | | 38 | | 19 | | 20 | |
| | 7041 | Antimony | µg/L | 0.00 | 15 | nc | 2.2 | U | 2.2 | U | 2.2 | U | 2.2 | U | 2.2 | U | 2.2 | U | 2.2 | U |
| | 7060A | Arsenic | µg/L | 3.2 | 0.045 | ca | **4.3** | | **9.9** | | **1.9** | B | **2.2** | | **0.82** | B | **0.73** | U | **0.73** | U |
| | 7421 | Lead | µg/L | 0.00 | 15 | mcl | 8.9 | | **70** | | 8.7 | | **36** | | **46** | | 1.2 | B | 1.4 | B |
| | 7470A | Mercury | µg/L | 0.00 | 11 | nc | 0.065 | B | 0.39 | | 0.12 | B | 0.33 | | 2.2 | | 1.7 | | 0.3 | |
| | 7841 | Thallium | µg/L | 0.00 | 2.4 | nc | 1.6 | U | 1.6 | U | 1.6 | U | 1.6 | U | 1.6 | U | 1.6 | U | 1.6 | U |

## Table 4-11
## Summary of Surface Water Results

| | | | | | | | LL9SW-002-0001-SW | | LL9SW-003-0001-SW | | LL9SW-004-0001-SW | | LL9SW-009-0001-SW | | LL9SW-010-0001-SW | | LL9SW-012-0001-DUP | | LL9SW-012-0001-SW | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/05/03 | | 12/05/03 | | 12/05/03 | | 12/09/03 | | 12/09/03 | | 12/09/03 | | 12/09/03 | |
| | | | | | | **Sample Depth** | Surface | | Surface | | Surface | | Surface | | Surface | | Surface | | Surface | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Surface Water Background Criteria** | **Region 9 (Tap Water) PRGs** | **SW PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| VOCs TCL 8260B | 8260B | 1,1,1-Trichloroethane | µg/L | -- | 3172 | nc | | | | | | | | | | | 0.08 | U | 0.08 | U |
| | | 1,1,2,2-Tetrachloroethane | µg/L | -- | 0.055 | ca | | | | | | | | | | | 0.09 | U | 0.09 | U |
| | | 1,1,2-Trichloroethane | µg/L | -- | 0.20 | ca | | | | | | | | | | | 0.15 | U | 0.15 | U |
| | | 1,1-Dichloroethane | µg/L | -- | 811 | nc | | | | | | | | | | | 0.11 | U | 0.11 | U |
| | | 1,1-Dichloroethene | µg/L | -- | 339 | nc | | | | | | | | | | | 0.12 | U | 0.12 | U |
| | | 1,2-Dichloroethane | µg/L | -- | 0.12 | ca | | | | | | | | | | | 0.09 | U | 0.09 | U |
| | | 1,2-Dichloroethene (total) | µg/L | -- | 120 | nc | | | | | | | | | | | 0.23 | U | 0.23 | U |
| | | 1,2-Dichloropropane | µg/L | -- | 0.16 | ca | | | | | | | | | | | 0.12 | U | 0.12 | U |
| | | 2-Butanone (MEK) | µg/L | -- | 6968 | nc | | | | | | | | | | | 1.2 | U | 1.2 | U |
| | | 2-Hexanone | µg/L | -- | 2000 | nc | | | | | | | | | | | 0.53 | U | 0.53 | U |
| | | 4-Methyl-2-pentanone (MIBK) | µg/L | -- | 1993 | nc | | | | | | | | | | | 0.65 | U | 0.65 | U |
| | | Acetone | µg/L | -- | 5475 | nc | | | | | | | | | | | 1.8 | U | 1.8 | U |
| | | Benzene | µg/L | -- | 0.35 | ca | | | | | | | | | | | 0.09 | U | 0.09 | U |
| | | Bromodichloromethane | µg/L | -- | 0.18 | ca | | | | | | | | | | | 0.11 | U | 0.11 | U |
| | | Bromoform | µg/L | -- | 8.5 | ca | | | | | | | | | | | 0.11 | U | 0.11 | U |
| | | Bromomethane | µg/L | -- | 8.7 | nc | | | | | | | | | | | 0.1 | U | 0.1 | U |
| | | Carbon disulfide | µg/L | -- | 1043 | nc | | | | | | | | | | | 0.2 | U | 0.2 | U |
| | | Carbon tetrachloride | µg/L | -- | 0.17 | ca | | | | | | | | | | | 0.13 | U | 0.13 | U |
| | | Chlorobenzene | µg/L | -- | 106 | nc | | | | | | | | | | | 0.08 | U | 0.08 | U |
| | | Chloroethane | µg/L | -- | 4.6 | ca | | | | | | | | | | | 0.08 | U | 0.08 | U |
| | | Chloroform | µg/L | -- | 0.17 | ca | | | | | | | | | | | 0.11 | U | 0.11 | U |
| | | Chloromethane | µg/L | -- | 158 | nc | | | | | | | | | | | 0.08 | U | 0.08 | U |
| | | cis-1,3-Dichloropropene | µg/L | -- | 0.40 | ca | | | | | | | | | | | 0.12 | U | 0.12 | U |
| | | Dibromochloromethane | µg/L | -- | 0.13 | ca | | | | | | | | | | | 0.06 | U | 0.06 | U |
| | | Ethylbenzene | µg/L | -- | 1340 | nc | | | | | | | | | | | 0.07 | U | 0.07 | U |
| | | Methylene chloride | µg/L | -- | 4.3 | ca | | | | | | | | | | | 0.35 | U | 0.35 | U |
| | | Styrene | µg/L | -- | 1641 | nc | | | | | | | | | | | 0.13 | U | 0.13 | U |
| | | Tetrachloroethene | µg/L | -- | 0.10 | ca | | | | | | | | | | | 0.09 | U | 0.09 | U |
| | | Toluene | µg/L | -- | 723 | nc | | | | | | | | | | | 0.1 | U | 0.1 | U |
| | | trans-1,3-Dichloropropene | µg/L | -- | 0.40 | ca | | | | | | | | | | | 0.15 | U | 0.15 | U |
| | | Trichloroethene | µg/L | -- | 0.028 | ca | | | | | | | | | | | 0.1 | U | 0.1 | U |
| | | Vinyl chloride | µg/L | -- | 0.020 | ca | | | | | | | | | | | 0.08 | U | 0.08 | U |
| | | Xylenes (total) | µg/L | -- | 0.020 | ca | | | | | | | | | | | 0.28 | U | 0.28 | U |

**Notes:**
-- - no background/PRG value is available for this analyte
blank cell indicates that the analysis was not performed
PRG - preliminary remediation goals (The PRG for lead is the Maximum Contaminant Level (MCL)
nc - non-cancer basis
ca - cancer basis
pbk - based on PBK modeling
mcl - based on CWA maximum contaminant level
max - ceiling limit
sat - soil saturation
[n] - nutrient
UC - unconsolidated
If Result = or > Background, then the value is presented with a shaded/highlighted style
If Result = or > Background and PRG, then the value is presented with a bold + shaded/highlighted style
If Result = or > PRG, then the value is presented with a bold style
If Result < PRG and Background, then the value is presented with a normal style

**Inorganic Qualifiers**
U - analyte was not detected at or above the stated limit
J - result is less than the RL, but greater than or equal to the MDL
B - result is less than the CRDL/RL, but greater than or equal to the IDL/MDL
**InOrganic Flags**
^ - instrument related QC exceed the upper or lower control limits
* - batch QC exceeds the upper or lower control limit
H - batch QC is greater than RL
**Organic Qualifiers**
U - analyte was not detected at or above the stated limit
J - result is an estimated value below the RL
**Organic Flags**
B - Method Blank: batch QC is greater than RL
* - batch QC exceeds the upper or lower control limit
^ - batch QC is greater than RL
a - concentration is below the method Reporting Limit (RL)
H - alternate peak selection upon analytical review

## Table 4-12
## Summary of Sediment Exceedances

| Sample Number | Sample Date | Sample Depth | Analyte | Result (mg/kg) | Qualifier | Sediment Background Criteria | Sediment Region 9 Criteria | SD PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| LL9SD-001-0001-SD | 3/13/2002 | 0-0.5 ft | Aluminum | 10800 | | 17700 | 7614.00 | NC | NO | YES |
| LL9SD-001-0001-SD | 3/13/2002 | 0-0.5 ft | Arsenic | 9.4 | | 19.5 | 0.39 | CA | NO | YES |
| LL9SD-001-0001-SD | 3/13/2002 | 0-0.5 ft | Iron | 22700 | H | 28200 | 2346.00 | NC | NO | YES |
| LL9SD-001-0001-SD | 3/13/2002 | 0-0.5 ft | Manganese | 563 | | 1950 | 176.00 | NC | NO | YES |
| LL9SD-001-0001-SD | 3/13/2002 | 0-0.5 ft | Vanadium | 22.1 | | 26.1 | 7.80 | NC | NO | YES |
| LL9SD-002-0001-SD | 12/05/03 | 0-0.5 ft | Arsenic | 9.7 | | 19.5 | 0.39 | CA | NO | YES |
| LL9SD-002-0001-SD | 12/05/03 | 0-0.5 ft | Manganese | 300 | | 1950 | 176 | NC | NO | YES |
| LL9SD-003-0001-SD | 3/13/2002 | 0-0.5 ft | Aluminum | 15600 | | 17700 | 7614.00 | NC | NO | YES |
| LL9SD-003-0001-SD | 3/13/2002 | 0-0.5 ft | Arsenic | 17.3 | | 19.5 | 0.39 | CA | NO | YES |
| LL9SD-003-0001-SD | 3/13/2002 | 0-0.5 ft | Manganese | 300 | | 1950 | 176.00 | NC | NO | YES |
| LL9SD-004-0001-SD | 12/05/03 | 0-0.5 ft | Arsenic | 11 | | 19.5 | 0.39 | CA | NO | YES |
| LL9SD-004-0001-SD | 12/05/03 | 0-0.5 ft | Iron | 26000 | | 28200 | 2346 | NC | NO | YES |
| LL9SD-004-0001-SD | 12/05/03 | 0-0.5 ft | Manganese | 1200 | | 1950 | 176 | NC | NO | YES |
| LL9SD-004-0001-SD | 12/05/03 | 0-0.5 ft | Vanadium | 26 | | 26.1 | 7.8 | NC | NO | YES |
| LL9SD-005-0001-SD | 3/13/2002 | 0-0.5 ft | Aluminum | 14500 | | 17700 | 7614.00 | NC | NO | YES |
| LL9SD-005-0001-SD | 3/13/2002 | 0-0.5 ft | Arsenic | 14.4 | | 19.5 | 0.39 | CA | NO | YES |
| LL9SD-005-0001-SD | 3/13/2002 | 0-0.5 ft | Iron | 26500 | H | 28200 | 2346.00 | NC | NO | YES |
| LL9SD-005-0001-SD | 3/13/2002 | 0-0.5 ft | Manganese | 395 | | 1950 | 176.00 | NC | NO | YES |
| LL9SD-006-0001-SD | 12/05/03 | 0-0.5 ft | Aluminum | 11000 | | 13900 | 7614 | NC | NO | YES |
| LL9SD-006-0001-SD | 12/05/03 | 0-0.5 ft | Arsenic | 10 | | 19.5 | 0.39 | CA | NO | YES |
| LL9SD-006-0001-SD | 12/05/03 | 0-0.5 ft | Iron | 18000 | | 28200 | 2346 | NC | NO | YES |
| LL9SD-006-0001-SD | 12/05/03 | 0-0.5 ft | Manganese | 250 | | 1950 | 176 | NC | NO | YES |
| LL9SD-006-0001-SD | 12/05/03 | 0-0.5 ft | Vanadium | 20 | | 26.1 | 7.8 | NC | NO | YES |
| LL9SD-009-0001-SD | 12/09/03 | 0-0.5 ft | Arsenic | 15 | | 19.5 | 0.39 | CA | NO | YES |
| LL9SD-009-0001-SD | 12/09/03 | 0-0.5 ft | Benzo(a)anthracene | 2.1 | | -- | 0.62 | CA | NO | YES |
| LL9SD-009-0001-SD | 12/09/03 | 0-0.5 ft | Benzo(a)pyrene | 2.2 | | -- | 0.062 | CA | NO | YES |
| LL9SD-009-0001-SD | 12/09/03 | 0-0.5 ft | Benzo(b)fluoranthene | 2.5 | | -- | 0.62 | CA | NO | YES |
| LL9SD-009-0001-SD | 12/09/03 | 0-0.5 ft | Dibenzo(a,h)anthracene | 0.61 | | -- | 0.062 | CA | NO | YES |
| LL9SD-009-0001-SD | 12/09/03 | 0-0.5 ft | Indeno(1,2,3-cd)pyrene | 1.1 | | -- | 0.62 | CA | NO | YES |
| LL9SD-009-0001-SD | 12/09/03 | 0-0.5 ft | Manganese | 400 | | 1950 | 176 | NC | NO | YES |
| LL9SD-009-0001-SD | 12/09/03 | 0-0.5 ft | Vanadium | 19 | | 26.1 | 7.8 | NC | NO | YES |
| LL9SD-010-0001-SD | 12/09/03 | 0-0.5 ft | Aluminum | 9100 | | 13900 | 7614 | NC | NO | YES |
| LL9SD-010-0001-SD | 12/09/03 | 0-0.5 ft | Manganese | 710 | | 1950 | 176 | NC | NO | YES |
| LL9SD-011-0001-SD | 12/05/03 | 0-1 ft | Aluminum | 8800 | | 13900 | 7614 | NC | NO | YES |
| LL9SD-011-0001-SD | 12/05/03 | 0-1 ft | Arsenic | 4.2 | | 19.5 | 0.39 | CA | NO | YES |
| LL9SD-011-0001-SD | 12/05/03 | 0-1 ft | Iron | 22000 | | 28200 | 2346 | NC | NO | YES |
| LL9SD-011-0001-SD | 12/05/03 | 0-1 ft | Manganese | 680 | | 1950 | 176 | NC | NO | YES |
| LL9SD-011-0001-SD | 12/05/03 | 0-1 ft | Vanadium | 15 | | 26.1 | 7.8 | NC | NO | YES |
| LL9SD-012-0001-SD | 12/09/03 | 0-0.5 ft | Aluminum | 12000 | | 13900 | 7614 | NC | NO | YES |
| LL9SD-012-0001-SD | 12/09/03 | 0-0.5 ft | Arsenic | 14 | | 19.5 | 0.39 | CA | NO | YES |
| LL9SD-012-0001-SD | 12/09/03 | 0-0.5 ft | Iron | 24000 | | 28200 | 2346 | NC | NO | YES |
| LL9SD-012-0001-SD | 12/09/03 | 0-0.5 ft | Manganese | 1300 | | 1950 | 176 | NC | NO | YES |
| LL9SD-012-0001-SD | 12/09/03 | 0-0.5 ft | Vanadium | 24 | | 26.1 | 7.8 | NC | NO | YES |
| LL9SD-013-0001-SD | 12/05/03 | 0-0.5 ft | Aluminum | 12000 | | 13900 | 7614 | NC | NO | YES |
| LL9SD-013-0001-SD | 12/05/03 | 0-0.5 ft | Arsenic | 15 | | 19.5 | 0.39 | CA | NO | YES |
| LL9SD-013-0001-SD | 12/05/03 | 0-0.5 ft | Iron | 26000 | | 28200 | 2346 | NC | NO | YES |

## Table 4-12
## Summary of Sediment Exceedances

| Sample Number | Sample Date | Sample Depth | Analyte | Result (mg/kg) | Qualifier | Sediment Background Criteria | Sediment Region 9 Criteria | SD PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| LL9SD-013-0001-SD | 12/05/03 | 0-0.5 ft | Manganese | 200 |  | 1950 | 176 | NC | NO | YES |
| LL9SD-013-0001-SD | 12/05/03 | 0-0.5 ft | Vanadium | 22 |  | 26.1 | 7.8 | NC | NO | YES |
| LL9SD-014-0001-SD | 12/05/03 | 0-0.5 ft | Aluminum | 11000 |  | 13900 | 7614 | NC | NO | YES |
| LL9SD-014-0001-SD | 12/05/03 | 0-0.5 ft | Arsenic | 10 |  | 19.5 | 0.39 | CA | NO | YES |
| LL9SD-014-0001-SD | 12/05/03 | 0-0.5 ft | Iron | 19000 |  | 28200 | 2346 | NC | NO | YES |
| LL9SD-014-0001-SD | 12/05/03 | 0-0.5 ft | Manganese | 880 |  | 1950 | 176 | NC | NO | YES |
| LL9SD-014-0001-SD | 12/05/03 | 0-0.5 ft | Vanadium | 20 |  | 26.1 | 7.8 | NC | NO | YES |
| LL9SD-015-0001-DUP | 12/09/03 | 0-0.5 ft | Aluminum | 12000 |  | 13900 | 7614 | NC | NO | YES |
| LL9SD-015-0001-DUP | 12/09/03 | 0-0.5 ft | Arsenic | 10 |  | 19.5 | 0.39 | CA | NO | YES |
| LL9SD-015-0001-DUP | 12/09/03 | 0-0.5 ft | Iron | 20000 |  | 28200 | 2346 | NC | NO | YES |
| LL9SD-015-0001-DUP | 12/09/03 | 0-0.5 ft | Manganese | 670 |  | 1950 | 176 | NC | NO | YES |
| LL9SD-015-0001-DUP | 12/09/03 | 0-0.5 ft | Vanadium | 23 |  | 26.1 | 7.8 | NC | NO | YES |
| LL9SD-015-0001-SD | 12/09/03 | 0-0.5 ft | Aluminum | 12000 |  | 13900 | 7614 | NC | NO | YES |
| LL9SD-015-0001-SD | 12/09/03 | 0-0.5 ft | Aluminum | 11506.62 |  | 13900 | 7614 | NC | NO | YES |
| LL9SD-015-0001-SD | 12/09/03 | 0-0.5 ft | Arsenic | 10 |  | 19.5 | 0.39 | CA | NO | YES |
| LL9SD-015-0001-SD | 12/09/03 | 0-0.5 ft | Arsenic | 9.41 |  | 19.5 | 0.39 | CA | NO | YES |
| LL9SD-015-0001-SD | 12/09/03 | 0-0.5 ft | Iron | 17000 |  | 28200 | 2346 | NC | NO | YES |
| LL9SD-015-0001-SD | 12/09/03 | 0-0.5 ft | Iron | 17116.59 |  | 28200 | 2346 | NC | NO | YES |
| LL9SD-015-0001-SD | 12/09/03 | 0-0.5 ft | Manganese | 610 |  | 1950 | 176 | NC | NO | YES |
| LL9SD-015-0001-SD | 12/09/03 | 0-0.5 ft | Manganese | 600.66 |  | 1950 | 176 | NC | NO | YES |
| LL9SD-015-0001-SD | 12/09/03 | 0-0.5 ft | Vanadium | 21 |  | 26.1 | 7.8 | NC | NO | YES |
| LL9SD-015-0001-SD | 12/09/03 | 0-0.5 ft | Vanadium | 21 |  | 26.1 | 7.8 | NC | NO | YES |
| LL9SD-016-0001-DUP | 12/05/03 | 0-0.5 ft | Aluminum | 13000 |  | 13900 | 7614 | NC | NO | YES |
| LL9SD-016-0001-DUP | 12/05/03 | 0-0.5 ft | Arsenic | 14 |  | 19.5 | 0.39 | CA | NO | YES |
| LL9SD-016-0001-DUP | 12/05/03 | 0-0.5 ft | Iron | 25000 |  | 28200 | 2346 | NC | NO | YES |
| LL9SD-016-0001-DUP | 12/05/03 | 0-0.5 ft | Manganese | 890 |  | 1950 | 176 | NC | NO | YES |
| LL9SD-016-0001-DUP | 12/05/03 | 0-0.5 ft | Vanadium | 23 |  | 26.1 | 7.8 | NC | NO | YES |
| LL9SD-016-0001-SD | 12/05/03 | 0-0.5 ft | Aluminum | 11000 |  | 13900 | 7614 | NC | NO | YES |
| LL9SD-016-0001-SD | 12/05/03 | 0-0.5 ft | Arsenic | 13 |  | 19.5 | 0.39 | CA | NO | YES |
| LL9SD-016-0001-SD | 12/05/03 | 0-0.5 ft | Iron | 23000 |  | 28200 | 2346 | NC | NO | YES |
| LL9SD-016-0001-SD | 12/05/03 | 0-0.5 ft | Manganese | 640 |  | 1950 | 176 | NC | NO | YES |
| LL9SD-016-0001-SD | 12/05/03 | 0-0.5 ft | Vanadium | 20 |  | 26.1 | 7.8 | NC | NO | YES |
| LL9SD-017-0001-SD | 12/05/03 | 0-0.5 ft | Aluminum | 12000 |  | 13900 | 7614 | NC | NO | YES |
| LL9SD-017-0001-SD | 12/05/03 | 0-0.5 ft | Arsenic | 13 |  | 19.5 | 0.39 | CA | NO | YES |
| LL9SD-017-0001-SD | 12/05/03 | 0-0.5 ft | Iron | 20000 |  | 28200 | 2346 | NC | NO | YES |
| LL9SD-017-0001-SD | 12/05/03 | 0-0.5 ft | Manganese | 1400 |  | 1950 | 176 | NC | NO | YES |
| LL9SD-017-0001-SD | 12/05/03 | 0-0.5 ft | Vanadium | 24 |  | 26.1 | 7.8 | NC | NO | YES |
| LL9SD-001-0001-SD | 3/13/2002 | 0-0.5 ft | Antimony | 0.49 |  | 0.00 | 3.10 | NC | YES | NO |
| LL9SD-001-0001-SD | 3/13/2002 | 0-0.5 ft | Beryllium | 0.99 |  | 0.38 | 15.00 | NC | YES | NO |
| LL9SD-001-0001-SD | 3/13/2002 | 0-0.5 ft | Cadmium | 0.47 |  | 0.0 | 3.70 | NC | YES | NO |
| LL9SD-001-0001-SD | 3/13/2002 | 0-0.5 ft | Lead | 47.2 |  | 27.4 | 400.00 | PBK | YES | NO |
| LL9SD-001-0001-SD | 3/13/2002 | 0-0.5 ft | Maximum Particle Size | 19 |  |  | -- |  | YES | NO |
| LL9SD-001-0001-SD | 3/13/2002 | 0-0.5 ft | Mercury | 0.15 |  | 0.06 | 2.30 | NC | YES | NO |
| LL9SD-001-0001-SD | 3/13/2002 | 0-0.5 ft | Nickel | 22.4 |  | 17.7 | 156.00 | NC | YES | NO |
| LL9SD-001-0001-SD | 3/13/2002 | 0-0.5 ft | Sodium | 136 | B | 112 | -- | [N] | YES | NO |
| LL9SD-002-0001-SD | 12/05/03 | 0-0.5 ft | Barium | 140 |  | 123 | 538 | NC | YES | NO |

## Table 4-12
## Summary of Sediment Exceedances

| Sample Number | Sample Date | Sample Depth | Analyte | Result (mg/kg) | Qualifier | Sediment Background Criteria | Sediment Region 9 Criteria | SD PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| LL9SD-002-0001-SD | 12/05/03 | 0-0.5 ft | Beryllium | 0.77 | | 0.38 | 15 | NC | YES | NO |
| LL9SD-002-0001-SD | 12/05/03 | 0-0.5 ft | Cadmium | 0.19 | B | 0 | 3.7 | NC | YES | NO |
| LL9SD-003-0001-SD | 3/13/2002 | 0-0.5 ft | Beryllium | 0.67 | | 0.38 | 15.00 | NC | YES | NO |
| LL9SD-003-0001-SD | 3/13/2002 | 0-0.5 ft | Chromium | 20.6 | | 18.1 | 30.00 | CA | YES | NO |
| LL9SD-003-0001-SD | 3/13/2002 | 0-0.5 ft | Lead | 37.8 | | 27.4 | 400.00 | PBK | YES | NO |
| LL9SD-003-0001-SD | 3/13/2002 | 0-0.5 ft | Magnesium | 3450 | | 2760 | -- | [N] | YES | NO |
| LL9SD-003-0001-SD | 3/13/2002 | 0-0.5 ft | Maximum Particle Size | 9.5 | | | -- | | YES | NO |
| LL9SD-003-0001-SD | 3/13/2002 | 0-0.5 ft | Mercury | 0.35 | | 0.06 | 2.30 | NC | YES | NO |
| LL9SD-003-0001-SD | 3/13/2002 | 0-0.5 ft | Nickel | 21.2 | | 17.7 | 156.00 | NC | YES | NO |
| LL9SD-003-0001-SD | 3/13/2002 | 0-0.5 ft | Sodium | 213 | | 112 | -- | [N] | YES | NO |
| LL9SD-004-0001-SD | 12/05/03 | 0-0.5 ft | Beryllium | 0.76 | | 0.38 | 15 | NC | YES | NO |
| LL9SD-004-0001-SD | 12/05/03 | 0-0.5 ft | Cadmium | 0.77 | | 0 | 3.7 | NC | YES | NO |
| LL9SD-004-0001-SD | 12/05/03 | 0-0.5 ft | Lead | 31 | | 27.4 | 400 | PBK | YES | NO |
| LL9SD-004-0001-SD | 12/05/03 | 0-0.5 ft | Mercury | 0.1 | | 0.06 | 2.3 | NC | YES | NO |
| LL9SD-004-0001-SD | 12/05/03 | 0-0.5 ft | Nickel | 18 | | 17.7 | 156 | NC | YES | NO |
| LL9SD-004-0001-SD | 12/05/03 | 0-0.5 ft | Selenium | 2.1 | | 1.7 | 39 | NC | YES | NO |
| LL9SD-005-0001-SD | 3/13/2002 | 0-0.5 ft | Beryllium | 0.62 | | 0.38 | 15.00 | NC | YES | NO |
| LL9SD-005-0001-SD | 3/13/2002 | 0-0.5 ft | Chromium | 18.9 | | 18.1 | 30.00 | CA | YES | NO |
| LL9SD-005-0001-SD | 3/13/2002 | 0-0.5 ft | Lead | 34.1 | | 27.4 | 400.00 | PBK | YES | NO |
| LL9SD-005-0001-SD | 3/13/2002 | 0-0.5 ft | Maximum Particle Size | 19 | | | -- | | YES | NO |
| LL9SD-005-0001-SD | 3/13/2002 | 0-0.5 ft | Mercury | 0.13 | | 0.06 | 2.30 | NC | YES | NO |
| LL9SD-005-0001-SD | 3/13/2002 | 0-0.5 ft | Sodium | 204 | | 112 | -- | [N] | YES | NO |
| LL9SD-006-0001-SD | 12/05/03 | 0-0.5 ft | Cadmium | 0.2 | B | 0 | 3.7 | NC | YES | NO |
| LL9SD-006-0001-SD | 12/05/03 | 0-0.5 ft | Lead | 36 | | 27.4 | 400 | PBK | YES | NO |
| LL9SD-006-0001-SD | 12/05/03 | 0-0.5 ft | Mercury | 0.072 | | 0.06 | 2.3 | NC | YES | NO |
| LL9SD-009-0001-SD | 12/09/03 | 0-0.5 ft | Beryllium | 0.41 | B | 0.38 | 15 | NC | YES | NO |
| LL9SD-009-0001-SD | 12/09/03 | 0-0.5 ft | Cadmium | 1 | | 0 | 3.7 | NC | YES | NO |
| LL9SD-009-0001-SD | 12/09/03 | 0-0.5 ft | Copper | 120 | H | 27.6 | 313 | NC | YES | NO |
| LL9SD-009-0001-SD | 12/09/03 | 0-0.5 ft | Lead | 200 | | 27.4 | 400 | PBK | YES | NO |
| LL9SD-009-0001-SD | 12/09/03 | 0-0.5 ft | Nickel | 24 | | 17.7 | 156 | NC | YES | NO |
| LL9SD-009-0001-SD | 12/09/03 | 0-0.5 ft | Nitrocellulose | 3.1 | J | 0 | -- | 0 | YES | NO |
| LL9SD-009-0001-SD | 12/09/03 | 0-0.5 ft | Nitroguanidine | 0.053 | J | 0 | 611 | NC | YES | NO |
| LL9SD-010-0001-SD | 12/09/03 | 0-0.5 ft | Beryllium | 0.48 | B | 0.38 | 15 | NC | YES | NO |
| LL9SD-010-0001-SD | 12/09/03 | 0-0.5 ft | Cadmium | 1.2 | | 0 | 3.7 | NC | YES | NO |
| LL9SD-010-0001-SD | 12/09/03 | 0-0.5 ft | Copper | 34 | H | 27.6 | 313 | NC | YES | NO |
| LL9SD-010-0001-SD | 12/09/03 | 0-0.5 ft | Lead | 300 | | 27.4 | 400 | PBK | YES | NO |
| LL9SD-010-0001-SD | 12/09/03 | 0-0.5 ft | Nickel | 26 | | 17.7 | 156 | NC | YES | NO |
| LL9SD-011-0001-SD | 12/05/03 | 0-1 ft | Beryllium | 0.51 | B | 0.38 | 15 | NC | YES | NO |
| LL9SD-011-0001-SD | 12/05/03 | 0-1 ft | Cadmium | 0.4 | | 0 | 3.7 | NC | YES | NO |
| LL9SD-011-0001-SD | 12/05/03 | 0-1 ft | Cobalt | 9.4 | | 9.1 | 30 | CA | YES | NO |
| LL9SD-012-0001-SD | 12/09/03 | 0-0.5 ft | Beryllium | 0.86 | | 0.38 | 15 | NC | YES | NO |
| LL9SD-012-0001-SD | 12/09/03 | 0-0.5 ft | Nickel | 19 | | 17.7 | 156 | NC | YES | NO |
| LL9SD-013-0001-SD | 12/05/03 | 0-0.5 ft | Beryllium | 0.52 | B | 0.38 | 15 | NC | YES | NO |
| LL9SD-013-0001-SD | 12/05/03 | 0-0.5 ft | Cadmium | 0.5 | | 0 | 3.7 | NC | YES | NO |
| LL9SD-013-0001-SD | 12/05/03 | 0-0.5 ft | Lead | 100 | | 27.4 | 400 | PBK | YES | NO |
| LL9SD-013-0001-SD | 12/05/03 | 0-0.5 ft | Mercury | 0.18 | | 0.06 | 2.3 | NC | YES | NO |

## Table 4-12
## Summary of Sediment Exceedances

| Sample Number | Sample Date | Sample Depth | Analyte | Result (mg/kg) | Qualifier | Sediment Background Criteria | Sediment Region 9 Criteria | SD PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| LL9SD-014-0001-SD | 12/05/03 | 0-0.5 ft | Beryllium | 0.63 | B | 0.38 | 15 | NC | YES | NO |
| LL9SD-014-0001-SD | 12/05/03 | 0-0.5 ft | Cadmium | 0.35 | B | 0 | 3.7 | NC | YES | NO |
| LL9SD-014-0001-SD | 12/05/03 | 0-0.5 ft | Lead | 35 |  | 27.4 | 400 | PBK | YES | NO |
| LL9SD-014-0001-SD | 12/05/03 | 0-0.5 ft | Mercury | 0.33 |  | 0.06 | 2.3 | NC | YES | NO |
| LL9SD-014-0001-SD | 12/05/03 | 0-0.5 ft | Nickel | 18 |  | 17.7 | 156 | NC | YES | NO |
| LL9SD-014-0001-SD | 12/05/03 | 0-0.5 ft | Selenium | 1.8 | B | 1.7 | 39 | NC | YES | NO |
| LL9SD-015-0001-DUP | 12/09/03 | 0-0.5 ft | Beryllium | 0.59 | B | 0.38 | 15 | NC | YES | NO |
| LL9SD-015-0001-DUP | 12/09/03 | 0-0.5 ft | Cadmium | 0.71 |  | 0 | 3.7 | NC | YES | NO |
| LL9SD-015-0001-DUP | 12/09/03 | 0-0.5 ft | Lead | 77 |  | 27.4 | 400 | PBK | YES | NO |
| LL9SD-015-0001-DUP | 12/09/03 | 0-0.5 ft | Mercury | 0.13 |  | 0.06 | 2.3 | NC | YES | NO |
| LL9SD-015-0001-DUP | 12/09/03 | 0-0.5 ft | Nickel | 18 |  | 17.7 | 156 | NC | YES | NO |
| LL9SD-015-0001-DUP | 12/09/03 | 0-0.5 ft | Nitrocellulose | 4.2 | J | 0 | -- | 0 | YES | NO |
| LL9SD-015-0001-SD | 12/09/03 | 0-0.5 ft | Beryllium | 0.54 | B | 0.38 | 15 | NC | YES | NO |
| LL9SD-015-0001-SD | 12/09/03 | 0-0.5 ft | Beryllium | 0.55 | B | 0.38 | 15 | NC | YES | NO |
| LL9SD-015-0001-SD | 12/09/03 | 0-0.5 ft | Cadmium | 0.61 |  | 0 | 3.7 | NC | YES | NO |
| LL9SD-015-0001-SD | 12/09/03 | 0-0.5 ft | Cadmium | 0.64 |  | 0 | 3.7 | NC | YES | NO |
| LL9SD-015-0001-SD | 12/09/03 | 0-0.5 ft | Lead | 71 |  | 27.4 | 400 | PBK | YES | NO |
| LL9SD-015-0001-SD | 12/09/03 | 0-0.5 ft | Lead | 75.88 |  | 27.4 | 400 | PBK | YES | NO |
| LL9SD-015-0001-SD | 12/09/03 | 0-0.5 ft | Mercury | 0.12 |  | 0.06 | 2.3 | NC | YES | NO |
| LL9SD-015-0001-SD | 12/09/03 | 0-0.5 ft | Mercury | 0.11 |  | 0.06 | 2.3 | NC | YES | NO |
| LL9SD-015-0001-SD | 12/09/03 | 0-0.5 ft | Nickel | 18 |  | 17.7 | 156 | NC | YES | NO |
| LL9SD-015-0001-SD | 12/09/03 | 0-0.5 ft | Nitrocellulose | 76 | * | 0 | -- | 0 | YES | NO |
| LL9SD-015-0001-SD | 12/09/03 | 0-0.5 ft | Nitrocellulose | 2.8 | B J | 0 | -- | 0 | YES | NO |
| LL9SD-015-0001-SD | 12/09/03 | 0-0.5 ft | Nitrocellulose | 59 |  | 0 | -- | 0 | YES | NO |
| LL9SD-015-0001-SD | 12/09/03 | 0-0.5 ft | Nitroglycerin | 4.86 |  | 0 | -- | 0 | YES | NO |
| LL9SD-015-0001-SD | 12/09/03 | 0-0.5 ft | Nitroglycerin | 4.74 |  | 0 | -- | 0 | YES | NO |
| LL9SD-015-0001-SD | 12/09/03 | 0-0.5 ft | Nitroguanidine | 0.844 |  | 0 | 611 | NC | YES | NO |
| LL9SD-015-0001-SD | 12/09/03 | 0-0.5 ft | Nitroguanidine | 0.873 |  | 0 | 611 | NC | YES | NO |
| LL9SD-016-0001-DUP | 12/05/03 | 0-0.5 ft | Beryllium | 0.51 | B | 0.38 | 15 | NC | YES | NO |
| LL9SD-016-0001-DUP | 12/05/03 | 0-0.5 ft | Cadmium | 0.53 |  | 0 | 3.7 | NC | YES | NO |
| LL9SD-016-0001-DUP | 12/05/03 | 0-0.5 ft | Calcium | 11000 |  | 5510 | --[n] | 0 | YES | NO |
| LL9SD-016-0001-DUP | 12/05/03 | 0-0.5 ft | Chromium | 22 |  | 18.1 | 30 | CA | YES | NO |
| LL9SD-016-0001-DUP | 12/05/03 | 0-0.5 ft | Cobalt | 9.5 |  | 9.1 | 30 | CA | YES | NO |
| LL9SD-016-0001-DUP | 12/05/03 | 0-0.5 ft | Lead | 49 |  | 27.4 | 400 | PBK | YES | NO |
| LL9SD-016-0001-DUP | 12/05/03 | 0-0.5 ft | Magnesium | 3000 |  | 2760 | --[n] | 0 | YES | NO |
| LL9SD-016-0001-DUP | 12/05/03 | 0-0.5 ft | Mercury | 1.3 |  | 0.06 | 2.3 | NC | YES | NO |
| LL9SD-016-0001-DUP | 12/05/03 | 0-0.5 ft | Nickel | 21 |  | 17.7 | 156 | NC | YES | NO |
| LL9SD-016-0001-DUP | 12/05/03 | 0-0.5 ft | Selenium | 1.9 |  | 1.7 | 39 | NC | YES | NO |
| LL9SD-016-0001-SD | 12/05/03 | 0-0.5 ft | Beryllium | 0.47 | B | 0.38 | 15 | NC | YES | NO |
| LL9SD-016-0001-SD | 12/05/03 | 0-0.5 ft | Cadmium | 0.32 |  | 0 | 3.7 | NC | YES | NO |
| LL9SD-016-0001-SD | 12/05/03 | 0-0.5 ft | Calcium | 6900 |  | 5510 | --[n] | 0 | YES | NO |
| LL9SD-016-0001-SD | 12/05/03 | 0-0.5 ft | Lead | 32 |  | 27.4 | 400 | PBK | YES | NO |
| LL9SD-016-0001-SD | 12/05/03 | 0-0.5 ft | Mercury | 0.45 |  | 0.06 | 2.3 | NC | YES | NO |
| LL9SD-017-0001-SD | 12/05/03 | 0-0.5 ft | Beryllium | 0.65 |  | 0.38 | 15 | NC | YES | NO |
| LL9SD-017-0001-SD | 12/05/03 | 0-0.5 ft | Cadmium | 0.31 | B | 0 | 3.7 | NC | YES | NO |
| LL9SD-017-0001-SD | 12/05/03 | 0-0.5 ft | Cobalt | 9.5 |  | 9.1 | 30 | CA | YES | NO |

## Table 4-12
## Summary of Sediment Exceedances

| Sample Number | Sample Date | Sample Depth | Analyte | Result (mg/kg) | Qualifier | Sediment Background Criteria | Sediment Region 9 Criteria | SD PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| LL9SD-017-0001-SD | 12/05/03 | 0-0.5 ft | Lead | 29 | | 27.4 | 400 | PBK | YES | NO |
| LL9SD-017-0001-SD | 12/05/03 | 0-0.5 ft | Mercury | 0.068 | | 0.06 | 2.3 | NC | YES | NO |
| LL9SD-001-0001-SD | 3/13/2002 | 0-0.5 ft | Organic Carbon | 23000 | | | | | YES | YES |
| LL9SD-002-0001-SD | 12/05/03 | 0-0.5 ft | Iron | 39000 | | 28200 | 2346 | NC | YES | YES |
| LL9SD-002-0001-SD | 12/05/03 | 0-0.5 ft | TOC Average Duplicates | 11000 | | 0.89 | 0.52 | NC | YES | YES |
| LL9SD-003-0001-SD | 3/13/2002 | 0-0.5 ft | Iron | 31900 | H | 28200 | 2346.00 | NC | YES | YES |
| LL9SD-003-0001-SD | 3/13/2002 | 0-0.5 ft | Organic Carbon | 3700 | | | | | YES | YES |
| LL9SD-003-0001-SD | 3/13/2002 | 0-0.5 ft | Vanadium | 26.2 | | 26.1 | 7.80 | NC | YES | YES |
| LL9SD-004-0001-SD | 12/05/03 | 0-0.5 ft | Aluminum | 14000 | | 13900 | 7614 | NC | YES | YES |
| LL9SD-004-0001-SD | 12/05/03 | 0-0.5 ft | TOC Average Duplicates | 15000 | | 0.89 | 0.52 | NC | YES | YES |
| LL9SD-005-0001-SD | 3/13/2002 | 0-0.5 ft | Organic Carbon | 5300 | | | | | YES | YES |
| LL9SD-005-0001-SD | 3/13/2002 | 0-0.5 ft | Vanadium | 27.2 | | 26.1 | 7.80 | NC | YES | YES |
| LL9SD-006-0001-SD | 12/05/03 | 0-0.5 ft | TOC Average Duplicates | 24000 | | 0.89 | 0.52 | NC | YES | YES |
| LL9SD-009-0001-SD | 12/09/03 | 0-0.5 ft | Iron | 31000 | | 28200 | 2346 | NC | YES | YES |
| LL9SD-009-0001-SD | 12/09/03 | 0-0.5 ft | Mercury | 6 | | 0.06 | 2.3 | NC | YES | YES |
| LL9SD-009-0001-SD | 12/09/03 | 0-0.5 ft | TOC Average Duplicates | 4200 | | 0.89 | 0.52 | NC | YES | YES |
| LL9SD-010-0001-SD | 12/09/03 | 0-0.5 ft | Arsenic | 25 | | 19.5 | 0.39 | CA | YES | YES |
| LL9SD-010-0001-SD | 12/09/03 | 0-0.5 ft | Iron | 33000 | | 28200 | 2346 | NC | YES | YES |
| LL9SD-010-0001-SD | 12/09/03 | 0-0.5 ft | Mercury | 110 | | 0.06 | 2.3 | NC | YES | YES |
| LL9SD-010-0001-SD | 12/09/03 | 0-0.5 ft | TOC Average Duplicates | 3700 | | 0.89 | 0.52 | NC | YES | YES |
| LL9SD-010-0001-SD | 12/09/03 | 0-0.5 ft | Vanadium | 38 | | 26.1 | 7.8 | NC | YES | YES |
| LL9SD-011-0001-SD | 12/05/03 | 0-1 ft | TOC Average Duplicates | 8700 | | 0.89 | 0.52 | NC | YES | YES |
| LL9SD-012-0001-SD | 12/09/03 | 0-0.5 ft | Mercury | 2.9 | | 0.06 | 2.3 | NC | YES | YES |
| LL9SD-012-0001-SD | 12/09/03 | 0-0.5 ft | TOC Average Duplicates | 3500 | | 0.89 | 0.52 | NC | YES | YES |
| LL9SD-013-0001-SD | 12/05/03 | 0-0.5 ft | TOC Average Duplicates | 28000 | | 0.89 | 0.52 | NC | YES | YES |
| LL9SD-014-0001-SD | 12/05/03 | 0-0.5 ft | TOC Average Duplicates | 24000 | | 0.89 | 0.52 | NC | YES | YES |
| LL9SD-015-0001-DUP | 12/09/03 | 0-0.5 ft | TOC Average Duplicates | 12000 | | 0.89 | 0.52 | NC | YES | YES |
| LL9SD-004-0001-SD | 3/13/2002 | 0-0.5 ft | Aluminum | NT | NA | 17700 | 7614.00 | NC | YES | YES |
| LL9SD-004-0001-SD | 3/13/2002 | 0-0.5 ft | Antimony | NT | NA | 0.00 | 3.10 | NC | YES | YES |
| LL9SD-004-0001-SD | 3/13/2002 | 0-0.5 ft | Arsenic | NT | NA | 19.5 | 0.39 | CA | YES | YES |
| LL9SD-004-0001-SD | 3/13/2002 | 0-0.5 ft | Barium | NT | NA | 123.0 | 538.00 | NC | YES | YES |
| LL9SD-004-0001-SD | 3/13/2002 | 0-0.5 ft | Beryllium | NT | NA | 0.38 | 15.00 | NC | YES | YES |
| LL9SD-004-0001-SD | 3/13/2002 | 0-0.5 ft | Cadmium | NT | NA | 0.0 | 3.70 | NC | YES | YES |
| LL9SD-004-0001-SD | 3/13/2002 | 0-0.5 ft | Calcium | NT | NA | 5500 | -- | [N] | YES | YES |
| LL9SD-004-0001-SD | 3/13/2002 | 0-0.5 ft | Chromium | NT | NA | 18.1 | 30.00 | CA | YES | YES |
| LL9SD-004-0001-SD | 3/13/2002 | 0-0.5 ft | Cobalt | NT | NA | 9.1 | 902.00 | CA | YES | YES |
| LL9SD-004-0001-SD | 3/13/2002 | 0-0.5 ft | Copper | NT | NA | 27.6 | 313.00 | NC | YES | YES |
| LL9SD-004-0001-SD | 3/13/2002 | 0-0.5 ft | Iron | NT | NA | 28200 | 2346.00 | NC | YES | YES |
| LL9SD-004-0001-SD | 3/13/2002 | 0-0.5 ft | Lead | NT | NA | 27.4 | 400.00 | PBK | YES | YES |
| LL9SD-004-0001-SD | 3/13/2002 | 0-0.5 ft | Magnesium | NT | NA | 2760 | -- | [N] | YES | YES |
| LL9SD-004-0001-SD | 3/13/2002 | 0-0.5 ft | Manganese | NT | NA | 1950 | 176.00 | NC | YES | YES |
| LL9SD-004-0001-SD | 3/13/2002 | 0-0.5 ft | Maximum Particle Size | NT | NA | | -- | | YES | YES |
| LL9SD-004-0001-SD | 3/13/2002 | 0-0.5 ft | Mercury | NT | NA | 0.06 | 2.30 | NC | YES | YES |
| LL9SD-004-0001-SD | 3/13/2002 | 0-0.5 ft | Nickel | NT | NA | 17.7 | 156.00 | NC | YES | YES |
| LL9SD-004-0001-SD | 3/13/2002 | 0-0.5 ft | Organic Carbon | NT | NA | | | | YES | YES |
| LL9SD-004-0001-SD | 3/13/2002 | 0-0.5 ft | Potassium | NT | NA | 1950 | -- | [N] | YES | YES |

## Table 4-12
## Summary of Sediment Exceedances

| Sample Number | Sample Date | Sample Depth | Analyte | Result (mg/kg) | Qualifier | Sediment Background Criteria | Sediment Region 9 Criteria | SD PRG Basis | Exceed Installation Background? | Exceed Region 9 Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| LL9SD-004-0001-SD | 3/13/2002 | 0-0.5 ft | Selenium | NT | NA | 1.7 | 39.00 | NC | YES | YES |
| LL9SD-004-0001-SD | 3/13/2002 | 0-0.5 ft | Silver | NT | NA | 0.0 | 39.00 | NC | YES | YES |
| LL9SD-004-0001-SD | 3/13/2002 | 0-0.5 ft | Sodium | NT | NA | 112 | -- | [N] | YES | YES |
| LL9SD-004-0001-SD | 3/13/2002 | 0-0.5 ft | Thallium | NT | NA | 0.9 | 0.52 | NC | YES | YES |
| LL9SD-004-0001-SD | 3/13/2002 | 0-0.5 ft | Vanadium | NT | NA | 26.1 | 7.80 | NC | YES | YES |
| LL9SD-004-0001-SD | 3/13/2002 | 0-0.5 ft | Zinc | NT | NA | 532.0 | 2346.00 | NC | YES | YES |
| LL9SD-015-0001-SD | 12/09/03 | 0-0.5 ft | TOC Average Duplicates | 16000 |  | 0.89 | 0.52 | NC | YES | YES |
| LL9SD-016-0001-DUP | 12/05/03 | 0-0.5 ft | TOC Average Duplicates | 15000 |  | 0.89 | 0.52 | NC | YES | YES |
| LL9SD-016-0001-SD | 12/05/03 | 0-0.5 ft | TOC Average Duplicates | 11000 |  | 0.89 | 0.52 | NC | YES | YES |
| LL9SD-017-0001-SD | 12/05/03 | 0-0.5 ft | TOC Average Duplicates | 26000 |  | 0.89 | 0.52 | NC | YES | YES |
| LL9SD-009-0001-SD | 12/09/03 | 0-0.5 ft | Nitroglycerin | ND |  | 0 | -- | 0 | YES | YES |
| LL9SD-015-0001-DUP | 12/09/03 | 0-0.5 ft | Nitroglycerin | ND |  | 0 | -- | 0 | YES | YES |
| LL9SD-015-0001-DUP | 12/09/03 | 0-0.5 ft | Nitroguanidine | ND |  | 0 | 611 | NC | YES | YES |
| LL9SD-015-0001-SD | 12/09/03 | 0-0.5 ft | Nitroglycerin | ND |  | 0 | -- | 0 | YES | YES |
| LL9SD-015-0001-SD | 12/09/03 | 0-0.5 ft | Nitroguanidine | ND |  | 0 | 611 | NC | YES | YES |

**Notes:**
-- - no background/PRG value is available for this analyte
PRG - preliminary remediation goals (The PRG for lead is the Maximum Contaminant Level (MCL)
nc - non-cancer basis
ca - cancer basis
pbk - based on PBK modeling
mcl - based on CWA maximum contaminant level
max - ceiling limit
sat - soil saturation
[n] - nutrient
UC - unconsolidated

**Inorganic Qualifiers**
U - analyte was not detected at or above the stated limit
J - result is less than the RL, but greater than or equal to the MDL
B - result is less than the CRDL/RL, but greater than or equal to the IDL/MDL
**InOrganic Flags**
^ - instrument related QC exceed the upper or lower control limits
* - batch QC exceeds the upper or lower control limit
H - batch QC is greater than RL
**Organic Qualifiers**
U - analyte was not detected at or above the stated limit
J - result is an estimated value below the RL
**Organic Flags**
B - Method Blank: batch QC is greater than RL
* - batch QC exceeds the upper or lower control limit
^ - batch QC is greater than RL
a - concentration is below the method Reporting Limit (RL)
H - alternate peak selection upon analytical review

## Table 4-13
## Summary of Sediment Results

| | | | | | | | LL9SD-002-0001-SD | | LL9SD-004-0001-SD | | LL9SD-006-0001-SD | | LL9SD-009-0001-SD | | LL9SD-010-0001-SD | | LL9SD-011-0001-SD | | LL9SD-012-0001-SD | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/05/03 | | 12/05/03 | | 12/05/03 | | 12/09/03 | | 12/09/03 | | 12/05/03 | | 12/09/03 | |
| | | | | | | **Sample Depth** | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 1 ft | | 0 - 0.5 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Sediment Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SD PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| Cyanide 9012A | 9014/9010B | Cyanide, Total | mg/Kg | 0.00 | 122 | nc | | | | | | | 0.25 | U | | | | | | |
| Explosives 8330 | 8330 | 1,3,5-Trinitrobenzene | mg/Kg | 0 | 183 | nc | | | | | | | 0.017 | U | | | | | | |
| | | 1,3-Dinitrobenzene | mg/Kg | 0 | 0.61 | nc | | | | | | | 0.018 | U | | | | | | |
| | | 2,4,6-TNT | mg/Kg | 0 | 16 | ca | | | | | | | 0.033 | U | | | | | | |
| | | 2,4-Dinitrotoluene | mg/Kg | 0 | 12 | nc | | | | | | | 0.035 | U | | | | | | |
| | | 2,6-Dinitrotoluene | mg/Kg | 0 | 6.1 | nc | | | | | | | 0.047 | U | | | | | | |
| | | 2-Nitrotoluene | mg/Kg | 0 | 0.88 | ca | | | | | | | 0.033 | U | | | | | | |
| | | 3-Nitrotoluene | mg/Kg | 0 | 73 | nc | | | | | | | 0.049 | U | | | | | | |
| | | 4-Nitrotoluene | mg/Kg | 0 | 12 | ca | | | | | | | 0.046 | U | | | | | | |
| | | HMX | mg/Kg | 0 | 306 | nc | | | | | | | 0.11 | U | | | | | | |
| | | Nitrobenzene | mg/Kg | 0 | 2 | nc | | | | | | | 0.022 | U | | | | | | |
| | | RDX | mg/Kg | 0 | 4.4 | ca | | | | | | | 0.058 | U | | | | | | |
| | | Tetryl | mg/Kg | 0 | 61 | nc | | | | | | | 0.043 | U | | | | | | |
| PCB TCL 8082 | 8082 | Aroclor 1016 | mg/Kg | -- | 0.39 | nc | | | | | | | 0.0024 | U | | | | | | |
| | | Aroclor 1221 | mg/Kg | -- | 0.22 | ca | | | | | | | 0.0026 | U | | | | | | |
| | | Aroclor 1232 | mg/Kg | -- | 0.22 | ca | | | | | | | 0.0026 | U | | | | | | |
| | | Aroclor 1242 | mg/Kg | -- | 0.22 | ca | | | | | | | 0.0026 | U | | | | | | |
| | | Aroclor 1248 | mg/Kg | -- | 0.22 | ca | | | | | | | 0.0026 | U | | | | | | |
| | | Aroclor 1254 | mg/Kg | -- | 0.22 | ca | | | | | | | 0.0026 | U | | | | | | |
| | | Aroclor 1260 | mg/Kg | -- | 0.22 | ca | | | | | | | 0.0018 | U | | | | | | |
| Pesticides 8081A | 8081A | 4,4'-DDD | mg/Kg | -- | 2.4 | ca | | | | | | | 0.0093 | U | | | | | | |
| | | 4,4'-DDE | mg/Kg | -- | 1.7 | ca | | | | | | | 0.017 | U | | | | | | |
| | | 4,4'-DDT | mg/Kg | -- | 1.7 | ca | | | | | | | 0.0095 | U | | | | | | |
| | | Aldrin | mg/Kg | -- | 0.029 | ca | | | | | | | 0.0033 | U | | | | | | |
| | | alpha-BHC | mg/Kg | -- | 0.09 | sat | | | | | | | 0.0041 | U | | | | | | |
| | | alpha-Chlordane | mg/Kg | -- | 1.6 | ca | | | | | | | 0.0031 | U | | | | | | |
| | | beta-BHC | mg/Kg | -- | 0.32 | ca | | | | | | | 0.0039 | U | | | | | | |
| | | delta-BHC | mg/Kg | -- | -- | 0 | | | | | | | 0.0028 | U | | | | | | |
| | | Dieldrin | mg/Kg | -- | 0.030 | ca | | | | | | | 0.0087 | U | | | | | | |
| | | Endosulfan I | mg/Kg | -- | 37 | nc | | | | | | | 0.0069 | U | | | | | | |
| | | Endosulfan II | mg/Kg | -- | 37 | nc | | | | | | | 0.0072 | U | | | | | | |
| | | Endosulfan sulfate | mg/Kg | -- | 37 | nc | | | | | | | 0.0075 | U | | | | | | |
| | | Endrin | mg/Kg | -- | 1.8 | nc | | | | | | | 0.011 | U | | | | | | |
| | | Endrin aldehyde | mg/Kg | -- | -- | 0 | | | | | | | 0.0085 | U | | | | | | |
| | | Endrin ketone | mg/Kg | -- | -- | 0 | | | | | | | 0.0075 | U | | | | | | |
| | | gamma-BHC (Lindane) | mg/Kg | -- | 0.44 | ca | | | | | | | 0.0059 | U | | | | | | |
| | | gamma-Chlordane | mg/Kg | -- | 1.6 | ca | | | | | | | 0.0039 | U | | | | | | |
| | | Heptachlor | mg/Kg | -- | 0.11 | ca | | | | | | | 0.0046 | U | | | | | | |
| | | Heptachlor epoxide | mg/Kg | -- | 0.053 | ca | | | | | | | 0.0036 | U | | | | | | |
| | | Methoxychlor | mg/Kg | -- | 31 | nc | | | | | | | 0.059 | U | | | | | | |
| | | Toxaphene | mg/Kg | -- | 0 | 0 | | | | | | | 0.12 | U | | | | | | |
| Propellants 8330 | 353.2 | Nitrocellulose | mg/Kg | 0 | -- | 0 | | | | | | | 3.1 | J | | | | | | |
| | 8330 | Nitroglycerin | mg/Kg | 0 | -- | 0 | | | | | | | 0.5 | U | | | | | | |
| | UV/HPLC per SOP | Nitroguanidine | mg/Kg | 0 | 611 | nc | | | | | | | 0.053 | J | | | | | | |
| SVOCs TCL 8270 C | 8270C | 1,2,4-Trichlorobenzene | mg/Kg | -- | 6.2 | nc | | | | | | | 0.076 | U | | | | | | |
| | | 1,2-Dichlorobenzene | mg/Kg | -- | 600 | sat | | | | | | | 0.1 | U | | | | | | |
| | | 1,3-Dichlorobenzene | mg/Kg | -- | 53 | nc | | | | | | | 0.1 | U | | | | | | |
| | | 1,4-Dichlorobenzene | mg/Kg | -- | 3.4 | ca | | | | | | | 0.091 | U | | | | | | |
| | | 2,2-oxybis (1-chloropropane) | mg/Kg | -- | 2.9 | ca | | | | | | | 0.096 | U | | | | | | |
| | | 2,4,5-Trichlorophenol | mg/Kg | -- | 611 | nc | | | | | | | 0.049 | U | | | | | | |

## Table 4-13
## Summary of Sediment Results

| | | | | | | | LL9SD-013-0001-SD | | LL9SD-014-0001-SD | | LL9SD-015-0001-DU | | LL9SD-015-0001-SD | | LL9SD-016-0001-DU | | LL9SD-016-0001-SD | | LL9SD-017-0001-SD | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/05/03 | | 12/05/03 | | 12/09/03 | | 12/09/03 | | 12/05/03 | | 12/05/03 | | 12/05/03 | |
| | | | | | | **Sample Depth** | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 0.5 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Sediment Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SD PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| Cyanide 9012A | 9014/9010B | Cyanide, Total | mg/Kg | 0.00 | 122 | nc | | | | | 0.27 | U | 0.3 | U | | | | | | |
| Explosives 8330 | 8330 | 1,3,5-Trinitrobenzene | mg/Kg | 0 | 183 | nc | | | | | 0.017 | U | 0.017 | U | | | | | | |
| | | 1,3-Dinitrobenzene | mg/Kg | 0 | 0.61 | nc | | | | | 0.017 | U | 0.018 | U | | | | | | |
| | | 2,4,6-TNT | mg/Kg | 0 | 16 | ca | | | | | 0.033 | U | 0.033 | U | | | | | | |
| | | 2,4-Dinitrotoluene | mg/Kg | 0 | 12 | nc | | | | | 0.035 | U | 0.035 | U | | | | | | |
| | | 2,6-Dinitrotoluene | mg/Kg | 0 | 6.1 | nc | | | | | 0.047 | U | 0.047 | U | | | | | | |
| | | 2-Nitrotoluene | mg/Kg | 0 | 0.88 | ca | | | | | 0.033 | U | 0.033 | U | | | | | | |
| | | 3-Nitrotoluene | mg/Kg | 0 | 73 | nc | | | | | 0.049 | U | 0.049 | U | | | | | | |
| | | 4-Nitrotoluene | mg/Kg | 0 | 12 | ca | | | | | 0.046 | U | 0.046 | U | | | | | | |
| | | HMX | mg/Kg | 0 | 306 | nc | | | | | 0.11 | U | 0.11 | U | | | | | | |
| | | Nitrobenzene | mg/Kg | 0 | 2 | nc | | | | | 0.022 | U | 0.022 | U | | | | | | |
| | | RDX | mg/Kg | 0 | 4.4 | ca | | | | | 0.057 | U | 0.058 | U | | | | | | |
| | | Tetryl | mg/Kg | 0 | 61 | nc | | | | | 0.043 | U | 0.043 | U | | | | | | |
| PCB TCL 8082 | 8082 | Aroclor 1016 | mg/Kg | -- | 0.39 | nc | | | | | 0.0035 | U | 0.0032 | U | | | | | | |
| | | Aroclor 1221 | mg/Kg | -- | 0.22 | ca | | | | | 0.0037 | U | 0.0034 | U | | | | | | |
| | | Aroclor 1232 | mg/Kg | -- | 0.22 | ca | | | | | 0.0037 | U | 0.0034 | U | | | | | | |
| | | Aroclor 1242 | mg/Kg | -- | 0.22 | ca | | | | | 0.0037 | U | 0.0034 | U | | | | | | |
| | | Aroclor 1248 | mg/Kg | -- | 0.22 | ca | | | | | 0.0037 | U | 0.0034 | U | | | | | | |
| | | Aroclor 1254 | mg/Kg | -- | 0.22 | ca | | | | | 0.0037 | U | 0.0034 | U | | | | | | |
| | | Aroclor 1260 | mg/Kg | -- | 0.22 | ca | | | | | 0.0026 | U | 0.0024 | U | | | | | | |
| Pesticides 8081A | 8081A | 4,4'-DDD | mg/Kg | -- | 2.4 | ca | | | | | 0.00066 | U | 0.00061 | U | | | | | | |
| | | 4,4'-DDE | mg/Kg | -- | 1.7 | ca | | | | | 0.0012 | U | 0.0011 | U | | | | | | |
| | | 4,4'-DDT | mg/Kg | -- | 1.7 | ca | | | | | 0.00068 | U | 0.00063 | U | | | | | | |
| | | Aldrin | mg/Kg | -- | 0.029 | ca | | | | | 0.00024 | U | 0.00022 | U | | | | | | |
| | | alpha-BHC | mg/Kg | -- | 0.09 | sat | | | | | 0.00029 | U | 0.00027 | U | | | | | | |
| | | alpha-Chlordane | mg/Kg | -- | 1.6 | ca | | | | | 0.00022 | U | 0.0002 | U | | | | | | |
| | | beta-BHC | mg/Kg | -- | 0.32 | ca | | | | | 0.00027 | U | 0.00026 | U | | | | | | |
| | | delta-BHC | mg/Kg | -- | -- | 0 | | | | | 0.0002 | U | 0.00019 | U | | | | | | |
| | | Dieldrin | mg/Kg | -- | 0.030 | ca | | | | | 0.00062 | U | 0.00058 | U | | | | | | |
| | | Endosulfan I | mg/Kg | -- | 37 | nc | | | | | 0.00049 | U | 0.00046 | U | | | | | | |
| | | Endosulfan II | mg/Kg | -- | 37 | nc | | | | | 0.00051 | U | 0.00048 | U | | | | | | |
| | | Endosulfan sulfate | mg/Kg | -- | 37 | nc | | | | | 0.00053 | U | 0.00049 | U | | | | | | |
| | | Endrin | mg/Kg | -- | 1.8 | nc | | | | | 0.00079 | U | 0.00073 | U | | | | | | |
| | | Endrin aldehyde | mg/Kg | -- | -- | 0 | | | | | 0.0006 | U | 0.00056 | U | | | | | | |
| | | Endrin ketone | mg/Kg | -- | -- | 0 | | | | | 0.00053 | U | 0.00049 | U | | | | | | |
| | | gamma-BHC (Lindane) | mg/Kg | -- | 0.44 | ca | | | | | 0.00042 | U | 0.00039 | U | | | | | | |
| | | gamma-Chlordane | mg/Kg | -- | 1.6 | ca | | | | | 0.00027 | U | 0.00026 | U | | | | | | |
| | | Heptachlor | mg/Kg | -- | 0.11 | ca | | | | | 0.00033 | U | 0.00031 | U | | | | | | |
| | | Heptachlor epoxide | mg/Kg | -- | 0.053 | ca | | | | | 0.00026 | U | 0.00024 | U | | | | | | |
| | | Methoxychlor | mg/Kg | -- | 31 | nc | | | | | 0.0042 | U | 0.0039 | U | | | | | | |
| | | Toxaphene | mg/Kg | -- | 0 | 0 | | | | | 0.0084 | U | 0.0078 | U | | | | | | |
| Propellants 8330 | 353.2 | Nitrocellulose | mg/Kg | 0 | -- | 0 | | | | | 4.2 | J | 2.8 | B J | | | | | | |
| | 8330 | Nitroglycerin | mg/Kg | 0 | -- | 0 | | | | | 0.5 | U | 0.5 | U | | | | | | |
| | UV/HPLC per SOP | Nitroguanidine | mg/Kg | 0 | 611 | nc | | | | | 0.25 | U | 0.25 | U | | | | | | |
| SVOCs TCL 8270 C | 8270C | 1,2,4-Trichlorobenzene | mg/Kg | -- | 6.2 | nc | | | | | 0.11 | U | 0.099 | U | | | | | | |
| | | 1,2-Dichlorobenzene | mg/Kg | -- | 600 | sat | | | | | 0.15 | U | 0.13 | U | | | | | | |
| | | 1,3-Dichlorobenzene | mg/Kg | -- | 53 | nc | | | | | 0.15 | U | 0.13 | U | | | | | | |
| | | 1,4-Dichlorobenzene | mg/Kg | -- | 3.4 | ca | | | | | 0.13 | U | 0.12 | U | | | | | | |
| | | 2,2-oxybis (1-chloropropane) | mg/Kg | -- | 2.9 | ca | | | | | 0.14 | U | 0.13 | U | | | | | | |
| | | 2,4,5-Trichlorophenol | mg/Kg | -- | 611 | nc | | | | | 0.071 | U | 0.064 | U | | | | | | |

# Table 4-13
## Summary of Sediment Results

| | | | | | | | LL9SD-002-0001-SD | | LL9SD-004-0001-SD | | LL9SD-006-0001-SD | | LL9SD-009-0001-SD | | LL9SD-010-0001-SD | | LL9SD-011-0001-SD | | LL9SD-012-0001-SD | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/05/03 | | 12/05/03 | | 12/05/03 | | 12/09/03 | | 12/09/03 | | 12/05/03 | | 12/09/03 | |
| | | | | | | **Sample Depth** | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 1 ft | | 0 - 0.5 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Sediment Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SD PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| | | 2,4,6-Trichlorophenol | mg/Kg | -- | 0.61 | nc | | | | | | | 0.06 | U | | | | | | |
| | | 2,4-Dichlorophenol | mg/Kg | -- | 18 | nc | | | | | | | 0.062 | U | | | | | | |
| | | 2,4-Dimethylphenol | mg/Kg | -- | 122 | nc | | | | | | | 0.077 | U | | | | | | |
| | | 2,4-Dinitrophenol | mg/Kg | -- | 12 | nc | | | | | | | 0.15 | U | | | | | | |
| | | 2-Chloronaphthalene | mg/Kg | -- | 494 | nc | | | | | | | 0.062 | U | | | | | | |
| | | 2-Chlorophenol | mg/Kg | -- | 6.3 | nc | | | | | | | 0.076 | U | | | | | | |
| | | 2-Methylnaphthalene | mg/Kg | -- | -- | 0 | | | | | | | 0.011 | Ja | | | | | | |
| | | 2-Methylphenol (o-cresol) | mg/Kg | -- | 306 | nc | | | | | | | 0.011 | U | | | | | | |
| | | 2-Nitroaniline | mg/Kg | -- | 18.3 | nc | | | | | | | 0.044 | U | | | | | | |
| | | 2-Nitrophenol | mg/Kg | -- | -- | 0 | | | | | | | 0.081 | U | | | | | | |
| | | 3,3-Dichlorobenzidine | mg/Kg | -- | 1.1 | ca | | | | | | | 0.023 | U | | | | | | |
| | | 3-Nitroaniline | mg/Kg | -- | 1.8 | nc | | | | | | | 0.14 | U | | | | | | |
| | | 4,6-Dinitro-2-methylphenol | mg/Kg | -- | 0.61 | nc | | | | | | | 0.12 | U | | | | | | |
| | | 4-Bromophenyl phenyl ether | mg/Kg | -- | -- | 0 | | | | | | | 0.004 | U | | | | | | |
| | | 4-Chloro-3-methylphenol | mg/Kg | -- | -- | 0 | | | | | | | 0.049 | U | | | | | | |
| | | 4-Chloroaniline | mg/Kg | -- | 24 | nc | | | | | | | 0.13 | U | | | | | | |
| | | 4-Chlorophenyl phenyl ether | mg/Kg | -- | -- | 0 | | | | | | | 0.0046 | U | | | | | | |
| | | 4-Methylphenol (m/p-cresol) | mg/Kg | -- | 31 | nc | | | | | | | 0.0075 | U | | | | | | |
| | | 4-Nitroaniline | mg/Kg | -- | 23 | ca | | | | | | | 0.05 | U | | | | | | |
| | | 4-Nitrophenol | mg/Kg | -- | -- | 0 | | | | | | | 0.11 | U | | | | | | |
| | | Acenaphthene | mg/Kg | -- | 368 | nc | | | | | | | 0.075 | | | | | | | |
| | | Acenaphthylene | mg/Kg | -- | -- | 0 | | | | | | | 0.05 | | | | | | | |
| | | Anthracene | mg/Kg | -- | 2189 | nc | | | | | | | 0.48 | | | | | | | |
| | | Benzo(a)anthracene | mg/Kg | -- | 0.62 | ca | | | | | | | **2.1** | | | | | | | |
| | | Benzo(a)pyrene | mg/Kg | -- | 0.062 | ca | | | | | | | **2.2** | | | | | | | |
| | | Benzo(b)fluoranthene | mg/Kg | -- | 0.62 | ca | | | | | | | **2.5** | | | | | | | |
| | | Benzo(ghi)perylene | mg/Kg | -- | -- | 0 | | | | | | | 1.2 | | | | | | | |
| | | Benzo(k)fluoranthene | mg/Kg | -- | 6.2 | ca | | | | | | | 1.3 | M | | | | | | |
| | | Bis(2-chloroethoxy)methane | mg/Kg | -- | -- | 0 | | | | | | | 0.0037 | U | | | | | | |
| | | Bis(2-chloroethyl)ether | mg/Kg | -- | 0.22 | ca | | | | | | | 0.0026 | U | | | | | | |
| | | Bis(2-ethylhexyl)phthalate | mg/Kg | -- | 35 | ca | | | | | | | 0.39 | | | | | | | |
| | | Butyl benzyl phthalate | mg/Kg | -- | 1222 | nc | | | | | | | 0.0053 | U | | | | | | |
| | | Carbazole | mg/Kg | -- | 24 | ca | | | | | | | 0.36 | | | | | | | |
| | | Chrysene | mg/Kg | -- | 62 | ca | | | | | | | 2.4 | | | | | | | |
| | | Dibenzo(a,h)anthracene | mg/Kg | -- | 0.062 | ca | | | | | | | **0.61** | | | | | | | |
| | | Dibenzofuran | mg/Kg | -- | 15 | nc | | | | | | | 0.097 | | | | | | | |
| | | Diethyl phthalate | mg/Kg | -- | 4888 | nc | | | | | | | 0.0048 | U | | | | | | |
| | | Dimethyl phthalate | mg/Kg | -- | 100000 | max | | | | | | | 0.0046 | U | | | | | | |
| | | Di-n-butyl phthalate | mg/Kg | -- | 611 | nc | | | | | | | 0.032 | Ja | | | | | | |
| | | Di-n-octyl phthalate | mg/Kg | -- | 244 | nc | | | | | | | 0.017 | Ja | | | | | | |
| | | Fluoranthene | mg/Kg | -- | 229 | nc | | | | | | | 4.1 | | | | | | | |
| | | Fluorene | mg/Kg | -- | 275 | nc | | | | | | | 0.22 | | | | | | | |
| | | Hexachlorobenzene | mg/Kg | -- | 0.30 | ca | | | | | | | 0.0023 | U | | | | | | |
| | | Hexachlorobutadiene | mg/Kg | -- | 6.2 | ca | | | | | | | 0.0042 | U | | | | | | |
| | | Hexachlorocyclopentadiene | mg/Kg | -- | 37 | nc | | | | | | | 0.069 | U | | | | | | |
| | | Hexachloroethane | mg/Kg | -- | 35 | ca | | | | | | | 0.0042 | U | | | | | | |
| | | Indeno(1,2,3-cd)pyrene | mg/Kg | -- | 0.62 | ca | | | | | | | **1.1** | | | | | | | |
| | | Isophorone | mg/Kg | -- | 512 | ca | | | | | | | 0.0031 | U | | | | | | |
| | | Naphthalene | mg/Kg | -- | 5.6 | nc | | | | | | | 0.016 | Ja | | | | | | |
| | | n-Nitroso-di-n-propylamine | mg/Kg | -- | 0.069 | ca | | | | | | | 0.003 | U | | | | | | |

# Table 4-13
## Summary of Sediment Results

| | | | | | | | LL9SD-013-0001-SD | | LL9SD-014-0001-SD | | LL9SD-015-0001-DU | | LL9SD-015-0001-SD | | LL9SD-016-0001-DU | | LL9SD-016-0001-SD | | LL9SD-017-0001-SD | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/05/03 | | 12/05/03 | | 12/09/03 | | 12/09/03 | | 12/05/03 | | 12/05/03 | | 12/05/03 | |
| | | | | | | **Sample Depth** | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 0.5 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Sediment Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SD PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| | | 2,4,6-Trichlorophenol | mg/Kg | -- | 0.61 | nc | | | | | 0.088 | U | 0.079 | U | | | | | | |
| | | 2,4-Dichlorophenol | mg/Kg | -- | 18 | nc | | | | | 0.09 | U | 0.081 | U | | | | | | |
| | | 2,4-Dimethylphenol | mg/Kg | -- | 122 | nc | | | | | 0.11 | U | 0.1 | U | | | | | | |
| | | 2,4-Dinitrophenol | mg/Kg | -- | 12 | nc | | | | | 0.21 | U | 0.19 | U | | | | | | |
| | | 2-Chloronaphthalene | mg/Kg | -- | 494 | nc | | | | | 0.09 | U | 0.081 | U | | | | | | |
| | | 2-Chlorophenol | mg/Kg | -- | 6.3 | nc | | | | | 0.11 | U | 0.099 | U | | | | | | |
| | | 2-Methylnaphthalene | mg/Kg | -- | -- | 0 | | | | | 0.0028 | U | 0.004 | Ja | | | | | | |
| | | 2-Methylphenol (o-cresol) | mg/Kg | -- | 306 | nc | | | | | 0.016 | U | 0.014 | U | | | | | | |
| | | 2-Nitroaniline | mg/Kg | -- | 18.3 | nc | | | | | 0.063 | U | 0.057 | U | | | | | | |
| | | 2-Nitrophenol | mg/Kg | -- | -- | 0 | | | | | 0.12 | U | 0.11 | U | | | | | | |
| | | 3,3-Dichlorobenzidine | mg/Kg | -- | 1.1 | ca | | | | | 0.034 | U | 0.03 | U | | | | | | |
| | | 3-Nitroaniline | mg/Kg | -- | 1.8 | nc | | | | | 0.21 | U | 0.19 | U | | | | | | |
| | | 4,6-Dinitro-2-methylphenol | mg/Kg | -- | 0.61 | nc | | | | | 0.18 | U | 0.16 | U | | | | | | |
| | | 4-Bromophenyl phenyl ether | mg/Kg | -- | -- | 0 | | | | | 0.0058 | U | 0.0052 | U | | | | | | |
| | | 4-Chloro-3-methylphenol | mg/Kg | -- | -- | 0 | | | | | 0.071 | U | 0.064 | U | | | | | | |
| | | 4-Chloroaniline | mg/Kg | -- | 24 | nc | | | | | 0.19 | U | 0.17 | U | | | | | | |
| | | 4-Chlorophenyl phenyl ether | mg/Kg | -- | -- | 0 | | | | | 0.0067 | U | 0.0061 | U | | | | | | |
| | | 4-Methylphenol (m/p-cresol) | mg/Kg | -- | 31 | nc | | | | | 0.011 | U | 0.0098 | U | | | | | | |
| | | 4-Nitroaniline | mg/Kg | -- | 23 | ca | | | | | 0.073 | U | 0.066 | U | | | | | | |
| | | 4-Nitrophenol | mg/Kg | -- | -- | 0 | | | | | 0.15 | U | 0.14 | U | | | | | | |
| | | Acenaphthene | mg/Kg | -- | 368 | nc | | | | | 0.0026 | U | 0.0024 | U | | | | | | |
| | | Acenaphthylene | mg/Kg | -- | -- | 0 | | | | | 0.0017 | U | 0.0018 | Ja | | | | | | |
| | | Anthracene | mg/Kg | -- | 2189 | nc | | | | | 0.0016 | U | 0.0031 | Ja | | | | | | |
| | | Benzo(a)anthracene | mg/Kg | -- | 0.62 | ca | | | | | 0.016 | Ja | 0.02 | Ja | | | | | | |
| | | Benzo(a)pyrene | mg/Kg | -- | 0.062 | ca | | | | | 0.021 | Ja | 0.025 | Ja | | | | | | |
| | | Benzo(b)fluoranthene | mg/Kg | -- | 0.62 | ca | | | | | 0.02 | Ja | 0.024 | Ja | | | | | | |
| | | Benzo(ghi)perylene | mg/Kg | -- | -- | 0 | | | | | 0.013 | Ja | 0.018 | Ja | | | | | | |
| | | Benzo(k)fluoranthene | mg/Kg | -- | 6.2 | ca | | | | | 0.019 | Ja | 0.029 | Ja | | | | | | |
| | | Bis(2-chloroethoxy)methane | mg/Kg | -- | -- | 0 | | | | | 0.0054 | U | 0.0049 | U | | | | | | |
| | | Bis(2-chloroethyl)ether | mg/Kg | -- | 0.22 | ca | | | | | 0.0037 | U | 0.0034 | U | | | | | | |
| | | Bis(2-ethylhexyl)phthalate | mg/Kg | -- | 35 | ca | | | | | 0.55 | | 0.66 | | | | | | | |
| | | Butyl benzyl phthalate | mg/Kg | -- | 1222 | nc | | | | | 0.0077 | U | 0.0088 | Ja | | | | | | |
| | | Carbazole | mg/Kg | -- | 24 | ca | | | | | 0.065 | U | 0.059 | U | | | | | | |
| | | Chrysene | mg/Kg | -- | 62 | ca | | | | | 0.023 | Ja | 0.029 | Ja | | | | | | |
| | | Dibenzo(a,h)anthracene | mg/Kg | -- | 0.062 | ca | | | | | 0.043 | Ja | 0.0037 | U | | | | | | |
| | | Dibenzofuran | mg/Kg | -- | 15 | nc | | | | | 0.005 | U | 0.0046 | U | | | | | | |
| | | Diethyl phthalate | mg/Kg | -- | 4888 | nc | | | | | 0.0069 | U | 0.0062 | U | | | | | | |
| | | Dimethyl phthalate | mg/Kg | -- | 100000 | max | | | | | 0.0067 | U | 0.0061 | U | | | | | | |
| | | Di-n-butyl phthalate | mg/Kg | -- | 611 | nc | | | | | 0.037 | U | 0.038 | Ja | | | | | | |
| | | Di-n-octyl phthalate | mg/Kg | -- | 244 | nc | | | | | 0.016 | U | 0.015 | U | | | | | | |
| | | Fluoranthene | mg/Kg | -- | 229 | nc | | | | | 0.037 | Ja | 0.048 | Ja | | | | | | |
| | | Fluorene | mg/Kg | -- | 275 | nc | | | | | 0.003 | U | 0.0027 | U | | | | | | |
| | | Hexachlorobenzene | mg/Kg | -- | 0.30 | ca | | | | | 0.0034 | U | 0.003 | U | | | | | | |
| | | Hexachlorobutadiene | mg/Kg | -- | 6.2 | ca | | | | | 0.0062 | U | 0.0056 | U | | | | | | |
| | | Hexachlorocyclopentadiene | mg/Kg | -- | 37 | nc | | | | | 0.1 | U | 0.091 | U | | | | | | |
| | | Hexachloroethane | mg/Kg | -- | 35 | ca | | | | | 0.0062 | U | 0.0056 | U | | | | | | |
| | | Indeno(1,2,3-cd)pyrene | mg/Kg | -- | 0.62 | ca | | | | | 0.037 | Ja | 0.039 | Ja | | | | | | |
| | | Isophorone | mg/Kg | -- | 512 | ca | | | | | 0.0045 | U | 0.004 | U | | | | | | |
| | | Naphthalene | mg/Kg | -- | 5.6 | nc | | | | | 0.0032 | U | 0.0029 | U | | | | | | |
| | | n-Nitroso-di-n-propylamine | mg/Kg | -- | 0.069 | ca | | | | | 0.0043 | U | 0.0039 | U | | | | | | |

## Table 4-13
## Summary of Sediment Results

| | | | | | | | LL9SD-002-0001-SD | | LL9SD-004-0001-SD | | LL9SD-006-0001-SD | | LL9SD-009-0001-SD | | LL9SD-010-0001-SD | | LL9SD-011-0001-SD | | LL9SD-012-0001-SD | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Sample Date | 12/05/03 | | 12/05/03 | | 12/05/03 | | 12/09/03 | | 12/09/03 | | 12/05/03 | | 12/09/03 | |
| | | | | | | Sample Depth | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 1 ft | | 0 - 0.5 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Sediment Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SD PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| | | n-Nitrosodiphenylamine | mg/Kg | -- | 99 | ca | | | | | | | 0.0037 | U | | | | | | |
| | | Pentachlorophenol | mg/Kg | -- | 3.0 | ca | | | | | | | 0.13 | U | | | | | | |
| | | Phenanthrene | mg/Kg | -- | -- | 0 | | | | | | | 2.1 | | | | | | | |
| | | Phenol | mg/Kg | -- | 1833 | nc | | | | | | | 0.0021 | U | | | | | | |
| | | Pyrene | mg/Kg | -- | 232 | nc | | | | | | | 3.7 | | | | | | | |
| TAL Metals 6010B | 6010B | Aluminum | mg/Kg | 13900 | 7614 | nc | 5500 | | **14000** | | **11000** | | 7200 | | **9100** | | **8800** | | **12000** | |
| | | Barium | mg/Kg | 123 | 538 | nc | 140 | | 89 | | 64 | | 63 | | 98 | | 58 | | 100 | |
| | | Beryllium | mg/Kg | 0.38 | 15 | nc | 0.77 | | 0.76 | | 0.31 | B | 0.41 | B | 0.48 | B | 0.51 | B | 0.86 | |
| | | Cadmium | mg/Kg | 0.00 | 3.7 | nc | 0.19 | B | 0.77 | | 0.2 | B | 1 | | 1.2 | | 0.4 | | 0.1 | U |
| | | Calcium | mg/Kg | 5510 | -- | 0 | 870 | | 3000 | | 1700 | | 1500 | | 3100 | | 1100 | | 1200 | |
| | | Chromium | mg/Kg | 18.1 | 30 | ca | 6.3 | | 17 | | 14 | | 14 | | 18 | | 12 | | 14 | |
| | | Cobalt | mg/Kg | 9.1 | 30 | ca | 6.2 | | 9.1 | | 5.2 | | 7.6 | | 9.1 | | 9.4 | | 7.1 | |
| | | Copper | mg/Kg | 27.6 | 313 | nc | 13 | | 16 | | 11 | | 120 | H | 34 | H | 14 | | 7.6 | |
| | | Iron | mg/Kg | 28200 | 2346 | nc | **39000** | | **26000** | | **18000** | | **31000** | | **33000** | | **22000** | | **24000** | |
| | | Magnesium | mg/Kg | 2760 | -- | 0 | 620 | | 2400 | | 1800 | | 2000 | | 2300 | | 2300 | | 1800 | |
| | | Manganese | mg/Kg | 1950 | 176 | nc | **300** | | **1200** | | **250** | | **400** | | **710** | | **680** | | **1300** | |
| | | Nickel | mg/Kg | 17.7 | 156 | nc | 16 | | 18 | | 11 | | 24 | | 26 | | 16 | | 19 | |
| | | Potassium | mg/Kg | 1950 | -- | 0 | 350 | | 1100 | | 860 | | 920 | | 1200 | | 830 | | 1000 | |
| | | Selenium | mg/Kg | 1.7 | 39 | nc | 1.4 | B | 2.1 | | 0.7 | B | 0.49 | U | 0.51 | B | 0.86 | B | 0.82 | B |
| | | Silver | mg/Kg | 0.00 | 39 | nc | 0.59 | U | 0.5 | U | 0.47 | U | 0.38 | U | 0.38 | U | 0.44 | U | 0.39 | U |
| | | Sodium | mg/Kg | 112 | -- | 0 | 170 | U | 140 | U | 130 | U | 110 | U | 110 | U | 120 | U | 110 | U |
| | | Vanadium | mg/Kg | 26.1 | 7.8 | nc | 7.6 | | **26** | | **20** | | **19** | | **38** | | **15** | | **24** | |
| | | Zinc | mg/Kg | 532 | 2346 | nc | 140 | | 420 | | 70 | | 220 | | 120 | | 210 | | 69 | |
| | 7041 | Antimony | mg/Kg | 0.00 | 3.1 | nc | 0.81 | U | 0.8 | U | 0.69 | U | 0.55 | U | 0.56 | U | 0.62 | U | 0.57 | U |
| | 7060A | Arsenic | mg/Kg | 19.5 | 0.39 | ca | **9.7** | | **11** | | **10** | | **15** | | **25** | | **4.2** | | **14** | |
| | 7421 | Lead | mg/Kg | 27.4 | 400 | pbk | 24 | | 31 | | 36 | | 200 | | 300 | | 15 | | 17 | |
| | 7471A | Mercury | mg/Kg | 0.06 | 2.3 | nc | 0.044 | | 0.1 | | 0.072 | | **6** | | **110** | | 0.026 | | **2.9** | |
| | 7841 | Thallium | mg/Kg | 0.89 | 0.52 | nc | 0.35 | U | 0.35 | U | 0.3 | U | 0.24 | U | 0.24 | U | 0.27 | U | 0.31 | |
| | Lloyd Kahn | TOC Average Duplicates | mg/Kg | 0.89 | 0.52 | nc | **11000** | | **15000** | | **24000** | | **4200** | | **3700** | | **8700** | | **3500** | |
| VOCs TCL 8260B | 8260B | 1,1,1-Trichloroethane | mg/Kg | -- | 1200 | sat | | | | | | | 0.0014 | U | | | | | | |
| | | 1,1,2,2-Tetrachloroethane | mg/Kg | -- | 0.41 | ca | | | | | | | 0.0012 | U | | | | | | |
| | | 1,1,2-Trichloroethane | mg/Kg | -- | 0.73 | ca | | | | | | | 0.0014 | U | | | | | | |
| | | 1,1-Dichloroethane | mg/Kg | -- | 51 | nc | | | | | | | 0.0013 | U | | | | | | |
| | | 1,1-Dichloroethene | mg/Kg | -- | 12 | nc | | | | | | | 0.0017 | U | | | | | | |
| | | 1,2-Dichloroethane | mg/Kg | -- | 0.28 | ca | | | | | | | 0.0012 | U | | | | | | |
| | | 1,2-Dichloroethene (total) | mg/Kg | -- | 6.9 | nc | | | | | | | 0.0027 | U | | | | | | |
| | | 1,2-Dichloropropane | mg/Kg | -- | 0.34 | ca | | | | | | | 0.0013 | U | | | | | | |
| | | 2-Butanone (MEK) | mg/Kg | -- | 2231 | nc | | | | | | | 0.005 | U | | | | | | |
| | | 2-Hexanone | mg/Kg | -- | 530 | nc | | | | | | | 0.0014 | U | | | | | | |
| | | 4-Methyl-2-pentanone (MIBK) | mg/Kg | -- | 528 | nc | | | | | | | 0.0013 | U | | | | | | |
| | | Acetone | mg/Kg | -- | 1412 | nc | | | | | | | 0.0059 | U | | | | | | |
| | | Benzene | mg/Kg | -- | 0.64 | ca | | | | | | | 0.0014 | U | | | | | | |
| | | Bromodichloromethane | mg/Kg | -- | 0.82 | ca | | | | | | | 0.0012 | U | | | | | | |
| | | Bromoform | mg/Kg | -- | 62 | ca | | | | | | | 0.00097 | U | | | | | | |
| | | Bromomethane | mg/Kg | -- | 0.39 | nc | | | | | | | 0.0017 | U | | | | | | |
| | | Carbon disulfide | mg/Kg | -- | 36 | nc | | | | | | | 0.0016 | U | | | | | | |
| | | Carbon tetrachloride | mg/Kg | -- | 0.25 | ca | | | | | | | 0.0014 | U | | | | | | |
| | | Chlorobenzene | mg/Kg | -- | 15 | nc | | | | | | | 0.0014 | U | | | | | | |
| | | Chloroethane | mg/Kg | -- | 3.0 | ca | | | | | | | 0.0013 | U | | | | | | |
| | | Chloroform | mg/Kg | -- | 0.22 | ca | | | | | | | 0.0014 | U | | | | | | |
| | | Chloromethane | mg/Kg | -- | 4.7 | nc | | | | | | | 0.0014 | U | | | | | | |

## Table 4-13
## Summary of Sediment Results

| | | | | | | | LL9SD-013-0001-SD | | LL9SD-014-0001-SD | | LL9SD-015-0001-DUP | | LL9SD-015-0001-SD | | LL9SD-016-0001-DUP | | LL9SD-016-0001-SD | | LL9SD-017-0001-SD | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/05/03 | | 12/05/03 | | 12/09/03 | | 12/09/03 | | 12/05/03 | | 12/05/03 | | 12/05/03 | |
| | | | | | | **Sample Depth** | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 0.5 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Sediment Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SD PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| | | n-Nitrosodiphenylamine | mg/Kg | -- | 99 | ca | | | | | 0.0054 | U | 0.0049 | U | | | | | | |
| | | Pentachlorophenol | mg/Kg | -- | 3.0 | ca | | | | | 0.19 | U | 0.17 | U | | | | | | |
| | | Phenanthrene | mg/Kg | -- | -- | 0 | | | | | 0.02 | Ja | 0.02 | Ja | | | | | | |
| | | Phenol | mg/Kg | -- | 1833 | nc | | | | | 0.003 | U | 0.0027 | U | | | | | | |
| | | Pyrene | mg/Kg | -- | 232 | nc | | | | | 0.028 | Ja | 0.034 | Ja | | | | | | |
| TAL Metals 6010B | 6010B | Aluminum | mg/Kg | 13900 | 7614 | nc | **12000** | | **11000** | | **12000** | | **12000** | | **13000** | | **11000** | | **12000** | |
| | | Barium | mg/Kg | 123 | 538 | nc | 65 | | 96 | | 92 | | 89 | | 86 | | 73 | | 100 | |
| | | Beryllium | mg/Kg | 0.38 | 15 | nc | 0.52 | B | 0.63 | B | 0.59 | B | 0.54 | B | 0.51 | B | 0.47 | B | 0.65 | |
| | | Cadmium | mg/Kg | 0.00 | 3.7 | nc | 0.5 | | 0.35 | B | 0.71 | | 0.61 | | 0.53 | | 0.32 | | 0.31 | B |
| | | Calcium | mg/Kg | 5510 | -- | 0 | 2100 | | 2700 | | 1900 | | 1800 | | 11000 | | 6900 | | 1700 | |
| | | Chromium | mg/Kg | 18.1 | 30 | ca | 18 | | 15 | | 16 | | 15 | | 22 | | 16 | | 15 | |
| | | Cobalt | mg/Kg | 9.1 | 30 | ca | 7.2 | | 7 | | 7.9 | | 7.4 | | 9.5 | | 8.2 | | 9.5 | |
| | | Copper | mg/Kg | 27.6 | 313 | nc | 18 | | 16 | | 14 | | 13 | | 22 | | 18 | | 12 | |
| | | Iron | mg/Kg | 28200 | 2346 | nc | **26000** | | **19000** | | **20000** | | **17000** | | **25000** | | **23000** | | **20000** | |
| | | Magnesium | mg/Kg | 2760 | -- | 0 | 2300 | | 2200 | | 1900 | | 1800 | | 3000 | | 2700 | | 2000 | |
| | | Manganese | mg/Kg | 1950 | 176 | nc | **200** | | **880** | | **670** | | **610** | | **890** | | **640** | | **1400** | |
| | | Nickel | mg/Kg | 17.7 | 156 | nc | 17 | | 18 | | 18 | | 18 | | 21 | | 17 | | 16 | |
| | | Potassium | mg/Kg | 1950 | -- | 0 | 1000 | | 1100 | | 950 | | 900 | | 1300 | | 1100 | | 830 | |
| | | Selenium | mg/Kg | 1.7 | 39 | nc | 1.6 | | 1.8 | B | 1.2 | B | 0.82 | B | 1.9 | | 1.4 | B | 1.4 | B |
| | | Silver | mg/Kg | 0.00 | 39 | nc | 0.51 | U | 0.74 | U | 0.56 | U | 0.49 | U | 0.57 | U | 0.49 | U | 0.49 | U |
| | | Sodium | mg/Kg | 112 | -- | 0 | 140 | U | 210 | U | 160 | U | 140 | U | 160 | U | 140 | U | 140 | U |
| | | Vanadium | mg/Kg | 26.1 | 7.8 | nc | **22** | | **20** | | **23** | | **21** | | **23** | | **20** | | **24** | |
| | | Zinc | mg/Kg | 532 | 2346 | nc | 130 | | 85 | | 160 | | 140 | | 120 | | 97 | | 110 | |
| | 7041 | Antimony | mg/Kg | 0.00 | 3.1 | nc | 0.88 | U | 0.99 | U | 0.78 | U | 0.69 | U | 0.85 | U | 0.69 | U | 0.74 | U |
| | 7060A | Arsenic | mg/Kg | 19.5 | 0.39 | ca | **15** | | **10** | | **10** | | **10** | | **14** | | **13** | | **13** | |
| | 7421 | Lead | mg/Kg | 27.4 | 400 | pbk | 100 | | 35 | | 77 | | 71 | | 49 | | 32 | | 29 | |
| | 7471A | Mercury | mg/Kg | 0.06 | 2.3 | nc | 0.18 | | 0.33 | | 0.13 | | 0.12 | | 1.3 | | 0.45 | | 0.068 | |
| | 7841 | Thallium | mg/Kg | 0.89 | 0.52 | nc | 0.38 | U | 0.43 | U | 0.34 | U | 0.3 | U | 0.37 | U | 0.3 | U | 0.32 | U |
| | Lloyd Kahn | TOC Average Duplicates | mg/Kg | 0.89 | 0.52 | nc | **28000** | | **24000** | | **12000** | | **16000** | | **15000** | | **11000** | | **26000** | |
| VOCs TCL 8260B | 8260B | 1,1,1-Trichloroethane | mg/Kg | -- | 1200 | sat | | | | | 0.0021 | U | 0.0019 | U | | | | | | |
| | | 1,1,2,2-Tetrachloroethane | mg/Kg | -- | 0.41 | ca | | | | | 0.0018 | U | 0.0016 | U | | | | | | |
| | | 1,1,2-Trichloroethane | mg/Kg | -- | 0.73 | ca | | | | | 0.0021 | U | 0.0019 | U | | | | | | |
| | | 1,1-Dichloroethane | mg/Kg | -- | 51 | nc | | | | | 0.0019 | U | 0.0017 | U | | | | | | |
| | | 1,1-Dichloroethene | mg/Kg | -- | 12 | nc | | | | | 0.0025 | U | 0.0022 | U | | | | | | |
| | | 1,2-Dichloroethane | mg/Kg | -- | 0.28 | ca | | | | | 0.0018 | U | 0.0016 | U | | | | | | |
| | | 1,2-Dichloroethene (total) | mg/Kg | -- | 6.9 | nc | | | | | 0.004 | U | 0.0036 | U | | | | | | |
| | | 1,2-Dichloropropane | mg/Kg | -- | 0.34 | ca | | | | | 0.0019 | U | 0.0017 | U | | | | | | |
| | | 2-Butanone (MEK) | mg/Kg | -- | 2231 | nc | | | | | 0.0075 | U | 0.0067 | U | | | | | | |
| | | 2-Hexanone | mg/Kg | -- | 530 | nc | | | | | 0.0021 | U | 0.0019 | U | | | | | | |
| | | 4-Methyl-2-pentanone (MIBK) | mg/Kg | -- | 528 | nc | | | | | 0.0019 | U | 0.0017 | U | | | | | | |
| | | Acetone | mg/Kg | -- | 1412 | nc | | | | | 0.0088 | U | 0.0078 | U | | | | | | |
| | | Benzene | mg/Kg | -- | 0.64 | ca | | | | | 0.0021 | U | 0.0019 | U | | | | | | |
| | | Bromodichloromethane | mg/Kg | -- | 0.82 | ca | | | | | 0.0018 | U | 0.0016 | U | | | | | | |
| | | Bromoform | mg/Kg | -- | 62 | ca | | | | | 0.0014 | U | 0.0013 | U | | | | | | |
| | | Bromomethane | mg/Kg | -- | 0.39 | nc | | | | | 0.0025 | U | 0.0022 | U | | | | | | |
| | | Carbon disulfide | mg/Kg | -- | 36 | nc | | | | | 0.0023 | U | 0.002 | U | | | | | | |
| | | Carbon tetrachloride | mg/Kg | -- | 0.25 | ca | | | | | 0.0021 | U | 0.0019 | U | | | | | | |
| | | Chlorobenzene | mg/Kg | -- | 15 | nc | | | | | 0.0021 | U | 0.0019 | U | | | | | | |
| | | Chloroethane | mg/Kg | -- | 3.0 | ca | | | | | 0.0019 | U | 0.0017 | U | | | | | | |
| | | Chloroform | mg/Kg | -- | 0.22 | ca | | | | | 0.0021 | U | 0.0019 | U | | | | | | |
| | | Chloromethane | mg/Kg | -- | 4.7 | nc | | | | | 0.0021 | U | 0.0019 | U | | | | | | |

# Table 4-13
# Summary of Sediment Results

| | | | | | | | LL9SD-002-0001-SD | | LL9SD-004-0001-SD | | LL9SD-006-0001-SD | | LL9SD-009-0001-SD | | LL9SD-010-0001-SD | | LL9SD-011-0001-SD | | LL9SD-012-0001-SD | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/05/03 | | 12/05/03 | | 12/05/03 | | 12/09/03 | | 12/09/03 | | 12/05/03 | | 12/09/03 | |
| | | | | | | **Sample Depth** | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 1 ft | | 0 - 0.5 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Sediment Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SD PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| | | cis-1,3-Dichloropropene | mg/Kg | -- | 0.78 | ca | | | | | | | 0.0012 | U | | | | | | |
| | | Dibromochloromethane | mg/Kg | -- | 1.1 | ca | | | | | | | 0.001 | U | | | | | | |
| | | Ethylbenzene | mg/Kg | -- | 395 | sat | | | | | | | 0.0014 | U | | | | | | |
| | | Methylene chloride | mg/Kg | -- | 9.1 | ca | | | | | | | 0.0037 | U | | | | | | |
| | | Styrene | mg/Kg | -- | 1700 | sat | | | | | | | 0.0014 | U | | | | | | |
| | | Tetrachloroethene | mg/Kg | -- | 0.48 | ca | | | | | | | 0.0016 | U | | | | | | |
| | | Toluene | mg/Kg | -- | 520 | sat | | | | | | | 0.0014 | U | | | | | | |
| | | trans-1,3-Dichloropropene | mg/Kg | -- | 0.78 | ca | | | | | | | 0.001 | U | | | | | | |
| | | Trichloroethene | mg/Kg | -- | 0.053 | ca | | | | | | | 0.0014 | U | | | | | | |
| | | Vinyl chloride | mg/Kg | -- | 0.079 | ca | | | | | | | 0.0014 | U | | | | | | |
| | | Xylenes (total) | mg/Kg | -- | 0.079 | ca | | | | | | | 0.0044 | U | | | | | | |

**Notes:**
-- - no background/PRG value is available for this analyte
blank cell indicates that the analysis was not performed
PRG - preliminary remediation goals (The PRG for lead is the Maximum Contaminant Level (MCL)
nc - non-cancer basis
ca - cancer basis
pbk - based on PBK modeling
mcl - based on CWA maximum contaminant level
max - ceiling limit
sat - soil saturation
[n] - nutrient
UC - unconsolidated
If Result = or > Background, then the value is presented with a shaded/highlighted style
If Result = or > Background and PRG, then the value is presented with a bold + shaded/highlighted style
If Result = or > PRG, then the value is presented with a bold style
If Result < PRG and Background, then the value is presented with a normal style

**Inorganic Qualifiers**
U - analyte was not detected at or above the stated limit
J - result is less than the RL, but greater than or equal to the MDL
B - result is less than the CRDL/RL, but greater than or equal to the IDL/MDL
**InOrganic Flags**
^ - instrument related QC exceed the upper or lower control limits
* - batch QC exceeds the upper or lower control limit
H - batch QC is greater than RL
**Organic Qualifiers**
U - analyte was not detected at or above the stated limit
J - result is an estimated value below the RL
**Organic Flags**
B - Method Blank: batch QC is greater than RL
* - batch QC exceeds the upper or lower control limit
^ - batch QC is greater than RL
a - concentration is below the method Reporting Limit (RL)
H - alternate peak selection upon analytical review

## Table 4-13
## Summary of Sediment Results

| | | | | | | | LL9SD-013-0001-SD | | LL9SD-014-0001-SD | | LL9SD-015-0001-DU | | LL9SD-015-0001-SD | | LL9SD-016-0001-DU | | LL9SD-016-0001-SD | | LL9SD-017-0001-SD | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Sample Date** | 12/05/03 | | 12/05/03 | | 12/09/03 | | 12/09/03 | | 12/05/03 | | 12/05/03 | | 12/05/03 | |
| | | | | | | **Sample Depth** | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 0.5 ft | | 0 - 0.5 ft | |
| **Group** | **Method** | **Analyte** | **Units** | **RVAAP Sediment Background Criteria** | **Region 9 (Residential Soil) PRGs** | **SD PRG Basis** | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| | | cis-1,3-Dichloropropene | mg/Kg | -- | 0.78 | ca | | | | | 0.0018 | U | 0.0016 | U | | | | | | |
| | | Dibromochloromethane | mg/Kg | -- | 1.1 | ca | | | | | 0.0015 | U | 0.0013 | U | | | | | | |
| | | Ethylbenzene | mg/Kg | -- | 395 | sat | | | | | 0.0021 | U | 0.0019 | U | | | | | | |
| | | Methylene chloride | mg/Kg | -- | 9.1 | ca | | | | | 0.0056 | U | 0.0049 | U | | | | | | |
| | | Styrene | mg/Kg | -- | 1700 | sat | | | | | 0.0021 | U | 0.0019 | U | | | | | | |
| | | Tetrachloroethene | mg/Kg | -- | 0.48 | ca | | | | | 0.0023 | U | 0.002 | U | | | | | | |
| | | Toluene | mg/Kg | -- | 520 | sat | | | | | 0.0021 | U | 0.0019 | U | | | | | | |
| | | trans-1,3-Dichloropropene | mg/Kg | -- | 0.78 | ca | | | | | 0.0015 | U | 0.0013 | U | | | | | | |
| | | Trichloroethene | mg/Kg | -- | 0.053 | ca | | | | | 0.0021 | U | 0.0019 | U | | | | | | |
| | | Vinyl chloride | mg/Kg | -- | 0.079 | ca | | | | | 0.0021 | U | 0.0019 | U | | | | | | |
| | | Xylenes (total) | mg/Kg | -- | 0.079 | ca | | | | | 0.0065 | U | 0.0058 | U | | | | | | |

**Notes:**
-- - no background/PRG value is available for this analyte
blank cell indicates that the analysis was not performed
PRG - preliminary remediation goals (The PRG for lead is the Maximum Contaminant Level (MCL)
nc - non-cancer basis
ca - cancer basis
pbk - based on PBK modeling
mcl - based on CWA maximum contaminant level
max - ceiling limit
sat - soil saturation
[n] - nutrient
UC - unconsolidated
If Result = or > Background, then the value is presented with a shaded/highlighted style
If Result = or > Background and PRG, then the value is presented with a bold + shaded/highlighted style
If Result = or > PRG, then the value is presented with a bold style
If Result < PRG and Background, then the value is presented with a normal style

**Inorganic Qualifiers**
U - analyte was not detected at or above the stated limit
J - result is less than the RL, but greater than or equal to the MDL
B - result is less than the CRDL/RL, but greater than or equal to the IDL/MDL
**InOrganic Flags**
^ - instrument related QC exceed the upper or lower control limits
* - batch QC exceeds the upper or lower control limit
H - batch QC is greater than RL
**Organic Qualifiers**
U - analyte was not detected at or above the stated limit
J - result is an estimated value below the RL
**Organic Flags**
B - Method Blank: batch QC is greater than RL
* - batch QC exceeds the upper or lower control limit
^ - batch QC is greater than RL
a - concentration is below the method Reporting Limit (RL)
H - alternate peak selection upon analytical review

# 5.0 CONTAMINANT FATE AND TRANSPORT

Knowledge about a contaminant's potential to migrate and persist in an environmental medium is important when evaluating its potential to elicit an adverse human health or ecological effect. This section contains information on properties and degradation potential of the chemicals detected at concentrations in excess of background levels, with an emphasis on chemicals selected as COPCs. The environmental conditions of the site and hydrological considerations that are likely to affect contaminant fate and transport near LL–9 and the surrounding area are also discussed. It is expected that the fate and transport of minor site contaminants would be similar to those of the major contaminants (i.e., COPCs) with similar physical and chemical properties.

Section 5.1 contains a general discussion of the various chemicals and their physical properties. Section 5.2 reviews the potential for chemical compounds to biodegrade or undergo other transformations. Section 5.3 discusses transport pathways where migration and attenuation might be occurring and how spatial and temporal variations in hydrologic conditions might be affecting transport. Section 5.4 presents an overall summary of contaminant migration in and around LL–9.

## 5.1 Chemical and Physical Properties Affecting Chemical Mobility

Table 5–1 presents physical and chemical properties of representative organic chemicals detected at LL–9. Because organic chemicals are not present in background, this table includes properties for the organic chemicals detected at LL–9 with the exception of minor contaminants. The COPCs are included in Table 5–1. Table 5–2 is a simple representation of the gross mobility of metal ions that is expected under various combinations of oxidation reduction (redox) potential and acidity (pH). These properties can be used to qualitatively to estimate the environmental mobility and fate of site contaminants. The properties that are discussed include the following:

- Specific gravity,
- Vapor pressure,
- Water solubility-Henry’s Law constant,
- Octanol/water partition coefficient ($K_{ow}$),
- Organic carbon partition coefficient ($K_{oc}$),
- Soil-water distribution coefficient (Kd),
- Bioconcentration factor (BCF), and
- Mobility index (MI).

## Table 5-1
## Environmental Fate and Transport Properties for Organic Chemicals

| Chemical | Specific Gravity (@ 20/4°C) (1) | Vapor Pressure (mm Hg @ 20°C) (1) | Solubility (mg/L @ 20°C) (1) | Octanol/Water Partition Coefficient (1) | Organic Carbon Partition Coefficient (2) | Henry's Law Constant (atm-m3/mole) (1) | Bioconcentration Factor (mg/L/mg/kg) (2) | Mobility Index log((solubility*VP)/Koc) |
|---|---|---|---|---|---|---|---|---|
| **ENERGETIC COMPOUNDS** | | | | | | | | |
| Nirocellulose | 1.67 (3) | NA | NA | NA | NA | NA | NA | NA |
| Nitroguanidine | 1.71 (4) | NA | NA | NA | NA | NA | NA | NA |
| RDX | 1.82 | NA | 5.98E+01 | 7.41E+00(4) | 7.89E+01 | 6.30E-08 | 1.92E+02(4) | NA |
| **MONOCYCLIC AROMATICS** | | | | | | | | |
| 2,6-Dinitrotoluene | 1.2833 (111°C) | 5.67E-04 | 1.82E+02 | 1.12E+02 | 2.04E+02 | 9.26E-08 | 1.20E+01 | -3.30E+00 |
| 2-Methylphenol | 1.047 | 2.99E-01 | 2.60E+04 | 9.55E+01 | 9.12E+01 | 1.20E-06 | 1.60E+01 | 1.93E+00 |
| 3-Methylphenol | 1.034 | 1.40E-01 | 2.27E+04 | 9.33E+00 | 8.99E+00 | 7.09E-07 | 1.90E+01 | 2.55E+00 |
| 4-Methylphenol | 1.0178 | 1.1E-1 (25°C) | 2.4E+4 (25°C) | 8.32E+01 | 9.0E-1(8) | 3.92E-07 | 1.7E+1(4) | 3.47E+00 |
| 4-Nitrophenol | 1.27 | 5.00E-03 | 1.16E+04 | 8.13E+01 | 3.90E+01 | 1.30E-08 | 1.60E+01 | 1.71E-01 |
| **POLYCUCLIC AROMATIC HYDROCARBONS (PAHs)** | | | | | | | | |
| 2-Methylnaphthalene | 1.0058 | 1E+1 (105°C) | 2.6E+1 (25°C) | 7.24E+03 | 7.27E+2 (5) | 4.99E-4 (25°C) | 5.1E+2 (4) | -4.47E-01 |
| Acenaphthene | 1.07 | 5.00E-03 | 4.24E+02 | 8.32E+03 | 7.08E+03 | 1.55E-04 | 1.10E+03 | -3.52E+00 |
| Acenaphthylene | 1.02 | 2.30E-02 | 1.61E+01 | 1.17E+04 | 2.00E+03 | 1.14E-04 | 3.80E+02 | -3.73E+00 |
| Anthracene | 1.283 (25/4°C) | 1.95E-4 (25°C) | 1.29E+0 (25°C) | 2.82E+04 | 2.95E+04 (6) | 8.6E-5 (25°C) | 4.70E+03 | -8.07E+00 |
| Benzo(a)anthracene | 1.274 | 5.00E-09 | 1E-2 (24°C) | 4.07E+05 | 3.98E+05 (6) | 6.60E-07 | 5.30E+04 | -1.59E+01 |
| Benzo(a)pyrene | 1.351 | 5.00E-09 | 3.8E-3 (25°C) | 9.55E+05 | 1.02E+06 (6) | 4.9E-7 (25°C) | 1.40E+05 | -1.67E+01 |
| Benzo(b)fluoranthene | NA | 5.00E-07 | 1.2E-3 (25°C) | 3.72E+06 | 1.23E+06 (6) | 1.20E-05 | 1.40E+05 | -1.53E+01 |
| Benzo(g,h,i)perylene | 1.35 | 1.00E-10 | 2.6E-4 (25°C) | 1.70E+07 | 1.60E+06 | 1.4E-7 (25°C) | 3.50E+05 | -1.98E+01 |
| Benzo(k)fluoranthene | NA | 9.59E-11 | 5.5E-4 (25°C) | 6.92E+06 | 1.23E+06 (6) | 1.04E-03 | 1.40E+05 | -1.94E+01 |
| Chrysene | 1.274 (20°C) | 6.3E-9 (25°C) | 6E-3 (25°C) | 4.07E+05 | 3.98E+05 (6) | 1.05E-6 (25°C) | 5.30E+04 | -1.60E+01 |
| Dibenzo(a,h)anthracene | 1.282 | 1.00E-10 | 5E-4 (25°C) | 9.33E+05 | 3.80E+06 (6) | 7.3E-8 (25°C) | 6.90E+05 | -1.99E+01 |
| Dibenzofuran | 1.0886 | 4.40E-02 | 4.22E+00 | 1.32E+04 | 8.13E+03 | NA | 8.00E+02 | -4.64E+00 |
| Fluoranthene | 1.252 | 5.0E-6 (25°C) | 2.65E-1 (25°C) | 2.14E+05 | 1.07E+05 (6) | 6.5E-6 (25°C) | 1.20E+04 | -1.09E+01 |
| Fluorene | 1.202 | 1.00E+01 | 1.98E+00 | 1.62E+04 | 1.38E+04 | 6.36E-05 | 3.80E+03 | -2.84E+00 |
| Indeno(1,2,3-cd)pyrene | NA | 1E-10 (25°C) | 6.20E-02 | 4.57E+07 | 3.47E+06 (6) | 6.95E-8 (25°C) | 3.50E+05 | -1.77E+01 |
| Naphthalene | 1.162 | 8.2E-2 (25°C) | 3E+1 (25°C) | 2.34E+03 | 2.00E+03 (6) | 4.83E-4 (25°C) | 4.20E+02 | -2.91E+00 |
| Phenanthrene | 0.980 (4°C) | 1E+0 (118.2°C) | 8.16E-1 (21°C) | 2.88E+04 | 1.40E+04 | 3.93E-5 (25°C) | 4.70E+03 | -4.23E+00 |
| Pyrene | 1.271 (23/4°C) | 2.5E+0 (200°C) | 1.6E-1 (26°C) | 1.51E+05 | 1.05E+05 (6) | 5.1E-6 (25°C) | 1.20E+04 | -5.42E+00 |
| **PHTHALATE ESTERS** | | | | | | | | |
| Bis(2-ethylhexyl)phthalate | 0.99 (20/20°C) | 1.2E+0 (200°C) | 4E-1 (25°C) | 2.00E+05 | 1.51E+07 (6) | 3.00E-07 | 2.30E+08 | -7.50E+00 |
| Butylbenzylphthalate | 1.113 | 8.60E-06 | 7.10E-01 | 6.92E+04 | 5.75E+04 | 1.26E-06 | 7.72E+02 | -9.97E+00 |
| Di-n-butylphthalate | 1.047 (20/20°C) | 1E-1 (115°C) | 4E+2 (25°C) | 1.58E+05 | 3.39E+04 (6) | 2.8E-7 (25°C) | 4.70E+04 | -2.93E+00 |

NA -Not Available

**Footnotes:**

1 EPA, September 1992, Handbook of RCRA Groundwater Monitoring Constituents: Chemical and Physical Properties.
2 USEPA, December 1982, Aquatic Fate Process Data for Organic Priority Pollutants.
3 Lyman et al., 1990; Equation 5-3, Handbook of Chemical Property Estimation Methods.
4 Lyman et al., 1990, Eq. 5-2
5 Lyman et al., 1990; Equation 4-5
6 EPA, July 1996, Soil Screening Guidance.

### Table 5–2

### Relative Mobility of Select Materials Under Various Environmental Conditions of Eh and pH

| Relative Mobility | Environmental Conditions | | | |
|---|---|---|---|---|
| | Oxidizing | Acidic | Neutral/Alkaline | Reducing |
| Very High | | | Se | |
| High | Se, Zn | Se, Zn, Cu, Ni, Hg,Ag | | |
| Medium | Cu, Ni, Hg, Ag, As, Cd | As, Cd | As, Cd | |
| Low | Pb, Ba, Se | Pb, Ba, Be | Pb, Ba, Be | |
| Very Low | Fe, Cr | Cr | Cr, Zn, Cu, Ni, Hg, Ag | Cr, Se, Zn, Cu, Ni, Hg, Pb, Ba, Be, Ag |

Notes:

As = Arsenic
Ag = Silver
Ba = Barium
Be = Beryllium
Cd = Cadmium
Cr = Chromium
Cu = Copper
Fe = Iron
Hg = Mercury
Ni = Nickel
Pb = Lead
Se = Selenium
Zn = Zinc
Eh = Standard Redox Potential

Source: Swartzbaugh, et al. Remediating Sites Contaminated with Heavy Metals. Hazardous Materials Control, November/December 1992.

Literature values of these properties are included for each organic chemical, when available, in Table 5–1. Calculated values, which were obtained using approximation methods, are listed when literature values are not available and the values could be computed. A discussion of the environmental significance of each of these parameters follows.

### 5.1.1 Specific Gravity

Specific gravity is the ratio of the density of a given volume of pure chemical at a specified temperature (usually 20 degrees Celsius [°C]) to the density of the same volume of water at a given temperature (usually 4°C). Its primary use is to determine whether a liquid chemical will have a tendency to float or sink in water if it is present as a pure chemical, i.e., at very high concentrations. Non-aqueous phase liquids (NAPLs) with a specific gravity greater than 1, including halogenated aliphatic compounds, polycyclic aromatic hydrocarbons (PAHs), and pesticides, will tend to sink if present as a pure liquid or mixture of pure liquids. This is true whether the NAPL is present in a water body or in a matrix such as soil. Chemicals with a specific gravity less than 1 (e.g., light hydrocarbons) will tend to float. This physical characteristic becomes important only when the chemicals are at very high concentrations and are liquid when they are in pure phase. However, no NAPLs were detected LL–9. Therefore, the characteristic of specific gravity is not expected to be important for LL–9.

### 5.1.2 Vapor Pressure

Vapor pressure indicates the tendency for a chemical to volatilize from both solid and aqueous matrices. It is of primary importance at environmental interfaces such as surface soil/air and surface water/air. In unsaturated soils, volatility also governs for interstitial air pockets to become saturated with chemical vapor. Volatilization from stream sediments could also be significant under low-flow conditions (i.e., during summer months and drought conditions) when the sediments are exposed to the atmosphere in a dry creek bed. Volatilization is not as important when evaluating contaminated groundwater and subsurface soils that are not exposed to the atmosphere. Vapor pressures for ketones and halogenated aliphatics are generally many times greater than vapor pressures for PAHs, pesticides, energetic compounds, and phthalate esters. Generally, the more volatile chemicals are liquid at normal temperatures and pressures whereas the less volatile chemicals are solids under the same conditions. Chemicals with greater vapor pressures are expected to enter the atmosphere much more readily than chemicals with lower vapor pressures. Volatilization from surface water, surface soil, and sediment is a significant loss process for VOCs. Volatilization is not significant for most inorganics unless the inorganic materials have been converted to organometallic compounds through biochemical action.

### 5.1.3 Water Solubility

Solubility is easily determined under laboratory conditions. Many chemicals of environmental interest are often considered to be insoluble in reference books (e.g., any “Handbook of Chemistry and Physics”) because they are insoluble, for most practical situations. However, most chemicals are soluble to some extent in water, and even those that are classified as insoluble may be soluble in the parts per billion (µg/L) or parts per million (mg/L) concentration ranges. These ranges may yield toxic effects, depending on the chemical, and are routinely measured during environmental work.

The tendency for a chemical to be leached from soil by infiltrating precipitation is governed by its water solubility. More-soluble chemicals are more readily leached than less-soluble chemicals. The water solubility listed in Table 5–1 indicate that ketones and halogenated aliphatics are usually several orders of magnitude more water soluble than pesticides, PCBs, and some of the

PAHs. PCBs, in particular, are not frequently detected as dissolved compounds in aqueous samples because of their low solubility.

### 5.1.4 Henry's Law Constant

Both vapor pressure and water solubility are useful for determining volatilization rates from surface water bodies and groundwater. The measured ratio of these two parameters (the Henry's Law constant) under equilibrium conditions is used to calculate the equilibrium chemical concentrations in the vapor (air) phase versus the liquid (water) phase for the dilute solutions commonly encountered in environmental settings. In general, chemicals having a Henry's Law constant less than 1 x $10^{-5}$ atm-$m^3$/mole, such as pesticides, PCBs, and PAHs, are expected to volatilize very little and to be present only in minute amounts in the atmosphere or soil vapor. For chemicals with Henry's Law constants greater than 5 x $10^{-3}$ atm-$m^3$/mole, such as many of the halogenated aliphatics, volatilization and diffusion in soil vapor could be significant.

### 5.1.5 Octanol/Water Partition Coefficient ($K_{ow}$)

$K_{ow}$ is a measure of the equilibrium partitioning of chemicals between octanol and water as determined under laboratory conditions. A linear relationship between the $K_{ow}$ and the uptake of chemicals by fatty tissues of animal and human receptors, or the bioconcentration factor (BCF), has been established (Lyman et al., 1990). The $K_{ow}$ is also useful in characterizing the sorption of compounds by organic soils where experimental values for soil are not available. Pesticides and aromatic compounds, lacking functional groups that enhance water solubility, are several orders of magnitude more likely to partition into fatty tissues than the more water-soluble VOCs. $K_{ow}$ values are also used to estimate BCFs in aquatic organisms.

### 5.1.6 Organic Carbon-Water Partition Coefficient ($K_{OC}$)

$K_{oc}$ indicates the tendency of a chemical to adhere to organic matter contained in soils under laboratory conditions. Many VOCs, for example, have relatively low $K_{oc}$ values and they tend to be fairly mobile in the environment as a result of groundwater or surface water movement. Chemicals with high $K_{oc}$ values generally have low water solubility and vice versa. This parameter may be used to infer the relative rates at which the more mobile chemicals (e.g., ketones and halogenated aliphatics) are transported in groundwater. Chemicals, such as most pesticides, PCBs, and PAHs, are relatively immobile in the soil and are preferentially bound to the soil. These compounds are not subject to groundwater transport to the same extent as compounds with higher water solubility. However, these immobile chemicals can be transported by erosional processes when they occur in surface soils.

Several factors affect the measured value of $K_{oc}$. Values of $K_{oc}$ usually decrease with increasing temperature. The fine silt and clay fraction of soil and sediments may have a greater tendency to absorb chemicals because they often have a higher concentration of organic matter and more adsorption sites per unit volume.

### 5.1.7 Soil-Water Distribution Coefficient (Kd)

Kd is a measure of the equilibrium distribution of a chemical in soil/water systems. The Kd of organic chemicals is a function of both the $K_{oc}$ and the fraction of organic carbon in the soil ($f_{oc}$):

$$Kd = K_{oc} * f_{oc}$$

The degree to which organic chemicals sorb to soils is very important when assessing migration potential. If a chemical tends to sorb strongly to soil, there is much less probability that the chemical will reach groundwater and affect the groundwater quality. In sediments, a high degree of sorption similarly indicates that the chemical is more likely to be transported in entrained sediments than as a dissolved species in surface water.

Chemicals, such as PAHs, that migrate slowly through soil and the upper unsaturated rock units have a relatively long time period where they are subjected to biodegradation processes before they reach the first water-bearing rock unit. As a consequence of low migration potential, there is a very low probability that chemicals with very high Kd values (i.e., PAHs) will reach surface water bodies via groundwater flow. However, if PAHs or pesticides are present at the ground surface, eroded, and transported in surface runoff with soil particles (as a sorbed phase), then there is potential for these compounds to reach adjacent stream channels.

For metals, the sorption coefficients are, in large part, a representation of the ion exchange tendencies of the metals with the soil. Table 5–3 presents sorption coefficients for select metals, several of which were detected at LL–9. Other factors aside, the more positively charged an ion, the more tightly it is bound to soils. Ions that bind tightly tend to displace ions that are less tightly bound because the ions compete for the same ion exchange sites. In addition, soils with high organic material content tend to bind metals in large chemical complexes. This process is described in the section below.

**Table 5–3**

**Soil-Water Partition Coefficients for Metals**

| Inorganic Element | Kd at pH = 5.5[(1)] (L/kg) | Kd at pH = 6.2[(2)] (L/kg) | Kd[(3)] (L/kg) |
|---|---|---|---|
| Aluminum | NA | NA | 1,500 |
| Antimony | NA | NA | 45 |
| Arsenic | 26 | 28 | 200 |

## Table 5–3 (Continued)

## Soil-Water Partition Coefficients for Metals

| Inorganic Element | Kd at pH = 5.5(1) (L/kg) | Kd at pH = 6.2(2) (L/kg) | Kd(3) (L/kg) |
|---|---|---|---|
| Barium | 21 | 33 | 41 |
| Beryllium | | | 790 |
| Cadmium | 27 | 42 | 75 |
| Chromium (as $Cr^{+3}$) | 2,100 | 420,000 | 1,800,000 |
| Chromium (as $Cr^{+6}$) | NA | NA | 850 |
| Cobalt | | | 45 |
| Copper | NA | NA | 428 |
| Iron | NA | NA | 25 |
| Lead | | | 900 |
| Magnesium | | | 5 |
| Manganese | NA | NA | 65 |
| Mercury | | | 52 |
| Nickel | 28 | 42 | 65 |
| Selenium | 12 | 75 | 5 |
| Silver | | | 8 |
| Strontium | NA | NA | 35 |
| Thallium | | | 71 |
| Vanadium | NA | NA | 1,000 |
| Zinc | 26 | 42 | 62 |

(1) Values from Illinois EPA Tiered Approach to Corrective Action Objectives (TACO) Program; Kd values presented assume an average pH of 5.5.

(2) Values from Illinois EPA TACO Program; Kd values presented assume an average pH of 6.2.

(3) Values from the U.S EPA-sponsored Risk Assessment Information System (RAIS) Internet site: "http://risk.lsd.ornl.gov/rap_hp.html"

NA = Not applicable.

Kd = Soil-water distribution coefficient.

### 5.1.8 Chemical Complex Formation

Metals may form chemical complexes or combinations that alter the mobility of the metals. This may also occur for non-metals. Some of the most important environmental chemicals that form metal complexes are the humic substances. These complex mixtures of organic acids and other organic matter are formed naturally in shallow surface soils, in pond bottoms, lake bottoms, through the decay of vegetable matter. These substances, after binding with a metal, can increase its mobility by dissolving into an aqueous phase. If the humic substances are adsorbed to a solid substrate, such as soil, sediment, or vegetation, they will tend to remove metal ions from solution by binding to the metals and fixing them to the solid substrate. The binding equilibria are affected by pH. At low pH, the bound metals are released and at high pH the metals are preferentially bound. Iron is an exception to this rule (Dragun, 1988). Fulvic acid is a component of humic substances. The pH at which fulvic acid complexes begin to release relatively large proportions of bound metals has been shown to be less than 5 (Dragun, 1988). Thus, most metals are expected to be preferentially bound to the humic substances at pH values greater than 5.

### 5.1.9 Bioconcentration Factor

BCF represents the ratio of aquatic anima tissue concentration to water concentration. The ratio is both contaminant- and species-specific. When site-specific values are not measured, literature values are used or the BCF is derived from the $K_{ow}$. Many of the pesticides and PAHs will bioconcentrate at levels three to five orders of magnitude greater than those concentrations found in the water, but VOCs and energetic compounds are not as readily bioconcentrated. Any bioconcentration that occurs generally requires that the chemical of interest be in the dissolved state; otherwise, the chemical is inaccessible to the organism. For plants, this means that the chemical must be dissolved in the surrounding soil. For other organisms that can inhale, aspirate, or ingest solid particles, the chemical may be bound to the particles and released after ingestion.

### 5.1.10 Mobility Index

The MI is a quantitative assessment of mobility that uses water solubility (S), vapor pressure (VP), and the $K_{oc}$ (Laskowski, 1983). It is defined as

$$MI = \log((S*VP)/K_{oc})$$

A scale to evaluate MI, as presented by Ford and Gurba (1984), is:

| Relative MI | Mobility Description |
|---|---|
| > 5 | extremely mobile |
| 0 to 5 | very mobile |
| -5 to 0 | slightly mobile |
| -10 to -5 | immobile |
| < -10 | very immobile |

Of the organic chemicals detected at LL–9, chlorinated solvents and ketones generally have MIs greater than 5 and are considered extremely mobile. Lighter molecular weight PAHs, such as naphthalene, have MIs ranging from -5 to 0 and are considered slightly mobile. Heavier molecular weight PAHs [e.g., benzo(a)pyrene] are classified as very immobile, having MIs less than -10.

### 5.1.11 Miscellaneous Characteristics

The solubility and mobility of an inorganic chemical is strongly influenced by its valence state(s) and mineral forms present in soils (e.g., silicates, hydroxides, oxides, and carbonates). The solubility of a metal also depends largely on the pH and oxidation-reduction potential (Eh) of its environment, the ambient temperature, and other ionic species in solution (the Debye-Huckel theory).

Most metals have increased solubility and mobility at lower water pH values (e.g., < 5.0). Some metals such as aluminum, however, have increased solubility at both low and high pH values (greater than 8). Iron and manganese are metals that have more than one common valence state and are more soluble in the reduced valence states. For example, iron(+3) and manganese(+4) are generally less soluble than iron(+2) and manganese(+2) in the environment. As a result, these metals are more mobile under reducing conditions. Chromium(+6), however, is more mobile than Chromium(+3) under typical environmental conditions. Mobility is highly dependent on the anions that are associated with the metal. For example, silver nitrate is very soluble in water, but most other silver compounds are highly insoluble. The solubility product constants reported in the literature vary with the type of chemical complex formed.

Metals can be rapidly transformed from one oxidation state to another as they encounter different local environments. For example, manganese that may have been dissolved from local geologic materials at one location may precipitate out of solution as the groundwater containing the dissolved manganese migrates to another area. The wide array of potential metal-anion combinations and environmental conditions leads to a wide array of potential metal mobility that must be evaluated on a case-by-case basis for potential environmental impact.

## 5.2 Chemical Persistence and Degradation Process

Degradation and other transformation processes that affect site contaminants are discussed in this section. Degradation leads to the following possibilities, depending on the contaminant of interest and the contaminant's environment:

- Transfer of the chemically unaltered contaminant from one environmental medium to another (physical changes may occur (e.g., transfer of dissolved contaminant to vapor);
- Transformation of the original contaminant into a less toxic chemical;
- Transformation of the original contaminant into a more toxic or otherwise problematic chemical; and
- Transfer of a chemically or biochemically transformed contaminant from one environmental medium to another.

These transformations may occur individually or together, and more than one of these processes may occur for any single chemical. Consequently, the number and complexity of possibilities is partly a function of the number of contaminants and partly a function of which contaminants are present.

For organic chemicals, degradation typically involves a gradual reduction in the molecular weight of the chemical as molecular bonds are cleaved. Cleavage may occur in sequential steps with the most susceptible bonds being cleaved first. Because of this, larger, more complex molecules that have more chemical bonds commonly have more molecular degradation pathways than smaller molecules. With the changes in molecular structure come changes in chemical and physical properties. For example, daughter compounds are commonly more volatile than their parent compounds. They may also be more or less toxic than the parent compound. For inorganic chemicals, degradation may be a purely inorganic chemical reaction that results in a change of valence state. Depending on the chemical, it may also involve biochemical reactions that transform the inorganic chemical into an organometallic compound or another inorganic species.

Hydrolysis, biodegradation, photolysis, and chemical oxidation/reduction reactions are four processes that are important for many environmental investigations because the potential for their occurrence is high, depending on the contaminants that are present and where those contaminants are located. These four processes are discussed in more detail below.

Hydrolysis is a reaction between the chemical of interest and water that results in a cleavage of the water molecules. Many of these reactions can be catalyzed by the presence of acids or bases.

Biodegradation is a generic term that includes oxidation or reduction transformations resulting from enzymatic or other biochemical processes that occur in or near living organisms. Many of these reactions take place in naturally occurring microorganisms, such as bacteria, that are present in the Earth’s crust, especially at the Earth’s surface. A chemical or family of chemicals (e.g., chlorinated solvents or ketones) may be highly susceptible to transformation by one type of microorganism but much less so by other organisms. Consequently, the rates of biodegradation can vary widely from no degradation to very rapid degradation, depending on the presence of organisms that can degrade the chemicals. The presence of other chemicals and the ambient conditions can also greatly influence the potential for, and the rate of, degradation. Rates are difficult to predict, however, because they are sensitive to ambient conditions, including the presence or absence of microorganisms that are capable of degrading particular chemicals biochemically. Some of these difficulties are described further below.

Photolysis is the cleavage of chemical bonds induced by light, especially the ultraviolet wavelengths. Hence, environmental photolysis characteristically occurs at the Earth’s surface in surface water, shallow surface soils, shallow sediments exposed to air, and in the atmosphere, where exposure of the chemicals to sunlight can occur routinely.

Degradation of chemical compounds can frequently be modeled as a first-order decrease or decay of the concentrations over time. If the concentration of the chemical is plotted over time, the concentration decrease is rapid early in the degradation process but becomes less rapid as time goes on because the rate of degradation at any point in time is directly proportional to the remaining concentration of the chemical. Such models are useful for predicting the concentration of a chemical at any future time. The true degradation, however, may not follow a first-order decay process even though a first-order decay is used to model the degradation. Furthermore, because many different decay processes can occur in concert, which may have different mechanisms, the first-order decay model will effectively be a composite of the pertinent processes. This often leads to significant uncertainties in estimating degradation rates. Any uncertainties associated with estimating the degradation rates translate into uncertainties in estimates of future concentrations.

A characteristic of first-order decays is a relationship between half-life and degradation rate. A half-life is the time required to reduce a concentration to one-half of its value. Chemicals with long half-lives have a long persistence in the environment, whereas chemicals with short half-lives degrade or disperse quickly. For first-order decays, the half-life, $t_{1/2}$, is equal to the natural logarithm (Ln) of 2 divided by the degradation rate constant, k (i.e., $t_{1/2} = Ln(2)/k$). In the discussions below, mathematical models are not used to estimate degradation rates or to predict future concentrations. The concept of half-life is, however, occasionally referenced to offer perspective on relative degradation rates of various chemicals. Table 5–4 presents half-lives of select chemicals detected at LL–9. The half-lives presented in Table 5–4 and discussed below are taken from literature studies and may not accurately represent degradation rates at LL–9, but they indicate relative degradation rates to be expected for these compounds.

**Table 5–4**

**Ranges of Biodegradation Rates for Representative Organic Chemicals**

| **Chemical** | **SOIL** | | **GROUND WATER** | |
|---|---|---|---|---|
| | **Short Half-Life** | **Long Half-Life** | **Short Half-Life** | **Long Half-Life** |
| | **(days)** | **(days)** | **(days)** | **(days)** |
| **Energetics** | | | | |
| RDX | NA | NA | NA | NA |
| Nitrocellulose | NA (1) | NA (1) | NA (1) | NA (1) |

## Table 5–4 (Continued)

## Ranges of Biodegradation Rates for Representative Organic Chemicals

| Chemical | SOIL | GROUND WATER | Chemical | SOIL |
|---|---|---|---|---|
| | Short Half-Life | Long Half-Life | Short Half-Life | Short Half-Life |
| | (days) | (days) | (days) | (days) |
| **Polycyclic Aromatic Hydrocarbons** | | | | |
| Acenaphthene | 12.3 | 102 | 24.6 | 204 |
| Benzo(a)anthracene | 102 | 680 | 204 | 1360 |
| Benzo(a)pyrene | 57 | 530 | 114 | 1060 |
| Benzo(b)fluoranthene | 360 | 610 | 720 | 1220 |
| Benzo(k)fluoranthene | 5 | 23 | 10 | 389 |
| Chrysene | | | | |
| Fluoranthene | 140 | 440 | 280 | 880 |
| Indeno(1,2,3–cd)pyrene | 560 | 730 | 1200 | 1460 |
| Phenanthrene | 16 | 200 | 32 | 400 |
| Pyrene | 210 | 1900 | 420 | 3800 |
| **Semi-volatile Organic Compounds** | | | | |
| Bis(2–ethylhexyl)phthalate | 5 | 23 | 10 | 389 |

1 Assume to be greater than 365 days, based on properties of cellulose.

2 Rough estimate based on: Erickson, 2001 – See text references for full citation. Actual half-lives vary widely.

NA = Not available.

The fate and transport of each contaminant detected at LL–9 is described below. The chemicals are discussed in groups that are indicated by their analytical fractions (e.g., VOCs or metals) because these fractions generally represent chemicals with similar properties. Only those processes that are most applicable to the indicated fractions are described. No attempt was made to model the fate and transport of the chemicals mathematically, in part because simple rules of thumb concerning contaminant half-lives are sufficient to gain an understanding of contaminant fate. In addition, the levels of contaminants are generally low, and migration will tend to reduce the concentrations further through dispersion, dilution, and other transport mechanisms. The contaminants that were identified are generally considered to be immobile or slow-moving contaminants so the migration rates will be slow, except when migrating in sediments and surface water as adsorbed or dissolved species.

### 5.2.1 Volatile Organic Chemicals

No chemicals in this category were detected at LL–9. Therefore, VOCs will not be discussed further.

### 5.2.2 Semi-volatile Organic Chemicals

Benzo(a)pyrene, dibenzo(a,h)anthracene, and polycyclic aromatic hydrocarbons (PAHs), were the only chemicals in the SVOC category to be selected as human health COPCs for LL–9. Several other SVOCs, most of which are PAHs, were detected at LL–9, and some of these were selected as ecological risk COPCs. Appendix V, Tables 2.1 through 2.5, and Appendix W, Tables 1 and 2, indicate which SVOCs were detected at LL–9 and, of those, which were selected as COPCs in various media. Benzo(a)pyrene and dibenzo(a,h)anthracene were selected as human health COPCs in soil only. Several PAHs were selected as ecological COPCs in surface soils, and dibenzo(a,h)anthracene and bis(2–ethylhexyl)phthalate were selected as ecological COPCs in sediment (see Tables 7–1 and 7–2).

PAHs, as a group, are much more likely to bind to soil and to be transported via erosion and surface water runoff than to be solubilized in surface water or groundwater. PAHs are subject to slow degradation *via* aerobic bacterial metabolism, but may be relatively persistent in the absence of microbial populations or macronutrients such as phosphorus and nitrogen.

Landspreading applications have indicated that PAHs are highly amenable to microbial degradation in soil. This would apply to sewer sediments as well. Although sewers and manholes were plugged, degradation is still expected to occur in those locations if residual contamination remains. The rates of degradation in these media are influenced by temperature, pH, oxygen concentrations, initial chemical concentrations, and moisture. Photolysis, hydrolysis, and oxidation are not important fate processes for the degradation of PAHs in soil (Agency for Toxic Substances and Disease Registry [ATSDR], 1997).

The most important fates of PAHs in water are photo-oxidation, chemical oxidation, and biodegradation. Metabolism in higher animals is another degradation pathway and becomes important when the PAHs are metabolized to carcinogenic species (UN, 1998). PAHs do not contain functional groups that are susceptible to hydrolytic action, and hydrolysis is considered to be an insignificant degradation mechanism. The rate of photo degradation is influenced by water depth, turbidity, and temperature. Benzo(a)pyrene is reported to be resistant to photo degradation. PAHs may also be metabolized by microbes under oxygenated conditions (ATSDR, 1997).

The longest PAH half-life (of those shown in Table 5–4) is about 4 years in groundwater and 1 year in soil. Thus, PAH concentrations should decrease significantly within a decade and should be effectively degraded in less than 30 years in groundwater and less than 10 years in soil. The small reservoir of PAHs at LL–9 indicates that long-term contamination will not be a problem.

Bis(2–ethylhexyl)phthalate is more soluble in water than the PAHs. Chemical hydrolysis is essentially non-existent, but photo degradation in the atmosphere is rapid (ToxNet, 2004). Aerobic degradation can be affected by several soil microorganisms; however, the microbial degradation in the environment has been reported to be slow and temperature-dependent (ToxNet, 2004). At temperatures below about 10° C, little degradation takes places. Butyl benzyl phthalate and di–n–butyl phthalate, also were detected at LL–9 but only in sediment. These chemicals, are expected to behave similarly to bis(2–ethylhexyl)phthalate with regard to chemical and biochemical transformations. Bis(2–ethylhexyl)phthalate is highly lipophilic and moderately persistent in the environment. The degree of bioaccumulation depends on the capability of an organism to metabolize this compound. The compound accumulates in a variety of aquatic invertebrates, fish, and amphibians. Plant uptake is low (ToxNet, 2004).

### 5.2.3 Pesticides and Polychlorinated Biphenyls

No pesticide or polychlorinated biphenyl compounds were detected at LL–9 in any of the investigated media. Therefore, these chemicals are not discussed further.

### 5.2.4 Explosive and Propellant Compounds

Nitroguanidine, nitrocellulose, and RDX were detected in soil samples collected from LL–9. Nitrocellulose was also detected in surface water, groundwater, and sediment; but the concentrations are very low and appear to be potential false detections. Nitroguanidine was detected in surface soil only and at a concentration (89 µg/kg) within the normal detection limit range; therefore, it may be a false detection. Of these, nitrocellulose (in soil, sediment, and surface water) was selected as an ecological COPC for shallow soil because there are no toxicity data for this compound. Nitroguanidine was selected as an ecological COPC in sediment for the same reason. Findings for these chemicals were within the range of normal detection limits, indicating that the detections could be false.

The low solubility of nitrocellulose suggests that it is not very toxic in soil and sediment. Although nitrocellulose (cellulose nitrate) may be incorporated into propellant mixtures, it has a very low solubility and, consequently, exhibits very limited mobility. It is a fibrous material composed essentially of cellulose fibers that have been modified to contain nitrate ($NO_3$) functional groups. The chemical composition, however, suggests that any environmental degradation of this chemical could release nitrates or nitrites to the environment. Because of its low solubility, relatively slow degradation rates in the environment are expected. Thus, any nitrates or nitrites detected at the site are presumably related to other nitrates that are much more soluble, such as sodium or potassium nitrate. These metal salts, especially sodium nitrate, are used in large quantities in the manufacture of black powder.

Studies (e.g., ANRCP, 1998; and Roberts and Kotharu, no date) indicate that RDX is likely to break down under highly reducing conditions to mono-, di-, and tri-nitroso derivatives as well as smaller molecules. One known reductive degradation pathway involves a sequential conversion of nitro functional groups to nitroso groups followed by ring cleavage to yield relatively non-toxic compounds. Another pathway involves degradation by microbial consortia to yield nitramines, formaldehyde and, ultimately, carbon dioxide and nitrous oxide. RDX is less commonly reported to be subject to oxidative degradation, usually persistent under aggressive oxidizing and moderately reducing conditions (e.g., Adam et al., *J. Environ. Qual.* 33:2165–2173 [2004]). Roberts et al. (no date) also report that oxidative biodegradation occurs via sequential oxidation of the nitro groups with ultimate formation of 4–nitro–2,4–diazabutanal. This dead-end product may react with other chemicals to form yet smaller degradation products. The oxidative pathway, however is generally thought to be much less prevalent than the reductive pathway under typical environmental conditions for pH values.

Detections of energetic compounds were generally sparse with the exception of nitrocellulose; therefore, only the nitrocellulose is considered to be a potential environmental concern. The potential environmental concern is minor because of its low solubility and, hence, low biochemical availability and migration potential. In addition, the majority of the nitrocellulose results were qualified as estimated (J), or (B) the concentration of nitrocellulose in the method blank was detected above the reporting limit, or both (B) (J). Additional information on the environmental significance of detected energetic compounds is included in Sections 6 and 7.

### 5.2.5 Metals

Metals are highly persistent environmental contaminants because they do not biodegrade. However, their valence states can readily change based on pH and Eh conditions, biotic uptake and assimilation into living organisms, and decay and decomposition of dead plant matter. The major fate mechanisms for metals are adsorption to the soil matrix or precipitation as a mineral coating, uptake and bioaccumulation in plants, or transport through the hydrologic system. Table 5–2 presents a qualitative characterization of select metal nobilities in the environment as a function of ambient conditions. Because the chemical properties of the metals can vary significantly from metal to metal, only those metals detected at LL–9 are discussed here. Metals that have similar properties (as presented in Table 5–2 or discussed in the text) will behave similarly with regard to fate and transport.

Metals commonly form carbonates, silicates, oxides, and hydroxides after they have been released to the environment and interact with carbon dioxide, oxygen, and water in their surroundings. The carbonate, oxide, and hydroxide equilibria that dictate whether one species predominates over another, are sensitive to the surrounding pH and oxidation-reduction (redox) potentials. At high pH values, oxides and hydroxides form readily. At pH values less than about 4, these species are essentially non-existent, except under highly oxidizing conditions.

The Earth serves as an almost limitless reservoir of metals. Soils, surface water, groundwater, and sediments are typically well-buffered with respect to pH (i.e., pH is not easily changed). Based on geotechnical data from other RVAAP load line soil samples, the pH of soils measured at RVAAP load lines is typically in the range of 5.5 to 7.4 (USACE, 2003a, 20003b, and 2003c). The same pH range is expected for LL–9. Soil samples occasionally exhibit pH values less than 5.0, but they are rare (USACE, 2003a, 20003b, and 2003c). Therefore, it is assumed that low pH values are limited to small soil volumes. The pH buffering capacity near neutral to slightly acidic pH values tends to limit the ability of most metals to migrate rapidly because the metals tend to precipitate as solids or to bind tightly to soil particles through cation exchange. The positively charged metals or oxidation metal ions adsorb to negatively charged hydroxyl groups at the surface of the soil or sediment particles, which are often silicate minerals. In general, the more highly positive a cation, the more tightly bound it will be to the soil. Hence, monovalent ions (e.g., potassium, sodium) are not tightly bound whereas the trivalent aluminum is.

Each of the metals detected at LL–9 (except for the macronutrients: calcium, magnesium, potassium, and sodium) is described briefly below regarding its most important environmental chemistry characteristics and information concerning plant uptake. These factors affect the mobility and, hence, the fate of metals in the environment.

Aluminum, atomic symbol Al (not listed in Table 5–2), is a COPC in LL–9 sediment, surface soil, subsurface soil, and surface water. This metal is a naturally occurring component of silicate minerals and other minerals. It does not migrate readily because its aqueous ion has a positive charge of “+3”. This high charge causes aluminum ions in solution to bind preferentially to negatively charged soil adsorption sites, such as OH groups located at the surfaces of silicate minerals. Aluminum also readily precipitates from solutions as aluminum hydroxides. Aluminum does dissolve in infiltrating precipitation, however, and may be taken up by plants from the resulting subsurface and surface soil solutions of aluminum. Any industrial releases of this metal to soils are not expected to migrate significantly. Releases to surface water will have the greatest mobility because aluminum adsorbed to sediments is transported this way, and aluminum in the dissolved phase can move for long distances before being completely removed from solution by binding to sediments and soils. Aluminum that is taken up by plants will be redeposited to soils when the vegetation dies or releases leaves and branches. Aluminum is not known to be transformed biologically.

Antimony, atomic symbol Sb (not listed in Table 5–2), is similar to arsenic (described below) in chemistry. This metal, commonly classified as a metalloid because its chemical properties lie between those of true metals and non-metals, has a mean concentration in soils around the world of approximately 1 mg/kg (Emsley, 2001). Stibnite ($Sb_2S_3$), a sulfide, is the predominant mineral of antimony found in native ores (Van Nostrand, 1976). The two prevalent valence states of antimony are Sb (III) and Sb (V). These relatively high oxidation charges tend to limit the mobility of antimony in the environment. This metal was selected as a human health COPC in LL–9 groundwater.

Arsenic, atomic symbol As, is a human health COPC in LL–9 surface and subsurface soil and surface water because its concentrations exceed human health screening levels in those media. It was selected as an ecological COPC in surface soil because its maximum concentration exceeded the ecological screening criteria for soil and it is a bioaccumulative chemical. Arsenic is a naturally occurring metal, commonly classified as a metalloid because it has properties that are transitional between metallic and non-metallic chemical elements. In minerals, this element commonly appears as a sulfide (NIH, 2004), which implies that this form of arsenic is a particularly abundant or persistent form. In water, inorganic arsenic occurs primarily in the "+5" valence state when conditions are oxidizing, such as in surface water. Under reducing conditions, such as may be found in groundwater, the inorganic form of arsenic is predominantly the "+3" valence state. In acidic or neutral waters, As (V) is extensively adsorbed but As (III) is not. At high pH (e.g., pH > 9), neither species of arsenic is tightly adsorbed (NIH, 2004). The mobility of arsenic is low to moderate in clay but higher in loamy or sandy soils. As (V) is adsorbed most strongly at pH 5 in clay minerals. As pH increases, more As (III) is adsorbed. Arsenic adsorbs strongly to sediments. If conditions change sufficiently from oxidizing to reducing, arsenic may be released from sediments.

Bacterial and fungal activity can convert inorganic arsenic to methyl arsines. These volatile organometallic compounds are mobile and can be transferred from sediments to the surrounding water and, ultimately, to the atmosphere. The potential for volatilization from moist surfaces varies greatly with local conditions. Tightly sorbed arsenic or complexed arsenic species will be unlikely to volatilize, whereas methylated arsenic species can volatilize fairly readily (NIH, 2004).

Barium, atomic symbol Ba, is not a COPC in any LL–9 media. This metal is commonly found in nature as sulfate (Emsley, 2001). It forms hydroxides, carbonates, and sulfates in soils. Barium carbonates and sulfates are relatively insoluble (negative logarithm of solubility product, $pK_{sp}$, constants near 9). By contrast, barium hydroxides ($pK_{sp}$ near 2), and especially nitrates and chlorides of barium, are quite soluble (Lang, 1985). Thus, over time, barium is expected to precipitate out of solution as it migrates to areas containing high carbonate or sulfate concentrations and high concentrations of other anions that form barium precipitates. In the absence of these anions, barium is likely to be moderately mobile. Barium is generally classified as a metal of low mobility (See Table 5–2).

Beryllium, atomic symbol Be, was detected in most LL–9 soil samples with a maximum detection site wide of 1.8 mg/kg. The maximum detection in sediment was 0.99 mg/kg. This metal is reported to have a typical concentration of 6 mg/kg in worldwide soils and was not selected as a human health COPC for LL–9 (Emsley, 2001). It was, however selected as an ecological COPC in sediment. Beryllium can be taken up by plants. Typical concentrations in plants are too low to exhibit any effects on animals that live off of them, even in plants that have the ability to concentrate the beryllium (Emsley, 2001). The divalent $Be^{+2}$ ion dominates environmental beryllium chemistry at pH values less than about 4. Above that pH it forms insoluble hydroxides (Dragun, 1988). Consequently, this metal generally exhibits low mobility under typical environmental conditions.

Cadmium, atomic symbol Cd (not listed in Table 5–1), is not a human health COPC in any LL–9 media but was retained as an ecological COPC in surface soil. While cadmium concentrations are typically less than 1 mg/kg in worldwide soils, local hot spots have been shown to contain cadmium concentrations as high as 40 mg/kg (Emsley, 2001). This element is widely present in food crops at low levels and can be concentrated by the fungus *Amanita muscaria*, even when grown in soils containing low cadmium levels. Tobacco and other large leaf crops are also known to contain cadmium. Cadmium is present in sewage; and crops grown in sewage land farms can lead to an accumulation of cadmium in animals that eat the crops, including humans. This metal mimics zinc in its chemical behavior, especially in the human body. The lifetime in the human body is reported to be about 30 years (Emsley, 2001). Cadmium is expected to be moderately mobile in soil because it is present under most naturally occurring redox and pH conditions as the “+2” ion. If it is combined with anions such as sulfide, it can be very immobile. At pH values greater than about 8, cadmium tends to form insoluble hydroxides. These conditions are not expected at LL–9; therefore, the cadmium mobility is expected to be moderate.

Chromium, atomic symbol Cr, exists primarily as two oxidation states – Cr (III) and Cr (VI). Cr (IV) is very mobile in the environment under oxidizing conditions, but Cr (III) is less mobile except at pH values less than about 4. The trivalent metal predominates under most conditions except those that are low pH (e.g., less than 4) and high oxidation potential (e.g., greater than 0.4). This element forms insoluble hydroxides under low to moderately reducing conditions. Under highly oxidizing conditions, it forms the soluble chromate ion at pH values greater than about 6 and the bichromate ion at lower pH values (Dragun, 1988). Concentration values in soils worldwide are reported to range from 1 to 450 mg/kg (Emsley, 2001). Chromium is mobile in ground and surface water under oxidizing conditions and can move in sediments when adsorbed to sediment grains. Chromium was selected as a human health COPC for LL–9 in soil and surface water. It was also selected as an ecological COPC for surface soil.

Cobalt, atomic symbol Co (not listed in Table 5–1), is not a COPC in any LL–9 media. This metal is an essential nutrient and is found in relatively low abundance (0.1 to 70 mg/kg) in the Earth’s crust (Emsley, 2001). Terrestrial plants absorb this element from soils. Based on its mean Kd equal to 4 (Dragun, 1988), this element has moderate to low mobility in soils and sediments. It forms insoluble oxides and hydroxides in the environment at pH values greater than about 8 but is otherwise generally present as the Co (II) ion at most oxidation-reduction potentials (Dragun, 1988).

Copper, atomic symbol Cu, is a relatively immobile element in soils (Emsley, 2001). Its affinity for organic matter causes it to be bound tightly in surface soils. Where subsurface releases of copper occur, this binding mechanism may not be as important because the most organic-rich layer of soils is generally the surface layer. Plant uptake varies widely for this element and it is transmitted through the food chain. Most of the copper taken up by plants, however, remains in the roots (Emsley, 2001). At low pH, this metal is prevalent as the divalent ion under most redox conditions. Under reducing conditions, the metal may appear as pure metal. At high pH, the metal tends to form hydroxides and oxides (Dragun, 1988). The concentrations of this metal were less than human health screening levels except in surface soil. The highest surface soil copper concentrations (1,240 mg/kg) was about an order of magnitude greater than the next highest concentration (170 mg/kg in sample LL9SS–068–0001–SO). The highest copper concentration was colocated with highest concentrations of lead, and mercury and the second-highest concentrations of zinc in surface soil. Copper was selected as a human health COPC for LL–9 surface soil. It was also selected as an ecological COPC for surface soil and surface water. Transport in surface water is expected to occur in the suspended solids that are washed into streams then washed downstream. The amount of material transported in this manner, however, is expected to be small because the reservoir of high copper concentrations is spatially limited. It appears that the colocated copper, lead, and zinc represent remnants of one or more shell casings and projectiles, which would be consistent with site operations.

Iron, atomic symbol Fe, is a major component of the Earth’s crust, being the fourth most abundant element (Emsley, 2001). It occurs widely as in oxide forms and is rarely found in the pure metal state. Iron in soil is readily transformed by organic matter into various oxides and other compounds. The most common oxidation state is “+3”. This valence state can, however, be readily altered to the “+2” valence in groundwater and other aqueous environs under chemically reducing conditions. Fe (II) is more mobile than Fe (III). An abundance of iron in the Fe (II) state can serve as a large electron reservoir to electron acceptors during redox reactions. Iron in soil is not expected to be mobile; but under reducing conditions, iron can be mobilized. In sediments, iron is expected to travel primarily as an adsorbed or particulate species in surface drainage channels because the water is mixed with oxygen in the air to maintain the Fe (III) state. The most prevalent occurrence of Fe (II), then, is groundwater under reducing conditions. Pure metal can be found at very low oxidation potentials and neutral to high pH. Iron was not selected as a human health COPC in any medium at LL–9. It was selected as a COPC for ecological risk in surface soil and surface water.

Lead, atomic symbol Pb, is a very immobile element in the environment. This metal has a relatively high soil-water distribution coefficient (ranging from 4.5 to 7,640 milliliters per gram [ml/g]; Dragun, 1988). This indicates that it preferentially binds to soils rather than dissolving in water. When adsorbed to sediments, this metal will be transported with the sediment as a bound species. This metal appears in the divalent (“+2”) state under most pH and redox conditions. At high pH values (e.g., greater than 8), it readily forms hydroxides and oxides. The highest concentration of soil lead was detected in sample LL9SS–011–0001–SO (1,330 mg/kg) and was co-located with high concentrations of copper, mercury, and zinc. The lead, copper, and zinc may represent residual contamination from brass shell casings (composed primarily of copper and zinc) and lead projectiles. Concentrations of this lead exceeded human health screening levels in soil but not in any other media except surface water. Therefore, lead was selected as a COPC for LL–9 soil and surface water. It was also selected as an ecological COPC for surface soil, sediment, and surface water.

Manganese, atomic symbol Mn (not shown in Table 5–2), exhibits chemistry similar to that of iron. This essential nutrient, the twelfth most abundant element in the Earth's crust, occurs primarily in the "+2" valence state. In soil, manganese occurs as hydroxides and oxides, and microbial action plays a role in valence state alteration. The least stable form of manganese, Mn (III), is the most biologically active (Emsley, 2001). Manganese can also exist as Mn (IV). Manganese is most soluble in water in the Mn (II) form; thus, its mobility is greatest under reducing conditions. Under these conditions it is most susceptible to migration in groundwater or uptake by plants (Emsley, 2001). When adsorbed to soil or sediment particles, manganese may migrate in surface water. The concentrations of this metal were greater than human health screening levels in surface and subsurface soils, groundwater, and surface water; and manganese was selected as a human health COPC for LL–9 in these media. Its concentrations in shallow soil and surface water also exceeded ecological screening criteria; and it is selected as an ecological COPC in surface soil and surface water.

Mercury, atomic symbol Hg, has a complex environmental chemistry. This metal, under most redox conditions, persists as an immobile species. It can be converted to organometallic species that are much more volatile, especially in wet sediments. The two common valence states are the "+1" and the "+2" states with Hg (II) predominating under typical environmental conditions. Mercury, when deposited as the pure liquid metal (e.g. from barometers, manometers, and thermometers), will persist for decades in the environment. The liquid mercury coalesces into globules that can slowly release dissolved mercury to the environment. However, the mercury thus released would be expected to precipitate as a chloride, carbonate, hydroxide, or oxide over time. Worldwide, concentrations of mercury in uncontaminated soil are reported to be 0.01 to 0.05 or 0.08 μg/kg (Dragun, 1988; Emsley, 2001). The concentrations of this metal in soil exceeded human health screening levels, especially in sample LL9SS–011–0001–SO (882 mg/kg). Mercury concentrations in soil of this magnitude are unusual. The fact that the high detection was co-located with other metals in a relatively small area suggests that the detection is real. The limited spatial extent of contamination, however, limits the total mass of mercury available for migration to other locations. Mercury was selected as a human health and ecological COPC for LL–9 soils. This metal was also selected as a COPC for sediment and surface water.

Nickel, atomic symbol Ni, predominates under typical environmental conditions as the Ni (II) species. Under high pH conditions (e.g., pH greater than 8), this metal will tend to precipitate as an oxide or hydroxide, except under very reducing conditions where pure metal may exist (Dragun, 1988). Typical soil concentrations are reported to be approximately 50 mg/kg (Emsley, 2001) or even as high as 1,000 mg/kg (Dragun, 1988). The concentrations of this metal were less than human health screening levels, and nickel was not selected as a human health COPC for LL–9; but it was selected as an ecological COPC for surface soil. The mobility of this metal ranges from low in neutral or alkaline conditions to high in acidic environments (see Table 5–2).

Selenium, atomic symbol Se, has chemistry similar to arsenic. This bioaccumulative essential nutrient is a metalloid, thus exhibiting properties similar to both metals and non-metals. Methyl and dimethyl selenide gases have been determined to be produced by anaerobic soils and sediments. Selenium is also taken up and concentrated by some plants which, in turn, may be ingested with ill effect by herbivorous or omnivorous animal species (Emsley, 2001). Selenium, however, is essential for life and participates in an endless cycle of transfer from soil and water to the atmosphere and back to soil and water. This chemical was detected at concentrations greater than ecological screening values in shallow soil and sediment and was, therefore, selected as an ecological COPC. Detected concentrations did not exceed human health risk screening value; therefore, it was not selected as a human health COPC.

Thallium (atomic symbol Tl) minerals are rare, although thallium (not listed in Table 5–2) is ten times more abundant than silver. This metal commonly appears in two different valence states: Tl (I) and Tl (III). When in the “+1” valence state, it has a behavior similar to potassium and sodium. Thallium salts are used in chemical research, and thallium sulfate has been banned as a pesticide in the Western countries (Emsley, 2001). Thallium is absorbed easily by plants, and the degree of absorption is proportional to the concentration of thallium in the associated soil. Tl (III) is easily reduced to Tl (I) (oxidation-reduction potential = 1.25 V). Thus, thallium is a strong oxidizer and the ease of reduction of Tl (III) explains its rarity in nature. Metallic ions of a single positive charge are characteristically mobile in the environment. Thus, thallium is not expected to be strongly bound to soils or sediments and it should move easily in aqueous media. LL–9 thallium concentrations did not exceed the screening levels for any medium and this metal was not selected as a human health or ecological COPC for LL–9.

Vanadium, atomic symbol V, has a very complex environmental chemistry. It exists as numerous species with an array of oxidation states, depending on ambient conditions. Generally, this element is expected to be immobile at neutral to high pH when redox potentials are negative. At moderately positive redox potentials (e.g., greater than 0.2 V), vanadium is expected to exist as soluble vanadate or other oxoanions at all but the lowest pH values. At pH values less than 4, this metal exists predominantly as positively charged oxocations (Dragun, 1988). LL–9 vanadium concentrations exceeded the human health screening values for surface water and sediments, and this metal was selected as a human health COPC for LL–9 in those media. It was selected as an ecological COPC for surface soil only because it exceeded the ecological risk-based screening value.

Zinc, atomic symbol Zn, is widely detected in worldwide soils at concentrations ranging from 5 to 770 mg/kg (Emsley, 2001). Soil concentrations have also been reported to vary from 10 to 300 mg/kg (Dragun, 1988). Plants can take up zinc from surrounding soils, the amount taken up depending on the amount in the soil (Emsley, 2001). This essential nutrient is vital to proper functioning of enzymes. Zinc is only found in the environment as the divalent Zn (II) ion. At high pH (greater than 8), zinc precipitates as a hydroxide. This metal is moderately to very mobile in soils under most conditions (Table 5–2). The highest detected zinc concentration (780 mg/kg) was observed in sample LL9SS–068–0001–SO. The second-highest concentration was also observed in a surface soil sample, LL9SS–011–0001–SO at 711 mg/kg. This latter concentration was co-located with high concentrations of copper, mercury, and lead, which suggest that the zinc is related to those metals. Its relationship as a component of brass shell casings, along with copper, is understandable. The high lead may represent remnants of projectiles. The relationship of the zinc to mercury, however, is not understood. Zinc concentrations were less than human health screening criteria in all media; hence, this metal was not selected as a human health COPC for LL–9. Zinc was selected as an ecological COPC in surface soil and surface water because it exceeded the ecological risk-based screening values for those media.

## 5.3 Contaminant Transport Pathways

A contaminant transport pathway represents the physical path or the mechanism by which a contaminant moves or may move from one location (i.e., the source area) to another. A transport pathway may also involve a phase change for the contaminant (e.g., a contaminant is absorbed to soil, volatilizes to soil gas in the vadose zone, and then migrates into a basement as a gas). In addition, contaminant transport pathways provide mechanisms and conduits for contaminants to migrate to a new location where they may contribute to a human health or ecological risk. The determination of whether a pathway is currently causing a risk or could potentially cause a future risk depends on the combination of chemical characteristics, the existence of a potential pathway, the physical site conditions, and the potential for exposure to occur now or in the future.

This section presents a brief summary of contaminant fate and transport pathways that exist at LL–9. Based on the evaluation of existing conditions, the following potential contaminant transport pathways may exist:

- Leaching of soil contaminants to groundwater;
- Migration of groundwater contaminants within the soil and bedrock strata;
- Mixing of groundwater (i.e., creek bed seepage) with surface water in adjacent stream channels during storm events;
- Erosion and runoff of contaminated particles from soil and deposition in surface water bodies;
- Leaching of contaminants from creek sediment to surface water;

- Migration of contaminants in surface water as dissolved or sorbed phases during storm events; and
- Volatilization from soil, groundwater, or surface water.

An inspection of the integrity of the LL–9 sewer lines was not conducted as a part of this RI. Sumps connected to and upgradient of the sewers were removed. Sewers were sampled for sediment and water at readily accessible locations at the manholes. The integrity of the sewer lines is not completely known. These man-made structures typically represent potential contaminant migration pathways. The potential for migration has been reduced by the sump removal.

### 5.3.1 Leaching of Soil Contaminants to Groundwater

Contaminants that adhere to soil particles or have accumulated in soil pore spaces at LL–9 can leach and migrate vertically to the groundwater as a result of infiltration of precipitation. The rate and extent of this leaching is influenced by the amount of precipitation, rate of infiltration, the physical and chemical properties of the soil, the physical and chemical properties of the contaminant, and the depth of the water table.

During the selection of COPCs in soil (Section 6.2.3), the maximum detected concentrations of individual soil contaminants were compared against screening levels and installation background criteria (USACE, 2001b) concentrations. The soil screening levels (SSLs) included levels protective of groundwater. The SSLs are derived from assumptions regarding aquifer hydraulic conductivity, hydraulic gradient, infiltration rate, mixing zone height, aquifer thickness, source length, and chemical-specific soil-water Kd. These SSLs for protection of groundwater are used to conservatively estimate whether a chemical could leach from soil, migrate to groundwater, and raise the groundwater concentration above the pertinent risk-based screening level for groundwater.

Based on the results of LL–9 soil analyses, six metals-aluminum, arsenic, chromium, cobalt, manganese, and mercury-exhibited concentrations in excess of the soil-to-groundwater SSLs (Appendix V, Tables 2–1 and 2–2). However, only three of these chemicals (aluminum, cobalt, and manganese) were detected in groundwater samples. Hence, leaching of the other three chemicals (arsenic, chromium, and mercury) from soil to groundwater is not considered to be significant. Aluminum, cobalt, and manganese were present within background levels in subsurface soil and were only detected in surface soil above background levels in sporadic locations. This indicates that there is not a large source area in soil; and migration of aluminum, cobalt, and manganese from soil to groundwater is not significant.

The rates of metal leaching from soils to groundwater will not increase unless geological conditions, such as pH or oxidation-reduction potentials, are changed. This is an unlikely event because it involves changes to soils and bedrock that would require massive influxes of chemical before a meaningful change could occur. If it were to occur, the reservoir of metals in the native minerals would vastly outweigh the amount of site-related contamination.

Aside from geological conditions, such as pH and oxidation-reduction potentials, a major factor affecting metal leaching rates is the length of time that the site has been non-operational. Metals are generally most mobile in soil soon after they are released. As time progresses, the assimilation of the metals into the mineral matrix renders them less mobile. If an excess of metals is not present beyond what the soil can readily bind, a steady state sets up. This steady state limits the leaching rates of the metals. Over time, the rates of leaching decrease as the excess metal reservoir is depleted and the more tightly bound metals are the only metals available for leaching. LL–9 has not been operational for about 60 years, which means that no new contaminants have been generated in the last 60 years and the previously released contaminants have had some time to bind to the mineral matrix. Thus, leaching rates can not be any greater than at the current time unless geologic conditions change.

A second factor is, with spatially localized exceptions, the relatively low concentrations of metal contaminants in soil compared to background concentrations. Using arsenic as the example, the site concentrations are only generally slightly greater than the background values with most values being less than the arsenic background value. The background concentrations for arsenic range from 15.4 to 19.8 mg/kg, depending on soil depth. The maximum arsenic concentration in any LL–9 soil sample was 32 mg/kg (sample LL9SB–019–0001–SO). This is less than two times the maximum background concentration. This may indicate that the arsenic is not a site contaminant or, if it is, that the total mass of arsenic contamination is not much greater than what is present naturally. However, arsenic is retained as a site-related contaminant evaluated by this report. This will further be discussed in the uncertainty section. The metals that had the greatest concentrations (i.e., copper, lead, mercury, and zinc), although much greater than normal background concentrations at the locations of highest contamination, also are generally comparable to background concentrations when the “hot spots” are discounted.

A third factor is the arsenic spatial distribution. Because many of LL–9 soil concentrations were less than the 19.8 mg/kg background value, the breadth of arsenic contamination is evidently limited to isolated locations. Furthermore, the isolated occurrences of screening value exceedances in the data available provide a very limited reservoir of contamination that could be transferred to groundwater. In addition, when the vertical profile of arsenic concentrations in soil is considered, it is clear that arsenic concentrations generally do not differ appreciably with soil depth (Tables 4–1 through 4–2). Instead, the concentration values, after allowing for natural soil sample heterogeneity, appear in the data available to be randomly distributed with depth over the entire observed concentration range up to 32 mg/kg in LL9SB–019–0001–SO. This kind of spatial distribution is often an indication that an apparent contaminant is not an actual contaminant. A similar situation exists in the lateral directions. It is an indication that the site soils are well leached and will not pose a significant risk to groundwater in the future. Of course, copper, mercury, lead, and zinc at isolated locations are gross exceptions to this general pattern. Arsenic concentrations as high as 32 mg/kg, however, are not normally observed in soil so this one value and perhaps the six (four subsurface and two surface) others that exceed 19.8 mg/kg up to 26 mg/kg could represent true contamination. This may indicate that the arsenic is not a site contaminant or, if it is, that the total mass of arsenic contamination is not much greater than what is present naturally. However, arsenic is retained as a site-related contaminant evaluated by this report. This will be discussed further in the uncertainty section. Thus, despite one or a few isolated concentration values that may represent true contamination, the evidence is strong that LL–9 soils are in a steady-state condition whereby the rate of leaching of metals into the groundwater will not increase over time. Even the grossly contaminated location LL9SB–011–0001–SO is expected to represent a steady-state condition because of the length of time that has passed since the release.

The final factor is the observed groundwater metal concentrations in comparison to soil concentrations. All wells had the same arsenic concentration (0.73 µg/L), regardless of location. The arsenic detection limit was 0.73 µg/L, which is well below the background screening value for groundwater. Furthermore, the consistent detection of arsenic at this value is likely to be an indication that arsenic is not a site-related contaminant. The low concentrations indicate that arsenic is not a contaminant migration concern and that leaching of contaminants from soil to groundwater has not occurred appreciably. Thus, there does not appear to be a link between elevated soil concentrations and elevated groundwater concentrations to suggest that arsenic is leaching from soil.

This last factor indicates that the site is in a steady state in which there is no significant release of metals contamination except that which is available in the natural soils and bedrock. Variations in groundwater arsenic concentrations are likely to be caused by natural fluctuations such as changes in rainfall. The rates will not increase because contaminants are no longer being released to LL–9.

Although the factors discussed above focus on arsenic, similar arguments can be made for other metals whose concentrations may have exceeded soil screening levels at isolated locations. Even in wells downgradient of the most contaminated surface soil sample (LL9SS–011–0001–SO), the groundwater did not exhibit significantly elevated metal concentrations.

As indicated in Section 5.2.5, many metals detected in LL–9 soils were not selected as COPCs in groundwater. This is additional evidence that the soil-to-groundwater leaching pathway is of limited applicability. Furthermore, the leaching potential of metals is expected to decrease over time as the available metals are leached from soils and not replenished. Because the metal COPC concentrations are not currently much greater than background concentrations, however, it would be difficult or impossible to measure any such rates of decrease. The well that exhibited the highest metal concentrations (MW–004) is on the other side of LL–9 from the most contaminated soil location and is side-gradient to that soil location. Soil samples upgradient of

MW–004 did not exhibit elevated metal concentrations that correspond to the elevated groundwater metal concentrations. These observations are an indication that the detected groundwater metal concentrations are not well correlated to soil concentrations.

Thirteen of the analyzed metals were detected in groundwater. Essential human nutrients (magnesium, potassium, calcium, and sodium) are considered toxic only at very high doses and do not have screening levels referenced in this report. These nutrients were eliminated from consideration as COPCs.

This leaves aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, silver, thallium, vanadium, and zinc as environmentally significant metals detected in groundwater. The detections, however, are generally comparable to other RVAAP AOC upgradient concentrations or what are otherwise considered to represent concentrations in uncontaminated wells worldwide. For example, zinc, atomic symbol Zn, is an essential nutrient at low concentrations. The concentration of this element in worldwide soils is reported to range from 5 mg/kg to 770 mg/kg. It is taken up by plants in amounts that are proportional to the concentration in the surrounding soil. At levels in excess of 500 mg/kg, zinc can interfere with the uptake of other essential nutrients such as iron and manganese in plants (Emsley, 2001). Zinc only appears in the divalent oxidation state, Zn (II). The metal is mobile under most conditions although it forms hydroxide precipitates in aqueous solutions at pH values greater than 8 (Dragun, 1988). The maximum observed zinc concentration was 40 µg/L in sample LL9MW–003–0001–GW. The three other metals (copper, mercury, and lead) that were detected at high concentrations in surface soil sample LL9SS–011–0001–SO do not appear at concentrations in groundwater that reflect transfer of soil contamination to groundwater. For example, the worldwide zinc concentration is reported to range from less than 10 to 2,000 µg/L, the worldwide copper concentration range is less than 1.0 to 30 µg/L, and the worldwide lead concentration range is less than 15 µg/L. The highest observed concentrations of copper, lead, mercury, and zinc in LL–9 groundwater were 14.0 µg/L (LL9MW–004–0001–GW), non-detect, non-detect, and 40 µg/L (LL9MW–003–0001–GW), respectively.

Several organic chemicals [several different PAHs, nitrocellulose, nitroguanidine, RDX, bis(2–ethylhexyl)phthalate, and di–n–butylphthalate] were detected in soil but, of these, only nitrocellulose and bis(2–ethylhexyl)phthalate were detected in groundwater (Appendix V, Tables 2–1, 2–2, and 2–3). The majority of the nitrocellulose detections were qualified as estimated (J), or (B) the concentration of nitrocellulose in the method blank was detected above the reporting limit, or both (B) (J). Therefore, the results may be false-positive detections, especially when the very low solubility of nitrocellulose is considered. The general lack of correlation between organic chemicals detected in soil and groundwater indicates the levels of these chemicals detected in soil do not present enough total mass to yield detectable groundwater concentrations after dilution, dispersion, and other natural mechanisms reduce their concentrations.

### 5.3.2 Migration of Groundwater Contaminants

Organic groundwater contaminants will alternately adsorb to and desorb from organic matter in the soil and bedrock at the molecular level as they migrate with groundwater radially away from LL–9. The radial movements are caused by the groundwater high located near the center of LL–9 (MW-003). Because general groundwater flow appears to be radial away from LL-9, contaminants in groundwater will ultimately flow in similar radial directions. Inorganic groundwater contaminants will follow a pathway similar to the organic contaminants. The relative migration rates will depend on individual contaminant adsorption characteristics and rates of degradation that may occur, as described in Sections 5.1 and 5.2.

The reservoir of organic contamination in soil that could feed groundwater is small, based on soil concentrations reported in Appendix V, Tables 2–1 and 2–2. Therefore, the level of importance of groundwater migration is expected to be minor. This is borne out by the low frequencies of organic contaminant detections for groundwater (Appendix V, Table 2–3).

Precipitation of metals as a mineral phase may physically transform contaminants. Contaminants may be chemically transformed through hydrolysis, oxidation/reduction, or biodegradation. Besides biodegradation, dilution from surface recharge is also a factor that causes the concentrations of contaminants to decrease in the downgradient directions.

Bis(2–ethylhexyl)phthalate was detected at low concentration (4.3 µg/L) in one out of seven wells; hence, this contaminant is not viewed to be an important LL–9 contaminant. However, migration would follow the same path as the groundwater with a retardation of the bis(2–ethylheyl)phthalate as it alternately adsorbs to, and desorbs from, soil and bedrock.

Nitrocellulose was detected in nine soil samples, five groundwater samples, one sediment sample, and one surface water sample scattered across LL–9. Most soil detections occurred in the central portion of the site near the locations of former operational buildings. Nitrocellulose is relatively insoluble, so it is expected to persist in soil and sediment for a long time. Half-life information could not be found for this chemical. Therefore, groundwater dissolution of nitrocellulose followed by groundwater transport does not appear to be a significant transport pathway.

Metals in groundwater will follow groundwater flow patterns just as the organic contaminants do. The metals may migrate in soluble form or as ions or non-ionized organometallic complexes bound to colloidal particles. Migration of soluble metals would be retarded by ion exchange with bedrock, and the rate of colloidal flow through the bedrock would depend on particle size with smaller particles moving more quickly than larger particles. In general, highly charged (+3 or greater) metals and complexes will be retarded to the greatest degree, and weakly charged species (+1) will be the most mobile. Lead, chemical symbol Pb, is a notable exception. This metal binds tightly to soil as the $Pb^{+2}$ ion, and is essentially immobile despite its moderate charge of "+2." This ion also binds tightly to sediments but is mobile when the sediments, themselves, migrate.

As explained in Section 5.3.1, however, the amount of metals leaching into groundwater and, hence, the migration of groundwater metal contaminants, will remain steady or decrease over time relative to the current concentrations.

### 5.3.3 Mixing of Groundwater (i.e., Creek Bed Seepage) with Surface Water in Adjacent Stream Channels During Storm Events

Groundwater may recharge nearby drainage channels, but knowledge of site conditions suggests that the primary source of drainage channel water is precipitation. Any contaminants that are in the groundwater would be transported to the creek with the groundwater. Rates of transport cannot be predicted; but because the concentrations of organic and metal contaminants are low in LL–9 groundwater, the rates are not significant. Precipitation tends to further dilute groundwater seepage that enters the drainage channels.

### 5.3.4 Migration of Contaminants from Surface Soil to Surface Water

Rainfall, snowmelt, and surface water runoff that come into direct contact with surface soils can leach contaminants from the soils and transport them to drainage channels via runoff during storm events. Soil particles containing sorbed contaminants can also be dislodged from the soil surface and be physically transported to the creek via overland runoff. The topographic relief at LL–9 is minor, so the amount of overland runoff from this site is expected to be very small.

Nitrocellulose, was detected at an estimated concentration 0.12 (J)(B) mg/L in sample LL9SW–012–0001–SW and 0.1 (J)(B) mg/L in sample LL9SW–012–0001–DUP, was the only organic chemical detected in surface water. However, the results were qualified as estimated (J) and (B) the concentration of nitrocellulose in the method blank was detected above the reporting limit. These two detections at low concentration indicate that surface runoff is not a significant migration pathway. Nitrocellulose, which is not expected to be soluble to any significant degree in surface water, will be transported as suspended particulates. The rate of transport is expected to be small because the reservoir of nitrocellulose is small. The detection of nitrocellulose cited here may be a false detection, based on its similarity to the analytical detection limit and the known limited solubility of nitrocellulose in water.

### 5.3.5 Leaching of Contaminants from Creek Sediment to Surface Water

The reservoir of organic and inorganic contamination in drainage channels and creek sediments is low and the source of water that LL–9 drainage channels receive is precipitation. Therefore, the opportunity for transfer from creek sediments to surface water is limited by the frequency of rainfall and snowmelt, and this insignificant migration pathway is not discussed further.

### 5.3.6 Migration of Contaminants in Surface Water as Dissolved or Sorbed Phases During Storm Events

Once contaminants are dislodged from surface soil particles, some of which then become dissolved, they may flow with surface water and entrained sediments to downgradient areas. The masses and concentrations of organic and inorganic contamination available in surface soils and sediments are generally low, with the notable exception of the high metal concentrations at LL9SS–011–0001-SO in surface soil. This location is near the western side of the site where the terrain becomes relatively steep further to the west. There are no clear drainage channels in the immediate vicinity of that location, however, so the erosion potential is concluded to be relatively low. Erosion is also limited by the grass cover in this area. Therefore, while the drainage channels represent potential migration pathways, it does not appear that these migration pathways are significant as a means of transporting contaminants.

### 5.3.7 Volatilization from Soil, Groundwater, or Surface Water

All detected compounds in soil were SVOCs or other relatively non-volatile chemicals; therefore, volatilization from soil in an insignificant transport pathway. A similar situation exists for the other media. Therefore volatilization from any of these media is considered to be insignificant. This is further supported by the generally small reservoir of contamination present in any of the investigated media. When small masses of contaminants are coupled with slow rates of release, the migration pathway of interest is insignificant. Where mercury concentrations were very high (i.e., LL9SS–011–0001–SO) transformation of mercury to methyl or ethyl mercury compounds is possible with subsequent evaporation from the soil. However, this is most likely to occur under anaerobic conditions, and the high mercury concentrations were detected in shallow soil where anaerobic conditions are not likely. Therefore, even this transformation pathway followed by volatilization is not expected to be significant. The rates of such transformation are low enough that such transformations would not be expected to result in the release of hazardous quantities of these very toxic organomercury compounds chemicals.

## 5.4 Conceptual Site Model

The CSM is a description based on known site conditions that explains in a conceptual manner how contaminants were or could have been deposited, how these contaminants can or do move in the environment, and the impact they may have on receptors. The focus of this section is on the physical model. Effects and potential effects on environmental organisms, including humans, are discussed in the risk assessment sections.

From 1941 to 1945, LL–9 operated to produce detonators. In 1945, the load line was deactivated, and the equipment was removed. There are no documented activities at LL–9 since closure in 1945. Primary explosives handled in detonators (Lead Azide/Mercury Fulminate) were present in smaller quantities. Secondary high explosives of interest included tetryl, and possibly others; propellants of interest include nitroglycerine, nitrocellulose, and nitroguanidine. Some of these contaminants and others were detected in several environmental media, although at low concentrations that represent small total masses of contaminants sparsely scattered across the site:

- There were analytical detections of metals, SVOCs, energetic compounds, and some miscellaneous inorganic chemicals. Metal contaminants were detected throughout the site, but primarily in the immediate vicinity of the production buildings. Organic compounds were also detected throughout the site. Nitrocellulose, which has an expected long half-life in the environment, was detected in several samples; but the detections appear to be false detections.
- In soils, metals, nitrocellulose, nitroguanidine, RDX, and SVOCs were detected throughout the site including the periphery areas. Nitroguanidine was detected at the far western edge of the site in surface soil only. When detected, these organic chemicals were generally detected at the greatest concentrations in surface soil, which is consistent with an aerial deposition mechanism.
- In sediment, metals, nitrocellulose, several PAHs, and three phthalate esters were detected. The distribution is similar to the distribution in soil: concentrations are generally higher in surface soils than subsurface soils
- In surface water sampling locations, only metals were detected at concentrations exceeding either a Region 9 tap water PRG or an RVAAP installation background concentration. No pattern of distribution could be discerned.
- Exceedances of RVAAP installation background and/or Region 9 tap water PRG values were reported in the seven groundwater samples. Analytes included metals and one detection of bis(2–ethylhexyl)phthalate. Monitor well MW–007, located downgradient of the production area, had exceedances on inorganics only. Nitrocellulose was reported as detected, but the reported detections appear to be false detections and there are no screening criteria for this operations-related compound.

The concentrations of contaminants are generally low, with a notable exception being a localized spot of high metal concentrations for copper, mercury, lead, and zinc at LL9SS–011–0001–SO in surface soil.

Sumps might have been a primary contamination source from operations water that was routinely diverted to them; however, sumps were removed during the LL–9 interim remedial action. Sewer lines may provide a contaminant transport pathway.

Contamination at LL–9 is sparsely dispersed across the site with some elevated chemical concentrations occurring near operational activities. Most metals appear to be fairly uniformly distributed across the site, with exception of location LL9SS–011–0001–SO as noted above.

Metals do not degrade in the environment, but they can be assimilated into minerals. Their oxidation states can change over time as they migrate from one location to another. Metals in general, however, are relatively immobile except for those with predominantly single positive charges, such as sodium and potassium. A few other metals, such as calcium and magnesium, are also relatively mobile. These four metals, however, generally pose little to no environmental risks to receptors. Receptor exposure and risk are treated more completely in the risk assessment sections (6.0 and 7.0).

Few organic chemicals that are directly related to site operations were selected as COPCs, indicating that the concentrations of detected organic chemicals are generally low enough not to pose a significant threat to the health of receptors.

The primary contaminant migration pathways for contaminants at LL–9 are:

- Leaching from soils to groundwater,
- Leaching from sediments to surface water, and
- Transport in surface drainage channels.

Leaching from soils would be expected to occur around sumps if contaminated soil remained in place after the sump removals. This is not expected to be a significant concern. The sump removal is complete. Given that the quantities of contamination present at LL–9 are generally low elsewhere, even if contaminated soil is in place from the sump removal, the mass of contaminants transported by this migration pathway is expected to be low. The sumps were holding water and appeared to be structurally intact. No staining was observed. Dilution effects should be large in drainage channels. This is reflected in the low concentrations of contaminants detected in surface waters. Similar effects are observed in groundwater. Nitrocellulose, which has evidently been widely distributed in surface and subsurface soils at low concentrations across LL–9, is notably recalcitrant to dissolution; hence, its persistence is expected to be long.

Any soil or sediment contaminants that leach into groundwater would flow radially away from the AOC based upon groundwater elevation mapping. Each contaminant will be retarded in its movement. The degree of retardation depends largely on the adsorption tendency of each contaminant and the amount of organic material in the soils and bedrock.

Surface water drainage channels can transport surface soil contaminants and sediments to downgradient locations; however, the topographical relief is moderate at LL–9 except at the LL–9 peripheries. Therefore, transport pathways are not expected to move sediments rapidly. An exception to this could be during storm events when flow rates increase significantly. Contaminants detected at LL–9 will tend to adsorb to sediments.

In summary, the low concentrations and small total masses of energetic compounds at LL–9 are consistent with good health and safety practices. In particular, primary explosives, such as metal azides (e.g., lead azide) and fulminates (e.g., mercury fulminate), which are very unstable with respect to physical shock, would not be expected to be released indiscriminately to non-operational areas. To do so would result in extreme safety hazards. The small reservoir of contamination in soil provides little total contaminant mass for migration to groundwater or other media. The metals will persist and the organics will degrade over time, albeit some of them (e.g., nitrocellulose) will do so slowly. Given the low concentrations observed at this site, modeling to estimate the degradation rates would not be fruitful. SESOIL and AT123D modeling were not performed for six metals (aluminum, arsenic, chromium, cobalt, manganese, and mercury) because aluminum, chromium, and manganese had concentrations that exceeded background less than 5% of the time, arsenic exceeded 26% and mercury 44%, but neither of these were detected in groundwater, indicating that little or no leaching is taking place. Cobalt exceeded background 18% of the time. Maximum concentrations of these metals were generally less than three times background, and the total volume of any contaminated soil is so small, that impacts on groundwater would not be measurable, either through a modeling exercise or through actual groundwater monitoring.

# 6.0 BASELINE HUMAN HEALTH RISK ASSESSMENT

This section presents the results of the Baseline Human Health Risk Assessment (BHHRA) conducted to characterize the risks to humans associated with potential current or future exposures to chemicals in surface soil, subsurface soil, groundwater, surface water, and sediment within LL–9 at the RVAAP, Ravenna, Ohio. This section also provides a list of chemicals of concern (COCs) for further evaluation by the risk managers.

## 6.1 Introduction

As described in previous sections, LL–9 is located at the intersection of Fuze and Booster Roads and George Road in the south-central region of RVAAP and consists of approximately 69 acres. LL-9 was utilized primarily for the production of detonators from 1941 to 1945. Site features include a gravel road around the former main production area and a water tower that is no longer connected to a water distribution system. Buildings formerly located at the site were previously thermally decontaminated and demolished (MKM, 2003a).

The methods used in the LL–9 BHHRA are based primarily on the protocol established in the RVAAP *Facility–Wide Human Health Risk Assessors Manual (FWHHRAM*) (USACE, January 2004.) Additional protocol is summarized in the *White Paper – Human Health Risk Assessment Approach for Load Lines 6, 9, and 11 Remedial Investigations, Ravenna Army Ammunition Plant, Ravenna, Ohio* (TtNUS, April 2004). A copy of the White Paper is included in Appendix X. Technical guidance discussed during March 2004 teleconferences with the USACE and Ohio EPA was also considered during preparation of the BHHRA.

The methods for the BHHRA consist of the following six steps:

- Step 1 – Data evaluation – Select site-related chemicals (SRCs) and chemicals of potential concern (COPCs) for environmental media at LL–9. The COPCs identified in Step 1 are evaluated quantitatively (when possible) and discussed qualitatively otherwise. Data evaluation is further discussed in Section 6.2.
- Step 2 – Exposure assessment – Identify potential current and future human receptors that may be exposed to the COPCs, evaluate the pathways by which the receptors may be exposed, and the estimate chemical intake resulting from exposure.
- Step 3 – Toxicity assessment – Assess toxicity of each COPC including the presentation of the toxicity criteria (i.e., cancer slope factors, reference doses) typically used by USEPA to estimate risk.

- Step 4 – Risk characterization – Estimate cancer and non-cancer risk using the intakes and toxicity criteria listed in the exposure assessment and toxicity assessment, respectively.
- Step 5 – Uncertainty analysis – Specify major uncertainties affecting the interpretation of the BHHRA results.
- Step 6 – Summary and Conclusions – Summarize and present the conclusions of the BHHRA.

The results of the BHHRA are used to (1) document and evaluate risks to human health; (2) determine the need, if any, for remedial action; and (3) identify COCs. COCs are those chemicals determined by the BHHRA to pose (or significantly contribute to) a potential risk to human receptors in excess of target risk benchmarks. The development of chemical-specific remediation levels may be required for these chemicals. Per the protocol established in the White Paper for LL–9 (TtNUS, 2004), potential COCs were identified for an environmental medium when the receptor risk exceeded a cumulative cancer risk benchmark of $1x10^{-5}$ or a total non-cancer hazard index (HI) benchmark of 1.

Three major conditions of chemical contamination and environmental fate and transport are considered when evaluating potential risks: (1) contaminants with toxic characteristics must be found in environmental media and must be released by either natural processes or by human action; (2) potential exposure points must exist; (3) human receptors must be present at the points of exposure. If any of the conditions listed above is absent, risks are not quantitatively evaluated for that exposure pathway.

The quantitative BHHRA for LL–9 includes tables based on RAGS Part D (USEPA, 2001a) and RVAAP specifications.

## 6.2 Data Evaluation

Data evaluation involves the gathering, evaluation, and organization of data into a form that is appropriate for a baseline risk assessment. The data gathering step involves the compilation of all available data and the sorting of data by medium. The quality of the data is evaluated with respect to qualifiers and codes applied as a consequence of the data validation process and via other quality measures (e.g., the adequacy of the analytical methods used in the site investigation, the adequacy of the sample quantitation limits, etc). COPCs are selected for evaluation in the BHHRA using protocols that include a comparison of site concentrations to facility background concentrations and to conservative toxicity screening concentrations. Section 6.2.1 describes the data sets compiled for use in the BHHRA and the data validation process used to evaluate the quality of the data. Section 6.2.2.summarizes the protocols for and the results of the COPC selection process.

### 6.2.1 Data Collection and Evaluation

The data used in the BHHRA consisted of the following:

- Analytical data available for soils, groundwater, surface water, and sediment samples collected at LL–9. The data sets evaluated are discussed in detail in Section 6.2.3. The data are the result of the environmental investigations described in Section 3.
- Surface soil was defined as soils collected from 0–1 ft bgs, and subsurface soil was defined as soils collected from depths greater than 1 ft bgs. The deep surface soil data set was composed of surface soil data and subsurface soil data from samples collected 1–4 ft bgs. For groundwater, filtered samples were collected and analyzed for TAL metals, per State of Ohio's directions. Unfiltered samples were collected and analyzed for volatile and semi-volatile compounds. The analytical laboratory selected the most appropriate analytical result if reanalysis/dilutions were necessary, and that result was evaluated in the determination of the SRCs for this risk assessment.
- Some data originally collected as part of the RI were not used in the BHHRA. For example, buildings and sumps were removed from LL–9; therefore, samples collected from these areas removed during the excavations were not used in the BHHRA. Consequently, the data sets evaluated in the BHHRA represent current conditions at LL–9.

Chemicals were analyzed and assessed in accordance with Louisville Chemistry Guidance. The analytical results were evaluated, using the National Functional Guidelines (USEPA, 1994a, and 1994b) to assess data usability and the laboratory's compliance with the analytical methods. The analytical data were reviewed, validated, and evaluated using the criteria specified in the data quality objectives. Validated data (and qualifiers) are included in Appendices F, G, J, L, and N. Unqualified positive detections and "J" qualified detections (estimated values) were considered as detected concentrations for this BHHRA. All non-detect results (indicated with a "U" qualifier) were retained in the BHHRA data set. None of the analytical data evaluated in the BHHRA were rejected as a consequence of the data validation process. A complete data quality summary is included in Appendix U.

The data evaluation included the calculation of basic descriptive statistics for each data set evaluated in the BHHRA. Basic statistics included frequency of detection, range of positive detections, arithmetic mean, normal 95% upper confidence level (95% UCL-N) on the mean, and log-normal 95% upper confidence level (95% UCL-L) on the mean. Appendix V provides the equations used to determine the 95% UCL-L and the 95% UCL-N on the mean. These descriptive statistics were also used in the determination of exposure point concentrations (EPCs) selected in the exposure assessment.

### 6.2.2 Selection of COPCs

COPCs for LL–9 were identified in two steps. First, SRCs were identified for each medium, then a toxicity screen was conducted to determine which SRCs would be selected as COPCs. The purpose of the screening process was to eliminate chemicals for which no further risk evaluation is needed. The premise of this screening step is that risk is typically dominated by a few chemicals and that, although dozens may actually be detected, many chemicals may contribute minimally to the total risk. Section 6.2.2.1 describes the SRC selection process, and Section 6.2.2.2 describes the COPC screening process.

#### *6.2.2.1 SRC Screens*

The following assumptions were made in the determination of the LL–9 SRCs:

- Physical chemistry data (e.g., alkalinity, pH, etc.) are not considered to be SRCs (and, therefore, are not considered to be COPCs) for LL–9.
- Groundwater samples were filtered in the field. Filtered metals data were used for TAL metals to determine inorganic groundwater SRCs. Filtered data are typically more indicative of the soluble or dissolved, and therefore, more mobile chemical concentrations in groundwater. Unfiltered data were used for volatiles and semi-volatile SRCs.
- Soil data were subdivided into three data sets based on the sampling depths for LL–9 and the receptors to be evaluated at LL–9. In accordance with the FWHHRAM, the surface soil data set is comprised of data for samples collected from the 0–1 ft bgs interval. The deep surface soil data set is composed of soil samples collected within the 0–4 ft bgs interval. Subsurface soil data is composed of sample results for soil samples collected below 1 ft bgs. Consequently, data from the surface soil data set were compared to the surface soil RVAAP background criteria, and data from the subsurface soil data set were compared to the subsurface soil background criteria. The chemical concentrations in the deep surface soil samples were compared to the lower of the RVAAP background benchmarks available for the background surface and subsurface soil data sets.

The LL–9 SRC screening process (a process by which chemicals are eliminated from further consideration in the BHHRA) involved two steps: comparing results to already established, RVAAP-specific background concentrations and weight-of-evidence screening. The background comparison was conducted to determine whether the metals detected in the environmental media were naturally occurring or potentially site-related. Per the protocol established in the White Paper (TtNUS, 2004), the RVAAP-specific background values are those presented in the *Phase II Remedial Investigation Report for the Winklepeck Burning Ground at Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE, 2001b). These values are either the 95% upper tolerance limits (UTLs) for the background dataset for each environmental media, or they are the maximum detected concentrations if the calculated UTLs exceed the maximum detected concentrations reported for the background samples. An inorganic was selected as a potential SRC if the maximum detected concentration exceeds the RVAAP background value. This background screen was applied to inorganic chemicals only; organic chemicals were not eliminated as SRCs based on background comparisons.

Two weight-of-evidence screens (a frequency-of-detection screen and a screen for naturally occurring essential elements) were also used as follows to eliminate chemicals from further consideration in the BHHRA:

- If a data subset contained 20 or more data points, a frequency-of-detection screen was applied. Chemicals with a frequency of detection of less than 5% of the samples analyzed in any medium may not be considered to be site-related for that medium if:

    1) The chemical was not detected at high concentrations relative to the detection limit or to the established background values;
    2) The chemical was not detected in another medium; and
    3) Knowledge of LL–9's history or processes did not suggest that the chemical would be present. For example, any explosive or propellant detected in any LL–9 medium was considered to be site-related regardless of frequency of detection.

- Naturally occurring essential elements, including calcium, chloride, iodine, iron, magnesium, potassium, phosphorous, and sodium, are typically considered to be toxic only at high concentrations and are typically not selected as SRCs. As detailed in the FWHHRAM, these metals are an integral part of the human food supply and are often added to food as supplements. USEPA recommends that these chemicals not be evaluated as COPCs as long as they are: (1) present at concentrations only slightly elevated above naturally occurring levels and (2) only toxic at doses much higher than those that could be associated with contact at a site. Recommended daily allowance (RDA) and recommended daily intake (RDI) values are available for seven of these metals. Based on the RDA/RDI values, a receptor ingesting 100 mg of soil per day would receive less than the RDA/RDI of calcium, magnesium, phosphorous, potassium, and sodium, even if the soil consisted of the pure mineral (i.e., soil concentrations greater than 1,000,000 mg/kg). Receptors ingesting 100 mg of soil per day would require soil concentrations of 1,500 mg/kg of iodine and 100,000 to 180,000 mg/kg of iron to meet their RDA/RDI for these metals. Concentrations of these metals in the environmental media at LL–9 do not exceed these levels. Consequently, these essential nutrients were not selected as potential SRCs.

The results of the SRC screen are shown for each medium in Appendix V, Tables 2.1 through 2.6.

### *6.2.2.2 COPC Toxicity Screen*

After the SRCs were identified, they were further evaluated using a toxicity screen to develop a list of human health COPCs. For this risk assessment, risk-based and health-based criteria were used to reduce the number of chemicals and exposure routes considered in the LL–9 BHHRA. More importantly, the screening focused the risk assessment on those chemicals most likely to be significant in terms of risk. COPCs were defined as chemicals that were positively detected in an environmental medium at a maximum concentration exceeding screening values.

Environmental sampling results were compared to risk-based screening concentrations (RBSCs) based on USEPA Region 9 residential PRGs (USEPA, 2004c) and, for groundwater only, federal Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCLs). The USEPA Region 9 risk-based residential PRGs represent a risk level of $1\text{x}10^{-6}$ for carcinogenic effects (i.e., a 1 in 1,000,000 excess chance of developing cancer over a lifetime) and an HI of 1.0 for non-carcinogenic effects (i.e., adverse non-carcinogenic health effects are not anticipated at or below this exposure concentration). The RBSCs represent a risk level of $1\text{x}10^{-6}$ for carcinogenic effects and an HI of 0.1 to account for additive non-carcinogenic effects. The Region 9 residential PRGs for soil were calculated for a human receptor hypothetically exposed to chemicals in soil assuming a residential land use scenario. The Region 9 PRGs for tap water were calculated for a human receptor hypothetically using a groundwater or surface water resource as a domestic water supply. Conservatively, RBSCs for non-carcinogens are one-tenth the Region 9 PRGs to further account for potential cumulative non-carcinogenic effects. The RBSCs for carcinogens are the Region 9 residential PRGs and represent the $1 \text{ x } 10^{-06}$ cancer risk level. If RBSCs exist for a chemical for both carcinogenic and non-carcinogenic effects, the lower of the two values was used as the COPC selection criterion.

The maximum detected concentration for each SRC in each medium was compared to the risk based screening concentration as follows:

- Chemicals in surface soil, subsurface soil, and sediment were screened against their respective RBSCs. The RBSCs used were the Region 9 residential soil PRGs that reflect residential land use. Data from these media were also compared to their respective industrial soil PRGs; that comparison is presented for informational purposes only.
- Chemicals in groundwater were screened against the lesser of the RBSCs based on the Region 9 tap water PRGs and Federal SDWA MCLs.
- Chemicals in surface water are screened against the RBSCs based on the Region 9 tap water PRGs.

Region 9 PRGs can be found at http://www.epa.gov/region09/waste/sfund/prg/index. Drinking water MCLs were obtained from http://www.epa.gov/safewater/mcl.

SRCs that exceeded toxicity screening levels and those lacking screening levels were retained as COPCs. Conversely, chemicals that were not detected at maximum concentrations exceeding toxicity screening levels were not retained as COPCs.

If USEPA-approved toxicity information, such as cancer slope factors or reference doses, is available, the COPCs are then classified as quantitative COPCs. If no toxicity information is available, the COPCs are considered to be qualitative COPCs. The qualitative COPCs identified for LL–9 were further evaluated in the uncertainty section of the BHHRA (Section 6.6.1). The quantitative COPCs are further discussed in the toxicity assessment section (Section 6.4). Toxicity profiles are presented for all COPCs in Section 6.4.

Appendix V, Tables 2.1 through 2.6, present the COPC screens for surface soil, deep surface soil (0- to 4-ft interval), subsurface soil, groundwater, surface water, and sediment, respectively. These tables include the following:

- Summary statistics, including the frequency of detection, range of non-detected values, maximum and minimum detected concentrations, location of maximum concentration, arithmetic average concentration, and upper 95% UCL on the mean concentration;
- Screening values (RVAAP background criteria [USACE, 2001b], RBSCs, and MCLs, as appropriate);
- SRC determination; and
- COPC determination.

The data sets evaluated for each environmental medium are presented in Tables 6-1 through 6-6. Table 6-7 summarizes the COPC list for each medium and indicates which COPCs will be addressed quantitatively and qualitatively for each medium.

#### *6.2.2.3 Screening for Lead*

USEPA-approved toxicity criteria (i.e., cancer slope factors and reference doses) have not been published for lead. Consequently, a calculated, toxicity criteria-based PRG is not available for this element. For this risk assessment, lead concentrations in soil and sediment at LL–9 (see Appendix V, Tables 2.1, 2.2, 2.3, and 2.6) were compared to the lead soil screening guidance concentration of 400 mg/kg for residential soil published in OSWER Directive #9355.4–12 (USEPA, 1994c). This value is presented as the residential PRG in the USEPA Region 9 table. Lead was not detected in sediment, subsurface soil, or groundwater at LL–9 at concentrations greater than the lead soil screening guidance concentration of 400 mg/kg for residential soil.

Lead was detected in surface water, and the SDWA action level of 15 µg/L was used as the screening level.

#### *6.2.2.4 COPC Screening Assumptions*

The following assumptions have been made regarding the use of PRGs in this BHHRA:

- LL–9 environmental samples were analyzed for total chromium. The maximum detected concentrations for chromium were screened against the Region 9 residential PRGs for hexavalent chromium. This is a conservative screening approach, because hexavalent chromium is more toxic than trivalent chromium and is a less commonly occurring form of the metal.
- As recommended by Ohio EPA, the Region 9 Cal-modified PRG for trichloroethene was used as the basis for the RBSC for trichloroethene.

### 6.2.3 COPCs for LL–9

Sections 6.2.3.1 through 6.2.3.6 identify LL–9 COPCs in surface soil, deep surface soil (i.e., the 0–4 ft interval), subsurface soil, groundwater, surface water, and sediment, respectively. Arsenic was determined to be a COPC in all media at LL–9. Antimony and manganese were selected as COPCs only for groundwater. Carcinogenic PAHs (benzo[a]pyrene and dibenzo[a,h]anthracene) were determined to be a COPC only in surface soil and deep surface soil.

#### *6.2.3.1 Surface Soil*

Analytical data available for 53 surface soil samples were evaluated in the BHRRA. Twenty-two metals, 19 SVOCs, nitroguanidine, and nitrocellulose were detected in the surface soil samples collected at LL–9. The samples evaluated in this BHHRA are listed in Table 6–1. The results of COPC selection for surface soils are summarized in Appendix V, Table 2.1. The following chemicals were identified as surface soil COPCs:

- Metals (aluminum, arsenic, chromium, copper, lead, manganese, and mercury);
- Organics (benzo[a]pyrene, and dibenzo[a,h]anthracene); and
- Nitrocellulose.

One aluminum detection, two manganese detections, and four chromium detections out of 53 exceeded their respective background concentrations; therefore, these metals were selected as COPCs.

## Table 6-1
## Human Health Risk Assessment Dataset for Surface Soils

| Sample ID | Depth bgs* |
|---|---|
| LL9SS-001 | 0-1 |
| LL9SS-002 | 0-1 |
| LL9SS-003 | 0-1 |
| LL9SS-004 | 0-1 |
| LL9SS-005 | 0-1 |
| LL9SS-006 | 0-1 |
| LL9SS-007 | 0-1 |
| LL9SS-008 | 0-1 |
| LL9SS-009 | 0-1 |
| LL9SS-010 | 0-1 |
| LL9SS-011 | 0-1 |
| LL9SS-012 | 0-1 |
| LL9SS-013 | 0-1 |
| LL9SS-014 | 0-1 |
| LL9SS-015 | 0-1 |
| LL9SS-016 | 0-1 |
| LL9SS-017 | 0-1 |
| LL9SS-018 | 0-1 |
| LL9SS-019 | 0-1 |
| LL9SS-020 | 0-1 |
| LL9SS-021 | 0-1 |
| LL9SS-022 | 0-1 |
| LL9SS-023 | 0-1 |
| LL9SS-024 | 0-1 |
| LL9SS-025 | 0-1 |
| LL9SS-026 | 0-1 |
| LL9SS-027 | 0-1 |
| LL9SS-028 | 0-1 |
| LL9SS-029 | 0-1 |
| LL9SS-030 | 0-1 |
| LL9SS-031 | 0-1 |
| LL9SS-032 | 0-1 |
| LL9SS-033 | 0-1 |
| LL9SS-034 | 0-1 |
| LL9SS-035 | 0-1 |
| LL9SS-036 | 0-1 |
| LL9SS-037 | 0-1 |
| LL9SS-038 | 0-1 |
| LL9SS-039 | 0-1 |
| LL9SS-040 | 0-1 |
| LL9SS-041 | 0-1 |
| LL9SS-042 | 0-1 |
| LL9SS-043 | 0-1 |
| LL9SS-044 | 0-1 |
| LL9SS-045 | 0-1 |
| LL9SS-046 | 0-1 |
| LL9SS-047 | 0-1 |
| LL9SS-068 | 0-1 |

# Table 6-2
## Human Health Risk Assessment Dataset For Subsurface Soils

| Sample ID | Depth bgs* |
|---|---|
| LL9SB-001 | 1 - 3 |
| LL9SB-002 | 1 - 3 |
| LL9SB-003 | 1 - 2 |
| LL9SB-004 | 1 - 3 |
| LL9SB-005 | 1 - 3 |
| LL9SB-006 | 1 - 2 |
| LL9SB-007 | 1 - 3 |
| LL9SB-008 | 1 - 3 |
| LL9SB-009 | 1 - 3 |
| LL9SB-010 | 1 - 2.5 |
| LL9SB-012 | 1 - 3 |
| LL9SB-013 | 1 - 3 |
| LL9SB-014 | 1 - 3 |
| LL9SB-015 | 1 - 3 |
| LL9SB-016 | 1 - 3 |
| LL9SB-017 | 1 - 3 |
| LL9SB-018 | 1 - 3 |
| LL9SB-019 | 1 - 3 |
| LL9SB-020 | 1 - 3 |
| LL9SB-021 | 1 - 2.5 |
| LL9SB-022 | 1 - 3 |
| LL9SB-023 | 1 - 3 |
| LL9SB-024 | 1 - 3 |
| LL9SB-025 | 1 - 3 |
| LL9SB-026 | 1 - 3 |
| LL9SB-027 | 1 - 3 |
| LL9SB-028 | 1 - 3 |
| LL9SB-029 | 1 - 3 |
| LL9SB-030 | 1 - 3 |
| LL9SB-031 | 1 - 3 |
| LL9SB-032 | 1 - 3 |
| LL9SB-040 | 6.5 - 6.5 |
| LL9SB-041 | 7 - 7 |
| LL9SB-042 | 8 - 10 |
| LL9SB-043 | 9 - 11 |
| LL9SB-044 | 8 - 10 |
| LL9SB-045 | 8 - 10 |
| LL9SB-046 | 4 - 6 |
| LL9SB-047 | 3 - 5 |
| LL9SB-048 | 1 - 3 |
| LL9SB-049 | 1 - 3 |
| LL9SB-050 | 1 - 3 |
| LL9SB-051 | 1 - 3 |
| LL9SB-052 | 1 - 3 |
| LL9SB-053 | 1 - 3 |
| LL9SB-055 | 1.5 - 3.5 |
| LL9SB-056 | 2 - 4 |
| LL9SB-059 | 3 - 5 |
| LL9SB-061 | 1 - 3 |
| LL9SB-065 | 3 - 5 |
| LL9SB-066 | 5 - 7 |
| LL9SB-069 | 7 - 7 |
| LL9SB-070 | 6.5 - 6.5 |

## Table 6-3
## Human Health Risk Assessment Dataset For Deep Surface Soils

| Sample ID | Depth bgs* |
|---|---|
| LL9SS-001 | 0-1 |
| LL9SS-002 | 0-1 |
| LL9SS-003 | 0-1 |
| LL9SS-004 | 0-1 |
| LL9SS-005 | 0-1 |
| LL9SS-006 | 0-1 |
| LL9SS-007 | 0-1 |
| LL9SS-008 | 0-1 |
| LL9SS-009 | 0-1 |
| LL9SS-010 | 0-1 |
| LL9SS-011 | 0-1 |
| LL9SS-012 | 0-1 |
| LL9SS-013 | 0-1 |
| LL9SS-014 | 0-1 |
| LL9SS-015 | 0-1 |
| LL9SS-016 | 0-1 |
| LL9SS-017 | 0-1 |
| LL9SS-018 | 0-1 |
| LL9SS-019 | 0-1 |
| LL9SS-020 | 0-1 |
| LL9SS-021 | 0-1 |
| LL9SS-022 | 0-1 |
| LL9SS-023 | 0-1 |
| LL9SS-024 | 0-1 |
| LL9SS-025 | 0-1 |
| LL9SS-026 | 0-1 |
| LL9SS-027 | 0-1 |
| LL9SS-028 | 0-1 |
| LL9SS-029 | 0-1 |
| LL9SS-030 | 0-1 |
| LL9SS-031 | 0-1 |
| LL9SS-032 | 0-1 |
| LL9SS-033 | 0-1 |
| LL9SS-034 | 0-1 |
| LL9SS-035 | 0-1 |
| LL9SS-036 | 0-1 |
| LL9SS-037 | 0-1 |
| LL9SS-038 | 0-1 |
| LL9SS-039 | 0-1 |
| LL9SS-040 | 0-1 |
| LL9SS-041 | 0-1 |
| LL9SS-042 | 0-1 |
| LL9SS-043 | 0-1 |
| LL9SS-044 | 0-1 |
| LL9SS-045 | 0-1 |
| LL9SS-046 | 0-1 |
| LL9SS-047 | 0-1 |
| LL9SS-068 | 0-1 |
| LL9SB-001 | 1-3 |

# Table 6-3
# Human Health Risk Assessment Dataset For Deep Surface Soils

| Sample ID | Depth bgs* |
|---|---|
| LL9SB-002 | 1-3 |
| LL9SB-003 | 1-2 |
| LL9SB-004 | 1-3 |
| LL9SB-005 | 1-3 |
| LL9SB-006 | 1-2 |
| LL9SB-007 | 1-3 |
| LL9SB-008 | 1-3 |
| LL9SB-009 | 1-3 |
| LL9SB-010 | 1-2.5 |
| LL9SB-012 | 1-3 |
| LL9SB-013 | 1-3 |
| LL9SB-014 | 1-3 |
| LL9SB-015 | 1-3 |
| LL9SB-016 | 1-3 |
| LL9SB-017 | 1-3 |
| LL9SB-018 | 1-3 |
| LL9SB-019 | 1-3 |
| LL9SB-020 | 1-3 |
| LL9SB-021 | 1-2.5 |
| LL9SB-022 | 1-3 |
| LL9SB-023 | 1-3 |
| LL9SB-024 | 1-3 |
| LL9SB-025 | 1-3 |
| LL9SB-026 | 1-3 |
| LL9SB-027 | 1-3 |
| LL9SB-028 | 1-3 |
| LL9SB-029 | 1-3 |
| LL9SB-030 | 1-3 |
| LL9SB-031 | 1-3 |
| LL9SB-032 | 1-3 |
| LL9SB-047 | 3-5 |
| LL9SB-048 | 1-3 |
| LL9SB-049 | 1-3 |
| LL9SB-050 | 1-3 |
| LL9SB-051 | 1-3 |
| LL9SB-052 | 1-3 |
| LL9SB-053 | 1-3 |
| LL9SB-055 | 1.5-3.5 |
| LL9SB-056 | 2-4 |
| LL9SB-059 | 3-5 |
| LL9SB-061 | 1-3 |
| LL9SB-065 | 3-5 |

## Table 6–4

## Human Health Risk Assessment Data Set for Groundwater

| Sample ID | Depth bgs* |
|---|---|
| LL9MW–001 | 15 |
| LL9MW–002 | 21 |
| LL9MW–003 | 18 |
| LL9MW–004 | 17 |
| LL9MW–005 | 15 |
| LL9MW–006 | 15 |
| LL9MW–007 | 10 |

*bgs = below ground surface

## Table 6–5

## Human Health Risk Assessment Data Set for Surface Water

| Sample Numbers |
|---|
| LL9SW–001 |
| LL9SW–002 |
| LL9SW–003 |
| LL9SW–004 |
| LL9SW–005 |
| LL9SW–012 |

## Table 6–6

## Human Health Risk Assessment Data Set for Sediments

| Sample ID | Depth bgs* |
|---|---|
| LL9SD–002 | 0–0.5 |
| LL9SD–003 | 0–0.5 |
| LL9SD–004 | 0–0.5 |
| LL9SD–005 | 0–0.5 |
| LL9SD–010 | 0–0.5 |
| LL9SD–013 | 0–0.5 |
| LL9SD–014 | 0–0.5 |
| LL9SD–015 | 0–0.5 |

*bgs = below ground surface

## Table 6–7

## Summary of Quantitative and Qualitative COPCs for Environmental Media

| Parameter | Surface Soil | Subsurface Soil | Deep Surface Soil | Ground-water | Surface Water | Sediment |
|---|---|---|---|---|---|---|
| **Quantitative COPCs** | | | | | | |
| **Metals** | | | | | | |
| Aluminum | X | | X | | X | X |
| Antimony | | | | X | | |
| Arsenic | X | X | X | | X | |
| Chromium | X | X | X | | X | |
| Lead | | | | | X | |
| Manganese | X | | X | X | X | |
| Mercury | X | X | X | | X | X |
| Vanadium | | | | | X | X |
| **Organics** | | | | | | |
| Benzo(a)pyrene | X | | X | | | |
| Dibenzo(a,h)anthracene | X | | X | | | |
| **Qualitative COPCs** | | | | | | |
| **Organics** | | | | | | |
| Nitrocellulose | X | X | X | X | X | X |

COPC = Chemical of potential concern

Quantitative COPCs are those COPCs for which risks and/or hazards have been calculated.

Qualitative COPCs are those COPCs for which risks and/or hazards have not been calculated because of a lack of reliable toxicity data.

The 95% UCL on the mean for aluminum, arsenic, chromium, and manganese are less than their respective background concentrations, as discussed further in the uncertainty section.

The maximum detected concentrations of aluminum and copper exceed the RBSCs (set at an HI equal to 0.1), so they were selected as COPCs; however, they do not exceed the residential Region 9 PRGs for soil.

Arsenic was detected in 10 samples at concentrations exceeding the RVAAP background benchmark for surface soil. The concentrations detected are within the literature background values (less than 0.1 to 97 mg/kg) reported in the PRG guidance document (USEPA, 2004c). Arsenic is a component of herbicides commonly used in the United States in the past and is, consequently, often detected at concentrations exceeding naturally occurring background concentrations. Arsenic is retained as a COPC for surface soil. Uncertainties associated with its selection as a COPC are further discussed in the Section 6.6.

Nitrocellulose was selected as a COPC because PRGs are not available for this chemical. However, according to the USEPA Office of Drinking Water, nitrocellulose is essentially non-toxic (USEPA, 2004d). Nitrocellulose is further discussed in the uncertainty section.

No chemicals were eliminated as COPCs for surface soil on the basis of frequency of detection.

#### *6.2.3.2 Subsurface Soil*

Analytical data available for 53 subsurface soil samples were evaluated in the BHRRA. Twenty-two metals, 16 SVOCs, RDX, and nitrocellulose were detected in the subsurface soil samples collected at LL–9. The samples evaluated in this BHHRA are listed in Table 6–2. The results of the COPC selection for subsurface soils are summarized in Appendix V, Table 2.2. The following chemicals were identified as subsurface soil COPCs:

- Metals (arsenic, chromium, and mercury); and
- Nitrocellulose.

One chromium detection exceeds the RVAAP background benchmark for subsurface soil. The maximum detected concentrations of mercury exceed the RBSCs (set at an HI equal to 0.1), however, it does not exceed the Region 9 residential PRGs for soil.

Arsenic was detected in 5 of 49 samples at concentrations exceeding the RVAAP background benchmark for subsurface soil.

Nitrocellulose was selected as a COPC because PRGs are not available for this chemical. However, according to the USEPA Office of Drinking Water, nitrocellulose is essentially nontoxic (USEPA, 2004d). Nitrocellulose is further discussed in the uncertainty section.

Aluminum, vanadium, and manganese were eliminated as COPCs for subsurface soil on the basis of the background screen only. The maximum detected concentration of manganese and vanadium exceeded the RBSC (set at an HI equal to 0.1). No chemicals were eliminated as COPCs for subsurface soil on the basis of frequency of detection.

#### *6.2.3.3 Deep Surface (0–4 ft bgs) Soils*

Analytical data available for 91 deep surface soil samples were evaluated in the BHRRA. Twenty-two metals, 19 SVOCs, RDX, nitroguanidine, and nitrocellulose were detected in the deep surface (0–4 ft bgs) soil samples collected at LL–9. The samples evaluated in this BHHRA are listed in Table 6–3. The results of the COPC selection for deep surface soil are summarized in Appendix V, Table 2.3. The following chemicals were identified as deep surface soil COPCs:

- Metals (aluminum, arsenic, chromium, copper, lead, manganese, and mercury);
- Organics (benzo[a]pyrene, and dibenzo[a,h]anthracene); and
- Nitrocellulose.

Three aluminum detections and two manganese detections in 85 samples exceeded their respective background concentrations. The maximum detected concentrations of aluminum and copper exceed the RBSCs (set at an HI equal to 0.1). Arsenic was detected in 22 of 85 samples at concentrations exceeding the RVAAP background benchmark for deep surface soil.

Nitrocellulose was selected as a COPC because PRGs are not available for this chemical. However, according to the USEPA Office of Drinking Water, nitrocellulose is essentially nontoxic (USEPA, 2004d). Nitrocellulose is further discussed in the uncertainty section.

No chemicals were eliminated as COPCs for deep surface soil on the basis of frequency of detection.

#### *6.2.3.4 Groundwater*

Analytical data available for seven groundwater samples were evaluated in the BHRRA. Thirteen metals, bis(2–ethylhexyl)phthalate, and nitrocellulose were detected in the seven groundwater samples collected at LL–9. The samples evaluated in this BHHRA are listed in Table 6–4. The results of the COPC selection for groundwater are summarized in Appendix V, Table 2.4. The following chemicals were identified as groundwater COPCs:

- Metals (antimony and manganese); and
- Nitrocellulose.

Only one manganese detection is greater than its background concentration. The maximum detection of antimony (4 µg/L) does not exceed the SDWA primary MCL of 6 µg/L. The maximum detections of antimony and manganese exceed the RBSC, which is set at an HI equal to 0.1.

No chemicals were eliminated as COPCs on the basis of frequency of detection.

#### *6.2.3.5 Surface Water*

Analytical data available for six surface water samples were evaluated in the BHRRA. Nineteen metals and nitrocellulose were detected in the six surface water samples collected at LL–9. The samples evaluated in this BHHRA are listed in Table 6–5. The results of the COPC selection for surface water are summarized in Appendix V, Table 2.5. The following chemicals were identified as surface water COPCs:

- Metals (aluminum, arsenic, chromium, lead, manganese, mercury, and vanadium) and
- Nitrocellulose.

Three chromium detections exceed the RBSC; however, no concentrations exceed the SDWA primary MCL (100 µg/L). The maximum detected concentrations of aluminum, chromium, and vanadium exceed the RBSCs, which are set at an HI equal to 0.1.

Nitrocellulose was selected as a COPC because a PRG is not available for this chemical. However, as noted above, nitrocellulose is essentially nontoxic (USEPA, 2004d). Nitrocellulose is further discussed in the uncertainty section.

No chemicals were eliminated as COPCs for surface water on the basis of the background screen.

#### *6.2.3.6 Sediment*

Analytical data available for 13 sediment samples were evaluated in the BHRRA. Twenty-two metals, 17 SVOCs, and nitrocellulose were detected in the sediment samples collected at LL–9. The samples evaluated in this BHHRA are listed in Table 6–6. The results of the COPC selection for sediments are summarized in Appendix V, Table 2.6. The following chemicals were identified as sediment COPCs:

- Metals (aluminum, mercury, and vanadium) and
- Nitrocellulose.

The maximum detected concentrations of the inorganic COPCs exceed the RBSCs (set at an HI equal to 0.1). Two vanadium and three aluminum detections exceed the RVAAP's background benchmarks for sediments.

Nitrocellulose was selected as a COPC because a PRG is not available for this chemical. However, as noted above, nitrocellulose is essentially nontoxic (USEPA, 2004d). Nitrocellulose is further discussed in the uncertainty section.

Arsenic and manganese were eliminated as COPCs for sediment on the basis of the background screen only. No chemicals were eliminated as COPCs on the basis of frequency of detection.

#### *6.2.3.7 Summary of COPC Selection*

The COPCs selected for LL–9 are summarized in Table 6–7. Several COPCs were detected at maximum concentrations only slightly greater than RVAAP background and may actually represent background conditions. The average concentrations and the 95% UCL on the mean are less than RVAAP background values for many metals in soil (surface soil, subsurface soil, and sediment).

## 6.3 Exposure Assessment

The exposure assessment defines and evaluates the current and potential future exposures by receptor populations. More specifically, an exposure assessment identifies the pathways by which humans are potentially exposed to COPCs, the magnitude of the potential human exposure, and the frequency and duration of exposure. This process involves the following steps:

- Characterization of the exposure setting in terms of physical characteristics and the populations that may potentially be exposed to site-related chemicals;
- Identification of potential exposure pathways and receptors; and
- Quantification of exposure for each receptor in terms of the amount of chemical that is ingested, inhaled, or absorbed through the skin from potentially complete exposure pathways.

The output of the exposure assessment (i.e., an estimate of COPC intake) is used in conjunction with toxicity criteria (i.e., cancer slope factors and reference doses) identified in the toxicity assessment (Section 6.4) to quantify risks and hazards to receptors during risk characterization (Section 6.5).

### 6.3.1 Exposure Setting

The exposure setting was described in the FWHHRAM and White Paper (TtNUS, 2004). The RVAAP installation is located in two counties of northeastern Ohio, Portage and Trumbull, with a majority of the facility in Portage County. According to the 2000 Census, the total populations of Portage and Trumbull counties were 152,061 and 225,116, respectively. The largest population centers in the area are the City of Ravenna (population 11,771) approximately 3.2 km (2 miles) to the west, and Newton Falls (population 5,002) approximately 1.6 km (1 mile) to the southeast (Science Applications International Corporation [SAIC, 2001]).

Approximately 55 percent of Portage County is either woodland or farmland (Portage County, 1985; Census Bureau, 1992). To the south of the facility, across State Route 5, is the Michael J. Kirwan Reservoir, which is used for recreational purposes. The reservoir is fed by the West

Branch of the Mahoning River, which flows south along the western edge of the installation. Hinckley Creek flows south across the western portion of the facility and eventually flows into the West Branch of the Mahoning River. The other major surface drainages at RVAAP, Sand Creek and the South Fork of Eagle Creek, exit the facility and eventually flow east to the Mahoning River (SAIC, 2001).

#### *6.3.1.1 Land Use*

The land use immediately surrounding the facility is primarily farmland with sparse private residences. Residential groundwater use occurs outside the facility. Residential wells in the vicinity of the RVAAP are constructed in both the unconsolidated unit and bedrock (SAIC, 2001). The last of the process production wells on the facility were abandoned in 1992. Two groundwater production wells in the central portion of the facility remain in operation to provide sanitary water to the remaining site personnel. An additional groundwater production well is not in operation but could be activated in the future.

Access to the facility is restricted by a perimeter fence. In 1992, the land use changed from “inactive -maintained” status to “modified (not maintained) caretaker” status (U.S. Department of the Army, 1993). This new status indicated that the facility was no longer needed to mobilize for production of ammunition for war efforts. The only remaining federally mandated mission for the facility – ammunition and bulk explosives storage – ended in December 2004 (SAIC, 2001).

LL–9 lies within the south-central portion of the RVAAP. Site workers (security guards and maintenance workers) infrequently visit LL–9; the load line is no longer mowed on a routine basis. On-site surface water is limited to intermittent drainage ditches or gullies. There are no groundwater or production wells at LL–9. The ground surface at LL–9 slopes gently to the north in the areas of the former LL–9 buildings, and there is a sharp drop in elevation north of the LL–9 perimeter road.

Future recreational goals for RVAAP are hunting (mainly deer), fishing, and trapping anywhere suitable habitat exists. In addition, National Guard training operations are very likely to occur in the LL–9 area in the future. The OHARNG-proposed land use for LL–9 is Mounted Training – No Digging*.* The National Guard trainee is assumed to come in direct contact with soil, surface water, and sediment for 24 days a year on inactive duty and 15 days a year during training. Digging is prohibited in this area, but mounted vehicles (e.g., tanks) are expected to disturb soil up to 4 ft bgs.

As noted above, the most plausible long-term use is a combination of OHARNG training and controlled recreation. Although other uses of the LL–9 area are unlikely, this BHHRA also evaluates additional potential future land uses that reflect a broader use of the land, including residential farm use and a more intensive use of the AOC by the National Guard (e.g., a National Guard resident trainer). The resident trainer would be expected to have similar exposures as the trainee, but the days-per-year exposure frequency is anticipated to be greater because the trainer would supervise the training of several groups of trainees. Table 6-8 summarizes the land uses and receptors that were evaluated as part of the BHHRA.

**Table 6–8**

**Potential Receptors for the LL–9 BHHRA**

| Land Use Designation | Description | Potential Receptors |
|---|---|---|
| Modified Caretaker – Managed Recreational | light maintenance and managed hunting/trapping | security guard/maintenance worker<br>permitted visitor: hunter/trapper |
| National Guard Training Area–<br>Managed Recreational | Ohio National Guard training activities and managed hunting/ trapping | National Guard trainee<br>National Guard resident/trainer<br>National Guard fire and dust control personnel<br>permitted visitor: hunter/ trapper |
| Open Residential | unrestricted residential housing and farming | on-site resident farmer |

#### *6.3.1.2 Receptors*

The potential receptors for each land use scenario are further defined in Table 6-9. The exposure pathways for each receptor and environmental medium evaluated are listed in Table 6-9 and reflect the protocol established in the RVAAP FWHHRAM and the White Paper developed for Load Lines 6, 9, and 11 (TtNUS, 2004). The adult and juvenile trespasser scenario is located in Appendix Y.

### **6.3.2 Exposure Pathways**

A summary of potential exposure pathways for the receptors evaluated in the LL–9 BHHRA are described in Section 5. Information in this section includes sources, release mechanisms, transport pathways, exposure routes, and receptors. The exposure assumptions used to estimate COPC intake for each receptor are shown in Table 6-10. The current and likely future land use scenarios and receptors identified in Section 6.3.1.1 are discussed in the following subsections.

#### *6.3.2.1 Modified Caretaker – Managed Recreational*

This scenario describes the current land use at LL–9. Receptor/exposure activities under the current land use scenario are expected to be as described in the FWHHRAM and the White Paper for Load Lines 6, 9, and 11 (TtNUS, 2004). Consequently, the exposure assumptions for the potential receptors (security guard/maintenance worker and hunter/trapper) presented in Table 6-10 for the current land use scenario are those suggested in the FWHHRAM and White Paper. The evaluation of the following authorized receptors (i.e. receptors allowed access to LL–9 during its future reuse) provides “reasonable worst-case” risk estimates that may be used to make risk management decisions, assuming that the future land use will not change significantly.

#### *6.3.2.2 Security Guard – Maintenance Worker*

Current activities at LL–9 include maintenance activities and security patrols. Consequently, a security guard or maintenance worker may contact environmental media (i.e., surface soil) at LL–9. However, the contact is likely to be limited because maintenance activities are not routinely scheduled for LL–9, and an individual performing a security patrol is not likely to intentionally contact environmental media on a regular basis. Use of the shallow aquifer for a potable water supply and contact with subsurface soil, surface water, and sediment are not considered likely. Although routine mowing does not currently take place in LL9, it will occur on a regular basis once the site is turned over to the OHARNG. Exposure parameter values used to assess this receptor in the BHHRA are presented in Table 6-10.

#### *6.3.2.3 Hunter/Trapper*

Information regarding hunting, trapping, and fishing activities at RVAAP is based on information summarized in the FWHHRAM and based on communications with on-site personnel. Permitted deer hunting occurs at RVAAP. A future goal for the RVAAP is to allow hunting, fishing, and trapping anywhere suitable habitat exists. According to the RVAAP FWHHRAM, a hunter is assumed to be within a particular RVAAP area at a particular frequency (e.g., 6 hours per day for 2 days per year), and the trapper is assumed to be exposed less frequently (e.g., 0.5 hour per day for 6 days per year); therefore, the hunter exposure is used as the more conservative scenario. The hunter/trapper is assumed to hunt/trap as long as he/she resides in the area, so 30 years – the residential default exposure duration – is used. A hunter/trapper operating in the vicinity of LL–9 may be exposed COPCs in surface soil, surface water, and sediment as well as through the ingestion of deer meat. Exposure parameter values used to assess the hunter/trapper receptor are found in Table 6-10.

The intermittent drainage ditches at LL–9 are not capable of sustaining fish population; consequently, fishing does not occur at LL–9.

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## Table 6-9
## Receptors and Exposure Pathways

| Exposure Pathways | Exposure Media | | | |
|---|---|---|---|---|
| | Groundwater | Surface Water | Sediment | Surface Soil[a] |
| **National Guard - Trainee** | | | | |
| Ingestion | | | | |
| Incidental | -- | X | X | X |
| Drinking water | X | -- | -- | -- |
| Dermal | X | X | X | X |
| Inhalation | | | | |
| Vapor | No VOCs | -- | No VOCs | No VOCs |
| Dust | -- | -- | X | X |
| Ingestion of food | -- | -- | -- | -- |
| **National Guard - Trainer/Resident** | | | | |
| Ingestion | | | | |
| Incidental | -- | X | X | X |
| Drinking water | X | -- | -- | -- |
| Dermal | X | X | X | X |
| Inhalation | | | | |
| Vapor | No VOCs | -- | No VOCs | No VOCs |
| Dust | -- | -- | X | X |
| Ingestion of food | -- | -- | -- | -- |
| **Future Hypothetical Resident** | | | | |
| Ingestion | | | | |
| Incidental | -- | X | X | X |
| Drinking water | X | -- | -- | -- |
| Dermal | X | X | X | X |
| Inhalation | | | | |
| Vapor | No VOCs | -- | No VOCs | No VOCs |
| Dust | -- | -- | X | X |
| Ingestion of beef, milk, and vegetables | X | -- | -- | X |
| Ingestion of venison | -- | -- | -- | X |
| **Recreators - Hunter/Trapper** | | | | |
| Ingestion | | | | |
| Incidental | -- | X | X | X |
| Drinking water | -- | -- | -- | -- |
| Dermal | -- | X | X | X |
| Inhalation | | | | |
| Vapor | -- | -- | No VOCs | No VOCs |
| Dust | -- | -- | X | X |
| Ingestion of venison | -- | -- | -- | X |
| **Security and Maintenance Personnel** | | | | |
| Ingestion | | | | |
| Incidental | -- | -- | -- | X |
| Drinking water | -- | -- | -- | -- |
| Dermal | -- | -- | -- | X |
| Inhalation | | | | |
| Vapor | -- | -- | -- | No VOCs |
| Dust | -- | -- | -- | X |
| Ingestion of food | -- | -- | -- | -- |

[a] Surface soil is defined as 0-1 feet for all receptors except the National Guard Trainee, where it is 0-4 feet bgs (deep surface soil) due to the nature of ground training activities.

## Table 6-10
## Exposure Assumptions

| Parameter | Units | Security Guard/ Maintenance Worker | National Guard Trainee | National Guard Trainer/Resident | Hunter/Trapper | Resident Farmer (child/adult) |
|---|---|---|---|---|---|---|
| **Pathway** | | | | | | |
| **Surface Soil** is defined as 0-1 for all receptors except the National Guard Trainee, where it is 0 to 4 feet bgs due to nature of ground training activities. | | | | | | |
| **Incidental ingestion** | | | | | | |
| Soil ingestion rate (Adult) | kg/day | 0.0001$^{a}$ | 0.0001$^{a}$ | **0.0001$^{a}$** | 0.0001$^{a}$ | 0.0001$^{a}$ |
| Soil ingestion rate (Child) | kg/day | NA | NA | **NA** | NA | 0.0002$^{a}$ |
| Exposure time | hours/day | 1$^{b}$ | 24$^{b}$ | **24$^{e}$** | 6 | 24$^{a}$ |
| Exposure frequency | days/year | 250$^{a}$ | 39$^{b}$ | **250$^{e}$** | 2 | 350$^{a}$ |
| Exposure duration (Adult) | years | 25$^{a}$ | 25$^{b}$ | **25$^{b}$** | 30$^{a}$ | 30$^{a}$ |
| Exposure duration (Child) | years | NA | NA | **NA** | NA | 6$^{a}$ |
| Body weight (Adult) | kg | 70$^{a}$ | 70$^{a}$ | **70$^{a}$** | 70$^{a}$ | 70$^{a}$ |
| Body weight (Child) | kg | NA | NA | **NA** | NA | 15$^{a}$ |
| Carcinogen averaging time | days | 25550$^{a}$ | 25550$^{a}$ | **25550$^{a}$** | 25550$^{a}$ | 25550$^{a}$ |
| Noncarcinogen averaging time (Adult) | days | 9125$^{a}$ | 9125$^{a}$ | **9125$^{a}$** | 10950$^{a}$ | 10950$^{a}$ |
| Noncarcinogen averaging time (Child) | days | NA | NA | **NA** | NA | 2190$^{a}$ |
| Fraction ingested | unitless | 1$^{b}$ | 1$^{b}$ | **1$^{b}$** | 1$^{b}$ | 1$^{a}$ |
| Conversion factor | days/hour | **0.0625$^{y}$** | 0.042 | **0.042** | **0.0625$^{y}$** | 0.042 |
| **Dermal contact** | | | | | | |
| Skin area | m$^{2}$/event | 0.33$^{d}$ | 0.33$^{d}$ | **0.33$^{d}$** | 0.57$^{d}$ | 0.22$^{h}$/0.57$^{d}$ |
| Adherence factor | mg/cm$^{2}$ | 0.7$^{c}$ | 0.3$^{c}$ | **0.3$^{c}$** | 0.3$^{c}$ | 0.2$^{h}$ /0.4$^{c}$ |
| Absorption fraction | Unitless | Chem. Spec$^{p}$ | Chem. Spec$^{p}$ | **Chem. Spec$^{p}$** | Chem. Spec$^{p}$ | Chem. Spec$^{p}$ |
| Exposure frequency | events/year | 250$^{a}$ | 39$^{b}$ | **250$^{e}$** | 2 | 350$^{a}$ |
| Exposure duration | years | 25$^{a}$ | 25$^{b}$ | **25$^{b}$** | 30$^{a}$ | 6$^{a}$ /30$^{a}$ |
| Body weight | kg | 70$^{a}$ | 70$^{a}$ | **70$^{a}$** | 70$^{a}$ | 15$^{a}$ /70$^{a}$ |
| Carcinogen averaging time | days | 25550$^{a}$ | 25550$^{a}$ | **25550$^{a}$** | 25550$^{a}$ | 25550$^{a}$ |
| Noncarcinogen averaging time | days | 9125$^{a}$ | 9125$^{a}$ | **9125$^{a}$** | 10950$^{a}$ | 2190$^{a}$ /10950$^{a}$ |
| Conversion factor | (kg-cm$^{2}$)/(mg-m$^{2}$) | 0.01 | 0.01 | **0.01** | 0.01 | 0.01 |
| **Inhalation of VOCs and dust** | | | | | | |
| Inhalation rate | -- | 0.83$^{a}$ m$^{3}$ /hr | 44.4 m$^{3}$/day | **44.4 m$^{3}$/day** | 1.47$^{r}$ m$^{3}$ /hr | 10$^{q}$ /20$^{a}$ m$^{3}$ /day |
| Exposure time | hours/day | 1$^{b}$ | 24$^{b}$ | **24$^{e}$** | 6 | 24/24$^{a}$ |
| Exposure frequency | days/year | 250$^{a}$ | 39$^{b}$ | **250$^{e}$** | 2 | 350$^{a}$ |
| Exposure duration | years | 25$^{a}$ | 25$^{b}$ | **25$^{b}$** | 30$^{a}$ | 6$^{a}$ /30$^{a}$ |
| Body weight | kg | 70$^{a}$ | 70$^{a}$ | **70$^{a}$** | 70$^{a}$ | 15$^{a}$/ 70$^{a}$ |
| Carcinogen averaging time | days | 25550$^{a}$ | 25550$^{a}$ | **25550$^{a}$** | 25550$^{a}$ | 25550$^{a}$ |
| Noncarcinogen averaging time | days | 9125$^{a}$ | 9125$^{a}$ | **9125$^{a}$** | 10950$^{a}$ | 2190$^{a}$/ 10950$^{a}$ |
| Conversion factor | days/hour | **NA** | 0.042 | **0.042** | **NA** | 0.042 |
| Particulate Emission Factor | m$^{3}$/kg | 9.24E+08$^{v}$ | 1.67E+06$^{w}$ | **9.24E+08$^{v}$** | 9.24E+08$^{v}$ | 9.24E+08$^{v}$ |
| **SEDIMENT** | | | | | | |
| **Incidental ingestion** | | | | | | |
| Soil ingestion rate (Adult) | kg/day | NA | 0.0001$^{a}$ | **0.0001$^{a}$** | 0.0001$^{a}$ | 0.0001$^{a}$ |
| Soil ingestion rate (Child) | kg/day | NA | NA | **NA** | NA | 0.0002$^{a}$ |
| Exposure time | hours/day | NA | 24$^{b}$ | **24$^{e}$** | 6 | 24$^{a}$ |
| Exposure frequency | days/year | NA | 39$^{b}$ | **250$^{e}$** | 2 | **75$^{b}$** |
| Exposure duration (Adult) | years | NA | 25$^{b}$ | **25$^{b}$** | 30$^{a}$ | 30$^{a}$ |
| Exposure duration (Child) | years | NA | NA | **NA** | NA | 6$^{a}$ |
| Body weight (Adult) | kg | NA | 70$^{a}$ | **70$^{a}$** | 70$^{a}$ | 70$^{a}$ |
| Body weight (Child) | kg | NA | NA | **NA** | NA | 15$^{a}$ |
| Carcinogen averaging time | days | NA | 25550$^{a}$ | **25550$^{a}$** | 25550$^{a}$ | 25550$^{a}$ |
| Noncarcinogen averaging time (Adult) | days | NA | 9125$^{a}$ | **9125$^{a}$** | 10950$^{a}$ | 10950$^{a}$ |
| Noncarcinogen averaging time (Child) | days | NA | NA | **NA** | NA | 2190$^{a}$ |
| Fraction ingested | unitless | NA | 1$^{b}$ | **1$^{b}$** | 1$^{b}$ | 1$^{a}$ |
| Conversion factor | days/hour | NA | 0.042 | **0.042** | **0.0625$^{y}$** | 0.042 |

## Table 6-10
## Exposure Assumptions

| Parameter | Units | Security Guard/ Maintenance Worker | National Guard Trainee | National Guard Trainer/Resident | Hunter/Trapper | Resident Farmer (child/adult) |
|---|---|---|---|---|---|---|
| **Pathway** | | | | | | |
| **Surface Soil** is defined as 0-1 for all receptors except the National Guard Trainee, where it is 0 to 4 feet bgs due to nature of ground training activities. | | | | | | |
| **Dermal contact** | | | | | | |
| Skin area | $m^2$/event | NA | 0.33[d] | **0.33[d]** | 0.52[d] | 0.22[h] /0.57[d] |
| Adherence factor | mg/$cm^2$ | NA | 0.3[c] | **0.3[c]** | 0.3[c] | 0.2[h] /0.4[c] |
| Absorption fraction | unitless | NA | chem. Spec[p] | **chem. Spec[p]** | chem. Spec[p] | chem. Spec[p] |
| Exposure frequency | events/year | NA | 39[b] | **250[e]** | 2 | **75[b]** |
| Exposure duration | years | NA | 25[b] | **25[b]** | 30[a] | 6[a] /30[a] |
| Body weight | kg | NA | 70[a] | **70[a]** | 70[a] | 15[a] /70[a] |
| Carcinogen averaging time | days | NA | 25550[a] | **25550[a]** | 25550[a] | 25550[a] |
| Noncarcinogen averaging time | days | NA | 9125[a] | **9125[a]** | 10950[a] | 2190[a] /10950[a] |
| Conversion factor | (kg-$cm^2$)/(mg-$m^2$) | NA | 0.01 | **0.01** | 0.01 | 0.01 |
| **Inhalation of VOCs and dust** | | | | | | |
| Inhalation rate | -- | NA | 44.4 $m^3$/day | **44.4 $m^3$/day** | 0.83[a] $m^3$ /hr | 10[q] /20[a] $m^3$ /day |
| Exposure time | hours/day | NA | 24[b] | **24[e]** | 6 | 24[a] |
| Exposure frequency | days/year | NA | 39[b] | **250[e]** | 2 | **75[b]** |
| Exposure duration | years | NA | 25[b] | **25[b]** | 30[a] | 6[a] /30[a] |
| Body weight | kg | NA | 70[a] | **70[a]** | 70[a] | 15[a] /70[a] |
| Carcinogen averaging time | days | NA | 25550[a] | **25550[a]** | 25550[a] | 25550[a] |
| Noncarcinogen averaging time | days | NA | 9125[a] | **9125[a]** | 10950[a] | 2190[a] /10950[a] |
| Conversion factor | days/hour | NA | 0.042 | **0.042** | **0.0625[y]** | 0.042 |
| Particulate Emission Factor | $m^3$/kg | NA | 1.67E+06[w] | **9.24E+08[v]** | 9.24E+08[v] | 9.24E+08[v] |
| **SURFACE WATER** | | | | | | |
| **Incidental ingestion while wading** | | | | | | |
| Drinking water ingestion rate | L/hr | NA | NA | **NA** | NA | NA |
| Incidental water ingestion rate | L/day | NA | 0.1[b] | **0.1[b]** | 0.05[b] | 0.1[b] |
| Exposure frequency | days/year | NA | 39[b] | **250[e]** | 2 | **45[b]** |
| Exposure duration | years | NA | 25[b] | **25[b]** | 30[a] | 6[a] /30[a] |
| Body weight | kg | NA | 70[a] | **70[a]** | 70[a] | 15[a] /70[a] |
| Carcinogen averaging time | days | NA | 25550[a] | **25550[a]** | 25550[a] | 25550[a] |
| Noncarcinogen averaging time | days | NA | 9125[a] | **9125[a]** | 10950[a] | 2190[a] /10950[a] |
| **Dermal contact while wading** | | | | | | |
| Skin area | $m^2$ | NA | 0.33[d] | **0.33[d]** | 0.52[d] | 0.22[h] /0.57[d] |
| Exposure time | hours/day | NA | **2[b]** | **2[b]** | **2[b]** | **2[b]** |
| Exposure frequency | days/year | NA | 39[b] | **250[e]** | 2 | **45[b]** |
| Exposure duration | years | NA | 25[b] | **25[b]** | 30[a] | 6[a] /30[a] |
| Body weight | kg | NA | 70[a] | **70[a]** | 70[a] | 15[a] /70[a] |
| Carcinogen averaging time | days | NA | 25550[a] | **25550[a]** | 25550[a] | 25550[a] |
| Noncarcinogen averaging time | days | NA | 9125[a] | **9125[a]** | 10950[a] | 2190[a] /10950[a] |
| Conversion factor | (m/cm)(L/$m^3$) | NA | 10 | **10** | 10 | 10 |
| **GROUNDWATER** | | | | | | |
| **Drinking Water Ingestion** | | | | | | |
| Drinking water ingestion rate | L/day | NA | 2[a] | **2[a]** | NA | 1.5[h] /2[a] |
| Exposure frequency | days/year | NA | 39[b] | **250[e]** | NA | 350[a] |
| Exposure duration | years | NA | 25[b] | **25[b]** | NA | 6[a] /30[a] |
| Body weight | kg | NA | 70[a] | **70[a]** | NA | 15[a] /70[a] |
| Carcinogen averaging time | days | NA | 25550[a] | **25550[a]** | NA | 25550[a] |
| Noncarcinogen averaging time | days | NA | 9125[a] | **9125[a]** | NA | 2190[a] /10950[a] |

## Table 6-10
## Exposure Assumptions

| Parameter | Units | Security Guard/ Maintenance Worker | National Guard Trainee | National Guard Trainer/Resident | Hunter/Trapper | Resident Farmer (child/adult) |
|---|---|---|---|---|---|---|
| **Pathway** | | | | | | |
| **Surface Soil** is defined as 0-1 for all receptors except the National Guard Trainee, where it is 0 to 4 feet bgs due to nature of ground training activities. | | | | | | |
| **Dermal contact while showering** | | | | | | |
| Skin area | $m^2$ | NA | 1.94[g] | 1.94[g] | NA | 0.866[s] /1.94[g] |
| Exposure time | hours/day | NA | 0.25[a] | 0.25[a] | NA | 0.25[a] |
| Exposure frequency | days/year | NA | 39[b] | 250[e] | NA | 350[a] |
| Exposure duration | years | NA | 25[b] | 25[b] | NA | 6[a] /30[a] |
| Body weight | kg | NA | 70[a] | 70[a] | NA | 15[a] /70[a] |
| Carcinogen averaging time | days | NA | 25550[a] | 25550[a] | NA | 25550[a] |
| Noncarcinogen averaging time | days | NA | 9125[a] | 9125[a] | NA | 2190[a] /10950[a] |
| Conversion factor | (m/cm)(L/$m^3$) | NA | 10 | 10 | NA | 10 |
| **Inhalation of VOCs during household water use (Only if applicable)** | | | | | | |
| Inhalation rate | -- | NA | 0.83[a] $m^3$ /hr | 0.83[a] $m^3$ /hr | NA | 10[q] /20[a] |
| Exposure time | hours/day | NA | 24 | 24 | NA | 24 |
| Exposure frequency | days/year | NA | 39[b] | 250[e] | NA | 350[a] |
| Exposure duration | years | NA | 25[b] | 25[b] | NA | 6[a] /30[a] |
| Body weight | kg | NA | 70[a] | 70[a] | NA | 15[a] /70[a] |
| Carcinogen averaging time | days | NA | 25550[a] | 25550[a] | NA | 25550[a] |
| Noncarcinogen averaging time | days | NA | 9125[a] | 9125[a] | NA | 2190[a] /10950[a] |
| Volatilization factor | L/$m^3$ | NA | 0.5[a] | 0.5[a] | NA | 0.5[a] |
| **FOODSTUFFS** | | | | | | |
| **Ingestion of venison** | | | | | | |
| Conversion factor | unitless | NA | NA | NA | 1.25 | 1.25 |
| Browse ingestion rate | kg dry weight/day | NA | NA | NA | 0.87[b] | 0.87[b] |
| Fraction browse ingested from site | unitless | NA | NA | NA | 0.16 | 0.16 |
| Fat ratio (venison to beef) | unitless | NA | NA | NA | 0.2 | 0.2 |
| Venison ingestion rate | kg/day | NA | NA | NA | 0.03[b] | 0.03[b] |
| Fraction ingested | unitless | NA | NA | NA | 1[b] | 1[b] |
| Exposure frequency | days/year | NA | NA | NA | 365[b] | 365[b] |
| Exposure duration | years | NA | NA | NA | 30[a] | 6[a] /30[a] |
| Body weight | kg | NA | NA | NA | 70[a] | 15[a] /70[a] |
| Carcinogen averaging time | days | NA | NA | NA | 25550[a] | 25550[a] |
| Noncarcinogen averaging time | days | NA | NA | NA | 10950[a] | 2190[a] /10950[a] |
| **Ingestion of beef** | | | | | | |
| Resuspension multiplier | unitless | NA | NA | NA | NA | 0.25[i] |
| Quantity of pasture ingested | kg dry weight/day | NA | NA | NA | NA | 7.2[j] |
| Fraction of year cow is on-site | unitless | NA | NA | NA | NA | 1 |
| Fraction of cow's food from on-site | unitless | NA | NA | NA | NA | 0.9[b] |
| Quantity of soil ingested by cow | kg/day | NA | NA | NA | NA | 1[k] |
| Beef ingestion rate | kg/day | NA | NA | NA | NA | 0.0094/0.044[l] |
| Fraction ingested | unitless | NA | NA | NA | NA | 1[b] |
| Exposure frequency | days/year | NA | NA | NA | NA | 365[b] |
| Exposure duration | years | NA | NA | NA | NA | 6[a] /30[a] |
| Body weight | kg | NA | NA | NA | NA | 15[a] /70[a] |
| Carcinogen averaging time | days | NA | NA | NA | NA | 25550[a] |
| Noncarcinogen averaging time | days | NA | NA | NA | NA | 2190[a] /10950[a] |

## Table 6-10
## Exposure Assumptions

| Parameter | Units | Security Guard/ Maintenance Worker | National Guard Trainee | National Guard Trainer/Resident | Hunter/Trapper | Resident Farmer (child/adult) |
|---|---|---|---|---|---|---|
| **Pathway** | | | | | | |
| **Surface Soil** is defined as 0-1 for all receptors except the National Guard Trainee, where it is 0 to 4 feet bgs due to nature of ground training activities. | | | | | | |
| **Ingestion of milk products** | | | | | | |
| Resuspension multiplier | unitless | NA | NA | NA | NA | 0.25[i] |
| Quantity of pasture ingested | kg dry weight/day | NA | NA | NA | NA | 16.1[j] |
| Fraction of year cow is on-site | unitless | NA | NA | NA | NA | 1[b] |
| Fraction of cow's food from on-site | unitless | NA | NA | NA | NA | 0.6[b] |
| Quantity of soil ingested by cow | kg/day | NA | NA | NA | NA | 1[k] |
| Milk ingestion rate (Adult) | kg/day | NA | NA | NA | NA | 0.305[l] |
| Milk ingestion rate (Child) | kg/day | NA | NA | NA | NA | 0.509[m] |
| Fraction ingested | unitless | NA | NA | NA | NA | 1[b] |
| Exposure frequency | days/year | NA | NA | NA | NA | 365[b] |
| Exposure duration (Adult) | years | NA | NA | NA | NA | 30[a] |
| Exposure duration (Child) | years | NA | NA | NA | NA | 6[a] |
| Body weight (Adult) | kg | NA | NA | NA | NA | 70[a] |
| Body weight (Child) | kg | NA | NA | NA | NA | 15[a] |
| Carcinogen averaging time | days | NA | NA | NA | NA | 25550[a] |
| Noncarcinogen averaging time (Adult) | days | NA | NA | NA | NA | 10950[a] |
| Noncarcinogen averaging time (Child) | days | NA | NA | NA | NA | 2190[a] |
| **Ingestion of vegetables** | | | | | | |
| Resuspension multiplier | unitless | NA | NA | NA | NA | 0.26[n] |
| Vegetable ingestion rate | kg/day | NA | NA | NA | NA | 0.043/0.2[l] |
| Fraction ingested | unitless | NA | NA | NA | NA | 0.4[l] |
| Exposure frequency | days/year | NA | NA | NA | NA | 365[a] |
| Exposure duration | years | NA | NA | NA | NA | 6[a] /30[a] |
| Body weight | kg | NA | NA | NA | NA | 15[a] /70[a] |
| Carcinogen averaging time | days | NA | NA | NA | NA | 25550[a] |
| Noncarcinogen averaging time | days | NA | NA | NA | NA | 2190[a] /10950[a] |
| Noncarcinogen averaging time | days | NA | NA | NA | 10950[a] | 10950[a] |

Note: Resident farmer is chosen instead of resident because the property would be used for farming in the unlikely event it was released from military use. Further, the resident farmer is expected to result in greater, more conservative exposure intake when compared to the resident.

Shading indicates values that differ than those presented in the Facility Wide Human Health Risk Assessors Manual.
NA = not applicable for this scenario.
a RAGS, Part B (EPA 1991a).
b Site-specific (value assumed for site or value obtained from site personnel). National Guard Trainee is assumed to be on –site 24 hrs/d for 24 d/yr for inactive duty training and 24 hrs/d for 15 d/yr for annual training. Both National Guard receptors are assumed to remain at RVAAP and at the AOC of interest for their entire 25 year enlistment. The Hunter is assumed to be on-site 6 hours/day for 2 days/year. The trapper will be exposed less (i.e., 0.5 hours/day for 6 days/year); therefore, the hunter exposure is used as the more conservative scenario. The hunter is assumed to hunt as long as he/she resides in the area, so the residential default exposure duration is used. The Security Guard/Maintenance Worker is assumed to visit each AOC for 1 hour/day for a standard worker default of 250 days/yr and 25 years.

National Guard Trainee, National Guard Resident, and Resident Farmer are assumed to ingest 0.05 L/hour [per RAGS Part A (EPA 1998)] for approximately 2 hours/day spent in the surface water. Hunter/trappers are assumed to ingest 0.05 L/day due to splashing while setting traps.

## Table 6-10
## Exposure Assumptions

| Parameter | Units | Security Guard/ Maintenance Worker | National Guard Trainee | National Guard Trainer/Resident | Hunter/Trapper | Resident Farmer (child/adult) |
|---|---|---|---|---|---|---|
| **Pathway** | | | | | | |
| **Surface Soil** is defined as 0-1 for all receptors except the National Guard Trainee, where it is 0 to 4 feet bgs due to nature of ground training activities. | | | | | | |

c Security Guard/Maintenance Worker = Adult Groundskeeper (95th percentile); Hunter/Trapper = Residential Default; National Guard Trainee = Construction Worker (95th percentile); Resident Farmer Adult= Adult Farmer (95th percentile) (RAGS, Vol. 1 Part E, Supplemental Guidance for Dermal Risk Assessment, Interim) EPA/540/R/99/005.

d Security Guard/Maintenance Worker, National Guard Trainee = Industrial Default; Hunter/Trapper and Resident Farmer = Adult Residential Default. Exposure Factors Handbook (EPA 1997a) (Note dermal contact for Hunter/trapper during wading is 0.52 based on head, hands, forearms and lower legs from Exposure Factors Handbook.)

e National Guard resident is assumed to reside on-site during the week (i.e., 24 hours/day, 5 days/week, 50 weeks/year) and go home on weekends.
f RAGS, Part A (EPA 1989a).
g Average total body surface area for an adult (EPA 1992b).
h Per OEPA comment 2002.
i Plant mass loading factor for pasture (Hinton 1992).
j International Atomic Energy agency 1994.
k Soil ingestion by dairy cattle (Darwin 1990).
l Exposure Factors Handbook (EPA 1997). 50th percentile beef ingestion 0.626 g/kg-day = 44 g/day for a 70 kg adult and 9.4 for a 15 kg child. 50th pecentile vegetable ingestion rate = 2.86 g/kg/day = 200 g/day for a 70 kg adult and 43 g/day for a 15 kg child. Ingestion rates for the total population and not any age-specific group.

m Pao et al. (1982).
n Plant mass loading factor for vegetables (Pinder 1989).
o Based on EPA/FDA Nation Advisory of 1 meal (8 oz uncooked weight) noncommmercial fish per week (EPA-823-F-04-008). Adult or Child
p Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment, Interim), EPA/540/R/99/005.
q Recommended value for child age 6-8 (EPA 1997a).
r The inhalation rate for hunter/trapper is based on an adult engaged in light activities 4 hours/day, moderate activities 1 hour/day, and heavy activities 1 hour/day.

s 50th percentile value for male child age 6-7 (EPA 1997a).
u Ecological Risk Assessment. Ohio EPA/DERR. February 2003
v Default value for Cleveland, Ohio. EPA Soil Screening Calculation Internet Site (http://risk.lsd.ornl.gov/calc_start.shtml).
w Based on a dust loading factor of 600 ug/m$^3$ (DOE, 1993).
x A site specific value will be developed following methodology in EPA's Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, December 2002, OSWER 9355.4-24.
y Based on a 16 hour day.

#### *6.3.2.4 National Guard – Managed Recreational*

Three receptors are expected under the National Guard managed recreational land use scenario, a hunter/trapper, National Guard training participant, and National Guard resident trainer. Although National Guard units typically participate in training 2 weeks a year with some weekend training, instructors and other National Guard personnel managing the training activities could be expected to be on site more frequently. The National Guard trainee is assumed to be on site 24 hours per day for 24 days per year for inactive duty training and 24 hours per day for 15 days per year for annual training, for a total of 39 days per year. The National Guard resident trainer is assumed to reside on site during the week (i.e., 24 hours per day, 5 days per week, 50 week per year) and go home on weekends, for a total of 250 days per year. Both National Guard receptors are assumed to remain at RVAAP and at the AOC for their entire 25-year enlistment. The National Guard resident trainer receptor is not included in the RVAAP FWHHRAM; however, based on the anticipated future land use for the LL–9, the National Guard trainee is the key receptor for LL–9. The National Guard resident trainer was included in this BHHRA after discussions with both the USACE and Ohio EPA. Risk estimates for this receptor may assist the risk managers for RVAAP when making certain risk management decisions.

The National Guard receptors may be exposed to COPCs in surface soil, subsurface soil, sediment, and surface water during various training activities such as those detailed in the FWHHRAM. Due to the nature of ground training activities (i.e., use of tracked vehicles and other military equipment), surface soil is defined as 0 to 4 ft bgs for the National Guard trainee. The BHHRA includes risk estimates for National Guard receptors assuming the receptors are using the groundwater as a potable water resource. Exposure parameter values used in this BHHRA to evaluate the National Guard receptors are found in Table 6-10.

#### *6.3.2.5* Open Residential

This potential scenario was evaluated to provide risk information assuming a future residential land use of the LL–9 area. Conservatively, a resident farmer adult and child are the receptors of concern. However, based on current and anticipated future land use information, it is unlikely that the LL–9 area will be used for residential purposes. This scenario is included principally for purposes of completeness and to provide information to risk managers regarding the need for institutional land use controls.

Adult and child resident farmers may come into direct contact with COPCs in all media and may also be exposed via indirect exposure pathways (i.e., ingestion of venison, beef, milk, and vegetables). Exposure parameters used to represent receptor activity patterns are listed in Table 6-10 and generally come from the FWHHRAM, with exceptions as outlined in the White Paper for Load Lines 6, 9 , and 11 (TtNUS, 2004).

#### *6.3.2.6* Trespasser

This potential scenario was evaluated in the BHHRA, and the results are presented in Appendix Y. Adult and juvenile trespassers may come into direct contact with surface soil, sediment, and surface water. Exposure parameters used to represent receptor activity patterns are listed in the 2005 addendum to the FWHHRAM.

### 6.3.3 Exposure Quantification

Intake or dose is defined as the amount of a COPC that could be in contact with the body per unit body weight per unit time. For the LL–9 BHHRA, the surface soil (deep surface soil for the National Guard trainee), subsurface soil, sediment, surface water, and groundwater ingestion, dermal, and inhalation intakes for each receptor as well as for the ingestion of homegrown vegetables, milk, meat, and venison were calculated using standard intake equations from USEPA guidance (e.g., USEPA, 1989a). The standard intake equations are presented in the FWHHRAM with exceptions as outlined in the White Paper for Load Lines 6, 9, and 11 (TtNUS, 2004).

The standard tables published in RAGS Part D (USEPA, 1989a) are used to present the exposure assumptions, intake equations, dose estimates, toxicity criteria (i.e., cancer slope factors, and reference doses), and cancer and non-cancer risk estimates for receptors evaluated in this BHHRA. These tables also include references for exposure assumptions. The *RAGS Part D* tables and example calculations for each receptor and exposure pathway are presented in Appendix V.

#### *6.3.3.1 Exposure to Surface Soil*

Appendix V (Tables 4.1, 4.2, 4.6, 4.11, 4.15, and 4.24) provides the dose equations used to estimate chemical intake for the security guard/maintenance worker, National Guard trainee, National Guard resident trainer, hunter/trapper, child resident farmer, and adult resident farmer hypothetically exposed to COPCs in surface soil. Where available, the exposure assumptions used to calculate COPC intakes were those suggested by standard USEPA guidance documents and listed in the FWHHRAM. Exposure assumptions for the National Guard trainer/resident were presented in the White Paper for Load Lines 6, 9, and 11 (TtNUS, 2004). Professional judgment was used to select the exposure parameter values in some cases. For example, it was assumed that the conversion factor for ingestion of soil/sediment should be 0.0625 day per hour (not 0.042 day per hour as originally presented in the risk assessments prepared for Winkelpeck remedial investigation) for receptors who are not on site for 24 hours a day (security guard/maintenance worker and hunter/trapper). The change was made to reflect the fact that these receptors are typically not exposed to soil/dust while they are sleeping, and the conversion factor used is more conservative than the value in the FWHHRAM.

Intake values for security guard/maintenance worker, National Guard trainee, National Guard resident trainer, hunter/trapper, child resident farmer, and adult resident farmer exposure to LL–9 surface soil COPCs are provided in Appendix V (Tables 7.1, 7.2, 7.3, 7.4, 7.5, and 7.6, respectively).

#### *6.3.3.2 Exposure to Subsurface Soil*

It is assumed two receptors – the National Guard resident trainer and the resident farmer – will be exposed to both surface soil and subsurface soil. The National Guard resident trainer may be exposed to shallow subsurface soil during certain training activities. Although unlikely, this BHHRA was prepared assuming that the future resident farmer may also come in contact with subsurface soils excavated and spread across the surface of the site. This scenario is included primarily for completeness and to provide information for informed future land use controls.

Appendix V (Tables 4.9, 4.18, and 4.27) provides the dose equations used to estimate chemical intakes for the National Guard resident trainer, child resident farmer, and adult resident farmer exposed to COPCs in subsurface soil. If available, the exposure assumptions used in the equations were those suggested by standard USEPA guidance documents and outlined in the FWHHRAM. Exposure assumptions for the National Guard resident trainer are not found in the FWHHRAM*,* but were presented in the White Paper for Load Lines 6, 9, and 11 (TtNUS, 2004).

Intake values for National Guard resident trainer, child resident farmer, and adult resident farmer exposure to LL–9 subsurface soil COPCs are provided in Appendix V (Tables 7.3, 7.5, and 7.6, respectively).

Intake values for National Guard resident trainer, child resident farmer, and adult resident farmer's exposure to LL–9 subsurface soil COPCs are provided in Appendix V (Tables 7.3, 7.5, and 7.6, respectively).

#### *6.3.3.3 Exposure to Surface Soil and Subsurface Soil*

When exposure to both surface and subsurface soil is anticipated, total receptor risk estimates were calculated separately to avoid an overestimation of risk (i.e., risk estimates for COPCs in surface soil were not be added to risk estimates developed for COPCs in subsurface soil).

#### *6.3.3.4 Exposure to Groundwater*

Appendix V (Tables 4.5, 4.10, 4.19, and 4.28) lists the dose equations used to estimate chemical intake for the National Guard trainees, National Guard resident trainer, child resident farmer, and adult resident farmer, respectively, hypothetically exposed to COPCs in groundwater. Where available, the exposure assumptions used in the equations were those suggested by standard USEPA guidance documents and listed in the FWHHRAM. Exposure assumptions for the National Guard resident trainer are presented in the White Paper for Load Lines 6, 9, and 11 (TtNUS, 2004).

Intake values for National Guard trainee, National Guard resident trainer, child resident farmer, and adult resident farmer exposure to LL–9 groundwater COPCs are provided in Appendix V (Tables 7.2, 7.3, 7.5, and 7.6, respectively).

#### *6.3.3.5 Exposure to Surface Water*

Appendix V (Tables 4.4, 4.8, 4.13, 4.17, and 4.26) provides the dose equations used to estimate chemical intake for the National Guard trainee, National Guard resident trainer, hunter/trapper, child resident farmer, and adult resident farmer, respectively, exposed to COPCs in surface water. Where available, the exposure assumptions used in the equations were those suggested by standard USEPA guidance documents and listed in the FWHHRAM. Exposure assumptions for the National Guard resident trainer are presented in the White Paper for Load Lines 6, 9, and 11 (TtNUS, 2004). However, some exposure factor values were not available from the guidance and were selected using site-specific information provided by RVAAP personnel and using professional judgment. These values are presented and discussed in the White Paper for Load Lines 6, 9, and 11 (TtNUS, 2004).

Intake values for National Guard trainee, National Guard resident trainer, hunter/trappers, child resident farmer, and adult resident farmer exposure to LL–9 surface water COPCs are provided in Appendix V (Tables 7.2, 7.3, 7.4, 7.5, and 7.6, respectively).

#### *6.3.3.6 Exposure to Sediment*

Appendix V (Tables 4.3, 4.7, 4.12, 4.16, and 4.25) provides the dose equations used to estimate chemical intake for the National Guard trainee, National Guard resident trainer, hunter/trapper, child resident farmer, and adult resident farmer exposed to COPCs in sediments. Where available, the exposure assumptions used in the equations were those suggested by standard USEPA guidance documents and listed in the FWHHRAM. Exposure assumptions for the National Guard resident trainer are presented in the White Paper for Load Lines 6, 9, and 11 (TtNUS, 2004). However, professional judgment was used to select exposure parameter values in some cases. For example, it was assumed that the conversion factor for ingestion of soil/sediment should be 0.0625 day per hour (not 0.042 day per hour) for receptors who are not on site for 24 hours a day (security guard/maintenance worker and hunter/trapper). The change was made to reflect the fact that these receptors are typically not exposed to soil/dust while they are sleeping, and the conversion factor used is more conservative than the value in the FWHHRAM.

Intake values for National Guard trainee, National Guard resident trainer, hunter/trapper, child resident farmer, and adult resident farmer exposure to LL–9 sediment COPCs are provided in Appendix V (Tables 7.2, 7.3, 7.4, 7.5, and 7.6 respectively).

#### *6.3.3.7 Exposure to Venison*

Appendix V (Tables 4.14, 4.20, and 4.29) provides the dose equations used to estimate chemical intake for venison consumption by the hunter/trapper, child resident farmer, and adult resident farmer. Where available, the exposure assumptions used in the equations were those suggested by the FWHHRAM. No exposure assumptions were listed in the FWHHRAM for the hunter/trapper; therefore, values used were those recommended in the White Paper for Load Lines 6, 9, and 11 (TtNUS, 2004). Site-specific information for LL–9 was used to adjust the fraction of the animals' food from the site to 0.16 to reflect the size of the site (approximately 28 ha) compared to the home range of a white-tailed deer (175 ha) (USEPA, 1993a).

Intake values for hunter/trapper, child resident farmer, and adult resident farmer exposure to LL–9 COPCs in venison are provided in Appendix V (Tables 7.4, 7.5, and 7.6, respectively).

#### *6.3.3.8 Exposure to Beef*

Appendix V (Tables 4.21 and 4.30) provides the dose equations used to estimate chemical intake for beef consumption by child resident farmer and adult resident farmer, respectively. The exposure assumptions used in the equations were those suggested by the FWHHRAM. Site-specific information for LL–9 was used to determine an exposure parameter as outlined in the FWHHRAM:

- The fraction of the year the animals are on site was presumed to be 1.0 (i.e., the animals are assumed to be on-site year round).
- As explained in the White Paper for Load Lines 6, 9, and 11 (TtNUS, 2004), the FWHHRAM recommends that COPC concentrations in beef products consider contaminant uptake as a result of the animal ingesting contaminated ground or surface water. The contribution from this pathway is considered minor for LL–9 and was not considered in the BHHRA. Note that the water ingestion contribution is shown in the intake equation given in the FWHHRAM, but no exposure parameter is given in Table 5 of the FWHHRAM.

Intake values for child resident farmer and adult resident farmer exposure to LL–9 COPCs in beef are provided in Appendix V (Tables 7.5 and 7.6).

#### *6.3.3.9 Exposure to Milk*

Appendix V (Tables 4.22 and 4.31) provides the dose equations used to estimate chemical intake for milk consumption by child resident farmer and adult resident farmer, respectively. The exposure assumptions used in the equations were those suggested by the FWHHRAM. However, as explained in the White Paper for Load Lines 6, 9, and 11 (TtNUS, 2004), the FWHHRAM recommends that COPC concentrations in milk products consider contaminant uptake as a result of the animal ingesting contaminated ground or surface water. The contribution from this pathway is considered minor and was not considered in the BHHRA. Note the water ingestion contribution is shown in the intake equation given in the FWHHRAM, but no exposure parameter is given in Table 5 of the FWHHRAM.

Intake values for child resident s and adult resident farmer exposure to LL–9 COPCs in milk are provided in Appendix V (Tables 7.5 and 7.6, respectively).

#### *6.3.3.10 Exposure to Vegetables*

Appendix V (Tables 4.23 and 4.32) provides the dose equations used to estimate chemical intake for vegetable consumption by child resident farmer and adult resident farmer. Where available, the exposure assumptions used in the equations were those suggested in the FWHHRAM.

Intake values for child resident s and adult resident farmer exposure to LL–9 COPCs in vegetables are provided in Appendix V (Tables 7.5 and 7.6, respectively).

### 6.3.4 Exposure Point Concentrations

The exposure point concentration (EPC) is the concentration of a COPC used to best estimate the intake of a COPC detected in an environmental media. Ideally the EPC should be the true average concentration within the exposure unit for the media. However, because of the uncertainty associated with estimating the true average concentration at a site, the 95% UCL of the arithmetic mean is selected as the EPC. The following protocol was used to determine EPCs in the BHHRA for LL–9:

- If there were fewer than 10 samples or fewer than 50% positive detections of chemicals in the samples, the maximum concentration was chosen as the EPC because the upper confidence level (UCL) does not provide a good estimation of the upper bound of the mean concentration for small data sets or for data sets that contain a large number of non-detected values (EPA, 2002c).
- If there were more than 10 samples and more than 50% detections, each data set was evaluated using the Shapiro-Wilk W test (Gilbert, 1987) to determine whether the data

set more closely reflected a normal or log-normal distribution. If results were inconclusive, the data were assumed to be log-normally distributed. The 95% UCL-L and 95% UCL-N were calculated for each analyte in each medium and data set, using one-half the reporting limit for non-detect results and the average for samples with duplicates. Example calculations are found in Appendix V. The 95% UCL-N was used as the EPC if the Shapiro-Wilk W test indicated a normal distribution, and the 95% UCL-L was used as the EPC if the Shapiro-Wilk W test indicated a log-normal distribution or if the distribution was undefined (i.e., where the Shapiro-Wilk W test did not indicate a normal or a log-normal distribution). If the calculated 95% UCL exceeded the maximum detected concentration, the maximum detected concentration was selected as the EPC.

EPCs were calculated for analytes detected in surface soil (0–1 ft bgs), deep surface soil (0–4 ft bgs), subsurface soil, groundwater, surface water, and sediment samples located in LL–9. These EPCs are presented in Appendix V (the RAGS Part D, Tables 3.1 through 3.6).

Route-specific EPCs were also calculated for the inhalation of particulates and vapors migrating from soil and sediment to air, the inhalation of VOCs volatilizing from groundwater, and for consumption of foodstuffs. The methods used for calculation of the route-specific EPCs are presented in Appendix V (Tables 4.1 through 4.32).

## 6.4 Toxicity Assessment

Information concerning the potential human health effects of exposure to COPCs is examined by the risk assessor during the toxicity assessment. For each COPC, the goal of the toxicity assessment is to provide a quantitative estimate of the relationship between the magnitude and type of exposure and the severity or probability of human health effects. The toxicity values presented in this section are integrated with the exposure assessment (Section 6.3) to characterize the potential for the occurrence of adverse health effects.

### 6.4.1 Toxicity Information and USEPA Guidance for Non-carcinogens

For non-carcinogens, it is assumed that a dose exists below which no adverse health effects will be seen. Below this “threshold” dose, exposure to a chemical can be tolerated without adverse effects. The potential for non-carcinogenic health effects resulting from exposure to chemicals is assessed by comparing the intake dose with this “threshold” dose, or reference dose (RfD). The RfD is determined using available dose-response data for individual chemicals. Uncertainty factors are applied to the highest no-observed-adverse-effect level (NOAEL) to adjust for inter- and intra-species variation, deficiencies in the toxicological database, and use of subchronic rather than chronic animal studies. Inter-species differences in toxicity responses occur as a consequence of the basic biological differences among the various species. Intra-species differences in toxicity responses occur as a consequence of the varying sensitivities amongst the individuals within a species. Additional uncertainty factors may be applied to estimate a NOAEL from a lowest-observed-adverse-effect level (LOAEL) if the critical study failed to determine a NOAEL. When chemical-specific data are not sufficient, an RfD may be derived from data for a chemical with structural and toxicologic similarity.

The RfD is expressed in units of mg/kg/day and represents a daily intake of contaminant per kilogram of body weight that is not sufficient to cause the threshold effect of concern. An RfD is specific to the chemical, the route of exposure, and the duration over which the exposure occurs. Separate RfDs are presented for ingestion and inhalation pathways. In particular, reference concentrations (RfCs) in units of [mg/m$^3$] are typically presented for the inhalation pathway. Because characterization of non-carcinogenic effects requires an estimate of dose in units of mg/kg/day, the inhalation RfC must be converted to an inhalation RfD. The conversion is performed by assuming that humans weigh 70 kg and inhale 20 m$^3$ of air per day (i.e., the inhalation RfC [mg/m$^3$] is multiplied by 20 m$^3$/day and divided by 70 kg to yield an inhalation RfD with units of [mg/kg/day]) (USEPA, 1995a). The RfDs used to evaluate the COPCs at LL–9 are presented in Appendix V, Table 5.1. The toxicity values were selected using the hierarchy from the FWHHRAM:

- Tier 1 – USEPA's IRIS
- Tier 2 – USEPA's Provisional Peer-Reviewed Toxicity Values (PPRTVs) – The Office of Research and Development/National Center for Environmental Assessment/Superfund Health Risk Technical Support Center (STSC) develops PPRTVs on a chemical-specific basis when requested by USEPA's Superfund program.
- Tier 3 – Other Toxicity Values – Tier 3 includes additional USEPA and non-USEPA sources of toxicity information. Priority should be given to those sources of information that are the most current, the basis for which is transparent and publicly available, and which have been peer reviewed.

### 6.4.2 Toxicity Information and USEPA Guidance for Carcinogens

The toxicity information considered in the assessment of potential carcinogenic risks includes a weight-of-evidence classification and a slope factor. The weight-of-evidence classification qualitatively describes the likelihood that a chemical is a human carcinogen, based on an evaluation of the available data from human and animal studies. Historically, a chemical was placed in one of three groups in USEPA's classification system to denote its potential for carcinogenic effects:

- Group A – known human carcinogen;
- Group B1 or B2 – probable human carcinogen; and
- Group C – possible human carcinogen.

Chemicals that cannot be classified as human carcinogens because of a lack of data are placed in Group D, and those for which there is evidence of noncarcinogenicity in humans are in Group E. More recently, the USEPA is evaluating the use of the following categories to describe the carcinogenic potential of a chemical:

- Carcinogenic to humans;
- Likely to be carcinogenic to humans;
- Suggestive evidence of carcinogenic potential;
- Inadequate information to assess carcinogenic potential; and
- Not likely to be carcinogenic to humans.

For carcinogens, risks are estimated as the probability that an individual will develop cancer over a lifetime as a result of exposure to the carcinogen. The cancer slope factor (CSF) is the toxicity value used to quantitatively express the carcinogenic hazard of cancer-causing chemicals. It is defined as the upper-bound estimate of the probability of cancer incidence per unit dose averaged over a lifetime. Slope factors are specific to a chemical and route of exposure and are expressed in units of [mg/kg–day] $^{-1}$ for both oral and inhalation routes. Inhalation cancer toxicity values are usually expressed as inhalation unit risks in units of reciprocal µg/m$^3$ [1/(µg/m$^3$)]. The inhalation unit risk must be converted to an inhalation slope factor. This is done by assuming that humans weigh 70 kg and inhale 20 m$^3$ of air per day (i.e., the inhalation unit risk [1/µg/m$^3$] is divided by 20 m$^3$/day, multiplied by 70 kg, and multiplied by 1,000 µg/mg to yield the mathematical equivalent of an inhalation slope factor [mg/kg–day]$^{-1}$) (USEPA, 1995a). CSFs used to evaluate the COPCs at LL–9 are included in Appendix V, Table 6.1, and were selected as described for the RfDs.

### 6.4.3 Estimation of Toxicity Values for Dermal Exposure

Dermal RfDs and dermal CSFs are derived from the corresponding oral values. In the derivation of a dermal CSF, the oral CSF is divided by the gastrointestinal absorption factor (GAF) to determine a CSF based on an absorbed dose rather than an administered dose. The oral CSF is divided by the GAF because CSFs are expressed as reciprocal doses. A dermal RfD is derived by multiplying an oral RfD by the GAF. Dermal CSFs and RfDs are shown in Appendix V, Tables 5.1 and 6.1. Values for GAF (or Gastrointestinal Absorption Fraction [$ABS_{GI}$]) were taken from *RAGS Part E*, Supplemental Guidance for Dermal Risk Assessment (USEPA, 2004a). For chemicals with greater than 50% $ABS_{GI}$ absorption, it is recommended that the default value of complete (i.e., 100 %) oral absorption be assumed, thereby eliminating the need for oral toxicity-value adjustment. Dermal adjustments to the oral CSF or RfD were made for antimony, cadmium, chromium, manganese, and vanadium.

### 6.4.4 Toxicity Criteria Assumptions

A provisional RfD is available for aluminum from the National Center for Environmental Assessment (NCEA); however, it is based on typical allowable intakes rather than adverse effect levels and is not considered strictly risk-based.

### 6.4.5 Chemicals Lacking USEPA Toxicity Criteria

Toxicity criteria are not available for one LL–9 COPC: nitrocellulose. Therefore, cancer and non-cancer risk estimates are not provided for this COPC.

## 6.5 Risk Characterization

The risk assessor evaluates information obtained through the exposure and toxicity assessments to estimate cancer risks and hazard indices in the risk characterization. Total non-carcinogenic and carcinogenic risk estimates for each exposure route, as well as the cumulative risks for each receptor, are included in Appendix V, Tables 9.1 through 9.7.

The risk characterization is presented in three sections. Methods are listed in Section 6.5.1, and results are included in Section 6.5.2. Remedial Goal Options (RGOs) are listed for potential chemicals of concern in Section 6.5.3.

### 6.5.1 Methodology

Two methods were employed to evaluate risks: one to estimate potential carcinogenic and another to estimate non-carinogenic risks.

#### *6.5.1.1 Methods for Estimation of Carcinogenic Risks*

Carcinogenic risks can be estimated by combining information on the strength or potency of a known or suspected carcinogen (CSF) with an estimate of the individual exposure doses (or intakes) of a chemical. Carcinogenic risk may be estimated as follows:

$$\text{Risk} = \text{CSF} \times \text{Dose}$$

Where:

CSF = carcinogenic slope factor $(\text{mg/kg–day})^{-1}$
Dose = amount of a contaminant absorbed by a receptor in mg/kg–day

The equation presented above, however, is valid only at risk levels less than or equal to 1E-02. When the risk estimate is expected to be greater than 1E-02, an alternate equation, such as the following one-exceedance equation, may be used to estimate risk (USEPA, 1989a):

$$\text{Risk} = 1 - \exp(-\text{Dose} \times \text{CSF})$$

Where:

exp = exponential

The resultant cancer risk value (i.e., 1E–06 or a 1–in–1,000,000 chance of developing cancer) can be applied to a given population to determine the increase in the cancer rate that could be expected to result from exposure (e.g., 1E–06 is one additional case of cancer in 1,000,000 exposed persons).

The total risk resulting from exposure of an individual receptor to multiple compounds in a particular medium is the sum of the cancer risks for the individual contaminants in that medium. Cancer risks are summarized for each receptor and each media.

To interpret the quantitative risk estimates and to aid risk managers in determining the need for remediation, quantitative risk estimates are compared to USEPA and Ohio EPA risk benchmarks. The USEPA has defined a “target cancer risk” range of 1E-04 to 1E-06. Incremental lifetime cancer risks (ILCRs) below 1E-06 are generally considered acceptable risks. ILCRs above 1E-04 are considered unacceptable risks. Risk management decisions are necessary for ILCRs between 1E-06 and 1E-04. The Ohio EPA cumulative cancer risk benchmark is 1E-05 and will be considered by the risk managers when making risk decisions for sites at RVAAP.

#### *6.5.1.2 Methods for Estimation of Non-carcinogenic Risks*

Potential health risks resulting from exposure to non-carcinogenic compounds are estimated by comparing the reasonable maximum daily intake dose calculated for an exposure to an acceptable intake dose, such as a chronic or subchronic reference dose (RfD). The ratio of the exposure dose (intake) to the RfD is referred to as the hazard quotient:

$$\text{Hazard Quotient} = \text{Dose}/\text{RfD}$$

If the hazard quotient (HQ) exceeds unity, there is a potential health risk associated with exposure to that chemical (USEPA, 1989a). The dose/RfD ratio is not a mathematical prediction of the severity or probability of toxic effects; it is simply a numerical indicator of the potential for adverse effects. The summation of HQs for several compounds is referred to as the hazard index (HI).

Conservatively, a total HI for any exposure route is calculated by summing the dose/RfD ratios (HQs) for the individual chemicals of concern (USEPA, 1989a). To provide a better indication of risks, dose/RfD ratios are summed according to the target organ affected. For example, the dose/RfD ratios for those chemicals affecting the liver should be summed separately from those chemicals affecting the central nervous system. An HI greater than 1 indicates potential adverse non-carcinogenic health effects (USEPA, 1989a).

The chemicals of concern (COCs) for a given medium are defined as those contaminants that contribute total cancer risk for a receptor greater than 1E-05 and/or HIs greater than 1.0 within a land use scenario, and that are not eliminated by risk managers after considering the information in the uncertainty analysis.

### 6.5.2 Risk Characterization Results

The risk characterization for LL–9 is summarized in this section. Total non-carcinogenic and carcinogenic risks for each exposure route, as well as the cumulative risks for each receptor, are included in Appendix V (Tables 9.1 through 9.7) and summarized in Table 6–11.

The following receptors were evaluated:

- The security guard/maintenance worker;
- The National Guard trainee;
- The National Guard resident trainer;
- The hunter/trapper; and
- The hypothetical future resident farmer (adult and child).

Example calculations and relevant risk calculation spreadsheets are included in Appendix V. It should be noted that although the risk estimates provided in Appendix V are presented using two significant figures, final receptor risk estimates are presented in the following narrative in terms of one significant figure as recommended by *RAGS Part A* (USEPA, 1989a).

## Table 6-11
## Summary of Cancer Risks and Hazard Indices

| Receptor | Media | Exposure Route | Cancer Risk | Chemicals with Cancer Risks > $10^{-4}$ | Chemicals with Cancer Risks > $10^{-5}$ and ≤ $10^{-4}$ | Chemicals with Cancer Risks > $10^{-6}$ and ≤ $10^{-5}$ | Hazard Index | Chemicals with HI > 1 |
|---|---|---|---|---|---|---|---|---|
| Security Guard/ Maintenance Worker | Surface Soil | Incidental Ingestion | 5E-07 | - - | - - | - - | 6E-03 | - - |
| | | Inhalation | 3E-09 | - - | - - | - - | 6E-04 | - - |
| | | Dermal Contact | 7E-06 | - - | - - | - - | 5E-02 | - - |
| | | Total | 8E-06 | - - | - - | Arsenic, Benzo(a)pyrene, Dibenzo(a,h)anthracene | 6E-02 | - - |
| National Guard Trainee | Deep Surface Soil | Incidental Ingestion | 1E-06 | - - | - - | Arsenic | 1E-02 | - - |
| | | Inhalation | 1E-05 | - - | - - | Arsenic, Chromium | 2E+00 | Manganese |
| | | Dermal Contact | 5E-07 | - - | - - | - - | 3E-03 | - - |
| | | Total | 1E-05 | - - | - - | Arsenic, Chromium | 2E+00 | Manganese |
| | Surface Water | Incidental Ingestion | 8E-07 | - - | - - | - - | 2E-02 | - - |
| | | Inhalation | | - - | - - | - - | | - - |
| | | Dermal Contact | 5E-08 | - - | - - | - - | 3E-02 | - - |
| | | Total | 9E-07 | - - | - - | - - | 5E-02 | - - |
| | Sediment | Incidental Ingestion | 0E+00 | - - | - - | - - | 7E-03 | - - |
| | | Inhalation | 0E+00 | - - | - - | - - | 1E-03 | - - |
| | | Dermal Contact | 0E+00 | - - | - - | - - | 2E-03 | - - |
| | | Total | 0E+00 | - - | - - | - - | 9E-03 | - - |
| | Groundwater | Incidental Ingestion | 0E+00 | - - | - - | - - | 3E-01 | - - |
| | | Inhalation | | - - | - - | - - | | - - |
| | | Dermal Contact | 0E+00 | - - | - - | - - | 2E-02 | - - |
| | | Total | 0E+00 | - - | - - | - - | 4E-01 | - - |
| | | Total All Media | 2E-05 | | | | 3E+00 | |
| National Guard Resident | Surface Soil | Incidental Ingestion | 8E-06 | - - | - - | Arsenic | 9E-02 | - - |
| | | Inhalation | 2E-06 | - - | - - | Chromium | 5E-01 | - - |
| | | Dermal Contact | 3E-06 | - - | - - | Arsenic | 2E-02 | - - |
| | | Total | 1E-05 | - - | - - | Arsenic, Benzo(a)pyrene, Chromium | 6E-01 | - - |
| | Surface Water | Incidental Ingestion | 5E-06 | - - | - - | Arsenic | 2E-01 | - - |
| | | Inhalation | | - - | - - | - - | | - - |
| | | Dermal Contact | 3E-07 | - - | - - | - - | 2E-01 | - - |
| | | Total | 6E-06 | - - | - - | Arsenic | 3E-01 | - - |
| | Sediment | Incidental Ingestion | 0E+00 | - - | - - | - - | 4E-02 | - - |
| | | Inhalation | 0E+00 | - - | - - | - - | 1E-01 | - - |
| | | Dermal Contact | 0E+00 | - - | - - | - - | 1E-02 | - - |
| | | Total | 0E+00 | - - | - - | - - | 2E-01 | - - |
| | Subsurface Soil | Incidental Ingestion | 8E-06 | - - | - - | Arsenic | 5E-02 | - - |
| | | Inhalation | 1E-07 | - - | - - | - - | 2E-04 | - - |
| | | Dermal Contact | 2E-06 | - - | - - | Arsenic | 2E-02 | - - |
| | | Total | 1E-05 | - - | Arsenic | - - | 7E-02 | - - |
| | Groundwater | Incidental Ingestion | 0E+00 | - - | - - | - - | 2E+00 | Manganese |
| | | Inhalation | | - - | - - | - - | | - - |
| | | Dermal Contact | 0E+00 | - - | - - | - - | 1E-01 | - - |
| | | Total | 0E+00 | - - | - - | - - | 2E+00 | Manganese |
| | | Total All Media | 3E-05 | | | | 3E+00 | |

## Table 6-11
## Summary of Cancer Risks and Hazard Indices

| Receptor | Media | Exposure Route | Cancer Risk | Chemicals with Cancer Risks > $10^{-4}$ | Chemicals with Cancer Risks > $10^{-5}$ and ≤ $10^{-4}$ | Chemicals with Cancer Risks > $10^{-6}$ and ≤ $10^{-5}$ | Hazard Index | Chemicals with HI > 1 |
|---|---|---|---|---|---|---|---|---|
| Hunter | Surface Soil | Incidental Ingestion | 2.7E-08 | - - | - - | - - | 3E-04 | - - |
| | | Inhalation | 2.8E-10 | - - | - - | - - | 5E-05 | - - |
| | | Dermal Contact | 5.3E-08 | - - | - - | - - | 3E-04 | - - |
| | | Total | 8E-08 | - - | - - | - - | 6E-04 | - - |
| | Sediment | Incidental Ingestion | 0E+00 | - - | - - | - - | 1E-04 | - - |
| | | Inhalation | 0E+00 | - - | - - | - - | 5E-06 | - - |
| | | Dermal Contact | 0E+00 | - - | - - | - - | 1E-04 | - - |
| | | Total | 0E+00 | - - | - - | - - | 3E-04 | - - |
| | Surface Water | Incidental Ingestion | 2E-08 | - - | - - | - - | 6E-04 | - - |
| | | Inhalation | | - - | - - | - - | | - - |
| | | Dermal Contact | 5E-09 | - - | - - | - - | 3E-03 | - - |
| | | Total | 3E-08 | - - | - - | - - | 3E-03 | - - |
| | Venison | Ingestion | 2E-08 | - - | - - | - - | 1E-03 | - - |
| | | Total All Media | 1E-07 | | | | 4E-03 | |
| | | | | | | | | |
| Child Resident Farmer | Surface Soil | Incidental Ingestion | na | - - | - - | - - | 1E+00 | - - |
| | | Inhalation | na | - - | - - | - - | 5E-02 | - - |
| | | Dermal Contact | na | - - | - - | - - | 7E-02 | - - |
| | | Total | na | - - | - - | - - | 1E+00 | - - |
| | Surface Water | Incidental Ingestion | na | - - | - - | - - | 1E-01 | - - |
| | | Inhalation | na | - - | - - | - - | | - - |
| | | Dermal Contact | na | - - | - - | - - | 1E-01 | - - |
| | | Total | na | - - | - - | - - | 2E-01 | - - |
| | Sediment | Incidental Ingestion | na | - - | - - | - - | 1E-01 | - - |
| | | Inhalation | na | - - | - - | - - | 2E-03 | - - |
| | | Dermal Contact | na | - - | - - | - - | 6E-03 | - - |
| | | Total | na | - - | - - | - - | 1E-01 | - - |
| | Subsurface Soil | Incidental Ingestion | na | - - | - - | - - | 7E-01 | - - |
| | | Inhalation | na | - - | - - | - - | 2E-05 | - - |
| | | Dermal Contact | na | - - | - - | - - | 5E-02 | - - |
| | | Total | na | - - | - - | - - | 8E-01 | - - |
| | Groundwater | Incidental Ingestion | na | - - | - - | - - | 1E+01 | Manganese |
| | | Inhalation | na | - - | - - | - - | | - - |
| | | Dermal Contact | na | - - | - - | - - | 4E-01 | - - |
| | | Total | na | - - | - - | - - | 1E+01 | Manganese |
| | Venison | Ingestion | na | - - | - - | - - | 5E-03 | - - |
| | Beef | Ingestion | na | - - | - - | - - | 6E-01 | - - |
| | Milk | Ingestion | na | - - | - - | - - | 2E+00 | - - |
| | Vegetables | Ingestion | na | - - | - - | - - | 3E+01 | Aluminum, Arsenic, Chromium, Manganese, Mercury |
| | | Total All Media | na | | | | 5E+01 | |

## Table 6-11
## Summary of Cancer Risks and Hazard Indices

| Receptor | Media | Exposure Route | Cancer Risk | Chemicals with Cancer Risks > $10^{-4}$ | Chemicals with Cancer Risks > $10^{-5}$ and ≤ $10^{-4}$ | Chemicals with Cancer Risks > $10^{-6}$ and ≤ $10^{-5}$ | Hazard Index | Chemicals with HI > 1 |
|---|---|---|---|---|---|---|---|---|
| Adult Resident Farmer | Surface Soil | Incidental Ingestion | na | - - | - - | - - | 1E-01 | - - |
| | | Inhalation | na | - - | - - | - - | 2E-02 | - - |
| | | Dermal Contact | na | - - | - - | - - | 7E-02 | - - |
| | | Total | na | - - | - - | - - | 2E-01 | - - |
| | Surface Water | Incidental Ingestion | na | - - | - - | - - | 3E-02 | - - |
| | | Inhalation | na | - - | - - | - - | | - - |
| | | Dermal Contact | na | - - | - - | - - | 6E-02 | - - |
| | | Total | na | - - | - - | - - | 9E-02 | - - |
| | Sediment | Incidental Ingestion | na | - - | - - | - - | 1E-02 | - - |
| | | Inhalation | na | - - | - - | - - | 8E-04 | - - |
| | | Dermal Contact | na | - - | - - | - - | 7E-03 | - - |
| | | Total | na | - - | - - | - - | 2E-02 | - - |
| | Subsurface Soil | Incidental Ingestion | na | - - | - - | - - | 8E-02 | - - |
| | | Inhalation | na | - - | - - | - - | 2E-04 | - - |
| | | Dermal Contact | na | - - | - - | - - | 5E-02 | - - |
| | | Total | na | - - | - - | - - | 1E-01 | - - |
| | Groundwater | Incidental Ingestion | na | - - | - - | - - | 3E+00 | - - |
| | | Inhalation | na | - - | - - | - - | | - - |
| | | Dermal Contact | na | - - | - - | - - | 2E-01 | - - |
| | | Total | na | - - | - - | - - | 3E+00 | Manganese |
| | Venison | Ingestion | na | - - | - - | - - | 1E-03 | - - |
| | Beef | Ingestion | na | - - | - - | - - | 6E-01 | - - |
| | Milk | Ingestion | na | - - | - - | - - | 3E-01 | - - |
| | Vegetables | Ingestion | na | - - | - - | - - | 3E+01 | Aluminum, Arsenic, Chromium, Manganese, Mercury |
| | | Total All Media | na | | | | 4E+01 | |
| | | | | | | | | |
| Lifelong Resident Farmer (Child and Adult) | Surface Soil | Incidental Ingestion | 4E-05 | - - | Arsenic | Benzo(a)pyrene, Dibenzo(a,h)anthracene | | - - |
| | | Inhalation | 2E-07 | - - | - - | - - | | - - |
| | | Dermal Contact | 1E-05 | - - | - - | Arsenic, Benzo(a)pyrene, Dibenzo(a,h)anthracene | | - - |
| | | Total | 5E-05 | - - | Arsenic | Benzo(a)pyrene, Dibenzo(a,h)anthracene | | - - |
| | Surface Water | Incidental Ingestion | 2E-06 | - - | - - | Arsenic | | - - |
| | | Inhalation | | - - | - - | - - | | - - |
| | | Dermal Contact | 2E-07 | - - | - - | - - | | - - |
| | | Total | 2E-06 | - - | - - | Arsenic | | - - |
| | Subsurface Soil | Incidental Ingestion | 4E-05 | - - | Arsenic | - - | | - - |
| | | Inhalation | 1E-07 | - - | - - | - - | | - - |
| | | Dermal Contact | 1E-05 | - - | - - | - - | | - - |
| | | Total | 5E-05 | - - | Arsenic | - - | | - - |
| | Venison | Ingestion | 3E-08 | - - | - - | - - | | - - |
| | Beef | Ingestion | 2E-04 | Dibenzo(a,h)anthracene | Arsenic, Benzo(a)pyrene | - - | | - - |
| | Milk | Ingestion | 1E-03 | Benzo(a)pyrene, Dibenzo(a,h)anthracene | Arsenic | - - | | - - |
| | Vegetables | Ingestion | 3E-03 | Arsenic, Benzo(a)pyrene, Dibenzo(a,h)anthracene | - - | - - | | |
| | | Total All Media | 5E-03 | | | | | |

## Table 6–12

## Non-Carcinogenic Risks for LL–9

| Receptor(1) | Medium | Hazard Index | Table in Appendix V |
|---|---|---|---|
| Security Guard/Maintenance Worker (Current/Future) | Surface Soil | 4E-02 | 9.1 |
| National Guard Trainee (Future) | Deep surface Soil | 2E+00 | 9.2 |
|  | Sediments | 8E-03 | 9.2 |
|  | Surface Water | 4E-02 | 9.2 |
|  | Ground Water | 2E-01 | 9.2 |
| Total (All Media) |  | 3E+00 | 9.2 |
| Total (Minus Deep Surface Soils) |  | 3E-01 | 9.2 |
| National Guard Resident | Surface Soils | 1E-01 | 9.3 |
|  | Subsurface Soils | 7E-02 | 9.3 |
|  | Sediment | 5E-02 | 9.3 |
|  | Surface water | 3E-01 | 9.3 |
|  | Groundwater | 1E+00 | 9.3 |
| Total (All Media) |  | 2E+00 | 9.3 |
| Total (All Media Minus GW) |  | 4E-01 | 9.3 |
| Hunter/Trapper (Current/Future) | Surface Soils | 5E-04 | 9.4 |
|  | Sediments | 2E-04 | 9.4 |
|  | Surface water | 2E-03 | 9.4 |
|  | Venison | 4E-04 | 9.4 |
| Total (All Media) |  | 3E-03 | 9.4 |
| Hypothetical Child Resident Farmer (Future) | Surface Soils | 9E01 | 9.5 |
|  | Subsurface | 7E-01 | 9.5 |
|  | Sediments | 5E-01 | 9.5 |
|  | Surface water | 2E+00 | 9.5 |
|  | Groundwater | 6E+00 | 9.5 |
| Total (All Media |  | 9E+00 | 9.5 |
| Total (Minus GW) |  | 3E+00 | 9.5 |
| Total (Minus GW and SS) |  | 3E+00 | 9.5 |

## Table 6–12 (Continued)

## Non-Carcinogenic Risks for LL–9

| Receptor[1] | Medium | Hazard Index | Table in Appendix V |
|---|---|---|---|
| Total (Minus GW and SB) | | 3E+00 | 9.5 |
| Hypothetical Adult Resident Farmer (Future) | Surface Soils | 2E-01 | 9.6 |
| | Subsurface Soils | 1E-01 | 9.6 |
| | Sediments | 9E-02 | 9.6 |
| | Surface water | 5E-01 | 9.6 |
| | Groundwater | 2E+00 | 9.6 |
| Total (All Media) | | 3E+00 | 9.6 |
| Total (Minus GW) | | 8E-01 | 9.6 |
| Total (Minus GW and SS) | | 6E-01 | 9.6 |
| Total (Minus GW and SB) | | 7E-01 | 9.6 |

1. More than one total risk estimate has been presented for several receptors to demonstrate the relative contribution of an environmental medium to the total risk for a receptor and because of the potential overestimation of risk that may occur when a receptor is assumed to be exposed to both surface and subsurface soils and sediments at a similar daily ingestion rate (i.e., the National Guard trainee, National Guard resident trainer, the hypothetical future farm resident). Also, risk estimates have been presented for domestic use of groundwater; however, it is very unlikely that the shallow groundwater resources at LL–9 would be used for domestic purposes.

Totals in Table 6–12 are shown for all media, as well as subtotals subtracting one or more media. These subtotals help illustrate which medium or media are responsible for any exceedances and are presented for informational purposes only.

HIs developed for the aforementioned receptors and presented in the referenced tables were as follows:

HIs calculated for the security guard/maintenance worker and the hunter/trapper are less than 1, indicating that adverse non-carcinogenic health effects are not anticipated under the conditions established in the exposure assessment.

The HIs calculated for the National Guard trainee receptor exposed to COPCs in groundwater, sediments, and surface water do not exceed 1. The HI for the National Guard trainee exposed to COPCs in deep surface soils (0 to 4 ft bgs) is 2. Manganese (inhalation of air particulates as the route of exposure) was the only significant contributor to the non-carcinogenic risk (i.e., risk driver) for the National Guard trainee. The HI calculated by summing the HIs calculated for all other COPCs does not exceed 1; only the HI calculated for the central nervous system (the target organ for manganese) exceeds 1. The non-cancer risk estimates for manganese are strongly affected by the particulate emission factor (PEF) specified for the National Guard Trainee receptor in the RVAAP FWHHRAM. The EPC for manganese (633 mg/kg) in soils is less than the surface soil background value of 1,450 mg/kg. The PEF, background concentrations, and the inhalation reference dose for aluminum and manganese are further discussed in Section 6.6.

Manganese at a concentration equal to RVAAP background would result in an HI of approximately 4, and at a concentration equal to its Region 9 residential PRG would result in an HI of 5.

HIs calculated for the National Guard resident trainer exceed 1, if it is assumed the receptor is using the shallow groundwater resource for domestic purposes. As discussed in Section 4, the use of the shallow groundwater at LL–9 for domestic purposes is considered unlikely currently, although OHARNG has expressed interest in drilling potable and non-potable wells at RVAAP. Manganese in groundwater is the main risk driver. The National Guard resident trainer receptor was not required by the RVAAP FWHHRAM (USACE, 2004). The receptor was added to this HHRA as the result of discussions with the USACE and Ohio EPA because risk estimates for this receptor may assist the risk management team when making risk management decisions for LL–9.

The HI calculated for the adult resident farmer routinely exposed to COPCs in surface soil, surface water, sediment, and groundwater, or routinely exposed to COPCs in subsurface soil, surface water, sediment, and groundwater via the direct-contact pathways, exceed 1 only when it is assumed that the shallow groundwater is used for domestic purposes. Manganese in groundwater is the only risk driver. The HIs calculated for the adult resident farmer routinely exposed via indirect exposure pathways (i.e., consumption of foodstuffs), also presented in Appendix V, Table 9.6, do exceed 1 for vegetable consumption only. However, there are significant sources of uncertainty associated with the risk estimates developed for the ingestion of foodstuffs exposure pathways. Consequently, these risk assessment results are included and discussed in Section 6.6.

The HI calculated for the child resident farmer routinely exposed to COPCs in surface soil, sediment, surface water, and groundwater or routinely exposed to COPCs in subsurface soil, sediment, surface water, and groundwater via the direct-contact exposure pathways exceed 1. The HIs calculated for the COPCs in groundwater and surface water exceed 1. The HIs calculated for sediments or subsurface soils do not exceed 1. Manganese in groundwater is the primary risk driver; HIs calculated for other COPCs evaluated do not exceed 1. The target-organ-specific HI calculated for the central nervous system (the target system for manganese) exceed 1, as well as the HIs for the target systems for arsenic, skin, and cardiovascular. The HIs calculated for the child resident farmer routinely exposed via indirect exposure pathways (i.e., consumption of foodstuffs) also included in Appendix V, Table 9.5; do exceed 1 for vegetable and milk consumption. However, there are significant sources of uncertainty associated with the risk estimates developed for the ingestion of foodstuffs exposure pathways. Consequently, these risk assessment results are included and discussed in Section 6.6.

#### *6.5.2.1 Carcinogenic Risks for LL–9*

ILCR estimates calculated for the aforementioned receptors and listed in the referenced tables are shown in Table 6–13.

**Table 6–13**

**Incremental Lifetime Cancer Risk Results**

| Receptor (1) | Media | Cancer Risk Estimate | Table in Appendix V |
|---|---|---|---|
| Security Guard/ Maintenance Worker (Current/Future) | Surface Soil | 8E-06 | 9.1 |
| National Guard Trainee (Future) | Deep Surface Soil | 2E-05 | 9.2 |
| | Sediment | 0 | 9.2 |
| | Surface Water | 9E-07 | 9.2 |
| | Groundwater (GW) | 0 | 9.2 |
| Total All Media | | 2E-05 | 9.2 |
| Total (Minus Deep Surface Soil) | | 9E-07 | 9.2 |
| National Guard Resident (Future) | Surface Soil (SS) | 1E-05 | 9.3 |
| | Subsurface Soil (SB) | 9.5E-06 | 9.3 |
| | Sediment (SD) | 0 | 9.3 |
| | Surface Water | 6E-06 | 9.3 |
| | Groundwater | 0 | 9.3 |
| [1]Total (All Media) | | 2E-05 | 9.2 |
| [1]Total (Minus Deep Surface Soil) | | 9E-07 | 9.2 |
| Hunter/Trapper (Current/Future) | Surface Soil | 8E-08 | 9.5 |
| | Sediment | 0 | 9.5 |
| | Surface Water | 3E-08 | 9.5 |
| | Venison | 2E-08 | 9.5 |
| Total (All Media) | | 1E-07 | 9.5 |
| Hypothetical Resident/Trainer (Future) | Surface Soil (SS) | 5E-05 | 9.8 |
| | Subsurface Soil (SB) | 5E-05 | 9.8 |
| | Sediment | 0 | 9.8 |
| | Surface Water | 2E-05 | 9.8 |

## Table 6–13 (Continued)

## Incremental Lifetime Cancer Risk Results

| Receptor [(1)] | Media | Cancer Risk Estimate | Table in Appendix V |
|---|---|---|---|
| | Groundwater (GW) | 0 | 9.8 |
| [1]Total (All Media Minus Subsurface Soil) | | 7E-05 | 9.8 |
| [1]Total (All Media Minus Surface Soil) | | 6E-05 | 9.8 |

1. More than one total risk estimate has been presented for several receptors to demonstrate the relative contribution of an environmental medium to the total risk for a receptor and because of the potential overestimation of risk that may occur when a receptor is assumed to be exposed to both surface and subsurface soils and sediments at a similar daily ingestion rate (e.g., the National Guard Trainee, National Guard resident trainer, the hypothetical future farm resident). Also, risk estimates have been presented for domestic use of groundwater; however, it is very unlikely that the shallow groundwater resource at LL–9 would be used for domestic purposes.

Totals in Table 6–13 are shown for all media, as well as subtotals subtracting one or more media. These subtotals help illustrate which medium or media are responsible for any exceedances and are presented for informational purposes only.

ILCR estimates calculated for the hunter/trapper do not exceed 1E-06, the conservative end of the USEPA target risk range. The cancer risk estimates for the security guard/maintenance worker are within the USEPA target risk range of 1E-04 to 1E-06 and do not exceed the Ohio EPA cancer risk benchmark of 1E-05. The cancer risk estimates calculated for arsenic, benzo(a)pyrene, and dibenzo(a,h)anthracene exceed 1E-06.

Cancer risk estimates for the National Guard trainee are within the USEPA target risk range of 1E-04 to 1E-06 but exceed the Ohio EPA cancer risk benchmark of 1E-05. Risk estimates summed for receptor exposure to surface water do not exceed 1E-06. There is no cancer risk from subsurface soil or groundwater. Inhalation of chromium in deep surface soil accounts for 1.0E-05, or 69% of the total cancer risk estimate for the National Guard trainee. Slightly less significant, the inhalation of arsenic in deep surface soil accounts for 2.9E-06, or 19% of the total cancer risk estimate for the National Guard trainee. Inhalation of both chromium and arsenic accounts for 88% of total cancer risk. The estimates for inhalation of chromium and arsenic in deep surface soil are strongly affected by the PEF specified for the National Guard trainee receptor in the RVAAP FWHHRAM. This PEF is further discussed in Section 6.6. The EPC for arsenic in deep surface soil (13 mg/kg) does not exceed the RVAAP background value of 15.4 mg/kg. The EPC of chromium in deep surface soil (17 mg/kg) does not exceed the RVAAP background value of 17.4 mg/kg; nor does it exceed the chromium Region 9 residential PRG of 30 mg/kg.

Cancer risk estimates for the National Guard resident trainer are within the USEPA target risk range of 1E-04 to 1E-06 but exceed the Ohio EPA cancer risk benchmark of 1E-05. The risk estimates for arsenic (surface soil, subsurface soil) and benzo(a)pyrene (surface soils) exceed 1E-06. The National Guard resident trainer receptor was not required by the RVAAP FWHHRAM. This receptor was added to this HHRA as the result of discussions with the USACE and Ohio EPA because risk estimates for this receptor may assist the risk management team when making risk management decisions for LL–9.

Cancer risk estimates for the hypothetical future resident farmer (combined adult and child) are within the USEPA target risk range of 1E-04 to 1E-06 but exceed the Ohio EPA cancer risk benchmark of 1E-05. Risk estimates developed for surface soils, subsurface soils, and surface water exceed the Ohio EPA 1E-05 risk benchmark. A review of the media and chemical-specific risk results indicate the following chemicals are primary contributors to the estimated cancer risk:

- Arsenic is the primary risk driver in soil and surface water. Risk drivers are the most significant risk contributors and are typically those COPCs whose contribution to the risk estimates causes the overall receptor or media risk exceeding federal or state risk benchmarks. The risk estimates for arsenic in soils and surface waters exceed 1E-05. EPCs of arsenic in surface soil (12 mg/kg), subsurface soil (13.8 mg/kg), and deep surface soil (13 mg/kg) were less than their respective RVAAP background concentrations (15.4 mg/kg, 19.8 mg/kg, and 15.4 mg/kg).
- The risk estimates for benzo(a)pyrene in surface soil exceed 1E-06, but do not exceed 1E-05.

The cancer risk estimates presented for the environmental media are subject to several significant sources of uncertainty, which are further discussed in Section 6.6. Section 6.6 also presents an evaluation of the ingestion of foodstuffs exposure pathways.

#### *6.5.2.2 Summary of COCs for Each Media/Receptor*

Chemicals of concern (COCs) are the COPCs that significantly contribute to a pathway in a use scenario for a receptor that either exceeds the 1E-05 cumulative cancer risk benchmark or exceeds a non-carcinogenic HI (target organ specific) of 1.0. A summary of COCs for each of the land use/receptor/medium combinations with COCs is listed in Table 6–14. Remedial goal options (RGOs) are calculated and included in Section 6.7 for the potential COCs identified in the risk evaluation.

### *6.5.2.3 Lead Exposure Analysis*

The maximum lead concentration (70 µg/L) in surface water exceeded the SDWA action level of 15 µg/L for residential land use. Concentrations of lead exceeded the action level in two samples. Exposures to lead are evaluated using arithmetic mean concentrations (USEPA, 1994c). The mean concentration of lead in surface water (25.5 µg/L) is slightly above the action level of 15 µg/L, indicating that using the surface water as a drinking water source may be of some concern at LL–9. However, surface water in the ditches at LL–9 will not be used as a drinking water source. Dermal contact (bathing and showering, and washing dishes or clothes) should be safe, even if the water contains lead over the USEPA action level, because human skin does not absorb lead from the water (MWCOG, 2004).

The maximum lead concentration (1330 mg/kg) in surface soil (and, therefore, deep surface soil) exceeded the OSWER soil screening level of 400 mg/kg for residential land use (USEPA, 1994c). Concentrations of lead exceeded the residential screening level in only one soil sample (LL9SS–011–0001–SO). Exposures to lead are evaluated using arithmetic mean concentrations (USEPA, 1994c). The mean concentrations of lead in surface soil (63 mg/kg) and deep surface soil (44 mg/kg) are well below the residential screening level of 400 mg/kg. Consequently, no adverse health effects are anticipated from exposures to lead in surface soil or deep surface soils at LL–9.

### *6.5.2.4 Sample Location of Concern*

Maximum detected concentrations of surface soil and deep surface soil COPCs copper (1,240 mg/kg), lead (1,330 mg/kg), and mercury (882 mg/kg) were at azide sample location LL9SS–011–0001–SO. The next highest detected concentrations were much lower (copper – 170 mg/kg, lead – 320 mg/kg, and mercury – 17 mg/kg). This sample location may be of particular concern when making risk decisions, particularly for exposure to mercury.

## 6.6 Uncertainty Analysis

A significant uncertainty is the fact that the nature and extent of the contamination in the environmental media at LL-9 has not been completely determined. Therefore, the human health risk assessment presented in Section 6 (and the associated uncertainties) is preliminary and subject to change based on the data collected to resolve the RI data gaps for LL-9. This section summarizes the uncertainties inherent in the BHHRA. It includes a discussion of how uncertainties may affect the quantitative risk estimates and conclusions of the risk analysis. The BHHRA for LL–9 was performed in accordance with current USEPA and RVAAP guidance and the aforementioned White Paper developed for LL–9 (TtNUS, 2004). However, there are varying degrees of uncertainty associated with the BHRRA. The following sections discuss general uncertainties in all risk assessments and uncertainties specific to the BHHRA for LL–9.

Uncertainty in the selection of COPCs can be related to the quality of the analytical data bases, groupings of samples, and procedures used to include or exclude constituents as COPCs.

## Table 6-14
## Potential Land Use/Receptor/Medium Pathway COCs

| Pathway | Surface Soil | Subsurface Soil | Surface Water | Deep Surface Soil | | Groundwater | Soil - Beef | | | Soil - Milk | | | Soil - Vegetables | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | As | As | As | Cr | Mn | Mn | As | B(a)P | D(ah)A | As | B(a)P | D(ah)A | Al | B(a)P | D(ah)A | As | Cr | Mn |
| Security Guard/Maintenance Worker | | -- | -- | | -- | -- | -- | | | -- | | | -- | | | -- | -- | -- |
| National Guard Trainee | -- | -- | | X | X | | -- | | | -- | | | -- | | | -- | -- | -- |
| National Guard Resident | | | | -- | -- | X | -- | | | -- | | | -- | | | -- | -- | -- |
| Hunter | | -- | | -- | -- | -- | -- | | | -- | | | -- | | | -- | -- | -- |
| Child Resident Farmer | | | | -- | -- | X | | | | | | | X | | | X | X | X |
| Adult Resident Farmer | | | | -- | -- | X | | | | | | | X | | | X | X | X |
| Lifelong Resident Farmer | X | X | X | -- | -- | | X | X | X | X | X | X | | X | X | X | | |

No COCs were identified for direct contact with surface water and ingestion of venison.

As - Arsenic
Cr - Chromium
Mn - Manganese
B(a)P - Benzo(a)pyrene
D(ah)A - Dibenzo(a,h)anthracene
"X" indicates chemical is a COC for receptor/medium
"--" indicates pathway not applicable in this BHHRA.
A blank indicates chemical is not identified as a COC for receptor/medium.

Uncertainties associated with the exposure assessment include the values used as input variables for a given intake route/scenario, the assumptions made to determine EPCs, and the predictions regarding future land use and population characteristics. Uncertainty in the toxicity assessment includes the quality of the existing toxicity data needed to support dose-response relationships and the weight of evidence used for determining the carcinogenicity of COPCs. Uncertainty in the risk characterization includes that associated with exposure to multiple chemicals and the cumulative uncertainty from combining conservative assumptions made in earlier steps of the risk assessment process.

Whereas there are various sources of uncertainty, the direction of uncertainty can be influenced by the assumptions made throughout the risk assessment, including selection of COPCs and selection of values for dose-response relationships. In general, assumptions are made considering safety factors so that the final calculated risks for a receptor are not underestimated and, in fact, such receptor risk estimates tend to be over-estimated.

After the risk assessment is complete, the results must be reviewed and evaluated to identify the type and magnitude of uncertainty involved. Reliance on results from a risk assessment without consideration of the uncertainties, limitations, and assumptions inherent in the process can be misleading. For example, to account for uncertainties in the development of exposure assessment, exposure assumptions (e.g., ingestion rates, exposure frequencies) must be estimated conservatively to protect sensitive subpopulations or the maximum exposure individuals. However, if a number of conservative assumptions are combined in an exposure model, the resulting calculations can propagate the uncertainties associated with those assumptions, thereby producing a much larger uncertainty for the final result. This uncertainty is biased toward over-predicting both carcinogenic and non-carcinogenic risks. Thus, both the results of the risk assessment and the uncertainties associated with those results must be considered when making risk management decisions.

The evaluation of uncertainty is especially relevant when risk estimates exceed the point of departure for defining “acceptable” risk. For example, when risks calculated using a high degree of uncertainty are less than an acceptable risk level (e.g., $1x10^{-6}$), the interpretation of “no significant risk” is typically straightforward. However, when risk calculated using a high degree of uncertainty exceeds an “acceptable” risk level, a conclusion can be difficult unless uncertainty is considered especially when the exceedance of acceptable risk is relatively “marginal.”

The following subsections discuss uncertainties associated with each major component of the risk assessment: COPC selection, exposure assessment, toxicity assessment, and risk characterization.

### 6.6.1 Uncertainties Associated with COPC Selection

The following issues may contribute to uncertainty in COPC selection for LL–9: the quality of the existing databases, inclusion of chemicals potentially attributable to background, toxicity screening levels used, absence of screening levels for a few chemicals detected in the site media, and frequency of detection reported for chemicals detected in the environmental media. A brief discussion of each of these issues is provided in the remainder of this section.

#### *6.6.1.1 Existing Databases*

All data used for this evaluation have been validated according to National Functional Guidance (USEPA, 1994a and 1994b). Therefore, uncertainties associated with the quality of the data are considered to be minimal. For most media (groundwater, surface water, sediment, and surface soil and subsurface soil [organic parameters only]), few samples (less than 10) were collected. The availability of small data sets only for these media may result in uncertainty both in terms of COPC selection and in the calculated risks. However, the LL-9 field sampling program was biased toward areas most likely to demonstrate contamination. Thus, receptor risk based on these biased data may be over-estimated rather than under-estimated.

Selected media samples collected during the LL–9 investigation were sent to a second laboratory, GPL, to substantiate the accuracy of the new GPL screening method for explosives utilized during the field investigation program (modified 8330). Because the GPL method is unproven, data results from this screening are presented in appendices but were not used in any risk evaluations. Surface soil data are presented in Appendix F, subsurface soil data are presented in Appendix I, and sediment data are presented in Appendix R. Several explosives detected using the GPL screening method were also detected in samples that were evaluated in the BHHRA and therefore may be present at LL–9. However, because the maximum reported concentrations of these explosives do not exceed their respective Region 9 residential PRGs, the exclusion of these screening samples from the risk evaluation is unlikely to lead to an underestimation of risk.

#### *6.6.1.2 Chemicals Potentially Attributable to Background*

The background values for RVAAP were determined as described in RVAAP WBG Phase II Remedial Investigation (SAIC, 2001). Outliers, results exceeding an upper cutoff limit, were removed from the background data set. The upper cutoff limit was the third quartile (the 75th percentile) plus 1.5 times the inter-quartile range. An outlier might indicate a mistake or anomaly in the data set. However, it could also represent a perfectly valid but rare result. Conservatively, some higher background values were removed from the background data set. This conservative approach to the selection of background values and the data discussions presented in the following paragraphs suggest that some chemicals selected as COPCs may marginally exceed background concentrations (if at all).

Arsenic EPCs calculated for surface soil (12 mg/kg), subsurface soil (13.8 mg/kg), and deep surface soil (13 mg/kg) were less than their respective background concentrations (15.4 mg/kg, 19.8 mg/kg, and 15.4 mg/kg)

Only 1 of 46 samples in surface soil and 3 of 85 samples in deep surface soil had aluminum concentrations greater than the background value, and the EPC for aluminum was less than its background concentration in both data sets. Only 2 of 46 surface soil samples and 2 of 85 deep surface soil samples had manganese concentrations greater than the background value. The EPC for manganese was less than its background concentration in both data sets. Only one groundwater sample had a manganese concentration greater than the background value.

The EPCs for chromium in surface soil, subsurface soil, and deep surface soil were less than its background value.

Finally, benzo(a)pyrene was detected in background soil samples at a maximum concentration of 100 µg/kg. The maximum detected concentration in surface soils was 240 µg/kg. As indicated previously, the PAH concentrations detected in LL–9 soil and sediment are within the range of background anthropogenic concentrations reported in the literature.

#### *6.6.1.3 COPC Screening Levels*

The use of risk-based screening values should ensure that the significant contributors to risk at a site are not eliminated but are retained for risk evaluation. COPC screening values were based on conservative land use scenarios (e.g., residential land use for soil) and protective levels of risk corresponding to ILCRs of $1x10^{-6}$ and HIs of 0.1. An exceedance of these conservative screening values is not conclusive evidence that a receptor is at risk. For example, as discussed in Section 6.2, non-carcinogenic chemicals selected as COPCs (e.g., aluminum and copper in surface soil) were not detected in environmental media at concentrations exceeding the Region 9 residential PRGs. Consequently, the aluminum and copper concentrations in the surface soils are unlikely to be significant from a human health perspective.

In addition, the toxicity values used in the derivation of PRGs are subject to change as additional information (from scientific research) becomes available. These periodic changes in toxicity values may cause the PRG values to change as well.

#### *6.6.1.4 Absence of COPC Screening Levels*

Essential human nutrients (e.g., magnesium, potassium, calcium, iron, and sodium) do not have toxicity screening levels for COPC selection. These nutrients were eliminated from consideration as COPCs (see Section 6.2.2). Exclusion of these chemicals as COPCs is not expected to add significant uncertainty to the risk estimates.

#### *6.6.1.5 Frequency of Detection*

No chemicals were eliminated as SRCs or COPCs on the basis of frequency of detection considerations described in Section 6.2.2.

#### *6.6.1.6 Data Analysis*

Uncertainty can be added to the risk estimates as a result of the limitations in the analytical methods. Some current analytical methods are limited in their ability to achieve detection limits at or below PRGs. Risks may be overestimated when some analyte concentrations are reported as non-detected at the method detection limit, but the actual concentration is much less than the method detection limit. Conversely, risks may be underestimated when some analytes are present, even at concentrations exceeding the Region 9 residential PRG, but are not detected because of limitations in the analytical methods and therefore the analytes are removed from the SRC list.

### 6.6.2 Uncertainties Associated with the Exposure Assessment

Uncertainty in the exposure assessment arises because of the methods used to calculate EPCs, selection of receptors, selection of land use scenarios to be evaluated, and selection of exposure parameters.

#### *6.6.2.1 Land Use*

The current land use patterns of LL–9 are established, thereby reducing the uncertainty associated with current land use assumptions. The anticipated future land use patterns of LL–9 are described in the RVAAP FWHHRAM. This BHHRA is based on these known and anticipated future land use scenarios; therefore, the land use assumptions presented herein are not expected to lead to an underestimation of risk.

#### *6.6.2.2 Exposure Point Concentration*

The maximum concentrations of some COPCs (e.g., all COPCs in surface water and groundwater and organics in soils) were used as the EPCs to quantify potential risks. Risk estimates are likely to be overestimated when the maximum detected concentration is selected as the EPC because it is unlikely that potential receptors would be exposed to the maximum concentration over the entire site for the assumed exposure period.

#### *6.6.2.3 Exposure Parameters*

The exposure assessment factors (e.g., exposure frequency and duration) utilized in the BHHRA are based on reasonable maximum exposure (RME) assumptions. Generally, these exposure factors are based on data available as a result of surveys of the physiological and lifestyle characteristics of the general population of the United States. The attributes and activities studied in these surveys generally have a broad distribution. RME exposure factor values were used in this risk evaluation to avoid an underestimation of risk. Risk is not likely to be underestimated for reasonably maximum exposed individuals and is more likely to be overestimated for the general population exposed to chemicals in environmental media at the site when RME assumptions are evaluated in a risk assessment. The following paragraphs exemplify the conservative nature of the exposure factors selected for the BHHRA.

A particulate emission factor (PEF) of $9.24 \times 10^8$ $m^3$/kg was calculated based on USEPA's *Soil Screening Guidance* (USEPA, 1996) using site-specific factors for Cleveland, Ohio, the city nearest Ravenna for which USEPA provided parameters to estimate PEF and volatilization factor (VF) values. This value was used to evaluate most receptors in this BHHRA. However, the RVAAP recommends a PEF of $1.67 \times 10^6$ $m^3$/kg for the National Guard trainee whose activities are considered more likely to generate more airborne dust than the activities of other receptors. The FWHHRAM states that this PEF was calculated from a dust loading factor (DLF) of 600 µg/$m^3$. This value greatly exceeds the National Ambient Air Quality Standard (NAAQS) PM 10 (particulate matter less than or equal to 10 microns in diameter) 24-hour and annual standards of 150 µg/$m^3$ and 50 µg/$m^3$, respectively. Although it is possible that National Guard activities could generate significant particulate matter less than or equal to 10 microns in diameter (PM10) for short periods of time and at locations adjacent to vehicles, it is very unlikely that these activities would generate ambient air particulate emissions for extended periods of time and across the entire site, especially at concentrations that exceed the NAAQS. As a point of comparison, use of the methods and default values for estimating dust emissions associated with construction activities in the USEPA *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites*, December 2002, results in a DLF of 364 µg/$m^3$. The HI for the National Guard trainee calculated based on COPC concentrations in the LL–9 deep surface soil and sediment using this guidance would be approximately half the value presented in Section 6.5.

No exposure time term is included in the intake equation for the dermal contact with soil exposure pathway. The underlying assumption is that the receptor does not bathe or remove soil from the skin surface for an extended period (e.g., the full 24 hours of the day). This may overestimate the risk associated with dermal contact with soil. This assumption is especially important when the dermal pathway is the major contributor to the risks and/or hazards, as it is for some receptors at LL–9. For example, the calculated risk from dermal exposure to benzo(a)pyrene in deep surface soil by the National Guard trainee is greater than the risk calculated from ingestion of deep surface soil.

Based on the climatic conditions in the eastern Ohio region, the assumption of 250 days per year and 350 days per year as exposure frequencies for the National Guard resident trainer and hypothetical future resident farmer, respectively, for soil and sediment likely results in an overestimation of risk because no exposure is likely to occur when these media are covered with snow or frozen solid. Consequently, risks calculated using these exposure assumptions are likely over-estimated. Likewise, the assumption of 250 days per year as an exposure frequency for the National Guard resident trainer contact with COPCs in surface water is very conservative for eastern Ohio and may lead to an overestimation of risk.

### 6.6.3 Uncertainties Related to Toxicity Information

Uncertainties associated with the toxicity assessment include the derivation of RfDs and CSFs from which the PRGs are calculated and limitations associated with the use of available criteria. These uncertainties are discussed in the following subsections.

#### *6.6.3.1 Derivation of Toxicity Criteria*

Uncertainty is associated with hazard assessment and dose-response evaluations. The hazard assessment deals with characterizing the nature and strength of the evidence of causation, or the likelihood that a chemical that induces adverse effects in animals will also induce adverse effects in humans. Hazard assessment of carcinogenicity is evaluated as a weight-of-evidence determination using USEPA methods. Positive animal cancer test data suggest that humans contain tissue(s) that may manifest a carcinogenic response; however, the animal data cannot necessarily be used to predict the target tissue in humans. In the hazard assessment of non-cancer effects however, the positive animal data often suggest the nature of the effects (i.e., the target tissues and type of effects) anticipated for humans.

Uncertainty in hazard assessment arises from the nature and quality of the toxicological information available as a result of both animal and human studies. Uncertainty is reduced when:

- Similar effects are observed across species, strain, sex, and exposure route:
- The magnitude of the response is clearly dose-related;
- Pharmacokinetic data indicate a similar fate in humans and animals;
- Postulated mechanisms of toxicity are similar for humans and animals; and
- The chemical of concern is structurally similar to other chemicals for which the toxicity is adequately characterized.

Uncertainty in the dose-response evaluation is associated with the determination of CSFs for the carcinogenic assessment and derivation of RfDs or RfCs for the non-carcinogenic assessment. Uncertainty introduced from inter-species (animal to human) extrapolation, which, in the absence of quantitative pharmacokinetic or mechanistic data, is usually based on consideration of inter-species differences in basal metabolic rate. Uncertainty also results from intra-species (i.e., variation within a species). Most toxicity experiments are performed with animals that are very similar in age and genotype so that intra-group biological variation is minimal, but the human population of concern may reflect a great deal of heterogeneity including unusual sensitivity or tolerance to the COPC. Even toxicity data from human occupational exposure reflect a bias because only those individuals sufficiently healthy to attend work regularly (the healthy worker effect) and those not unusually sensitive to the chemical are likely to be exposed to chemicals in the workplace. Finally, uncertainty arises from the quality of the key study from which the quantitative estimate (i.e., the CSF or the RfD) is derived and the supporting database of toxicity information. For cancer effects, the uncertainty associated with dose-response factors is somewhat mitigated by assuming the 95 percent upper bound for the slope factor. Another source of uncertainty in carcinogenic assessment is the method by which data from high doses in animal studies are extrapolated to the dose range expected for environmentally exposed humans. The linearized multistage model, which is used in most quantitative estimations of human risk from animal data, is based on a non-threshold assumption of carcinogenesis. Evidence suggests however, that epigenetic carcinogens, as well as many genotoxic carcinogens, have a threshold below which they are non-carcinogenic (Williams and Welsburger, 1991). Therefore, the use of the linearized multistage model is conservative for chemicals that exhibit a threshold for carcinogenicity.

For non-cancer effects, additional uncertainty factors are often applied in the derivation of RfDs or RfCs to compensate for poor quality data for key study group or gaps in the database. Uncertainty factors are usually applied to the estimate of a no-effects level when lowest-adverse-effect level data only are available. Additional uncertainty arises in estimation of RfDs or RfCs for chronic exposure from subchronic data. Unless empirical data indicate that effects do not worsen with increasing duration of exposure, an additional uncertainty factor is applied to the no-effect level in the subchronic study when deriving toxicity criteria for chronic exposure. Uncertainty in the derivation of RfDs is also addressed by the use of modifying factors that normally range between 3 and 10. The resulting combination of uncertainty and modifying factors are used proportionally to adjust the RfD downward and thereby intentionally often introduce a conservative bias in the RfD by a factor of 1,000 or more.

The derivation of dermal RfDs and CSFs from oral values may also cause uncertainty. This is particularly the case when no gastrointestinal absorption rates are available in the literature or when only qualitative statements regarding absorption are available.

### *6.6.3.2 Chromium Toxicity Criteria*

Some uncertainty is associated with the evaluation of chromium, which was assumed to be present in its hexavalent state. The estimated risks from chromium for the National Guard trainee exceeded 1 x $10^{-5}$ only because chromium was assumed to be present in the hexavalent form. Because hexavalent chromium is considered to be more toxic than trivalent chromium and the latter is more commonly found in the environment, risks for this chemical are probably over estimated.

#### *6.6.3.3 Toxicity Criteria for Arsenic*

The toxicity criteria for arsenic are a major source of uncertainty in this BHHRA. Although conventional risk assessment methods suggest that there is no “zero risk concentration” for a carcinogen such as arsenic, the human body does have a limited capacity to methylate arsenic, and this limit is not generally reached until the body’s intake of arsenic exceeds 500 µg per day. Most environmental exposures result in intakes lower than 500 µg per day. Additionally, the USEPA suggests that an order-of-magnitude adjustment of risk (downward) may be appropriate for arsenic in some cases (USEPA, 1987a).

#### *6.6.3.4 Toxicity Criteria for Aluminum*

A provisional RfD is available for aluminum (a COPC in soil and sediment) from the NCEA; however, it is based on typical allowable intakes rather than adverse effect levels and is not considered risk based. This is likely to be a significant source of uncertainty in the BHHRA because aluminum is a significant COPC for LL–9 (although the maximum detected concentration does not exceed the Region 9 residential PRG and the metal was detected infrequently at concentrations exceeding the RVAAP background benchmarks). Aluminum at the background soil concentrations would result in an HI of 17.

### 6.6.4 Uncertainties and Assumptions in the Risk Characterization

Uncertainty in risk characterization often results from the lack of toxicity criteria and from assumptions made regarding additive effects of exposure to multiple COPCs from various exposure routes. For example, high uncertainty exists when summing cancer risks for several substances across different exposure pathways. This assumes that each substance has a similar effect, mode of action, or both. Often compounds affect different organs, have different mechanisms of action, and differ in fate in the body; therefore, additivity may not be an appropriate assumption. However, the assumption of additivity is often made to produce a conservative estimate of risk. The risk characterization also does not consider antagonistic or synergistic effects of COPCs. Antagonistic effects (i.e., the toxic effect of a chemical is mitigated by the presence of another chemical) could mean the risk is overestimated, whereas synergistic effects (i.e., the toxic effect of a chemical is magnified by the presence of another chemical) could mean the risk is underestimated.

#### *6.6.4.1 Unavailable or Provisional Toxicity Criteria*

Risk-based screening levels and/or toxicity criteria are not available for nitrocellulose detected in LL–9 media. According to the USEPA Office of Drinking Water, nitrocellulose is essentially non-toxic (USEPA, 2000d).

#### *6.6.4.2 Foodstuffs Pathway*

As indicated in Section 6.5.2, there is a significant amount of uncertainty associated with the risk evaluation of the ingestion-of-foodstuffs exposure pathways discussed in the RVAAP FWHHRAM (i.e., ingestion of homegrown beef, milk, and vegetables). Frequently, risk estimates based on background concentrations of chemicals exceed risk benchmarks when these pathways are evaluated. However, conservatively, risk estimates were developed for the hypothetical future resident farmer assuming the receptor is routinely consuming homegrown beef and vegetables and consuming milk from dairy cattle raised on site. COPC concentrations in these media were modeled based on the COPC concentrations detected in surface soil at LL–9 and the equations presented in the RVAAP FWHHRA. The risk estimates are included in Appendix V (Tables 9.6, 9.7, and 9.8) and discussed in the following paragraphs.

Cancer risk estimates for the ingestion of beef, ingestion of milk, and ingestion of vegetables exposure pathways were $2 \times 10^{-4}$, $1 \times 10^{-3}$, and $3 \times 10^{-3}$, respectively. Chemical-specific risk estimates for carcinogenic COPCs selected for surface soil exceed $1 \times 10^{-5}$ in all cases presented in Appendix V, Table 9.7.

HIs developed for the adult resident farmer and child resident farmer exposed via the ingestion of beef, milk, and vegetables pathways are presented in Appendix V (Tables 9.5 and 9.6.) HIs calculated for the child resident farmer and adult resident farmer exceed 1 for aluminum, arsenic, chromium, and manganese in vegetables.

#### *6.6.4.3 Summation of Risk*

There are uncertainties concerning the summation of hazards and carcinogenic risk estimates across chemicals and pathways. These include the possibility of synergistic or antagonistic reactions and the varying levels of accuracy and precision of the RfDs or CSFs. In addition, the target organs for carcinogens may be different and therefore, summation of the risk may not be appropriate in all cases.

## 6.7 Remedial Goal Options

RGOs are developed for each direct-contact exposure COC (i.e., not for COCs identified for the foodstuff exposure pathways). The RGOs are risk-based concentrations that may be used in future risk-based decision making. RGOs are determined using the methods, equations, and parameters for determining COPC intake shown in Appendix V (Tables 4.1 through 4.32), as well as the CSFs and RfDs shown in Appendix V (Tables 5.1, 5.2, 6.1, and 6.2). The cancer risk (or hazard) equation was rearranged to determine (i.e., to solve for) the concentration that would result in a specified risk or hazard. As discussed in Section 6.5.1, the cancer risk estimate and non-cancer hazard indices are calculated as:

$$\text{Cancer Risk Estimate} = \text{Intake} \times \text{CSF}$$
$$\text{Hazard Index} = \text{Intake} / \text{RfD}$$

Therefore, for a specified risk or hazard, the allowable intake may be determined as follows:

$$\text{Intake} = \text{Cancer Risk Estimate} / \text{CSF}$$
$$\text{Intake} = \text{Hazard Index} \times \text{RfD}$$

The COPC intake equations shown in Appendix V, Tables 4.1 through 4.32, are then rearranged to determine the allowable concentration, or RGO, for a specified risk level (e.g., the RGO associated with the 1E-06 risk level).

RGOs are determined for each medium and land use/receptor scenario. For example, the RGO for arsenic in surface soil at the cancer risk level of 1E-04 for the National Guard trainee receptor is the concentration of arsenic that produces a risk of 1E-04 when using the exposure parameters specified for the National Guard trainee receptor, as shown in Appendix V, Table 4.1.

Direct-contact soil RGOs were not evaluated with regard to residual soil contaminants leaching to groundwater. This pathway is considered not to be a significant pathway, as discussed in Section 5.3.2.

For example, the ingestion of surface soil, the RGO is determined as:

$$Cs = \frac{TR \times BW \times AT}{IR \times FI \times ET \times EF \times ED \times (CSF \text{ or } 1/RfD)}$$

Where:

Cs = concentration in soil (RGO)
TR = target risk (or hazard)
BW = body weight
AT = averaging time
IR = ingestion rate of soil
FI = fraction ingested
ET = exposure time
EF = exposure frequency
ED = exposure duration
CSF = cancer slope factor
RfD = reference dose

Calculated RGOs that are not physically possible (i.e., the calculated value exceeds 1E+06 mg/kg) are adjusted accordingly. A concentration of 1E+06 indicates a 100% pure substance (i.e., 1,000,000 parts per million). RGOs are calculated for each exposure route (e.g., ingestion), as well as the total risk or hazard for each chemical identified as a COC in an environmental medium. Carcinogenic RGOs are calculated for risk levels of 1E-04, 1E-05, and 1E-06. Non-carcinogenic RGOs are calculated for hazard levels of 0.1 and 1.0.

The potential COCs identified for groundwater, subsurface soil, sediment, and surface soil are shown in Table 6–14. RGOs are calculated for all receptor/medium combinations that have been evaluated in this BHHRA. For example, although manganese is not a surface soil COC for the resident farmer receptor, surface soil RGOs for manganese are calculated for the resident farmer.

RGOs for the direct-contact exposure surface soil COC (arsenic) were calculated for all receptors and included in Table 6–15. RGOs for the subsurface soil COC (arsenic) were calculated for the National Guard resident trainer, and the resident farmer receptors and included in Table 6–16. RGOs for the direct-contact exposure for the National Guard trainee exposed to deep surface soil (0–4 ft bgs) are included in Table 6–17. RGOs for the groundwater COC were calculated for the National Guard trainee, the National Guard resident trainer, and the resident farmer receptors and included in Table 6–18. RGOs for the surface water COC were calculated for the National Guard trainee, the National Guard resident trainer, the hunter/trapper, and the resident farmer receptors and included in Table 6–19.

It should be noted that the COCs discussed in this section should only be considered potential COCs at this time. The final list of COCs for LL–9 will be determined in consultation with the risk management team for RVAAP.

## 6.8 Summary and Conclusions

This section summarizes the BHHRA and discusses conclusions drawn from the assessment.

### 6.8.1 Summary

A LL–9 BHHRA was performed using analytical data for groundwater, soil, sediment, and surface water collected from October through December 2003. The LL–9 BHHRA methods are based on the protocol established in the RVAAP FWHHRAM (USACE, 2004) and the *White Paper – Human Health Risk Assessment Approach for Load Lines 6, 9, and 11 Remedial Investigations, Ravenna Army Ammunition Plant, Ravenna, Ohio* (TtNUS, 2004).

Five human receptors were evaluated:

- Security Guard/Maintenance Worker;
- National Guard Trainee;

## Table 6-15
## Surface Soil (0-1 ft bgs) RGOs

| | Ingestion | | | | | Dermal | | | | | Inhalation | | | | | Total Across All Pathways | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COC | HQ = 0.1 | HQ = 1.0 | Risk = 10-6 | Risk = 10-5 | Risk = 10-4 | HQ = 0.1 | HQ = 1.0 | Risk = 10-6 | Risk = 10-5 | Risk = 10-4 | HQ = 0.1 | HQ = 1.0 | Risk = 10-6 | Risk = 10-5 | Risk = 10-4 | HQ = 0.1 | HQ = 1.0 | Risk = 10-6 | Risk = 10-5 | Risk = 10-4 |
| Security Guard/Maintenance Worker | | | | | | | | | | | | | | | | | | | | |
| Arsenic | 4.91E+02 | 4.91E+03 | 3.05E+01 | 3.05E+02 | 3.05E+03 | 4.42E+01 | 4.42E+02 | 2.75E+00 | 2.75E+01 | 2.75E+02 | | | 2.12E+04 | 2.12E+05 | 1.00E+06 | 4.06E+01 | 4.06E+02 | 2.52E+00 | 2.52E+01 | 2.52E+02 |
| Hunter/Trapper | | | | | | | | | | | | | | | | | | | | |
| Arsenic | 1.02E+04 | 1.02E+05 | 5.30E+02 | 5.30E+03 | 5.30E+04 | 7.47E+03 | 7.47E+04 | 3.87E+02 | 3.87E+03 | 3.87E+04 | | | 2.07E+05 | 1.00E+06 | 1.00E+06 | 4.32E+03 | 4.32E+04 | 2.24E+02 | 2.24E+03 | 2.24E+04 |
| National Guard Trainer | | | | | | | | | | | | | | | | | | | | |
| Arsenic | 3.04E+01 | 3.04E+02 | 1.89E+00 | 1.89E+01 | 1.89E+02 | 1.03E+02 | 1.03E+03 | 6.42E+00 | 6.42E+01 | 6.42E+02 | | | 5.73E+02 | 5.73E+03 | 5.73E+04 | 2.35E+01 | 2.35E+02 | 1.46E+00 | 1.46E+01 | 1.46E+02 |
| National Guard Fire Dust | | | | | | | | | | | | | | | | | | | | |
| Arsenic | 2.04E+03 | 2.04E+04 | 1.27E+02 | 1.27E+03 | 1.27E+04 | 1.72E+03 | 1.72E+04 | 1.07E+02 | 1.07E+03 | 1.07E+04 | | | 7.09E+01 | 7.09E+02 | 7.09E+03 | 9.34E+02 | 9.34E+03 | 3.20E+01 | 3.20E+02 | 3.20E+03 |
| Resident Child Farmer | | | | | | | | | | | | | | | | | | | | |
| Arsenic | 2.33E+00 | 2.33E+01 | | | | 3.56E+01 | 3.56E+02 | | | | | | | | | 2.18E+00 | 2.18E+01 | | | |
| Resident Adult Farmer | | | | | | | | | | | | | | | | | | | | |
| Arsenic | 2.17E+01 | 2.17E+02 | | | | 3.20E+01 | 3.20E+02 | | | | | | | | | 1.29E+01 | 1.29E+02 | | | |
| Resident Farmer | | | | | | | | | | | | | | | | | | | | |
| Arsenic | | | 3.93E-01 | 3.93E+00 | 3.93E+01 | | | 1.41E+00 | 1.41E+01 | 1.41E+02 | | | 3.54E+02 | 3.54E+03 | 3.54E+04 | | | 3.07E-01 | 3.07E+00 | 3.07E+01 |

RGO = Remedial Goal Option
COC = Chemical of Concern
HQ = Hazard Quotient
HI = Hazard Index
All units in mg/kg

# Table 6-16
# Subsurface Soil RGOs

| | Ingestion | | | | | Dermal | | | | | Inhalation | | | | | Total Across All Pathways | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COC | HQ = 0.1 | HQ = 1.0 | Risk = 10-6 | Risk = 10-5 | Risk = 10-4 | HQ = 0.1 | HQ = 1.0 | Risk = 10-6 | Risk = 10-5 | Risk = 10-4 | HQ = 0.1 | HQ = 1.0 | Risk = 10-6 | Risk = 10-5 | Risk = 10-4 | HQ = 0.1 | HQ = 1.0 | Risk = 10-6 | Risk = 10-5 | Risk = 10-4 |
| National Guard Trainer | | | | | | | | | | | | | | | | | | | | |
| Arsenic | 3.04E+01 | 3.04E+02 | 1.89E+00 | 1.89E+01 | 1.89E+02 | 1.03E+02 | 1.03E+03 | 6.42E+00 | 6.42E+01 | 6.42E+02 | | | 5.88E+02 | 5.88E+03 | 5.88E+04 | 2.35E+01 | 2.35E+02 | 1.46E+00 | 1.46E+01 | 1.46E+02 |
| Resident Child Farmer | | | | | | | | | | | | | | | | | | | | |
| Arsenic | 2.33E+00 | 2.33E+01 | | | | 3.56E+01 | 3.56E+02 | | | | | | | | | 2.18E+00 | 2.18E+01 | | | |
| Resident Adult Farmer | | | | | | | | | | | | | | | | | | | | |
| Arsenic | 2.17E+01 | 2.17E+02 | | | | 3.20E+01 | 3.20E+02 | | | | | | | | | 1.29E+01 | 1.29E+02 | | | |
| Resident Farmer | | | | | | | | | | | | | | | | | | | | |
| Arsenic | | | 3.93E-01 | 3.93E+00 | 3.93E+01 | | | 1.41E+00 | 1.41E+01 | 1.41E+02 | | | 3.54E+02 | 3.54E+03 | 3.54E+04 | | | 3.07E-01 | 3.07E+00 | 3.07E+01 |

RGO = Remedial Goal Option
COC = Chemical of Concern
HQ = Hazard Quotient
HI = Hazard Index
All units in mg/kg

# Table 6-17
## National Guard Trainee Deep Surface Soil (0-4 ft bgs) RGOs

| | Ingestion | | | | | Dermal | | | | | Inhalation | | | | | Total Across All Pathways | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COC | HQ = 0.1 | HQ = 1.0 | Risk = 10-6 | Risk = 10-5 | Risk = 10-4 | HQ = 0.1 | HQ = 1.0 | Risk = 10-6 | Risk = 10-5 | Risk = 10-4 | HQ = 0.1 | HQ = 1.0 | Risk = 10-6 | Risk = 10-5 | Risk = 10-4 | HQ = 0.1 | HQ = 1.0 | Risk = 10-6 | Risk = 10-5 | Risk = 10-4 |
| National Guard Trainee | | | | | | | | | | | | | | | | | | | | |
| Chromium | 1.95E+03 | 1.95E+04 | | | | 4.96E+03 | 4.96E+04 | | | | 6.98E+01 | 6.98E+02 | | | | 6.65E+01 | 6.65E+02 | | | |
| Manganese | 9.10E+04 | 9.10E+05 | | | | 3.71E+05 | 1.00E+06 | | | | 3.49E+01 | 3.49E+02 | | | | 3.49E+01 | 3.49E+02 | | | |

RGO = Remedial Goal Option
COC = Chemical of Concern
HQ = Hazard Quotient
HI = Hazard Index
All units in mg/kg

# Table 6-18
# Groundwater RGOs

| | Ingestion | | | | | Dermal | | | | | Inhalation | | | | | Total Across All Pathways | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COC | HQ = 0.1 | HQ = 1.0 | Risk = 10-6 | Risk = 10-5 | Risk = 10-4 | HQ = 0.1 | HQ = 1.0 | Risk = 10-6 | Risk = 10-5 | Risk = 10-4 | HQ = 0.1 | HQ = 1.0 | Risk = 10-6 | Risk = 10-5 | Risk = 10-4 | HQ = 0.1 | HQ = 1.0 | Risk = 10-6 | Risk = 10-5 | Risk = 10-4 |
| National Guard Trainee | | | | | | | | | | | | | | | | | | | | |
| Manganese | 1.53E+03 | 1.53E+04 | | | | 2.52E+04 | 2.52E+05 | | | | | | | | | 1.44E+03 | 1.44E+04 | | | |
| National Guard Trainer | | | | | | | | | | | | | | | | | | | | |
| Manganese | 2.38E+02 | 2.38E+03 | | | | 4.08E+03 | 4.08E+04 | | | | | | | | | 2.25E+02 | 2.25E+03 | | | |
| Resident Child Farmer | | | | | | | | | | | | | | | | | | | | |
| Manganese | 4.86E+01 | 4.86E+02 | | | | 1.36E+03 | 1.36E+04 | | | | | | | | | 4.69E+01 | 4.69E+02 | | | |
| Resident Adult Farmer | | | | | | | | | | | | | | | | | | | | |
| Manganese | 1.70E+02 | 1.70E+03 | | | | 2.91E+03 | 2.91E+04 | | | | | | | | | 1.61E+02 | 1.61E+03 | | | |
| Resident Farmer | | | | | | | | | | | | | | | | | | | | |
| Manganese | | | | | | | | | | | | | | | | | | | | |

RGO = Remedial Goal Option
COC = Chemical of Concern
HQ = Hazard Quotient
HI = Hazard Index
All units in ug/L

# Table 6-19
# Surface Water RGOs

| | Ingestion | | | | | Dermal | | | | | Inhalation | | | | | Total Across All Pathways | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COC | HQ = 0.1 | HQ = 1.0 | Risk = 10-6 | Risk = 10-5 | Risk = 10-4 | HQ = 0.1 | HQ = 1.0 | Risk = 10-6 | Risk = 10-5 | Risk = 10-4 | HQ = 0.1 | HQ = 1.0 | Risk = 10-6 | Risk = 10-5 | Risk = 10-4 | HQ = 0.1 | HQ = 1.0 | Risk = 10-6 | Risk = 10-5 | Risk = 10-4 |
| National Guard Trainee | | | | | | | | | | | | | | | | | | | | |
| Arsenic | 1.97E+02 | 1.97E+03 | 1.22E+01 | 1.22E+02 | 1.22E+03 | 3.10E+03 | 3.10E+04 | 1.90E+02 | 1.90E+03 | 1.90E+04 | | | | | | 1.85E+02 | 1.85E+03 | 1.15E+01 | 1.15E+02 | 1.15E+03 |
| National Guard Trainer | | | | | | | | | | | | | | | | | | | | |
| Arsenic | 3.07E+01 | 3.07E+02 | 1.91E+00 | 1.91E+01 | 1.91E+02 | 4.70E+02 | 4.70E+03 | 3.00E+01 | 3.00E+02 | 3.00E+03 | | | | | | 2.88E+01 | 2.88E+02 | 1.79E+00 | 1.79E+01 | 1.79E+02 |
| Hunter/Trapper/Fisher | | | | | | | | | | | | | | | | | | | | |
| Arsenic | 7.67E+03 | 7.67E+04 | 3.97E+02 | 3.97E+03 | 3.97E+04 | 3.80E+04 | 3.80E+05 | 2.00E+03 | 2.00E+04 | 2.00E+05 | | | | | | 6.38E+03 | 6.38E+04 | 3.32E+02 | 3.32E+03 | 3.32E+04 |
| Resident Child Farmer | | | | | | | | | | | | | | | | | | | | |
| Arsenic | 4.70E+00 | 4.70E+01 | | | | 1.07E+02 | 1.07E+03 | | | | | | | | | 4.50E+00 | 4.50E+01 | | | |
| Resident Adult Farmer | | | | | | | | | | | | | | | | | | | | |
| Arsenic | 2.20E+01 | 2.20E+02 | | | | 1.92E+02 | 1.92E+03 | | | | | | | | | 1.97E+01 | 1.97E+02 | | | |
| Resident Farmer | | | | | | | | | | | | | | | | | | | | |
| Arsenic | | | 5.88E-01 | 5.88E+00 | 5.88E+01 | | | 7.35E+00 | 7.35E+01 | 7.35E+02 | | | | | | | | 5.45E-01 | 5.45E+00 | 5.45E+01 |

RGO = Remedial Goal Option
COC = Chemical of Concern
HQ = Hazard Quotient
HI = Hazard Index
All units in ug/L

- National Guard resident trainer;
- Hunter/Trapper; and
- Hypothetical Future Resident Farmer (adult and child).

The National Guard trainee is an important receptor because it is anticipated that the LL–9 area will be used by OHARNG for training activities described in the FWHHRAM as *“Mounted Training by Ohio National Guard Soldiers – No Digging Allowed.”* The planned training activities would involve potential exposure to soils (no deeper than 4 ft bgs), as well as to the other environmental media, at LL–9. The hunter/trapper receptor is an important receptor because a long-term goal for RVAAP is to be able to hunt, fish, and trap anywhere suitable habitat exists for recreational fishing and hunting. (Please note that fishing does not currently occur at LL–9.) The National Guard resident and the hypothetical future resident farmer are included in the BHHRA for purposes of completeness and because risk estimates for these receptors may be useful to the RVAAP risk managers. For example, the need for deed restrictions at LL–9 may be eliminated if no unacceptable risk was determined by the BHHRA for these receptors. The security guard/maintenance receptor is included because of the routine activities (e.g., security patrols) currently occurring by personnel who visit the site for short periods of time.

The following chemicals were selected as COPCs for quantitative human health risk assessment:

| ***Soils*** | ***Groundwater*** | ***Surface Waters*** | ***Sediment*** |
|---|---|---|---|
| Aluminum | Antimony | Aluminum | Aluminum |
| Arsenic | Manganese | Arsenic | Mercury |
| Benzo(a)pyrene | | Chromium | Vanadium |
| Chromium | | Lead | |
| Copper | | Manganese | |
| Dibenzo(a,h)anthracene | | Mercury | |
| Lead | | Vanadium | |
| Manganese | | | |
| Mercury | | | |

These COPCs were selected based on chemical concentrations detected in the environmental media at LL–9. The COPC selection protocol included a conservative toxicity screen (based on the Region 9 residential PRGs) and a background screen. The following should be considered when evaluating this list of COPCs:

- Only 1 manganese detection of 5 samples in groundwater exceeded the background benchmark for RVAAP.

- Only 2 detections of manganese of 85 samples in deep surface soil exceeded their respective background benchmarks for RVAAP. The EPC in deep surface soil (634 mg/kg) did not exceed RVAAP background (1,450 mg/kg)
- The benzo(a)pyrene concentrations detected in soils are similar to anthropogenic background concentrations and concentrations reported for background soil samples collected at RVAAP.
- Maximum arsenic concentrations detected in environmental media at LL–9 exceeded background benchmarks established for RIs at RVAAP (10 out of 46 surface soil samples and 5 out of 49 subsurface soil samples). The EPC of arsenic in surface soil (13.8 mg/kg), and in deep surface soil (13 mg/kg) are less than their respective background concentrations (19.8 mg/kg, and 15.4 mg/kg). The historical, widespread application of arsenic-based herbicides across many areas of the United States may have contributed to the concentrations detected in soils. Also, the arsenic concentrations detected at LL–9 are within background concentrations reported by the USEPA (1987a).

A summary of the risk characterization for LL–9 is presented in Table 6–11 and in the following items:

- Non-cancer risk estimates (HIs) developed for the security guard/maintenance worker and the hunter/trapper are less than 1, indicating that adverse non-carcinogenic effects are not anticipated under the exposure conditions considered in the risk assessment. The cancer risk estimates for the security guard/maintenance worker do not exceed 1E-05 and for the hunter/trapper do not exceed 1E-06. No potential COCs are identified for these receptors.
- The HIs calculated for the National Guard trainee receptor exposed to COPCs in groundwater, sediments, and surface water do not exceed 1. The HI for the National Guard trainee exposed to COPCs in deep surface soils (0–4 ft bgs) is 2. Manganese (inhalation of air particulates being the route of exposure) was the significant contributor to the non-carcinogenic risk (i.e., risk driver) for the National Guard trainee. The estimates for inhalation of manganese in deep surface soil are strongly affected by the PEF specified for the National Guard trainee receptor in the RVAAP FWHHRAM. This PEF is further discussed in Section 6.6. Manganese at a concentration equal to RVAAP background would result in an HI of 4, and at a concentration equal to its Region 9 residential PRG would result in an HI of 5. The EPC for manganese in deep surface soil (633 mg/kg) did not exceed RVAAP background (1,450 mg/kg).
- The total cancer risk estimate for National Guard trainee exposure to all media (2E-05) is within the USEPA target cancer risk range (1E-04 to 1E-06) but exceeds the Ohio EPA benchmark of 1E-05. Inhalation of arsenic and chromium in deep surface soil account

for 1E-05, or 82%, of the total cancer risk estimate for the National Guard trainee. The estimates for inhalation in deep surface soil are strongly affected by the PEF specified for the National Guard trainee receptor in the RVAAP FWHHRAM. This PEF is further discussed in Section 6.6.The EPCs of arsenic (13 mg/kg) and chromium (17 mg/kg) in deep surface soil do not exceed their respective RVAAP background values of 15.4 mg/kg and 17.4 mg/kg.

- The total HI for the National Guard resident trainer is 2. The HI calculated for receptor exposure to groundwater is 1. The HI for exposure to all other media (not including groundwater) combined is 0.4. Manganese in groundwater is the only chemical identified as a potential COC.
- The total cancer risk estimate for the National Guard resident trainer, (2E-05) is within the EPA target risk range of 1E-04 to 1E-06 but exceeded the Ohio EPA cancer risk benchmark of 1E-05. No risk estimates developed for individual COPCs exceed 1E-05. The cancer risk estimate for surface water is 6E-06. Arsenic is a potential COC for subsurface soil. The EPC of arsenic in subsurface soil (13.8 mg/kg) is less than its background concentration of 19.8 mg/kg.
- The total HI calculated for the adult resident farmer routinely exposed to COPCs in surface soil, surface water, sediment, and groundwater, or routinely exposed to COPCs in subsurface soil, surface water, sediment, and groundwater via the direct-contact pathways, exceed 1 only when it is assumed that the shallow groundwater is used for domestic purposes. Manganese in groundwater is the only risk driver. The HIs calculated for the adult resident farmer routinely exposed via indirect exposure pathways (i.e., consumption of foodstuffs) and also presented in Appendix V, Table 9.6, exceeded 1 for vegetable consumption only. Aluminum, arsenic, chromium, and manganese are potential COCs for the ingestion of vegetables. However, the food chain modeling used to characterize risk is very conservative. HIs calculated for the resident farmer exposed to these metals at site background concentrations would exceed 1.
- The total HI calculated for the child resident farmer routinely exposed to COPCs in surface soil, sediment, surface water, and groundwater, or routinely exposed to COPCs in subsurface soil, sediment, surface water, and groundwater via the direct-contact exposure pathways, exceed 1. The HIs calculated for the COPCs in groundwater and surface water exceed 1. The HIs calculated for sediments and subsurface soils do not exceed 1. Arsenic and manganese are the primary risk drivers; HIs calculated for other COPCs evaluated do not exceed 1. The target-organ-specific HI calculated for the skin and cardiovascular system (the target organs for arsenic) and the central nervous system (the target system for manganese) exceed 1. The HIs calculated for the child resident farmer routinely exposed via indirect exposure pathways (i.e., consumption of foodstuffs) also presented in Appendix V, Table 9.5, do exceed 1 for vegetable and milk consumption. Aluminum, arsenic, chromium, and manganese are potential COCs for

the ingestion of vegetables. However, the food chain modeling used to characterize risk is very conservative. HIs calculated for the resident farmer exposed to these metals at site background concentrations would exceed 1.

- The ILCR estimates for the hypothetical future resident farmer are 5E-05, 5E-05, and 2E-05 for direct-contact exposure pathways for surface soil, subsurface soil, and surface water, respectively. The total cancer risk for the direct-contact exposure pathways did not exceed 1E-04 when surface soil and subsurface soil risks were considered separately. Arsenic in soils is identified as a potential COC for the direct-contact exposure pathway. The cancer risk estimates calculated for the indirect exposure pathways (i.e., consumption of beef, milk, and vegetables raised on site) exceed 1E-04. Benzo(a)pyrene, dibenzo(a,h)anthracene, and arsenic are identified as potential COCs for foodstuff consumption. However, the uncertainties highlighted in the previous items are also relevant for the risk estimates presented for the future hypothetical resident farmer.
- Maximum detected concentrations of surface soil and deep surface soil COPCs copper (1240 mg/kg), lead (1330 mg/kg), and mercury (882 mg/kg) were at sample location LL9SS–011–0001–SO. The next-highest detected concentrations were much lower (copper [170 mg/kg], lead [320 mg/kg], and mercury [17 mg/kg]). This sample location may be of concern when making risk decisions, particularly for exposure to mercury.

Table 6–11 presents a summary of all receptors evaluated in this BHHRA and identifies the contaminants that produce risks greater than 1E-06, 1E-05, and 1E-04 or hazards greater than 1.0.

### 6.8.2 Conclusions

The total cancer risk estimate of 2E-05 (summarized for each receptor and each media) for the primary receptor of concern (the National Guard trainee) is within the USEPA target cancer risk range (1E-04 to 1E-06), but exceeds the Ohio EPA benchmark of 1E-05. The cancer risk estimates developed for inhalation of arsenic and chromium in deep surface soils exceed 1E-06, but not 1E-05. The total non-cancer risk (HI) estimate (summarized for each receptor and each media) equals 3. Manganese (inhalation of air particulates being the route of exposure) was the significant contributor to the non-carcinogenic risk. However, as discussed in the preceding narrative, significant uncertainties were identified for the risk estimates for arsenic, manganese, and chromium in soils and for the inhalation pathway; these should be considered by the risk management team for RVAAP when making further remedial decisions for LL–9. Manganese at background would result in an HI of 4, and at its Region 9 residential PRG would result in an HI of 5.

HIs calculated for the security guard/maintenance worker and the hunter/trapper are less than 1, and total cancer risk estimates for the same receptors do not exceed the Ohio EPA cancer risk benchmark of 1E-05.

The total cancer risk estimate (summarized for each receptor and each media) for the National Guard resident trainer exceeds 1E-05. The total HI (summarized for each receptor and each media) for the National Guard resident trainer exceeds 1.0 for the future domestic use of the shallow groundwater resource. HIs for all other media for the National Guard resident trainer do not exceed 1. As noted above, significant uncertainties were identified for the risk estimates for manganese in groundwater and arsenic in soils and should be considered by the risk management team for RVAAP when making further remedial decisions for LL–9.

The total cancer risk estimate (summarized for each receptor and each media) for the hypothetical future resident farmer exposed by the direct contact exposure pathways did not exceed 1E-04 when surface soil and subsurface soil risks were considered separately. Cancer risk estimates for soils evaluated for the direct-contact exposure pathways exceed 1E-05 but do not exceed 1E-04. Total non-cancer risk estimates (HI) calculated on a target-organ-specific basis exceed 1 only when future domestic use of the shallow groundwater resource is evaluated for the adult farmer. For the child farmer, total HI calculated on a target-organ-specific basis exceed 1 when future domestic use of the shallow groundwater resource is evaluated and exceed 1 for arsenic’s target organs when direct exposure to media other than groundwater are evaluated and only if the HIs for surface soil and subsurface soil are combined. However, cancer and non-cancer risk estimates developed for the indirect exposure pathways (i.e., consumption of home grown food stuffs) exceed both cancer and non-cancer risk benchmarks (i.e., 1E-04 and HI = 1, respectively) for consumption of foodstuffs. Significant uncertainties were identified for the risk estimates for manganese in groundwater and for the evaluation of the indirect exposure pathways, and these should be considered by the risk management team for RVAAP when making further remedial decisions for LL–9.

# 7.0 SCREENING-LEVEL ECOLOGICAL RISK ASSESSMENT

## 7.1 Introduction

The goal of this SERA is to determine whether potential ecological impacts are present as a result of exposure to chemicals released to the environment through past site operations at RVAAP LL9. This SERA provides information to scientists and managers that will enable them to conclude either that ecological risks at the site are most likely negligible or that further information is necessary to evaluate potential ecological risks at the site. The SERA methodology follows the guidance presented in the RVAAP *Facility – Wide Ecological Risk Work Plan* (USACE, 2003) and *Guidance for Conducting Ecological Risk Assessments* (Ohio EPA, 2003).

The ERA process consists of the following eight steps that are required by the RVAAP, Ohio EPA, and USEPA for any ecological risk assessment:

- Step 1 – Screening-Level Problem Formulation and Ecological Effects Evaluation
- Step 2 – Screening-Level Exposure Estimate and Risk calculation
- Step 3 – Baseline Risk Assessment Problem Formulation
- Step 4 – Study Design and Data Quality Objective Process
- Step 5 – Filed Verification of Sampling design
- Step 6 – Site Investigation and Analysis Phase
- Step 7 – Risk Characterization
- Step 8 – Risk Management

A SERA typically consists of Steps 1 and 2 and a Baseline Ecological Risk Assessment (BERA) consists of Steps 3 through 7. Step 8, Risk Management, is a distinctly different process from risk assessment. In risk management, the results of the risk assessment are integrated with other considerations to make and justify risk management decisions (USEPA, 1997). This SERA for RVAAP LL9 consists of Steps 1 and 2, along with the first part of Step 3, which is termed Step 3a. Step 3a considers factors other than comparisons of chemical concentrations to screening levels to further refine the list of COPCs (see Section 7.6 for more details). The remaining steps (the rest of Step 3 through Step 7) are conducted only if additional evaluations or investigations are necessary; these steps were not conducted as part of this report. A decision to proceed to a BERA is usually only made after the results of the SERA are evaluated.

## 7.2 Preliminary Problem Formulation

Problem formulation is the first step of the SERA and includes identification of potential receptor groups, potential contaminants, and the mechanisms for contaminant fate and transport and toxicity. Determination of the complete exposure pathways that exist at a site is accomplished at this point to facilitate proper receptor selection. Site habitats, exposure pathways, and potential ecological receptors are identified as part of the problem formulation. This information, which is gathered from the field investigation and site visits, is used to focus the SERA on the primary chemicals, receptors, and exposure pathways at the site.

### 7.2.1 Habitat Types and Ecological Receptors

The LL9 site consists of open field habitat with grasses, weeds, and small shrubs (approximately 70% of the site). There are some isolated pockets of mature trees as well (approximately 30% of the site). A visual approximation of the habitat was obtained from the aerial photograph provided in Appendix C. The area surrounding LL9 consists of early successional tree species, as well as trees 15–20 ft tall and woody shrubs. Shallow man-made ditches drain the site, but contain water only during rain events of approximately 1 in or greater based on site observations. However, the amount of rain required to cause the ditches to contain water depends upon various factors such as the dryness of the soil, soil type and frequency of rain events. As can be seen in the photographs in Appendix C, surface water sample locations LL9SW–001–SW, LL9SW–003–SW, LL9SW–004–SW, and LL9SW–005–SW appear to be intermittent drainage ditches with no aquatic habitat, while aquatic receptors may be present at locations LL9SW–002–SW and LL9SW–012–SW. Note that no aquatic plants were present at any of the locations. This could indicate that the ditches do not contain water for significant periods of time. Although all of the surface water and associated sediment samples will be evaluated as aquatic habitat because of the potential for contaminants to migrate downstream where aquatic receptors may be more prevalent, the uncertainties in this evaluation at locations where water is only present during rain events are discussed in the uncertainty analysis section of this SERA (Sections 7.8.2 and 7.8.4). Section 2.8 presents the general ecology for RVAAP. Based on the ecology, and the environmental setting at LL9, it is likely that LL9 is occupied by a variety of mammal and avian receptors. Field observations from a site visit on February 13, 2001 identified crows (*Corvus* sp.), hawks (*Buteo* sp.), bluebirds (*Sialia sialis)*, blue jays (*Cyanocitta cristata)*, white-tailed deer (*Odocoileus virginianus)*, and owls (Tytonidae and/or Strigidae famlies) (from pellets).

### 7.2.2 Major Chemical Sources and Migration Pathways

LL9 was used as a detonator processing facility. Fulminate, azide, and tetryl mixing and processing activities were conducted in various buildings at LL9 to support detonator manufacturing processes.

Based on historical site data and sampling, the following parameters are among the site-related chemical contaminants that were detected at LL9. Note that not all the chemicals mentioned in the following bullets were detected or analyzed for in each sample. Figure 7-1 presents a conceptual site model (CSM) that shows the major migration pathways that could occur at the site.

- Explosives (surface soil);
- Metals (surface soil, sediment, and surface water); and
- Semi-volatile organic compounds (SVOCs) (surface soil and sediment).

The results of the surface soil, surface water, and sediment sampling are included in earlier sections of this report. Physical and chemical characteristics of contaminants may affect their mobility, transport, and bioavailability in the environment. These characteristics include the organic carbon partition coefficient, octanol water partition coefficient, and vapor pressure. Table 5-1 presents the physical and chemical characteristics for the chemicals detected at LL9. The fate and transport of these chemicals is discussed in detail in Section 5.0. Although these physical and chemical characteristics were not used directly in this SERA, many of the characteristics were used to develop some of the values that were used in this SERA. For example, $K_{ow}$ values were used to determine some of the biotransfer factors in Appendix W. Also, some of the sediment screening values are based on equilibrium partitioning which utilizes the $K_{oc}$ of the chemical.

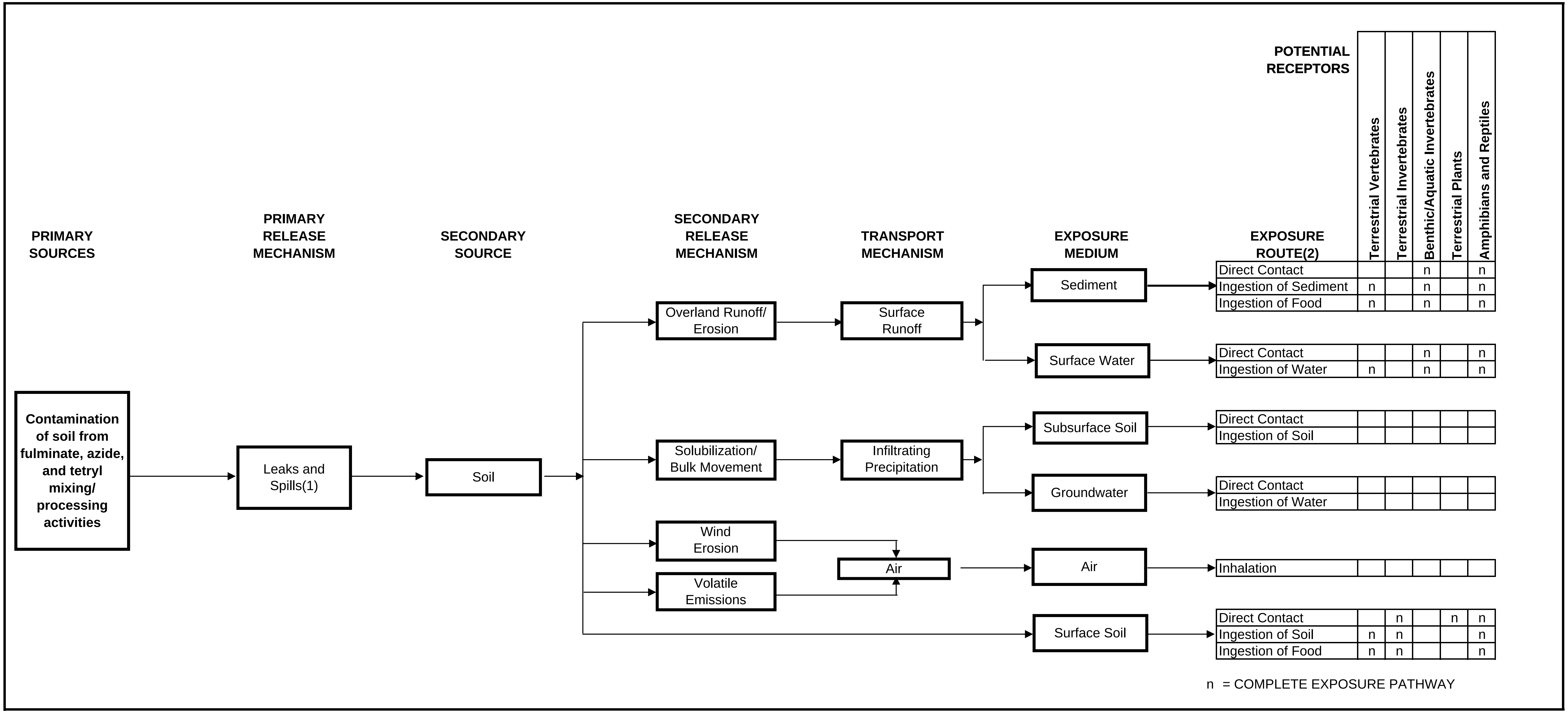
Various bioaccumulation factors (BAFs) and/or bioconcentration factors (BCFs) were used to estimate contaminant loading in plants and soil invertebrates from chemical concentrations in LL 9 surface soil. For soil to plant uptake, two separate BAFs are used to predict the biological transfer of contaminants from soil to vegetative (foliage) or reproductive (berries) and storage (roots) plant parts (Baes et al, 1984; Travis and Arms, 1988). Additional transfer factors include soil to animal (i.e., earthworm) and animal to animal (i.e., earthworm to shrew). Factors were from the RVAAP *Facility-Wide Ecological Risk Guidance* (USACE, 2003). Contaminants that do not have BAFs are assigned a default value of 1. Appendix W presents two tables with the transfer factors for soil to plant, soil to animal, and animal to animal.

### 7.2.3 Exposure Routes

The potential pathways by which ecological receptors may be exposed to COPCs were identified, along with the species that could be adversely affected by these chemicals. Several potential exposure pathways may exist. For example, terrestrial animals may be exposed to soil contaminants through ingestion of contaminated food items. Animals can also incidentally ingest soil while grooming fur, preening feathers, digging, grazing close to the soil, or feeding on items to which soil has adhered (such as roots and tubers). Terrestrial vegetation may be exposed to contaminants via direct aerial deposition and root translocation. Terrestrial animal receptors may also come into contact with contaminants in surface water by drinking the water,

## FIGURE 7-1

## Ecological Conceptual Site Model



| Exposure Medium | Exposure Route(2) | Terrestrial Vertebrates | Terrestrial Invertebrates | Benthic/Aquatic Invertebrates | Terrestrial Plants | Amphibians and Reptiles |
|---|---|---|---|---|---|---|
| Sediment | Direct Contact | | | n | | n |
| | Ingestion of Sediment | n | | n | | n |
| | Ingestion of Food | n | | n | | n |
| Surface Water | Direct Contact | | | n | | n |
| | Ingestion of Water | n | | n | | n |
| Subsurface Soil | Direct Contact | | | | | |
| | Ingestion of Soil | | | | | |
| Groundwater | Direct Contact | | | | | |
| | Ingestion of Water | | | | | |
| Air | Inhalation | | | | | |
| Surface Soil | Direct Contact | | n | | n | n |
| | Ingestion of Soil | n | n | | | n |
| | Ingestion of Food | n | n | | | n |

n = COMPLETE EXPOSURE PATHWAY

1. Leaks and spills from explosives processing activities
2. Blank space indicates incomplete exposure pathway or relatively insignificant or not applicable potential exposure.

although this exposure route typically represents a negligible portion of total exposure for most terrestrial receptors because of the relatively low contaminant concentrations in surface water as compared to other media.  Aquatic and semi-aquatic organisms may be exposed to contaminants via direct contact with surface water and sediments, incidental ingestion of surface water and sediments, and consumption of contaminated food items.  Aquatic and semi-aquatic organisms may also be exposed to constituents from contaminated groundwater that flows into surface water.

#### *7.2.3.1 Surface Soil*

Several groups of terrestrial ecological receptors can be exposed to contaminants in the soil (0–4 ft), although most of the exposure is expected to occur in the top 1 ft.  Invertebrates, such as earthworms, are exposed to the contaminants as they move through the soil and ingest soil particles while searching for food.  Plants are exposed to the contaminants via direct contact as contaminants are absorbed through the roots, which may then translocate to different parts of the plants (i.e., leaves, seeds).

Small mammals may be exposed to contaminants in the soil via several exposure routes.  They may be exposed by direct contact as they search for food or burrow into the soil.  However, exposure of terrestrial wildlife to contaminants in the soil via dermal contact is unlikely to represent a major exposure pathway because fur, feathers, and chitinous exoskeletons are expected to minimize transfer of contaminants across dermal tissue.  The exposure of animals to constituents in soil by dermal contact is likely to be a small fraction of the direct exposure to constituents in soil by incidental ingestion and the indirect exposure by ingestion of contaminated biota. It is true that for amphibians and reptiles, the dermal pathway may be more important.  However, there currently are no standard methods for evaluating risks to amphibians and reptiles from dermal exposure to chemicals in soil.  Therefore, the dermal pathway is not evaluated in this SERA.  Small mammals also may be exposed to contaminants in the soil via incidental ingestion of soil and ingestion of plants and/or invertebrates that have accumulated contaminants from the soil.  The soil and food ingestion pathways are evaluated in this SERA.

Larger predatory species, such as the red fox (*Vulpes vulpes*), barn owl (*Tyto alba*) and red-tailed hawk (*Buteo jamaicensis*), can be exposed (indirectly) to site contaminants in the soil by ingesting small mammals that have accumulated contaminants from the soil.  The small mammal ingestion pathway is evaluated in this SERA.

#### *7.2.3.2 Groundwater*

Ecological receptors are not directly exposed to contaminants in the groundwater, so this exposure pathway is not complete.  According to USACE (2003d), because groundwater is more than 2 ft deep, it does not need to be evaluated as surface water.

#### *7.2.3.3 Surface Water/Sediment*

Contaminants in the soil may enter the drainage ditches via overland flow. The water bodies immediately adjacent to the LL–9 buildings are small drainage ditches that have poor ecological habitat and probably only support a small invertebrate population. Aquatic receptors could be exposed to contaminants in the water or sediment by direct contact and incidental ingestion of water. Because habitat is not present that would support a fish population, piscivorous wildlife were not evaluated in the SERA.

#### *7.2.3.4 Air*

Although inhalation of particulates may be a complete pathway, it is expected to be insignificant compared to other pathways such as ingestion of food items that have accumulated contaminants from soil. Also, inhalation pathways are typically not evaluated in SERAs because of the uncertainty in exposures and effects concentrations. The exposure of animals to constituents in soil by inhalation is likely to be a small fraction of the direct exposure to constituents in soil by incidental ingestion and the indirect exposure by ingestion of contaminated biota. It is true that for amphibians and reptiles, the inhalation pathway may be more important. However, there currently are no standard methods for evaluating risks to amphibians and reptiles from inhalation exposure to chemicals in soil. Therefore, this pathway was not evaluated.

### 7.2.4 Preliminary Assessment and Measurement Endpoints

One of the major tasks in the screening-level problem formulation is the selection of assessment and measurement endpoints.

#### *7.2.4.1 Assessment Endpoints*

Assessment endpoints are explicit expressions of the environmental value that is to be protected (USEPA, 1997). The selection of these endpoints is based on the habitats present, the migration pathways of probable contaminants, and the routes that contaminants may take to reach receptors.

The habitat at and adjacent to the site consists of forested areas, open fields with grasses, and drainage ways that contain water only during rain events. For this SERA, the assessment endpoints are the protection of the following groups of receptors from adverse effects of contaminants on their growth, survival, and reproduction (note that although toxicity data may not be available for all of the potential effects for each receptor group, it is assumed that the toxicity data from one endpoint will be sufficiently protective of the other endpoints):

- Soil invertebrates;

- Terrestrial vegetation;
- Herbivorous mammals;
- Invertivorous birds and mammals;
- Carnivorous birds and mammals; and
- Aquatic organisms and benthic invertebrates.

The following paragraphs discuss why the above receptors are selected for this SERA:

Soil Invertebrates – Soil invertebrates are expected to be present in the soil at the site. They aid in the formation of soil and redistribution and decomposition of organic matter in the soil and serve as a food source for higher trophic level organisms. They also can accumulate some contaminants that can then be transferred to the higher trophic level organisms that consume invertebrates.

Terrestrial Vegetation – Terrestrial vegetation at the site consists of grasses, shrubs, and trees. These serve as a food source, provide shade and cover for many organisms, and help prevent soil erosion, among other important functions. They also can accumulate some contaminants that can then be transferred to higher trophic level organisms that consume plants.

Herbivorous Mammals – Herbivorous mammals (animals that consume only plant tissue) may be present at the site because of the vegetative habitats. Their role in the community is essential because, without them, higher trophic levels could not exist. They may be exposed to and accumulate contaminants that are present in the plants they consume.

Invertivorous Birds and Mammals – Birds and mammals that eat soil invertebrates (invertivores) are present throughout RVAAP in different terrestrial habitats (i.e., forested, open field). These are considered first-level carnivores, and they serve as a food source for higher trophic level carnivores. The invertivores may be exposed to and accumulate contaminants that are present in the food items they consume.

Carnivorous Birds and Mammals – Carnivorous birds and mammals consist of birds and mammals that consume invertebrates, fish, and other mammals and birds. Carnivorous birds and mammals that feed on other birds and mammals are at the top of the food chain. The top carnivores typically are less densely distributed than the herbivores and first-level carnivores because they require a larger area to hunt for their food. Carnivores may accumulate contaminants that are present in the food items they consume.

Aquatic Organisms and Benthic Macroinvertebrates – Aquatic organisms and benthic macroinvertebrates are similar to the soil invertebrates in that they serve as a food source for higher trophic level organisms (i.e., fish, amphibians, birds, mammals). They may also accumulate some contaminants that can then be transferred to the higher trophic level organisms that consume them. Based on the poor aquatic habitat at the site, and because the drainage ditches are wet only during and after rain events, it is not likely that significant populations of aquatic organisms or benthic invertebrates exist at the site.

All of the potential receptors are not evaluated in the SERA. As indicated in USEPA guidance (1997), "It is not practical or possible to directly evaluate risks to all of the individual components of the ecosystem at a site. Instead, the receptors included in the risk assessment focus on particular components of the ecosystem that could be adversely affected by contaminants from the site." Therefore, the SERA focuses on the receptors that have the greatest exposure and greatest likelihood of being impacted by site contaminants, which should then account for receptors with lower exposures. For example, to be conservative, large carnivorous mammals (i.e., red fox) and birds (i.e., barn owl and red-tailed hawk) are evaluated in this SERA, although the area of LL9 is small (69 acres) and less than the typical home and feeding ranges of carnivorous animals. The greatest exposure to site contaminants is expected to occur to the small mammals and birds that ingest earthworms or plants. Also, omnivores were not selected as assessment endpoints because exposure to contaminants in plants is greatest for herbivores and exposure to contaminants in animals is greatest for insectivores. Therefore, omnivores were protected by protecting herbivores and insectivores."

The assessment endpoints presented in this section are evaluated using various measurement endpoints as described in the next section. For example, the assessment endpoint "Protection of soil invertebrates from adverse effects of contaminants on their growth, survival, and reproduction" is evaluated using the measurement endpoint in the first bullet in Section 7.2.4.2. Note that at this screening step in the ERA process, the assessment and measurement endpoints are relatively general in nature. However, should the site progress further into a BERA, the assessment and measurement endpoints would become more specific.

#### *7.2.4.2 Measurement Endpoints*

Measurement endpoints are estimates of biological impacts (e.g., mortality and reduction in growth or reproduction) that are used to evaluate the assessment endpoints. The following measures of effects are used to evaluate the assessment endpoints in this SERA, where applicable.

- Soil screening values – Mortality, growth, and reproduction of plants and soil invertebrates are evaluated by comparing the measured concentrations of chemicals in the surface soil to screening values designed to be protective of ecological receptors.

- No-observed-adverse effects levels (NOAELs) for surrogate wildlife species – Mortality, reproductive, and/or developmental effects of birds and mammals are evaluated by comparing the estimated ingested dose from contaminants in the surface water, sediment, surface soil, plants, and/or invertebrates to these levels.

- Sediment screening values – Mortality and other adverse effects (e.g., growth, feeding rates, and behavioral changes) of benthic macroinvertebrates are evaluated by comparing the measured concentrations of chemicals in the sediment to screening values designed to be protective of ecological receptors.

- Surface water screening values – Mortality and other adverse effects (e.g., growth, feeding rates, and behavioral changes) of aquatic organisms are evaluated by comparing the measured concentrations of chemicals in the surface water to screening values designed to be protective of ecological receptors.

### 7.2.5 Selection of Receptor Species for Food Chain Model

To address potential effects to wildlife via food chain modeling (see Section 7.5.5), several species of vertebrates were selected to be evaluated in this SERA. The dietary exposure (dose of contaminants from ingesting and drinking) of these receptors was estimated and then compared to effect levels (threshold values that, if exceeded, may elicit an effect).

For most receptor species, ingestion is the primary route of exposure. Representative species are selected for their preferred habitat, body size, sensitivity, home range, abundance, commercial or sport value, legal status, and functional role (e.g., predators). For conservativeness, representative species may be small and have small home ranges. The availability of exposure parameters, such as body mass, feeding rate, and drinking rate, may also be a factor in selecting representative species. The following representative species are used for the food chain modeling:

- Herbivorous mammal: meadow vole (*Microtus pennsylvanicus*);
- Invertivorous mammal: short-tail shrew (*Blarina brevicauda*);
- Invertivorous bird: American robin (*Turdis migratorius*);
- Carnivorous bird: barn owl and red-tailed hawk; and
- Carnivorous mammals: red fox.

## 7.3 Preliminary Ecological Effects Evaluation

The preliminary ecological effects evaluation is an investigation of the relationship between the magnitude of exposure to a chemical and the nature and magnitude of adverse effects resulting from exposure. As the first step in the ecological effects evaluation, COPCs screening-level risk calculations are used to compare the conservative exposure estimate to ecological effect values estimated by ESVs. A hierarchy of ESVs has been specified by Ohio EPA and RVAAP (Ohio EPA, 2003; USACE, 2003). The first available screening value is used in the hierarchy, regardless of whether it may be greater or lesser than other screening values.

Surface water chemical concentrations are compared to chemical criteria using a surface water hierarchy of: (1) outside mixing zone maximum (OMZM) criteria for the protection of aquatic life in the Lake Erie Basin from Ohio administrative Codes (OAC) 3745–1 (Ohio EPA, 2004) and (2) USEPA ambient water quality criteria (AWQC) (USEPA, 2002).

Sediment concentrations are screened using the site-specific background concentrations and Ohio-specific sediment reference values (SRVs) (Appendix H in Ohio EPA, 2003), then using a sediment screening hierarchy of: (1) consensus-based threshold effect concentrations (TECs) (MacDonald et al., 2000) and (2) Region 5 ecological data quality levels (EDQLs) (USEPA Region 5, 1999).

Soil concentrations are screened using the site-specific background concentrations, then using a soil screening value hierarchy in the order given in the guidance, as follows: (1) PRGs (Efroymson et al., 1997a); (2) toxicological benchmarks for soil and litter invertebrates (Efroymson et al., 1997b); (3) toxicological benchmarks for terrestrial plants (Efroymson et al., 1997c); and (4) Region 5 EDQLs (USEPA Region 5, 1999).

Although the EDQLs have since been updated by the ecological screening levels (ESLs) (USEPA, 2003a), they were not used as soil or sediment screening levels, based on e-mail correspondence from Laurie Moore of the Ohio EPA on December 17, 2004.

## 7.4 Preliminary Risk Calculation and Selection of COPC

This initial selection of COPCs uses conservative assumptions to eliminate chemicals detected during the remedial investigation at concentrations below those levels reported in the literature to cause adverse effects on growth, survival, or reproduction. This process involves the combination of a preliminary exposure estimate with a preliminary risk calculation.

The first step in selecting initial COPCs is to select a conservative EPC for comparison with background and ESVs. The maximum concentration is used as the initial EPC for comparison to the ESV. The ratio of the initial EPC to the ESV is called a hazard quotient (HQ) and is defined as follows:

$$HQ_I = EPC_I / ESV_I$$

Where: $HQ_I$ = hazard quotient for analyte “I” (unitless)
$EPC_I$ = exposure point concentration for analyte “I” (mg/L or mg/kg)
$ESV_I$ = ecological screening value for analyte “I” (mg/L or mg/kg)

When the ratio of the EPC to its respective screening value or benchmark exceeds 1.0, adverse impacts are possible, and the chemical is considered for selection as a COPC. The HQ is not probabilistic but a numerical indicator of the extent to which an EPC exceeds an ESV.

### 7.4.1 Selection of Soil COPCs

The following summarizes the procedures that were used in the SERA for LL9 to select COPCs. Note that calcium, magnesium, potassium, and sodium are not retained as COPCs in any medium because of their relatively low toxicity to ecological receptors and their high natural variability in concentrations. Contaminants without ESVs are retained as COPCs for further evaluation.

- Inorganic contaminants whose maximum concentrations do not exceed the site-specific background concentrations are not selected as COPCs.
- Inorganic and organic contaminants whose maximum concentrations do not exceed soil screening levels are not retained as COPCs, unless the chemicals are bioaccumulative and/or persistent, bioaccumulative, and toxic (PBT). Inorganic and organic contaminants that are bioaccumulative and/or PBT are selected as COPCs even if their maximum concentration does not exceed a screening level. A chemical was considered to be bioaccumulative if it is included in the list of important bioaccumulative chemicals in USEPA (2000a). A chemical was considered a PBT chemical as defined in the Ohio EPA ERA guidance (Ohio EPA, 2003).
- Inorganic and organic contaminants without screening values are selected as COPCs.

Table 7–1 summarizes the screening of soil COPCs. Four analytes (dibenzofuran, nitroguanidine, RDX, and nitrocellulose) were selected as COPCs because no screening values are available. According to the USEPA Office of Drinking Water, nitrocellulose is essentially nontoxic (USEPA, 2004d). Nitrocellulose is further discussed in Section 6.6. Twelve analytes (aluminum, arsenic, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, vanadium, and zinc) were selected as COPCs because their maximum concentrations exceeded their respective ESVs. Eight of those analytes (arsenic, chromium, copper, lead, mercury, nickel, selenium, and zinc) were selected as COPCs for the food chain model because they are bioaccumulative. Although some of the ESVs were developed for the protection of wildlife, 16 bioaccumulative analytes (acenaphthene, acenaphthylene, anthracene, benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[g,h,i]perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno[1,2,3–cd]pyrene, phenanthrene, pyrene, and cadmium) were selected as COPCs for the food chain model to be conservative, even though their maximum detected concentrations did not exceed soil screening levels.

### 7.4.2 Selection of Sediment COPCs

The following summarizes the procedures that were used in the SERA for LL9 to select COPCs:

- Inorganic contaminants whose maximum concentrations do not exceed Ohio-Specific SRVs and site-specific background are not selected as COPCs.

- Inorganic and organic contaminants whose maximum concentrations do not exceed screening levels are not selected as COPCs.
- Inorganic and organic contaminants without screening values are selected as COPCs.

Table 7–2 summarizes the initial selection of sediment COPCs. Beryllium, selenium, and nitrocellulose were selected as COPCs because no sediment screening values are available. According to the USEPA Office of Drinking Water, nitrocellulose is essentially nontoxic (USEPA, 2004d). Nitrocellulose is further discussed in Section 6.6. Four analytes [bis(2–ethylhexyl)phthalate, dibenzo(a,h)anthracene, lead, and mercury] were selected as COPCs because their maximum concentrations exceeded their respective sediment ESVs.

### 7.4.3 Selection of Surface Water COPCs

The following summarizes the procedures that were used in the SERA for LL9 to select COPCs:

- Inorganic contaminants whose maximum concentrations do not exceed background are not selected as COPCs.
- Inorganic and organic contaminants whose maximum concentrations do not exceed water quality criteria in OAC 3745–1 (or the AWQC, as discussed in Section 7.3) are not retained as COPCs.
- Inorganic and organic contaminants without screening values are retained as COPCs.

Table 7–3 summarizes the screening of surface water COPCs. Manganese and nitrocellulose were selected as COPCs because no surface water screening level is available. According to the USEPA Office of Drinking Water, nitrocellulose is essentially nontoxic (USEPA, 2004d). Nitrocellulose is further discussed in Section 6.6. Six analytes (aluminum, copper, iron, lead, mercury, and zinc) were retained as COPCs because they had concentrations that exceeded their respective surface water ESVs.

## 7.5 Methodology for Refining Conservative Exposure Assumptions

As discussed in Section 7.1, Step 3a is technically the first step of a BERA (although it is included in this SERA) and consists of refining the conservative exposure assumptions/concentrations when evaluating potential risks to ecological receptors (i.e., plants, invertebrates, and wildlife receptors) and re-evaluating the analytical data using benchmarks that may be more appropriate for the assessment endpoints. The objective of the Step 3a evaluation is to reduce the number of chemicals retained as COPCs, if possible, so the SERA can focus on the remaining COPCs that pose the greatest risks to ecological receptors. The Step 3a evaluation is designed to eliminate chemicals from further evaluation for certain groups of receptors.

# Table 7-1
## Ecological COPC Selection Table of Shallow Soil (0 - 4 ft bgs)

| Parameter | Frequency of Detection | Minimum Concentration | Maximum Concentration | Mean Concentration | Average of Positive Detects | Sample of Maximum Detect | 95% UCL on Mean$^{(1)}$ | Site Background Criteria$^{(1)}$ |
|---|---|---|---|---|---|---|---|---|
| **Semivolatile Organics (µg/kg)** | | | | | | | | |
| 2-METHYLNAPHTHALENE | 1/13 | 15 J | 15 J | 1.98 | 15.0 | LL9SS-068-0001-SO | 2.66 | NA |
| ACENAPHTHENE | 4/13 | 6 J | 19 Ja | 3.81 | 10.5 | LL9SB-050-0001-SO | 10.7 | NA |
| ACENAPHTHYLENE | 1/13 | 50 J | 50 J | 4.35 | 50.0 | LL9SS-068-0001-SO | 5.64 | NA |
| ANTHRACENE | 4/13 | 6.3 J | 48 J | 7.71 | 23.9 | LL9SS-068-0001-SO | 48 | NA |
| BENZO(A)ANTHRACENE | 10/13 | 3.1 J | 230 | 31.3 | 40.5 | LL9SS-068-0001-SO | 230 | NA |
| BENZO(A)PYRENE | 9/13 | 6.1 J | 240 | 32.2 | 46.0 | LL9SS-068-0001-SO | 240 | NA |
| BENZO(B)FLUORANTHENE | 10/13 | 4.5 J | 240 M | 34.6 | 44.6 | LL9SS-068-0001-SO | 240 | NA |
| BENZO(G,H,I)PERYLENE | 10/13 | 3.3 J | 170 | 23.3 | 29.9 | LL9SS-068-0001-SO | 141 | NA |
| BENZO(K)FLUORANTHENE | 9/13 | 4.9 J | 200 M | 27.5 | 39.0 | LL9SS-068-0001-SO | 151 | NA |
| BIS(2-ETHYLHEXYL)PHTHALATE | 4/13 | 14 Ja | 150 J | 19.3 | 49.8 | LL9SS-014-0001-SO | 40.1 | NA |
| CHRYSENE | 10/13 | 3.1 J | 250 | 35.0 | 45.2 | LL9SS-068-0001-SO | 250 | NA |
| DIBENZO(A,H)ANTHRACENE | 7/13 | 6.4 J | 130 | 20.6 | 37.1 | LL9SS-068-0001-SO | 130 | NA |
| DIBENZOFURAN | 2/13 | 7.9 Ja | 13 J | 2.98 | 10.5 | LL9SS-068-0001-SO | 4.41 | NA |
| FLUORANTHENE | 10/13 | 6.4 J | 360 | 60.8 | 78.8 | LL9SS-068-0001-SO | 360 | NA |
| FLUORENE | 3/13 | 8.5 Ja | 25 J | 4.18 | 14.9 | LL9SS-068-0001-SO | 9.81 | NA |
| INDENO(1,2,3-CD)PYRENE | 10/13 | 3.9 J | 170 | 26.6 | 34.2 | LL9SS-068-0001-SO | 170 | NA |
| NAPHTHALENE | 1/13 | 19 J | 19 J | 2.41 | 19.0 | LL9SS-068-0001-SO | 3.23 | NA |
| PHENANTHRENE | 9/13 | 4.9 J | 280 | 40.4 | 58.1 | LL9SS-068-0001-SO | 280 | NA |
| PYRENE | 10/13 | 4 J | 400 | 56.9 | 73.6 | LL9SS-068-0001-SO | 400 | NA |
| **Energetics (µg/kg)** | | | | | | | | |
| NITROGUANIDINE | 1/9 | 89 | 89 | 121 | 89.0 | LL9SS-034-0001-SO | 89 | NA |
| RDX | 1/21 | 110 | 110 | 37.0 | 69.5 | LL9SB-053-0001-SO | 41.5 | NA |
| **Inorganics (mg/kg)** | | | | | | | | |
| ALUMINUM | 85/85 | 5,700 | 20,000 | 10,182 | 10,182 | LL9SS-023-0001-SO | 10692 | 17700 |
| ANTIMONY | 21/85 | 0.19 B | 1.4 | 0.365 | 0.723 | LL9SS-011-0001-SO | 0.392 | 0.96 |
| ARSENIC | 85/85 | 3.1 | 32 | 12.3 | 12.3 | LL9SB-019-0001-SO | 13.6 | 15.4 |
| BARIUM | 85/85 | 26 | 170 | 63.7 | 63.7 | LL9SS-019-0001-SO | 68.5 | 88.4 |
| BERYLLIUM | 85/85 | 0.16 B | 1.8 | 0.493 | 0.493 | LL9SS-005-0001-SO | 0.527 | 0.88 |
| CADMIUM | 20/85 | 0.095 B | 2.9 | 0.183 | 0.625 | LL9SS-006-0001-SO | 0.152 | NA |
| CALCIUM | 85/85 | 11 | 113,000 H | 4,198 | 4,198 | LL9SS-005-0001-SO | 3769 | 15800 |
| CHROMIUM | 85/85 | 8.1 | 110 | 15.4 | 15.4 | LL9SS-024-0001-SO | 15.9 | 17.4 |
| COBALT | 85/85 | 1.6 | 18 | 8.17 | 8.17 | LL9SS-027-0001-SO | 8.92 | 10.4 |
| COPPER | 85/85 | 5.2 | 1240 | 32.7 | 32.7 | LL9SS-011-0001-SO | 24.2 | 17.7 |
| IRON | 85/85 | 6,140 H | 76,000 | 22,357 | 22,357 | LL9SS-031-0001-SO | 23706 | 23100 |
| LEAD | 85/85 | 5.2 | 1330 | 46.2 | 46.2 | LL9SS-011-0001-SO | 40.2 | 19.1 |
| MAGNESIUM | 85/85 | 1,100 | 9,600 | 2,275 | 2,275 | LL9SS-005-0001-SO | 2417 | 3030 |
| MANGANESE | 85/85 | 50 | 3,800 | 559 | 559 | LL9SS-027-0001-SO | 634 | 1450 |
| MERCURY | 85/85 | 0.0057 B | 882 | 10.8 | 10.8 | LL9SS-011-0001-SO | 0.433 | 0.04 |
| NICKEL | 85/85 | 5.7 | 32 | 16.1 | 16.1 | LL9SB-015-0001-SO | 17.2 | 21.1 |
| POTASSIUM | 85/85 | 2 | 1,600 | 821 | 821 | LL9SB-024-0001-SO,<br>LL9SB-025-0001-SO,<br>LL9SB-052-0001-SO | 1350 | 927 |
| SELENIUM | 38/85 | 0.15 B | 1.8 B | 0.436 | 0.648 | LL9SS-068-0001-SO | 0.484 | 1.4 |
| SODIUM | 24/85 | 94.3 | 1,300 | 246 | 748 | LL9SS-038-0001-SO,<br>LL9SS-046-0001-SO,<br>LL9SB-065-0001-SO | 266 | 123 |
| THALLIUM | 1/85 | 0.33 | 0.33 | 0.177 | 0.33 | LL9SB-021-0001-SO | 0.19 | 0.91 |
| VANADIUM | 85/85 | 6.9 | 29 | 17.5 | 17.5 | LL9SB-024-0001-SO,<br>LL9SB-025-0001-SO | 18.5 | 31.1 |
| ZINC | 85/85 | 27 | 780 | 87.6 | 87.6 | LL9SS-068-0001-SO | 89.3 | 61.8 |
| **Miscellaneous Parameters** | | | | | | | | |
| NITROCELLULOSE (ug/kg) | 9/9 | 1,100 | 4,300 | 2,206 | 2,206 | LL9SB-050-0001-SO | 4300 | NA |

## Table 7-1
## Ecological COPC Selection Table of Shallow Soil (0 - 4 ft bgs)

| Parameter | Detects > Site Background Criteria[2] | Max Conc > Bkg Conc | Surface Soil Screening Level |  | HQ | Bio Chemical | PBT Chemical | Selected as a COPC? | Rationale[3] |
|---|---|---|---|---|---|---|---|---|---|
|  |  |  | Value | Source |  |  |  |  |  |
| **Semivolatile Organics (µg/kg)** |  |  |  |  |  |  |  |  |  |
| 2-METHYLNAPHTHALENE | NA | NA | 3,240 | d | 0.005 | NO | NO | NO | BSL |
| ACENAPHTHENE | NA | NA | 20,000 | a | 0.001 | YES | NO | YES | BIO |
| ACENAPHTHYLENE | NA | NA | 682,000 | d | 0.00007 | YES | NO | YES | BIO |
| ANTHRACENE | NA | NA | 1,480,000 | d | 0.00003 | YES | NO | YES | BIO |
| BENZO(A)ANTHRACENE | NA | NA | 5,210 | d | 0.04 | YES | NO | YES | BIO |
| BENZO(A)PYRENE | NA | NA | 1,520 | d | 0.16 | YES | NO | YES | BIO |
| BENZO(B)FLUORANTHENE | NA | NA | 59,800 | d | 0.004 | YES | NO | YES | BIO |
| BENZO(G,H,I)PERYLENE | NA | NA | 119,000 | d | 0.001 | YES | NO | YES | BIO |
| BENZO(K)FLUORANTHENE | NA | NA | 148,000 | d | 0.001 | YES | NO | YES | BIO |
| BIS(2-ETHYLHEXYL)PHTHALATE | NA | NA | 926 | d | 0.16 | NO | NO | NO | BSL |
| CHRYSENE | NA | NA | 4,730 | d | 0.05 | YES | NO | YES | BIO |
| DIBENZO(A,H)ANTHRACENE | NA | NA | 18,400 | d | 0.007 | YES | NO | YES | BIO |
| DIBENZOFURAN | NA | NA | NA | NA | NA | NO | NO | YES | NTX |
| FLUORANTHENE | NA | NA | 122,000 | d | 0.003 | YES | NO | YES | BIO |
| FLUORENE | NA | NA | 30,000 | b | 0.0008 | YES | NO | YES | BIO |
| INDENO(1,2,3-CD)PYRENE | NA | NA | 109,000 | d | 0.002 | YES | NO | YES | BIO |
| NAPHTHALENE | NA | NA | 99.4 | d | 0.19 | NO | NO | NO | BSL |
| PHENANTHRENE | NA | NA | 45,700 | d | 0.006 | YES | NO | YES | BIO |
| PYRENE | NA | NA | 78,500 | d | 0.005 | YES | NO | YES | BIO |
| **Energetics (µg/kg)** |  |  |  |  |  |  |  |  |  |
| NITROGUANIDINE | NA | NA | NA | NA | NA | NO | NO | YES | NTX |
| RDX | NA | NA | NA | NA | NA | NO | NO | YES | NTX |
| **Inorganics (mg/kg)** |  |  |  |  |  |  |  |  |  |
| ALUMINUM | 3/85 | YES | 50 | c | 400 | NO | NO | YES | ASL |
| ANTIMONY | 4/85 | YES | 5 | a | 0.28 | NO | NO | NO | BSL |
| ARSENIC | 22/85 | YES | 9.9 | a | 3.23 | YES | NO | YES | ASL,BIO |
| BARIUM | 11/85 | YES | 283 | a | 0.60 | NO | NO | NO | BSL |
| BERYLLIUM | 1/85 | YES | 10 | a | 0.18 | NO | NO | NO | BSL |
| CADMIUM | NA | NA | 4 | a | 0.73 | YES | NO | YES | BIO |
| CALCIUM | 4/85 | YES | NA | NA | NA | NO | NO | NO | NUT |
| CHROMIUM | 10/85 | YES | 0.4 | a | 275 | YES | NO | YES | ASL,BIO |
| COBALT | 15/85 | YES | 20 | a | 0.9 | NO | NO | NO | BSL |
| COPPER | 44/85 | YES | 60 | a | 20.7 | YES | NO | YES | ASL,BIO |
| IRON | 33/85 | YES | 200 | b[4] | 380 | NO | NO | YES | ASL |
| LEAD | 38/85 | YES | 40.5 | a | 32.8 | YES | NO | YES | ASL,BIO |
| MAGNESIUM | 13/85 | YES | NA | NA | NA | NO | NO | NO | NUT |
| MANGANESE | 2/85 | YES | 100 | b[4] | 38 | NO | NO | YES | ASL |
| MERCURY | 37/85 | YES | 0.00051 | a | 1,729,000 | YES | YES | YES | ASL,BIO,PBT |
| NICKEL | 13/85 | YES | 30 | a | 1.07 | YES | NO | YES | ASL,BIO |
| POTASSIUM | 25/85 | YES | NA | NA | NA | NO | NO | NO | NUT |
| SELENIUM | 1/85 | YES | 0.21 | a | 8.57 | YES | NO | YES | ASL,BIO |
| SODIUM | 22/85 | YES | NA | NA | NA | NO | NO | NO | NUT |
| THALLIUM | 0/85 | NO | 1 | a | 0.33 | NO | NO | NO | BKG |
| VANADIUM | 0/85 | NO | 2 | a | 14.5 | NO | NO | YES | ASL |
| ZINC | 49/85 | YES | 8.5 | a | 91.8 | YES | NO | YES | ASL,BIO |
| **Miscellaneous Parameters** |  |  |  |  |  |  |  |  |  |
| NITROCELLULOSE (ug/kg) | NA | NA | NA | NA | NA | NO | NO | YES | NTX |

## Table 7-1
## Ecological COPC Selection Table of Shallow Soil (0 - 4 ft bgs)

**Notes:**

1 - Shaded cells indicate parameter was selected as a COPC
2 - Background criteria as described in Section 4.
3 - For duplicate pairs, the average chemical concentrations of the original and duplicate samples were compared to the site background criteria.
4 - Rationale Codes
  Above Screening Levels (ASL)
  Toxicity information not available (NTX)
  Maximum detected concentration is below background screening criteria (BKG)
  Below Screening Levels (BSL)
  Essential Nutrient (NUT)
  Bioaccumulative Chemical (BIO)
  Persistent, Bioaccumulative, and Toxic chemical (PBT)
5 - Value is based on effects to microorganisms.

**Sources of Screening Levels and Heirarchy for Selection:**

a - Preliminary Remediation Goals from Efroymson et al. (1997a)
b - Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Processes from Efroymson et al. (1997b)
c - Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants from Efroymson et al. (1997c)
d - Ecological Data Quality Level (USEPA Region 5, 1999)

# Table 7-2
# Ecological COPC Selection Table for Sediment

| Parameter | Frequency of Detection | Minimum Concentration | Maximum Concentration | Mean Concentration | Average of Positive Detects | Sample of Maximum Detect | Site Background Criteria[1] | Detects > Site Background Criteria[2] | Ohio Sediment Reference Value (SRV) | Max Conc > Bkg Conc and Ohio SRV | Sediment Screening Level | | HQ | Selected as a COPC? | Rationale[3] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Value | Source | | | |
| **Semivolatile Organics (µg/kg)** | | | | | | | | | | | | | | | |
| 2-METHYLNAPHTHALENE | 1/1 | 4 Ja | 4 Ja | 2.70 | 2.70 | LL9SD-015-0001-SD | NA | NA | NA | NA | 20.2 | b | 0.20 | NO | BSL |
| ACENAPHTHYLENE | 1/1 | 1.8 Ja | 1.8 Ja | 1.33 | 1.33 | LL9SD-015-0001-SD | NA | NA | NA | NA | 5.87 | b | 0.31 | NO | BSL |
| ANTHRACENE | 1/1 | 3.1 Ja | 3.1 Ja | 1.95 | 1.95 | LL9SD-015-0001-SD | NA | NA | NA | NA | 57.2 | a | 0.05 | NO | BSL |
| BENZO(A)ANTHRACENE | 1/1 | 16 Ja | 20 Ja | 18.0 | 18.0 | LL9SD-015-0001-SD | NA | NA | NA | NA | 108 | a | 0.19 | NO | BSL |
| BENZO(A)PYRENE | 1/1 | 21 Ja | 25 Ja | 23.0 | 23.0 | LL9SD-015-0001-SD | NA | NA | NA | NA | 150 | a | 0.17 | NO | BSL |
| BENZO(B)FLUORANTHENE | 1/1 | 20 Ja | 24 Ja | 22.0 | 22.0 | LL9SD-015-0001-SD | NA | NA | NA | NA | 10,400 | b | 0.002 | NO | BSL |
| BENZO(G,H,I)PERYLENE | 1/1 | 13 Ja | 18 Ja | 15.5 | 15.5 | LL9SD-015-0001-SD | NA | NA | NA | NA | 170 | b | 0.11 | NO | BSL |
| BENZO(K)FLUORANTHENE | 1/1 | 19 Ja | 29 Ja | 24.0 | 24.0 | LL9SD-015-0001-SD | NA | NA | NA | NA | 240 | b | 0.12 | NO | BSL |
| BIS(2-ETHYLHEXYL)PHTHALATE | 1/1 | 550 | 660 | 605 | 605 | LL9SD-015-0001-SD | NA | NA | NA | NA | 182 | b | 3.63 | YES | ASL |
| BUTYL BENZYL PHTHALATE | 1/1 | 8.8 Ja | 8.8 Ja | 6.33 | 6.33 | LL9SD-015-0001-SD | NA | NA | NA | NA | 4,190 | b | 0.002 | NO | BSL |
| CHRYSENE | 1/1 | 23 Ja | 29 Ja | 26.0 | 26.0 | LL9SD-015-0001-SD | NA | NA | NA | NA | 166 | a | 0.17 | NO | BSL |
| DI-N-BUTYL PHTHALATE | 1/1 | 38 Ja | 38 Ja | 28.3 | 28.3 | LL9SD-015-0001-SD | NA | NA | NA | NA | 110.5 | b | 0.34 | NO | BSL |
| DIBENZO(A,H)ANTHRACENE | 1/1 | 43 Ja | 43 Ja | 22.4 | 22.4 | LL9SD-015-0001-SD-D | NA | NA | NA | NA | 33 | a | 1.30 | YES | ASL |
| FLUORANTHENE | 1/1 | 37 Ja | 48 Ja | 42.5 | 42.5 | LL9SD-015-0001-SD | NA | NA | NA | NA | 423 | a | 0.11 | NO | BSL |
| INDENO(1,2,3-CD)PYRENE | 1/1 | 37 Ja | 39 Ja | 38.0 | 38.0 | LL9SD-015-0001-SD | NA | NA | NA | NA | 200 | b | 0.20 | NO | BSL |
| PHENANTHRENE | 1/1 | 20 Ja | 20 Ja | 20.0 | 20.0 | LL9SD-015-0001-SD,<br>LL9SD-015-0001-SD-D | NA | NA | NA | NA | 204 | a | 0.10 | NO | BSL |
| PYRENE | 1/1 | 28 Ja | 34 Ja | 31.0 | 31.0 | LL9SD-015-0001-SD | NA | NA | NA | NA | 195 | a | 0.17 | NO | BSL |
| **Inorganics (mg/kg)** | | | | | | | | | | | | | | | |
| ALUMINUM | 13/13 | 5,500 | 15,600 | 11,635 | 11,635 | LL9SD-003-0001-SD | 13,900 | 3/13 | 29,000 | NO | NA | NA | NA | NO | BKG |
| ANTIMONY | 1/13 | 0.49 | 0.49 | 0.347 | 0.355 | LL9SD-001-0001-SD | NA | NA | 1.3 | NO | NA | NA | NA | NO | BKG |
| ARSENIC | 13/13 | 4.2 | 17.3 | 11.7 | 11.7 | LL9SD-003-0001-SD | 19.5 | 0/13 | 25 | NO | 9.79 | a | 1.8 | NO | BKG |
| BARIUM | 13/13 | 58 | 140 | 84.0 | 84.0 | LL9SD-002-0001-SD | 123 | 1/13 | 190 | NO | NA | NA | NA | NO | BKG |
| BERYLLIUM | 13/13 | 0.31 B | 0.99 | 0.638 | 0.638 | LL9SD-001-0001-SD | 0.38 | 12/13 | 0.8 | YES | NA | NA | NA | YES | NTX |
| CADMIUM | 10/13 | 0.19 B | 0.77 | 0.340 | 0.416 | LL9SD-004-0001-SD | NA | NA | 0.79 | NO | 0.99 | a | 0.78 | NO | BKG |
| CALCIUM | 13/13 | 870 | 11,000 | 2,266 | 2,266 | LL9SD-016-0001-SD-D | 5,510 | 1/13 | 21,000 | NO | NA | NA | NA | NO | NUT |
| CHROMIUM | 13/13 | 6.3 | 22 | 15.3 | 15.3 | LL9SD-016-0001-SD-D | 18.1 | 3/13 | 29 | NO | 43.4 | a | 0.51 | NO | BKG |
| COBALT | 13/13 | 5.2 | 9.5 | 7.67 | 7.67 | LL9SD-016-0001-SD-D,<br>LL9SD-017-0001-SD | 9.1 | 2/13 | 12 | NO | 50 | b | 0.19 | NO | BKG |
| COPPER | 13/13 | 7.6 | 23 | 15.0 | 15.0 | LL9SD-003-0001-SD | 27.6 | 0/13 | 32 | NO | 31.6 | a | 0.73 | NO | BKG |
| IRON | 13/13 | 17,000 H | 39,000 | 24,265 | 24,265 | LL9SD-002-0001-SD | 28,200 | 2/13 | 41,000 | NO | NA | NA | NA | NO | BKG |
| LEAD | 13/13 | 15 | 100 | 40.1 | 40.1 | LL9SD-013-0001-SD | 27.4 | 10/13 | 47 | YES | 35.8 | a | 2.79 | YES | ASL |
| MAGNESIUM | 13/13 | 620 | 3,450 | 2,149 | 2,149 | LL9SD-003-0001-SD | 2,760 | 2/13 | 7,100 | NO | NA | NA | NA | NO | NUT |
| MANGANESE | 13/13 | 200 | 1,400 | 678 | 678 | LL9SD-017-0001-SD | 1,950 | 0/13 | 1,500 | NO | NA | NA | NA | NO | BKG |
| MERCURY | 13/13 | 0.026 | 2.9 | 0.412 | 0.412 | LL9SD-012-0001-SD | 0.06 | 11/13 | 0.12 | YES | 0.18 | a | 16.1 | YES | ASL |
| NICKEL | 13/13 | 11 | 22.4 | 17.5 | 17.5 | LL9SD-001-0001-SD | 17.7 | 7/13 | 33 | NO | 22.7 | a | 0.99 | NO | BKG |
| POTASSIUM | 13/13 | 350 | 1,820 | 1,002 | 1,002 | LL9SD-003-0001-SD | 1,950 | 0/13 | 6,800 | NO | NA | NA | NA | NO | NUT |
| SELENIUM | 11/13 | 0.7 B | 2.1 | 1.19 | 1.31 | LL9SD-004-0001-SD | 1.7 | 2/13 | 1.7 | YES | NA | NA | NA | YES | NTX |
| SODIUM | 3/13 | 120 B | 213 | 98.1 | 182 | LL9SD-003-0001-SD | 112 | 3/13 | NA | YES | NA | NA | NA | NO | NUT |
| THALLIUM | 1/13 | 0.31 | 0.31 | 0.171 | 0.310 | LL9SD-012-0001-SD | 0.89 | 0/13 | 4.7 | NO | NA | NA | NA | NO | BKG |
| VANADIUM | 13/13 | 7.6 | 27.2 | 21.3 | 21.3 | LL9SD-005-0001-SD | 26.1 | 2/13 | 40 | NO | NA | NA | NA | NO | BKG |
| ZINC | 13/13 | 9 | 420 | 134 | 134 | LL9SD-004-0001-SD | 532 | 0/13 | 160 | NO | 121 | a | 3.47 | NO | BKG |
| **Miscellaneous Parameters** | | | | | | | | | | | | | | | |
| NITROCELLULOSE (µg/kg) | 1/1 | 2,800 | 4,200 | 3,500 | 3,500 | LL9SD-015-0001-SD-D | NA | NA | NA | NA | NA | NA | NA | YES | NTX |
| TOTAL ORGANIC CARBON (mg/kg) | 13/13 | 3,500 | 28,000 | 15,323 | 15,323 | LL9SD-013-0001-SD | NA | NA | NA | NA | NA | NA | NA | NO | NA |

**Notes:**

1 - Shaded cells indicate parameter was selected as a COPC
2 - Background criteria as described in Section 4.
3 - For duplicate pairs, the average chemical concentrations of the original and duplicate samples were compared to the site background criteria.
4 - Rationale Codes
  Above Screening Levels (ASL)
  Toxicity information not available (NTX)
  Maximum detected concentration is less than the site background criteria level or Ohio Sediment Reference Value (BKG)
  Below Screening Level (BSL)
  Essential Nutrient (NUT)

Sources of Screening Levels and Heirarchy for Selection:
  a - Threshold Effects Concentration from McDonald et al., (2000)
  b - Ecological Data Quality Level (USEPA Region 5, 1999)

## Table 7-3
## Ecological COPC Selection Table for Surface Water

| Parameter | Frequency of Detection | Minimum Concentration | Maximum Concentration | Mean Concentration | Average of Positive Detects | Sample of Maximum Detect | Site Background Criteria(1) | Detects > Site Background Criteria(2) | Max Conc > Bkg Conc | Surface Water Screening Level | | HQ | PBT Chemical | Selected as a COPC? | Rationale(3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Value | Source | | | | |
| **Inorganics (μg/L)** | | | | | | | | | | | | | | | |
| ALUMINUM | 6/6 | 339 | 17,800 | 5,929 | 5,929 | LL9SW-005-0001-SW | 3,370 | 2/6 | YES | 87 | b | 205 | NO | YES | ASL |
| ARSENIC | 4/6 | 1.9 B | 9.9 | 4.24 | 6.03 | LL9SW-003-0001-SW | 3.2 | 3/6 | YES | 340(5) | a | 0.03 | NO | NO | BSL |
| BARIUM | 6/6 | 21.4 | 145 | 71.2 | 71.2 | LL9SW-005-0001-SW | 47.5 | 3/6 | YES | 2000(4) | a | 0.07 | NO | NO | BSL |
| BERYLLIUM | 3/6 | 0.26 B | 0.7 B | 0.572 | 0.420 | LL9SW-005-0001-SW | NA | NA | NA | 15.9(4,6) | a | 0.04 | NO | NO | BSL |
| CADMIUM | 1/6 | 1.1 B | 1.1 B | 0.497 | 1.10 | LL9SW-005-0001-SW | NA | NA | NA | 1.23(4,5,6) | a | 0.89 | NO | NO | BSL |
| CALCIUM | 6/6 | 9,830 H | 61,000 | 20,772 | 20,772 | LL9SW-003-0001-SW | 41,400 | 1/6 | YES | NA | NA | NA | NO | NO | NUT |
| CHROMIUM | 4/6 | 3.3 B | 20.2 | 7.84 | 10.3 | LL9SW-005-0001-SW | NA | NA | NA | 231(4,5,6) | a | 0.09 | NO | NO | BSL |
| COBALT | 4/6 | 1.2 B | 8 | 3.80 | 4.95 | LL9SW-003-0001-SW | NA | NA | NA | 220(4) | a | 0.04 | NO | NO | BSL |
| COPPER | 4/6 | 4.4 B | 20 | 9.10 | 12.2 | LL9SW-003-0001-SW | 7.9 | 2/6 | YES | 4.76(4,5,6) | a | 4.20 | NO | YES | ASL |
| IRON | 6/6 | 249 | 20,000 | 9,973 | 9,973 | LL9SW-002-0001-SW | 2,560 | 4/6 | YES | 1000 | b | 20 | NO | YES | ASL |
| LEAD | 5/6 | 1.2 B | 70 | 25.5 | 30.4 | LL9SW-003-0001-SW | NA | NA | NA | 23.8(4,5,6) | a | 2.94 | NO | YES | ASL |
| MAGNESIUM | 6/6 | 2,110 | 9,600 | 4,578 | 4,578 | LL9SW-003-0001-SW | 10,800 | 0/6 | NO | NA | NA | NA | NO | NO | NUT |
| MANGANESE | 6/6 | 10.1 | 1,400 | 638 | 638 | LL9SW-003-0001-SW | 391 | 4/6 | YES | NA | NA | NA | NO | YES | NTX |
| MERCURY | 5/6 | 0.065 B | 1.7 | 0.341 | 0.389 | LL9SW-012-0001-SW-D | NA | NA | NA | 1.4(5) | a | 1.21 | YES | YES | ASL,PBT |
| NICKEL | 5/6 | 4 B | 20.1 | 10.0 | 11.0 | LL9SW-005-0001-SW | NA | NA | NA | 184(4,5,6) | a | 0.11 | NO | NO | BSL |
| POTASSIUM | 6/6 | 798 | 5,200 | 2,366 | 2,366 | LL9SW-003-0001-SW | 3,170 | 2/6 | YES | NA | NA | NA | NO | NO | NUT |
| SODIUM | 6/6 | 966 B | 4,300 | 2,161 | 2,161 | LL9SW-003-0001-SW | 21,300 | 0/6 | NO | NA | NA | NA | NO | NO | NUT |
| VANADIUM | 3/6 | 4.9 B | 31.9 | 10.1 | 18.6 | LL9SW-005-0001-SW | NA | NA | NA | 150(4) | a | 0.21 | NO | NO | BSL |
| ZINC | 6/6 | 19 | 228 | 91.7 | 91.7 | LL9SW-005-0001-SW | 42 | 2/6 | YES | 46(4,5,6) | a | 4.96 | NO | YES | ASL |
| **Miscellaneous Parameters (mg/L)** | | | | | | | | | | | | | | | |
| NITROCELLULOSE | 1/1 | 0.1 | 0.12 | 0.110 | 0.110 | LL9SW-012-0001-SW | NA | NA | NA | NA | NA | NA | NO | YES | NTX |

**Notes:**
1 - Background criteria as described in Section 4.
2 - For duplicate pairs, the average chemical concentrations of the original and duplicate samples were compared to the site background criteria.
3 - Rationale Codes
    Above Screening Levels (ASL)
    Toxicity information not available (NTX)
    Essential Nutrient (NUT)
    Below Screening Levels (BSL)
    Persistent, Bioaccumulative, and Toxic chemical (PBT)
4 - Outside Mixing Zone Maximum value.
5 - Dissolved criteria.
6 - Based on a calculated water hardness of 33.2 mg/L (in order to be most conservative, the minimum hardness at location LL9SW-001 was used).

**Sources of Screening Levels and Heirarchy for Selection:**
a - Ohio Water Quality Criteria
b - USEPA Recommended Water Quality Criteria

For example, if a chemical concentration is less than a toxicity benchmark for invertebrates, but greater than a benchmark for plants, the chemical may be eliminated as a COPC in soil for risks to soil invertebrates, but it may be retained as a COPC in soil for risks to plants. Therefore, chemicals are evaluated during Step 3a in order of plants/invertebrates, aquatic receptors, and wildlife. The following sections present the methodology for evaluating risks to these receptors.

### 7.5.1 Surface Soil

Chemicals that were initially selected as COPCs in surface soil were evaluated for risks to: (1) plants, (2) invertebrates, and (3) wildlife (i.e., mammals and birds). This further evaluation was conducted to determine whether there are potential risks to all three receptor groups (i.e., plants, invertebrates, and wildlife), or to only one or two of the receptor groups. This is important because if the site proceeds further in a BERA, the studies in the BERA should focus only on the receptors that are potentially at risk. The first step in the Step 3a evaluation was to compare the maximum and average chemical concentrations in the soil to toxicity benchmarks that are based on effects to earthworms and plants. Tables 7–4 and 7–5 present this comparison for earthworms and plants, respectively.

The following hierarchy was used to select the earthworm benchmark in Table 7–4:

- USEPA ecological soil screening levels (Eco-SSLs) for earthworms (USEPA, 2003a,b and c). These values were selected first because they are USEPA values and are the most recent values.
- The greater of the values from the following two sources. Because both of the following sources are typically used as screening levels in ERAs, the values from either source should be protective of earthworms. For that reason, the greater value was selected to refine the list of chemicals retained as COPCs.
    - Canadian Soil Quality Guidelines (individual documents for each chemical), and
    - Oak Ridge National Laboratory (ORNL), *Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process,* 1997 Revision (Efroymson, et al., 1997b).

The following hierarchy was used to select the plant benchmark in Table 7–5:

- USEPA Eco-SSLs for plants (USEPA, 2003 a, b, and c) These values were selected first because they are USEPA values and are the most recent values.
- The greater of the values from the following two sources. Because both of the following sources are typically used as screening levels in ERAs, the values from either source should be protective of plants. For that reason, the greater value was selected to refine the list of chemicals retained as COPCs.

# Table 7-4
# Direct Toxicity to Earthworms

| Parameter | Frequency of Detection | Maximum Concentration | Average Concentration | Selected Upper Confidence Level | Earthworm Toxicity Benchmarks | Source | Maximum > TRV? | Average > TRV? |
|---|---|---|---|---|---|---|---|---|
| **Semivolatile Organics (µg/kg)** | | | | | | | | |
| DIBENZOFURAN | 2/13 | 13 | 2.98 | 4.41 | No TRV | NA | No TRV | No TRV |
| **Energetics (ug/kg)** | | | | | | | | |
| NITROGUANIDINE | 1/9 | 89 | 121 | 89 | No TRV | NA | No TRV | No TRV |
| RDX | 1/21 | 110 | 37.0 | 41.5 | No TRV | NA | No TRV | No TRV |
| **Inorganics (mg/kg)** | | | | | | | | |
| ALUMINUM | 85/85 | 20,000 | 10,182 | 10692 | pH[(1)] | a | NA | NA |
| ARSENIC | 85/85 | 32 | 12.3 | 13.6 | 60 | c | NO | NO |
| CHROMIUM | 85/85 | 110 | 15.4 | 15.9 | 64 | d | YES | NO |
| COPPER | 85/85 | 1240 | 32.7 | 24.2 | 63 | d | YES | NO |
| IRON | 85/85 | 76,000 | 22,357 | 23706 | No TRV | NA | No TRV | No TRV |
| LEAD | 85/85 | 1330 | 46.2 | 40.2 | 1700 | b | NO | NO |
| MANGANESE | 85/85 | 3,800 | 559 | 634 | No TRV | NA | No TRV | No TRV |
| MERCURY | 85/85 | 882 | 10.8 | 0.433 | 12 | d | YES | NO |
| NICKEL | 85/85 | 32 | 16.1 | 17.2 | 200 | c | NO | NO |
| SELENIUM | 38/85 | 1.8 | 0.436 | 0.484 | 70 | c | NO | NO |
| VANADIUM | 85/85 | 29 | 17.5 | 18.5 | 130 | d | NO | NO |
| ZINC | 85/85 | 780 | 87.6 | 89.3 | 200 | d | YES | NO |
| **Miscellaneous Parameters (µg/kg)** | | | | | | | | |
| NITROCELLULOSE | 9/9 | 4,300 | 2,206 | 4300 | No TRV | NA | No TRV | No TRV |

Notes:

'- Shaded cells are chemicals that are retained for further evaluation in Step 3a.

- Average concentration includes positive detections and non-detected results. Detection limits are divided by two for non-detected values.
- Frequency of detection refers to number of times compound was detected among all samples versus total number of samples analyzed for that parameter.
- Number of samples may vary based on the number of usable results.

1 - Aluminum is only considered a COPC when the pH is <5.5

**Sources of Earthworm Toxicity Benchmarks:**

a - Ecological Soil Screening Level (Eco-SSL) from U.S. EPA (2003b).
b - Ecological Soil Screening Level (Eco-SSL) from U.S. EPA (2005b).
c - Earthworm toxicity benchmark from Efroymson et al., 1997b.
d - Canadian Soil Quality Guideline (SQG) from Environment Canada (EC, 1999a-c, e-f).

# Table 7-5
# Direct Toxicity to Plants

| Parameter | Frequency of Detection | Maximum Concentration | Average Concentration | Selected Upper Confidence Level | Plant Toxicity Benchmarks | Source | Maximum > TRV? | Average > TRV? |
|---|---|---|---|---|---|---|---|---|
| **Semivolatile Organics (µg/kg)** | | | | | | | | |
| DIBENZOFURAN | 2/13 | 13 | 2.98 | 4.41 | No TRV | NA | No TRV | No TRV |
| **Energetics (ug/kg)** | | | | | | | | |
| NITROGUANIDINE | 1/9 | 89 | 121 | 89 | No TRV | NA | No TRV | No TRV |
| RDX | 1/21 | 110 | 37.0 | 41.5 | No TRV | NA | No TRV | No TRV |
| **Inorganics (mg/kg)** | | | | | | | | |
| ALUMINUM | 85/85 | 20,000 | 10,182 | 10692 | pH(1) | a | NA | NA |
| ARSENIC | 85/85 | 32 | 12.3 | 13.6 | 18 | b | YES | NO |
| CHROMIUM | 85/85 | 110 | 15.4 | 15.9 | 64 | d | YES | NO |
| COPPER | 85/85 | 1240 | 32.7 | 24.2 | 100 | c | YES | NO |
| IRON | 85/85 | 76,000 | 22,357 | 23706 | pH(1) | a | NA | NA |
| LEAD | 85/85 | 1330 | 46.2 | 40.2 | 120 | b | YES | NO |
| MANGANESE | 85/85 | 3,800 | 559 | 634 | 500 | c | YES | YES |
| MERCURY | 85/85 | 882 | 10.8 | 0.433 | 12 | d | YES | NO |
| NICKEL | 85/85 | 32 | 16.1 | 17.2 | 50 | d | NO | NO |
| SELENIUM | 38/85 | 1.8 | 0.436 | 0.484 | 1 | c | YES | NO |
| VANADIUM | 85/85 | 29 | 17.5 | 18.5 | 130 | d | NO | NO |
| ZINC | 85/85 | 780 | 87.6 | 89.3 | 200 | d | YES | NO |
| **Miscellaneous Parameters (µg/kg)** | | | | | | | | |
| NITROCELLULOSE | 9/9 | 4,300 | 2,206 | 4300 | No TRV | NA | No TRV | No TRV |

Notes:
'- Shaded cells are chemicls that are retained for further evaluation in Step 3a.
- Average concentration includes positive detections and non-detected results. Detection limits are divided by two for non-detected values.
- Frequency of detection refers to number of times compound was detected among all samples versus total number of samples analyzed for that parameter.
- Number of samples may vary based on the number of usable results.
1 - Benchmarks for aluminum and iron are based on pH of the soil.

**Sources of Plant Toxicity Benchmarks:**
a - Ecological Soil Screening Level (Eco-SSL) from U.S. EPA (2003b,c).
b - Ecological Soil Screening Level (Eco-SSL) from U.S. EPA, (2005a,b).
c - Plant toxicity benchmark from Efroymson et al., 1997c.
d - Canadian Soil Quality Guideline (SQG) from Environment Canada (EC, 1999 a, c-f).

Canadian Soil Quality Guidelines (individual documents for each chemical), and

  - ORNL, *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants*, 1997 Revision (Efroymson, et al., 1997c).

If the chemical concentration is less than the benchmarks for earthworms and/or plants, it was concluded that the chemical is not likely causing a risk to that receptor group and the chemical was not evaluated further in Step 3a for that receptor group.

If the chemical concentration was greater than the benchmarks for earthworms and/or plants (or the chemical does not have a benchmark), the chemical was further evaluated in Step 3a to determine whether the risks are great enough to warrant additional evaluations (i.e., proceed to a BERA, develop cleanup levels).

In addition, bioaccumulative chemicals that were retained as COPCs were further evaluated to determine whether there are likely risks to wildlife. If the chemical is not bioaccumulative, it was not carried through the food chain model (see Section 7.5.5), and it was concluded that the chemical is not likely causing a risk to wildlife. If the chemical is bioaccumulative, it was carried through the food chain model. The following bullets outline decisions that were made based on the results of the food chain model:

- If the HQ is less than 1.0, using average contaminant concentrations and the NOAEL as the toxicity organic value (TRV), it was concluded that the chemical is not likely causing a risk to wildlife and the chemical was not evaluated further in Step 3a.
- If the HQ is greater than 1.0, using average contaminant concentrations and the NOAEL as the TRV, the chemical was further evaluated in Step 3a to determine whether the risks are great enough to warrant additional evaluations (i.e., proceed to a BERA, develop cleanup levels).

For chemicals evaluated further in Step 3a, the other Step 3a factors described below in Section 7.5.4 were used to determine whether the risks are great enough to warrant additional evaluations (i.e., proceed to a BERA, develop cleanup levels).

### 7.5.2 Sediment

Chemicals selected as COPCs in sediment were evaluated to assess potential risks from the chemical to benthic invertebrates. The first step in the Step 3a evaluation was to compare the average chemical concentrations in the sediment to the screening level, and then to compare the maximum and average chemical concentrations in the sediment to higher effects-levels (as described below). Table 7–6 presents this comparison.

## Table 7-6
## Step 3a Table for Evaluating Risks to Sediment Invertebrates

| | | | | Screening Level Comparison | | Higher Effects-Level Comparison | | | |
|---|---|---|---|---|---|---|---|---|---|
| Chemical of Potential Concern (COPC)[(1)] | Frequency of Detection | Maximum Concentration | Average Concentration | Screening Level[(2)] | Average> Screening Level | Higher Effects Level | Source | Maximum> Higher Effects Level? | Average> Higher Effects Level? |
| **Semivolatile Organics (µg/kg)** | | | | | | | | | |
| BIS(2-ETHYLHEXYL)PHTHALATE | 1/1 | 660 | 605 | 182 | YES | 1300 | c | NO | NO |
| DIBENZO(A,H)ANTHRACENE | 1/1 | 43 | 22.4 | 33 | NO | 1989 | b | NO | NO |
| **Inorganics (mg/kg)** | | | | | | | | | |
| BERYLLIUM | 13/13 | 0.99 | 0.638 | No TRV | No TRV | No TRV | NA | No TRV | No TRV |
| LEAD | 13/13 | 100 | 40.1 | 35.8 | YES | 128 | a | NO | NO |
| MERCURY | 13/13 | 2.9 | 0.412 | 0.18 | YES | 1.06 | a | YES | NO |
| SELENIUM | 11/13 | 2.1 | 1.19 | No TRV | No TRV | 1 | c | YES | YES |
| **Miscellaneous Parameters (µg/kg)** | | | | | | | | | |
| NITROCELLULOSE | 1/1 | 4,200 | 3,500 | No TRV | No TRV | No TRV | NA | No TRV | No TRV |

Notes:

- Shaded cells are chemicls that are retained for further evaluation in Step 3a.

1 - This table only presents that chemicals that were retained as COPCs because the maximum detected concentration exceeded the screening level or the chemical did not have a screening level.

2 - Table 7-2 presents the sources of the screening levels.

**Sources of Higher Effects Levels:**

a - Probable Effects Concentration from MacDonald et al., 2000.

b - Severe Effect Level from OMOE, 1993. Value for dibenzo(a,h)anthracene was calculated using 1.53% TOC.

c - Apparent Effect Threshold from Buchman 1999.

As discussed in Section 7.3, the TEC from MacDonald el al. (2000) was used as the primary source of the sediment screening, followed by the USEPA Region 5 EDQL (USEPA Region 5, 1999). TECs are considered "lower effects levels" because they are intended to identify contaminant concentrations below which harmful effects on benthic organisms are not expected. Probable effects concentrations (PECs) are considered “higher effects levels” because they are intended to identify concentrations above which harmful effects are expected to occur. Therefore, the PECs were selected first as the higher effects level in Table 7–6. Because there are no corresponding higher effects levels for the EDQLs, the severe effects level (SEL) from the Ontario sediment quality guidelines (OMOE, 1993) and the apparent effects threshold (AET) in Buchman (1999), if available, were also used to evaluate risks to benthic organisms.

The chemicals that were selected as COPCs were evaluated further in Step 3a, using the benchmarks described above along with the other Step 3a factors described below, to determine whether the risks are great enough to warrant additional evaluations (i.e., proceed to a BERA, develop cleanup levels).

### 7.5.3 Surface Water

Chemicals selected as COPCs in surface water were further evaluated using the other Step 3a factors described below to determine whether the risks to aquatic organisms are great enough to warrant additional evaluations (i.e., proceed to a BERA, develop cleanup levels).

### 7.5.4 Other Step 3a Factors

For chemicals that are evaluated further in Step 3a, the following factors were evaluated, as appropriate, to determine whether the risks are great enough to warrant additional evaluations (i.e., proceed to a BERA, develop cleanup levels).

- Magnitude of criterion exceedance: Although the magnitude of the risks may not relate directly to the magnitude of a criterion exceedance, the magnitude of the criterion exceedance may be one item used in a lines-of-evidence approach to determine the need for further site evaluation. The greater the criterion exceedance, the greater the probability and concern that a possible risk exists.
- Frequency of chemical detection and spatial distribution: A chemical detected at a low frequency typically is of less concern than a chemical detected at higher frequency if toxicity and concentrations and spatial areas represented by the data are similar. Chemicals detected frequently were given greater consideration than those detected infrequently.
- Contaminant bioavailability: Many contaminants (especially metals) are present in the environment in forms that are typically not bioavailable, and the limited bioavailability

was considered when evaluating the exposures of receptors to site contaminants. Contaminants with generally less bioavailability are considered to be less toxic than the more bioavailable contaminants, all other factors being equal.

- Habitat: Although exceedances of criteria may occur, potential risks to ecological receptors may be minimal if there is little habitat for those receptors. Therefore, the extent of habitat was used qualitatively when considering additional evaluation. Areas with little habitat were of less concern than areas with suitable habitat to support the receptors of interest.

- Alternate benchmarks: Use of alternate benchmarks ensures that more realistic exposure assumptions are evaluated. However, some of the alternate benchmarks are overly protective for some receptors and may not have been available in some cases. For example, the EDQLs and PRGs for soil may be based on risks to small mammals. Therefore, an exceedance of that EDQL does not necessarily indicate that potential risks to plants or invertebrates exist, so other more appropriate benchmarks were used to evaluate potential risks to those receptors (as was conducted in Tables 7–4 and 7–5). Use of these alternate benchmarks was case-specific. Additionally, screening values may not have been available for some chemicals in some media. For example, chemicals retained as COPCs in Tables 7–1, 7–2, and 7–3 are evaluated in Step 3a using alternate benchmarks when available.

### 7.5.5 Terrestrial Food Chain Modeling

Terrestrial intake modeling was used to estimate the exposure of the COPCs to terrestrial wildlife receptors and to evaluate potential risks to terrestrial wildlife ingestion of the soil, surface water, plants, invertebrates, and small mammals. Note that the food chain model incorporates chemical concentrations that are estimated into various food items (i.e., plants, invertebrates), but it does not model the amount of chemical transferred from one trophic level to the next. Chemicals evaluated in the terrestrial food chain model were limited to those identified by the USEPA as bioaccumulative (USEPA, 2000). Although wildlife may be exposed to non-bioaccumulative chemicals via direct ingestion of the media (i.e., soil), the exposure to the chemical will be low compared to the exposure to bioaccumulative chemicals through the food. It is common practice to only include bioaccumulative chemicals in food chain models and this approach results in more chemicals being included in the food chain model than what is required by Ohio EPA (2003) in their risk assessment guidance. In Attachment A, Section 2, of Ohio EPA (2003), it states that “Food-web and direct contact evaluations are required for a Level III ERA and are dependent upon the type of contamination and the affected media. … Persistent, bioaccumulative and toxic (PBT, see Level II ERA guidance) compounds are also to be evaluated using direct contact and food-web models…” The Ohio PBT list is only a subset of the list of bioaccumulative chemicals. Therefore, only bioaccumulative chemicals were included in the food chain model.

Risk to terrestrial receptors from COPCs in the soil, surface water, and prey is determined by estimating the chronic daily intake (CDI) and comparing the CDI to toxicity reference value (TRVs) representing acceptable daily doses in mg/kg/day. The TRVs are developed from NOAELs and LOAELs obtained from wildlife studies, if available. The majority of the TRVs are obtained from the ORNL *Toxicological Benchmarks for Wildlife,* 1996 revision (Sample et al., 1996). Other sources for NOAELs and LOAELs were used as necessary. Appendix W presents the TRVs that are used in this report and the derivation of the TRVs using the body-weight scaling equation presented below.

For avian species, the NOAEL (or LOAEL) for the test species is used as the NOAEL (or LOAEL) for the surrogate species in accordance with Sample et al. (1996). For mammalian species, the NOAEL (or LOAEL) from one species is adjusted to a NOAEL (or LOAEL) for the surrogate species using the following body-weight scaling equation from Sample et al. (1996):

$$\text{NOAELw} = \text{NOAELt} * (\text{bwt}/\text{bww})^{0.25}$$

Where: NOAELw = no-observed-adverse-effect-level for the surrogate wildlife species
NOAELt = no-observed-adverse-effect-level for the test species
bwt = body weight of the test species
bww = body weight of the surrogate test species

The body-weight scaling is done because studies have shown that, for mammals, numerous physiological functions such as metabolic rate, as well as responses to toxic chemicals, are a function of body size (Sample et al., 1996). However, Sample et al. (1996) indicated that physiological scaling factors may not be appropriate for birds. Therefore, no body-weight scaling was conducted for the bird TRVs. No avian TRVs were available for PAHs, so a default of 2 mg/kg/d was used for the NOAEL. Appendix W presents the body weights that are used for the surrogate and potential test species.

The Ravenna ERA guidance provided one set of TRVs that were either based on NOAELs, or based on LOAELs that were divided by 10. Therefore, LOAEL TRVs were estimated by multiplying the TRVs from the Ravenna ERA guidance by 10.

#### *7.5.5.1 Characterization of Exposure*

This section describes the potential or actual contact or co-occurrence of the contaminants with the receptors to determine their exposure dose.

Terrestrial soil invertebrates and plants are exposed to contaminants in the surface soil through direct contact, ingestion, or both. Aquatic organisms are exposed to contaminants in the surface water and sediment through direct contact, ingestion, or both. The maximum or selected upper confidence level (UCL) (whichever is lower) and average soil and/or surface water concentrations are used in the food chain model to obtain a range of exposure from ingestion of soil, surface water, or both.

Exposure of the terrestrial receptors to the COPCs in the surface soil and surface water is determined by estimating the daily doses in mg/kg/day using exposure equations. The contaminant concentrations in the surface soil and surface water are used to calculate the CDI doses. The following equation presents the food chain model that is used for the surrogate species that are selected for modeling:

$$\text{CDI Dose (mg/kg/day)} = \frac{(FI * FC) + (WI * C_{Sw}) + (SI * C_{Ss})}{BW}$$

Where: CDI = chronic daily intake (mg/kg/day)
FI = food ingestion rate (kg/day)
FC = food concentration (mg/kg)
WI = surface water ingestion rate (L/day)
$C_{Sw}$ = contaminant concentration in surface water (mg/L)
BW = body weight (kg)
SI = incidental soil ingestion rate (kg/day)
$C_{Ss}$ = contaminant concentration in surface soil (mg/kg)

For inorganic and organic constituents in surface soil, the contaminant concentration of the prey items (i.e., earthworms) is calculated using the following equation:

$$FC = C_{Ss} * BAF$$

Where: FC = contaminant concentration in food (mg/kg)
$C_{Ss}$ = contaminant concentration in soil (mg/kg)
BAF = bioaccumulation factor (chemical-specific)

For inorganic and organic constituents in small mammal tissue, the contaminant concentration of the prey items (i.e., small mammal) is calculated using the following equation:

$$FC = C_{Ss} * BAF_{si} * BAF_{dm}$$

Where: FC = contaminant concentration in food (mg/kg)
$C_{Ss}$ = contaminant concentration in surface soil (mg/kg)
$BAF_{si}$ = bioaccumulation factor for soil to invertebrate (chemical-specific)
$BAF_{dm}$ = bioaccumulation factor for diet to mammal (chemical-specific)

The exposure assumptions (i.e., ingestion rate, body weight) are obtained from the RVAAP ecological risk guidance (USACE, 2003). Appendix W presents the exposure parameters that are used in the SERA. Note that the receptors' home ranges are not used quantitatively in the food chain model. However, the home ranges are discussed qualitatively in the Step 3a evaluation and uncertainty analysis section, when applicable. The receptors home ranges were not quantitatively used in the food chain model because the home ranges for most of the receptors were less than the size of LL9 (69 acres). Although the home ranges for the owl, fox, and hawk are greater than 69 acres (see Table W-5), the home ranges were not used in the initial food chain to be conservative. If the HQs from the conservative food chain model for the owl, fox, and hawk are greater than 1.0, the home ranges would be quantitatively used for the refinement.

#### *7.5.5.2 Ecological Risk Characterization*

The risk characterization is the final phase of a risk assessment that compares the exposure to the ecological effects. It is at this phase that the likelihood of adverse effects occurring as a result of exposure to a stressor will be evaluated. The HQ approach (as described in Section 7.4) is used to characterize the risk to terrestrial receptors. This approach characterizes the potential effects by comparing exposure concentrations with the effects data. An HQ greater than 1.0 is considered to indicate a potential risk. The HQ is not an expression of probability, and the significance of values greater than 1.0 must be interpreted carefully, considering the number of uncertainties associated with the SERA process.

The HQ for the terrestrial wildlife model is calculated as follows:

$$HQ = DOSE / TRV$$

Where: HQ = ecological Effects Quotient (unitless)
Dose = daily intake dose (mg/kg/day)
TRV = toxicity reference value (NOAEL or LOAEL) (mg/kg/day)

## 7.6 Step 3a Refinement

Subsequent to the initial screening, other factors are considered to further refine COPCs, as discussed in Section 7.5. The following sections present the results of the Step 3a refinement.

### 7.6.1 Risks to Terrestrial Plants and Invertebrates – Surface Soil

Potential risks to terrestrial plants and terrestrial invertebrates from exposure to COPCs were evaluated using the methodologies described in Section 7.5.1. The following subsections discuss whether the chemicals initially selected as COPCs should be retained for further evaluation of risks to soil invertebrates and terrestrial vegetation. Note that bioaccumulative chemicals that were detected at concentrations less than their respective screening levels are not discussed in the following sections because the chemicals are not COPCs for risks to plants and invertebrates (see Table 7–1).

Tables 7–4 and 7–5 summarize the results of potential direct toxicity of chemicals in soil to earthworms and plants, respectively. The tables list only the chemicals that were retained as COPCs because they were detected at concentrations that exceeded screening levels or they did not have screening levels. Both maximum and average concentrations are compared to the toxicity benchmarks for earthworms and plants. Chromium, copper, mercury, and zinc were the only chemicals with maximum detected concentrations that were greater than the earthworm toxicity benchmarks; however, the average chemical concentrations for these chemicals were less than the benchmarks. Aluminum toxicity is dependent on the pH of the soil. Arsenic, chromium, copper, lead, manganese, mercury, selenium, and zinc were the only chemicals with maximum concentrations that were greater than the plant toxicity benchmarks; the average chemical concentration for manganese was also greater than the benchmarks. Aluminum and iron toxicity are dependent on the pH of the soil. Earthworm and/or plant benchmarks were not available for several of the chemicals.

The following text presents the Step 3a evaluation for the chemicals listed above that were detected at concentrations greater than the earthworm or plant toxicity benchmarks and chemicals that do not have earthworm or plant toxicity benchmarks.

Dibenzofuran

Dibenzofuran was initially selected as a COPC because a screening level was not available. Additional toxicity information for dibenzofuran is not available; therefore, this chemical was further evaluated using the other Step 3a factors listed in Section 7.5.4. This analyte was detected in 2 of 13 sample locations. The maximum concentration is at LL9SS–068–0001–SO, which is a wooded area where surface debris (glass, metal, and other rubbish) was found. The other detection is from a subsurface sample collected under the soil subfloor of a building (LL9SB–050–0001–SO). Because of the lack of toxicity data for dibenzofuran, its relatively low frequency of detection, and its relatively low maximum detected concentration (13 µg/kg), it is not likely that dibenzofuran is significantly affecting plants or invertebrates at LL9. Therefore, risks from dibenzofuran are not likely and it was not retained as a COPC.

Nitroguanidine

Nitroguanidine was initially selected as a COPC because a screening level was not available. Additional toxicity information for nitroguanidine is also not available; therefore, this chemical was further evaluated using the Step 3a factors listed in Section 7.5.4. This analyte was detected in 1 of 9 samples, with the detection found in the surface soil at LL9SS–034–0001–SO. A duplicate sample collected from this location was non-detect for nitroguanidine, so the initial detection could be an anomaly that is not representative of site contamination. Therefore, risks from nitroguanidine are not likely and nitroguanidine was not retained as a COPC.

RDX

RDX was initially selected as a COPC because a screening level was not available. The following alternate toxicity information for RDX was located:

- Plants – 100 mg/kg (Talmage et al., 1999); and
- Lowest-Observed-Effect Concentration for earthworm reproduction – 95 mg/kg (Robidoux et al., 2000).

The plant benchmark of 100 mg/kg from Talmage et al. (1999) is from a study in which an RDX concentration of 100 mg/kg significantly reduced the biomass of cucumber plants. The LOEC for earthworm reproduction was based on the productivity of juveniles (total number of juveniles, biomass, and number of juveniles per hatched cocoon) being significantly reduced by RDX at 95 mg/kg in soil; a no-observed-effect concentration (NOEC) was not generated from the study (Robidoux et al., 2000).

RDX was detected in 1 of 21 samples, with the detection at LL9SB–053–0001–SO. Because a duplicate sample collected from this location was non-detected for RDX, the average soil concentration for LL9 is 37 mg/kg. The average LL9 RDX concentration is less than both the plant and invertebrate benchmarks. Because the average RDX concentration at LL9 is less than the benchmarks and given the low frequency of detection, risks to plants and invertebrates are not likely and RDX was not retained as a COPC.

Aluminum

Aluminum was initially selected as a COPC because the maximum detected concentration (20,000 mg/kg) exceeded the ORNL plant benchmark of 50 mg/kg (Efroymson et al., 1997c). However, the screening value is the toxicological benchmark to protect plants and is based on laboratory toxicity testing using soluble aluminum added to soils. The standard analytical measurement of aluminum in soils is total recoverable aluminum (soluble + fixed). Comparison of total aluminum concentration in soils to soluble aluminum-based benchmarks and screening values is probably not appropriate. According to the Eco-SSL benchmark, aluminum is considered a COPC only when the pH is less than 5.5 (USEPA, 2003b). Although pH data are not available at LL9, the average pH values for LL 2, 3, and 4 are greater than 5.5 S.U. (SAIC, 2003a, 2003b, and 2003c); therefore, it is likely that soil pH at LL9 is also greater than 5.5 S.U. Additionally, the maximum concentration is slightly greater than the background concentration (17,700 mg/kg). With the detected considerations, potential impacts from aluminum are unlikely. Consequently, risks to plants and invertebrates from aluminum are not likely and aluminum is not retained as a COPC. Therefore, aluminum is not considered toxic to plants and invertebrates and was not retained as a COPC.

Arsenic

Arsenic was initially selected as a COPC because the maximum detected concentration (32 mg/kg) exceeded the ORNL PRG of 9.9 mg/kg (Efroymson, et al., 1997a). The PRG is based on risks to wildlife (short-tailed shrew) and plants. Alternate benchmarks were used to further evaluate risks to soil receptors. The maximum concentration is less than the ORNL earthworm benchmark of 60 mg/kg (Efroymson et al., 1997b), but is greater than the Eco-SSL plant benchmark or 18 mg/kg (USEPA, 2005a). Although potential risks to plants are possible, the risks are not great enough to warrant retaining arsenic as a COPC for further evaluation in the BERA for several reasons. The maximum detected arsenic concentration of 32 mg/kg is only two times greater than the background concentration (15.4 mg/kg). Therefore, the average arsenic concentration of 12.3 mg/kg was compared to the Eco-SSL plant benchmark to determine whether risks are widespread. Because the average concentration is less than the Eco-SSL plant benchmark and the background concentration, the overall site contamination is low and further evaluation of risks to plants in the BERA is not necessary. Therefore, risks to plants and invertebrates from arsenic are not likely and arsenic is not retained as a COPC.

Chromium

Chromium was retained as a COPC in soil because the maximum concentration of 110 mg/kg exceeded the ORNL PRG of 0.4 mg/kg (Efroymson et al., 1997a). The Canadian soil quality guideline (SQG) for chromium is 64 mg/kg (EC, 1999a), which is based on direct soil contact. Only the maximum concentration at LL9SS–024–0001–SO exceeded this alternate benchmark. This sample is located adjacent to an unused water tower (Figure 3–1). Because only 1 out of the 85 samples exceeded the Canadian SQG, risks to plants and invertebrates are not likely and chromium was not retained as a COPC.

Copper

Copper was retained as a COPC in soil because the maximum concentration of 1,240 mg/kg at LL9SS–011–0001–SO exceeded the ORNL PRG of 60 mg/kg (Efroymson et al., 1997a). Alternate benchmarks were used to further evaluate risks to soil receptors. The Canadian SQG for copper is 63 mg/kg (EC, 1999b) and the ORNL plant benchmark for copper is 100 mg/kg (Efroymson et al., 1997c). Only 2 of the 85 sample locations (LL9SS–011–0001–SO and LL9SS–068–0001–SO) exceed both of these benchmarks. Sample LL9SS–011–0001–SO is a subfloor sample collected where a detonator destroying house with a wood frame and a sand floor used to be. The explosives that were destroyed in this building included lead azide and mercury fulminate; but other metals, such as copper, may have been present in these explosives as well. Location LL9SS–068–0001–SO, with a copper concentration of 170 mg/kg, is a wooded area where surface debris (glass, metal, and other rubbish) was found, so it is likely that the copper is associated with this debris. Although only 2 of the 85 samples had copper concentrations that exceeded the benchmarks, because of the elevated copper concentrations at these locations, copper was retained as a COPC for further evaluation.

Iron

Iron was initially selected as a COPC because both the maximum (76,000 mg/kg) and average (22,357 mg/kg) soil concentrations greatly exceeded the screening level based on toxicity to microorganisms (200 mg/kg) (Efroymson et al., 1997b). According to the Eco-SSL for iron (USEPA, 2003c), iron is essential for plant growth, and is generally considered to be a micronutrient. Because plants regulate its uptake, iron is not expected to be toxic to plants in well-aerated soils with pH levels between 5 and 8 S.U. (USEPA, 2003c). Although soil pH data have not been collected at LL–9, the average soil pH levels at LL 2, 3, and 4 were within the pH range of 5 to 8 S.U. (SAIC, 2003a, 2003b, and 2003c). Therefore, iron is not expected to be toxic to plants at this site. No toxicity data were available to evaluate risks to invertebrates from iron. However, because iron is generally considered a non-toxic metal, it is highly unlikely that soil invertebrates are being affected by iron at the site. For these reasons, risks to plants and invertebrates from iron are not likely and iron is not retained as a COPC.

Lead

Lead was initially selected as a COPC in soil because the maximum concentration of 1,330 mg/kg at LL9SS–011–0001–SO exceeded the ORNL PRG of 40.5 mg/kg (Efroymson et al., 1997a). Alternate benchmarks were used to further evaluate risks to soil receptors. The maximum concentration is less than the Eco-SSL invertebrate benchmark of 1,700 mg/kg (USEPA, 2005b). However, the maximum concentration is greater than the Eco-SSL plant benchmark of 120 mg/kg (USEPA, 2005b). The location of the maximum concentration (LL9SS–011–0001–SO) is a soil subfloor from a building where detonators were destroyed. One of the explosives destroyed in this building was lead azide, which would explain the high lead concentration. Four additional locations (LL9SS–003–0001–SO, LL9SS–006–0001–SO, LL9SS–024–0001–SO, and LL9SS–068–0001–SO) throughout LL9 have lead concentrations that are greater than the plant benchmark with concentrations ranging from 140 mg/kg to 320 mg/kg. Risks to invertebrates from lead are not anticipated, but risks to plants are possible. Therefore, lead was retained as a COPC for further evaluation.

Manganese

Manganese was selected as a COPC in soil because the maximum concentration of 3,800 mg/kg at LL9SS–027–0001–SO exceeded the ORNL screening level of 100 mg/kg based on toxicity to microorganisms (Efroymson et al., 1997b). Alternate benchmarks were used to further evaluate risks to soil receptors. No benchmark was available for earthworms, but the maximum and average concentrations exceed the ORNL plant benchmark of 500 mg/kg (Efroymson et al., 1997c). Of the 85 samples, only four samples had concentrations (2,000 mg/kg and 3,800 mg/kg) greater than the background concentration (1,450 mg/kg). Two samples were located adjacent to sumps (LL9SS–040–0001–SO and LL9SS–041–0001–SO), and the other two were on the LL–9 boundary (LL9SS–027–0001–SO and LL9SS–031–0001–SO) (Figure 3–1). Because the location with the greatest manganese concentration is several hundred feet from the load line, it is likely that the elevated manganese concentrations greater than background are not related to site activities. Although risks to earthworms cannot be determined because of lack of toxicity data, because manganese does not appear to be site-related, it was not retained as a COPC.

Mercury

Mercury was initially selected as a COPC because the maximum soil concentration of 882 mg/kg at LL9SS–011–0001–SO exceeded the ORNL PRG of 0.00051 mg/kg, which is based on risks to the woodcock. Because this benchmark is based on risks to wildlife, alternate benchmarks were used to evaluate risks to soil receptors. The Canadian SQG of 12 mg/kg (EC, 1999c) was used to evaluate risks to earthworms and plants. The location of the maximum is a soil subfloor from a building where detonators were destroyed. One of the explosives destroyed in this building was mercury fulminate, which would explain the high mercury concentration. One sample (plus a duplicate) was taken approximately 50 ft from this location (LL9SS–034–0001–SO) (Figure 3–1). At this location, the average concentration of mercury is 14.5 mg/kg, which is greater than the Canadian SQG. All other sample concentrations were less than the SQG. Because of the extremely elevated mercury concentration at LL9SS–011–0001–SO and the possibility of contaminant migration, and because risks to plants and invertebrates are possible, mercury was retained as a COPC for further evaluation.

Selenium

Selenium was initially selected as a COPC because the maximum soil concentration of 1.8 mg/kg at LL9SS–068–0001–SO exceeded the ORNL PRG of 0.21 mg/kg (Efroymson et al., 1997a), which is based on risks to mice. Because this benchmark is based on risks to wildlife, alternate benchmarks were used to evaluate risks to soil receptors. The ORNL earthworm benchmark is 70 mg/kg (Efroymson et al., 1997b). The ORNL plant benchmark is 1 mg/kg (Efroymson et al., 1997c). All results were less than the earthworm benchmark. Three locations had concentrations that slightly exceeded the plant benchmark, but only the maximum concentration exceeded the background concentration (1.4 mg/kg). Therefore, most of the selenium concentrations are not likely to be site-related. The location of the maximum detection (LL9SS–068–0001–SO) is a wooded area where surface debris (glass, metal, and other rubbish) was found. Because the maximum concentration only slightly exceeded the background concentration, risks to plants and invertebrates are not likely and selenium was not retained as a COPC.

Zinc

Zinc was initially selected as a COPC because the maximum soil concentration of 780 mg/kg at LL9SS–068–0001–SO exceeded the ORNL PRG of 8.5 mg/kg, which is based on dietary toxicity to the woodcock. Because this benchmark is based on risks to wildlife, alternate benchmarks were used for risks to soil receptors. The selected alternate benchmark for risks to invertebrates and plants was the Canadian SQG of 200 mg/kg (EC, 1999f). The average zinc concentration (87.6 mg/kg) is less than this benchmark, but a few locations across LL9 have zinc concentrations that exceed the SQG. The two highest concentrations are at LL9SS–011–0001–SO (711 mg/kg) and LL9SS–068–0001–SO (780 mg/kg). Sample LL9SS–011–0001–SO was collected from the subfloor of a building where detonators were destroyed. The explosives that were destroyed in this building included lead azide and mercury fulminate; but other metals, such as zinc, may have been present in these explosives as well. Location LL9SS–068–0001–SO (with a zinc concentration of 780 mg/kg) is a wooded area where surface debris (glass, metal, and other rubbish) was found, so it is likely that the zinc is associated with this debris. The three additional locations had zinc concentrations that slightly exceeded the SQG with concentrations ranging from 210 mg/kg to 290 mg/kg. Although only 2 of the 85 samples had zinc concentrations that significantly exceeded the SQG, because of the elevated zinc concentrations at these locations, zinc was retained as a COPC for further evaluation.

Nitrocellulose

Nitrocellulose was initially selected as a COPC because a screening level was not available. Although it is probable that nitrocellulose is related to the site, it is typically considered to be a relatively inert compound, so it is unlikely to affect plants or invertebrates. Therefore, it was not retained as a COPC for risks to plants or invertebrates.

Summary of Risks to Terrestrial Plants and Invertebrates

As presented above, a few sample locations had concentrations of metals that were greater than invertebrate and/or plant benchmarks, indicating that risks are possible to these receptors at those locations. The location with the greatest concentrations of several metals – copper, lead, mercury, and zinc – was LL9SS–011–0001–SO. This was a subfloor sample collected in a detonator destroying house where explosives, including lead azide and mercury fulminate, were destroyed. An elevated, but much lower, mercury concentration was also found at sample location LL9SS–034–0001–SO, which was about 50 ft from LL9SS–011–0001–SO; but the copper, lead, and zinc concentrations were low at that location. It is not known whether the detonator destroying house is the source of mercury at LL9SS–034–0001–SO. The extent of the elevated levels of metals at LL9SS–011–0001–SO is not known because there are no samples to the west and southwest to bound the contamination. Based on a review of the aerial photo in Appendix C, however, the area surrounding LL9SS–034–0001–SO is heavily vegetated and does not appear to be significantly affected by metals at this location.

LL9SS–068–0001–SO had concentrations of several metals that exceeded benchmarks for invertebrates and/or plants. This location was described as being in a wooded area where surface debris such as glass, metal, and other rubbish was present. Therefore, it is likely that the debris is the source of metals in the soil. However, because the location is in a wooded area, where vegetation is present, it is not likely that significant impacts on plants and invertebrates are occurring.

A few other locations across LL–9 had metals with concentrations that slightly exceeded benchmarks for invertebrates and/or plants, but these sporadic exceedances are not likely to significantly affect plants and invertebrates across the site. As can be seen from the aerial photograph and the site photographs in Appendix C, the site is well vegetated except in the areas where there is considerable vehicle traffic.

### 7.6.2 Risks to Benthic Invertebrates – Sediment

Potential risks to benthic invertebrates from exposure to COPCs were evaluated using the methodologies described in Section 7.5.2. Sediment samples were collected from sewer manholes at LL9SD–009–0001–SD and LL9SD–010–0001–SD. These sewers do not discharge in LL–9, so there is not a direct pathway to ecological receptors. Therefore, these sediment samples were not included in the risk assessment. The following subsections discuss whether the chemicals initially selected as COPCs should be retained for further evaluation of risks to benthic invertebrates.

Table 7–6 summarizes the results of potential direct toxicity of chemicals in sediment to benthic invertebrates. The table lists only the chemicals that were retained as COPCs because they were detected at concentrations that exceeded screening levels or they did not have screening levels. Table 7–6 presents the average chemical concentrations compared to the same screening levels that were used to select chemicals as COPCs because the COPC screening table (Table 7–2) only presented the comparison of the maximum concentrations to the screening levels. Table 7–6 also presents the maximum and average concentrations compared to the higher effects levels (i.e., the PEC, as discussed in Section 7.5.2) for benthic invertebrates to indicate the range of probability of effects. The following text presents the Step 3a evaluation for the chemicals listed in Table 7–6.

Bis(2–ethylhexyl)phthalate

Bis(2–ethylhexyl)phthalate was retained as a COPC because the maximum concentration of 660 µg/kg at LL9SD–015–0001–SD exceeded the screening level. An alternative benchmark was used to further evaluate risks to benthic invertebrates. The detected concentration is less than the AET of 1,300 µg/kg (Buchman, 1999). Bis(2–ethylhexyl)phthalate is also a common laboratory contaminant. Therefore, risks to benthic invertebrates are not likely and bis(2–ethylhexyl)phthalate was not retained as a COPC.

Dibenzo(a,h)anthracene

Dibenzo(a,h)anthracene was retained as a COPC because the maximum concentration of 43 µg/kg at LL9SD–015–0001–SD exceeded the screening level. An alternate benchmark was used to further evaluate risks to benthic invertebrates. The maximum (43 µg/kg) and average (22.4 µg/kg) concentrations are less than the SEL of 1,989 µg/kg (OMOE, 1993) which was calculated using 1.53% total organic carbon (TOC) (average TOC at the site). Also, the drainage ditches where sediment samples were collected are not wet year-round and are not likely to support benthic invertebrates for most of the year. Therefore, risks to benthic invertebrates are not likely and dibenzo(a,h)anthracene was not retained as a COPC.

Beryllium

Beryllium was initially selected as a COPC because a sediment screening level was not available and the maximum concentration exceeded the RVAAP background concentration (0.38 mg/kg) and the Ohio SRV (0.8 mg/kg). No toxicity benchmarks for benthic invertebrates were available, but only two sample locations (LL9SD–001–0001–SD and LL9SD–012–0001–SD) had beryllium concentrations that were slightly greater than the Ohio SRV, with concentrations of 0.99 and 0.86 mg/kg, respectively. Because these concentrations only slightly exceed the Ohio SRV, beryllium concentrations are unlikely related to site activities. In addition, all sediment samples were collected from drainage ditches that are wet only during rain events and are unlikely to support benthic organisms for most of the year. Therefore, risks from beryllium to benthic invertebrates at LL–9 are not likely and beryllium was not retained as a COPC.

Lead

Lead was initially selected as a COPC because the maximum concentration of 100 mg/kg at LL9SD–013–0001–SD exceeded the Threshold Effects Concentration (TEC) of 35.8 mg/kg (MacDonald et al., 2000) and the Ohio SRV of 47 mg/kg. An alternate screening level was used to further evaluate risks to benthic invertebrates. The Probable Effects Concentration (PEC) for lead is 128 mg/kg (MacDonald et al., 2000). Because the maximum concentration is less than this benchmark, and because the drainage ditches where sediment samples were collected are not likely to support benthic organisms for most of the year, risks from lead are not likely and lead was not retained as a COPC.

Mercury

Mercury was initially selected as a COPC because the maximum concentration of 2.9 mg/kg at LL9SD–012–0001–SD exceeded the TEC of 0.18 mg/kg (MacDonald et al., 2000) and the Ohio SRV of 0.12 mg/kg. An alternate screening level was used to further evaluate risks to benthic invertebrates. The PEC for mercury is 1.06 mg/kg (MacDonald et al., 2000). Because the maximum concentration exceeded the higher effects benchmark, and because the concentration is much greater than the background concentration and the Ohio SRV, risks to benthic invertebrates are possible at LL9SD–012–0001–SD, so mercury was retained as a COPC for further evaluation. Mercury was also detected at a concentration of 9.7 mg/kg in a nearby surface soil sample location (LL9SS–065–0001–SO), which may be the source of the mercury in the sediment. As discussed above, the drainage ditches are not likely to support benthic invertebrates for most of the year owing to lack of suitable habitat, so the significance of the possible risks to invertebrates is likely to be low.

Selenium

Selenium was initially selected as a COPC because a sediment screening level was not available, and the maximum detected concentration of 2.1 mg/kg at LL9SD–004–0001–SD exceeded the RVAAP background concentration (1.7 mg/kg) and the Ohio SRV (1.7 mg/kg). The AET for selenium is 1.0 mg/kg (Buchman, 1999). The maximum and average selenium concentrations exceed this benchmark, but the concentrations only slightly exceeded the background concentration and Ohio SRV. Therefore, selenium concentrations are unlikely to be site-related. Also, all of the sediment samples were collected from drainage ditches. These ditches are wet only during rain events, so it is unlikely that they can support benthic invertebrates for most of the year. Therefore, risks from selenium to benthic invertebrates at LL–9 are not likely and selenium was not retained as a COPC.

Nitrocellulose

Nitrocellulose was initially selected as a COPC because a screening level was not available. Although it is probable that nitrocellulose is related to the site, it is typically considered to be a relatively inert compound, so it is unlikely to affect benthic invertebrates. Also, because of the general lack of habitat for benthic invertebrates in the drainage ditches (as discussed above), risks from nitrocellulose to benthic invertebrates at LL–9 are not likely and nitrocellulose was not retained as a COPC.

Summary of Risks to Benthic Invertebrates

A few chemicals were initially selected as COPCs in the sediment because they were either detected at concentrations that exceeded screening levels or they did not have screening levels. Based on the Step 3a refinement, mercury, at one location, was the only chemical that may pose a risk to benthic invertebrates. However, as discussed above, the drainage ditches are not wet throughout the year, so benthic invertebrates would be present only at certain times. Therefore, the significance of the possible risks is likely to be low.

### 7.6.3 Risks to Aquatic Organisms – Surface Water

Potential risks to aquatic receptors from COPCs were further evaluated according to the methodologies described in Section 7.5.3. Surface water samples were collected from sumps at LL9SW–007–0001–SW and LL9SW–008–0001–SW. These sumps have since been backfilled and are no longer present at the site, so they were not included in the risk assessment. Also, surface water samples were collected from sewer manholes at LL9SW–009–0001–SW and LL9SW–010–0001–SW. These sewers do not discharge in LL–9, so there is not a direct pathway to ecological receptors. Therefore, these surface water samples were not included in the risk assessment. The following subsections discuss whether the chemicals initially selected should be retained for further evaluation of risks to aquatic receptors.

Aluminum

Aluminum was initially selected as a COPC because the maximum surface water concentration of 17,800 µg/L at location LL9SW–005–0001–SW exceeded the AWQC screening level of 87 µg/L (USEPA, 2002) and the RVAAP background concentration (3,370 µg/L). The samples with high aluminum concentrations also had high or medium-high turbidity with water levels approximately 0.3 ft deep when the samples were collected. The actual impact on aquatic receptors at these locations is not known because of the high level of suspended solids (i.e., relatively low bioavailability) and the poor aquatic habitat in the ditches. Risks at most of the sample locations are not expected to be site-related because the concentrations are less than background. However, concentrations of aluminum at two of the locations above the AWQC and the RVAAP background criteria indicate possible risks to aquatic organisms present in the ditches. Therefore, aluminum was retained as a COPC for risks to aquatic organisms in surface water for further evaluation.

Copper

Copper was initially selected as a COPC because the maximum concentration of 20 µg/L at LL9SW–003–0001–SW exceeded the Ohio water quality criteria (WQC) of 4.76 µg/L (Ohio EPA, 2004) and the RVAAP background concentration (7.9 µg/L). The Ohio WQC is based on the minimum water hardness of 33.2 mg/L at LL9SW–001–0001–SW. The maximum hardness occurs at LL9SW–003–0001–SW. The Ohio WQC for LL9SW–003–0001–SW (using a hardness of 191.8 mg/L from this location) is 24.8 µg/L. The maximum copper concentration is less than this benchmark. However, the Ohio WQC for LL9SW–002–0001–SW (using a hardness of 37.1 mg/L from this location) is 5.28 µg/L. The concentration of copper at that location (5.8 µg/L) slightly exceeds this benchmark. Also, the Ohio WQC for LL9SW–005–0001–SW (using a hardness of 56.8 mg/L from this location) is 7.88 µg/L. The concentration of copper at that location (18.6 µg/L) exceeds this benchmark. Although the drainage ditches are unlikely to support aquatic organisms, because the copper concentration at LL9SW–005–0001–SW is greater than two times the Ohio WQC for the location, risks to aquatic receptors from copper are possible and copper was retained as a COPC for further evaluation.

Iron

Iron was initially selected as a COPC because the maximum concentration of 20,000 µg/L at location LL9SW–002–0001–SW exceeded the surface water screening level of 1,000 µg/L (USEPA, 2002) and the RVAAP background concentration (2,560 µg/L). The location of the maximum detection was described as being orange in color, which indicates high iron and mineral content. The other locations with concentrations greater than the screening level had high or medium-high turbidity, so the level of suspended solids is high (relatively low bioavailability). All of the surface water samples were collected from drainage ditches with little habitat for aquatic receptors. However, because four of the six samples contained iron concentrations above the screening level and site background, risks to aquatic organisms from iron are possible and iron was retained as a COPC for further evaluation.

Lead

Lead was initially selected as a COPC because the maximum concentration of 70 µg/L at LL9SW–003–0001–SW exceeded the Ohio WQC of 23.8 µg/L (Ohio EPA, 2004), which is based on the minimum water hardness (33.2 mg/L) at LL9SW–001–0001–SW. The maximum hardness is located at LL9SW–003–0001–SW. The Ohio WQC for lead at LL9SW–003–0001–SW (using a hardness of 191.8 mg/L from this location) is 222 µg/L. The maximum concentration is less than this benchmark. However, the Ohio WQC for LL9SW–005–0001–SW (using a hardness of 56.8 mg/L from this location) is 47.1 µg/L. The concentration of lead at this location (62.9 µg/L) is greater than the benchmark. Although the drainage ditches provide little habitat for aquatic receptors, because the concentration at LL9SW–005–0001–SW is greater than the benchmark, risks to aquatic receptors from lead are possible and lead was retained as a COPC for further evaluation.

Manganese

Manganese was initially selected as a COPC because a surface water screening level was not available and because the maximum surface water concentration of 1,400 µg/L at LL9SW–003–0001–SW exceeded the RVAAP background concentration of 391 µg/L.

The ORNL chronic benchmark (120 µg/L) was developed using the Tier II method described in the USEPA's 1993 Proposed Water Quality Guidance for the Great Lakes System (Suter and Tsao, 1996). Tier II values were developed so that aquatic benchmarks could be established with fewer data than are required for the USEPA water quality criteria. Tier II values are concentrations expected to be higher than WQC in no more than 20% of cases (Suter and Tsao, 1996). In the USEPA's 1986 Quality Criteria for Water (the Gold Book), it states that ions of manganese are found rarely at concentrations greater than 1 mg/L; and because the tolerance values reported range from 1.5 mg/L to over 1,000 mg/L, manganese is not considered to typically be a problem in fresh waters (USEPA, 1986). The ORNL benchmark is likely lower than the tolerance values cited in the Gold Book because of the numerous uncertainty factors used to calculate the benchmark (Suter and Tsao, 1996).

All of the detections were less than the minimum tolerance value (1,500 µg/L) cited in USEPA (1986), so impacts to aquatic organisms are not expected. Also, as discussed previously in this SERA, there is very little aquatic habitat in the ditches, so there is unlikely to be a significant population of aquatic receptors. Therefore, risks to aquatic receptors from manganese at LL–9 are not likely and manganese was not retained as a COPC.

<u>Mercury</u>

Mercury was initially selected as a COPC because the maximum concentration of 1.7 µg/L at LL9SW–012–0001–SW exceeded the screening level of 1.4 µg/L (Ohio EPA, 2004). A duplicate sample was taken from the location of the maximum, and the average concentration at this location (1.0 µg/L) is less than the screening value. Also, the overall average mercury concentration for LL–9 (0.341 µg/L) is less than the screening level. As discussed above, there is very little aquatic habitat in the ditches where the surface water samples were collected, so there is unlikely to be a significant population of aquatic receptors. Therefore, risks to aquatic receptors from mercury at LL–9 are not likely and mercury was not retained as a COPC.

<u>Zinc</u>

Zinc was initially selected as a COPC because the maximum concentration of 228 µg/L at LL9SW–005–0001–SW exceeded the Ohio WQC of 46 µg/L (Ohio EPA, 2004) and the RVAAP site background concentration (42 µg/L). The Ohio WQC is based on the minimum hardness (33.2 mg/L) at LL9SW–001–0001–SW. The Ohio WQC were recalculated based on the water hardness at the two locations (LL9SW–005–0001–SW and LL9SW–003–0001–SW) with screening level and background concentration exceedances. The Ohio WQC at LL9SW–005–0001–SW (using a water hardness of 56.8 mg/L from this location) is 73 µg/L. The zinc concentration at this location (228 µg/L) exceeds the benchmark. The Ohio WQC at LL9SW–003–0001–SW (using a water hardness of 191.8 mg/L from this location) is 204 µg/L. The zinc concentration at this location (190 µg/L) is less than the benchmark. Although the drainage ditches are not likely to support aquatic organisms, risks from zinc are possible at LL9SW–003–0001–SW, so zinc was retained as a COPC for further evaluation.

<u>Nitrocellulose</u>

Nitrocellulose was initially selected as a COPC because no water quality criteria were available. Nitrocellulose is generally considered to be an inert compound. Also, as discussed above, there is very little aquatic habitat in the ditches where the surface water samples were collected, so there is unlikely to be a significant population of aquatic receptors. Therefore, risks to aquatic receptors from nitrocellulose at LL–9 are not likely and nitrocellulose was not retained as a COPC.

Summary of Risks for Aquatic Organisms

Several chemicals were initially selected as COPCs in the surface water because they were either detected at concentrations that exceeded screening levels or they did not have screening levels. Based on the Step 3a refinement, it was determined that aluminum, copper, iron, lead, and zinc, at some locations may cause a risk to aquatic organisms. There are several uncertainties in this determination, however. Most of the samples with the elevated metals concentrations were turbid. Filtered samples were not collected, so the concentrations of dissolved metals (which is the bioavailable fraction) are not known. Also, because the drainage ditches are not wet throughout the year, significant populations of aquatic organisms are not likely to be present. Therefore, the significance of the possible risks to aquatic organisms is likely to be low.

## 7.7 Risks to Terrestrial Wildlife

A food chain model was used to evaluate potential risks posed by COPCs to upper-level terrestrial wildlife receptors. Section 7.5.5 describes the food chain model methodology. Chemicals evaluated in the terrestrial food chain model were limited to those identified by the USEPA as bioaccumulative (USEPA, 2000a). Separate discussions are provided below for evaluations of potential risk to insectivorous/herbivorous and carnivorous receptors. The maximum (or 95% UCL) concentration detected in the surface soil and surface water samples is used as the EPC for the conservative food chain model. The average concentration detected in the surface soil and surface water samples is used as the EPC for the average food chain model. Appendix W presents the spreadsheets used to calculate the doses and HQs.

### 7.7.1 Risks to Insectivorous/Herbivorous Species

Table 7–7 presents the terrestrial wildlife model HQs based on conservative input parameters for terrestrial surrogate species (meadow vole, short-tailed shrew, and American robin).

For PAHs, the NOAEL HQs in the conservative models are less than 1.0. However, the HQs in the conservative scenario exceed 1.0 for the following analytes and receptors:

- Arsenic NOAEL for the vole and shrew;
- Chromium NOAEL for the robin;
- Lead NOAEL for the robin and shrew;
- Lead LOAEL for the robin; and
- Zinc NOAEL for the robin.

# Table 7-7
# Terrestrial Food Chain Model -
# Conservative Scenario (Insectivorous, Herbivorous, and Carnivorous Receptors)

| | Herbivorous Receptor EEQs | | Insectivorous Receptors EEQs | | | | Carnovorous Receptors EEQs | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Meadow Vole | | American Robin | | Short-tailed Shrew | | Barn Owl | | Red Fox | | Red-Tailed Hawk | |
| Chemical | NOAEL | LOAEL | NOAEL | LOAEL | NOAEL | LOAEL | NOAEL | LOAEL | NOAEL | LOAEL | NOAEL | LOAEL |
| **Semivolatile Organics** | | | | | | | | | | | | |
| ACENAPHTHENE | 8.3E-04 | 8.3E-05 | 1.2E-03 | 1.2E-04 | 1.0E-03 | 1.0E-04 | NA | NA | NA | NA | NA | NA |
| ACENAPHTHYLENE | 3.5E-04 | 3.5E-05 | 5.4E-04 | 5.4E-05 | 5.3E-04 | 5.3E-05 | NA | NA | NA | NA | NA | NA |
| ANTHRACENE | 1.8E-03 | 1.8E-04 | 3.5E-03 | 3.5E-04 | 4.3E-03 | 4.3E-04 | NA | NA | NA | NA | NA | NA |
| BENZO(A)ANTHRACENE | 3.1E-03 | 3.1E-04 | 1.2E-02 | 1.2E-03 | 2.0E-02 | 2.0E-03 | NA | NA | NA | NA | NA | NA |
| BENZO(A)PYRENE | 2.5E-03 | 2.5E-04 | 1.2E-02 | 1.2E-03 | 2.0E-02 | 2.0E-03 | NA | NA | NA | NA | NA | NA |
| BENZO(B)FLUORANTHE | 2.6E-03 | 2.6E-04 | 1.2E-02 | 1.2E-03 | 2.0E-02 | 2.0E-03 | NA | NA | NA | NA | NA | NA |
| BENZO(G,H,I)PERYLENE | 1.2E-03 | 1.2E-04 | 6.6E-03 | 6.6E-04 | 1.2E-02 | 1.2E-03 | NA | NA | NA | NA | NA | NA |
| BENZO(K)FLUORANTHE | 1.6E-03 | 1.6E-04 | 7.3E-03 | 7.3E-04 | 1.3E-02 | 1.3E-03 | NA | NA | NA | NA | NA | NA |
| CHRYSENE | 3.4E-03 | 3.4E-04 | 1.3E-02 | 1.3E-03 | 2.1E-02 | 2.1E-03 | NA | NA | NA | NA | NA | NA |
| DIBENZO(A,H)ANTHRAC | 1.2E-03 | 1.2E-04 | 6.1E-03 | 6.1E-04 | 1.1E-02 | 1.1E-03 | NA | NA | NA | NA | NA | NA |
| FLUORANTHENE | 7.6E-03 | 7.6E-04 | 2.1E-02 | 2.1E-03 | 3.1E-02 | 3.1E-03 | NA | NA | NA | NA | NA | NA |
| FLUORENE | 5.4E-04 | 5.4E-05 | 8.6E-04 | 8.6E-05 | 9.2E-04 | 9.2E-05 | NA | NA | NA | NA | NA | NA |
| INDENO(1,2,3-CD)PYRE | 1.4E-03 | 1.4E-04 | 7.9E-03 | 7.9E-04 | 1.4E-02 | 1.4E-03 | NA | NA | NA | NA | NA | NA |
| PHENANTHRENE | 1.0E-02 | 1.0E-03 | 2.0E-02 | 2.0E-03 | 2.5E-02 | 2.5E-03 | NA | NA | NA | NA | NA | NA |
| PYRENE | 8.4E-03 | 8.4E-04 | 2.3E-02 | 2.3E-03 | 3.5E-02 | 3.5E-03 | NA | NA | NA | NA | NA | NA |
| **Inorganics** | | | | | | | | | | | | |
| ARSENIC | 1.0E+00 | 1.0E-01 | 1.7E-01 | 1.7E-02 | 7.2E+00 | 7.2E-01 | NA | NA | NA | NA | NA | NA |
| CADMIUM | 3.9E-03 | 3.9E-04 | 7.0E-01 | 7.0E-02 | 4.0E-01 | 4.0E-02 | NA | NA | NA | NA | NA | NA |
| CHROMIUM | 2.4E-05 | 2.4E-06 | 2.5E+00 | 2.5E-01 | 4.1E-04 | 4.1E-05 | NA | NA | NA | NA | NA | NA |
| COPPER | 2.9E-02 | 2.9E-03 | 9.6E-02 | 9.6E-03 | 1.2E-01 | 1.2E-02 | NA | NA | NA | NA | NA | NA |
| LEAD | 2.8E-02 | 2.8E-03 | 4.5E+01 | 4.5E+00 | 2.5E+00 | 2.5E-01 | NA | NA | NA | NA | NA | NA |
| MERCURY | 1.2E-02 | 1.2E-03 | 2.8E-01 | 2.8E-02 | 3.9E-02 | 3.9E-03 | 5.3E-01 | 5.3E-02 | 1.8E-01 | 1.8E-02 | 4.7E-01 | 4.7E-02 |
| NICKEL | 2.6E-03 | 2.6E-04 | 4.6E-02 | 4.6E-03 | 3.8E-02 | 3.8E-03 | NA | NA | NA | NA | NA | NA |
| SELENIUM | 1.1E-02 | 1.1E-03 | 5.0E-01 | 5.0E-02 | 5.0E-01 | 5.0E-02 | NA | NA | NA | NA | NA | NA |
| ZINC | 3.3E-02 | 3.3E-03 | 7.7E+00 | 7.7E-01 | 2.5E-01 | 2.5E-02 | NA | NA | NA | NA | NA | NA |

Shaded cells indicate a NOAEL value > 1.0

Although the home ranges of the vole, robin, and shrew are less than 1 acre, average COPC concentrations are more realistic EPCs for most wildlife receptors than maximum concentrations because they are exposed to COPC concentrations throughout the load line, rather than at a single location. Eighty-five surface and shallow subsurface soil samples were collected at soil borings scattered throughout the 69–acre load line, so there is adequate spatial coverage within the exposure area making it appropriate to calculate an average concentration as the EPC.

Table 7–8 presents the HQs based on average exposure input parameters for the insectivorous and herbivorous species. Note that Table 7–8 lists only the chemicals that had NOAEL HQs greater than 1.0 using the maximum (or 95% UCL) concentrations. HQs in the average scenario are greater than 1 for the following analytes and receptors:

- Arsenic NOAEL for the shrew;
- Chromium NOAEL for the robin;
- Lead NOAEL for the robin and shrew;
- Lead LOAEL for the robin; and
- Zinc NOAEL for the robin.

Arsenic was detected in all 85 samples with a 95% UCL of 13.6 mg/kg and an average concentration of 12.3 mg/kg. Although arsenic concentrations in approximately 25 % of the samples (22/85) were greater than the RVAAP background concentration (15.4 mg/kg), most of those detected concentrations only slightly exceeded the background concentration, and the greatest concentration was only twice the background level. Therefore, arsenic may or may not be related to site activities. Also, because the average arsenic concentration that was used in the food chain model is less than background, the risks from arsenic are similar to background risks. For these reasons, it is not likely that potential site-related risks to small mammals are great enough to warrant further evaluation of arsenic in the BERA. Therefore, arsenic is eliminated as a COPC for risks to small mammals.

Chromium was detected in all 85 samples with a 95% UCL of 15.9 mg/kg and an average concentration of 15.4 mg/kg. Although chromium concentrations in approximately 12% of the samples (10/85) were greater than the RVAAP background concentration (17.4 mg/kg), most of the detected concentrations only slightly exceeded the background level. Therefore, chromium may or may not be related to site activities. The NOAEL estogenic equivalent (EEQ) for the robin (2.4) is only slightly greater than 1.0. Also, because the average chromium concentration that was used in the food chain model is less than the background concentration, risks from chromium are similar to background risks.

# Table 7-8
# Terrestrial Food Chain Model - Average Scenario (Insectivorous, Herbivorous, and Carnivorous Receptors)

| Chemical | Herbivorous Receptor EEQs | | Insectivorous Receptors EEQs | | | | Carnovorous Receptors EEQs | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Meadow Vole | | American Robin | | Short-tailed Shrew | | Barn Owl | | Red Fox | | Red-Tailed Hawk | |
| | NOAEL | LOAEL | NOAEL | LOAEL | NOAEL | LOAEL | NOAEL | LOAEL | NOAEL | LOAEL | NOAEL | LOAEL |
| **Inorganics** | | | | | | | | | | | | |
| ARSENIC | 9.3E-01 | 9.3E-02 | 1.6E-01 | 1.6E-02 | 6.5E+00 | 6.5E-01 | NA | NA | NA | NA | NA | NA |
| CHROMIUM | 2.2E-05 | 2.2E-06 | 2.4E+00 | 2.4E-01 | 4.0E-04 | 4.0E-05 | NA | NA | NA | NA | NA | NA |
| LEAD | 2.7E-02 | 2.7E-03 | 4.5E+01 | 4.5E+00 | 2.5E+00 | 2.5E-01 | NA | NA | NA | NA | NA | NA |
| ZINC | 3.2E-02 | 3.2E-03 | 7.6E+00 | 7.6E-01 | 2.5E-01 | 2.5E-02 | NA | NA | NA | NA | NA | NA |

Shaded cells indicate a NOAEL value > 1.0
NA = No data available

For these reasons, it is unlikely that potential site-related risks to birds are great enough to warrant further evaluation of chromium in the BERA. Therefore, chromium is eliminated as a COPC for risks to birds.

Lead was detected in all 85 samples with a 95% UCL of 40.2 mg/kg and an average concentration of 46.2 mg/kg. Because the average concentration is greater than the 95% UCL, the 95% UCL was used for the average scenario food chain model. The lead NOAEL and LOAEL-based EEQs exceeded 1.0 in the average exposure scenario food chain model for the robin and the NOAEL-based EEQ exceeded 1.0 in the food chain model for the shrew. Lead concentrations in approximately 45% of the samples (38/85) were greater than the RVAAP background concentration (19.1 mg/kg). Many of the detected concentrations greatly exceeded the background concentration. As can be seen in the food chain model calculation spreadsheets in Appendix W, the dose from soil invertebrates accounts for a large portion of the total calculated dose. The estimated earthworm concentration (80.4 mg/kg) was caused by the BAF of 2.0 that was used in the food chain model. USEPA (2005c) presents a soil to earthworm uptake equation for estimating lead concentrations in earthworms from soil. Using the equation from USEPA (2005c), the estimated earthworm concentration in the robin and shrew food chain models is 2.53 mg/kg. Using the earthworm concentration as estimated from the equation in USEPA (2005c), the NOAEL-based EEQ under the average exposure scenario in the robin food chain model is 3.5 and the LOAEL-based EEQ is less than 1.0. Similarly, if the earthworm concentration is calculated using the equation from USEPA (2005c) in the shrew food chain model, both NOAEL and LOAEL-based EEQs are less than 1.0. Because only the NOAEL-based EEQ exceeds 1.0 in the robin food chain model using the estimated earthworm concentration as calculated in USEPA (2005c), the risks to the robin overall are expected to be low. Therefore, lead was eliminated as a COPC for risks to small mammals and birds.

Zinc was detected in all 85 samples with a 95% UCL of 89.3 mg/kg and an average concentration of 87.6 mg/kg. Zinc concentrations in approximately 58% of the samples (49/85) were greater than the RVAAP background concentration (61.8 mg/kg). Similar to lead presented above, the estimated earthworm concentration (158 mg/kg) was caused by the BAF of 1.8 that was used in the food chain model. USEPA (2005c) also presents a soil to earthworm uptake equation for estimating zinc concentrations in earthworms from soil. Using the equation from USEPA (2005c), the estimated earthworm concentration in the robin food chain models is 59.3 mg/kg. Using the earthworm concentration as estimated from the equation in USEPA (2005c), the NOAEL-based EEQ under the average exposure scenario in the robin food chain model is 3.5 and the LOAEL-based EEQ is less than 1.0. Most zinc concentrations were similar to the background concentration with some exceptions. Most notably, two locations (LL9SS–011–0001–SO and LL9SS–068–0001–SO) had concentrations (711 mg/kg and 780 mg/kg, respectively) greatly exceeding background; but the area represented by these few samples is small. Because only the NOAEL-based EEQ exceeds 1.0 in the robin food chain model using the estimated earthworm concentration as calculated in USEPA (2005c), the risks to the robin overall are expected to be low. Therefore, zinc is eliminated as a COPC for risks to birds.

In summary, using average exposure concentrations and more recent BAFs (for lead and zinc), the HQs based on the NOAEL exceeded 1.0 for several chemicals and receptors, but no HQs based on the LOAEL exceeded 1.0. When the additional following factors are considered, it is unlikely that wildlife receptors will be affected and no chemicals were retained as COPCs for further evaluation of risks to small mammals or birds:

- The chemicals in soil will likely be less bioavailable than the form of the chemicals used to conduct the toxicity test to establish the NOAELs, so the risks are overestimated.
- The average concentrations for most metals used in the food chain model were similar to background concentrations, so potential risks would be similar to background risks.

### 7.7.2 Risks to Carnivorous Species

Table 7–7 presents the carnivorous wildlife model HQs based on conservative input parameters for surrogate species (barn owl, red fox, and red-tailed hawk). Note that only PBT COPCs were carried through the carnivorous wildlife food chain model in accordance with the Ohio EPA guidance (Ohio EPA, 2003). No chemicals had conservative scenario HQs greater than 1.0. Therefore, no chemicals were retained as COPCs for further evaluation regarding risks to carnivorous wildlife.

## 7.8 Ecological Risk Uncertainty Analysis

This section discusses the uncertainties associated with this SERA at LL–9. A significant uncertainty is the fact that the nature and extent of contamination in the environmental media has not been completely determined. Therefore the results of the ecological risk assessment presented in Section 7 (and the associated uncertainties) are preliminary and subject to change based on the data collected to resolve the RI data gaps for LL–9.

### 7.8.1 Measurement and Assessment Endpoints

Measurement endpoints are used to evaluate the assessment endpoints that are selected for the SERA. Measures of effects are not the same as the assessment endpoints. The measures are used to predict effects to the assessment endpoints by selecting surrogate species that will be evaluated. For example, the shrew was chosen as a surrogate species to predict effects to the small mammal population. A decrease in reproduction of a shrew is used to assess a decrease in reproduction of the small mammal population. However, because of differences in ingestion rates, toxicity, food preferences, etc. among different species, predicting a decrease in reproduction of a shrew may either under- or over-protect the small mammal population as a whole. Although reptiles and amphibians are likely to be present on the site, risks are not quantitatively evaluated because exposure factors are not established for most species and toxicity data are very limited. Using aquatic organisms as a surrogate species, risks to amphibians exposed to the surface water and sediment are expected to be low based on the Step 3a evaluations.

### 7.8.2 Exposure Characterization

The contaminant dose to terrestrial wildlife is calculated using an equation that incorporates ingestion rates, body weights, bioaccumulation factors, and other exposure factors. These exposure factors are obtained from literature or are predicted using various equations. Ingestion rates and body weights vary among species, especially among species inhabiting different areas.

Bioaccumulation of contaminants into various biological media (i.e., plants, invertebrates, small mammals) depends on characteristics of the media (soil, sediment, and surface water) such as pH, organic carbon, etc. Therefore, actual bioaccumulation factors at the site may differ from those used in the SERA that were obtained from the guidance. For example, in the case of lead and zinc in the shrew and robin food chain models, the estimated earthworm concentrations were significantly greater when calculated using BAFs from the RVAAP guidance than when the earthworm concentrations were calculated using BAFs from the more recent USEPA guidance (2005c).

Also, the bioavailability of the chemicals is not taken into account in this SERA. All the chemicals are assumed to be 100% bioavailable at the detected concentrations, which is unlikely to occur for contaminants in the environment. For example, surface water samples with elevated concentrations (with respect to the AWQC and background criteria) were noted on the field forms as having “medium-high turbidity” and “high turbidity.” The elevated concentrations reported in these samples are potentially attributable to the suspended solids of these samples and not actual water concentrations. However, the suspended solids do not represent the bioavailable portion of the contaminant in the water column. Typically, uncertainties regarding the bioavailability of contaminants in surface water can be reduced by analyzing dissolved concentrations.

There is uncertainty in the chemical data that are collected at the site. Measured levels of chemicals are only estimates of the true site chemical concentrations. For samples that are deliberately biased toward known or suspected high concentrations, predicted doses probably will be higher than actual doses.

Finally, under the food chain model exposure scenario, terrestrial wildlife are assumed to live and feed only at the site. These assumptions will tend to over predict risk because it is unlikely that most receptors will obtain their food from within the site boundaries and from the most contaminated areas.

### 7.8.3 Ecological Effects Data

There is uncertainty in comparing the ecological toxicity value to the EPC to determine risk to a receptor. The water quality criteria developed by USEPA in theory protects 95% of the exposed species. Therefore, some sensitive species may be present that are not protected by the use of these criteria. There also may be situations where the surface water screening levels (SWSLs) are over-predictive of risk if the sensitive species used to develop the criteria do not inhabit the site. Finally, with the exception of hardness for a few metals, SWSLs do not account for site-specific factors, such as TOC or pH that may affect toxicity.

Potential adverse impacts on aquatic receptors from constituents in the sediment are evaluated by comparing the COPC concentration to sediment screening level (SdSLs). SdSLs have more uncertainty associated with them than do SWSLs. The procedures for developing SdSLs are not as well established as the procedures for developing SWSLs. As a result, the sediment screening levels have been developed using different methodologies. Additionally, there are fewer sediment toxicity data than surface water toxicity data. Sediment characteristics (i.e., pH, acid volatile sulfides, and total organic carbon) also will have a large impact on the bioavailability and toxicity of constituents.

Potentially adverse impacts on terrestrial plants and invertebrates from constituents in the surface soil are evaluated by comparing the COPC concentration to shallow soil screening level (SSSLs). SSSLs are similar to the sediment screening levels in that they are less established than SWSLs. Fewer studies and fewer data are available for establishing SSSLs than SdSLs, and many SSSLs are based on the results of only a few studies. In addition, SSSLs are based on different endpoints, depending on the preference of the agency that developed them. Therefore, they have more uncertainty than surface water and sediment screening values.

Ecological screening levels are not available for nitrocellulose detected in LL–9 media. According to the USEPA Office of Drinking Water, nitrocellulose is essentially nontoxic (USEPA, 2004d).

Several soil samples were collected and sent to GPL for explosives analyses. The results from these analyses are not useable for risk assessment purposes and are not included in the quantitative risk assessment because a screening method was used. The results of this screening evaluation are shown in Table 7–9. Six explosives were detected in the soil at LL–9. Three of them (2,4,6–trinitrotoluene, 4–amino–2,6–dinitrotoluene, and RDX) were detected infrequently (1 of 33 samples). 2,4–Dinitrotoluene only exceeded the screening value of 1,280 µg/kg in 1 of 33 samples. A screening value was not available for 3–nitrotoluene, but all results were below the screening value for 2,4–dinitrotoluene. For 2,6–dinitrotoluene, 4 of 33 samples exceeded the screening value of 32.83. Because these data were only used for screening purposes, risks were not assessed.

The NOAELs and LOAELs that were selected for the wildlife endpoint species were based on other than the endpoint species (i.e., rats, mice, ducks). There is uncertainty in the application of toxicity data across species because the contaminant may be more or less toxic to the endpoint species than it was to the test study species.

# Table 7-9
# GPL Explosives Data Shallow Soil Samples (0-4 ft bgs)

| Parameter | Frequency of Detection | Minimum Concentration | Maximum Concentration | Mean Concentration | Average of Positive Detects | Sample of Maximum Detect | Screening Level | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Value | Source |
| **Energetics (ug/kg)** | | | | | | | | |
| 2,4,6-TRINITROTOLUENE | 1/33 | 200 | 200 | 54.5 | 200 | LL9SS-030-0001-SO-GPL | NA | NA |
| 2,4-DINITROTOLUENE | 3/33 | 120 | 3700 | 170 | 1370 | LL9SS-002-0001-SO-GPL | 1280 | a |
| 2,6-DINITROTOLUENE | 4/33 | 340 | 3100 | 188 | 1190 | LL9SB-002-0001-SO-GPL | 32.83 | a |
| 3-NITROTOLUENE | 4/33 | 90 J | 410 | 115 | 220 | LL9SS-002-0001-SO-GPL | NA | NA |
| 4-AMINO-2,6-DINITROTOLUENE | 1/33 | 120 | 120 | 52.1 | 120 | LL9SS-004-0001-SO-GPL | NA | NA |
| RDX | 1/33 | 220 | 220 | 104 | 220 | LL9SS-027-0001-SO-GPL | NA | NA |

**Source of Screening Level:**
a - Ecological Data Quality Level (USEPA Region 5, 1999)

The toxicity of chemical mixtures is not well understood. The toxicity information used in the SERA for evaluating risk to the ecological receptors is for individual chemicals. Chemical mixtures can affect the organisms very differently than the individual chemicals because of synergistic or antagonistic effects.

Toxicological data for a few of the COPCs are limited or do not exist. Therefore, there is uncertainty in any conclusions involving the potential impacts on ecological receptors from these constituents. However, attempts were made to reduce the uncertainties with these COPCs using the other Step 3a factors discussed in Section 7.5.4.

Several alternative benchmark values were used to gain a better understanding of the relationship between the maximum concentrations of the selected COPCs to the overall ecological risks of the site. There is some uncertainty involved when using these alternative benchmarks. The Canadian SQGs, which are used as alternative benchmarks for both plants and invertebrates, are based on effects on either plants or invertebrates and, thus, differentiation of risk to plants versus risk to invertebrates cannot be made using the Canadian guidelines. The ORNL values are separated into guidelines for plants and guidelines for invertebrates. However, the values are limited to only a few chemicals.

### 7.8.4 Risk Characterization

Risks are possible if an HQ is greater than or equal to unity, regardless of the magnitude of the HQ. However, the magnitude of effects on ecological receptors cannot be inferred based on the magnitude of the HQ. Rather, an HQ greater than 1.0 simply indicates that the dose used to derive the toxicity reference value was exceeded. Finally, there is uncertainty in how the predicted risks to a species at the site translate into risk to the population in the area as a whole.

Several chemicals were selected as COPCs in surface water. There are uncertainties in evaluating these chemicals because most of the drainage ditches at LL9 are not perennial and are wet only seasonally, depending on precipitation and temperature. However, to be conservative, these areas were evaluated as if aquatic receptors were present or could be present for part of the year. Before proceeding further into a BERA based on potential risks to aquatic receptors, a more detailed evaluation of the aquatic habitats will need to be conducted to determine whether sufficient aquatic habitat is present to support aquatic receptor populations.

## 7.9 Conclusions

Based on the SERA and the first step of the BERA (Step 3a), the following conclusions were drawn.

### 7.9.1 Terrestrial Plants and Soil Invertebrates

After the initial screening (Table 7–1), 12 metals (aluminum, arsenic, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, vanadium, and zinc), 3 energetics (nitroguanidine, RDX, and nitrocellulose), and 1 SVOC (dibenzofuran) were detected at concentrations that exceeded RVAAP background, and exceeded soil screening levels or did not have soil screening levels. Other chemicals (i.e., PAHs and cadmium) were retained as COPCs only because they were bioaccumulative. These chemicals were not included in the evaluation of risks to plants and invertebrates because they were not detected at concentrations that exceeded soil screening levels.

Tables 7–4 and 7–5 summarize the results of potential direct toxicity of chemicals in soil to earthworms and plants, respectively. Chromium, copper, mercury, and zinc had maximum concentrations that were greater than the earthworm toxicity benchmarks; the average chemical concentrations for these chemicals were less than the benchmarks. Iron, manganese, dibenzofuran, nitroguanidine, RDX, and nitrocellulose did not have earthworm toxicity benchmarks. Aluminum toxicity to earthworms is based on the pH of the soil. Arsenic, chromium, copper, lead, manganese, mercury, selenium, and zinc had maximum concentrations that were greater than the plant toxicity benchmarks; the average chemical concentration for manganese was also greater than the plant benchmark. Dibenzofuran, nitroguanidine, RDX, and nitrocellulose did not have plant toxicity benchmarks. Aluminum and iron toxicity to plants are based on the pH of the soil. Based on the Step 3a factors discussed in Section 7.6.1, all analytes except copper, lead, mercury, and zinc were eliminated as COPCs. The other analytes were eliminated for several reasons, including concentrations below plant and invertebrate benchmarks and background concentrations, low frequencies of detection, and relatively low toxicity of the analytes. Copper, lead, mercury, and zinc are retained as COPCs at LL9SS–011–0001–SO, which had elevated concentrations of these analytes. This was a subfloor sample collected in a detonator destroying house where explosives including lead azide and mercury fulminate were destroyed. It is difficult to determine whether contamination is confined to this area owing to a lack of samples collected around this location. A few other locations across LL9 had metals with concentrations that exceeded benchmarks for invertebrates and/or plants. However, they are not likely to affect invertebrates and plants across the site because the site is well vegetated except where there is heavy vehicle traffic. Therefore, the only significant potential risks that are expected from metals at LL–9 are at LL9SS–011–0001–SO.

### 7.9.2 Benthic Invertebrates

After the initial screening (Table 7–2), bis(2–ethylhexyl)phthalate, dibenzo(a,h)anthracene, nitrocellulose, and four metals (beryllium, lead, mercury, and selenium) were detected at concentrations that exceeded Ohio SRVs and sediment screening levels or screening levels were not available.

Table 7–6 summarizes the results of potential direct toxicity of chemicals in sediment to benthic invertebrates and includes the average chemical concentrations compared to the same screening levels and the maximum and average concentrations compared to the higher effects levels. Based on the Step 3a factors discussed in Section 7.6.2, mercury, at one location, was the only chemical that may pose a risk to benthic invertebrates. However, because the drainage ditches are not wet year-round, they would not likely support benthic invertebrates for much of the year. Therefore, risks to benthic invertebrates from mercury are likely to be low, and it does not appear that the site needs to proceed further in the BERA because of mercury in sediment.

### 7.9.3 Aquatic Organisms

After the initial screening (Table 7–3), aluminum, copper, iron, lead, manganese, mercury, zinc, and nitrocellulose were selected as COPCs because maximum concentrations exceeded the screening levels or screening levels were not available. Based on the Step 3a factors discussed in Section 7.6.3, aluminum, copper, iron, lead, and zinc were retained as COPCs because of possible risks to aquatic organisms. However, there is significant uncertainty in the likelihood of potential impacts to aquatic organisms from the above-listed metals. Most of the samples with elevated metals concentrations were turbid, so the metals may be attributable to a high level of suspended solids during the sample collection and may not be dissolved in the surface water. For aquatic organisms, dissolved metals are the bioavailable and potentially toxic fraction of metals in surface water. More significant, however, is the fact that the drainage ditches are intermittent and typically wet only during and after rain events. Therefore, they likely do not support aquatic organisms for much of the year. These factors should be taken into consideration when risk management decisions for LL–9 are made. Because of these factors, it does not appear that the site needs to proceed further in the BERA because of metals in surface water.

### 7.9.4 Terrestrial Wildlife

The potential risks to mammals and birds associated with the COPCs in the surface soil, surface water, or both were further evaluated to determine whether site-related risks from the chemicals were unlikely or the risks were great enough to warrant retaining the chemicals as COPCs and proceeding further into the BERA.

The conservative assumption of total bioavailability, the use of average exposure concentrations (which are similar to background concentrations), and the use of current BAFs (for lead and zinc) from USEPA were used to conclude that impacts on insectivorous and herbivorous receptors are unlikely. In summary, no chemicals were retained as COPCs for further evaluation of risk to small mammals or birds.

Based on the conservative scenario and the NOAEL, no carnivorous animals had HQs greater than 1.0 for any carnivorous receptor. Consequently, no chemicals were retained as COPCs for further evaluation of risks to upper-level carnivorous mammals and birds.

# 8.0 SUMMARY AND CONCLUSIONS

This section briefly summarizes the existing LL–9 conditions that were found during the RI, the possible fate and transport of contaminants found at the site, and the risk assessments tasks that were completed. The conclusions are based on the outcome of the BHHRA and SERA.

## 8.1 Summary

The following subsections summarize the existing conditions at LL–9.

## 8.2 Nature and Extent of Contamination

The concentrations of contaminants are generally low, with a notable exception being a localized spot of high metal concentrations for copper, mercury, lead, and zinc at LL9SS–011–0001–SO in surface soil.

Sumps might have been a primary contamination source from operations water that was routinely diverted to them. However, sumps were removed during the LL–9 demolition and removal of the load line structures. Sewer lines that might have provided a contaminant transport pathway have been plugged. Thus, contaminant transport has been eliminated in these conveyances.

Contamination at LL–9 is sparsely dispersed across the site with some elevated chemical concentrations occurring near operational activities. Most metals appear to be fairly uniformly distributed across the site, with exception of location LL9SS–011–0001–SO noted above.

Metals do not degrade in the environment, but they can be assimilated into minerals. Their oxidation states can change over time as they migrate from one location to another. Metals in general, however, are relatively immobile except for those with predominantly single positive charges, such as sodium and potassium. A few other metals such as calcium and magnesium are also relatively mobile. These four metals, however, generally pose little to no environmental risks to receptors. Receptor exposure and risk are treated more completely in the risk assessment sections (6.0 and 7.0).

Few organic chemicals that are directly related to site operations were selected as COPCs, thus indicating that the concentrations of detected organic chemicals are generally low enough not to pose a significant threat to the health of receptors. However, nature and extent have not been fully determined during this Phase I RI. Additional sampling and analysis may be required to delineate the full lateral and vertical extent of contamination at LL–9.

## 8.3 Contaminant Fate and Transport

The primary contaminant migration pathways for contaminants at LL–9 are:

- Leaching from soils to groundwater;
- Leaching from sediments to surface water; and
- Transport in surface drainage channels.

Leaching from soils would be expected to occur around sumps if contaminated soil remained in place after the sump removals. This is not expected to be a significant concern. The quantities of contamination present at LL–9 are generally low, and sump removal is completed. Therefore, the mass of contaminants transported by this migration pathway is low. Dilution effects should be large in drainage channels. This is reflected in the low concentrations of contaminants detected in surface waters. Similar effects are observed in groundwater. Nitrocellulose, which has evidently been widely distributed in surface and subsurface soils at low concentrations across LL–9, is notably recalcitrant to dissolution; hence, its persistence is expected to be long.

Any soil or sediment contaminants that leach into groundwater would flow radially away from LL-9. Each contaminant will be retarded in its movement. The degree of retardation depends largely on the adsorption tendency of each contaminant and the amount of organic material in the soils and bedrock.

Surface water drainage channels can transport surface soil contaminants and sediments to downgradient locations. However, the topographical relief is moderate at LL–9 except at the peripheries. Therefore, transport pathways are not expected to move sediments rapidly. An exception to this could be during storm events when flow rates increase significantly. Contaminants detected at LL–9 will tend to adsorb to sediments.

In summary, the low concentrations and small total masses of energetic compounds at LL–9 are consistent with good health and safety practices. In particular, primary explosives such as metal azides (e.g., lead azide) and fulminates (e.g., mercury fulminate), which are very unstable with respect to physical shock, would not be expected to be released indiscriminately to non-operational areas. To do so would results in extreme safety hazards. The small reservoir of contamination in soil provides little total contaminant mass for migration to groundwater or other media. The metals will persist and the organics will degrade over time, albeit some of them (e.g., nitrocellulose) will do so slowly. Given the low concentrations observed at this site, modeling to estimate the degradation rates would not be fruitful.

## 8.4 Baseline Human Health Risk Assessment

A BHHRA was performed to assess the potential current and future risks associated with human exposure to site-related contaminants found in LL–9. The BHHRA included:

- Data evaluation: selecting COPCs;
- Exposure assessment: identifying potential receptors, evaluating potential exposure pathways, and estimating the chemical intake resulting from exposure;
- Toxicity assessment: evaluating the toxicity of each COPC and summarizing the toxicity criteria that were used;
- Risk characterization: estimating the cancer and noncarcinogenic risk(s); and
- Uncertainty analysis: identifying significant uncertainties that could affect the BHHRA results.

The COPCs selected for quantitative human health risk assessment are summarized in Table 8–1.

**Table 8–1**

**Summary of COPCs Selected for the Quantitative Human Health Risk Assessment**

| Soils | Groundwater | Surface Water | Sediment |
|---|---|---|---|
| Aluminum | Antimony | Aluminum | Aluminum |
| Arsenic | Manganese | Arsenic | Mercury |
| Chromium | | Chromium | Vanadium |
| Manganese | | Lead | |
| Mercury | | Manganese | |
| Benzo(a)pyrene | | Mercury | |
| Dibenzo(a,h)anthracene | | Vanadium | |

The receptors evaluated were a security guard/maintenance worker, a National Guard trainee, a National Guard resident trainer, a hunter/trapper, and hypothetical future farmer residents (adult and child). The risk assessment calculations are summarized in Table 8–2.

## Table 8–2

## Human Health Risk Assessment Calculation Summary

| Receptor | Non-Carcinogenic | Incremental Lifetime Cancer Risks |
|---|---|---|
| Security guard/maintenance worker | HI <1 (no adverse non-carcinogenic health effects) | Within USEPA target risk range of 1E-04 to 1E-06; does not exceed Ohio EPA's target of 1E-05. |
| Hunter/trapper | HI <1 (no adverse non-carcinogenic health effects) | <1E-06; Does not exceed Ohio EPA's target risk value or USEPA target risk range. |
| National Guard resident trainer | HI >1 if it is assumed the receptor is using the shallow groundwater for domestic purposes and exposed to surface water.  Manganese in groundwater is the risk driver. | Within USEPA target risk range of 1E-04 to 1E-06; exceeds Ohio EPA's target of 1E-05. Arsenic in soil is the major contributor to the risk. |
| National Guard trainee | Total HI >1 because of inhalation of manganese in deep surface soil.  Manganese at background would result in an HI of 4, and at its Region 9 residential PRG would result in an HI of 5. | Within USEPA target risk range of 1E-04 to 1E-06; exceeds Ohio EPA's target of 1E-05 because of inhalation of arsenic and chromium in deep surface soil. |
| Adult resident farmer | HI >1 only if it is assumed the receptor is using the shallow groundwater for domestic purposes and if the ingestion of foodstuffs pathways is evaluated.  Manganese is the primary risk driver in groundwater.  See the uncertainty discussion. | Not applicable |
| Child resident farmer | HI >1. However, target-organ-specific HI > 1 for direct exposure if it is assumed that groundwater is used for domestic purposes and HI > 1 for arsenic's target organs when direct exposure to media other than groundwater is evaluated.  Only true if HIs for surface soil and subsurface soil are combined. For indirect exposure via the ingestion of foodstuffs pathways, HI > 1 for ingestion of milk and vegetables.   See the uncertainty discussion. | Not applicable |

**Table 8–2 (Continued)**

**Human Health Risk Assessment Calculation Summary**

| Receptor | Non-Carcinogenic | Incremental Lifetime Cancer Risks |
|---|---|---|
| Lifelong resident farmer | Not applicable | For direct exposure pathways, within USEPA target risk range of 1E-04 to 1E-06; exceeds Ohio EPA's target of 1E-05. Arsenic in soils is the major contributor to the risk. For indirect exposure via the ingestion of foodstuffs pathways, exceeds target risk range for ingestion of beef, milk, and vegetables. |

Several significant uncertainties associated with the risk assessment were identified, as outlined in Section 6.6 and should be considered when making any risk management decisions. In many cases, conservative exposure and toxicity assumptions were applied, which may have resulted in conservative conclusions about potential risks.

Maximum detected concentrations of surface soil and deep surface soil COPCs copper (1,240 mg/kg), lead (1,330 mg/kg), and mercury (882 mg/kg) were at azide sample location LL9SS–011–0001–SO. The next-highest detected concentrations were much lower (copper [170 mg/kg], lead [320 mg/kg], and mercury [17 mg/kg]). This sample location may be of particular concern when making risk decisions, particularly for exposure to mercury.

## 8.5 Screening Ecological Risk Assessment

A SERA was performed to assess whether adverse ecological impacts are present as a result of site-related contaminants found in LL–9. The SERA included completing Steps 1 through 3a of the eight steps that comprise a Baseline Ecological Risk Assessment. The ecological risk assessment steps are stipulated in U.S. EPA, Ohio EPA, and RVAAP FWERWP (USACE, 2003). The steps that were completed as part of the LL–9 SERA are described below:

- Formulate the preliminary problem by identifying potential receptor groups and complete exposure pathways.
- Compare the contaminant concentrations for the chemicals found in LL 9 surface water, sediment, and surface soil to ecological screening values (ESVs) to initially select COPCs. The ESVs used in this risk assessment were stipulated by Ohio EPA and RVAAP guidance.

- Refine the list of COPCs by comparing exposure point concentrations to toxicity benchmarks established for specific receptor groups, by conducting food chain modeling for mammals and birds, and by evaluating other factors such as presence of suitable habitat, frequency of detection, and spatial distribution.

Ecological impact was evaluated for plants, soil, sediment invertebrates, aquatic organisms, and terrestrial wildlife. Three types of mammals and birds were evaluated: insectivores, herbivores, and carnivores.

The ecological risk calculations are shown in table 8–3.

**Table 8–3**

**Ecological Risk Calculations**

| Type of Species | Screening Results | Notes |
|---|---|---|
| Terrestrial plants and soil invertebrates | Copper, lead, mercury, and zinc were retained as COPCs. | Copper, lead, mercury, and zinc could pose possible risks to terrestrial plants at LL9SS–011–0001–SO. Copper, mercury, and zinc could pose possible risks to soil invertebrates at LL9SS–011–0001–SO. This location was a subfloor sample collected in a detonator destroying house where explosives, including lead azide and mercury fulminate, were destroyed. The contamination needs to be better bounded to determine the extent of the elevated levels of metals. A few other locations across LL–9 had metals with concentrations that exceeded benchmarks for invertebrates and/or plants. However, they are not likely to affect invertebrates and plants across the site because the site is well vegetated except where there is heavy vehicle traffic. |
| Benthic Invertebrates | Mercury was retained as a COPC. | Mercury, at one location, was the only chemical that may pose a risk to benthic invertebrates. The drainage ditches do not likely support a significant population of benthic invertebrates. Therefore, risks to benthic invertebrates from mercury are likely to be low, and it does not appear that the site needs to proceed further in the BERA because of mercury in sediment. |

## Table 8–3 (Continued)

## Ecological Risk Calculations

| Type of Species | Screening Results | Notes |
|---|---|---|
| Aquatic Organisms | Aluminum, copper, iron, lead, and zinc were retained as COPCs. | Elevated concentrations are likely the result of high levels of suspended solids in the surface water samples. Also, the drainage ditches at LL–9 provide poor ecological habitat. These factors should be taken into consideration when risk management decisions for LL–9 are made. Based on these factors, it does not appear that the site needs to proceed further in the BERA because of metals in surface water. |
| Terrestrial Wildlife–Insectivores/Herbivores | No COPCs retained. | Because of the conservative assumption of total bioavailability, no HQs based on the LOAEL were greater than 1.0, and because average concentrations for most metals used in the food chain model were similar to background concentrations, potential risks are not likely. |
| Terrestrial Wildlife–Carnivores | No COPCs retained. | Because no HQs based on the NOAEL were greater than 1.0 using conservative chemical concentrations, potential risks are not likely. |

# 9.0 RECOMMENDATIONS

The conclusions of the risk assessments are based on available data. If data collected in the Phase II RI alters the conceptual site model presented in this Phase I RI, then the risk assessment findings presented in this report will require revision. Although the BHHRA indicated potential risk to a National Guard trainee due to exposure to arsenic, chromium, and manganese, conservative toxicity and exposure values (such as PEF) were used to calculate the potential risk. Thus, the risk estimates presented for those chemicals likely overestimate the potential for non-carcinogenic risk. Additionally, the concentrations detected in the environmental media may represent background conditions. Manganese at background would result in an HI of 4, and the Region 9 residential PRG for manganese would result in an HI of 5. Arsenic at background would result in a risk of 5E-06. Chromium at background would results in a risk of 1.1E-05, and at the Region 9 residential PRG for chromium would result in a risk of 1.8E-05. It is recommended that the risk management team consider the need for any further remedial action based on the risk assessment results presented for this receptor.

Concentrations of target analytes (primarily metals and propellants) were detected in surface soil, subsurface soil, and sediment samples at concentrations exceeding RVAAP installation background (USACE, 2001b) concentrations, Region 9 residential soil PRGs, or both. Copper, lead, mercury, and zinc in surface soil require further evaluation to determine the extent of contamination because these chemicals may pose a risk to plants and invertebrates. Most of the contaminants were detected in very few samples and there are insufficient occurrences to provide statistically valid analysis for contaminant distribution. Therefore, the nature and extent of the contamination in soil, sediment, surface water and groundwater at LL–9 have not been fully determined and additional sampling will be necessary to fully identify the lateral and vertical extent of the contamination at LL–9 for metals and propellants. A Phase II RI should be conducted to fill data gaps identified in this Phase I RI. If data collected in the Phase II RI alters the conceptual site model presented in this Phase I RI, then the conclusions of the risk assessments presented in this report will require revision.

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