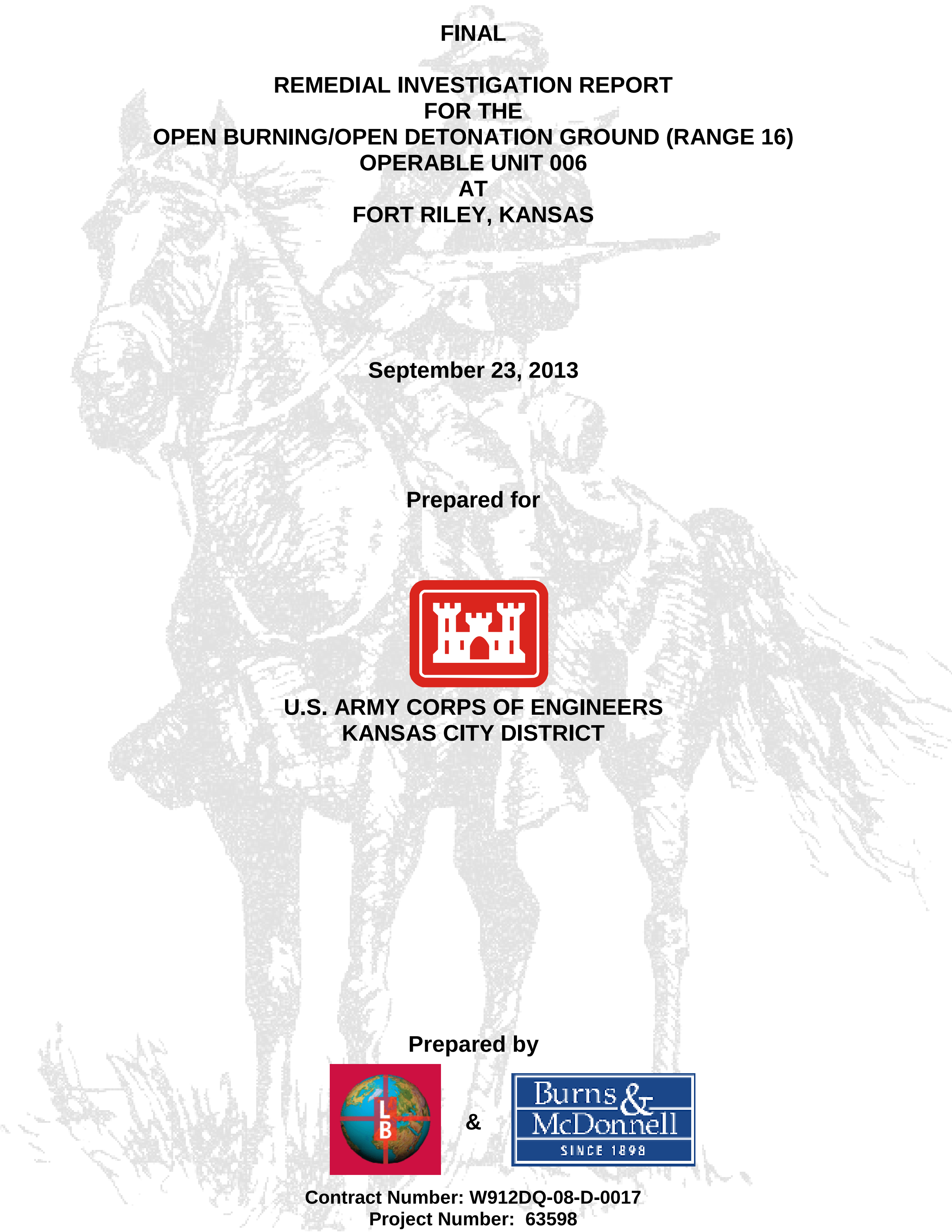


FINAL

REMEDIAL INVESTIGATION REPORT FOR THE OPEN BURNING/OPEN DETONATION GROUND (RANGE 16) OPERABLE UNIT 006 AT FORT RILEY, KANSAS

September 23, 2013

Prepared for

U.S. ARMY CORPS OF ENGINEERS
KANSAS CITY DISTRICT

Prepared by

LB & Burns & McDonnell SINCE 1898

Contract Number: W912DQ-08-D-0017
Project Number: 63598

Table of Contents

Page No.

Table of Contents

Page No.

Table of Contents

Table of Contents

Page No.

List of Appendices

List of Tables

List of Tables (continued)

List of Figures

List of Acronyms and Abbreviations

amsl	Above Mean Sea Level
atm-m^3/mol	atmospheres-cubic meters per mol
ATSDR	Agency for Toxic Substances and Disease Registry
BCFs	bioconcentration factors
bgs	below ground surface
BMcD	Burns & McDonnell Engineering Co., Inc.
BLRA	Baseline Risk Assessment
CENWK	Corps of Engineers Kansas City District
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cis-1,2-DCE	cis-1,2-Dichloroethene
cm^2	square centimeters
cm/sec	centimeters per second
COPC	chemical of potential concern
COPEC	chemicals of potential ecological concern
CSM	conceptual site model
DO	dissolved oxygen
DoD	United States Department of Defence
EHI	Ecological Hazard Index
EOD	Explosive Ordnance Disposal
ft/ft	foot per foot
ft/day	feet per day
ºF	degrees Fahrenheit
FR	Federal Register
FS	Feasibility Study
GC	gas chromatograph
GRI	Gas Research Institute
g/mol	grams per mol
H	Henry's Law constant
HEAST	Health Effects Assessment Summary Tables
HI	hazard index
HMX	octahydro-1,3,5,7-tetranirto-1,3,5,7-tetrazocine
HQ	hazard quotient
HTW	hazardous and toxic waste
I	hydraulic gradient
INRMP	Integrated Natural Resources Management Plan
IPaC	Information, Planning and Conservation System
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
IUR	Inhalation Unit Risk
IW-SAP	*Installation-Wide Sampling and Analysis Plan (Including UFP-Quality Assurance Project Plan) for the Fort Riley CERCLA Process Support at Fort Riley, Kansas* (LBG-BMcD, 2011b)

List of Acronyms and Abbreviations (continued)

J	estimated value
K	conductivity
KDHE	Kansas Department of Health and Environment
kg	kilograms
K_{oc}	propensity for organic compounds to be absorbed by organic carbon in soil and sediment
K_{ow}	octanol-water partition coefficient
LBA	Louis Berger & Associates
LBG	The Louis Berger Group, Inc.
LCS	laboratory control sample
L/day	liters per day
L/kg	liter per kilogram
LOAELs	lowest observed adverse effect levels
MCL	Maximum Contaminant Level
MEC-AP	*Munitions and Explosives of Concern Avoidance Plan for Remedial Investigation/ Feasibility Study and Related Activities at the Open Burning/ Open Detonation Grounds (OB/OD) (Range 16) – Operable Unit 006 at Fort Riley, Kansas* (LBG and ARCADIS/MP, 2011)
mg/cm^2	milligrams per square centimeter
mg/day	milligrams per day
mg/kg/day	milligrams per kilograms per day
mg/L	milligrams per liter
mg/m^3	milligrams per cubic meter
m^3/kg	cubic meters per kilogram
MP	Malcolm Pirnie
m/s	meters per second
mV	millivolts
N	nitrogen
N_e	effective porosity
NCDC	National Climatic Data Center
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NOAELs	no adverse effect levels
NWI	National Wetland Inventory
OB/OD	Open Burning/Open Detonation Ground
ORP	oxidation-reduction potential of groundwater
ORNL	Oak Ridge National Laboratory
OU	Operable Unit
P	phosphorus
PCA	1,1,2,2-tetrachloroethane
PCE	tetrachloroethene
PEF	Particulate Emission Factor
PID	photoionization detector
PPRTV	Professional Peer-Reviewed Toxicity Values
PWE	Fort Riley Directorate of Public Works – Environmental Division

List of Acronyms and Abbreviations (continued)

Q/C	inverse of the mean concentration at the center of a source
QCSR	Quality Control Summary Report
R	qualified as Rejected
RAGS	Risk Assessment Guidance for Superfund
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
RfC	Reference Concentration
RfD	Reference Dose
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
RSK	Risk-Based Standards for Kansas
RSL	Regional Screening Level
SARA	Superfund Amendments and Reauthorization Act
SI	Site Investigation
SOP	standard operating procedure
SS-SAP	*Remedial Investigation/Feasibility Study Site-Specific Sampling and Analysis Plan (Including Site-Specific UFP-Quality Assurance Project Plan) for the Open Burning-Open Detonation Grounds (Range 16) Operable Unit 006 at Fort Riley, Kansas* (LBG-BMcD, 2011c)
SVOC	semivolatile organic compound
TCE	trichloroethene
TOC	total organic carbon
TPH	total petroleum hydrocarbon
trans-1,2-DCE	trans-1,2- Dichloroethene
U10	annual wind speed at 10 meters above ground surface
UCL	upper confidence limit
UFP	Uniform Federal Policy
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
$\mu g/m^3$	micrograms per cubic meter
U_m	wind speed through the box
US	United States
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
UXO	unexploded ordnance
V_s	seepage velocity
VFs	volatilization factors
VOC	volatile organic compound

List of Acronyms and Abbreviations (continued)

Work Plan	*Remedial Investigation/Feasibility Study Work Plan for the Open Burning-Open Detonation Ground (Range 16) Operable Unit 006 at Fort Riley, Kansas* (LBG-BMcD, 2011a)
Work Plan Addendum	*Technical Memorandum Work Plan Addendum for the Direct-Push Soil Investigation at the Metal Debris Pits, Open Burning-Open Detonation Grounds (Range 16) Operable Unit 006 at Fort Riley, Kansas* (LBG-BMcD, 2013a)
WWC	Water Well Completion

* * * * *

1.0 INTRODUCTION

The Fort Riley Directorate of Public Works – Environmental Division (PWE) under the Installation Restoration Program (IRP) at Fort Riley, Kansas is conducting a Remedial Investigation (RI)/Feasibility Study (FS) at the Open Burning/Open Detonation Ground (OB/OD) (Range 16) Operable Unit 006 (OU 006) (Figures 1-1 and 1-2). The RI/FS at OB/OD is being conducted by The Louis Berger Group, Inc. (LBG) and Burns & McDonnell Engineering Co., Inc. (BMcD) under the United States Army Corps of Engineers (USACE) – Kansas City District's (CENWK's) Contract Number W912DQ-08-D-0017, Task Order Number 0027. Work at OB/OD is being conducted to meet the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986.

1.1 PURPOSE OF THE RI

The objectives of the OB/OD RI and Baseline Risk Assessment (BLRA) are:

- Quantify the nature and extent of on-site United States Department of Defense (DoD)-related contamination at the OB/OD;
- Characterize the physical and chemical nature of contamination at OB/OD, including fate and transport mechanisms;
- Determine potential ecological and human health risk posed by contamination at OB/OD; and
- Obtain information necessary to evaluate remedial alternatives, as needed, in the FS.

The objective of the OB/OD FS is:

- Develop remedial action goals and
- Develop and evaluate remediation alternatives.

The RI/FS is being performed in accordance with CERCLA and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and will follow the United States Environmental Protection Agency (USEPA) *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA, 1988), and the *Risk Assessment Guidance for Superfund (RAGS) Volume I: Human Health Evaluation Manual (Parts A, E, and F)* (USEPA, 1989, 2004, and 2009), as well as all other applicable regulations and requirements.

This RI Report has been prepared to:

- Summarize field investigation and data gathering activities completed as part of the RI;
- Present the nature and extent of contamination determined to be present;
- Summarize the potential fate and transport of contaminants determined to be present;
- Describe the conceptual site model (CSM);
- Present the calculations and potential risk associated with the OB/OD as determined in the BLRA; and
- Convey conclusions and recommendations for on-going efforts.

1.2 SITE BACKGROUND

1.2.1 Site Location and Description

The Fort Riley Military Reservation is centrally located between the cities of Salina and Topeka in north central Kansas (see Figure 1-1). The reservation is over 100,000 acres in size and includes portions of Riley, Clay, and Geary Counties. The developed areas of Fort Riley are divided into six cantonment areas: Main Post, Camp Forsyth, Camp Funston, Camp Whitside, Marshall Army Airfield, and Custer Hill. OB/OD is located approximately 2.5 miles to the northeast of Custer Hill, outside of the developed areas of Fort Riley (Figure 1-1).

The OB/OD is located within Range 16 in the southern part of the Impact Area, approximately 2,300 feet north of Vinton School Road (see Figures 1-2 and 1-3). The active portion of the site is an inverted L-shaped area and consists of an area approximately 700 feet by 550 feet. The active portion of the site is centered on the north burn pit where open detonation takes place. The site is bounded on the east and west by ephemeral streams. The elevation of the southernmost point of the western ephemeral stream is approximately 1,132 feet above mean sea level (amsl). The land to the north, east, and west of the OB/OD is also part of the Impact Area and is used as training ranges. Open vacant fields surround the remainder of the OB/OD.

1.2.2 Site Use

1.2.2.1 Historic and Current

Prior to 1942, the OB/OD area was used for ranching and farming. The land was obtained by the military in 1942 and has been in use by the United States (US) Army from 1942 to the present. Historic and present site use has not changed, although detonation activities have diminished. Currently, the 774th Explosive Ordnance Disposal (EOD) Detachment at Fort Riley handles ordnance materials from Fort

Riley, the DoD, and other state and federal agencies. Since 1991, the 774th EOD Detachment has been responsible for providing support to military installations, operations, exercises; and to civilian and federal authorities within an operational area that includes the states of Kansas, Nebraska, Missouri, and South Dakota.

Ordnance was formerly disposed of by the 774th EOD Detachment at the OB/OD by open burning and open detonation. Currently, only open detonations for emergency disposal of ordnance and training are conducted. Open detonation occurs on open ground and creates crater-like pits, which typically reach a maximum size of 25 feet in diameter and 10 to 15 feet in depth. Open burning was formerly conducted within a specific area that was characterized by a small pit with a metal grating surrounded by a 9-foot high, horseshoe-shaped embankment (South Burn Pit). The open burn pit was primarily used to dispose of black powder and phosphorus-based munitions. At present, there are three active detonation pit areas, two metal debris pits, and two non-active burn pits at the OB/OD (see Figure 1-2). Open detonation is currently being conducted at the Northwest, West, and East Demolition Pits. Open detonation at the site is dynamic; generally, detonations are conducted within the same area but may not be within the same pit.

Historically chlorinated solvents, including trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE), tetrachloroethene (PCE), and 1,1,2,2-tetrachloroethane (PCA), have been detected in the groundwater and spring at the OB/OD (see Section 1.2.3). There is no known historical or current use of solvents or knowledge of solvent dispoal at the OB/OD.

1.2.2.2 Future Land Use and Plans

Based on the Fort Riley Real Property Master Plan (Black & Veatch, 2007), land use is not projected to change significantly in the future.

1.2.3 Previous Environmental Investigations

Previous environmental investigations that have been conducted at the OB/OD are detailed in this section. A chronology of environmental investigations conducted and associated documents for OB/OD is presented in Table 1-1. Tables with historical data and historical figures are included in Appendix A.

- **Fall 1993:** An initial Site Investigation (SI) was conducted at the OB/OD to evaluate the presence or absence of contamination by Louis Berger & Associates (LBA). This SI reported in the *Site Investigation Report for High Priority Sites at Fort Riley, Kansas* (LBA, 1994). Field activities conducted during this investigation included the collection of surface soil samples from the pits used for the burning and detonation of ordnance; soil samples from subsurface borings; sediment and surface water samples from ephemeral streams; and the installation, development, and sampling of Monitoring Wells OB-93-01 through OB-93-04 (see Appendix A). Analytical data from this investigation are presented in the tables on Appendix A. TCE was found in groundwater above the Safe Drinking Water Act Maximum Contaminant Level (MCL) of 5 micrograms per liter (µg/L) in Monitoring Well OB-93-04 (29 µg/L). Low levels of uranium were detected were in soil samples. As the levels were less than those reported in the *Impact Area Site Assessment Report for Fort Riley, Kansas* (LBA, 1993) which were determined to be naturally occurring based upon isotope-specific analyses, it was determined that the detections were the result of naturally occurring uranium.

- **December 1995:** Confirmation sampling of Monitoring Wells OB-93-01 through OB-93-04 was conducted in December 1995. Analytical results were reported in the *Data Summary Report for Confirmation Groundwater Sampling Multi-Sites, Fort Riley, Kansas* (LBA, 1996a) and the *Quality Control Summary Report (QCSR) Confirmation Groundwater Sampling at the Multi-Sites, Fort Riley, Kansas* (LBA, 1996b). The only TCE concentration detected above the 5 µg/L MCL was in the sample from Monitoring Well OB-93-04 (17 µg/L).
- **March/April 1997 – Mobilization #1:** Additional SI activities were conducted to evaluate possible sources and extent of contamination at the OB/OD. Descriptions of the field activities are presented in the *Technical Memorandum, Overview of Mobilization # 1, Preliminary Findings and Proposed Mobilization # 2 Activities, Open Burn/Open Detonation Area, Fort Riley, Kansas* (LBA, 1997a). During this field effort, Monitoring Wells OB-97-05 through OB-97-08 were installed and groundwater samples were collected. Samples were also collected from the spring and hand-dug well. Concentrations of TCE exceeding the MCL were detected in the groundwater sample from Monitoring Well OB-97-07 (490 µg/L). Monitoring Wells OB-93-01 through OB-93-04 were not sampled during this field effort. Due to some data being rejected from the March/April 1997 event, this sampling event was not included in Appendix A.
- **June 1997 – Mobilization #2:** Additional investigation activities were conducted to further characterize subsurface hydrogeology at OB/OD. Field activities are summarized in the *Supplemental Technical Memorandum, Mobilization #2 Activities, Open Burn/Open Detonation Area, Fort Riley, Kansas* (LBA, 1997b) and the *Technical Memorandum, Mobilization # 2 Activities, Open Burn/Open Detonation Area, Fort Riley, Kansas* (LBA, 1998a). Five sets of nested piezometers OB-97-09PZ through OB-97-13PZ were installed. One piezometer, the spring, and the hand-dug well were sampled. Water samples collected that exceeded the TCE MCL included the spring (190 µg/L) and the hand-dug well (230 µg/L).

- **September 1997 – Groundwater Sampling Event:** Groundwater samples were collected from the monitoring wells, piezometers, and the hand-dug well. One surface water sample was collected. Monitoring Well OBHD-97-14 was installed at the location of the hand-dug well. Analytical results were reported in the *Data Summary Report for Groundwater Sampling and Groundwater Elevations at the Open Burn/Open Detonation Area, Fort Riley, Kansas* (LBA, 1999). TCE concentrations above the MCL of 5 µg/L were found in groundwater samples collected from Monitoring Wells OB-93-04 (17 µg/L), OB-97-07 (400 µg/L), OB-97-08 (200 µg/L), OBHD-97-14 (440 µg/L), and the hand dug well (260 µg/L) (Appendix A). TCE concentrations above the MCL were also found in groundwater samples collected from Piezometers OB-97-10PZ (3), OB-97-11PZ (0), OB-97-11PZ (1), OB-97-11PZ (4), OB-97-12PZ, and all five of OB-97-13PZs. Each piezometer location had multiple nested piezometers at varying depths noted as piezometer 0 (deep) through 4 (shallow). PCE concentrations above the MCL of 5 µg/L were also found in samples collected from Monitoring Wells OB-97-07 (14 µg/L), OB-97-08 (8 µg/L), and OBHD-97-14 (11 µg/L).

- **December 1997 – Groundwater Sampling Event:** Groundwater samples were collected from the monitoring wells, the hand-dug well, and the spring. Two surface water samples were also collected. Analytical results were reported in the *Data Summary Report for Groundwater Sampling and Groundwater Elevations at the Open Burn/Open Detonation Area, Fort Riley, Kansas* (LBA, 1999). TCE concentrations above the MCL of 5 µg/L were reported for groundwater samples collected from Monitoring Wells OB-93-04 (15 µg/L), OB-97-07 (530 µg/L), OB-97-08 (110 µg/L), OBHD-97-14 (63 µg/L), and the hand dug well (110 µg/L) (see Appendix A). TCE concentrations above the MCL were also found in the sample from the spring (110 µg/L). A PCE concentration above the 5 µg/L MCL was reported in the sample from Monitoring Well OB-97-07 (14 µg/L). The piezometer clusters were not sampled during this field effort.

- **April 1998 – Groundwater Sampling Event:** Groundwater samples were collected from the monitoring wells, two spring locations, and five surface water locations. Analytical results were reported in the *Data Summary Report for Groundwater Sampling and Groundwater Elevations at the Open Burn/Open Detonation Area, Fort Riley, Kansas* (LBA, 1999). TCE concentrations above the 5 µg/L MCL were reported for samples collected from Monitoring Wells OB-93-04 (12.8 µg/L), OB-97-07 (223 µg/L), OB-97-08 (32.4 µg/L), and OBHD-97-14 (34.3 µg/L). TCE concentrations above the MCL were also reported for the spring (62.5 µg/L). A PCE concentration at the MCL of 5 µg/L was reported for the groundwater sample collected from

Monitoring Well OB-97-07 (5 µg/L) (see Appendix A). The piezometer clusters were not sampled during this field effort.

- **August 1998 – Groundwater Sampling Event:** Groundwater samples were collected from the monitoring wells, the spring, and five surface water locations (see Appendix A). Analytical results were reported in the *Data Summary Report for Groundwater Sampling and Groundwater Elevation at the Open Burn/Open Detonation Area, Fort Riley, Kansas* (LBA, 1999). TCE concentrations above the MCL of 5 µg/L were reported for samples collected from Monitoring Wells OB-93-04 (14.1 µg/L), OB-97-07 (246 µg/L), OB-97-08 (65.3 µg/L), and OBHD-97-14 (89.6 µg/L). A TCE concentration above the MCL was also reported for the sample collected from the spring (145 µg/L). The piezometer clusters were not sampled during this field effort.

- **January 1999 – Groundwater Sampling Event:** Groundwater samples were collected from the monitoring wells, the spring, and four surface water locations. Analytical results were reported in the *Data Summary Report for Groundwater Sampling and Groundwater Elevations at the Open Burn/Open Detonation Area, Fort Riley, Kansas* (LBA, 1999). TCE concentrations above the MCL of 5 µg/L were reported for samples collected from Monitoring Wells OB-93-04 (13.1 µg/L), OB-97-07 (78.1 µg/L), OB-97-08 (9.3 µg/L), and OBHD-97-14 (49 µg/L) (see Appendix A). A TCE concentration above the MCL was also reported for the sample collected from the spring (51.4 µg/L). A concentration of cis-1,2-DCE above the MCL of 70 µg/L was reported for the groundwater sample collected from Monitoring Well OBHD-97-14 (151 µg/L). The piezometer clusters were not sampled during this field effort.

- **June 1999 - Site Analysis Report:** A site analysis was conducted regarding the geology, stratigraphy, structure, and hydrology of OB/OD. This information was presented in the *Analysis of Geological Stratigraphy, Structure, and Hydrology of the OB/OD Site, Fort Riley, Kansas* (Archer and Martin, 1999). This analysis included a historical report review, site reconnaissance in April, May, and August of 1998, an examination of existing rock cores, and an evaluation of hydrogeologic and analytical data from 1997 and 1998. It was concluded that the OB/OD is underlain by alternating Permian limestone and shale units with joints running east-northeast and north-northwest

- **April 2003 – Auto Sampler Event:** A surface water sample was collected on April 23, 2003 from an auto sampler located on the western ephemeral stream. The surface water sample was analyzed for volatile organic compounds (VOCs). No VOCs were detected in this sample. This information was presented in the *QCSR April 2003 Surface Water Sampling Event, OB/OD Site, Fort Riley, Kansas* (BMcD, 2003).

- **March 2004 – Auto Sampler Event:** A surface water sample was collected on March 4, 2004 from an auto sampler located on the western ephemeral stream. The surface water sample was analyzed for VOCs. No VOCs were detected in this sample. This information was presented in the *QCSR April 2004 Sampling Event, Open Burning/Open Detonation (Range 16), Fort Riley, Kansas* (Malcolm Pirnie (MP)-BMcD, 2004).

- **August 2005 – Monitoring Well Installation:** Monitoring Well OB-05-15 was installed down gradient of the active portion of Range 16 in the southwestern portion of OB/OD. Monitoring Well OB-05-15 is screened within the regolith with the bottom of the well setting on the Havensville Shale Member.

- **July 2006 – Direct-Push Investigation**: Seven locations were pushed for the collection of groundwater samples. Exceedances of the TCE MCL were reported for groundwater samples collected from Direct-Push Locations DP-3 (12.6 µg/L) and DP-5 (5.9 µg/L). Locations DP-8 through DP-11 were pushed south of the DP-7 location, but these locations were dry (see Appendix A, Figure 5-1). Locations DP-1, DP-2, DP-4, and DP-6 were not probed because TCE had been detected at a down gradient location (MP-BMcD, 2007-2010).

- **2004 - 2011 – Groundwater Sampling Events:** Groundwater samples were collected from the monitoring wells with available sample volume and surface water locations during multiple sampling events (See Appendix A). Analytical results were reported in the *Data Summary Reports for Groundwater, Spring, and Seep Sampling for Open Burn/Open Detonation Ground (Range 16) at Fort Riley, Kansas* (MP-BMcD, 2007-2010). Summary tables of historical analytical results from these sampling events are provided in Appendix A.

1.3 RI REPORT ORGANIZATION

This report has been organized per the recommended format presented in the *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA, 1988). Sections included in this RI Report include:

- **Section 1.0 Introduction** – Includes the objectives of the RI/FS, site background, and a summary of previous investigations.

- **Section 2.0 Remedial Investigation Activities** – Includes a summary of the activities that were completed as part of the RI.

- **Section 3.0 Site Setting** – Presents the site location and description, the physical setting, water use, climatology, demography, and ecology of the study area.
- **Section 4.0 Nature and Extent of Contamination** – Presents the analytical results, screens the results against state and federal screening levels and discusses the extent of impacts.
- **Section 5.0 Fate and Transport** – Discusses the environmental fate and transport of the chemicals of potential concern (COPCs), and presents the CSM.
- **Section 6.0 Human Health Risk Evaluation** – Presents the parameters and equations used in the BLRA for human health and the results of those calculations.
- **Section 7.0 Ecological Risk Assessment** – Presents the parameters and equations used in the ecological risk assessment and the results of those calculations.
- **Section 8.0 Summary and Conclusions –** Summarizes the RI and presents the final conclusions.
- **Section 9.0 References, Tables, Figures, and Appendices** – Provide the supporting information for the RI Report.

* * * * *

2.0 RI ACTIVITIES

2.1 INTRODUCTION

The current RI/FS is being conducted in accordance with the approved work plan – *Remedial Investigation/Feasibility Study Work Plan for the Open Burning-Open Detonation Ground (Range 16) Operable Unit 006 at Fort Riley, Kansas* (LBG-BMcD, 2011a) (Work Plan) (see Appendix B). The Phase Three investigation was conducted in accordance with the *Technical Memorandum Work Plan Addendum for the Direct-Push Soil Investigation at the Metal Debris Pits, Open Burning-Open Detonation Ground (Range 16), Operable Unit 006 at Fort Riley, Kansas* (LBG-BMcD, 2013a) (Work Plan Addendum) (see Appendix C). Field work was conducted at the site in phases per the approved Work Plan and Work Plan Addendum. Field activities were conducted in accordance with the appropriate standard operating procedure (SOP) as presented in the *Installation-Wide Sampling and Analysis Plan (Including Uniform Federal Policy [UFP]-Quality Assurance Project Plan) for the Fort Riley CERCLA Process Support at Fort Riley, Kansas* (LBG-BMcD, 2011b) (IW-SAP) and the *Remedial Investigation/Feasibility Study Site-Specific Sampling and Analysis Plan (Including Site-Specific UFP-Quality Assurance Project Plan) for the Open Burning-Open Detonation Grounds (Range 16) Operable Unit 006 at Fort Riley, Kansas* (LBG-BMcD, 2011c) (SS-SAP) (see Appendix B).

Field activities conducted to support the RI/FS at OB/OD included:

- Collection of groundwater samples via direct-push borings and monitoring wells;
- Collection of surface and subsurface soil samples within and surrounding the burn and debris/demolition pit areas;
- Collection of water samples from the ephemeral streams, seeps, and spring on site;
- Collection of sediment samples from the two bordering ephemeral streams;
- Physical characterization of soil and bedrock; and
- Characterization of hydrogeologic properties of the aquifer.

A phased approach was used for sampling activities, allowing subsequent phases to be built upon the results of earlier phases. The investigation process for each matrix investigated at OB/OD was directed toward the historical and currently active areas. The investigation areas and locations were selected based on historical concentrations, areas of historical use, and observable areas of anthropogenic disturbance; and used a radial sample collection pattern from these areas to mimic ejection of material from munitions detonations. Phase One included groundwater, surface water, surface soil, subsurface soil, and dry sediment sampling; Phase Two included multi-incremental soil sampling, monitoring well installation, bedrock borings, in-situ hydraulic conductivity testing, and piezometer abandonment; and Phase Four included four rounds of quarterly groundwater/surface water sampling. Upon completion of the planned Phases One, Two, and Four, it was decided to do additional work (Phase Three) consisting of additional soil samples from the metal debris pits.

Samples collected were selectively analyzed for the following parameters per the prescribed procedures in the Work Plan:

Analytical Group	Method	Matrix Sampled
VOCs	SW-846 8260B	Soil, Sediment, Surface Water, and Groundwater
Semi-Volatile Organic Compounds (SVOCs)	SW-846 8270D	Soil, Sediment, Surface Water, and Groundwater
Explosives	SW-846 8330/8330B	Soil, Sediment, Surface Water, and Groundwater
Metals (Antimony, Arsenic, Beryllium, Cadmium, Chromium, Copper, Lead, Nickel, Selenium, Silver, Thallium, and Zinc)	SW-846 6010/6020/7470A/7471A	Soil, Sediment, Surface Water, and Groundwater
Perchlorate	SW-846 6850	Soil, Sediment, Surface Water, and Groundwater
Anions (Chloride, Nitrate as Nitrogen (N), Nitrite as N, Orthophosphate as Phosphorous (P), and Sulfate)	SW-846 9056	Groundwater
Ammonia	EPA 350.1	Groundwater
Sulfide	SW-846 9034	Groundwater
Methane, Ethane, and Ethene	RSK-175	Groundwater
Total Organic Carbon (TOC)	SW-846 9060	Groundwater

All field activities were documented in field log books, hazardous and toxic waste (HTW) drilling logs, and groundwater sampling forms. Copies of the field logbooks are included in Appendix D of this RI Report. Appendix E includes the HTW Drilling Logs for the newly installed monitoring wells, the accompanying monitoring well construction and development forms, and the Kansas Department of Health and Environment (KDHE) Water Well Record Forms (WWC-5 and WWC-5P); the direct-push HTW drilling logs; the HTW Drilling Logs for the core holes; and the KDHE WWC-5P Forms for the abandoned piezometers. Data and calculations for the in-situ testing are included in Appendix F and groundwater sampling forms are included in Appendix G. Survey data for the sampling locations and reference points are included in Appendix H.

2.2 PHASE ONE – NOVEMBER 2011 THROUGH DECEMBER 2011

Phase One of the field investigation occurred between November 21, 2011 and December 19, 2011 and included pre-investigation work; an ecological risk assessment; and groundwater, surface water, surface soil, subsurface soil, and dry sediment sampling. Results of the Phase One investigation were used to plan the Phase Two investigation.

2.2.1 Pre-Investigation Activities

Field investigation activities were conducted in accordance with the unexploded ordnance (UXO) safety procedures specified in the *Munitions and Explosives of Concern Avoidance Plan for Remedial Investigation/ Feasibility Study and Related Activities at the Open Burning/ Open Detonation Ground (OB/OD) (Range 16) – Operable Unit 006 at Fort Riley, Kansas (LBG and ARCADIS/ MP, 2011)* (MEC-AP). These activities included clearing an access route for the sampling crews, vehicles, and equipment prior to field sampling or drilling crews going on site, and following the prescribed avoidance procedures for surface and subsurface sampling and well installation. Additionally all intrusive sample locations were cleared for utilities per the *Installation-Wide Accident Prevention Plan for Environmental Investigations at Fort Riley, Kansas* (LBG/BMcD, 2012a).

Concurrent with the start of the Phase I field activities, an archaeological assessment was made of the OB/OD area by Fort Riley PWE and BMcD. An evaluation was made on Archeological Site 14RY3136 located within the OB/OD area. The OB/OD area was, per the 1909 Atlas, previously the Sunny Slope Ranch owned by J.C. Frey. The 1909 Atlas showed two buildings present within the OB/OD area. The archaeological walkover found no features remaining except for a small push pile of concrete and the remains of a stone wall. No artifacts were recovered. Based on this, a recommendation was made to the Kansas State Historic Preservation Office that the site was not eligible for listing in the National Register of Historic Places. The Kansas State Historic Preservation Office concurred with the recommendation (see Appendix I).

2.2.2 Ecological Risk Assessment Survey

An ecological risk assessment survey was conducted at the OB/OD on December 15, 2011 per the procedures set forth in the Work Plan. The ecological risk assessment for the OB/OD is presented in section 7.0 of this RI Report.

2.2.3 Groundwater Sampling and Analysis

A direct-push investigation was conducted in the southern and western portion of the site where a vertical and horizontal delineation of contamination in groundwater was needed. A direct-push borehole was advanced at 40 of the planned 41 direct-push locations, GW-01 through GW-41, for groundwater sampling. Some locations were adjusted in the field due to field accessibility, UXO clearance, and real time screening results. Locations GW-03 and GW-05 were not pushed as the locations were inaccessible. An additional five locations, GW-42 through GW-46, were added during the field activities to better delineate contaminants in groundwater. The locations for GW-01 through GW-46 are shown on Figure 2-1.

Due to limited groundwater, a temporary piezometer was placed at each direct-push borehole except for GW-44 and was sampled within seven days, if sufficient water was present. Shallow bedrock prevented the installation of a temporary piezometer at GW-44. Groundwater samples were collected from 26 out of the 45 direct-push borings and screened using an on-site field laboratory for TCE, PCE, and cis-1,2-dichloroethylene (cis-1,2-DCE) and analyzed off site for VOCs, perchlorate, and explosives. Nineteen of the borings were dry even after installation of temporary piezometers and were not sampled. All boreholes and temporary piezometers were abandoned upon completion of this phase of field work per the procedures in the IW-SAP and the SS-SAP. Table 2-1 summarizes the groundwater direct-push activities including sample locations, dates, and depths; and the installation of temporary piezometers.

2.2.4 Surface Water Sampling and Analysis

With the exception of the upgradient sample (Stream Sample 01), there were no ponded areas observed in the western ephemeral stream in December 2011 and the surface water sample locations as proposed in the Work Plan, were dry. Surface water during the initial phase was, however, present in the eastern ephemeral stream and below the confluence of the eastern and western ephemeral stream. Additional locations were added to these areas and sampled (see Figure 2-2). One seep and eight surface water locations were sampled for VOCs, SVOCs, metals, perchlorate, and explosives on December 8, 2011.

2.2.5 Sediment Sampling and Analysis

Fourteen sediment sample locations along the east and west ephemeral streams (see Figure 2-3) were sampled from 0.0 to 0.5 feet bgs. Surface water was not present at any of the locations. Sediment samples were analyzed for VOCs, SVOCs, metals, perchlorate, and explosives.

2.2.6 Surface Soil Sampling and Analysis

Surface soil samples (RISS-01 through RISS-42) were collected from 42 locations (see Figure 2-4) as proposed in the Work Plan. Some locations were adjusted due to field accessibility and UXO clearance. Maximum depth of surface sample collection was 2.5 feet below ground surface (bgs) for surface sample locations. Actual depths varied based on field screening results using a photoionization detector (PID) to determine the highest concentration interval, depth to bedrock, and field judgment. Sample interval depth was biased toward higher PID readings. If PID readings were at or below background, the sample depth interval was based on field judgment. One surface soil sample was collected per boring per the procedures detailed in the IW-SAP and SS-SAP for analysis of VOCs, SVOCs, metals, perchlorate, and explosives. Upon completion of sampling, the borings were abandoned following the procedures outlined in the IW-SAP and SS-SAP.

2.2.7 Subsurface Soil Sampling and Analysis

Subsurface soil samples were collected concurrently with the surface soil samples to better delineate contamination in subsurface soil. Thirty-three subsurface soil samples were collected from 18 direct-push locations (see Figure 2-5) and analyzed for VOCs, SVOCs, metals, perchlorate, and explosives. Some of these locations were co-located and collected concurrently with surface sample locations. Due to shallow bedrock, subsurface soil samples were not able to be collected from Locations RISB-09 through RISB-16 and RISB-41; and only one subsurface soil sample was able to be collected from each of Locations RISB-08, RISB-21, and RISB-22. Actual depths varied based on field screening results using a photoionization detector (PID) to determine the highest concentration interval, depth to bedrock, and field judgment. Upon completion of sampling, the borings were abandoned following the procedures outlined in the IW-SAP and SS-SAP. HTW boring logs for the direct-push subsurface soil sample locations are included in Appendix E.

2.2.8 Burn and Demolition Pit Soil Sampling and Analysis

Surface soil samples were collected from 24 locations (BDSS01 through BSSS-24) within the burn and demolition pit areas (see Figure 2-6). Two subsurface soil samples (SB01 and SB02) were also planned for collection from five of these locations (BDSS-03, BDSS-08, BDSS-13, BDSS-20, and BDSS-22). At three of the locations (BDSS-03, BDSS-20, and BDSS-22), two subsurface soil samples were collected from each location. Due to shallow bedrock, only one subsurface soil sample was collected at Location BDSS-13 and none were able to be collected from Location BDSS-08. Soil samples were analyzed for VOCs, SVOCs, metals, perchlorate, and explosives. Upon completion of sampling, the borings were abandoned following the procedures outlined in the IW-SAP and SS-SAP.

2.2.9 Background Soil and Sediment Sampling

Soil and sediment samples were planned to be collected for the determination of background soil concentrations of VOCs, SVOCs, metals, perchlorate, and explosives. It was proposed in the Work Plan that samples for background concentrations be collected from locations with an analogous soil type and depositional environment to the Site. Due to nature of the site and surrounding impact areas, neither background soil nor sediment samples could be taken within the OB/OD Range 16 or surrounding impact areas. During Phase I of the Field Activities, BMcD with the assistance of the Fort Riley PWE and USACE Project Managers endeavored to determine appropriate locations for the samples; however could not find locations that were similar in soil type and depositional environment that had not been impacted by the on-going work that is occurring at the OB/OD. After discussion with the Fort Riley PWE and USACE Project Managers, it was decided to forgo the background soil and sediment sampling.

2.3 PHASE TWO – JANUARY 2012 THROUGH MARCH 2012

The Phase Two investigation was conducted between January 21, 2012 and March 2, 2012. Field activities included multi-incremental soil sampling for explosives, monitoring well installation, bedrock borings, in-situ hydraulic conductivity testing, and piezometer abandonment.

2.3.1 Multi-Incremental Soil Sampling and Analysis

Four multi-incremental soil samples were collected at the decision units shown on Figure 2-7. Each of the multi-incremental soil samples consisted of soil samples collected from 100 incremental locations and composited per the procedures detailed in Work Plan. Samples were collected from the ground surface to approximately three inches bgs. The soil samples were analyzed for explosives.

2.3.2 Monitoring Well Installation

Six monitoring wells were installed and developed during the Phase Two Investigation per the procedures presented in the Work Plan. Monitoring Wells OB-12-16, OB-12-17, and OB-12-18 were screened within the regolith. Soil samples for the regolith wells were continuously collected from the ground surface to the top of bedrock for logging purposes. Monitoring Wells OB-12-15D, OB-12-19D, and OB-12-20D were screened within bedrock. Soil samples were continuously collected from the ground surface to the top of bedrock for logging purposes for Monitoring Wells OB-12-19D and OB-12-20D. As Monitoring Well OB-12-15D was co-located with OB-05-15, the soil was not sampled for logging purposes. Bedrock core was collected and logged from the top of bedrock to total depth. The three bedrock monitoring wells were advanced to the Threemile Limestone Member and screened within the bedrock. The monitoring wells were installed and developed in accordance with the SOPs provided in the IW-SAP and SS-SAP. Monitoring well construction details for the new monitoring wells can be found on

Table 2-2. Monitoring well logs, construction diagrams, development forms, and KDHE WWC-5 forms are included in Appendix E. The locations of the monitoring wells and bedrock borings are shown on Figure 2-8.

2.3.3 Bedrock Borings

Three bedrock borings were advanced during the Phase Two Investigation. Bedrock Borings (Core Holes) CH-1, CH-2, and CH-3 were advanced to 49, 36, and 29 feet bgs, respectively, to determine subsurface stratigraphy at the site. Soil was collected for logging purposes from the ground surface to the top of bedrock. Split spoon samplers where used to collect bedrock core where the uppermost layer was weathered shale and air rotary coring was used in the competent rock until first water was reached. Temporary casing was installed into competent bedrock to prevent regolith groundwater migrating into the bedrock at Bedrock Boring (Core Hole) CH-3. As Bedrock Borings (Core Holes) CH-1 and CH-2 were located in areas where groundwater was not present in the regolith, temporary casing was not required. Once the target depth of first water was reached, a groundwater grab sample was collected from the open core hole with a bailer and analyzed for VOCs and explosives. Following groundwater sampling, CH-1, CH-2, and CH-3 were abandoned per the SOPs presented in the IW-SAP and the SS-SAP. The locations of the bedrock borings are shown on Figure 2-8. HTW boring logs and KDHE WWC-5/WWC-5P forms are included in Appendix E.

2.3.4 Piezometer Abandonment

Following installation of the regolith and bedrock monitoring wells, the five piezometer sets installed in 1997 (OB-97-09PZ through OB-97-13PZ) were abandoned according to KDHE regulations and the abandonment SOPs provided in the SS-SAP and the IW-SAP. The completed KDHE Kansas WWC-5P forms are included in Appendix E. Locations of the abandoned piezometers are shown on Figure 2-8.

2.3.5 Aquifer Testing

In-situ hydraulic conductivity tests (slug tests) were conducted at Monitoring Wells OB-97-06, OB-05-15, and OB-12-19D (see Figure 2-8) on September 26 and 27, 2012 in conjunction with the third round of groundwater sampling. Calculations for the slug tests are included in Appendix F. Results of the slug tests are discussed in Section 3.1.4 of this RI Report.

2.4 PHASE FOUR – MARCH 2012 THROUGH DECEMBER 2012

Quarterly groundwater/surface water sampling events were conducted in March, June, September, and December of 2012. Sixteen monitoring wells (see Figure 2-9) were sampled during each event. Groundwater level measurements were collected prior to each groundwater sampling round. The monitoring wells were sampled for VOCs, SVOCs, metals, perchlorate, explosives, water quality parameters, and monitored natural attenuation parameters per the protocol presented in the SS-SAP and the IW-SAP. Complete analytical sets were collected from the monitoring wells for each of the sampling rounds with the exception of Monitoring Well OB-97-08 where, due to a limited volume of sample available, only VOCs, perchlorate, and metal samples were collected during the third quarter and only VOC, perchlorate, metals, and a partial set of water quality samples were collected during the fourth quarter.

During each quarterly round, surface water samples including one spring, two stream, and two surface water (seep) samples were planned for collection (see Figure 2-9). A spring and two streams sample were collected in March and analyzed for VOCs, SVOCs, metals, perchlorate, and explosives. The surface water locations were dry during each sampling event and were not sampled. During the June, September, and December sampling events, the spring and two stream locations were also dry and no samples were collected.

2.5 PHASE THREE – JANUARY 2013

Based upon the results of the Phase One soil sampling, additional soil samples were collected in the areas of BDSS-12 and BDSS-17, both located within the metal debris pits. (As the Work Plan had originally included additional samples in the third phase of field activities, the Phase Three nomenclature was kept even though Phase Three was completed after the Phase Four). Sampling was conducted in an iterative manner per the procedure detailed in the Work Plan Addendum with the exception that soil samples were collected from the entire regolith interval. Twenty direct-push borings (see Figure 2-10) were advanced to the top of bedrock with one soil sample collected from within the 0.0 to 1.0 feet bgs interval, one collected from the 1.0 to 3.0 foot bgs interval and one from the four-foot intervals below that until bedrock was encountered with the exception of Borings MD-34, MD-35, MD-36, and MD-39. For these borings, samples were collected at the top and bottom of the boring but were not collected in the middle intervals where PID readings were 0 parts per million. Clearance of the location proposed for MD-25 using a Schonstedt magnetic locator, Model GA-52Cx indicated a metallic signature. MD-25 was off set to the south. Testing of the area with the Schonstedt indicated an area approximately 10 feet by 10 feet with a metallic signature (see Figure 2-10). Soil samples were analyzed on site using a field gas chromatograph (GC) for cis-1,2-DCE, TCE, and PCE with 10 percent of the samples also analyzed for VOCs at an off-site analytical laboratory.

2.6 DATA VALIDATION

Analytical data were validated as specified per the protocol presented in the SS-SAP and the IW-SAP. QCSRs were produced and submitted to the Fort Riley, USACE, USEPA, and KDHE after all major sampling events. QCSRs were generated for the following data sets:

- Phase One Direct-Push Groundwater Samples and Surface Water Samples - *Quality Control Summary Report, Open Burning-Open Detonation Grounds (Range 16), Operable Unit 006 at Fort Riley, Kansas*, January 2012 (LBG-BMcD, 2012b)
- Phase One Soil and Sediment Samples - *Quality Control Summary Report, Remedial Investigation/Feasibility Study Phase One, Sediment and Soil Sampling at the Open Burning/Open Detonation Grounds (Range 16) Operable Unit 006 at Fort Riley, Kansas*, July 2012 (LBG-BMcD, 2012c).
- Phase Two Multi-Incremental Soil Sampling - *Quality Control Summary Report, Remedial Investigation/Feasibility Study, Phase Two, Multi-Incremental Soil Sampling at the Open Burning-Open Detonation Grounds (Range 16) Operable Unit 006 at Fort Riley, Kansas*, March 2012 (LBG-BMcD, 2012d).
- Phase Four Groundwater Sampling, Quarter 1 - *Quality Control Summary Report Remedial Investigation/Feasibility Study Phase Four, Quarterly Groundwater Sampling, Baseline Groundwater Sampling Event, at the Open Burning-Open Detonation Grounds (Range 16) Operable Unit 006 at Fort Riley, Kansas*, May 2012 (LBG-BMcD, 2012e)
- Phase Four Groundwater Sampling, Quarter 2 - *Quality Control Summary Report, Remedial Investigation/Feasibility Study Phase Four, Quarterly Groundwater Sampling, Second Quarter Groundwater Sampling Event at the Open Burning/Open Detonation Grounds (Range 16) Operable Unit 006 at Fort Riley, Kansas*, August 2012 (LBG-BMcD, 2012f).
- Phase Four Groundwater Sampling, Quarter 3 - *Quality Control Summary Report, Remedial Investigation/Feasibility Study Phase Four, Quarterly Groundwater Sampling, Third Quarter Groundwater Sampling Event at the Open Burning/Open Detonation Grounds (Range 16) Operable Unit 006 at Fort Riley, Kansas,* November 2012 (LBG-BMcD, 2012g).
- Phase Four Groundwater Sampling, Quarter 4 - *Quality Control Summary Report, Remedial Investigation/Feasibility Study Phase Four, Quarterly Groundwater Sampling, Fourth Quarter Groundwater Sampling Event at the Open Burning/Open Detonation Grounds (Range 16) Operable Unit 006 at Fort Riley, Kansas,* February 2013 (LBG-BMcD, 2113b).

- Phase Three Direct-Push Sampling at the Metal Debris Pits - *Quality Control Summary Report, Metal Debris Pit Soil Confirmation Investigation, Open Burning/Open Detonation Grounds (Range 16) Operable Unit 006 at Fort Riley, Kansas*, March 2013 (LBG-BMcD, 2013c).

Full analytical results tables from the QCSRs can be found in Appendix J of this RI Report.

* * * * *

3.0 SITE SETTING

3.1 PHYSICAL SETTING

3.1.1 Site Features

The topography of Fort Riley and the surrounding area consists of a low plain that has been eroded by streams and rivers. The area is designated as the Osage Plains section of the Central Lowlands physiographic province (Schoewe, 1949). Sedimentary bedrock strata dip gently to the west-northwest. East-facing escarpments of more resistant rock units are separated by gentle, westward-sloping plains. The resulting topography can be divided into upland areas with bluffs along alluvial valleys, and lowland areas that consist of alluvial plains and associated terraces. The upland areas are dissected by numerous intermittent and perennial streams; the lowlands areas occur along the banks of the major rivers in the area: the Republican, Smoky Hill, and Kansas Rivers (Jewett, 1941).

The geology of Fort Riley and the surrounding area consists of Pennsylvanian and Permian Age sedimentary rock overlain by eolian and fluvial deposits of Pleistocene and Recent Age (Jewett, 1941). The Nemaha Anticline is the prominent structural feature in the area, and Fort Riley is situated on the western limb of this fold within the Salina Basin (Merriam, 1963). Bedrock dips gently (approximately 30 feet per mile) to the west-northwest and consists of alternating beds of limestone and shale of the Permian Chase and Council Grove Groups. The Barneston Formation of the Chase Group (composed of the Fort Riley Limestone, Oketo Shale, and Florence Limestone Members) is the uppermost bedrock in the upland areas. This sequence of interbedded limestones and shales continues to depths of several hundred feet. The bedrock surface has been eroded by the major rivers and streams. The major streams tend to flow to the east and south due to topography. The rivers are broad, shallow, and slow-moving.

In the major river valleys, alluvial sand, silt, and gravel deposits reach a thickness of approximately one hundred feet near the rivers and decrease in thickness toward the margins of the floodplain. Alluvium and loess cover portions of the upland areas, including terraces underlain by Buck Creek terrace deposits (Fader, 1974). These terrace deposits include both alluvium and loess. Eudora and Kenesaw soils are developed throughout Fort Riley (Jantz et al., 1975). Eudora silt loams are well drained, have moderate permeability, and normally form in coarse, silty alluvium on high flood plains or low terraces.

3.1.2 Site-Specific Soils

OB/OD is underlain by regolith (the layer of soil and loose rock overlying the bedrock) consisting of residual silty clays that grade into weathered bedrock. The regolith is composed of the Smolan silty loam and the Wymore silty clay loam (Jantz, 1975). The Smolan soils are commonly found in terrace and upland areas adjacent to the Kansas and Republican River Valleys and are formed from loess deposits. The Wymore silt, also formed from loess deposits, is also found in the upland areas. Soils originating from the weathering of terrace bedrock formations are also found in the upland areas.

3.1.3 Site-Specific Geology

OB/OD is underlain by an alternating sequence of limestone and shale of the Permian Chase and Council Grove Groups (see Figures 3-1, 3-2, and 3-3). Bedrock present at OB/OD includes the Blue Springs Shale Member, Kinney Limestone Member, Wymore Shale Member, Schroyer Limestone Member, and Havensville Shale Member. The Threemile Limestone Member and Speiser Shale Member underlie the Havensville Shale Member. The bedrock at OB/OD generally dips toward the southwest. The localized bedrock dip is slightly steeper toward the southwest in the eastern portion of the site, but levels out in the western portion of the site. Descriptions of the specific bedrock units encountered at OB/OD are provided below.

- **Florence Limestone Member** – The Florence Limestone generally consists of a fossiliferous light to yellowish-gray limestone with chert and shale (Zeller, 1994). The Florence Limestone was not observed at OB/OD during RI field activities but outcrops north of the study area.
- **Blue Springs Shale Member** – The Blue Springs Shale generally consists of a red to gray shale with minor amounts of limestone (Zeller, 1994). A description of the Blue Springs at OB/OD Area is a greenish-gray to dark reddish-brown, dry, slightly-calcareous shale with a measured thickness of 21 feet. At OB/OD, the three detonation pits, two metal debris pits, and a portion of the north burn pit are located within the Blue Springs Shale Member.
- **Kinney Limestone Member** – The Kinney Limestone generally consists of two gray, fossiliferous, limestone beds separated by gray, fossiliferous shale (Zeller, 1994). The Kinney Limestone at OB/OD is a pale-yellow, moist to wet, slightly-weathered, cherty limestone with a thickness of 4 feet. A portion of the north burn pit is located within the Kinney Limestone Member.
- **Wymore Shale Member** – The Wymore Shale consists of gray and yellowish-gray shale with varicolored red, green, and purple beds, and limestone and fossiliferous beds in the lower portions (Zeller, 1994). The Wymore Shale at OB/OD is a gray to greenish-gray, calcareous shale that is wet in the upper zone, dry in the middle portion, and moist to wet in the lower portion. The Wymore has an approximate thickness of 25 feet. The south burn pit and spring are located within the Wymore Shale Member.

- **Schroyer Limestone Member** – The Schroyer Limestone consists of a chert-bearing, light-gray to nearly white limestone with a 3-foot, non-cherty section in the upper portion (Zeller, 1994). The Schroyer at OB/OD is a wet, crystalline, medium-hard to dense, gray to pale-yellow limestone with an average thickness of 9 feet. A majority of the western ephemeral stream and the southern portion of the eastern ephemeral stream lie in the Schroyer Limestone Member.
- **Havensville Shale Member** – The Havensville Shale consists of gray calcareous shale with thin limestone beds (Zeller, 1994). The Havensville Shale at OB/OD is a dark gray, dry, calcareous, subplaty shale with an average thickness of 15 feet. The Havensville underlies the southern portion of OB/OD.
- **Threemile Limestone Member** – The Threemile Limestone consists of a light-gray to nearly white limestone with chert-bearing zones. Massive non-cherty beds are located in the middle and lower portions of the member (Zeller, 1994). The Threemile Limestone at OB/OD is a dark gray limestone with interbedded shales with an average thickness of 12 to 20 feet.
- **Speiser Shale** – The Speiser Shale consists of a fossiliferous shale underlain by a limestone in the upper portion of the unit while the remainder of the unit is composed of varicolored beds with red as the predominant color. The Speiser Shale has an average thickness of 15 to 18 feet.

Three cross sections for the OB/OD area have been constructed using geologic logs produced during various field activities since 1993. Figure 3-1 indicates where the three cross sections cut the site. Cross Section A to A' cuts east west through the northern portion of the OB/OD. As shown on Figure 3-2, topography and the underlying bedrock surface slope to the south and to the west. The uppermost bedrock is the Kinney Limestone Member on the eastern portion of the cross section and the Havensville on the western portion. Cross Section B to B' cuts the OB/OD area from the northeast to the southwest (see Figure 3-2). As seen on this figure the metal debris pit is located between OB-97-09PZ and OB-97-11PZ and is upgradient from the spring. As seen on this cross section, the thickness of the Kinney Limestone Member is thickening locally to the southwest. Cross Section C to C' cuts the site from the north to the south through the three core holes advanced as part of the RI field activities and ends at Monitoring Well OB-12-19D (see Figure 3-3). As seen on this cross section, the Schroyer Limestone Member is bisected by the east ephemeral stream.

3.1.4 Hydrogeology

3.1.4.1 Regional Hydrogeology

The Fort Riley area lies within the Nonglaciated Central Region Groundwater Province (Heath, 1984). This region is hydrogeologically complex and is generally characterized by both consolidated rock aquifers having low yields and alluvial aquifers along the major rivers having moderate to high yields. Both types of aquifers are present in Geary and Riley Counties. Consolidated Permian limestone and shale aquifers produce small quantities of groundwater in the uplands areas. These aquifers are developed within fractures and cavities in the Permian Chase and Council Grove Groups (Buchanan and Buddemeier, 1993). In the river valleys, aquifers are developed within the unconsolidated alluvial sediments deposited by the rivers and major streams. These alluvial aquifers are unconfined, and water wells completed within the floodplain have high yields in the hundreds of gallons per minute. Elevated alluvial terrace deposits, which are located along the margins and above the modern flood plain, also act as low-yield aquifers. These deposits usually have lower transmissivities than the deposits of the modern alluvial floodplain as the saturated thickness of sediments is much less and are, consequently, not a reliable source of supply. However, the terrace aquifers provide recharge to the Kansas River alluvial aquifer and can also act as conduits for contaminants. Alluvial, terrace, and bedrock aquifers are present at Fort Riley.

3.1.4.2 Site-Specific Hydrogeology

Groundwater at OB/OD is present from up gradient aquifer recharge and through precipitation. Precipitation that falls on the site infiltrates downward through the soil into the underlying bedrock. (During rain events, overland flow also occurs from the higher elevation portions of the sites to the two ephemeral streams located to the east and west of the site.) Groundwater moves horizontally along bedding planes in the shale and limestone formations and vertically through joints and fractures. Joint sets running east-northeast and north-northwest are present at the site in the bedrock. Additional fractures are also possible at the site due to the historical and continued use of the site as a range for detonation of explosives. Spring and wet weather seeps are present at OB/OD. The wet weather seeps, which are located within or near the drainage areas, produce water mainly after heavier precipitation events. The spring (see Figure 1-2) produces water on a more consistent basis; however, it is more commonly dry than flowing.

Groundwater at OB/OD is found mainly within two horizons, the regolith/weathered bedrock horizon and the Threemile Limestone Member. The majority of the monitoring wells at OB/OD are set within the upper regolith/weathered bedrock horizon. Table 2-2 summarizes the monitoring well construction details including the formation and aquifer screened. Piezometric measurements for the March, June, September, and December quarterly sampling events are summarized on Table 3-1. Piezometric surfaces for the regolith/weathered aquifer are shown on Figures 3-4 through 3-7 for the four quarters of groundwater sampling events. As shown on the figures, the groundwater gradient within this aquifer is to the south southwest. Hydraulic conductivity testing at Monitoring Well OB-05-15, which is screened within the regolith, resulted in a conductivity value of 4.05×10^{-3} centimeters per second (cm/sec) and at Monitoring Well OB-97-06, which is screened within the Schroyer Limestone Member, resulted in a conductivity value of 5.30×10^{-2} cm/sec. Appendix F contains the calculations for the hydraulic conductivities.

Groundwater within the Threemile Limestone has a significantly lower piezometric level, as shown in Monitoring Wells OB-93-03, OB-93-04, OB-12-19D, and OB-12-20D. Piezometric measurements for the Threemile Limestone interval are shown in green on Figures 3-4 through 3-7 for the four quarters of groundwater sampling events. As shown on the figures, the groundwater gradient within the Threemile is basically flat within the area of OB/OD (Monitoring Wells OB-93-03, OB-93-04, and OB-12-20D) then slopes southward towards Monitoring Well OB-12-19D. Hydraulic conductivity testing at Monitoring Well OB-12-19D, which is screened within the Threemile Limestone Member and the Speiser Shale, resulted in a conductivity value of 7.30×10^{-2} cm/sec. Appendix F contains the calculations for the hydraulic conductivity.

3.1.5 Surface Water Hydrology

3.1.5.1 Regional Surface Water Drainage

Fort Riley is located along the Kansas River, and is surrounded by other large bodies of water associated with the Kansas River system. The river system in the area includes Milford Lake (a reservoir on the Republican River) to the west, the Republican River (downstream of Milford Lake to the southwest), and the Smoky Hill River to the south. The Republican and Smoky Hill Rivers merge to form the Kansas River. There are numerous other ephemeral, intermittent, and perennial creeks/streams that dissect Fort Riley, eventually feeding into the large rivers identified above (Jewett, 1941).

3.1.5.2 Site-Specific Surface Water Drainage

During rainfall events, surface runoff from the surrounding area travels into one of the two ephemeral streams bordering OB/OD on the east and west based on topographic elevation. These two ephemeral streams join approximately 1,500 feet south of OB/OD. This ephemeral stream intercepts the Threemile Creek approximately 3,700 feet south of the site and eventually enters the Kansas River to the southeast.

Surface water in the ephemeral streams generally occurs following precipitation events. During these events, surface water flows in the stream bed while precipitation infiltrates the overlying regolith and migrates into bedrock through fractures, joints and bedding planes. Where the bedrock outcrops along the stream beds, temporary seeps are developed which allows water to seep from the outcropping bedrock into the streams. Following the precipitation events, the stream flow gradually reduces until flow no longer occurs and ponded areas are formed, which eventually dry up. Additionally, seeps and springs dry up when there is no longer any infiltration to support a continuing flow. Examples of this are the spring located at the base of the Kinney and the seeps along the western ephemeral stream located within the outcropping Schroyer.

During the RI field activities, surface water samples were only collected during two of the five planned sampling events. Planned locations were biased towards locations most likely to have surface water based upon previous investigations. During the first planned sample collection, surface water was mainly found in the eastern ephemeral stream. Of the planned surface water sample locations within the western ephemeral stream only one location north of the active portion of the OB/OD had water. A surface water sample was not collected from the spring as it was not flowing during this event. Surface water samples were planned from five locations during each of the quarterly sampling events; however surface water was only present during the March 2012 event and then was present at only three of the five locations.

3.2 WATER USE

OB/OD is located in an isolated part of Fort Riley (see Figure 1-3). This area is part of the Impact Area for weapons training at Fort Riley and access is restricted by the US Army due to the nature of the training. The only personnel within a 1-mile radius of OB/OD are US Army personnel. Access to the OB/OD site is limited to OB/OD personnel during the detonation of ordnance. The two streams that border the site on the east and west sides are classified as ephemeral streams as these streams are dry except during precipitation events.

A water supply well is located on the military reservation at Range 18, approximately 4,200 feet toward the east, up gradient of OB/OD. This well is only used for non-potable purposes. A potable water supply well is also located on the former Range 19, approximately 5000 feet to the east and up gradient of the OB/OD. No other supply wells are located on or within one mile of the site. The nearest potable public water supply well is the City of Ogden well field located approximately three miles away to the southeast and screened in the Kansas River Alluvium. Based on the Fort Riley Master Plan, the mission for OB/OD will not change for the foreseeable future and water will not be used for either potable or non-potable purposes.

3.3 CLIMATOLOGY

The average temperature for the area (measured at Station 144972, located at Manhattan, Kansas) is 55 degrees Fahrenheit (ºF). Temperature extremes range from a record low of –31 ºF (January 1947) to a record high of 116 ºF (August 1936). Annual precipitation from 1893 through 2012 ranged from a minimum of 15.42 inches to a maximum of 60.38 inches, with an average of approximately 33 inches per year. The maximum 24-hour rain event during the same period was reported at 6.28 inches. Annual precipitation for 2010, 2011, and 2012 was 33.34, 33.05, and 21.88 inches, respectively. Average annual snowfall is approximately 18 inches, with a maximum annual snowfall during the reporting period of 49.5 inches in 1960. The maximum 24-hour snowfall event during this same period was reported at 18 inches (High Plains Regional Climate Center, 2013). Pan evaporation, measured by the USACE at Tuttle Creek Lake north of Manhattan, averaged 47.13 inches/year between 1980 and 1997, with extremes of 37.39 inches/year and 58.66 inches/year. Prevailing wind directions are variable. Winds are predominantly from the south and southwest during March through December, and winds are predominantly from the north during the months of January and February. Wind speeds generally range from seven to ten miles per hour (personal communication, First Weather Group, Detachment 8, Fort Riley MAAF, 1998).

3.4 DEMOGRAPHY

The lands surrounding OB/OD consist of undeveloped wooded and grassy lands. No residential or commercial structures exist near the site. The only personnel within a 1-mile radius of OB/OD are US Army personnel. Access to the Impact Area is restricted due to the nature of the training. Access to OB/OD site is limited to OB/OD personnel during the detonation of ordnance.

In addition to the other cantonment areas of Fort Riley (all of which are within eight miles of OB/OD), the following towns are within fifteen miles of OB/OD: Junction City and Grandview Plaza (to the south) and Ogden (approximately seven miles to the southeast). The approximate populations of the surrounding major towns are: Junction City (23,353), Grandview Plaza (1,560), and Ogden (2,087) (United States Department of Commerce, 2010).

3.5 ECOLOGY

Fort Riley lies within a transitional zone between deciduous forests of Eastern Kansas and the grass prairies of the Great Plains. The area supports a wide variety of wildlife, adapted to a variety of habitat types. Habitat types found throughout Fort Riley consist of a mosaic of upland and riparian woodland, cropland, tall grass prairie, pasture/hayfield, revegetated grassland, and lawn based upon previous investigations performed. The Kansas River provides additional wildlife habitat.

The Fort Riley PWE Conservation Branch has identified 28 listed and rare species that have been identified or could potentially exist in the Fort Riley area. A list of these species is provided on Table 3-2. Many of the species have recently been documented at Fort Riley.

Habitat types found at OB/OD consist of woodland areas near the banks of the ephemeral streams and grasslands with low lying plants comprising most of the active portion of the site.

* * * * *

4.0 NATURE AND EXTENT OF CONTAMINATION

4.1 INTRODUCTION

Within this section of the RI Report, the nature and extent of impacts at the OB/OD are discussed on a media-specific basis. Soil (regolith) results are discussed as surface soil (0 to 2 feet bgs) and subsurface soil (>2 feet bgs). These depths have been used to be consistent with the current risk assessment guidance as used in the BLRA portion of this report. Other media discussed in this section include surface water, dry sediment, and groundwater. Historic information is discussed where available.

Analytical results were compared to screening levels per the procedures set forth in the Work Plan (LBG-BMcD, 2011a). Table 4-1 summarizes the screening levels used and the source of the screening levels for the analytes detected for each medium. For the RI, soil and sediment analytical concentrations were first compared to the KDHE Risk-Based Standards for Kansas (RSKs) for the non-residential scenario, soil pathway (KDHE, 2010). If a RSK was not available for a specific analyte, then the USEPA Regional Screening Level (RSLs) for industrial soil was used (USEPA, 2012). For surface water and groundwater, the USEPA MCL was used, followed by the KDHE RSK for groundwater or the USEPA tapwater RSL if the RSK and MCL are not available. As the ephemeral streams at the OB/OD are not classified water bodies, the Kansas Surface Water Quality Criteria are not applicable. Copies of all applicable screening standard documents are provided in Appendix K.

4.2 SURFACE SOIL (0-2 FEET BGS)

Surface soil samples were collected during Phase One of the RI field activities as part of the site-wide delineation of contamination in surface soil and as part of the investigation of the burn and demolition pit areas. Surface Soil Samples RISS-01 through RISS-42 were collected from 42 locations located across the OB/OD (see Figure 4-1). Surface soil samples were also collected from 24 locations within the burn and debris/demolition pit areas. Surface soil samples collected during the Phase One of the RI field activities were analyzed for VOCs, SVOCs, metals, perchlorate, and explosives.

During Phase Two of the RI field activities, four multi-incremental soil samples (MIS-01 through MIS-04, Figure 4-1) were collected; one from the northern burn pit and three from the debris/demolition pits and analyzed for explosives. The multi-incremental soil samples were collected from the ground surface to approximately 3 inches in depth. Each multi-incremental soil sample was a sample composited from 100 aliquots collected from over the sample area.

During Phase Three of the RI field activities, 23 field GC and two laboratory confirmation surface soil samples were collected from 20 direct-push borings (MD-12 through MD-39, Figure 4-2) in the area of the metal debris pits. These additional surface soil samples were collected in the areas of BDSS-12 and BDSS-17, both located within the metal debris pits. Soil samples were analyzed on site using a field GC for cis-1,2-DCE, TCE, and PCE with the two confirmation samples also analyzed for VOCs at an off-site analytical laboratory.

4.2.1 VOCs – Field Screening

Twenty-three surface soil samples were collected from 20 locations at the metal debris pits during the Phase Three field activities. The surface soil samples were analyzed for cis-1,2-DCE, PCE, and TCE using a field GC. Confirmation samples were collected for Samples MD-25/SB01 and MD-34/SS01 and were analyzed off site for VOCs. TCE was detected in 14 of the 23 samples; one soil samples, MD-22/SS01 at 24,000 J micrograms per kilogram (µg/kg), exceeded the screening level of 9,910 µg/kg (see Table 4-2). As noted in the QCSR (LBG-BMcD, 2013b), the correlation coefficient between the field GC and off site confirmation results using linear regression techniques was 0.6429, which was below the 0.70 linear regression acceptance criteria. The low correlation coefficient was likely due to the difference between the TCE results for sample locations with significant detected concentrations. PCE was detected in eight samples; none of the detections exceeded the screening level of 210,000 µg/kg. Cis-1,2-DCE was detected in three samples; none of the detections exceeded the screening level of 194,000 µg/kg.

4.2.2 VOCs – Laboratory Analysis

Seventeen VOCs including 1,1,1,2-tetrachloroethane, PCA, 1,1,2-trichloroethane, 1,2,4-trimethylbenzene, 1,3-dichlorobenzene, acetone, bromochloromethane, chlorobenzene, cis-1,2-DCE, isopropylbenzene, p-isopropyltoluene, sec-butylbenzene, tert-butylbenzene, PCE, toluene, trans-1,2-dichloroethene (trans-1,2-DCE), and TCE were detected in 68 surface soil samples (see Table 4-3). None of the VOCs were detected at levels above screening levels.

4.2.3 SVOCs

Four SVOCs, 2,4-dinitrotoluene, 2,6-dinitrotoluene, di-n-butyl phthalate, and N-nitrosodiphenylamine were detected in surface soil samples (see Table 4-3). None of the SVOCs were detected at levels above screening levels.

4.2.4 Perchlorate

Perchlorate was detected in 24 of the 66 surface soil samples analyzed for perchlorate. The highest detection was 25 µg/kg for Soil Sample BDSS-23/SS01 (see Table 4-3). All of the detected concentrations were below the screening level of 1,430,000 µg/kg.

4.2.5 Explosives – Discrete Samples

Six explosives including 2,4,6-trinitrotoluene, 2,4-dinitrotoluene, 4-amino-2,6-dinitrotoluene, octahydro-1,3,5,7-tetranitro-1,3,5,7-terazocine (HMX), nitroglycerin, and hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) were detected in the 66 surface soil samples collected during the RI field activities (see Table 4-3). None of the explosives were detected at levels above screening levels.

4.2.6 Explosives – MIS Composite Samples

Seven explosives including 2,4,6-trinitrotoluene, 2,4-dinitrotoluene, 2,6-dinitrotoluene, 4-nitrotoluene, octahydro-1,3,5,7-tetranitro-1,3,5,7-terazocine (HMX), nitroglycerin, and hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) were detected in the four composite MIS surface soil samples collected during the RI field activities (see Table 4-4). None of the explosives were detected at levels above screening levels.

4.2.7 Metals

Thirteen metals including antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc were detected in the 66 surface soil samples (see Table 4-3). None of the metals were detected at levels above screening levels.

4.2.8 Historical Data

Eight surface soil samples were collected from within the active area of the OB/OD during the initial 1993 SI and analyzed for explosives and metals (see Appendix A). RDX was detected in one sample at 2.5 mg/kg. No other explosives were detected. Arsenic, beryllium, cadmium, chromium, copper, nickel, lead, zinc, and uranium were detected in each of the samples. One sample (SS-1) was also analyzed for VOCs, and SVOCs. No VOCs were detected. Di-n-butylphthalate was the only SVOC detected.

4.2.9 Summary

Seventy-two surface soil samples were collected at the OB/OD during the RI field activities for laboratory analysis and 23 for VOC analysis using an on-site GC. Surface soil samples were analyzed for VOCs, SVOCs, perchlorate, explosives, and metals. Seventeen VOCs, four SVOCs, perchlorate, eight explosives and thirteen metals were detected in surface soil samples. TCE was detected above the screening level of 9,910 µg/kg in two surface soil samples analyzed using an on-site GC. All other detections for VOCs, SVOCs, perchlorate, explosives, and metals were below screening levels. Metal results in the surface samples with the exception of BDSS-06/SS01 and BDSS-12/SS01 are fairly consistent and do not appear to be the result of impacts due to site usage.

4.3 SUBSURFACE SOIL (>2 FEET BGS)

Subsurface soil samples were collected during Phase One of the investigation as part of the site-wide delineation of contamination in subsurface soil and as part of the investigation of the burn and demolition pit areas. For the site-wide delineation, 33 subsurface soil samples were collected from 18 direct-push locations (RISB-01 through RISB-40) and analyzed for VOCs, SVOCs, metals, perchlorate, and explosives (see Figure 4-3). All but one (RISB-24) of these locations were collocated with surface sample locations. Due to shallow bedrock, subsurface soil samples were not able to be collected from Locations RISB-09 through RISB-16 and RISB-41; and only one subsurface soil sample was able to be collected from each of Locations RISB-08, RISB-21, and RISB-22. Seven subsurface soil samples were collected during the investigation of the burn and demolition pit areas. At three of the locations (BDSS-03, BDSS-20, and BDSS-22), two subsurface soil samples were collected from each location. Due to shallow bedrock, only one subsurface soil sample was collected at Location BDSS-13. Soil samples were analyzed for VOCs, SVOCs, metals, perchlorate, and explosives. Table 4-5 summarizes the detections for the subsurface soil samples.

Additional subsurface soil samples were collected during the Phase Three investigation of the metal debris pits. Twenty direct-push borings (MD-12 through MD-39) were advanced to the top of bedrock with one soil sample collected from within the 0.0 to 1.0 feet bgs interval, one collected from the 1.0 to 3.0 foot bgs interval and one from the four-foot intervals below that until bedrock was encountered. Soil samples were analyzed on site using a field GC for cis-1,2-DCE, TCE, and PCE with 10 percent of the samples also analyzed for VOCs at an off-site analytical laboratory. Forty-five subsurface soil samples were collected for GC analysis with five also analyzed off site as confirmation samples. Table 4-2 presents the field GC results, and Table 4-5 presents the detections from confirmation samples that were analyzed at an off-site laboratory.

4.3.1 VOCs – Field Screening

Forty-five subsurface soil samples were collected from 20 locations at the metal debris pits during the Phase Three field activities (see Figure 4-2). The subsurface soil samples were analyzed for cis-1,2-DCE, PCE, and TCE using a field GC (see Table 4-2). Confirmation samples were collected for Samples MD-16/SBO2, MD-25/SB03, MD-26/SB03, MD-31/SB03, and MD-33/SB03 and analyzed off site for VOCs. TCE was detected in 36 of the 45 subsurface samples and at levels that exceed the screening level of 9,910 µg/kg in eight samples (see Table 4-2). As noted in the QCSR (LBG-BMcD, 2013b), the correlation coefficient between the field GC and off site confirmation results using linear regression techniques was 0.6429, which was below the 0.70 linear regression acceptance criteria. The low correlation coefficient was likely due to the difference between the TCE results for sample locations with significant detected concentrations. As shown on Figure 4-2, TCE sample exceedances are centered on the area with metallic signature that is present between the two metal debris pits. PCE was detected in 20 subsurface samples; none of the detections exceeded the screening level of 210,000 μg/kg. Cis-1,2-DCE was detected in 14 subsurface samples; none of the detections were above the screening level of 194,000 μg/kg.

4.3.2 VOCs – Laboratory Analysis

Twelve VOCs including PCA, 1,1,2-trichloroethane, acetone, bromochloromethane, chloroform, cis-1,2-DCE, methylene chloride, styrene, PCE, toluene, trans-1,2-DCE, and TCE were detected in subsurface soil samples (see Table 4-5). Of these detections, only TCE was detected at levels that exceeded the screening levels. TCE was detected at levels that exceed the screening level of 9,910 μg/kg in two of 45 samples. These two samples were collected during the Phase Three investigation at the metal debris pits (see Figure 4-4). The majority of VOCs detections in subsurface soil samples occurred in soil samples (other three subsurface soil samples MD-25/SB03, MD-26/SB03, MD-16/SB02, MD 31/SB03, and MD 33/SB03 which were collected during the Phase Three investigation at the metal debris pits. Of the 45 subsurface soil samples collected, 30 were nondetect for VOCs. Ten samples had detections of VOCs including three with low level detections of TCE, one with low level concentrations of PCA and TCE, and six with low level detections of acetone (a known lab contaminant). As shown on Figure 4-4, TCE exceedances within the subsurface soil are contained within the immediate area of the metal debris pits.

4.3.3 SVOCs

No SVOCs were detected in the subsurface soil samples (see Table 4-5).

4.3.4 Perchlorate

Forty subsurface soil samples were analyzed for perchlorate. Perchlorate was detected in 24 of the 40 samples with all detections occurring in the burn and demolition pit areas. None of the concentrations exceeded the screening level of 1,430,000 μg/kg (see Table 4-5).

4.3.5 Explosives

HMX was the only explosive detected in the subsurface soil samples. HMX was detected in one sample (BD-SS13, 3.0 to 4.0 feet bgs) located within the metal debris pits area. The concentration (0.035 estimated value [J] μg/kg) was below the screening level of 44,000 μg/kg (see Table 4-5).

4.3.6 Metals

Thirteen metals including antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc were detected in subsurface soil samples. None of these were detected at levels above screening levels (see Table 4-5). Metal detections in soil can be a result of naturally occurring metals as well as anthropogenic processes. Metal results in the subsurface samples with the exception of BDSS-13/SB01 which contains the highest concentrations of copper, lead, and nickel are fairly consistent and do not appear to be the result of impacts due to site usage. Subsurface metal detections at the OB/OD are generally low and appear to be naturally occurring.

4.3.7 Historical Data

Subsurface soil samples were collected for the 1993 SI (see Appendix A). One sample was analyzed for VOCs, SVOCs, total petroleum hydrocarbon (TPH), explosives, and metals. Only metals were detected. Fourteen subsurface soil samples were collected and analyzed for metals and explosives. Only metals were detected. Metals results were comparable to the metals detections discussed above.

4.3.8 Summary

Forty-five subsurface soil samples were collected during the RI field activities at the OB/OD. Forty subsurface soil samples were analyzed for VOCs, SVOCs, metals, perchlorate, and explosives and five were analyzed for VOCs. Additionally 45 subsurface soil samples were collected from 20 locations at the metal debris pits during the Phase Three field activities and analyzed for cis-1,2-DCE, PCE, and TCE using a field GC. VOC exceedances for TCE were present in eight subsurface soil samples collected from the metal debris pits area that were screened using the field GC. No SVOCs were detected in the subsurface soil samples. Perchlorate and one explosive, HMX, were detected but at levels below screening levels. Thirteen metals were detected but at levels below applicable screening levels. Metal results in the subsurface samples with the exception of BDSS-13/SB01 are fairly consistent and do not appear to be the result of impacts due to site usage.

4.4 SEDIMENT

Fourteen sediment sample locations along the east and west ephemeral streams (see Figure 4-5) were sampled on December 7, 2011. Surface water was not present at any of the locations. Sediment samples were analyzed for VOCs, SVOCs, metals, perchlorate, and explosives. Detections are discussed below and summarized in Table 4-6.

4.4.1 VOCs

PCE and toluene were the only VOCs detected in sediment samples. PCE was detected in one sample (SD-03) and toluene was detected in two samples (SD-05 and SD-11) at concentrations below the screening levels (see Table 4-6).

4.4.2 SVOCs

No SVOCs were detected in the sediment samples (see Table 4-6).

4.4.3 Perchlorate

Perchlorate was not detected in the sediment samples (see Table 4-6).

4.4.4 Explosives

No explosives were detected in the sediment samples (see Table 4-6).

4.4.5 Metals

Thirteen metals including antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium and zinc were detected in the sediment samples. None of these were detected at levels above screening levels (see Table 4-6). Metal detections can be a result of naturally occurring metals as well as anthropogenic processes. Metal results in the sediment samples are fairly consistent and do not appear to be the result of impacts due to site usage. Sediment metal detections at the OB/OD are generally low and appear to be naturally occurring.

4.4.6 Historical Sediment Data

Three sediment samples were collected during the 1993 SI field activities and analyzed for explosives and metals (LBA, 1994). Explosives were not detected. Metals detected included arsenic, beryllium, cadmium, chromium, copper, nickel, lead, zinc, and uranium (see Appendix A). Metals results were similar to the December 2011 results.

4.4.7 Summary

Fourteen sediment samples were collected and analyzed for VOCs, SVOCs, perchlorate, explosives, and metals. The only detections were for the VOCs, PCE and toluene, and thirteen metals. This is consistent with historical data. Results for metals appear to be more indicative of natural occurrence than impacts due to OB/OD activities.

4.5 SURFACE WATER

Surface water samples were collected twice during the RI field activities. Nine surface water samples were collected in December 2011 during the Phase One field activities and three were collected in March 2012 during the baseline groundwater sampling of the Phase Four field activities. Surface water sample locations are shown on Figure 4-6. Only one of the locations, Location 01 was sampled during both events. Surface water samples were analyzed for VOCs, SVOCs, perchlorate, explosives, and metals. Detections are discussed below and summarized in Table 4-7.

4.5.1 VOCs

VOCs detected in surface water samples include PCA, methyl ethyl ketone, acetone, cis-1,2-DCE, m&p xylenes, PCE, trans-1,2-DCE, and TCE. Of the VOCs detected, only PCA and TCE were detected above the screening levels. PCA was detected above the screening level in the Spring Sample and TCE was detected above the screening level in the Spring Sample and Stream Sample 02. Results for PCA and TCE are shown on Figure 4-7.

4.5.2 SVOCs

SVOCs detected in surface water samples included benzo(a)pyrene and bis(2-ethylhexyl)phthalate. Benzo(a)pyrene was detected above the screening level in Stream Sample 11. Bis(2-ethylhexyl)phthalate was not detected above the screening level. Results for benzo(a)pyrene are shown on Figure 4-7.

4.5.3 Perchlorate

Perchlorate was detected in eleven of the twelve locations. None of the detections exceeded the screening level (see Table 4-7).

4.5.4 Explosives

4-Amino-2, 6-dinitrotoluene was the only explosive detected in the surface water samples. 4-Amino-2,6-dinitrotoluene was not detected above the screening level (see Table 4-7).

4.5.5 Metals

Seven metals including beryllium, copper, lead, mercury, nickel, selenium, and zinc were detected in the surface water samples. None of the detections exceeded the screening level (see Table 4-7).

4.5.6 Historical Results

Surface water samples have been collected from the spring, seeps, and ephemeral streams since 1997 (see Appendix A). All surface water sampling has been intermittent due to the ephemeral nature of surface water at the OB/OD. TCE and PCA have been present in all but one of the spring samples collected. cis-

1,2-DCE and PCE have also been detected in water samples from the spring. TCE results for the spring have ranged from a high of 300 µg/L in March of 1997 to ND in July of 2008. PCA results have ranged from a high of 99 µg/L in March of 1997 to ND in July of 2008. TCE results are variable and are probably linked to precipitation and groundwater recharge and discharge events. PCA results for the spring are less than TCE results but tend to rise and fall in correlation with the TCE results.

Seep and stream surface water samples were collected in 2004, 2005, 2008, and 2010 (see Appendix A). TCE and PCE have been detected in the surface water samples at levels above their MCL and RSL, respectively. cis-1,2-DCE has also been detected at low levels.

4.5.7 Summary

Twelve surface water samples were collected during the RI field activities; nine in December 2011 and three in March 2012. Surface water samples were planned for five sampling events; once during the Phase I field activities in December 2011 and during each of the quarterly sampling activities in March, June, September, and December 2012. However only limited locations could be sampled in December 2011 and March 2012 and no locations could be sampled in June, September, and December 2012 due to the lack of surface water presence. Surface water occurs in the ephemeral streams, seeps and spring only intermittently following precipitation events. Surface water samples were analyzed for VOCs, SVOCs, perchlorate, explosives, and metals. Only the VOCs, PCA and TCE, and the SVOC, benzo(a)pyrene, were detected at levels above the screening levels. The VOC exceedances were in the spring and Stream Sample 02. Both of these locations are down gradient and downhill of the TCE and PCA exceedances in soil and groundwater.

4.6 GROUNDWATER

4.6.1 Direct-Push Investigation

A direct-push investigation was conducted in the southern and western portion of the site where vertical and horizontal delineation of contamination in groundwater was needed. Groundwater samples were collected from 26 of the 45 direct-push borings and screened using an on-site field laboratory for TCE, PCE, and cis-1,2-DCE and analyzed off site for VOCs, perchlorate, and explosives. On-site field laboratory results can be found in Appendix L. Nineteen of the borings were dry even after installation of temporary piezometers and were not sampled.

Twenty VOCs were detected with only two VOCs, TCE and PCA, detected at levels that exceeded their screening levels. All other VOC detections were low with the majority being trace (<1 µg/L) detections. Of the 26 locations from which groundwater samples were obtained, TCE was present in 18 of the groundwater samples at levels greater than the MCL of 5 µg/L. As shown on Figure 4-7, TCE concentrations are highest in the area west of the north burn pit and decrease in the down gradient direction. PCA was present at levels greater than the KDHE RSK level of 1.28 µg/L in groundwater samples from five locations. As shown on Figure 4-8, PCA detections are highest in the area west of the north burn pit. PCA was also detected in the western portion of the area with an area of exceedances in the central southwest portion of the area. All other detections for the direct-push investigation were at levels less than the screening levels (see Table 4-8).

4.6.2 Core Hole Grab Samples

Bedrock Borings (Core Hole) CH-1, CH-2, and CH-3 were advanced to 49, 36, and 29 feet bgs, respectively, to determine subsurface stratigraphy in these areas (see Figure 2-8). Once the target depth of first water was reached, a groundwater grab sample was collected from the core hole using a bailer and analyzed for VOCs and explosives. Eleven VOCs were detected (see Table 4-9). All of the VOC detections were well below the screening levels. There were no chlorinated VOCs detected. Nitroglycerin was detected in Core Hole CH-3 at 1.3 µg/L, below the screening level of 1.5 µg/L. No other explosives were detected at these bedrock boring locations.

4.6.3 Monitoring Well Groundwater Sampling

Four (4) groundwater sampling events were conducted in March, June, September and December of 2012. Sixteen monitoring wells were sampled during each event for VOCs, SVOCs, metals, perchlorate, explosives, water quality parameters, and natural attenuation parameters. (Note that due to low volume of water, Monitoring Well OB-97-08 was only sampled for limited parameters during the third and fourth quarterly events.) Analytical detections for the groundwater samples are presented in Table 4-10 and summarized below.

4.6.3.1 VOCs

Ten VOCs including 1,1,1,2-tetrachloroethane, PCA, 1,2,3-trichlorobenzene, 2-butanone, acetone, cis-1,2-DCE, naphthalene, PCE, trans-1,2-DCE, and TCE were detected during the four groundwater sampling events. Of the VOCs detected only TCE, PCA, and naphthalene were detected at levels above screening levels (see Table 4-10).

TCE was detected in 13 of the 16 monitoring wells sampled during the quarterly sampling events. TCE was detected above the MCL of 5 µg/L in eight of the sixteen wells including seven of the monitoring wells set in the upper regolith/weathered bedrock (OB-97-07, OB-97-08, OBHD-97-14, OB-05-15, OB-12-16, OB-12-17, and OB-12-18) and one monitoring well set in the deeper Threemile Limestone interval

(OB-93-04). TCE results for the four quarters are shown on Figure 4-9. TCE was detected at the highest concentrations in OB-12-18 (60, 260, 250, and 230 µg/L for the March, June, September, and December sampling, respectively). TCE concentrations decrease down gradient to the southwest in the same pattern as that seen in the results obtained during the groundwater direct-push investigation. TCE was detected in Monitoring Well OB- OB-93-04 set within the deeper aquifer at 5.5, 5.8, 6.2, and 5.7 µg/L for the March, June, September, and December sampling, respectively. TCE concentrations in the other three monitoring wells set within the deeper aquifer, OB-93-03, OB-12-15, and OB-12-19D were either nondetect or below the MCL of 5 µg/L.

PCA was detected in seven of the 16 monitoring wells sampled during the quarterly sampling events. PCA was detected above the RSL of 1.28 µg/L in four of the sixteen monitoring wells all of which are set in the upper regolith/weathered bedrock (OB-97-07, OB-97-08, OBHD-97-14, and OB-12-18). PCA results for the four quarters are shown on Figure 4-10. PCA was detected at the highest concentrations in OB-12-18 (11, 45, 43, and 45 µg/L for the March, June, September, and December sampling, respectively). PCA concentrations decrease down gradient to the southwest in the same pattern as that seen in the results obtained during the groundwater direct-push investigation. PCA was not detected in any of the monitoring wells set in the deeper Threemile Limestone interval.

Naphthalene was infrequently detected in four monitoring wells, OB-97-07, second quarter; OB-12-15D, first quarter; OB-12-18, second and fourth quarter; and OB-12-20D, second quarter. Naphthalene was detected above the RSK screening level of 2.11 µg/L in Monitoring Well OB-12-18 during the fourth quarter when it was detected at 2.5 J µg/L.

4.6.3.2 SVOCs

Three SVOCs including benzo(a)pyrene, benzo(g,h,i)perylene, and bis(2-ethylhexyl)phthalate were detected during the four groundwater sampling events. Benzo(a)pyrene and bis(2-ethylhexyl)phthalate were detected at levels above screening levels (see Table 4-10). Benzo(a)pyrene was detected in Monitoring Well OB-93-03 during the fourth quarter sampling event at 0.76 µg/L, which is above the MCL of 0.2 µg/L. All other samples were nondetect for benzo(a)pyrene. Bis(2-ethylhexyl)phthalate was sporadically detected in 15 of the 16 monitoring wells with exceedances of the MCL of 6 µg/L in two samples, the groundwater sample collected from Monitoring Well OB-97-08 during the second quarter of sampling (24 µg/L) and Monitoring Well OB-12-17 during the third quarter of sampling (7.3 J µg/L). Bis(2-ethylhexyl)phthalate was not detected during the first quarter of sampling at Monitoring Well OB-97-08. Groundwater samples were not collected for SVOCs from Monitoring Well OB-97-08 during the third and fourth quarters due to limited sample volume. Bis(2-ethylhexyl)phthalate was detected in

Monitoring Well OB-12-17 during the first and fourth quarterly sampling events at levels below the MCLs.

4.6.3.3 Perchlorate

Perchlorate was detected in 14 of the 16 monitoring wells sampled during the quarterly sampling events. None of the detections were above the screening level of 70.9 µg/L (see Table 4-10).

4.6.3.4 Explosives

Two explosives, HMX and RDX, were detected in groundwater samples for the four quarterly sampling events. None of the explosives detections were above screening levels (see Table 4-10).

4.6.3.5 Metals

Twelve metals including antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc were detected during the four groundwater sampling events. None of the metals detections were above screening levels (see Table 4-10).

4.6.3.6 Water Quality and Monitored Natural Attenuation Parameters

Groundwater quality parameters analyzed included ammonia, chloride, nitrate as nitrogen, nitrite as nitrogen, orthophosphate as phosphorus, sulfate, and sulfide; and monitored natural attenuation parameters included methane, ethane, ethylene, and total organic carbon. Nitrite as nitrogen and ethylene were not detected. Of the parameters detected, only nitrate as nitrogen has a screening level. Nitrate as nitrogen was detected in 13 of the monitoring wells but did not exceed the MCL of 10 milligrams per liter (mg/L) in any sample (see Table 4-10). Water quality and natural attenuation parameter will be further discussed in Section 5.0, Fate and Transport.

4.6.4 Historical Results for Groundwater

Groundwater samples have been collected at the OB/OD on a semi-regular basis since 1993. Groundwater samples have typically been analyzed for VOCs, perchlorate, metals, inorganics, and water quality parameters. For VOCs, TCE, PCE, and cis-1,2-DCE were detected at levels greater than their MCLs. Although it did not present an exceedances in historical documents, PCA was historically detected at levels above the current RSL. Of the VOCs, TCE was the most common VOC detected and was the VOC most often detected at values that exceed the MCL. Figure 4-11 is a chart of TCE concentrations over time for monitoring wells with exceedances of the MCL for which there is historic information. As shown on the figure, the level of TCE in the wells is decreasing over time; however the variability between sampling events is high. This is likely due to the variations in recharge of groundwater via precipitation.

Between 2004 and 2010, perchlorate was detected once above the RSK level of 70.9 µg/L in Monitoring Well OB-97-07 in April 2004 and lead was detected once above the MCL of 15 µg/L in Monitoring Well OB-05-15 in September 2006. There were no other detections of lead in Monitoring Well OB-05-15. All other detections between 2004 and 2010 were below appropriate screening levels.

4.6.5 Summary

Groundwater samples were collected during three separate phases of the RI field activities. Groundwater samples were collected during the Phase One field activities from a direct-push investigation conducted in the southern and western portion of the site for the vertical and horizontal delineation of contamination in groundwater within the regolith. Twenty-six groundwater samples were collected from and analyzed for VOCs, perchlorate, and explosives. Only TCE and PCA were detected at levels that exceeded their screening levels. During Phase Two of the RI field activities, a groundwater sample was collected from each of the core holes and analyzed for VOCs and explosives. There were no detections above screening levels in the three samples. During the Phase Three of the RI field activities, 16 monitoring wells were sampled during four quarterly sampling events for VOCs, SVOCs, metals, perchlorate, explosives, water quality parameters, and monitored natural attenuation parameters. Two VOCs, TCE and PCA, and two SVOCs, benzo(a)pyrene and bis(2-ethylhexyl)phthalate were detected at levels above screening levels. There were no exceedances for explosives or metals in groundwater.

The highest detections for TCE and PCA for the quarterly groundwater monitoring events were in Monitoring Wells OB-12-18 and OB-97-07 which are located down gradient of the metal debris pits. The TCE and PCA plume as shown on Figures 4-9 and 4-10 extends to the southwest towards the western ephemeral stream. Concentrations of TCE and PCA decrease in the down gradient portions of the plume. Bis(2-ethylhexyl)phthalate was sporadically detected in 15 of the 16 monitoring wells with exceedances of the MCL of 6 µg/L in two samples and benzo(a)pyrene was detected in a single monitoring well during one event.

4.7 SUMMARY OF NATURE AND EXTENT

Detections above applicable screening level for samples collected during the RI field activities have been summarized on the Table 4-11 by medium. Nature and extent of contaminants at the OB/OD can be summarized by the following statements:

- VOCs - TCE and PCA are the most common VOC exceedances. Exceedances for TCE are concentrated in the area of the metal debris pits for the surface and subsurface soil media (see Figures 4-2, 4-3, and 4-4) and down gradient of these pits, along with PCA, for the groundwater and surface water, where the groundwater discharges to the surface water (see Figures 4-6 through 4-10).
- Explosives and SVOCs – There were no exceedances of explosives or SVOCs in the surface or subsurface soil or sediment. In groundwater, bis(2-ethylhexyl)phthalate was sporadically detected and benzo(a)pyrene was detected once.
- Perchlorate – There were no exceedances of perchlorate.
- Metals – Detections for metals in surface soil, subsurface soil and sediment appear to be mainly natural in origin with the exceptions of two surface soil and one subsurface soil samples located within the northern burn pit and the metal debris pits. There were no exceedances of metals.

* * * * *

5.0 FATE AND TRANSPORT

This section presents a discussion of fate and transport of the constituent groups of concern within the context of constituent characteristics and probable fate and transport mechanisms, including sorption, volatilization, biodegradation, advection, and dispersion. Fate and transport mechanisms are identified, and followed by an evaluation of the fate and transport mechanisms in relation to COPC constituent groupings, which include VOCs, SVOCs, perchlorate, explosives, and metals.

5.1 IDENTIFICATION OF FATE AND TRANSPORT MECHANISMS

Possible contaminant transport mechanisms at the site include sorption, biodegradation, volatilization, advection, and dispersion. Each of these is briefly discussed in the following bullets and in more depth further within the section:

- **Sorption**, either in the form of adsorption (surface of soil matrix) and absorption (interior surfaces of soil matrix), can result in the retardation of the fronts of contaminant plumes and a loss of mass from the aqueous phase. Sorption affects primarily the fate and transport of COPCs within the soil and subsurface aqueous media. At the site, only VOCs were detected above applicable screening levels within the soil matrix.
- **Volatilization** is the process of evaporation that occurs when contaminants present either as nonaqueous phase liquids or dissolved in water, contact a gas phase. Volatilization can play a role in fate and transport in both solid and aqueous matrices. For this reason, volatilization will be discussed in regards to VOCs and SVOCs for the site.
- **Biodegradation** is the chemical transformation of certain organic compounds to carbon dioxide and water by microbes in the subsurface. Biodegradation can play a role in fate and transport in both solid and aqueous matrices. For this reason, biodegradation will be discussed in regards to VOCs and SVOCs for the site.
- **Advection** is the process whereby contaminants advance with the flowing groundwater at the seepage velocity of the porous media. Advection is relevant in aqueous environments only. At the site, only VOCs and SVOCs were detected above applicable screening levels within the surface water and/or groundwater matrices.
- **Dispersion** is the process of mixing caused by velocity variations within porous media, resulting in the dispersal and dilution of contaminants along the leading edge of the plume fronts and the dilution of contaminant concentrations at the margins of the plume. Dispersion is relevant in

aqueous environments only. At the site, only VOCs and SVOCs were detected above applicable screening levels within the surface water and/or groundwater matrices.

All of the preceding contaminant transport mechanism processes, as previously defined, affect the fate and transport of contaminants; however, usually only two or three will dominate the physical-chemical distribution of contaminants. At the site, sorption and volatilization appear to dominate, with biodegradation, advection and dispersion playing secondary roles.

5.2 EVALUATION OF FATE AND TRANSPORT MECHANISMS

Processes that result in the reduction of contaminant concentrations, but do not result in a decrease in total mass of the contaminant compound, are referred to as non-destructive. Advection, dispersion, sorption, and volatilization are examples of non-destructive contaminant transport processes. Destructive processes result in the reduction of total contaminant mass, usually by transforming the contaminant to other compounds. Biodegradation is an example of a destructive transport process. This section addresses both non-destructive and destructive fate and transport processes. The physical properties of site COPCs are provided on Table 5-1.

5.2.1 Sorption

Sorption is the partitioning of organic contaminants from the dissolved phase onto or into the soil matrix. This can result in the retardation of the fronts of contaminant plumes and a loss of mass from the aqueous phase. Sorption is controlled by characteristics of the contaminant, soil matrix, and the fluid media.

Contaminant characteristics affecting sorption include water solubility, molecular size, and organic carbon partition coefficient. Water solubility is the most important characteristic, with less soluble compounds having a greater tendency to sorb onto soils. In other words, the more soluble a compound is the more mobile it will likely be. Organic compounds with water solubilities greater than 10 mg/L are expected to migrate significantly, while compounds with water solubility less than 10 mg/L are not expected to migrate. For the COPCs identified at the site (as provided on Table 5-1), VOCs have solubilities that are above the 10 mg/L threshold for mobility. This indicates that VOCs migrate more readily through the subsurface primarily in the form of leaching from soil to groundwater. Weakly sorbed COPCs (i.e., VOCs) would be more susceptible to transport via leaching from soil to groundwater and surface runoff.

Molecular size significantly influences a soil's sorption potential. The larger the organic molecule is, the stronger the sorption and the lower the contaminant mobility. As a general rule, when the molecular weight of an organic molecule exceeds 400 to 500 grams per mol (g/mol), it will be adsorbed to the soil.

As shown on Table 5-1, the chemicals detected at the site have molecular weights below 400 g/mol, thus molecular weight will not be a significant limiting factor in contaminant mobility (Dragun, 1988).

The organic carbon partition coefficient (K_{oc}) value is a measure of the propensity for organic compounds to be adsorbed by organic carbon in soil and sediment. The K_{oc} value can be estimated by using several different variables, including the octanol-water partition coefficient (K_{ow}) or from water solubility data. There is a direct relationship between the K_{oc} value and the mobility of a solute. If the K_{oc} is greater than 2,000 liters per kilogram (L/kg), the solute is tightly adsorbed to carbon-containing soil and is immobile. Conversely, if the K_{oc} is less than 50 L/kg, the solute is weakly adsorbed to the carbon-containing soil and is very mobile (Dragun, 1988). As shown on Table 5-1, VOCs have K_{oc} values in the range of 60.7 L/kg to 1,544 L/kg, which makes them very mobile to intermediately mobile.

Soil characteristics include texture, permeability/porosity, and surface area. Finer-grained silts and clays generally have more total surface area than sandy soils, thus providing more total surface area onto which contaminants can adsorb. Due to large amount of clay and loess materials present at the OB/OD, it is likely that sorption plays a primary role in fate and transport at the site despite the characteristics that imply high mobility.

5.2.2 Volatilization

Volatilization commonly occurs with organic contaminants within the unsaturated zone and at the top of the saturated zone. This process is controlled by the vapor pressure of the constituent. The vapor pressure represents a compound's tendency to evaporate and is essentially the solubility of the organic solvent in a gas (Domenico and Schwartz, 1990). Volatilization of dissolved organic solutes and mercury from water is described by Henry's Law; the Henry's Law constant (H) is expressed as atmospheres-cubic meters per mol (atm-m^3/mol). Given that VOCs are a primary contaminant group, volatilization is likely to be a significant fate and transport mechanism at the site. Volatilization is the primary fate and transport mechanism in the unsaturated zone and is a mechanism that could contribute to a loss of contaminant mass.

5.2.3 Biodegradation

Biodegradation processes result in a reduction of contaminant mass through the transformation of these compounds to other compounds, which may be less or more toxic depending on the compound. Depending on conditions in the subsurface, biodegradation can be a significant attenuation mechanism.

Concentrations of chlorinated solvents and their degradation products give a direct indication of the presence or absence of microbial degradation (both reductive and oxidative) processes. The production of cis-1,2-DCE and vinyl chloride along aquifer flowpaths is often direct evidence of biodegradation. Also, cis-1,2-DCE (rather than trans-1,2-DCE) is usually produced from the reductive dechlorination of TCE. As a general rule, if cis-1,2-DCE comprises more than 80 percent of the DCE, then the DCE is likely of biogenic origin (USEPA ,1998a). Under these conditions, vinyl chloride and cis-1,2-DCE can be reliable indicators of microbial reductive dechlorination. Based on the data collected at the site, it does not appear that biodegradation in the form of reductive dechlorination is contributing significantly to fate and transport of chlorinated solvents at the site.

In addition to chemical indicators, there are also geochemical indicators that can be used to assess the prevalence of biodegradation. The process of reductive dechlorination of organic compounds, whether natural or anthropogenic, creates measurable changes in the groundwater chemistry. By measuring these changes, it is possible to document and qualitatively evaluate the biodegradation occurring at the site (USEPA, 1988).

- **Oxidation-Reduction Potential (ORP):** The ORP of groundwater is a measure of electron activity and is an indicator of the relative tendency of a solution to accept or transfer electrons. In the case of chlorinated solvents, each sequential use of electron acceptors drives the ORP into a range within which reductive dechlorination can occur. ORP of less than 50 millivolts (mV) is considered optimal for reductive dechlorination (USEPA, 1998a). As provided on Table 5-2, ORP values at the site range from -117.90 mV to 152.10 mV. Thirteen of the 16 monitoring wells had ORP readings suggesting favorable conditions for reductive dechlorination at least 50 percent of the time.

- **Dissolved Oxygen (DO)**: The DO is the most thermodynamically favored electron acceptor used by microbes for the biodegradation of organic carbon, whether natural or anthropogenic. In the case of chlorinated solvents, anaerobic bacteria optimally function at DO concentrations less than approximately 0.5 mg/L (USEPA, 1998a). Therefore, reductive dechlorination will not occur above this level. Explosives also favorably biodegrade under anaerobic conditions. As provided on Table 5-2, DO values at the site range from 0.35 mg/L to 9.52 mg/L, which indicates that conditions at the site are not favorable for reductive dechlorination via DO.

- **Nitrate:** Nitrate provides a substrate for microbial respiration if oxygen is depleted. For chlorinated solvents, nitrate concentrations in the contaminated portion of the aquifer less than 1.0 mg/L are favorable for reductive dechlorination (USEPA, 1998a). All sixteen of the monitoring wells had nitrate readings suggesting favorable conditions for reductive dechlorination at least 75 percent of the time.

- **Iron:** Fe(III) is reduced to Fe(II) during biodegradation of organics, thus Fe(II) concentrations can be used as an indicator of anaerobic degradation of chlorinated solvents. Levels of Fe(II) greater than 1.0 mg/L provide evidence that reductive dechlorination is occurring (USEPA, 1999a). The Fe(II) data collected from the monitoring wells ranged from 0.54 mg/L to 0.0 mg/L (Table 5-2) suggesting that favorable conditions for reductive dechlorination is not present.
- **Sulfate:** Sulfate may be used as an electron acceptor for anaerobic degradation, resulting in the formation of sulfide. In the case of chlorinated solvents, concentrations of sulfate greater than 20 mg/L may cause competitive exclusion of dechlorination, while the presence of sulfide indicates that dechlorination may be occurring (USEPA, 1998a). The sulfate data collected from the monitoring wells ranged from 1020 to 18.1 mg/L with only one detection below 20 mg/L (Table 5-2). Sulfide was detected at six monitoring wells during the four groundwater monitoring events evaluated. Four of the detections were below 1 mg/L and two were just above. The high sulfate and low sulfide levels detected suggest that sulfate reduction is not occurring.
- **Methane:** During methanogenesis, organics are used as electron acceptors and are reduced to methane. For chlorinated solvents, the presence of methane in the groundwater is indicative of strongly reducing conditions. Methane concentrations greater than 500 µg/L indicate methanogenic conditions favorable to degradation of chlorinated solvents (USEPA,1998a). Methane concentrations greater than 500 µg/L occurred only in Monitoring Well OBHD-97-14. All other methane concentrations were below 5 µg/L indicating reductive dechlororination that would produce methane isn't occurring.
- **Chloride:** During biodegradation of chlorinated hydrocarbons, chloride is released to the environment, and chloride concentrations in the plume will be elevated compared to background concentrations. Chloride can serve as a conservative tracer for reductive dechlorination (USEPA, 1998a). For the chlorinated solvent plume, not the OB/OD, the chloride concentration value was determined to be 8 mg/L (twice background as calculated based upon Monitoring Wells OB-93-01 and OB-93-02). Only three monitoring wells had detections higher than this value: OB-93-03 - all quarters, OB-93-04 - 1st and 2nd quarter, and OB-05-15 - 3rd quarter. Chloride concentrations at most monitoring wells indicate that reductive dechlorination is not occurring at the OB/OD.
- **TOC:** The TOC is a measure of the carbon and energy source in the media. For reductive dechlorination to occur in groundwater at optimal conditions, the TOC values should be greater than 20 mg/L (USEPA, 1998a). The highest detection of TOC was 2.6 mg/L indicating that a carbon and energy source for dechlorination is insufficient.

- **Daughter Products:** Daughter products of chlorinated solvents include DCE, vinyl chloride, and chloroethane among others. Cis-1,2-DCE was detected at the OB/OD during the quarterly sampling (see Table 4-9); however, other daughter products such as vinyl chloride and chloroethane were not detected at the OB/OD.

ORP, DO, nitrate, iron, sulfate, sulfide, methane, chloride, TOC, and solvent daughter products were examined to determine if biodegradation is occurring or has the potential to occur. ORP and nitrate readings/concentrations were favorable while DO, iron, sulfate, sulfide, methane, chloride, TOC, and solvent daughter products were largely unfavorable.

5.2.4 Advection/Dispersion

Advection and dispersion are likely secondary non-destructive fate and transport mechanisms at the Site. One of the hydrogeologic methods used to provide insight on both the direction and velocity with which contaminants are moving through the aquifer at the site is the determination of the seepage velocity (V_s) of groundwater. Since contaminants can advance congruently with flowing groundwater at the V_s of the porous media, this velocity can be used to show contaminant plume migration across the site. The formula used to calculate the seepage velocity is:

V_s = hydraulic conductivity (K) x hydraulic gradient (I)/effective porosity (n_e) (USEPA, 1998a).

- As provided in Section 3.1.4.2, K values at the site range from 4.05×10^{-3} cm/sec in the upper regolith to 7.3×10^{-2} cm/sec in the Threemile Limestone Member. Since a majority of the monitoring wells at the site are set within the upper regolith/weathered bedrock horizon, this conductivity value was used in the calculation below.
- I values were calculated using Wells OB-93-02 and OB-05-15 since they transect the site in the direction of ground flow. Using these two points, I was calculated to be 0.009 feet per foot (ft/ft) for the December 2012 sampling event.
- N_e for loess of 0.08 was used based on a literature review (Horton, et. al., 1988).

Given this information, the seepage velocity at the Site is 1.29 feet per day (ft/day) to the southwest. These calculations will differ slightly with each groundwater sampling event based on the measured groundwater levels, but are used here to illustrate the probable groundwater flow velocities at the site.

5.3 SUMMARY OF FATE AND TRANSPORT

The primary fate and transport mechanisms at the site are sorption and volatilization. Advection, and dispersion appear to be active at the site; however, they are affecting fate and transport of the COPCs at a lesser rate. Biodegradation appears to be minimal at the OB/OD.

Sorption plays a primary role in the fate and transport of constituent groups and COPCs that have lower water solubility and a high K_{oc} value; both of which are indicators of COPC mobility. Based on chemical-specific data, the detected VOCs are highly mobile and would move freely through the soil strata to groundwater. Given the prevalence of VOCs in the site matrices, volatilization is also likely a primary factor affecting fate and transport at the site in both the vadose zone and at the surface of the saturated zone.

As discussed, it is likely that advection and dispersion affect fate and transport of COPCs at the site with biodegradation playing only a minor role; however, their effect on the overall contaminant mass and movement are minimal compared to sorption and volatilization.

5.4 CONTAMINANT RELEASE AND TRANSPORT MODEL

Based on investigation data, the primary chlorinated solvent source appears to be located in the vicinity of the metal debris pits located in the north central portion of the site. Within this area, soil results are the highest in the eastern portion of the metal debris pits near the area with a metallic signature. VOCs are present within both the surface and subsurface soil in this area. VOC results for soil samples directly down gradient of this area are higher for the deeper soils near the bedrock interface.

Groundwater within this area is primarily recharged through precipitation. Precipitation is transported along the ground surface via overland flow and also migrates downward by infiltration and percolation through micro- and macro-fractures within the regoligth. Following infiltration and percolation, precipitation then moves downward by preferential and non-preferential pathways into the weathered bedrock mass through fractures and joints. As the infiltrated precipitation moves through the VOC-contaminated soil, the water dissolves and transports the VOCs. The VOCs-impacted fluids migrate downward into the uppermost groundwater surface located within the regolith and weathered bedrock at the OB/OD. Results from groundwater samples indicate that the VOCs are migrating down gradient within this aquifer and also downward into the lower aquifer in some locations.

During periods of heavier precipitation, wet weather seeps (including the spring) flow as the facture and joint network within the weathered bedrock mass reach maximum pore volume/fracture aperture capacities. This allows wet weather features like ephemeral streams, springs, and springs to flow and weep. Samples collected from the seeps, spring, and the western ephemeral stream located down gradient of the soil source contain chlorinated VOCs as found in the soil and groundwater samples. This flow path along the top of more resistant units in the soil/weathered bedrock interface is also the probable source of the VOC detections within the deeper soils near the bedrock interface located down gradient of the metal debris pits.

* * * * *

6.0 HUMAN HEALTH RISK EVALUATION

6.1 INTRODUCTION

6.1.1 Purpose

The purpose of this BLRA human health evaluation is to determine potential risks that might be experienced by human receptors coming into contact with COPCs associated with the site. This evaluation was completed in accordance with procedures outlined in the USEPA's *Risk Assessment Guidance for Superfund (RAGS) Volume I: Human Health Evaluation Manual (Parts A, E, and F)* (USEPA, 1989, 2004, and 2009); other USEPA supplemental guidance documents; the KDHE *Risk-Based Standards for Kansas (RSK) Manual – 5th Version* (KDHE, 2010); and other documents referenced throughout the text.

6.1.2 BLRA Organization

This BLRA consists of the following sections:

- **6.1 Introduction** – The first section states the purpose and scope of the BLRA and explains the organization.
- **6.2 Identification of COPCs** – In this section, analytical data representing current site conditions are reviewed, the chemicals detected are summarized, and COPCs are identified.
- **6.3 Toxicity Assessment** – This section presents information on the sources used to acquire toxicity values. It includes a brief discussion of the nature and form of the toxicity values.
- **6.4 Exposure Assessment –** This section presents a summary of information on the exposure setting, potentially exposed populations, and exposure pathways. It includes information on chemical intake estimation and chemical concentration calculations.
- **6.5 Risk Characterization** – The risk characterization section is a summary of the possible nature and magnitude of health risk associated with the site. Risks are characterized by combining calculated chemical intake with chemical toxicity information, as presented in a series of tables.
- **6.6 Uncertainty and Variability** – This section presents a discussion of the uncertainty and variability inherent in the risk assessment process.
- **6.7 Summary and Conclusions** – This section summarizes the risk assessment and presents conclusions.

6.2 IDENTIFICATION OF COPCS

COPCs include those chemicals detected at the site that have the potential to impact human health. The following sections detail the procedure undertaken to select the COPCs evaluated in this BLRA. Section 6.2.1 identifies the media of potential concern, and Section 6.2.2 describes the identification of the COPCs.

6.2.1 Media of Potential Concern

In order to determine COPCs, it is necessary to establish potential media of concern. Sampling and analysis activities resulted in the detection of site-related constituents in shallow (0-2 feet bgs) and subsurface soils, sediment, surface water, and groundwater. Because chemicals in shallow soil can be directly contacted by receptors (ingestion, dermal contact, and inhalation of dust), exposure to shallow soil could present potential human health concerns. Direct contact with subsurface soil (ingestion, dermal contact, and inhalation of dust) could occur as the result of demolition activities (i.e. ordnance disposal activities). Additionally, volatile constituents in shallow and subsurface soil could migrate to the surface and impact outdoor air. Because chemicals in sediment can be directly contacted by receptors, exposure to sediment could present potential human health concerns. Direct contact with surface water, as well as volatile constituents in surface water migrating to outdoor air are possible; therefore, exposure to surface water could present potential human health concerns. Although unlikely, groundwater at the site could be used in the future as a potable water source. In addition, due to areas of the site with shallow groundwater, it could be contacted during demolition activities (i.e. ordnance disposal activities). Given the potential for exposure, shallow soil, subsurface soil, sediment, surface water, and groundwater were retained as media of potential concern.

6.2.2 Identification of COPCs

The first step in quantifying potential risks to human health is to identify COPCs. COPCs include those site-related chemicals that have the potential to impact human health. COPCs were identified separately for each of the data sets compiled for this risk assessment – shallow soil, demolition soil, comprehensive soil, sediment, surface water, and groundwater. The shallow soil data set includes those samples that were collected during the RI activities within the 0-2 feet bgs interval, while the demolition soil data set includes all soil samples that were collected during the RI activities from a depth of less than 15 feet. The comprehensive soil data set includes all soil samples that were collected during the RI activities from the unsaturated zone (a maximum depth of 11.5 feet), and is used in the estimation of vapor migration from soil to outdoor air. As discussed in Section 4.2.1, twenty-three surface soil samples were collected and analyzed using field screening methods. However, the correlation coefficient between the field GC and off-site confirmation results using linear regression techniques was 0.6429, which was below the 0.70 linear regression acceptance criteria. Therefore, this data is not appropriate for use in the BLRA. The shallow soil data set was evaluated using fixed analytical laboratory results and not the field screening results. The sediment data set includes all sediment samples collected during the RI activities. It should be noted that sediment samples were collected as dry sediment. The surface water data set includes all surface water samples collected in December 2011 and March 2012 (the only sampling events in which there was surface water). The groundwater data set includes all groundwater samples collected during the four quarterly groundwater sampling events in 2012 (March, June, September, and December). The sample locations included in each data set are summarized on Table 6-1.

For this risk assessment, all chemicals that were positively detected in at least one sample from a given data set were initially considered COPCs. The COPC list was then reduced through a comparison to human health-based screening levels as discussed in Section 4.1. KDHE non-residential soil pathway and USEPA industrial soil screening levels were primarily used to select COPCs in soil. Chemicals that were retained as COPCs after a comparison to human health-based screening levels are shown on Table 6-2.

6.3 TOXICITY ASSESSMENT

The toxicity of COPCs is evaluated for both carcinogenic potential and noncarcinogenic adverse health effects. Data regarding health effects are then used by various agencies to derive numerical toxicity values. The USEPA gathers toxicological information from a variety of sources including experimental animal studies, epidemiological investigations, and clinical human studies. Well-conducted epidemiological studies that show a positive correlation between an agent and a disease represent the most convincing evidence about human risk. At present, human data adequate to serve as the sole basis for the development of toxicity values are available for only a few chemicals. In most cases where there are insufficient direct human data, USEPA uses toxicity information developed from experiments conducted on non-human mammals such as rats, mice, dogs, or rabbits.

Toxicity values were compiled following the USEPA's Memorandum *Human Health Toxicity Values in Superfund Risk Assessments* (USEPA, 2003). The primary source of toxicological information for this report was the USEPA-sponsored *Integrated Risk Information System* (IRIS) (USEPA, 2013). If toxicity values were not found in IRIS, the USEPA National Center for Environmental Assessment's list of Provisional Peer-Reviewed Toxicity Values (PPRTV) was consulted for provisional information. If neither of these sources provided toxicity values, other state or federal agencies were consulted.

The following subsections detail information regarding both noncancer and cancer toxicity values.

6.3.1 Noncancer Toxicity Values

The Reference Dose (RfD) and Reference Concentration (RfC) are the toxicity values used in assessing noncancer health effects from oral and inhalation exposures, respectively. For noncancer health effects, the level of exposure below which no adverse health effects develop is termed the threshold level or threshold dose. RfDs and RfCs represent exposure levels that are below the threshold. Each is an estimate of daily exposure to the general human population (including sensitive subpopulations) that is unlikely to pose an appreciable likelihood of adverse effects during a given term of exposure.

RfD values are expressed as milligrams of chemical per kilogram body weight per day (mg/kg/day), and RfC values are expressed as a chemical concentration in air in milligrams per cubic meter (mg/m^3).

Table 6-3 summarizes available RfDs and reference sources. By convention, RfD values, as with all toxicity numbers and risk assessment calculations, are expressed in scientific notation. For example, the oral RfD for benzene, 0.004 mg/kg/day, is expressed as 4×10^{-3} mg/kg/day or 4E-03 mg/kg/day, as shown in the table.

No dermal toxicity values are currently available, necessitating the adaptation and use of oral toxicity values. Dermal toxicity, other than relatively short-term effects at the point of contact, generally occurs as a result of chemical absorption. However, oral values are typically developed from laboratory animal studies and reflect an administered (in feed or water), rather than an absorbed (through the gastrointestinal tract) dose. The degree of gastrointestinal absorption varies between chemicals with some being readily absorbed and some being poorly absorbed. To reflect this, default gastrointestinal absorption efficiency factors are applied to the oral values if laboratory studies indicate less than 50 percent gastrointestinal absorption (USEPA, 2004). Table 6-4 provides the gastrointestinal absorption efficiency factors, an indication of whether an absorption adjustment is needed, and the RfD to be used for dermal exposure.

6.3.2 Cancer Toxicity Values

The toxicity values used in assessing cancer risk are slope factors and/or inhalation unit risks. A slope factor represents the 95 percent upper confidence limit (UCL) on the probability that a carcinogen will cause cancer at a dose of one mg/kg/day over a lifetime. Unlike most noncancer health effects, genotoxic carcinogenesis is not generally believed to conform to the concept of a threshold dose. Mechanistic data indicate that in some instances even the smallest dose of a carcinogen can lead to a clinical state of disease. For this reason, it is not possible to determine a no response dose, but rather it is necessary to relate a specific dose to the statistical probability of a carcinogenic response.

An inhalation unit risk is defined as the upper-bound excess lifetime cancer risk estimated to result from continuous exposure to an agent at a concentration of 1 microgram per cubic meter ($\mu g/m^3$) in air. Inhalation unit risk toxicity values are expressed in units of $(\mu g/m^3)^{-1}$.

When available, inhalation unit risk values from EPA's IRIS or PPRTV assessments are used. The Agency for Toxic Substances and Disease Registry (ATSDR) does not derive cancer toxicity values (e.g. slope factors or inhalation unit risks). Some inhalation unit risk values used in these screening tables were derived by the California Environmental Protection Agency, whose methods are quite similar to those used by USEPA's IRIS and PPRTV assessments. Screening toxicity values in an appendix to some PPRTV assessments were added to the hierarchy in the fall of 2009. When inhalation unit risk values are not available in IRIS then PPRTVs, Cal EPA assessments, PPRTV appendices, or values from the Health Effects Assessment Summary Tables (HEAST) are used.

For carcinogenic effects, a cancer weight-of-evidence descriptor is used to describe a substance's potential to cause cancer in humans and the conditions under which the carcinogenic effects may be expressed. This judgment is independent of consideration of the agent's carcinogenic potency. Under the USEPA's 1986 guidelines for carcinogen risk assessment, the weight-of-evidence was described by categories "A through E" – Group A for known human carcinogens through Group E for agents with evidence of noncarcinogenicity. Under the USEPA's 2005 guidelines for carcinogen risk assessment, a narrative approach, rather than categories, is used to characterize carcinogenicity. Five standard weight-of-evidence descriptors (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) are used as part of the narrative.

Table 6-5 summarizes the available slope factors, reference sources, and weight of evidence classifications for the carcinogenic COPCs.

As with RfDs, slope factors are not available for dermal exposure. For dermal exposure, current guidance recommends that oral slope factors be adjusted to reflect gastrointestinal absorption efficiency only when the absorption efficiency is less than 50 percent (USEPA, 2004). Slope factors for dermal exposure are provided on Table 6-4 along with the gastrointestinal absorption efficiencies and an indication of the need for an absorption adjustment.

6.4 EXPOSURE ASSESSMENT

In the exposure assessment, potentially exposed populations and potential pathways of exposure are identified. The assessment considers the current and theoretical future land use in order to identify pathways and potentially exposed populations. Only completed exposure pathways (i.e., human receptors in contact with impacted media) may pose a human health risk. Section 6.4.1 presents a brief description of the exposure setting, Section 6.4.2 identifies human populations likely to have contact with chemicals detected at the site, Section 6.4.3 identifies potentially completed exposure pathways, and Section 6.4.4 presents a discussion of the process for estimating chemical intake.

6.4.1 Characterization of the Exposure Setting

The first step in evaluating exposure is to characterize a site with respect to its physical features, current and future land uses, and observed and predicted human activities so that potentially exposed populations at and near the site can be identified.

6.4.1.1 Current and Future Land Use

OB/OD has been in use by the US Army from 1942 to the present. Historic and present site use has not changed, although detonation has diminished and open burning has ceased. Currently, the 774th EOD Detachment at Fort Riley handles ordnance materials from Fort Riley, the DoD, and other state and federal agencies. Since 1991, the 774th EOD Detachment has been responsible for providing support to military installations, operations, exercises; and to civilian and federal authorities within an operational area that includes the states of Kansas, Nebraska, Missouri, and South Dakota.

Ordnance was formerly disposed of by the 774th EOD Detachment at OB/OD by open burning and open detonation. Currently, only open detonations for emergency disposal of ordnance and training are conducted. Open detonation occurs on open ground and creates crater-like pits, which typically reach a maximum size of 25 ft in diameter and 10 to 15 ft in depth (North Burn Pit). Open burning was formerly conducted at a specific area that was characterized by a small pit with a metal grating surrounded by a 9-foot high, horseshoe-shaped embankment (South Burn Pit). The open burn pit was primarily used to dispose of black powder and phosphorus-based munitions. At present, there are five detonation pits and two burn pits at OB/OD (See Figure 1-2). Open detonation is currently being conducted at the North Burn Pit.

Future land use is anticipated to remain unchanged, and is considered in conjunction with the USEPA’s *Land Use in the CERCLA Remedy Selection Process Memorandum* (USEPA, 1995)

6.4.1.2 Current and Future Water Use

OB/OD is located in an isolated part of Fort Riley. This area is part of the Impact Area for weapons training at Fort Riley and access is restricted by the US Army due to the nature of the training. The only personnel within a 1-mile radius of OB/OD are US Army personnel. Access to the OB/OD site is limited to OB/OD personnel during the detonation of ordnance. There are two streams that border the site on the east and west side that are classified as ephemeral streams because these streams are dry except during precipitation events. There is also a spring located in the central portion of OB/OD (See Figure 1-2), which is typically dry during periods of limited precipitation.

The nearest supply well is located on the military reservation at Range 18, approximately 4,200 feet toward the east, up gradient of OB/OD. This well is only used for non-potable purposes. The nearest potable water supply well is located on the former Range 19, approximately 5,000 feet to the east and up gradient of the site. Based on the Fort Riley Master Plan, the mission for OB/OD will not change for the foreseeable future and groundwater at the OB/OD will not be used for either potable or non-potable purposes. However, groundwater is of sufficient yield (minimum 150 gallons per day) and quality (total dissolved solids less than 1,200 mg/L) that it does not meet the KDHE requirements for excluding the potable water pathway.

6.4.2 Potentially Exposed Populations

Potential receptors are defined as the human populations that may be exposed to chemicals in an exposure medium through one or more exposure routes. This is described as a complete exposure pathway and must have the following essential components: site-related chemical release to environment; transport to an exposure point; the presence of a receptor at the exposure point; and an exposure route. The following is a discussion of human receptors for which potentially complete exposure pathways may exist currently or in the future, in the absence of remediation.

Potentially exposed human populations include those persons whose locations and activities create an opportunity for contact with impacted media. Site conditions and land and water uses influence human activities and patterns of behavior and are considered in identifying potential receptors. It should be noted that not every receptor is likely to be present or contact all exposure media. The human receptors that are evaluated quantitatively include current and future site workers and current/future demolition workers. Current site workers are assumed to be potentially exposed to vapors in outdoor air and surface water in the Spring and streams at the site. Future site workers are assumed to be potentially exposed to vapors in outdoor air, surface water in the spring and streams at the site, and groundwater. Future demolition workers are assumed to be potentially exposed to shallow soil, subsurface soil, vapors and particulates in outdoor air, surface water in the spring and streams at the site, and groundwater.

In summary, populations that could be expected to be present at the site are: current and future site workers and current/future demolition workers.

6.4.3 Potential Exposure Pathways

Health risks may occur only when there is contact with a chemical by a receptor population. Exposed populations must then either ingest, inhale, or dermally absorb COPCs to complete an exposure pathway and possibly experience a health risk. Figure 6-1 displays a graphical representation of the human health conceptual site model. The following is a discussion of the likelihood of completed pathways for each receptor population.

6.4.3.1 Current Site Worker Scenario

The current site worker population was assumed to consist of workers engaged in regular site maintenance activities, as well as ordnance disposal. Since most common maintenance activities would not include subsurface excavation, it was assumed that current site workers would not directly contact subsurface media. Given the presence of VOCs and SVOCs in soil and groundwater, inhalation of chemical vapors in outdoor air was considered a potentially completed pathway.

Contact with contaminated surface water is possible if site activities are conducted in the spring and/or streams. Contact with surface water could lead to chemical absorption through dermal contact and inhalation of chemical vapors in outdoor air. Therefore, contact with surface water was considered a potentially completed pathway.

In summary, the potentially completed exposure pathways for the current site worker are:

- Inhalation of outdoor vapors from soil and/or groundwater,
- Absorption through dermal contact with surface water, and
- Inhalation of outdoor vapors from surface water.

6.4.3.2 Future Site Worker Scenario

The future site worker population was assumed to consist of workers engaged in regular site maintenance activities, as well as ordnance disposal. Since most common maintenance activities would not include subsurface excavation, it was assumed that future site workers would not directly contact subsurface media. Given the presence of VOCs and SVOCs in soil and groundwater, inhalation of chemical vapors in outdoor air was considered a potentially completed pathway.

Contact with contaminated surface water is possible if site activities are conducted in the spring and/or streams. Contact with surface water could lead to chemical absorption through dermal contact and inhalation of chemical vapors in outdoor air. Therefore, contact with surface water was considered a potentially completed pathway. Contact with contaminated groundwater is possible via ingestion if a potable water supply well is installed at the site in the future.

In summary, the potentially completed exposure pathways for the future site worker are:

- Inhalation of outdoor vapors from soil and/or groundwater,
- Absorption through dermal contact with surface water,
- Inhalation of outdoor vapors from surface water,
- Ingestion of groundwater as a drinking water source,
- Absorption through dermal contact with groundwater, and
- Inhalation of vapors from groundwater use.

6.4.3.3 Future Demolition Worker Scenario

Future demolition workers could be present if trenching and/or digging activities are required at the site, and could directly contact contaminated shallow and subsurface soil. Direct contact with soil could lead to incidental ingestion of soil and chemical absorption through dermal contact. Digging activities could disturb soils and generate fugitive dusts that could be inhaled. Therefore, direct contact with soil was considered a potentially completed pathway. Given the presence of VOCs and SVOCs in soil and groundwater, inhalation of chemical vapors in outdoor air was considered a potentially completed pathway.

Contact with contaminated surface water is possible if trenching and/or digging activities are conducted in the spring and/or streams. Contact with surface water could lead to chemical absorption through dermal contact and inhalation of chemical vapors in outdoor air. Therefore, contact with surface water was considered a potentially completed pathway. Although the average depth to groundwater at the site (30.25 feet bgs) is deeper than what would normally be contacted during demolition work, several monitoring wells at the site have groundwater elevations shallower than 15 feet bgs (a typical demolition depth). Therefore, there is potential for current/future demolition workers to directly contact impacted groundwater. Additionally, contact with contaminated groundwater is possible via ingestion if a potable water supply well is installed at the site in the future.

In summary, the potentially completed exposure pathways for the current/future demolition worker are:

- Incidental ingestion of shallow and subsurface soil,
- Absorption through dermal contact with shallow and subsurface soil,
- Inhalation of fugitive dust from shallow and subsurface soil,
- Inhalation of outdoor vapors from soil and/or groundwater,

- Absorption through dermal contact with surface water,
- Inhalation of outdoor vapors from surface water,
- Ingestion of groundwater as a drinking water source, and
- Absorption through dermal contact with groundwater

6.4.4 Estimation of Intake

Intake rates for all COPCs were quantified using the ingestion and dermal contact equations taken from RAGS (USEPA, 1989) and supplementary documents. Equations for inhalation exposures were quantified using USEPA's *Risk Assessment Guidance for Superfund (RAGS) Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final* (USEPA, 2009). The equations and variable values used to calculate chemical intake are presented on Tables 6-6 to 6-13. The calculated intakes and concentrations are later used in conjunction with toxicity values to characterize risk, as discussed in Section 6.5, Risk Characterization.

6.4.4.1 Exposure Variables

Where available, recommended exposure variable values from guidance documents were used; otherwise, best professional judgment about current and hypothetical future exposure settings was employed in estimating values for the exposure scenarios. The recommended values and estimated values were specifically chosen to result in a reasonable maximum exposure (RME) estimate. An RME conservatively represents the highest exposure that can be reasonably expected to occur at the site.

Although current and future site use would be expected to result in much lower exposure variables (frequency, duration, etc.), default exposure variables were used to remain consistent with USEPA guidance on conducting a BLRA.

Current and Future Site Worker Exposure Variables

Site workers were assumed to weigh 70 kilograms (kg) (USEPA, 1989). Use of mean weight requires use of mean skin surface area. In evaluating dermal contact with soil and surface water, 3,300 square centimeters (cm^2) will be used as the total area of exposed skin based upon the adult mean values for hands, forearms, and feet (USEPA, 2004). The soil-to-skin adherence factor is assumed to be 0.2 milligrams per square centimeter (mg/cm^2) (USEPA, 2002) for soil.

An ingestion rate of 100 milligrams per day (mg/day) (USEPA, 2002) was used to estimate intake of contaminated soil. The variable of fraction from a contaminated source was conservatively assumed to be

1.0 (100 percent). A groundwater ingestion rate of 2 liters per day (L/day) (USEPA, 1991) was used to estimate intake through ingestion of groundwater.

The standard 250 workdays per year for 25 years was used for exposure frequency and duration, respectively (USEPA, 1991). The exposure time for inhalation of fugitive dust and chemical vapors was set at eight hours based on a standard working day.

Current and Future Demolition Worker Exposure Variables

Demolition workers are also assumed to weigh 70 kg, a mean adult weight requiring use of mean surface area. In evaluating dermal contact with soil, groundwater, and surface water, 3,300 cm^2 will be used as the total area of exposed skin based upon the mean values for hands, forearms, and feet (USEPA, 1997). A soil-to-skin adherence factor of 0.3 mg/cm^2 is assumed (USEPA, 2002) for soil. This value represents the 95^{th} percentile weighted soil adherence factor for current/future demolition workers.

A higher level of soil contact can reasonably be expected to occur during demolition activities; consequently, a higher soil ingestion rate than the normal adult default value is assumed for demolition workers. An incidental soil ingestion rate of 330 mg/day (USEPA, 2002) was used to estimate intake for demolition workers. It was conservatively assumed that 100 percent of the soil contacted by a demolition worker was from a contaminated source. A groundwater ingestion rate of 2 L/day (USEPA, 1991) was used to estimate intake through ingestion of groundwater.

Demolition workers were assumed to contact groundwater 120 times over the course of utility work, for 2 hours per event. This conservatively results in daily exposure during the six month excavation period. Given that the surface water bodies are often dry, this represents a highly conservative assumption.

Because of the size of the site and the frequency with which ordnance activities are performed, the demolition work was assumed to occur for 8 hours per day for 6 months (120 working days out of a 168-day time period).

6.4.4.2 Chemical Variables

6.4.4.2.1 Data Selection

Analytical laboratory data were evaluated for use in the quantitative risk assessment in accordance with the data evaluation procedures outlined in RAGS (USEPA, 1989) and USEPA's "*Guidance on Data Useability in Risk Assessment*" (USEPA, 1992b). As stated in RAGS and USEPA, 1992, data qualified as rejected (R) were not used in the risk assessment; a data point may have been rejected due to excessive exceedance of analytical holding times, high temperature or other inappropriate sample preservation, laboratory control sample (LCS) or surrogate (organic only) recovery failure, and calibration failures, among other factors. All analytical data were considered valid and were considered in the risk assessment. For duplicate sample results, the most appropriate data point for use in the risk assessment was identified using the following guidelines:

- If both analytical results were nondetect, then the lowest nondetect result was carried forward in the risk assessment.
- If both analytical results were detections, then the highest detected concentration was carried forward in the risk assessment.
- If the data group contained both detect and nondetect results, then the detect result was carried forward and used.

6.4.4.2.2 Exposure Concentrations

Current USEPA risk assessment guidance specifies that the RME for a receptor population be calculated using the 95 percent UCL of the arithmetic mean of chemical concentrations. 95 percent UCLs were calculated for the soil and surface water data sets; however, since groundwater pathways (ingestion and inhalation of outdoor vapors) represent a point-source contact, a 95 percent UCL is not appropriate for use. Therefore, the maximum detected concentrations were used as exposure point concentrations for COPCs in groundwater.

UCLs were calculated using USEPA's ProUCL software Version 4.1. Nondetect chemical concentrations were entered into ProUCL, which uses a statistical analysis to incorporate those nondetects into the output. The program's statistical output for each compound in each data set is provided in Appendix M. It should be noted that some of the UCL calculations may result in 95 percent UCLs that are higher than the maximum detected concentration. In these instances, the maximum detected concentration was used (USEPA, 1992b). In addition, in instances where less than four distinct detected data were observed, the maximum detected concentration was used (USEPA, 2010). Tables 6-14 to 6-17 summarize the selection of exposure concentrations for soil, surface water, and groundwater.

6.4.4.2.3 Dermal Absorption

Recommended absorption factors for dermal absorption of COPCs from soil were obtained from the most recent USEPA guidance (USEPA, 2004). An absorption factor of 0.13 was used for benzo(a)pyrene. An absorption factor of 0.1 was used for the remaining SVOCs. Current USEPA guidance recommends a dermal absorption value of zero for VOCs based on the assumption that VOCs are likely to volatilize from soil before being absorbed through the skin (USEPA, 2004). Current guidance does not provide a default dermal absorption factor for inorganics; therefore, a dermal absorption value of zero was used for inorganic COPCs, with the exception of arsenic and cadmium.

Recommended absorption factors for dermal absorption of COPCs from soil were obtained from recent USEPA guidance (USEPA, 2004). When evaluating dermal absorption of chemicals from groundwater and surface water, chemical-specific absorbed doses were calculated using the equations on Tables 6-18 to 6-19 (USEPA, 2004).

6.4.4.2.4 Particulate Emission Factor

Daily wind dispersion can result in the generation of fugitive dust, which produces a potential chemical exposure for outdoor workers and demolition workers. To evaluate exposure through inhalation of dust, a default particulate emission factor (PEF) value of 1.316E+09 cubic meters per kilogram (m^3/kg) (USEPA, 2002) was used for the current/future site worker and current/future demolition worker populations.

6.4.4.2.5 Vapor Modeling and Estimated Concentrations

Modeling is commonly used to estimate chemical vapor concentrations in air, especially for future scenarios. There are a variety of vapor models available for use, requiring differing degrees of site-specific information. Vapor transport modeling from soil and/or groundwater to outdoor air was conducted for the current and future site worker and current/future demolition worker scenarios. It should be noted that vapor intrusion was not considered for this BLRA because there are no currently occupied buildings at risk of contamination by vapor intrusion, and there are not likely to be any, based upon future land use.

Volatilization from Soil to Outdoor Air

For the current and future site worker and current/future demolition worker scenarios, outdoor vapor concentrations from soil were estimated by applying chemical-specific volatilization factors (VFs) to the measured chemical concentrations in soil. VFs represent media transfer factors that account for all three steps of the vapor migration process. The equation for calculating the VF from soil to outdoor air was obtained from the EPA guidance on soil screening levels (USEPA, 2002) and combines an estimate of the chemical flux from soil with a simulation of contaminant dispersion in ambient air. The estimate of chemical flux from soil is based on a commonly used partitioning equation, and the simulation of contaminant dispersion in ambient air is represented by the inverse of the mean concentration at the center of a source (Q/C) term.

The chemical flux component of the equation reflects both soil characteristics and chemical-specific physical properties. Default data were used for the soil properties. The Q/C term reflects the results of air dispersion modeling conducted by USEPA using varying contaminant source sizes and meteorological conditions. The equations and variables for calculating the soil to outdoor air VFs are presented on Tables 6-20 and 6-21.

The calculated VF values were then combined with the measured concentrations in soil to estimate chemical concentrations in outdoor air. Tables 6-22 and 6-23 summarize the predicted concentrations in outdoor air from soil and show the concentration used in the risk assessment. The data used to model soil volatilization to outdoor air is presented on Table 6-15.

Volatilization from Groundwater to Outdoor Air

Chemical vapor migration from groundwater to outdoor air for the current and future site worker and current/future demolition worker scenarios was evaluated in three steps: chemical partitioning from groundwater to vapor, migration of chemical vapors through the soil column and subsequent emission to outdoor air, and mixing of chemical vapors within the ambient environment. The partitioning equation used to estimate the chemical vapor concentration in soil gas (in mg/m^3) from groundwater simply multiplies the chemical concentration in groundwater by the chemical-specific dimensionless H. This is a very conservative equation in that it assumes the maximum amount of chemical that can physically volatilize from the water will volatilize, without taking into account adsorption to soil particulates or other factors. Table 6-24 presents the partitioning equation and input values used to determine vapor concentrations in soil gas from groundwater.

The rate of vapor migration through soil was estimated using Farmer's (1980) emission rate calculation. This emission rate equation incorporates several conservative assumptions. It ignores biodegradation, removal by leaching, and adsorption of vapors to soil. It also assumes no depletion of the source over time and a zero concentration of the contaminant in the excavation. Values for soil physical properties were based on default values for silty clay. Diffusion upward through soil to the excavation is the controlling factor. Chemical-specific, effective diffusion coefficients were calculated following the definition developed by Millington and Quirk (1961) using chemical-specific air diffusivity values and default soil porosity.

The area assumed to be available for diffusion of vapors through soil was based on an assumed excavation of approximately 35 feet by 35 feet (a conservative estimate of the area of ordnance activities). The distance the vapors were assumed to travel upward through soil was conservatively set at 9.22 meters, the average of the water level measurements obtained from monitoring wells with sample results containing COPCs. Table 6-25 presents the vapor emission rate equation and variables.

The vapor emission rate for each chemical was then entered into a near field box model (Gas Research Institute [GRI], 1988) to estimate concentrations in breathing zone air. The near field box model is a representation of the effective mixing zone in which evolved vapors are diluted and delivered to a receptor point. The box defines the volume within which vapor emissions from a source area are mixed with ambient air. For this modeling effort, the near field box was sized to correspond to a surface area of 35 feet by 35 feet. This results in a corresponding box height of 1.4 meters. Wind speed through the box (Um) was calculated based on the annual mean wind speed which is measured at 10 meters above ground surface (U10) (GRI, 1988). Annual mean wind speed (U10) for Topeka, Kansas of 4.3 meters per second (m/s) was obtained from the National Climatic Data Center (NCDC) website (NCDC, 2008).

The results of the near-field box model were used as exposure concentrations when calculating daily intake through vapor inhalation for the current and future site worker and current/future demolition worker scenarios. The equation and variables for vapor concentrations in outdoor air are presented in Table 6-26.

Volatilization from Surface Water to Outdoor Air

Chemical vapor migration from surface water to outdoor air for the current and future site worker and current/future demolition worker scenarios was evaluated in three steps: chemical partitioning from surface water to vapor, emission of chemical vapors to outdoor air, and mixing of chemical vapors within the ambient environment. The partitioning equation used to estimate the chemical vapor concentration in soil gas (in mg/m^3) from groundwater simply multiplies the chemical concentration in groundwater by the chemical-specific dimensionless H. This is a very conservative equation in that it assumes the maximum amount of chemical that can physically volatilize from the water will volatilize, without taking into account adsorption to soil particulates or other factors.

The rate of vapor emissions to outdoor air was estimated using an adaptation of the Foster and Chrostowski model (Foster and Chrostowski, 1986). This model is based on an adaptation of the gas-liquid film mass transfer model and the simple box model concept. Table 6-27 presents the vapor emission rate equation and variables.

The vapor emission rate for each chemical was then entered into a near field box model (GRI, 1988) to estimate concentrations in breathing zone air. The near field box model is a representation of the effective mixing zone in which evolved vapors are diluted and delivered to a receptor point. The box defines the volume within which vapor emissions from a source area are mixed with ambient air. For this modeling effort, the near field box was sized to correspond to a surface area of 35 feet by 35 feet. This results in a corresponding box height of 1.4 meters. Um was calculated based on the U10 (GRI, 1988). Annual mean wind speed (U10) for Topeka, Kansas of 4.3 m/s was obtained from the National Climatic Data Center website (NCDC, 2008).

The results of the near-field box model were used as exposure concentrations when calculating daily intake through vapor inhalation for the current and future site worker and current/future demolition worker scenarios. The equation and variables for vapor concentrations in outdoor air are presented in Table 6-28.

6.5 RISK CHARACTERIZATION

To quantify the potential risk posed by exposure to chemicals through identified pathways, the intake of each chemical is combined mathematically with the appropriate toxicity value to estimate the likelihood of health risks. For noncancer risk or hazard, the intake is compared to the RfD or RfC. If the intake or the estimated chemical concentration in air does not exceed the reference value, no adverse effects would be expected. For cancer risk, the intake is multiplied by the slope factor or inhalation unit risk (IUR). The result is a theoretical statistical probability of a cancer effect.

The following two sections define the general risk characterization process for evaluating noncancer and cancer risks. Risk characterization for each potentially exposed population then follows.

6.5.1 Noncancer Risk

To characterize the risk of noncancer effects, toxicity values for COPCs are used in conjunction with intake estimates or estimated chemical concentrations in air developed from exposure scenarios to quantitatively estimate the potential for adverse health effects associated with a site. Chemical-specific intakes or chemical concentrations in air are compared to the RfD or RfC for the chemical. The comparison of intake or chemical concentration in air to RfDs or RfCs is expressed mathematically as a hazard quotient, which is the intake or chemical concentration in air divided by the reference value:

$$\text{Hazard Quotient (HQ)} = \frac{\text{Intake (mg/kg/day)}/}{\text{RfD (mg/kg/day)}} \quad \text{or} \quad \frac{\text{Concentration in Air (mg/m}^3\text{) /}}{\text{RfC (mg/m}^3\text{)}}$$

HQs for chemicals within the evaluated pathway are summed to give the pathway HI. If multiple pathways are evaluated, pathway hazard indices are then summed for a total exposure HI. If the total HI is one or less, the site poses essentially no likelihood of causing adverse noncancer health effects within the described scenario.

6.5.2 Cancer Risk

Cancer risk is expressed as a probability of a cancer effect as a result of a period of exposure to a given chemical at a site. This represents risk that is solely attributable to exposure from the site and in excess of the general background risk. The estimated intake or chemical concentration in air for each carcinogen is multiplied by the corresponding slope factor or IUR to calculate risk. The expression is:

$$\text{Risk} = \text{Intake (mg/kg/day)} \times \text{Slope Factor (mg/kg/day)}^{-1}$$
$$\text{Risk} = \text{Concentration in Air (mg/m}^3\text{)} \times \text{IUR (mg/m}^3\text{)}^{-1}$$

Given the current assumption that any exposure to a carcinogen poses some risk, zero risk is not achievable in a practical sense. To be protective of human health, USEPA believes that exposure to site-related carcinogens should be limited so as to result in an individual, upper-bound, excess lifetime cancer risk level of one in 10,000 or less (Federal Register [FR], 1990). Ranges of risk have been developed for use as remediation goals. The risk range of one in 10,000 to one in a million is a commonly accepted remediation goal. In other words, an excess lifetime cancer risk greater than one in 10,000 would generally be considered unacceptably high (would require remedial action), while risks within the risk management range are not necessarily considered protective, but require site-specific risk management decisions to be made. Risks of one in a million or less are generally considered insignificant (do not require remedial action).

6.5.3 Risk Characterization

The following sections detail the results of both the noncancer and cancer risk calculations for each potentially exposed population.

6.5.3.1 Current Site Worker Scenario

Table 6-29 shows intake, reference values, and hazard indices for the current site worker population. The hazard index for inhalation of outdoor vapors was 1. Dermal contact with chemicals in surface water resulted in a HI of 0.3. The hazard index for inhalation of vapors from surface water was 0.0007. The total hazard index for all pathways combined was **1.3**. This is above the USEPA level of concern for noncancer risk, which is a HI greater than one. The majority of the risk is from inhalation of TCE vapors from soil.

Table 6-30 presents intake, slope factors/IURs, and the excess lifetime cancer risk associated with chemical exposure for the current site worker population. The pathway cancer risk for exposure to chemicals through inhalation of outdoor vapors was **4E-06**. The pathway cancer risk for exposure to chemicals in surface water through dermal contact was **6E-04**. The pathway cancer risk for exposure to chemicals in surface water inhalation of vapors was 5E-09. The total potential excess cancer risk for all pathways combined was **6E-04**. This is above the USEPA 1E-04 to 1E 06 (one in 10,000 to one in a million) risk management range. The majority of the risk is from dermal contact with benzo(a)pyrene in surface water.

6.5.3.2 Future Site Worker Scenario

Table 6-31 shows intake, reference values, and HIs for the future site worker population. The HI for inhalation of outdoor vapors was **1**. Dermal contact with chemicals in surface water resulted in a HI of 0.3. The HI for inhalation of vapors from surface water was 0.0007. Ingestion of groundwater resulted in a HI of **10**. The HI for dermal contact with groundwater was 0.7. Inhalation of vapors from groundwater use resulted in a HI of **4**. The total HI for all pathways combined was **16**. This is above the USEPA level of concern for noncancer risk, which is a HI greater than one. The majority of the risk is from inhalation of TCE vapors from soil.

Table 6-32 presents intake, slope factors/IURs, and the excess lifetime cancer risk associated with chemical exposure for the future site worker population. The pathway cancer risk for exposure to chemicals through inhalation of outdoor vapors was **4E-06**. The pathway cancer risk for exposure to chemicals in surface water through dermal contact was **6E-04**. The pathway cancer risk for exposure to chemicals in surface water inhalation of vapors was 5E-09. The pathway cancer risk for exposure to chemicals in groundwater through ingestion was **2E-04**. The pathway cancer risk for exposure to chemicals in groundwater through dermal contact was **3E-04**. The pathway cancer risk for exposure to chemicals in groundwater use inhalation of vapors was **2E-05**. The total potential excess cancer risk for all pathways combined was **1E-03**. This is above the USEPA 1E-04 to 1E 06 (one in 10,000 to one in a million) risk management range. The majority of the risk is from dermal contact with benzo(a)pyrene in surface water.

6.5.3.3 Future Demolition Worker Scenario

Table 6-33 shows intake, reference values, and HIs for the current/future demolition worker population. Incidental ingestion of shallow and subsurface soil resulted in a HI of 0.3. The HI for dermal contact with chemicals in shallow and subsurface soil could not be calculated due to a lack of chemical absorbence. Inhalation of chemicals in fugitive dust resulted in a HI of 0.000004. The HI for inhalation of outdoor vapors was **17**. Dermal contact with chemicals in surface water resulted in a HI of 0.3. The HI for inhalation of vapors from surface water was 0.0007. Ingestion of groundwater resulted in a HI of **11**. The HI for dermal contact with groundwater was 0.7. The total HI for all pathways combined was **30**. This is above the USEPA level of concern for noncancer risk, which is a HI greater than one. The majority of the risk is from inhalation of TCE vapors from soil and ingestion of TCE in groundwater.

Table 6-34 presents intake, slope factors/IURs, and the excess lifetime cancer risk associated with chemical exposure for the current/future demolition worker population. The pathway cancer risk for exposure to chemicals in shallow and subsurface soil through incidental ingestion was 4E-08. The pathway cancer risk for exposure to chemicals in shallow and subsurface soil through dermal contact could not be calculated due to a lack of chemical absorbence. The pathway cancer risk for exposure to chemicals through inhalation of fugitive dust was 2E-13. The pathway cancer risk for exposure to chemicals through inhalation of outdoor vapors was 1E-06. The pathway cancer risk for exposure to chemicals in surface water through dermal contact was **1E-05**. The pathway cancer risk for exposure to chemicals in surface water inhalation of vapors was 9E-11. The pathway cancer risk for exposure to chemicals in groundwater through ingestion was **4E-06**. The pathway cancer risk for exposure to chemicals in groundwater through dermal contact was **6E-06**. The total potential excess cancer risk for all pathways combined was **2E-05**. This is within the USEPA 1E-04 to 1E 06 (one in 10,000 to one in a million) risk management range. The majority of the risk is from dermal contact with benzo(a)pyrene in surface water.

6.5.3.4 Risk from Exposure to Lead

USEPA has provided guidance on soil lead levels for residential land use (USEPA, 1994). This guidance recommends a screening level of 400 mg/kg for lead in residential soil. A screening level that is protective of residents can reasonably be expected to be protective of commercial/industrial populations.

At the site, the highest detected concentration of lead in soil was 231 mg/kg (Sample BDSS-12, 0-1’), which is below the residential screening level.

6.6 UNCERTAINTY AND VARIABILITY

Preparation of a risk evaluation requires making a number of assumptions. These assumptions serve to introduce degrees of uncertainty and variability. Uncertainty arises from imperfect knowledge of the true value for a particular input, such as the current mean concentration of chemicals in soil. Variability is due to naturally occurring ranges in the values for inputs, such as employment duration or length of residency. Risk evaluations are also conservative in nature, typically resulting in an overestimation of potential risk rather than an underestimation. The following sections discuss some of the more important of these uncertainties.

6.6.1 Uncertainty Associated with Chemical Identification

At any site, it is possible that there are more individual chemical substances present than identified in the sampling and analysis effort. The selection of media to be sampled, number of samples, and analyses requested are determined by a review of the history of the site, information on current conditions, and an evaluation as to which chemicals could potentially be present. The analyses selected during the site investigation were identified based on knowledge of historical site practices. The use of such knowledge provides confidence that the related constituents present at the site have been identified. It should be noted that trichloroethene results in surface soil in field screened data is higher than the laboratory data for trichloroethene. However, as noted in Section 6.2.2, field screened data was not appropriate for use in the risk assessment.

The application of quality control throughout the sampling, analysis, and data validation phases reduced uncertainty in the results. Therefore, the chemical identification phase of the risk assessment does not appear to have introduced significant uncertainty.

6.6.2 Uncertainty from Toxicity Assessment

For some chemical substances there is little or no toxicity information available and for many chemicals, what is available is typically from animal studies. The relative strength of the available toxicological information generates some uncertainty in the evaluation of possible adverse health effects and the exposure level at which they may occur. To provide for a margin of error, USEPA applies conservative adjustments to the toxicity values.

For noncarcinogenic substances, RfD and RfC values are typically established only after uncertainty and/or modifying factors are applied. These factors may result in an RfD/RfC that is as little as a thousandth or less of the "safe" dose level determined through animal studies. In addition, it should be noted that subchronic toxicity values were not used for the current/future demolition worker scenario. This provides a conservative estimate of risk for the current/future demolition worker scenario.

For carcinogens, the slope factor represents the 95 percent UCL of an extrapolated low dose response curve. The actual carcinogenic potency of a substance at low doses is almost certainly less.

To quantify risk from chemicals that do not have toxicity numbers posted in IRIS, provisional numbers are used when available. These provisional numbers receive both internal and independent external peer review before the assessment is released. PPRTV assessments differ from IRIS assessments in that PPRTV assessments are not also subjected to the review of other agencies outside of the USEPA. Uncertainty is generated by the use of provisional numbers. However, this uncertainty is less than that generated by ignoring or qualitatively assessing risks. For chemicals with no provisional numbers, risk could not be quantified. In those cases, the risk from exposure to those chemicals is likely underestimated.

Numerical toxicity values for dermal exposures have not been developed by USEPA. To quantitatively assess risk from dermal exposure, USEPA guidance recommends adjusting oral RfDs and slope factors, usually presented as administered instead of absorbed doses, by chemical-specific gastrointestinal absorption factors to account for the differing dose calculation. Because of potential differences in patterns of distribution, metabolism, and excretion between the oral and dermal routes of exposure, use of adjusted oral toxicity values may over- or under-estimate risk, depending on the chemical.

6.6.3 Uncertainty from Exposure Assessment

When evaluating exposure, probable scenarios are developed to estimate conditions and duration of human contact with COPCs. Scenarios are based on observations or assumptions about the current or potential activities of human populations that could result in direct exposure. To prevent underestimation of risk, scenarios incorporate exposure levels, frequencies, and durations at or near the top end of the range of probable values. This is sometimes termed a reasonable maximum exposure, one that may be unlikely or at the high end of a range of exposures, but still possible.

Default values, such as ingestion rates, are used in the exposure calculations to quantify intakes. Although they are based on USEPA-validated data, there is uncertainty in the applicability of such values to any particular exposed population or individual. To compensate for this uncertainty, the default values are typically set to the upper end (usually the 90^{th} or 95^{th} percentile) of the normal range.

For the calculation of risk associated with groundwater exposure, the maximum detected concentration was used. Since groundwater is a point-source exposure, calculation of 95 percent UCLs is not appropriate. Therefore, risk from exposure to groundwater is likely over-estimated since a potentially exposed population cannot be present in many locations at the same time, and maximum concentrations may not occur all in the same well.

Uncertainty also arises from the treatment of nondetected concentrations in the risk assessment. The actual concentration of the contaminant could be anywhere between zero and the reporting limit. This may result in either an over- or underestimation of risk.

Models were used for exposure to chemicals through vapor inhalation for outdoor scenarios. Models are simplified representations of reality, which cannot effectively account for variations in subsurface conditions or the attenuation processes that will lead to a reduction in source concentrations over time.

All of these factors add uncertainty in the estimates of potential risk. However, due to the inherently conservative nature of risk assessments, the uncertainty is generally that risk has been overestimated, not underestimated.

6.7 SUMMARY AND CONCLUSIONS

The potential for human health risk from exposure to COPCs at the site was evaluated for soil, sediment, surface water, and groundwater. Detected constituents in each medium that exceeded the screening process were retained as COPCs. Media evaluated in the risk assessment were shallow soil, subsurface soil, sediment, surface water, and groundwater.

The site is part of the Impact Area for weapons training at Fort Riley. Information regarding current and potential future land and water use was used to develop the exposure scenarios evaluated. Future land use will likely remain as ordnance disposal. Based on the current and potential future uses of the site, current site worker, future site worker, and current/future demolition worker scenarios were evaluated.

Current site workers were assumed to be potentially exposed to COPCs in shallow soil through incidental ingestion, dermal contact, and inhalation of dust and vapors in outdoor air, and in surface water through dermal contact and inhalation of vapors in outdoor air. Future site workers were assumed to be potentially exposed to COPCs in shallow soil through incidental ingestion, dermal contact, and inhalation of dust and vapors in outdoor air; in surface water through dermal contact and inhalation of vapors in outdoor air; and in groundwater through ingestion as a drinking water source. Future demolition workers were assumed to be potentially exposed to COPCs in shallow and subsurface soil through incidental ingestion, dermal contact, and inhalation of dust and vapors in outdoor air; in surface water through dermal contact and inhalation of vapors in outdoor air; and in groundwater through ingestion as a drinking water source and dermal contact with infiltrating groundwater in an excavation.

Table 6-35 summarizes the noncancer HIs and excess lifetime cancer risk values calculated for each of the potentially exposed populations evaluated in the risk assessment. HIs for each of the populations being evaluated exceeded the USEPA level of concern for noncancer risk, which is a HI greater than one. The excess lifetime cancer risk value for the current/future demolition worker was within the USEPA 1E-04 to 1E-06 (one in 10,000 to one in a million) risk management range. The excess lifetime cancer risk values for the current site worker and future site worker were above the USEPA 1E-04 to 1E-06 (one in 10,000 to one in a million) risk management range.

Based on the noncancer and cancer risk levels calculated for the site, appropriate remedial alternatives should be developed and evaluated in the feasibility study.

* * * * *

(This page purposely left blank.)

7.0 ECOLOGICAL RISK ASSESSMENT

7.1 INTRODUCTION

This component of the risk assessment is designed to be a qualitative and semi-quantitative evaluation of whether ecological receptors could experience potential adverse effects from exposure to site-related chemicals. The purposes of the ecological risk assessment are to determine the following:

- If significant ecological effects are occurring at the site;
- The causes of these effects;
- The source of the causal agents; and
- The consequences of leaving the system unremediated (Oak Ridge National Laboratory [ORNL], 1996b).

An ecological risk assessment consists of toxicity tests using ambient media from the site, biological survey data from the site, and the comparison of contaminant exposure experienced by endpoint species at the site to plant and wildlife no observed adverse effects levels (NOAELs) and lowest observed adverse effects levels (LOAELs). An ecological risk does not exist unless:

- The chemical, or stressor, has the inherent ability to cause one or more adverse effects, and
- It co-occurs with or contacts an ecological receptor for a sufficient time and intensity to elicit the identified adverse effect (USEPA, 1992a).

In order to assess the potential risk to ecological receptors the following steps are necessary:

- Identify the stressors;
- Determine the potential of the stressor to cause adverse effects;
- Determine the level at which the stressor is present in the environment; and
- Determine the availability of the stressor to ecological receptors.

This ecological evaluation was conducted following the procedures outlined in *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessment* (USEPA, 1997b) and other USEPA supplemental guidance documents referenced throughout the text. The ecological evaluation is organized into the following sections:

- **7.1 Introduction -** The first section states the purpose and scope of the ecological risk assessment and explains the organization.

- **7.2 Ecological Site Characterization** – This section provides a description of the ecology at the OB/OD. Threatened, endangered, and rare species in the area are identified, and ecological conditions that influence the presence or absence of ecological receptors are detailed.
- **7.3 Ecological Evaluation Process –** This section describes the method for this quantitative screening and the process of refining the list of chemicals of potential ecological concern (COPECs). The primary exposure pathways are identified.
- **7.4 Potential Ecological Receptors -** Probable ecological receptors are described in general for the OB/OD and appropriate species for the screening evaluation are selected.
- **7.5 Exposure Pathways** – This section identifies the primary exposure pathways of interest.
- **7.6 Bioaccumulation in Food –** The potential for COPECs to be transferred through the environmental food chain to plant and wildlife receptors is evaluated in this section.
- **7.7 Risk Characterization** – This section evaluates the likelihood of potential risk to ecological receptors.
- **7.8 Exposure Variables –** Factors affecting wildlife are discussed in the section.
- **7.9 Hazard Quotient Analysis** – This section presents the calculated hazard quotients for plant and wildlife receptors.
- **7.10 Predicted Future Conditions and Potential Risk –** This section discusses the likelihood of future potential risk.
- **7.11 Uncertainties –** This section of the evaluation explains the uncertainties inherent in the process.
- **7.12 Summary –** This section provides a summary of the ecological evaluation.

7.2 ECOLOGICAL SITE CHARACTERIZATION

The ecological site characterization is a description of the local ecology of the potentially impacted areas and ecological receptors. The first step in the ecological site characterization is to characterize the environmental conditions at the OB/OD. A background search of references, including the April 30, 2010, *Fort Riley, Kansas, Integrated Natural Resources Management Plan (INRMP); Vegetation of the Fort Riley Military Reservation, Kansas* (Freeman and Delisile, 2004); *Vegetation Survey and Mapping of the Fort Riley Military Reservation, Kansas* (Delisle et al., 2012); topographical maps; National Wetland Inventory (NWI) maps; and various other sources was conducted to provide preliminary information on the OB/OD's ecological communities. Field investigations were conducted on December 15, 2011 to confirm the preliminary information obtained in developing the ecological characterization. Data recorded during the field investigation included observed species, a description of the area ecology and habitat types present, and evidence of stress or any abnormal conditions observed among local flora and fauna.

Ecological line of evidence, such as absence of typically present species, dead or dying vegetation, or unusually high numbers of a less dominant species, are important to data interpretation and risk analysis and were investigated at the OB/OD. The potential presence of sensitive receptors in the area, including threatened or endangered species, wetlands, streams, etc., were identified by reconnaissance conducted by BMcD biologists familiar with regional flora and fauna. Additionally, the United States Fish and Wildlife Service, Information, Planning, and Conservation System (IPaC) and the Kansas Department of Wildlife, Parks, and Tourism's lists of threatened and endangered species were also reviewed (see Section 3.5).

Ecological surveys were conducted on December 15, 2011 at the OB/OD. Wildlife or potential habitat at the OB/OD was identified during the site visit. Although minimal wildlife was observed during the site visit, a list of the plants and wildlife that likely occur within the vicinity of the OB/OD is provided in Section 3.5.

The OB/OD is located in Riley County, Kansas in the middle of Fort Riley. The OB/OD has been used as an ordnance disposal area since its purchase by the US Army in 1942. The OB/OD consists of a 4.8-acre area that was used for ordnance disposal within a 70-acre OB/OD (See Section 3.0). The vegetation communities at the OB/OD consist mostly of open grasslands with hackberry, cottonwood, sycamore, and eastern red cedar trees occurring mostly along streams and drainages.

The OB/OD is bounded by open grasslands to the north and west, an existing gunnery range to the east, and Vinton School Road to the south. Two ephemeral streams are present at the OB/OD; one marks the west edge of the OB/OD and the other marks east and south edges of the OB/OD. The plant and animal species composition of the OB/OD is composed of common species that are tolerant of human disturbances. No potential protected species habitat was observed during the December 15, 2011 site visit.

The 4.8-acre ordnance disposal portion of the OB/OD has been previously disturbed and includes roads and excavated areas. Minimal habitat for wildlife species is present in the ordnance disposal area. The remainder of the OB/OD consists of managed and unmanaged grasslands and riparian habitats and provides habitat for common wildlife species that are transient and tolerant of human disturbances.

7.2.1 Vegetation

Woody vegetation at the OB/OD was restricted to narrow riparian zones along the two ephemeral stream channels. The common species found within the riparian habitats included American sycamore (*Platanus occidentalis*), osage orange (*Maclura pomifera*), hackberry (*Celtis occidentalis*), elm (*Ulmus* spp.), bur oak (*Quercus macrocarpa*), black walnut (*Juglans nigra*), eastern cottonwood (*Populus deltoides*), honey locust (*Gleditsia triacanthos*), smooth sumac (*Rhus glabra*), eastern red cedar (*Juniperus virginiana*), coralberry (*Symphoricarpos orbiculatus*), rough-leaved dogwood (*Cornus drummondii*), hemp dogbane (*Apocynum cannabinum*), giant ragweed (*Ambrosia trifida*), blackberry (*Rubus occidentalis*), wild rye (*Elymus* spp.), and greenbrier (*Smilax bona-nox*). The common species found within the grassland habitat include little bluestem (*Schizachyrium scoparium*), big bluestem (*Andropogon gerardi*), indiangrass (*Sorghastrum nutans*), Johnsongrass (*Sorghum halepense*), bristlegrass (*Setaria* spp.), western ragweed (*Ambrosia psilostachya*), common milkweed (*Asclepias syriaca*), common mullein (*Verbascum thapsus*), Illinois bundleflower (*Desmanthus illinoensis*), Canada goldenrod (*Solidago canadensis*), common sunflower (*Helianthus annuus*), western salsify (*Tragopogon dubius*), roundheaded bushclover (*Lespedeza capitata*), heath aster (*Aster ericoides*), and thistle (*Cirsium* spp.). Pennsylvania smartweed (*Polygonum pensylvanicum*) was present along the spring within the ordnance disposal area of the OB/OD.

7.2.2 Terrestrial Wildlife

The lands surrounding OB/OD consist of undeveloped wooded and grassy lands. Species observed at and in the vicinity of the OB/OD included white-tailed deer (*Odocoileus virginianus*), Northern cardinal (*Cardinalis cardinalis*), American robin (*Turdus migratorius*), American crow (*Corvus brachyrhynchos*), and wild turkey (*Meleagris gallopavo*). Evidence of other wildlife species at and in the vicinity of the OB/OD included coyote (*Canis latrans*) feces. Additional species that were not observed but likely occur at the OB/OD include eastern cottontail rabbit (*Sylvilagus floridanus*), opossum (*Didelphis virginiana*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), red fox (*Vulpes vulpes*), voles (*Microtus* spp.), shrews, and field mice. With the exception of the voles, shrews, and field mice, the terrestrial wildlife species are expected to have home ranges larger than the OB/OD and only be transient visitors to the OB/OD.

7.2.3 Aquatic Biota

No aquatic species were observed at the OB/OD. Both ephemeral streams on the OB/OD were dry during the December 15, 2011, site visit; however, water was present at the spring. Water striders (*Gerris* spp.) were observed within a shallow pool of water located along the western ephemeral stream and north of the OB/OD. Similarly, a small pool of water was observed south of the OB/OD and within the stream just north of Vinton School Road. The small pool of water contained creek chubs (*Semotilus atromaculatus*), bluntnose minnows (*Pimephales notatus*), and crayfish. The crayfish observed in the pool disappeared beneath leaf litter and submerged woody debris before they could be captured and identified to genus and/or species. No aquatic plants were observed in the two ephemeral streams on the OB/OD, the shallow pool of water located along the western ephemeral stream and north of the OB/OD, or the small pool of water within the stream south of the OB/OD and north of Vinton School Road.

7.3 ECOLOGICAL EVALUATION PROCESS

The following sections summarize the screening method used for this ecological evaluation. In the evaluation process, COPECs; potentially exposed populations of wildlife, plants, and aquatic organisms; and potential pathways of exposure are identified. This assessment considers physical site features and surrounding land uses to determine the likelihood for exposure. Only completed exposure pathways (i.e., wildlife, plants, and aquatic organism receptors that come in contact with COPECs through contaminated media such as soils, sediments, and surface water) may actually pose an ecological risk.

7.3.1 Chemicals of Potential Ecological Concern

Ecological receptors, including plants and animals, are exposed to a variety of elements and chemicals throughout their lives. Additionally, the needs of an individual receptor may change seasonally as a reflection of its various life functions, such as during egg production or other reproductive activities, hibernation, or migration. While many substances are essential for the health, survival, and wellbeing of the individual receptor, other naturally-occurring and man-made substances may have no effect on the receptor, be beneficial, or have an adverse effect on the ability of the receptor to sustain itself. Chemicals that may elicit adverse effects to ecological receptors or that had detection limits above the ecological screening level for that chemical are considered COPECs.

The first step in determining a COPEC was to review the analytical data collected for soil, sediments, and surface water samples and determine the potential exposure pathways for various species of wildlife, plant, and aquatic organism. In soils, surface water, and sediments, organic compounds and metals were considered as preliminary COPECs if they were detected, exceeded ecological screening levels, or had no available screening level (see Tables 7-1 through 7-4). The comprehensive soil data set includes all soil samples that were collected during the RI activities from the unsaturated zone (a maximum depth of 11.5 feet). As discussed in Section 4.2.1, twenty-three surface soil samples were collected and analyzed using field screening methods. However, the correlation coefficient between the field GC and off-site confirmation results using linear regression techniques was 0.6429, which was below the 0.70 linear regression acceptance criteria. Therefore, this data is not appropriate for use in the BLRA. The shallow soil data set was evaluated using fixed analytical laboratory results and not the field screening results. The sediment data set includes all sediment samples collected during the RI activities. It should be noted that sediment samples were collected as dry sediment. The surface water data set includes all surface water samples collected in December 2011 and March 2012 (the only sampling events in which there was surface water).

COPECs include those site-related chemicals that have the potential to impact ecological receptors. For this ecological risk assessment, the COPECs were identified primarily through a comparison to ecological-based screening levels. The primary source of screening levels was the USEPA Region 7 Ecological Screening Levels for water sediment and soil. Constituents with detections greater than screening levels were retained. Detections of constituents without screening levels were also retained. Constituents that were classified as non-detects were not retained. Bioaccumulative compounds such as arsenic were retained even if they did not exceed screening levels. Constituents that were retained as COPECs were evaluated and compared to toxicological benchmarks.

7.3.1.1 Surface Soils (0-2 feet bgs)

The following constituents were detected in surface soils above applicable USEPA ecological screening levels for soils and retained as COPECs for the ecological risk assessment (Table 7-1).

- PCA
- 2,4-Dinitrotoluene
- 2,6-Dinitrotoluene
- Di-n-butyl phthalate
- N-Nitrosodiphenylamine
- Antimony
- Cadmium
- Chromium
- Copper
- Lead
- Nickel
- Selenium
- Thallium
- Zinc

The following constituents were retained as a COPEC and evaluated due to a lack of an applicable ecological screening level.

- 1,2,4-Trimethylbenzene
- Isopropylbenzene
- p-Isopropyltoluene
- sec-Butylbenzene
- tert-Butylbenzene
- Perchlorate
- 4-Amino-2,6-dintirotoluene
- 4-Nitrotoluene
- Nitroglycerin

The following constituents, were detected in surface soil samples, did not exceed USEPA ecological screening levels for soils, but were retained as COPECs and evaluated because they are bioaccumulative and could potentially result in a greater exposure risk to higher trophic level organisms in the environment.

- Arsenic
- Mercury

7.3.1.2 Subsurface Soils (>2 feet bgs)

The following constituents were detected in subsurface soils above applicable USEPA ecological screening levels for soils and retained as COPECs for the ecological risk assessment (Table 7-2).

- PCA
- cis-1,2-DCE
- TCE
- Antimony
- Cadmium
- Chromium
- Copper
- Lead
- Nickel
- Selenium
- Thallium
- Zinc

The following constituent was retained as a COPEC and evaluated due to a lack of an applicable ecological screening level.

- Perchlorate

The following constituents, were detected in subsurface soil samples, did not exceed USEPA ecological screening levels for soils, but were retained as COPECs and evaluated because they are bioaccumulative and could potentially result in a greater exposure risk to higher trophic level organisms in the environment.

- Arsenic
- Mercury

7.3.1.3 Surface Water

The following constituents were detected in surface water above applicable USEPA ecological screening levels for water and retained as COPECs for the ecological risk assessment (Table 7-3).

- TCE
- Benzo(a)pyrene
- bis(2-ethylhexyl) phthalate
- Copper
- Lead
- Mercury

The following constituent was retained as a COPEC and evaluated due to a lack of an applicable ecological screening level.

- Perchlorate

The following constituents, were detected in surface water samples, did not exceed USEPA ecological screening levels for water, but were retained as COPECs and evaluated because they are bioaccumulative and could potentially result in a greater exposure risk to higher trophic level organisms in the environment.

- Nickel
- Selenium
- Zinc

7.3.1.4 Sediments

The following constitutes were detected in sediments above applicable USEPA ecological screening levels for sediment and retained as COPECs for the ecological risk assessment (Table 7-4).

- Beryllium
- Cadmium
- Copper
- Nickel
- Selenium

The following constituents, were detected in sediment samples, did not exceed USEPA ecological screening levels for water, but were retained as COPECs and evaluated because they are bioaccumulative and could potentially result in a greater exposure risk to higher trophic level organisms in the environment.

- Antimony
- Arsenic
- Chromium
- Lead
- Mercury
- Zinc

7.4 POTENTIAL ECOLOGICAL RECEPTORS

For this ecological evaluation, potential ecological receptors (terrestrial and aquatic wildlife, terrestrial and aquatic plants, and soil and benthic organisms) were selected based on species observed while conducting the field investigation, habitats available at the OB/OD, and best professional judgment of what species are likely present in the area.

7.4.1 Vegetation

As stated in Section 3.5.1, the majority of the OB/OD consists of grasslands composed of common grass and forb species. Woody vegetation on the OB/OD was restricted to narrow riparian zones along the two ephemeral stream channels. The plant species observed at the OB/OD during the December 15, 2011 site visit are common plant species to grassland and riparian habitats in northeastern Kansas and consistent with the species and communities presented in the Fort Riley INRMP, *Vegetation of the Fort Riley Military Reservation, Kansas* (Freeman and Delisile, 2004), and *Vegetation Survey and Mapping of the Fort Riley Military Reservation, Kansas* (Delisle et al., 2012). Some of the species at the OB/OD likely have extensive root systems that contact surface and subsurface soils; therefore, it was assumed that the plant species at the OB/OD are likely to be exposed to COPECs in both surface soils (soils between 0 and 2 feet bgs) and subsurface soils (soils greater than 2 feet bgs).

7.4.2 Terrestrial Species

White-tailed deer, Northern cardinal, American robin, American crow, and wild turkey were observed during the December 15, 2011 site visit. Additionally, coyote feces were also observed at the OB/OD. Additional species that were not observed but likely occur at the OB/OD include eastern cottontail rabbit, opossum, raccoon, striped skunk, red fox, voles, shrews, and field mice. These species are likely to be exposed to surface soils (soils between 0 and 2 feet bgs) and surface water contaminants and soil invertebrates and vegetation that may have accumulated contaminants from soils at OB/OD. Similarly, the raccoon could potentially be exposed to contaminants in surface water, sediments, and fish and aquatic invertebrates that may have accumulated contaminants. It was assumed that none of the animals came in contact with subsurface soils (soils greater than 2 feet bgs).

The short-tailed shrew, white-footed mouse, meadow vole (close relative and surrogate for the prairie vole), eastern cottontail rabbit, red fox, raccoon, white-tailed deer, American robin, and red-tailed hawk were selected as the representative terrestrial wildlife species that occur or are likely to occur at the OB/OD. Various aspects of these species' life histories and relative sensitivity to contaminants have been estimated, measured, and quantified in previous USEPA documents and were used to evaluate potential risk. The chosen species represent several different sizes of animals (see Table 7-5) and feeding guilds. These species represent insectivorous (short-tailed shrew), herbivorous (white-footed mouse, eastern cottontail rabbit, and white-tailed deer), omnivorous (meadow vole, raccoon, and American robin), and carnivorous (red fox and red-tailed hawk) animals that were observed at or are likely to inhabit the OB/OD (Note, body mass listed in the tables is expressed as wet weight). Most of these species were observed at the OB/OD and have toxicological benchmarks for many of the COPECs listed in Section 7.3.1.

Various aspects of the receptor species' diets are provided in Table 7-6. The diet of the omnivorous meadow vole and American robin were assumed to be composed of 80 percent soil invertebrates (earthworms) and 20 percent vegetation. The diet of the omnivorous raccoon was assumed to be composed of equal parts of benthic invertebrates, soil invertebrates, fish, terrestrial plants, and small mammals. The insectivorous short-tailed shrew's diet was assumed to be composed of 100 percent soil invertebrates (earthworms). The herbivorous white-footed mouse, eastern cottontail rabbit, and white-tailed deer were assumed to be 100 percent vegetation. It was also assumed that the carnivorous red fox and red-tailed hawk consumed only small mammal prey such as the mice, voles, and rabbits that inhabit the OB/OD.

Based on available food, their means of travel, and their relatively large size, it is likely that the red fox, raccoon, white-tailed deer, and red-tailed hawk spend only a fraction of their time in the vicinity of the OB/OD. These animals have large home ranges and the OB/OD constitutes only a fraction of these animals' total home ranges (see Table 7-7). This risk assessment assumes that the potential for risk is determined by the amount of time that the species is present in the vicinity of a COPEC. Since the red fox, raccoon, white-tailed deer, and red-tailed hawk are likely to spend equal amounts of time in the different regions of their home range, it was assumed that the amount of contaminant that these animals are exposed to is dependent on what fraction that the OB/OD makes up in their home range.

7.4.3 Aquatic Species

No aquatic species were observed at the OB/OD. Both ephemeral streams on the OB/OD were dry during the December 15, 2011, site visit. Water was present at the spring during the site visit; however, it was not in a significant quantity to form a pool that would be considered aquatic habitat.

Water striders (*Gerris* spp.) were observed within a shallow pool of water located along the western ephemeral stream and north of the OB/OD site. Similarly, a small pool of water was observed south of the OB/OD and within the stream just north of Vinton School Road. The small pool of water contained creek chubs (*Semotilus atromaculatus*), bluntnose minnows (*Pimephales notatus*), and crayfish. No aquatic plants were observed in the two ephemeral streams on the OB/OD, the shallow pool of water located along the western ephemeral stream and north of the OB/OD, or the small pool of water within the stream south of the OB/OD and north of Vinton School Road. However, it is assumed that aquatic vegetation would be present if stream flow or pools were to occur in the ephemeral streams for a significant amount of time during the growing season.

Fish, aquatic plants, and aquatic and benthic invertebrates were assumed to inhabit the ephemeral streams on the OB/OD and are likely to be exposed to contaminants within the surface water and sediments. Although sediments were dry at the time of sampling, it was assumed they would be wet for purposes of evaluating risk to aquatic benthic species. As stated previously, the raccoon, which consumes sediments, benthic invertebrates, and fish is also likely to be exposed to contaminants associated with the surface water features at the OB/OD.

For the purposes of this evaluation, aquatic and benthic invertebrates, fish, and aquatic plants were selected as the representative aquatic species that likely occur at the OB/OD. Various aspects of these species' life histories and relative sensitivity to contaminants have been estimated, measured, and quantified in previous USEPA documents and were used to evaluate potential risk. This ecological risk assessment assumes that the potential for risk is determined by the amount of time that the species is present in the vicinity of a COPEC.

7.5 EXPOSURE PATHWAYS

Surface soils, subsurface soils, surface water, and sediments were sampled at the OB/OD. These potentially impacted media may provide a contact point for ecological receptors. Surface soils, subsurface soils, and surface water were evaluated as potential exposure media for terrestrial receptors. Surface water and sediments were evaluated as potential exposure media for aquatic species. Groundwater was not analyzed in this ecological evaluation because it was assumed that, due to the depth, the wildlife and plants at the OB/OD would not come in contact with the groundwater. Figure 7-1 displays a graphical representation of the ecological conceptual site model.

The primary completed exposure pathways (i.e., pathways for those contaminants that can reach ecological receptors) for the contaminated media and the potentially exposed ecological receptors include direct and accidental ingestion of contaminants through feeding. Soil invertebrates, burrowing animals, insectivorous animals, and herbivores may be exposed to contaminants in the surface soils due to ingesting soils, whether intentionally or accidentally; however, it was assumed that none of terrestrial wildlife species came in contact with subsurface soils (soils greater than 2 feet bgs). It was assumed that the plant species at the OB/OD are likely to be exposed to contaminants in both surface soils (soils between 0 and 2 feet bgs) and subsurface soils (soils greater than 2 feet bgs). Plants and soil invertebrates may also accumulate soil contaminants and subsequently be consumed by insectivorous, herbivorous, and omnivorous species. Predatory animals may consume smaller animals that have consumed contaminated soils or plants and other smaller animals that have accumulated contaminants.

Aquatic species may be exposed to contaminants in the surface water and sediments by ingesting contaminants in the water and sediments, whether intentionally or accidentally. Lastly, surface water may also be a potential source of contamination. Potential OB/OD contaminants may be ingested by animals while drinking water from the surface waters at the OB/OD. Similarly, aquatic plants, fish, and aquatic and benthic invertebrates, may accumulate contaminants in surface water and sediments and subsequently be consumed by the raccoon.

Exposure pathways for many species may not be completed for a particular medium due to life history characteristics or available habitat. The following discussion provides a description of the types of ecological receptors potentially exposed to each medium along with wildlife species-specific characteristics that are used later in the COPEC screening process.

7.5.1 Soils

Soil samples were collected to evaluate the nature and extent of contamination. Soil organisms, including microorganisms and earthworms, may be directly exposed to impacted soil. Plants may be exposed by the uptake through root systems. Acute and chronic toxicity effects to plants and soil organisms can be evaluated directly or indirectly through a qualitative assessment. Ecological evidence such as areas devoid of vegetation, notable overpopulation of a particular species, and/or accumulation of detritus, are symptoms of toxicity to plants and/or soil organisms.

Potential risk to wildlife ecological receptors from soil contaminants was assessed using analytical data for samples collected from surface soil. The OB/OD site, which consists of managed grasslands and scattered trees in the riparian habitats along the ephemeral streams, contains cover and grazing opportunities for small and larger animal species. Plant species at the OB/OD are likely to be exposed to contaminants in both surface soils and subsurface soils. Terrestrial wildlife receptor species could be exposed to soils as they graze and burrow in the surface soils of the OB/OD. Thus, the soil exposure pathway for wildlife species was assumed to be limited to the maximum detected chemicals in surface soils within the OB/OD. The small mammal and American robin receptor species were assumed to spend all of their time and feed within the OB/OD.

The maximum detected concentration for each COPEC in soil was used in this evaluation. This is the most conservative approach because it assumes that the highest concentration for each COPEC will be encountered. It was assumed that the burrowing terrestrial receptors such as red foxes, voles, and white-footed mice, are not occupying dens or burrows more than two feet bgs. Similarly, it was assumed that earthworms would not occur deeper than two feet bgs. Therefore, the terrestrial wildlife species are not contacting subsurface soils at the OB/OD.

Representative species that were selected for evaluation of completed soil exposure pathways at the OB/OD include the earthworm, short-tailed shrew, white-footed mouse, meadow vole, eastern cottontail rabbit, red fox, raccoon, white-tailed deer, American robin and red-tailed hawk. All of these species for one reason or another could potentially ingest OB/OD site soils.

7.5.2 Surface Water

Surface water samples were taken from the two ephemeral streams on the OB/OD. Neither ephemeral stream contained flowing water during the December 15, 2011, OB/OD visit; however, pools of water were located along the western ephemeral drainage north and south of the OB/OD. Based on their presence in the small pool of water that was observed south of the OB/OD site, aquatic and benthic invertebrates, aquatic plants, and fish were the representative aquatic species selected for evaluation because of assumed completed surface water exposure pathways that could occur when flowing water is present in the two ephemeral streams on the OB/OD.

All the terrestrial wildlife receptor species, short-tailed shrew, white-footed mouse, meadow vole, eastern cottontail rabbit, red fox, white-tailed deer, American robin, and red-tailed hawk, are assumed to be ingesting water from the ephemeral stream at the OB/OD. The maximum concentrations of COPECs detected in surface water for the OB/OD were used for evaluating the risk to terrestrial wildlife. This method of using the maximum concentrations detected in surface water for evaluating surface water exposure by representative terrestrial wildlife species is conservative in that it assumes the receptor is spending all of its time within the vicinity and/or is habitually drinking from the location along the ephemeral streams that contains the highest detected concentration of each COPEC. However, it is unlikely that an individual animal will consistently ingest the maximum chemical concentrations. The representative terrestrial wildlife species that drink from ephemeral streams with flowing water are likely to use other, perennial water sources within their home range. Other representative wildlife species, such as shrews, mice, voles, and rabbits, may actually get most their water from the plants and animals that they ingest, rather than from ponds or surface water sources.

Potential risk to ecological receptors from the maximum COPEC concentrations of surface water contaminants detected was assessed using analytical data for samples collected from the ephemeral streams on the OB/OD. All the aquatic receptor species are assumed to be ingesting constituents detected in the surface water from the ephemeral streams on the OB/OD.

7.5.3 Sediment

Dry sediment samples were taken from the two ephemeral streams on the OB/OD. Benthic invertebrate receptor species are assumed to be contacting COPECs in sediment from the ephemeral streams at the OB/OD. The maximum concentrations detected in sediments for the OB/OD were used for evaluating the risk to the benthic invertebrate receptor species. This method of using the maximum concentrations detected in sediments for evaluating sediment exposure by representative benthic invertebrate receptor species is conservative in that it assumes the receptor will be exposed to the highest detected concentration of each COPEC. Potential risk to benthic invertebrate receptor species from sediment contaminants was assessed using analytical data for samples collected from the ephemeral streams on the OB/OD.

7.6 BIOACCUMULATION IN FOOD

The potential for COPECs to be transferred from soil to plants, soil to soil invertebrates (earthworm), sediments to benthic invertebrates, and surface water to fish, aquatic plants, and aquatic invertebrates by uptake was evaluated in this ecological risk assessment. It was assumed that the terrestrial insectivorous, herbivorous, and omnivorous species were consuming vegetation and/or earthworms that have been exposed and accumulated COPECs by root uptake (plants) or by direct ingestion of soils (earthworms). Similarly, the terrestrial omnivore and carnivores were assumed to consume the small mammals (shrew, white-footed mouse, vole, and eastern cottontail rabbit) that inhabit the OB/OD. These small mammals are consuming soils, surface water, soil organisms (earthworms), and vegetation that may contain concentrations of COPECs.

It was also assumed that the omnivorous raccoon was consuming fish and benthic invertebrates that have been exposed and accumulated COPECs by absorption or by direct ingestion of surface water and sediments. The fish are assumed to be consuming sediments, surface water, and aquatic and benthic invertebrates that may contain concentrations of COPECs.

7.7 RISK CHARACTERIZATION

Risk characterization assesses the likelihood of adverse ecological effects associated with exposure to site contamination. The risk characterization combines the quantitative evaluation with the qualitative assessment to conclude if significant risk to ecological receptors exists (USEPA, 1997b). After ecological receptors were identified, receptors with available toxicity data or benchmarks were selected. A benchmark value is a known concentration of a substance that elicits known effects ranging from no effect to death for the ecological receptor under study. Some benchmarks for the COPECs were not available for fish, avian, mammal, plant or invertebrate receptor species. When available, the receptor and chemical-specific benchmark is compared to the chemical concentration absorbed by the receptor to yield the HQ. The sum of all the HQs equals the HI, which accounts for the potential additive toxicity of each contaminant.

Chemical concentrations that exceeded benchmarks were detected in soils, sediments, and surface water. Although no visible adverse ecological effects to terrestrial and aquatic receptors were observed during field investigations conducted by BMcD biologists, the quantitative assessment, discussed below, indicates that the plant and wildlife communities within the OB/OD may be experiencing some adverse effects due to the detected contaminants.

7.7.1 Soil Organism Evaluation Method

The availability of benchmarks for the COPECs for soil invertebrates (earthworms) were limited. All chemicals detected were assumed to be 100 percent bioavailable. Therefore, the maximum concentration detected in the surface soils at the OB/OD was divided by the available published lowest observable effects concentration benchmarks for earthworms (USEPA ECOTOX Database [http://cfpub.epa.gov/ecotox/]; Efroymson et al., 1997b) to yield the HQ (Tables 7-8). As indicated on Table 7-8, there were no published lowest observable effects concentrations for PCA, isopropylbenzene, p-isopropyltoluene, sec-butylbenzene, tert-butylbenzene, di-n-butyl phthalate, perchlorate, 4-amino-2,6-dinitrotoluene, 4-nitrotoluene, and nitroglycerin.

For the purposes of evaluating multiple contaminant exposure, it was conservatively assumed that simultaneous exposure would result in additive toxicity from each contaminant. To account for the additive toxicity of each contaminant, HIs were calculated for the soil organisms (earthworm) by adding the HQs for all contaminants.

7.7.2 Benthic Invertebrate Evaluation Method

The availability of benchmarks for the COPECs for benthic invertebrates was limited. Threshold effect concentration benchmarks for freshwater sediment for each COPEC were used to evaluate the potential risk to benthic invertebrates (Jones et. al., 1997). All chemicals detected were assumed to be 100 percent bioavailable. Therefore, the maximum concentration detected for each COPEC in the sediments at the OB/OD was divided by the threshold effect concentration benchmark to yield the HQ (Table 7-9). As indicated on Table 7-9, there was not a published threshold effect concentration benchmark for antimony, beryllium, and selenium.

For the purposes of evaluating multiple contaminant exposure, it was conservatively assumed that simultaneous exposure would result in additive toxicity from each contaminant. To account for the additive toxicity of each contaminant, HIs were calculated for the benthic invertebrates by adding the HQs for all contaminants.

7.7.3 Terrestrial Plant Evaluation Method

The most important factor affecting terrestrial plant exposure to contamination is substance solubility and the plant's ability to uptake substances through its root system. All chemicals detected were assumed to be 100 percent bioavailable. Therefore, the maximum concentration detected for each COPEC in the surface and subsurface soils at the OB/OD was divided by the available published lowest observed effect concentration benchmarks (USEPA ECOTOX Database [http://cfpub.epa.gov/ecotox/]; Efroymson et al., 1997c) to yield the HQ (Tables 7-10 and 7-11). As indicated on Table 7-10, there was not a published lowest observable effects concentration for isopropylbenzene, sec-butylbenzene, tert-butylbenzene, N-nitrosodiphenylamine, 4-amino-2,6-dinitrotoluene, 4-nitrotoluene, and nitroglycerin.

For the purposes of evaluating multiple contaminant exposure, it was conservatively assumed that simultaneous exposure would result in additive toxicity from each contaminant. To account for the additive toxicity of each contaminant, HIs were calculated for plants by adding the HQs for all contaminants.

7.7.4 Aquatic Plant Evaluation Method

The most important factor affecting aquatic plant exposure to contamination is substance solubility because only the amount of a substance that is soluble is available to plants. This is referred to as plant bioavailability. All chemicals detected were assumed to be 100 percent bioavailable. Therefore, the maximum concentration detected for each COPEC in the surface water of the ephemeral streams on the OB/OD was divided by the available published lowest chronic value for aquatic plants (USEPA ECOTOX Database [http://cfpub.epa.gov/ecotox/]; Sutter and Tsao, 1996 [ES/ER/TM-96/R2]) to yield the HQ (Tables 7-12). As indicated on Table 7-12, there was not a published lowest chronic value for perchlorate.

For the purposes of evaluating multiple contaminant exposure, it was conservatively assumed that simultaneous exposure would result in additive toxicity from each contaminant. To account for the additive toxicity of each contaminant, HIs were calculated for plants by adding the HQs for all contaminants.

7.7.5 Aquatic Invertebrate Evaluation Method

The availability of benchmarks for the COPECs for aquatic invertebrates was limited. All chemicals detected were assumed to be 100 percent bioavailable. Therefore, the maximum concentration detected for each COPEC in the surface water of the ephemeral streams on the OB/OD was divided by the available published lowest chronic value benchmarks for daphnids (USEPA ECOTOX Database [http://cfpub.epa.gov/ecotox/]; Sutter and Tsao, 1996 [ES/ER/TM-96/R2]) to yield the HQ (Table 7-13). As indicated on Table 7-13, there was not a published lowest chronic value for perchlorate.

For the purposes of evaluating multiple contaminant exposure, it was conservatively assumed that simultaneous exposure would result in additive toxicity from each contaminant. To account for the additive toxicity of each contaminant, HIs were calculated for the benthic invertebrates by adding the HQs for all contaminants.

7.7.6 Fish Evaluation Method

The availability of benchmarks for the COPECs for fish was limited. All chemicals detected were assumed to be 100 percent bioavailable. Therefore, the maximum concentration detected for each COPEC in the surface water of the ephemeral streams on the OB/OD was divided by the available published lowest chronic value benchmarks for fish (Sutter and Tsao, 1996 [ES/ER/TM-96/R2]) to yield the HQ (Table 7-14). As indicated on Table 7-14, there was not a published lowest chronic value for perchlorate.

For the purposes of evaluating multiple contaminant exposure, it was conservatively assumed that simultaneous exposure would result in additive toxicity from each contaminant. To account for the additive toxicity of each contaminant, HIs were calculated for the fish by adding the HQs for all contaminants.

7.7.7 Wildlife Benchmark Evaluation Method

Based on the available habitat at the OB/OD, wildlife receptors potentially present were identified and compared to a list of species for which benchmarks have been established. Terrestrial receptors selected as representative species included the short-tailed shrew, white-footed mouse, meadow vole (close relative and surrogate for the prairie vole), eastern cottontail rabbit, red fox, raccoon, white-tailed deer, American robin, and red-tailed hawk. Benchmarks for these receptors were obtained from the Oak Ridge National Laboratories' (ORNL) *Toxicological Benchmarks for Wildlife: 1996 Revision* (ORNL, 1996a) and the USEPA ECOTOX Database (http://cfpub.epa.gov/ecotox/). Natural history characteristics (See Tables 7-5, 7-6, and 7-7) used to calculate exposure were obtained from the *Wildlife Exposure Factors Handbook Vol. I & II* (USEPA, 1993), *Preliminary Remediation Goals for Ecological Endpoints* (Efroymson et. al., 1997a), *Toxicological Benchmarks for Wildlife: 1996 Revision* (ORNL, 1996a), and *The Wild Mammals of Missouri* (Schwartz and Schwartz, 1981).

The wildlife screening used the most conservative benchmarks expressed as the NOAEL. The NOAEL is the highest level of a stressor evaluated in a toxicity test or biological field survey that causes no difference in effect compared with the controls or reference site (USEPA, 1997b). All contaminant exposure levels were assumed to equal the maximum detected concentrations and conservative assumptions were used in determining the initial exposure parameters. Exposure parameters are those physical factors that might influence receptor exposure. All contaminants exceeding the preliminary screening (Tables 7-1 through 7-4) were considered preliminary COPEC and retained for the site-specific wildlife evaluations.

7.7.8 Estimation of Intake

For this ecological risk assessment, the primary routes of exposure for terrestrial and aquatic wildlife are through ingestion of food (either plant or animal), surface water, and soil and/or sediment (either ingested incidentally while foraging or purposefully to meet nutrient needs). The preliminary ingestion dose for a given route of exposure (food, water, soil or sediment) was calculated by multiplying the food, water, soil or sediment ingestion rate and the maximum detected concentration in the respective medium (see Tables 7-15 through 7-23). Rates of food, water, and soil ingestion for the receptor species were taken from available literature (see Table 7-5). The total exposure experienced by a wildlife species is represented by the sum of the exposures from each individual source and may be represented by the following equation from ORNL (1996a):

$$E_{total} = E_{food} + E_{water} + E_{soil}$$

E_{total} = exposure from all sources
E_{food} = exposure from food consumption
E_{water} = exposure from water consumption
E_{soil} = exposure through consumption of soil or sediment (either incidental or deliberate)

The exposure from all sources was divided by the weight normalized NOAEL to get the HQ (see Table 7-24). The body mass estimates for wildlife species were taken from available literature (see Table 7-5). An HQ greater than 1 indicates that the exposure to the contaminant has the potential to cause adverse effects in the organism. For the wildlife receptors, the NOAEL was expressed in mg/kg/day. NOAEL benchmarks were not available for 1,2,4-trimethylbenzene, cis-1,2-DCE, isopropylbenzene, p-isopropyltoluene, sec-butylbenzene, tert-butylbenzene, n-nitrosodiphenylamine, perchlorate, 4-amino-2,6-dinitrotoluene, and 4-nitrotoluene for the short-tailed shrew, white-footed mouse, meadow vole, eastern cottontail rabbit, red fox, raccoon, white-tailed deer, American robin, and red-tailed hawk. Additionally, NOAEL benchmarks were not available for PCA, TCE, benzo(a)pyrene, nitroglycerin, antimony, and beryllium, for the American robin, and red-tailed hawk; however, LOAEL benchmarks for benzo(a)pyrene were used as a surrogate NOAEL benchmarks for the American robin, and red-tailed hawk.

For the purposes of evaluating multiple contaminant exposure, it was conservatively assumed that simultaneous exposure would result in additive toxicity from each contaminant. To account for the additive toxicity of each contaminant, HIs were calculated for each species by adding the HQs for all contaminants (see Table 7-24). HQs and HIs for each species evaluated are presented in Section 7.9 of this assessment.

7.8 EXPOSURE VARIABLES

Factors affecting wildlife exposure may include home range size; the amount of time a given species spends in a given area; bioavailability; and food, water, soil, and sediment ingestion rates. Assumptions were made regarding receptor species with home ranges larger than the OB/OD site. The red fox, raccoon, white-tailed deer, and red-tailed hawk were assumed to only spend a fraction of their time foraging within the OB/OD. Smaller receptor species with home range areas less than the total area of the OB/OD (short-tailed shrew, white-footed mouse, meadow vole, eastern cottontail rabbit, and American robin) were assumed to spend 100 percent of their time within the OB/OD. Smaller receptor species such as fish and benthic and aquatic invertebrates and sessile receptor species such as terrestrial and aquatic plants were assumed to spend their entire lives within the OB/OD.

The contaminants at the OB/OD were identified in soil, surface water, and sediments, and it was assumed that the ingestion route was completed by ingesting soil, surface water, sediments, and plants and animals that may have accumulated chemical contaminants from the soils, surface water, and sediments. Although it was assumed that not all representative species ingested soil or sediments, it was assumed that each species ingested surface water from the OB/OD. It was also assumed that all of the chemical ingested by the representative wildlife species was absorbed into the organism’s tissue (100 percent bioavailability for each chemical detected at the OB/OD).

7.8.1 Soil to Soil Organism Bioconcentration

The concentration of site-specific constituents in soil organisms (earthworms) was used to determine the exposure from consumption of earthworms by insectivorous and omnivorous receptor species, such as the short-tailed shrew, meadow vole, raccoon, and the American robin. In the case of the omnivores (vole, raccoon, and American robin) it was assumed that a portion of their exposure came from consuming earthworms and a portion came from consuming vegetation or another food source. The soil to soil organism uptake of COPECs was estimated using soil-to-soil organism bioconcentration factors (BCFs).

Reported BCFs for soil organisms (USEPA, 1999) for each of the COPECs were used to calculate the estimated concentration of each COPEC in earthworms. BCFs provide an estimate of the uptake of compounds from a medium, such as soil, to applicable receptor food items, such as soil organisms and, specifically, earthworms. Where an appropriate BCF was not available, a regression equation based on the compound's log K_{ow} value was used to calculate the recommended BCF value (USEPA, 1999). The estimated concentrations of site-specific chemicals in soil invertebrates to which insectivorous and omnivorous wildlife are exposed are provided in Table 7-19.

7.8.2 Soil to Plant Bioconcentration

The concentration of site-specific chemicals in plants was used to determine the exposure from consumption of vegetation by herbivorous and omnivorous receptor species, such as the white-footed mouse, meadow vole, eastern cottontail rabbit, raccoon, white-tailed deer, and American robin. In the case of the omnivores (vole, raccoon, and American robin) it was assumed that a portion of their exposure came from consuming vegetation and a portion came from consuming earthworms or another food source. The soil-to-plant uptake of COPECs was estimated using soil-to-plant BCFs. Reported BCFs for plants (USEPA, 1998b) for each of the COPECs were used to calculate the estimated concentration of each COPEC in vegetation. BCFs provide an estimate of the uptake of compounds from a medium, such as soil, to applicable receptor food items, such as plants. Where an appropriate BCF was not available, a regression equation based on the compound's log K_{ow} value was used to calculate the recommended BCF value (USEPA, 1999). The estimated concentrations of site-specific chemicals in vegetation that herbivorous wildlife is exposed to are provided in Table 7-20.

7.8.3 Sediment to Benthic Invertebrates Bioconcentration

The concentration of site-specific constituents in benthic invertebrates was used to determine the exposure that the raccoon received from consuming benthic invertebrates. It was assumed that one-fifth of the raccoon's exposure came from consuming benthic invertebrates, and four-fifths came from consuming other sources of food. The sediment-to-benthic invertebrate uptake of COPECs was estimated using sediment-to-benthic invertebrate BCFs. Reported BCFs for benthic invertebrates (USEPA, 1999) for each of the COPECs were used to calculate the estimated concentration of each COPEC in benthic invertebrates. BCFs provide an estimate of the uptake of compounds from a medium, such as sediments, to applicable receptor food items, such as benthic invertebrates. The estimated concentrations of site-specific chemicals in benthic invertebrates to which racoons are exposed are provided in Table 7-18.

7.8.4 Surface Water to Fish Bioconcentration

The concentration of site-specific constituents in fish was used to determine the exposure that the raccoon received from consuming fish. It was assumed that one-fifth of the raccoon's exposure came from consuming fish, and four-fifths came from consuming other sources of food. The surface water-to-fish uptake of COPECs was estimated using surface water-to-fish BCFs. Reported BCFs for fish (USEPA, 1999) for each of the COPECs were used to calculate the estimated concentration of each COPEC in fish. BCFs provide an estimate of the uptake of compounds from a medium, such as surface water, to applicable receptor food items, such as fish. Where an appropriate BCF was not available, a regression equation based on the compound's log K_{ow} value was used to calculate the recommended BCF value (USEPA, 1999). The estimated concentrations of site-specific chemicals in fish to which raccoons are exposed are provided in Table 7-21.

7.8.5 Prey to Predator Biotransfer

The exposure of prey species to site-specific chemicals was used to determine the exposure for predatory receptor species, such as the red fox, raccoon, and red-tailed hawk, from consumption of small mammals like the short-tailed shrew, white-footed mouse, meadow vole, and eastern cottontail rabbit. Specifically, the total intake for predatory receptor species was based on the product of the predatory food intake rate and the calculated chemical dose estimates for the short-tailed shrew, white-footed mouse, meadow vole, and eastern cottontail rabbit averaged across all four species.

The terrestrial predator's chemical intake, the average dose received for each of the four small mammal prey species based on ingestion of small mammal prey, is calculated in Table 7-22. Each predator (red fox, raccoon, and red-tailed hawk) was assumed to consume an equal amount, by weight, of the small mammals (shrew, white-footed mouse, vole, and eastern cottontail rabbit) that inhabit the OB/OD. This was estimated to be the total exposure from small mammal prey consumption for the red fox, raccoon, and red-tailed hawk.

7.8.6 Home Range

The size of the receptor species home range is also factored into the receptor species total exposure from all sources. For example, the 70-acre OB/OD site represents a fraction of total area within the home ranges of the red fox, raccoon, white-tailed deer, and red-tailed hawk (see Table 7-7). This risk assessment assumes that the potential for risk is determined by the amount of time that each species is present in the vicinity of a COPEC. Since the red fox, raccoon, white-tailed deer, and red-tailed hawk are likely to spend equal amounts of time in the different regions of their home range, it was assumed that the amount of risk that these animals are exposed to is proportional to what fraction that the OB/OD makes up in their home range. This represents the fraction of the time that these species will spend within the OB/OD. The total dose received by each receptor species, based on the fraction of the species home range within the OB/OD, is provided in Table 7-24.

7.9 HAZARD QUOTIENT ANALYSIS

Tables 7-8 through 7-14, and 7-24 provide the calculated hazard quotients, based on available benchmarks, for the plants and wildlife receptors at the OB/OD. The following sections summarize HQ, cumulative Ecological Hazard Index (EHI), and identify the largest potential contributors to overall risk experienced by a given species. This constitutes the ecological risk characterization for the OB/OD.

7.9.1 Soil Invertebrates

A total EHI of 4.6E+00 was calculated for the soil invertebrates (earthworms) at the OB/OD site. However, toxicity data, lowest observable effects concentration benchmarks, were not available for 11 COPECs.

- PCA
- 1,2,4-Trimethylbenzene
- Isopropylbenzene
- p-Isopropyltoluene
- sec-Butylbenzene
- tert-Butylbenzene
- Di-n-butyl phthalate
- Perchlorate
- 4-Amino-2,6-dinitrotoluene
- 4-Nitrotoluene
- Nitroglycerin

The 11 chemicals that lacked toxicity data were not evaluated quantitatively. The results of the soil invertebrate evaluation based on maximum detections in surface soils, presented in Table 7-8, indicated that the soil invertebrates at the OB/OD did not receive a significant dose from the individual COPECs (HQs less than 1) that had publically available toxicity data.

7.9.2 Terrestrial Plants

A total EHI of 3.2E+02 was calculated for plants based on exposure to COPECs in surface soils and a total EHI of 2.8E+02 was calculated for plants based on exposure to COPECs in subsurface soils (Tables 7-10 and 7-11). This indicates that the COPEC concentrations in surface soils have a greater potential effect on terrestrial plants than the COPEC concentrations in subsurface soils. Toxicity data was available for all the COPECs detected in subsurface soils; however, nine COPECs detected in the surface soils were not evaluated due to a lack of toxicity data.

- 1,2,4-Trimethylbenzene
- cis-1,2-DCE
- N-Nitrosodiphenylamine
- 4-Amino-2,6-dinitrotoluene

- Isopropylbenzene
- sec-Butylbenzene
- tert-Butylbenzene
- 4-Nitrotoluene
- Nitroglycerin

The nine chemicals that lacked toxicity data were not evaluated quantitatively. The results of the terrestrial plant evaluation based on maximum detections in surface soils, presented in Table 7-10 indicate that the terrestrial plants at the OB/OD potentially received a significant dose from PCA, 2,4-dinitrotoluene antimony, cadmium, chromium, copper, lead, nickel, selenium, and zinc in surface soils. Toxicity data for 2,6-dinitrotoluene was used as a surrogate for 2,4-dinitrotoluene, which lacked available toxicity data. The results of the terrestrial plant evaluation based on maximum detections in subsurface soils presented in Table 7-11 indicate that the terrestrial plants at the OB/OD potentially received a significant dose from PCA, cadmium, chromium, nickel, and zinc in subsurface soils. All other chemicals evaluated in the surface and subsurface soils resulted in HQs less than 1.

7.9.3 Aquatic Plants

A total EHI of 9.2E+00 was calculated for aquatic plants based on exposure to COPECs in surface water (Table 7-12). Toxicity data was available for all the COPECs detected in surface water except perchlorate, which was not evaluated quantitatively. The results of the aquatic plant evaluation based on maximum detections in surface water, presented in Table 7-12 indicate that the aquatic plants at the OB/OD potentially received a significant dose from TCE and copper in surface water. All other chemicals evaluated resulted in HQs less than 1.

7.9.4 Aquatic Invertebrates

A total EHI of 2.8E+01 was calculated for aquatic invertebrates based on exposure to COPECs in surface water (Table 7-13). Toxicity data was available for all the COPECs detected in surface water except perchlorate, which was not evaluated quantitatively. The results of the aquatic invertebrate evaluation based on maximum detections in surface water, presented in Table 7-13 indicate that the aquatic invertebrates in the ephemeral streams on the OB/OD potentially received a significant dose from benzo(a)pyrene and copper in surface water. All other chemicals evaluated resulted in HQs less than 1.

7.9.5 Benthic Invertebrates

A total EHI of 7.6E+00 was calculated for benthic invertebrates based on exposure to COPECs in sediments. Toxicity data was not available for antimony, beryllium, and selenium. The results of the benthic invertebrate evaluation based on maximum detections in sediments presented in Table 7-9 indicates that the benthic invertebrates within the ephemeral streams on the OB/OD potentially received a significant dose from cadmium, copper, and nickel in sediments.

7.9.6 Fish

A total EHI of 3.2E+00 was calculated for fish based on exposure to COPECs in surface water (Table 7-14). Perchlorate, which was the only COPEC detected in the surface water that was not evaluated due to a lack of toxicity data, was not evaluated quantitatively. Toxicity data for the water flea (lowest chronic values) was used as a surrogate for benzo(a)pyrene and bis(2-ethylhexyl)phthalate detected in surface water, which lacked available toxicity data for fish.

The results of the fish evaluation based on maximum detections in surface water, presented in Table 7-14 indicate that fish in the ephemeral stream at the OB/OD, if present, potentially received a significant dose from copper and mercury in surface water. All other chemicals detected in surface water that were evaluated resulted in HQs less than 1.

7.9.7 Short-tailed Shrew

A total EHI of 4.6E+01 was calculated for the short-tailed shrew (Table 7-24). Ten COPECs were not evaluated quantitatively due to a lack of toxicity data.

- 1,2,4-Trimethylbenzene
- cis-1,2-DCE
- Isopropylbenzene
- p-Isopropyltoluene
- sec-Butylbenzene
- tert-Butylbenzene
- N-Nitrosodiphenylamine
- Perchlorate
- 4-Amino-2,6-dinitrotoluene
- 4-Nitrotoluene

Most of the potential risk experienced by the short-tailed shrew resulted from PCA, di-n-butyl phthalate, antimony, arsenic, cadmium, lead, and zinc at the OB/OD. All other chemicals evaluated had HQs less than 1.

7.9.8 White-footed Mouse

A total EHI of 4.9E+01 was calculated for the white-footed mouse (Table 7-24). Ten COPECs were not evaluated quantitatively due to a lack of toxicity data.

- 1,2,4-Trimethylbenzene
- cis-1,2-DCE
- Isopropylbenzene
- p-Isopropyltoluene
- tert-Butylbenzene
- N-Nitrosodiphenylamine
- Perchlorate
- 4-Amino-2,6-dinitrotoluene

- sec-Butylbenzene
- 4-Nitrotoluene

Most of the potential risk experienced by the white-footed mouse resulted from TCE and antimony at the OB/OD. All other chemicals evaluated had HQs less than 1.

7.9.9 Meadow Vole

A total EHI of 2.5E+01 was calculated for the meadow vole (Table 7-24). A total of ten COPECs were not evaluated quantitatively due to a lack of toxicity data.

- 1,2,4-Trimethylbenzene
- cis-1,2-DCE
- Isopropylbenzene
- p-Isopropyltoluene
- sec-Butylbenzene
- tert-Butylbenzene
- N-Nitrosodiphenylamine
- Perchlorate
- 4-Amino-2,6-dinitrotoluene
- 4-Nitrotoluene

Most of the potential risk experienced by the meadow vole resulted from PCA, TCE, di-n-butyl phthalate, and antimony at the OB/OD. All other chemicals evaluated had HQs less than 1.

7.9.10 Eastern Cottontail Rabbit

A total EHI of 1.7E+02 was calculated for the eastern cottontail rabbit (Table 7-24). A total of ten COPECs were not evaluated quantitatively due to a lack of toxicity data.

- 1,2,4-Trimethylbenzene
- cis-1,2-DCE
- Isopropylbenzene
- p-Isopropyltoluene
- sec-Butylbenzene
- tert-Butylbenzene
- N-Nirtosodiphenylamine
- Perchlorate
- 4-Amino-2,6-dinitrotoluene
- 4-Nitrotoluene

Most of the potential risk experienced by the eastern cottontail rabbit resulted from PCA, TCE, nitroglycerin, antimony, arsenic, cadmium, and copper at the OB/OD. All other chemicals evaluated had HQs less than 1.

7.9.11 Red Fox

A total EHI of 1.2E+01 was calculated for the red fox (Table 7-24). Ten COPECs were not evaluated quantitatively due to a lack of toxicity data.

- 1,2,4-Trimethylbenzene
- cis-1,2-DCE
- tert-Butylbenzene
- N-Nitrosodiphenylamine

- Isopropylbenzene
- p-Isopropyltoluene
- sec-Butylbenzene
- Perchlorate
- 4-Amino-2,6-dinitrotoluene
- 4-Nitrotoluene

Most of the potential risk experienced by the red fox resulted from TCE at the OB/OD. All other chemicals evaluated had HQs less than 1.

7.9.12 Raccoon

A total EHI of 3.4E+00 was calculated for the raccoon (Table 7-24). Ten COPECs were not evaluated quantitatively due to a lack of toxicity data.

- 1,2,4-Trimethylbenzene
- cis-1,2-DCE
- Isopropylbenzene
- p-Isopropyltoluene
- sec-Butylbenzene
- tert-Butylbenzene
- N-Nitrosodiphenylamine
- Perchlorate
- 4-Amino-2,6-dinitrotoluene
- 4-Nitrotoluene

Most of the potential risk experienced by the raccoon resulted from TCE at the OB/OD. All other chemicals evaluated had HQs less than 1.

7.9.13 White-tailed Deer

A total EHI of 1.5E+01 was calculated for the white-tailed deer (Table 7-24). Ten COPECs were not evaluated quantitatively due to a lack of toxicity data.

- 1,2,4-Trimethylbenzene
- cis-1,2-DCE
- Isopropylbenzene
- p-Isopropyltoluene
- sec-Butylbenzene
- tert-Butylbenzene
- N-Nitrosodiphenylamine
- Perchlorate
- 4-Amino-2,6-dinitrotoluene
- 4-Nitrotoluene

Most of the potential risk experienced by the white-tailed deer resulted from TCE at the OB/OD. All other chemicals evaluated had HQs less than 1.

7.9.14 American Robin

A total EHI of 1.0E+05 was calculated for the American robin (Table 7-24). A total of 15 COPECs were not evaluated quantitatively due to a lack of toxicity data.

- PCA
- 1,2,4-Trimethylbenzene
- cis-1,2-DCE
- Isopropylbenzene
- p-Isopropyltoluene
- sec-Butylbenzene
- tert-Butylbenzene
- TCE
- N-Nitrosodiphenylamine
- Perchlorate
- 4-Amino-2,6-dinitrotoluene
- 4-Nirtotoluene
- Nitroglycerin
- Antimony

A LOAEL benchmark for benzo(a)pyrene was substituted for a NOAEL benchmark for the American robin. Most of the potential risk experienced by the American robin resulted from 2,4-dinitrotoluene, di-n-butyl phthalate, cadmium, chromium, copper, lead, and zinc at the OB/OD. All other chemicals evaluated had HQs less than 1.

7.9.15 Red-tailed Hawk

A total EHI of 6.9E+00 was calculated for the red-tailed hawk (Table 7-24). A total of 15 COPECs were not evaluated quantitatively due to a lack of toxicity data.

- PCA
- 1,2,4-Trimethylbenzene
- cis-1,2-DCE
- Isopropylbenzene
- p-Isopropyltoluene
- sec-Butylbenzene
- tert-Butylbenzene
- TCE
- N-Nitrosodiphenylamine
- Perchlorate
- 4-Amino-2,6-dinitrotoluene
- 4-Nirtotoluene
- Nitroglycerin
- Antimony

A LOAEL benchmark for benzo(a)pyrene was substituted for a NOAEL benchmark for the red-tailed hawk. Most of the potential risk experienced by the red-tailed hawk resulted from di-n-butyl phthalate at the OB/OD. All other chemicals evaluated had HQs less than 1.

7.10 PREDICTED FUTURE CONDITIONS AND POTENTIAL RISK

Currently, the OB/OD site is being used as an ordnance disposal area with plans to continue to use the site as an ordnance disposal area. The current disturbed nature of the OB/OD site is unlikely to attract new populations of rare or protected species. Wildlife species that are tolerant of humans and disturbances will remain in the area and continue to use the OB/OD. It was assumed that, regardless of the future of the OB/OD site, the existing representative wildlife species, which include benthic invertebrates, aquatic invertebrates, soil invertebrates, aquatic and terrestrial plants, fish, short-tailed shrew, white-footed mouse, meadow vole, eastern cottontail rabbit, red fox, raccoon, white-tailed deer, American robin, and red-tailed hawk, would continue to occupy the OB/OD site and continue to come into contact with COPECs through various daily activities.

7.11 UNCERTAINTIES

When evaluating the ecological risks, several inherent uncertainties exist. These uncertainties pertain to all aspects of the risk analysis. To evaluate the potential ecological risk, several assumptions must be made. Uncertainties associated with this ecological evaluation are presented in the following assumptions.

- The samples collected adequately cover all areas of concern and accurately represent what is occurring at the OB/OD.
- All ecological receptors, including plants and wildlife, are present at the OB/OD.
- All chemicals are identified.
- Reported chemical concentrations are accurate.
- Chemicals identified are 100 percent biologically available, co-located, and do not interact in an antagonistic manner.
- Relevant exposure pathways have been identified.
- Species are consistently exposed to the maximum concentrations of COPECs at the OB/OD.
- Species exposure values under laboratory conditions are applicable to natural conditions.
- Wildlife exposure values are applicable to species of similar size and life history.
- Ingestion rates for representative species are accurate.
- The sizes of home ranges for representative species are comparable to what occurs in the field.
- Uptake modeling is representative of actual events that occur in the field.
- The OB/OD is inhabited by the plant and wildlife receptor species for at least some portion of their lives and that use is a reflection of the percentage of the species range composed by the area.
- Groundwater was not part of a completed pathway and animals that inhabit the OB/OD would not be exposed to site-related constituents through direct contact and/or ingestion of groundwater.
- Percentage of soil, surface water, sediment, and food ingested by ecological receptors is related to the percentage of time receptors spend within the OB/OD.

These uncertainties may combine to over-estimate risks for some compounds, but may potentially underestimate risk for others. The potential risk to aquatic species and the raccoon (resulting from consumption of fish and benthic organisms) may be overestimated because the two streams on the OB/OD are ephemeral and only likely contain water after precipitation events. Similarly, the ephemeral nature of the two streams likely overestimate risk to all wildlife species that consume surface water at the OB/OD.

This risk characterization relies on many assumptions to calculate risk. While the current data consists of surface soil samples, subsurface soil samples, surface water samples, and sediment samples, no biological (plant or animal) tissue samples were collected or analyzed. Similarly, no reference soil, surface water, and sediment samples were collected or analyzed that could be used to evaluate potential risk to plant and wildlife species from neighboring areas and background conditions.

An additional source of uncertainty results from the wildlife toxicity benchmarks, which are often extrapolated from laboratory or domesticated species rather than the receptor species of concern. For example, the use of NOAEL-based benchmarks developed for captive ringed doves, Japanese pheasants, rats, mice, or chickens may not reflect actual effects on short-tailed shrews, white-footed mice, meadow voles, eastern cottontail rabbits, red fox, raccoons, white-tailed deer, American robins, and red-tailed hawks. As can be seen from Table 7-24, a significant proportion of the COPECs were lacking wildlife benchmarks and could not be evaluated.

The uncertainties associated with the NOAEL-based benchmarks and HQs are not necessarily reflective of chemical mixtures. Chemical speciation is normally assumed to be in the most toxic form, increasing the chance for overestimation of adverse effects. Although an additive approach of HQs was assumed for this ecological risk assessment, there is very limited information on the toxicity of simultaneous exposure to mixtures of contaminants. This uncertainty would affect the EHIs.

Lastly, this risk assessment does not take into account any exposure of the receptor species to contaminants that might occur adjacent to the OB/OD or in background conditions. Wide-ranging receptor species, such as red fox, raccoons, white-tailed deer, and red-tailed hawks, may be visiting other contaminated areas. Species may roam on and off the OB/OD, home range boundaries may change over time, and seasonal migrations occur. These exposure scenarios are also not taken into account in this risk assessment.

7.12 SUMMARY

The OB/OD site was evaluated both qualitatively and quantitatively to assess risk to ecological receptors. Ecological surveys were conducted on December 15, 2011 at the OB/OD to identify any wildlife or potential habitat affected by site-related constituents. The entire OB/OD site was evaluated for the presence of completed ecological exposure pathways. Based on the site visit, it was concluded that flora and fauna could be exposed to site-related constituents through direct contact and/or ingestion of soil, surface water, and sediments and that area fauna could be exposed through the bioaccumulation of site-related constituents in benthic invertebrates, aquatic and terrestrial invertebrates, aquatic and terrestrial plants, small mammal prey, and fish.

The results of the qualitative assessment of the OB/OD concluded that, no significant effects were observed during the December 15, 2011, site visit. The OB/OD was occupied by a variety of common plant and animal species tolerant of human disturbances. Fish and crayfish were observed in a pool along an ephemeral stream located downstream of the OB/OD. Areas devoid of vegetation or stressed vegetation were not observed during the site visit.

Based on the results of the quantitative evaluations to assess risk to ecological receptors, ecological receptors exposed to soils experienced the most potential risk and ecological receptors exposed to surface water experienced the least amount of potential risk (Table 7-25). The American robin, which is an omnivore consuming soil invertebrates (earthworms), vegetation, and some surface soils from the OB/OD, experienced the greatest potential risk of all the terrestrial wildlife species (EHI 1.0E+05). The eastern cottontail rabbit, which was assumed to feed exclusively on plants from the OB/OD, had relatively high rates of surface soil ingestion and experienced the second greatest potential risk of any mammalian species evaluated (EHI 1.7E+02). Among the terrestrial wildlife species, the species that have large home ranges, the red fox (EHI 1.2E+01), raccoon (EHI 3.3E+00), white-tailed deer (EHI 1.5E+01), and red-tailed hawk (EHI 6.9E+00), experienced the least potential risk. Among invertebrates, aquatic invertebrates (EHI 2.8+01) experienced the greatest potential risk but this could be due to fewer toxicity benchmarks for the COPECs detected in sediments than for the COPECs detected in surface water. Soil invertebrates (earthworms; EHI 4.5E+00) experienced the least amount of potential risk. Plants exposed to soils at the OB/OD experienced a greater amount of potential risk from the surface soils (EHI of 3.0E+02) than subsurface soils (EHI of 2.8E+02). Fish experienced the least amount of potential risk (EHI of 1.8E+00).

* * * * *

8.0 SUMMARY AND CONCLUSIONS

8.1 SUMMARY

8.1.1 Nature and Extent of Contamination

Surface and subsurface soil, sediment, surface water and groundwater samples were collected from the OB/OD during RI field activities and analyzed for VOCs, SVOCs, perchlorate, explosives, and metals. The results of the analyses were compared to appropriate industrial screening levels. Nature and extent of contaminants at the OB/OD can be summarized by the following statements:

- VOCs – TCE and PCA are the most common VOC exceedances. Exceedances for these two VOCs are concentrated in the area of the metal debris pits for the surface and subsurface soil media (see Figures 4-2, 4-3, and 4-7) and down gradient of these pits for the groundwater and surface water, where the groundwater discharges to the surface water (see Figures 4-9 through 4-13).
- SVOCs – There were no exceedances of SVOCs in the surface or subsurface soil or in the sediment. In groundwater, bis(2-ethylhexyl)phthalate was sporadically detected and benzo(a)pyrene was detected once.
- Explosives – There were no exceedances of explosives in any of the media of concern.
- Perchlorate – There were no exceedances of perchlorate in any of the media of concern.
- Metals – There were no exceedances of metals in any of the media of concern.

8.1.2 Fate and Transport

The primary fate and transport mechanisms at the site are sorption and volatilization. Advection, and dispersion appear to be active at the site; however, they are affecting fate and transport of the COPCs at a lesser rate. Biodegradation appears to be minimal at the OB/OD.

Sorption plays a primary role in the fate and transport of constituent groups and COPCs that have a lower water solubility and a high K_{oc} value; both of which are indicators of COPC mobility. Based on chemical-specific data, VOCs are highly mobile and would move freely through the soil strata to groundwater. Given the prevalence of VOCs in the site matrices, volatilization is also likely a primary factor affecting fate and transport at the site in both the vadose zone and at the surface of the saturated zone.

As discussed, it is likely that advection and dispersion affect fate and transport of COPCs at the site with biodegradation playing only a minor role; however, their effect on the overall contaminant mass and movement are minimal compared to sorption and volatilization.

8.1.3 Contaminant Release and Transport Model

Based on investigation data, the primary chlorinated solvent source appears to be located in the vicinity of the metal debris pits located in the north central portion of the site. Within this area, soil results are the highest in the eastern portion of the metal debris pits near the area with a metallic signature. VOCs are present within both the surface and subsurface soil in this area. VOC results for soil samples directly down gradient of this area are higher for the deeper soils near the bedrock interface.

Groundwater within this area is primarily recharged through precipitation. Precipitation is transported along the ground surface via overland flow and also migrates downward by infiltration and percolation through micro- and macro-fractures within the regoligth. Following infiltration and percolation, precipitation then moves downward by preferential and non-preferential pathways into the weathered bedrock mass through fractures and joints. As the infiltrated precipitation moves through the VOC-contaminated soil, the water dissolves and transports the VOCs. The VOCs-impacted fluids migrate downward into the uppermost groundwater surface located within the regolith and weathered bedrock at the OB/OD. Results from groundwater samples indicate that the VOCs are migrating down gradient within this aquifer and also downward into the lower aquifer in some locations.

During periods of heavier precipitation, wet weather seeps (including the spring) flow as the facture and joint network within the weathered bedrock mass reach maximum pore volume/fracture aperture capacities. This allows wet weather features like ephemeral streams, springs, and seeps to flow and weep. Samples collected from the seeps, spring, and the western ephemeral stream located down gradient of the soil source contain chlorinated VOCs as found in the soil and groundwater samples. This flow path along the top of more resistant units in the soil/weathered bedrock interface is also the probable source of the VOC detections within the deeper soils near the bedrock interface located down gradient of the metal debris pits.

8.1.4 Human Health Risk Evaluation

The potential for human health risk from exposure to COPCs at the site was evaluated for soil, sediment, surface water, and groundwater. Detected constituents in each medium that exceeded the screening process were retained as COPCs. Media evaluated in the risk assessment were shallow soil, subsurface soil, sediment, surface water, and groundwater.

The site is part of the Impact Area for weapons training at Fort Riley. Information regarding current and potential future land and water use was used to develop the exposure scenarios evaluated. Future land use will likely remain as ordnance disposal. Based on the current and potential future uses of the site, current site worker, future site worker, and current/future demolition worker scenarios were evaluated.

Current site workers were assumed to be potentially exposed to COPCs in shallow soil through incidental ingestion, dermal contact, and inhalation of dust and vapors in outdoor air; and in surface water through dermal contact and inhalation of vapors in outdoor air. Future site workers were assumed to be potentially exposed to COPCs in shallow soil through incidental ingestion, dermal contact, and inhalation of dust and vapors in outdoor air; in surface water through dermal contact and inhalation of vapors in outdoor air; and in groundwater through ingestion as a drinking water source. Future demolition workers were assumed to be potentially exposed to COPCs in shallow and subsurface soil through incidental ingestion, dermal contact, and inhalation of dust and vapors in outdoor air; in surface water through dermal contact and inhalation of vapors in outdoor air; and in groundwater through ingestion as a drinking water source and dermal contact with infiltrating groundwater in an excavation.

Hazard indices for each of the populations evaluated exceeded the USEPA level of concern for noncancer risk, which is a hazard index greater than one. The excess lifetime cancer risk value for the current/future demolition worker was within the USEPA 1E-04 to 1E-06 (one in 10,000 to one in a million) risk management range. The excess lifetime cancer risk values for the current site worker and future site worker were above the USEPA 1E-04 to 1E-06 (one in 10,000 to one in a million) risk management range.

Based on the noncancer and cancer risk levels calculated for the site, appropriate remedial alternatives should be developed and evaluated in the feasibility study.

8.1.5 Ecological Risk Assessment

The OB/OD was evaluated both qualitatively and quantitatively to assess risk to ecological receptors. Ecological surveys were conducted on December 15, 2011 at the OB/OD to identify any wildlife or potential habitat affected by site-related constituents. The entire OB/OD site was evaluated for the presence of completed ecological exposure pathways. Based on the site visit, it was concluded that flora and fauna could be exposed to site-related constituents through direct contact and/or ingestion of soil, surface water, and sediments and that area fauna could be exposed through the bioaccumulation of site-related constituents in benthic invertebrates, aquatic and terrestrial invertebrates, aquatic and terrestrial plants, small mammal prey, and fish.

The results of the qualitative assessment of the OB/OD concluded that, no significant effects were observed during the December 15, 2011, site visit. The OB/OD was occupied by a variety of common plant and animal species tolerant of human disturbances. Fish and crayfish were observed in a pool along an ephemeral stream located downstream of the OB/OD. Areas devoid of vegetation or stressed vegetation were not observed during the site visit.

Based on the results of the quantitative evaluations to assess risk to ecological receptors, ecological receptors exposed to soils experienced the most potential risk and ecological receptors exposed to surface water experienced the least amount of potential risk. The American robin, which is an omnivore consuming soil invertebrates (earthworms), vegetation, and some surface soils from the OB/OD, experienced the greatest potential risk of all the terrestrial wildlife species (EHI 1.0E+05). The eastern cottontail rabbit, which was assumed to feed exclusively on plants from the OB/OD, had relatively high rates of surface soil ingestion and experienced the second greatest potential risk of any mammalian species evaluated (EHI 1.7E+02). Among the terrestrial wildlife species, the species that have large home ranges, the red fox (EHI 1.2E+01), raccoon (EHI 3.3E+00), white-tailed deer (EHI 1.5E+01), and red-tailed hawk (EHI 6.9E+00), experienced the least potential risk. Among invertebrates, aquatic invertebrates (EHI 2.8+01) experienced the greatest potential risk but this could be due to fewer toxicity benchmarks for the COPECs detected in sediments than for the COPECs detected in surface water. Soil invertebrates (earthworms; EHI 4.5E+00) experienced the least amount of potential risk. Plants exposed to soils at the OB/OD experienced a greater amount of potential risk from the surface soils (EHI of 3.0E+02) than subsurface soils (EHI of 2.8E+02). Fish experienced the least amount of potential risk (EHI of 1.8E+00).

8.2 CONCLUSIONS

8.2.1 Data Limitations

Sufficient data was obtained to adequately characterize the OB/OD, evaluate nature and extent of contamination, determine fate and transport, construct an appropriate CSM, and calculate human health and ecological risk. Data obtained met goals for field and analytical completeness (BMcD, 2012b – 2012g, 2013b, and 2013c) and was determine to be usable overall.

8.2.2 Recommended Remedial Action Objectives

Based upon the data obtained and the BLRA Human Health Risk Evaluation, the following remedial action objectives are recommended:

Soil

- Prevent migration of contaminants that would result in groundwater contamination producing an excess cancer or noncancer risk.

Sediment

- No remedial action objectives are needed for sediment based on the results from analyzed data.

Groundwater

- Prevent ingestion of or direct contact with groundwater having a total excess cancer risk greater than the USEPA 1E-04 to 1E-06 risk management range.

- Prevent ingestion of groundwater having a HI greater than one.

- Prevent ingestion of groundwater with contaminants exceeding the USEPA MCLs.

Surface Water

- Prevent direct contact with surface water having a total excess cancer risk greater than the USEPA 1E-04 to 1E-06 risk management range.

Air

- Prevent inhalation of vapors from soil and groundwater or inhalation of vapors from groundwater use having a total excess cancer risk greater than the USEPA 1E-04 to 1E-06 risk management range.

- Prevent inhalation of vapors from soil and groundwater or inhalation of vapors from groundwater use having a HI greater than one.

* * * * *

(This page purposely left blank.)

9.0 REFERENCES

Archer, Allen W., and Martin, Sabine, 1999, *Analysis of Geological Stratigraphy, Structure, and Hydrology of the OB/OD Site, Fort Riley, Kansas,* June 1999.

Burns & McDonnell Engineering Co., Inc. (BMcD), 2003, *Quality Control Summary Report (QCSR) April 2003 Surface Water Sampling Event, OB/OD Site, Fort Riley, Kansas,* April 2003.

Beyer, W.N., E. Conner, and S. Gerould, 1994, Estimates of Soil Ingestion by Wildlife. J. Wildlife Management. 58:375-382.

Black & Veatch, 2007, *Fort Riley Master Plan*.

Buchanan and Buddemeier, 1993, *Kansas Groundwater*, Kansas Geological Survey Educational Series.

Delisle, J. M., C. C. Freeman, and D. L. Peterson, 2012, Vegetation Survey and Mapping of the Fort Riley Military Reservation, Kansas. Open-file Report No. 174. Kansas Biological Survey. Lawrence, KS. 78 pp.

Domenico, P.A. and F.W. Schwartz, 1990, *Physical and Chemical Hydrogeology,* John Wiley & Sons, Inc. 824 p3.

Dragun, James, 1988, *The Soil Chemistry of Hazardous Materials.* Hazardous Materials Control Research Institute, Chapter 6.

Efroymson, R.A., G.W. Suter II, B.E. Sample, and D.S. Jones, 1997a, *Preliminary Remediation Goals for Ecological Endpoints.* ES/ER/TM-162/R2. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Efroymson, R.A., M.E. Will, and G.W. Suter II, 1997b. *Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterophic Process: 1997 Revision.* ES/ER/TM-126/R3. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Efroymson, R.A., M.E. Will, G.W. Suter II, and A.C. Wooten, 1997c. *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision*. ES/ER/TM-85/R3. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Fader, S.W., 1974, *Ground Water in the Kansas River Valley, Junction City to Kansas City, Kansas,* State Geological Survey of Kansas, Bulletin 206, Part 2.

Farmer, W. J., et al., 1980, *Hexachlorobenzene: Its Vapor Pressure and Vapor Phase Diffusion in Soil*. Soil Science Society of America Journal. Vol. 44, pp.676-680.

Federal Register (FR), 1990, *Corrective Action for Solid Waste Management Units at Hazardous Waste Management Facilities, Proposed Rule*. Vol. 5, No. 145. 27 July.

First Weather Group, Detachment 8, Fort Riley MAAF, 1998, *Personal communication.*

Foster, S. A. and P. C. Chrostowski, 1986, *Integrated Household Exposure Model for use of Tap Water Contaminated with Volatile Organic Chemicals*, ICF-Clement, Arlington, Virginia, Presented at the 79th Annual Meeting of the Air Pollution Control Association, Minneapolis, MI, June 22-27.

Freeman, C. C. and J. M. Delisle, 2004, *Vegetation of the Fort Riley Military Reservation, Kansas. Open-file Report No. 119,* Kansas Biological Survey, Lawrence, Kansas, 110 pp.

Gas Research Institute (GRI), 1988, *Management of Manufactured Gas Plant Sites, Volume III: Risk Assessment*. GRI-87/0260.3.

Heath, R.C., 1984, *Basic Groundwater Hydrology*. USGS Water Supply Paper 2220.

High Plains Regional Climate Center, 2013, Webpage: www.hprcc.unl.edu , University of Nebraska – Lincoln.

Horton, R, M.L. Thompson, and J.F. McBride, 1988, *Determination of effective porosity of soil materials,* U.S. Environmental Protection Agency, Hazardous Waste Engineering Research Laboratory.

Jantz, D.R., R.F. Harmer, H.T. Rowland, and D.A. Gier, 1975, *Soil Survey of Riley County and Part of Geary County, Kansas,* U.S. Department of Agriculture, Soil Conservation Service.

Jewett, J.M., 1941, *The Geology of Riley and Geary Counties, Kansas*, State Geological Survey of Kansas, Bulletin 39.

Jones, D.M., G.W. Sutter II, and R.N. Hull, 1997, *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment-Associated Biota: 1997 Revision*. ES/ER/TM-95/R4, Oak Ridge National Laboratory, Oak Ridge Tennessee.

KDHE, October 2010, *Risk-Based Standards for Kansas, RSK Manual – 5th Version.*

Louis Berger & Associates (LBA), 1993, *Impact Area Site Assessment Report for Fort Riley, Kansas,* March 1993.

LBA, 1994, *Site Investigation Report for High Priority Sites at Fort Riley, Kansas,* November 1994

LBA, 1996a, *Data Summary Report for Confirmation Groundwater Sampling Multi-Sites, Fort Riley, Kansas*, June 1996.

LBA, 1996b, *Quality Control Summary Report (QCSR) Confirmation Groundwater Sampling at the Multi-Sites, Fort Riley, Kansas*, June 1996.

LBA, 1997a, *Technical Memorandum, Overview of Mobilization # 1, Preliminary Findings and Proposed Mobilization # 2 Activities, Open Burn/Open Detonation Area, Fort Riley, Kansas,* 1997.

LBA, 1997b, *Supplemental Technical Memorandum, Mobilization #2 Activities, Open Burn/Open Detonation Area, Fort Riley, Kansas,* 1997.

LBA, 1998a, *Technical Memorandum, Mobilization # 2 Activities, Open Burn/Open Detonation Area, Fort Riley, Kansas,* 1998.

LBA, 1999, *Data Summary Report For Groundwater Sampling and Groundwater Elevations at the Open Burn/Open Detonation Area, Fort Riley, Kansas,* June 1999.

The Louis Berger Group, Inc. (LBG) and ARCADIS/Malcolm Pirnie (MP), 2011, *Munitions and Explosives of Concern Avoidance Plan for Remedial Investigation/ Feasibility Study and Related*

Activities at the Open Burning/ Open Detonation Ground (OB/OD) (Range 16) – Operable Unit 006 at Fort Riley, Kansas.

LBG-BMcD, 2011a, *Remedial Investigation/Feasibility Study Work Plan for the Open Burning-Open Detonation Ground (Range 16) Operable Unit 006 at Fort Riley, Kansas*, November 2011.

LBG-BMcD, 2011b, *Installation-Wide Sampling and Analysis Plan (Including UFP-Quality Assurance Project Plan) for the Fort Riley CERCLA Process Support at Fort Riley, Kansas,* December 2011.

LBG-BMcD, 2011c, *Remedial Investigation/Feasibility Study Site-Specific Sampling and Analysis Plan (Including Site-Specific UFP-Quality Assurance Project Plan) for the Open Burning-Open Detonation Grounds (Range 16) Operable Unit 006 (OU 006) at Fort Riley, Kansas,* November 2011.

LBG/BMcD, 2012a*, Installation-Wide Accident Prevention Plan for Environmental Investigations at Fort Riley, Kansas*, January 2012.

LBG-BMcD, 2012b, *Quality Control Summary Report, Open Burning-Open Detonation Grounds (Range 16), Operable Unit 006 at Fort Riley, Kansas*, January 2012.

LBG-BMcD, 2012c, *Quality Control Summary Report, Remedial Investigation/Feasibility Study Phase One, Sediment and Soil Sampling at the Open Burning/Open Detonation Grounds (Range 16) Operable Unit 006 at Fort Riley, Kansas*, July 2012.

LBG-BMcD, 2012d, *Quality Control Summary Report, Remedial Investigation/Feasibility Study, Phase Two, Multi-Incremental Soil Sampling at the Open Burning-Open Detonation Grounds (Range 16) Operable Unit 006 at Fort Riley, Kansas*, March 2012.

LBG-BMcD, 2012e, *Quality Control Summary Report Remedial Investigation/Feasibility Study Phase Four, Quarterly Groundwater Sampling, Baseline Groundwater Sampling Event, at the Open Burning-Open Detonation Grounds (Range 16) Operable Unit 006 at Fort Riley, Kansas*, May 2012.

LBG-BMcD, 2012f, *Quality Control Summary Report, Remedial Investigation/Feasibility Study Phase Three, Quarterly Groundwater Sampling, Second Quarter Groundwater Sampling Event at the Open Burning/Open Detonation Grounds (Range 16) Operable Unit 006 at Fort Riley, Kansas*, August 2012.

LBG-BMcD, 2012g, *Quality Control Summary Report, Remedial Investigation/Feasibility Study Phase Three, Quarterly Groundwater Sampling, Third Quarter Groundwater Sampling Event at the Open Burning/Open Detonation Grounds (Range 16) Operable Unit 006 at Fort Riley, Kansas,* November 2012.

LBG-BMcD, 2013a, *Technical Memorandum Work Plan Addendum for the Direct-Push Soil Investigation at the Metal Debris Pits, Open Burning-Open Detonation Ground (Range 16), Operable Unit 006 at Fort Riley, Kansas.*

LBG-BMcD, 2013b, *Quality Control Summary Report, Remedial Investigation/Feasibility Study Phase Three, Quarterly Groundwater Sampling, Fourth Quarter Groundwater Sampling Event at the Open Burning/Open Detonation Grounds (Range 16) Operable Unit 006 at Fort Riley, Kansas,* February 2013.

LBG-BMcD, 2013c, - *Quality Control Summary Report, Metal Debris Pit Soil Confirmation Investigation, Open Burning/Open Detonation Grounds (Range 16) Operable Unit 006 at Fort Riley, Kansas*, March 2013.

Merriam, D.F., 1963, *The Geologic History of Kansas*, State Geological Survey of Kansas, Bulletin 162.

Millington, R.J., and Quirk, J.M., 1961, *Permeability of Porous Solids*, Transactions of the Faraday Society, Vol. 57, pp.1200-1207.

MP-BMcD, 2004, *QCSR April 2004 Sampling Event, Open Burning/Open Detonation (Range 16), Fort Riley, Kansas*, June 2004.

MP-BMcD, 2007-2010, *Data Summary Reports for Groundwater, Spring, and Seep Sampling for Open Burning/Open Detonation Ground (Range 16) at Fort Riley, Kansas*.

National Climatic Data Center (NCDC), 2008, *Climatic Wind Data for the United States*, http://lwf.ncdc.noaa.gov/oa/climate/online/ccd/avgwind.html.

Oak Ridge National Laboratory (ORNL), 1996a, *Toxicological Benchmarks for Wildlife: 1996 Revision*. ES/ER/TM-86/R3, June.

ORNL, 1996b, *Toxicological Benchmark Screening for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision*. ES/ER/TM-96/R2. June.

Schwartz, C.W. and E. R. Schwartz, 1981, *The Wild Mammals of Missouri: Revised Edition*. University of Missouri Press, Columbia, Missouri.

Schoewe, W.H., 1949, *The Geography of Kansas, Pt. 2 Physical Geography*, Kansas Acad. Sci. Trans., v. 52, no. 3, pg. 261-333.

Sutter, G.W. and C.L. Tsao, 1996, *Toxicological Benchmarks for Screening of Potential Contaminants of Concern for Effects on Aquatic Biota on Oak Ridge Reservation: 1996 Revision.* ES/ER/TM-96/R2. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

United States Department of Commerce, 2010, Census 2010.

United States Environmental Protection Agency (USEPA), 1988, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA,* EPA/540/G-89/004.

USEPA, 1989, *Risk Assessment Guidance for Superfund (RAGS) Volume I: Human Health Evaluation Manual (Part A)*. EPA/540/1-89/002.

USEPA, 1991, *Supplemental Guidance, Standard Default Exposure Factors*. OSWER Directive 99235.6-303.

USEPA, 1992a, *Framework for Ecological Risk Assessment*, EPA/630/R-92/001, February.

USEPA, 1992b, *Guidance on Data Usability in Risk Assessment* (Part A), 9285.7-09A, April.

USEPA, 1993, *Wildlife Exposure Factors Handbook: Volume I & II.* EPA/600/R-93/187a, December.

USEPA, 1994, *Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities*. Office of Solid Waste and Emergency Response. OSWER Directive # 9355.4-12.

USEPA, 1995, *Land Use in the CERCLA Remedy Selection Process Memorandum*, Office of Emergency and Remedial Response. OSWER Directive 9355.7-04.

USEPA, 1996, *Soil Screening Guidance: Technical Background Document*. EPA/540/R-96/018. April.

USEPA, 1997a, *Exposure Factors Handbook*, Office of Research and Development, EPA/600/P-95/002F. August.

USEPA, 1997b, *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments*, EPA/540/R-97/006, June.

USEPA, 1998a, *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater*. EPA/600/R-98/128.

USEPA, 1998b, *Guidelines for Ecological Risk Assessment*. EPA/630/R-95/002F.

USEPA, 1999, *Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities*, EPA 530-D-99-001A, August.

USEPA, 2002, *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites*. Office of Solid Waste and Emergency Response, OSWER 9355.4-24. December.

USEPA, 2003, *Memorandum on Human Health Toxicity Values in Superfund Risk Assessments*. Office of Solid Waste and Emergency Response, OSWER 9285.7-53. December.

USEPA, 2004, *Risk Assessment Guidance for Superfund (RAGS) Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final*. Office of Emergency and Remedial Response. EPA/540/R/99/005. July.

USEPA, 2005, *User's Guide for Evaluating Subsurface Vapor Intrusion Into Buildings*. Office of Emergency and Remedial Response. February.

USEPA, 2009, *Risk Assessment Guidance for Superfund (RAGS) Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final*. Office of Superfund Remediation and Technology Innovation. EPA-540-R-070-002. January.

USEPA, 2010, *ProUCL Version 4.1.00 Technical Guide (Draft)*. Office of Research and Development. EPA/600/R-07/041. May.

USEPA, 2012, *Regional Screening Level (RSL) Table November 2012*.

USEPA, 2013, *Integrated Risk Information System (IRIS)*.

Zeller, Doris, 1994, *The Stratigraphic Succession of Kansas*, University of Kansas Publications, Bulletin 189, 1968, revised 1994 by Baars, D.L.

* * * * *

(This page purposely left blank.)

TABLES

Table 1-1
Chronology of Environmental Investigations
OB/OD RI Report
Fort Riley, Kansas

Date	Activity	Reports/References
Fall 1993	Collection of surface soils samples from burning and detonation pits. Collection of soil samples from subsurface borings, sediment samples, and surface water samples from ephemeral streams. Installation, development, and sampling of Monitoring Wells OB-93-01 through OB-93-04.	*Site Investigation Report for High Priority Sites*, (LBA, 1994)
December 1995	Confirmation sampling of Monitoring Wells OB-93-01 through OB-93-04.	*DSR and QCSR for Confirmation Groundwater Sampling Multi-Sites*, (LBA, 1996)
March/April 1997	Installation of Monitoring Wells OB-97-05 through OB-97-08. Sampling of Monitoring Wells OB-97-05 through OB-97-08, hand dug well, and Spring 1.	*Technical Memorandum, Overview of Mobilization #1, Preliminary Findings and Proposes Mobilization #2 Activities, Open Burn/Open Detonation Area, Fort Riley, Kansas* (LBA, 1997a)
June 1997	Collection of sample from the spring and hand dug well. Installation of nested piezometers OB-97-09PZ through OB-97-13PZ.	*Supplemental Technical Memorandum, Mobilization #2 Activities, Open Burn/Open Detonation Area, Fort Riley, Kansas* (LBA, 1998a)
September 1997	Collection of groundwater samples from Monitoring Wells OB-93-01 through OB-97-08, Piezometers OB-97-09PZ through OB-97-13PZ, and a hand dug well. Collection of surface water samples. Installation of Monitoring Well OBHD-97-14 at the hand dug well location.	*DSR for Groundwater Sampling and Groundwater Elevations at the Open Burn/Open Detonation Area*, (LBA, 1999)
December 1997	Collection of groundwater samples from Monitoring Wells OB-93-01 through OB-97-08 and a hand dug well. Collection of two surface water samples. Collection of sample from Spring 1.	*DSR for Groundwater Sampling and Groundwater Elevations at the Open Burn/Open Detonation Area*, (LBA, 1999)
April 1998	Collection of groundwater samples from Monitoring Wells OB-93-01 through OBHD-97-14. Collection of five surface water samples. Collection of sample from Spring 1 and Spring 2.	*DSR for Groundwater Sampling and Groundwater Elevations at the Open Burn/Open Detonation Area*, (LBA, 1999)
August 1998	Collection of groundwater samples from Monitoring Wells OB-93-01 through OBHD-97-14. Collection of five surface water samples.	*DSR for Groundwater Sampling and Groundwater Elevations at the Open Burn/Open Detonation Area*, (LBA, 1999)

Table 1-1
Chronology of Environmental Investigations
OB/OD RI Report
Fort Riley, Kansas

Date	Activity	Reports/References
January 1999	Collection of groundwater samples from Monitoring Wells OB-93-01 through OBHD-97-14. Collection of four surface water samples. Collection of sample from Spring 1.	*DSR for Groundwater Sampling and Groundwater Elevations at the Open Burn/Open Detonation Area*, (LBA, 1999)
June 1999	Site analysis regarding geology, stratigraphy, structure, and hydrology of the OB/OD Area.	*Analysis of Geological Stratigraphy, Structure, and Hydrology of the OB/OD Site, Fort Riley, Kansas*, (Archer and Martin, 1999)
April 2003	Collection of surface water sample.	*QCSR April 2003 Surface Water Sampling Event, OB/OD Site, Fort Riley, Kansas*, (BMcD, 2003b)
March 2004	Collection of surface water sample.	*QCSR March 2004 Surface Water Sampling Event, OB/OD Site, Fort Riley, Kansas*, (MP-BMcD, 2004f)
April 2004	Collection of groundwater samples from Monitoring Wells OB-93-01 through OBHD-97-14, Piezometers OB-97-09PZ(0), OB-97-10PZ(1) through (3), OB-97-11PZ(0) and (1), OB-97-12PZ(1) and (3), OB-97-13PZ(0) through (3). Collection of samples from Spring 1, Surface 1, Seep 1, and Seep 2.	*QCSR April 2004 Sampling Event, OB/OD Site, Fort Riley, Kansas*, (MP-BMcD, 2004g)
2007-2010	Collection of groundwater samples from Monitoring Wells OB-93-01 through OBHD-97-14, Piezometers OB-97-09PZ(0), OB-97-10PZ(1) through (3), OB-97-11PZ(0) and (1), OB-97-12PZ(1) and (3), OB-97-13PZ(0) through (3). Collection of samples from Spring 1, Surface 1, Seep 1, and Seep 2.	*Data Summary Reports For Ground Water, Spring, and Seep Sampling, Fort Riley, Kansas*, (MP-BMcD, 2007-2011)
2011-2013	Collection of soil, dry sediment, and surface water samples, installation of six monitoring wells, abandonment of piezometers, and four rounds of quarterly sampling of sixteen monitoring wells	Results to be included in upcoming RI Report, 2013.

DSR = Data Summary Report
BMcD = Burns & McDonnell
LBA = Louis Berger & Associates
OB = Open Burning
OD = Open Detonation
PZ = Piezometer
QCSR = Quality Control Summary Report

Table 2-1
Summary of Direct-Push Groundwater Field Activities
OB/OD RI Report
Fort Riley, Kansas

Boring Number	Survey Data Northing (feet)	Survey Data Easting (feet)	Survey Data Elevation (feet amsl)	Total Depth (feet)	Date Pushed	Temporary Piezometer	Date Sampled	Water Level (feet bgs)
GW-01	296851.72	1662430.26	1151.89	12	12/6/2011	Yes	Dry	12.18
GW-02	296725.02	1662379.08	1149.31	12	12/6/2011	Yes	Dry	NA
GW-03*				NA	NA	NA	NA	NA
GW-04	296359.57	1662541.96	1148.29	NA[1]	12/6/2011	Yes	Dry	NA
GW-05*				NA	NA	NA	NA	NA
GW-06	296869.5	1662556.79	1152.88	14	12/5/2011	Yes	Dry	NA
GW-07	296745.02	1662565.98	1149.07	14	12/5/2011	Yes	12/6/2011	12.1
GW-08	296669.07	1662571.26	1152.08	19	12/5/2011	Yes	12/6/2011	14.2
GW-09	296526.58	1662629.97	1150.27	16	12/5/2012	Yes	12/5/2011	14.7
GW-10	296225.43	1662732.27	1147.07	18.5	11/29/2011	Yes	11/30/2011	18.4
GW-11	296035.44	1662779	1145.29	22	40882	Yes	12/5/2011	13.5
GW-12	295804.11	1662826.04	1144.92	22	12/5/2011	Yes	12/5/2011	13
GW-13	295483.62	1662928.74	1142.56	24	12/5/2011	Yes	12/5/2011	19.5
GW-14	NA[3]	NA[3]	NA[3]	22	12/5/2011	Yes	12/5/2011	18.56
GW-15	297132.31	1662881.95	1170.24	18.5	12/2/2011	Yes	Dry	NA
GW-16	297037.84	1662851.22	1165.67	24.5	12/2/2011	Yes	Dry	NA
GW-17	296846.66	1662828.93	1159.23	18.2	40879	Yes	Dry	NA
GW-18	296673.64	1662798.85	1153.95	22.8	11/30/2011	Yes	12/1/2011	15.5
GW-19	296545.03	1662832.12	1151.58	22.3	11/30/2011	Yes	12/1/2011	13.61
GW-20	NA[3]	NA[3]	NA[3]	20.7	11/30/2011	Yes	12/1/2011	13.14
GW-21	296150.01	1662897.27	1147.33	20.5	11/29/2011	Yes	11/29/2011	19.1
GW-22	295900.96	1662966.65	1144.36	19	12/5/2011	Yes	12/5/2011	13.2
GW-23	295707.18	1663024.46	1142.18	20	40882	Yes	12/5/2011	14.6
GW-24	295474.44	1663080.6	1139.93	20	12/5/2011	Yes	12/6/2011	18.24
GW-25	297063.8	1663051.36	1171.44	8	11/30/2011	Yes	Dry	NA
GW-26	296909.37	1662999.38	1162.9	25	11/30/2011	Yes	12/2/2011	21.45
GW-27	296802.4	1663009.16	1159.16	18	11/30/2011	Yes	Dry	NA
GW-28	NA[3]	NA[3]	NA[3]	15.5	11/30/2011	Yes	11/30/2011	12.1
GW-29	NA[3]	NA[3]	NA[3]	16	40878	Yes	12/2/2011	12.5
GW-30	296450.34	1663084.16	1152.59	18	12/1/2011	Yes	12/2/2011	13.95
GW-31	296337.75	1663083.98	1150.26	20	12/1/2011	Yes	12/2/2011	13.02
GW-32	296083.44	1663135.19	1148.01	8.5	12/1/2011	Yes	12/2/2011	5.25
GW-33	295830.81	1663250.85	1147.08	21	12/1/2011	Yes	12/1/2011	16.40
GW-34	295658.5	1663274.29	1142.88	21	12/1/2011	Yes	12/2/2011	19.31
GW-35	297186.81	1663184.85	1190.71	6	40876	Yes	Dry	NA
GW-36	296952.71	1663186.54	1171.32	3.5	11/29/2011	Yes	Dry	NA
GW-37	296713.05	1663236.59	1161.66	18.3	11/29/2011	Yes	Dry	NA
GW-38	296428.76	1663270.05	1159.78	14	11/29/2011	Yes	Dry	NA
GW-39	296240.12	1663333.94	1162.07	12.8	11/29/2011	Yes	Dry	NA
GW-40	295989.21	1663378.39	1154.4	6.3	11/29/2011	Yes	Dry	NA
GW-41	295749.14	1663446.55	1146.78	20.3	40876	Yes	11/30/2011	12.5
GW-42	296639.86	1663150.7	1157.07	18.5	12/1/2011	Yes	12/2/2011	16.1
GW-43	296824.36	1662916.22	1159.47	19	12/6/2011	Yes	Dry	NA
GW-44	296978.8	1663096.17	1168.15	3	12/6/2011	No	Dry	NA
GW-45	296960.46	1663038.43	1165.81	18.5	12/6/2011	Yes	12/6/2011	17.8
GW-46	295921.68	1662721.37	1142.86	5.5	12/6/2011	Yes	Dry	NA

* Not installed due to topgraphy
NA = Not Available
NA[1] = Total depth for GW-04 not documented.
NA[3] = Not Available, placed on figures with field measurements.

Table 2-2
Monitoring Well Construction Summary
OB/OD RI Report
Fort Riley, Kansas

Well Number	Date Installed	Location		Elevation GS (feet amsl)	Elevation TOC (feet amsl)	Total Depth from TOC	Elevation Top of Screen (feet amsl)	Screen Length (feet)	Formation(s) Screened	Aquifer Screened
		Northing (feet)	Easting (feet)							
OB-93-01	9/28/1993	297022.41	1663859.97	1181.12	1182.79	42.14	1155.62	15	Wymore, Schroyer (Limestone/Shale)	Weathered Bedrock
OB-93-02	9/29/1993	297462.29	1663670.38	1207.57	1209.19	73.88	1150.87	15	Wymore, Schroyer, Havensville (Limestone/Shale)	Weathered Bedrock
OB-93-03	9/28/1993	296896.54	1663421.98	1171.98	1173.91	79.3	1110.28	15	Havensville, Threemile, Speiser (Limestone/Shale)	Lower Bedrock
OB-93-04	10/1/1993	296607.81	1663159.69	1157.47	1159.22	58.27	1115.77	15	Havensville, Threemile, Speiser (Limestone/Shale)	Lower Bedrock
OB-97-05	3/30/1997	29146.99	1663070.96	1177.53	1179.26	71.94	1115.53	9.5	Threemile (Limestone/Shale)	Lower Bedrock
OB-97-06	3/23/1997	296906.75	1663420.58	1172.59	1174.45	38.53	1146.09	9.5	Threemile, Speiser (Limestone/Shale)	Weathered Bedrock
OB-97-07	3/23/1997	296617.84	1663161.62	1157.89	1159.5	31.99	1137.89	9.5	Schroyer, Havensville (Limestone/Shale)	Weathered Bedrock
OB-97-08	3/24/1997	296756.73	1662947.5	1157.35	1159.22	20.4	1149.35	9.5	Regolith	Regolith
OBHD-97-14	12/2/1997	296821.99	1662792.09	1152.81	1155.83	21.65	1139.26	5	Regolith	Regolith
OB-05-15	8/17/2005	296120.55	1662834.13	1146.94	1149.87	20.5	1136.44	10	Regolith	Regolith
OB-12-15D	2/25/2012	296118.05	1662824.02	1146.59	1149.03	35.25	1119.34	8	Havensville, Threemile (Limestone/Shale)	Weathered Bedrock
OB-12-16	2/10/2012	295487.46	1662941.59	1142.27	1145.25	24.35	1127.92	10	Regolith	Regolith
OB-12-17	2/8/2012	296568.48	1662751.13	1152.26	1154.69	20.35	1139.92	8	Regolith	Regolith
OB-12-18	2/7/2012	296912.08	1663002.25	1163.19	1165.64	27.1	1146.09	10	Regolith	Regolith
OB-12-19D	2/20/2012	294132.64	1663526.91	1153.86	1156.41	49.43	1109.43	5	Threemile (Limestone/Shale)	Lower Bedrock
OB-12-20D	2/26/2012	295751.68	1663073.74	1142.77	1145.2	31.27	1116.5	5	Havensville, Threemile (Limestone/Shale)	Lower Bedrock

GS - Ground Surface
TOC - Top of Casing
amsl - Above mean sea level

Table 3-1
Quarterly Groundwater Elevations
OB/OD RI Report
Fort Riley, Kansas

Well ID	TOC Elevation (ft amsl)	Depth to Water (TOC) Mar-2012 (ft)	Depth to Water (TOC) June-2012 (ft)	Depth to Water (TOC) Sep-2012 (ft)	Depth to Water (TOC) Dec-2012 (ft)	WL Elevation Mar-2012 (ft amsl)	WL Elevation June-2012 (ft amsl)	WL Elevation Sep-2012 (ft amsl)	WL Elevation Dec-2012 (ft amsl)
OB-93-01*	1182.79	34.87	35.16	36.52	36.68	1147.92	1147.63	1146.27	1146.11
OB-93-02*	1209.19	61.33	61.54	62.03	62.40	1147.86	1147.65	1147.16	1146.79
OB-93-03	1173.91	52.66	53.23	54.45	54.38	1121.25	1120.68	1119.46	1119.53
OB-93-04	1159.22	37.06	38.34	40.04	39.87	1122.16	1120.88	1119.18	1119.35
OB-97-05	1179.26	58.01	58.57	59.85	59.84	1121.25	1120.69	1119.41	1119.42
OB-97-06*	1174.45	26.50	26.78	28.53	29.70	1147.95	1147.67	1145.92	1144.75
OB-97-07*	1159.5	15.05	15.70	16.33	16.72	1144.45	1143.80	1143.17	1142.78
OB-97-08*	1159.22	16.35	BTOP	18.82	19.30	1142.87	NA	1140.40	1139.92
OBHD-97-14*	1155.83	13.79	16.43	17.15	17.25	1142.04	1139.40	1138.68	1138.58
OB-05-15*	1149.87	10.18	14.67	18.61	17.91	1139.69	1135.20	1131.26	1131.96
OB-12-15D*	1149.03	10.45	14.38	18.24	17.83	1138.58	1134.65	1130.79	1131.20
OB-12-16*	1145.25	11.83	19.10	21.84	21.65	1133.42	1126.15	1123.41	1123.60
OB-12-17*	1154.69	13.32	16.11	18.05	17.85	1141.37	1138.58	1136.64	1136.84
OB-12-18*	1165.64	22.42	23.98	24.39	24.52	1143.22	1141.66	1141.25	1141.12
OB-12-19D	1156.41	39.80	39.22	39.71	39.81	1116.61	1117.19	1116.70	1116.60
OB-12-20D	1145.20	22.32	24.19	26.13	25.89	1122.88	1121.01	1119.07	1119.31

Notes:
TOC - Top of Casing
ft - feet
(ft amsl) - Feet Above Mean Sea Level
WL - Water Level
NA - Not Available
BTOP - Below Top of Pump
* Used in calculating piezometric elevation contours

Table 3-2
Listed and Rare Species Occuring and Potentially Occuring in the Fort Riley Area
OB/OD RI Report
Fort Riley, Kansas

Common Name	Scientific Name	Federal Status	State Status	Known to Occur in Geary County	Known to Occur in Riley County
American Burying Beetle	*Nicrophorus americanus*	E	E	Yes	Yes
Black Rail	*Laterallus jamaicensis*	None	SINC	No	Yes
Black Tern	*Chlidonias niger*	None	SINC	Yes	Yes
Bobolink	*Dolichonyx oryzivorus*	None	SINC	No	Yes
Common Shiner	*Luxilus cornutus*	None	SINC	Yes	No
Eastern Hognose Snake	*Heterodon platirhinos*	None	SINC	Yes	Yes
Eastern Spotted Skunk	*Spilogale putorius*	None	T	Yes	Yes
Eskimo Cerlew	*Numenius borealis*	E	E	Yes	Yes
Franklin's Ground Squirrel	*Spermophilus franklinii*	None	SINC	No	Yes
Golden Eagle	*Aquila chrysaetos*	None	SINC	Yes	Yes
Henslow's Sparrow	*Ammodramus henslowii*	None	SINC	Yes	Yes
Highfin Carpsucker	*Carpiodes velifer*	None	SINC	No	Yes
Least Tern	*Sterna antillarum*	E	E	Yes-Critical Habitat Designated[1]	Yes-Critical Habitat Designated[1]
Long-billed Curlew	*Numenius americanus*	None	SINC	No	Yes
Piping Plover	*Charadrius melodus*	T	T	Yes-Critical Habitat Designated[1]	Yes-Critical Habitat Designated[1]
Plains Minnow	*Hybognathus placitus*	None	T	Yes-Temporary Critical Habitat Designated[2]	Yes-Temporary Critical Habitat Designated[2]
Shoal Chub	*Macrhybopsis histoma*	None	T	Yes-Temporary Critical Habitat Designated[3]	No
Short-Eared Owl	*Asio flammeus*	None	SINC	Yes	Yes
Silver Chub	*Macrhybopsis storeriana*	None	E	Yes-Critical Habitat Designated[4]	Yes
Snowy Plover	*Charadrius alexandrinus*	None	T	Yes	Yes
Southern Bog Lemming	*Synaptomys copperi*	None	SINC	No	Yes
Sturgeon Chub	*Macrhybopsis gelida*	None	T	Yes-Critical Habitat Designated[5]	Yes-Critical Habitat Designated[5]
Timber Rattlesnake	*Crotalus horridus*	None	SINC	Yes	Yes
Topeka Shiner	*Notropis topeka*	E	T	Yes-Critical Habitat Designated[6]	Yes-Critical Habitat Designated[6]
Western Hognosed Snake	*Heterodon nasicus*	None	SINC	Yes	Yes
Whip-Poor-Will	*Caprimulgus vociferus*	None	SINC	Yes	Yes
Whooping Crane	*Grus americana*	E	E	No	Yes
Yellow-throated Warbler	*Dendroica dominica*	None	SINC	No	Yes

Notes:

[1] All the waters within a corridor along the main stem of the Kansas River from the confluence of the Republican River and Smoky Hill River on Fort Riley in Geary County to the confluence of the Missouri River in Kansas City, Wyandotte County.

[2] The Kansas River in Geary and Riley Counties.

[3] The Kansas River in Geary County.

[4] The Kansas River from the confluence of the Republican and Smoky Hill Rivers to the Missouri River (Section 1 & 2, Township 11 South, Range 25 East).

[5] The main stem of the Kansas River from its start at the confluence of the Republican River and Smoky Hill River on Fort Riley in Geary County to the confluence of the Missouri River in Kansas City, Wyandotte County.

[6] Cary Creek and its tributaries in Dickinson County from where it crosses the Dickinson/Geary County line (Sec. 6, T14S, R5E) upstream to its headwaters (Sec. 33, T15S, R3E); Thomas Creek and Dry Creek in Geary County; Little Arkansas Creek and Seven-mile Creek in Riley County; Deep Creek main stem in Riley County from where it crosses the Riley/Wabaunsee County line (Sec. 22, T10S, R9E) upstream to Interstate Highway 70 (Sec. 25, T11S, R9E).

E = Endangered SINC = Species in Need of Conservation T = Threatened

Table 4-1
Screening Levels Used and Sources
OB/OD RI Report
Fort Riley, Kansas

Groundwater and/or Surface Water[1]			
Detected Parameter	**Units**	**Screening Level**	**Source[3]**
Volatile Organic Compounds			
1,1,1,2-Tetrachloroethane	µg/L	9.91	RSK
1,1,2,2-Tetrachloroethane	µg/L	1.28	RSK
1,2,3-Trichlorobenzene	µg/L	5.2	RSL
1,2,4-Trichlorobenzene	µg/L	70	MCL
1,2,4-Trimethylbenzene	µg/L	17.4	RSK
1,2-Dichloroethene, Total	µg/L	NA	--
2-Butanone (MEK)	µg/L	11,800	RSK
2-Hexanone	µg/L	34	RSL
4-Methyl-2-pentanone (MIBK)	µg/L	4,170	RSK
Acetone	µg/L	45,500	RSK
Benzene	µg/L	5	MCL
Bromoform	µg/L	80	MCL
Carbon disulfide	µg/L	1,660	RSK
cis-1,2-Dichloroethene	µg/L	70	MCL
Dibromochloromethane	µg/L	80	MCL
Ethylbenzene	µg/L	700	MCL
m-Xylene & p-Xylene	µg/L	190	RSL
Naphthalene	µg/L	2.11	RSK
n-Propylbenzene	µg/L	1,910	RSK
o-Xylene	µg/L	190	RSL
Tetrachloroethene	µg/L	5	MCL
Toluene	µg/L	1,000	MCL
trans-1,2-Dichloroethene	µg/L	100	MCL
Trichloroethene	µg/L	5	MCL
Semi-volatile Organic Compounds			
Benzo(a)pyrene	µg/L	0.2	MCL
Benzo(ghi)perylene	µg/L	NA	--
Bis(2-ethylhexyl)phthalate	µg/L	6	MCL
Perchlorate			
Perchlorate	µg/L	70.9	RSK
Explosives			
2,4-Dinitrotoluene	µg/L	8.98	RSK
4-Amino-2,6-dinitrotoluene	µg/L	30	RSL
HMX	µg/L	5,110	RSK
Nitroglycerin	µg/L	1.5	RSL
RDX	µg/L	25.9	RSK
Tetryl	µg/L	407	RSK
Metals			
Antimony	µg/L	6	MCL
Arsenic	µg/L	10	MCL
Beryllium	µg/L	4	MCL
Cadmium	µg/L	5	MCL
Chromium	µg/L	100	MCL
Copper	µg/L	1,300	MCL
Lead	µg/L	15	MCL
Mercury	mg/L	0.002	MCL
Nickel	µg/L	2,040	RSK
Selenium	µg/L	50	MCL
Silver	µg/L	508	RSK
Zinc	µg/L	30,500	RSK
Groundwater Quality Package			
Ammonia	mg/L	NA	--
Chloride	mg/L	NA	(Secondary Standard)[4]
Nitrate as N	mg/L	10	MCL
Orthophosphate as P	mg/L	NA	--
Sulfate	mg/L	NA	(Secondary Standard)[4]
Sulfide	mg/L	NA	--
Monitored Natural Attenuation Package			
Methane	µg/L	NA	--
Ethane	µg/L	NA	--
Total Organic Carbon	mg/L	NA	--

Soil[2]			
Detected Parameter	**Units**	**Screening Level**	**Source[3]**
Volatile Organic Compounds			
1,1,1,2-Tetrachloroethane	µg/kg	48,800	RSK
1,1,2,2-Tetrachloroethane	µg/kg	15,200	RSK
1,1,2-Trichloroethane	µg/kg	27,600	RSK
1,2,4-Trimethylbenzene	µg/kg	126,000	RSK
1,3-Dichlorobenzene	µg/kg	NA	--
Acetone	µg/kg	406,000,000	RSK
Bromochloromethane	µg/kg	680,000	RSL
Chlorobenzene	µg/kg	740,000	RSK
Chloroform	µg/kg	7,140	RSK
cis-1,2-Dichloroethene	µg/kg	194,000	RSK
Isopropylbenzene	µg/kg	5,680,000	RSK
Methylene chloride	µg/kg	267,000	RSK
p-Isopropyltoluene	µg/kg	NA	--
sec-Butylbenzene	µg/kg	654,000	RSK
Styrene	µg/kg	20,400,000	RSK
tert-Butylbenzene	µg/kg	NA	--
Tetrachloroethene	µg/kg	210,000	RSK
Toluene	µg/kg	29,800,000	RSK
trans-1,2-Dichloroethene	µg/kg	333,000	RSK
Trichloroethene	µg/kg	9,910	RSK
Semivolatile Organic Compounds			
2,4-Dinitrotoluene	µg/kg	79,600	RSK
2,6-Dinitrotoluene	µg/kg	881,000	RSK
Di-n-butyl phthalate	µg/kg	62,000,000	RSL
N-Nitrosodiphenylamine	µg/kg	350,000	RSL
Perchlorate			
Perchlorate	µg/kg	1,430,000	RSK
Explosives			
2,4,6-Trinitrotoluene	mg/kg	440	RSK
2,4-Dinitrotoluene	mg/kg	79.6	RSK
2,6-Dinitrotoluene	mg/kg	881	RSK
4-Amino-2,6-dinitrotoluene	mg/kg	1,900	RSL
4-Nitrotoluene	mg/kg	110	RSL
HMX	mg/kg	44,000	RSK
Nitroglycerin	mg/kg	62	RSL
RDX	mg/kg	224	RSK
Metals			
Antimony	mg/kg	817	RSK
Arsenic	mg/kg	38	RSK
Beryllium	mg/kg	3,650	RSK
Cadmium	mg/kg	965	RSK
Chromium	mg/kg	111	RSK
Copper	mg/kg	81,700	RSK
Lead	mg/kg	1,000	RSK
Mercury	mg/kg	20	RSK
Nickel	mg/kg	32,400	RSK
Selenium	mg/kg	10,200	RSK
Silver	mg/kg	10,200	RSK
Thallium	mg/kg	10	RSL
Zinc	mg/kg	613,000	RSK

Dry Sediment[2]			
Detected Parameter	**Units**	**Screening Level**	**Source[3]**
Volatile Organic Compounds			
Tetrachloroethene	µg/kg	210,000	RSK
Toluene	µg/kg	29,800,000	RSK
Metals			
Antimony	mg/kg	817	RSK
Arsenic	mg/kg	38	RSK
Beryllium	mg/kg	3,650	RSK
Cadmium	mg/kg	965	RSK
Chromium	mg/kg	111	RSK
Copper	mg/kg	81700	RSK
Lead	mg/kg	1000	RSK
Mercury	mg/kg	20	RSK
Nickel	mg/kg	32400	RSK
Selenium	mg/kg	10200	RSK
Silver	mg/kg	10200	RSK
Thallium	mg/kg	10	RSL
Zinc	mg/kg	613000	RSK

Notes:

[1] Screening levels for groundwater and/or surface water samples are EPA MCL, KDHE RSK (non-residential groundwater), or EPA RSL (tapwater).

[2] Screening levels for soil samples are KDHE RSK (non-residential soil pathway) or EPA RSL (industrial soil).

[3] Sources are as follows:

MCL - United States Environmental Protection Agency, National Primary (and/or Secondary) Drinking Water Regulations, EPA 816-F-09-004, May 2009.
Access: http://water.epa.gov/drink/contaminants/upload/mcl-2.pdf

RSK - Kansas Department of Health and Environment, Risk-Based Standards for Kansas, RSK Manual - 5th Version, Appendix A, October 2010.
Access: http://www.kdheks.gov/remedial/download/RSK_Manual_10.pdf

RSL - United States Environmental Protection Agency, Regional Screening Level (RSL) Summary Table, November 2012.
Access: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/pdf/master_sl_table_bwrun_NOV2012.pdf

[4] The secondary standard for chloride in 250 mg/L and for sulfate is 250 mg/L. Secondary standards are based on aethetic considerations and not risk to human health. Therefore these levels are not being applied as screening levels.

EPA = United States Environmental Protection Agency
KDHE = Kansas Department of Health and Environment
MCL = Maximum Contaminant Level
mg/kg = milligrams per kilogram
mg/L = milligrams per liter
NA = Not available
RSK = Risk-Based Standards for Kansas
RSL = Regional Screening Level
µg/kg = micrograms per kilogram
µg/L = micrograms per liter

Table 4-2
Field GC Soil Results, Metal Debris Pits
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	MD-12/SS01-0.5'	MD-12/SB01-2.0'	MD-12/SB02-6.5'	MD-12/SB03-10.5'	MD-15/SS01-0.5'	MD-15/SB01-2.0'
		Date Sampled:	01/29/2013	01/29/2013	01/29/2013	01/29/2013	01/29/2013	01/29/2013
		Medium:	Surface Soil	Surface Soil	Subsurface Soil	Subsurface Soil	Surface Soil	Surface Soil
Parameter	**Units**	**Screening Level[1]**						
Volatile Organic Compounds								
cis-1,2-Dichloroethene	µg/kg	194,000	10 U	10 U	10 U	10 U	10 U	10 U
Tetrachloroethene	µg/kg	210,000	10 U	10 U	***32***	***11***	10 U	10 U
Trichloroethene	µg/kg	9,910	***36***	10 U	***378***	***38***	***302***	***80***

		Sample ID:	MD-15/SB02-7.0'	MD-16/SS01-1.0'	MD-16/SB01-3.0'	MD-16/SB02-6.0'	MD-20/SS01-0.9'	MD-20/SB01-3.0'
		Date Sampled:	01/29/2013	01/30/2013	01/30/2013	01/30/2013	01/29/2013	01/29/2013
		Medium:	Subsurface Soil	Surface Soil	Subsurface Soil	Subsurface Soil	Surface Soil	Subsurface Soil
Parameter	**Units**	**Screening Level[1]**						
Volatile Organic Compounds								
cis-1,2-Dichloroethene	µg/kg	194,000	10 U	10 U	10 U	10 U	10 U	10 U
Tetrachloroethene	µg/kg	210,000	10 U	10 U	***12***	10 U	***16***	10 U
Trichloroethene	µg/kg	9,910	***121***	***144***	***620***	***111***	***430***	***74***

		Sample ID:	MD-20/SB02-6.5'	MD-20/SB03-10.0'	MD-21/SS01-1.0'	MD-21/SB01-3.0'	MD-21/SB02-8.0'	MD-21/SB03-11.0'
		Date Sampled:	01/29/2013	01/29/2013	01/29/2013	01/29/2013	01/29/2013	01/29/2013
		Medium:	Subsurface Soil	Subsurface Soil	Surface Soil	Subsurface Soil	Subsurface Soil	Subsurface Soil
Parameter	**Units**	**Screening Level[1]**						
Volatile Organic Compounds								
cis-1,2-Dichloroethene	µg/kg	194,000	10 U	10 U	10 U	10 U	***10***	***17***
Tetrachloroethene	µg/kg	210,000	10 U	10 U	***500***	***22***	***64***	***117***
Trichloroethene	µg/kg	9,910	***428***	***144***	***9,700 J***	***540***	***4,200 J***	***11,000 J***

Notes:

[1] For source of screening level, see Table 4-1.

Bold / Italics = compound was detected

Highlighted = Concentration exceeds screening level

GC = Gas Chromatograph

ID = Identification

J = estimated value

U = compound was not detected (or qualified as not detected during QA/QC review)

µg/kg = micrograms per kilogram

Table 4-2
Field GC Soil Results, Metal Debris Pits
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	MD-22/SS01-1.0'	MD-22/SB01-3.0'	MD-22/SB02-8.0'	MD-22/SB03-11.0'	MD-25/SS01-1.0'	MD-25/SB01-2.0'
		Date Sampled:	01/29/2013	01/29/2013	01/29/2013	01/29/2013	01/28/2013	01/28/2013
		Medium:	Surface Soil	Subsurface Soil	Subsurface Soil	Subsurface Soil	Surface Soil	Surface Soil
Parameter	**Units**	**Screening Level[1]**						
Volatile Organic Compounds								
cis-1,2-Dichloroethene	µg/kg	194,000	***57***	***15***	***310***	***540***	***190***	***28***
Tetrachloroethene	µg/kg	210,000	***1,500 J***	***108***	***3,900 J***	***39,000 J***	***490***	***17***
Trichloroethene	µg/kg	9,910	***24,000 J***	***4,300 J***	***790,000 J***	***2,000,000 J***	***9,100 J***	***640***

		Sample ID:	MD-25/SB02-7.0'	MD-25/SB03-10.0'	MD-25/SB04-13'	MD-26/SS01-0.9'	MD-26/SB01-3.0'	MD-26/SB02-7.0'
		Date Sampled:	01/28/2013	01/28/2013	01/28/2013	01/29/2013	01/29/2013	01/29/2013
		Medium:	Subsurface Soil	Subsurface Soil	Subsurface Soil	Surface Soil	Subsurface Soil	Subsurface Soil
Parameter	**Units**	**Screening Level[1]**						
Volatile Organic Compounds								
cis-1,2-Dichloroethene	µg/kg	194,000	***980***	***4,400 J***	***1,000 J***	10 U	10 U	***89***
Tetrachloroethene	µg/kg	210,000	***230***	***1,000 J***	***1,500 J***	***58***	***18***	***222***
Trichloroethene	µg/kg	9,910	***28,000 J***	***43,000 J***	***1,200,000 J***	***1,400 J***	***875***	***27,000 J***

		Sample ID:	MD-26/SB03-11.5'	MD-27/SS01-0.5'	MD-27/SB01-3.0'	MD-27/SB02-6.0'	MD-28/SS01-0.5'	MD-28/SB01-3.0'
		Date Sampled:	01/29/2013	01/28/2013	01/28/2013	01/28/2013	01/28/2013	01/28/2013
		Medium:	Subsurface Soil	Surface Soil	Subsurface Soil	Subsurface Soil	Surface Soil	Subsurface Soil
Parameter	**Units**	**Screening Level[1]**						
Volatile Organic Compounds								
cis-1,2-Dichloroethene	µg/kg	194,000	***290***	10 U	10 U	10 U J	10 U	10 U
Tetrachloroethene	µg/kg	210,000	***720***	10 U	10 U	10 U	***10***	10 U
Trichloroethene	µg/kg	9,910	***200,000 J***	10 U	10 U	10 U	***78***	***62***

Notes:

[1] The source of screening levels (KDHE RSK or EPA RSL) is noted on Table 4-1.

Bold / Italics = compound was detected

Highlighted = Concentration exceeds screening level

GC = Gas Chromatograph

ID = Identification

J = estimated value

U = compound was not detected (or qualified as not detected during QA/QC review)

µg/kg = micrograms per kilogram

Table 4-2
Field GC Soil Results, Metal Debris Pits
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	MD-28/SB02-7.0'	MD-29/SS01-0.9'	MD-29/SB01-3.0'	MD-29/SB02-7.0'	MD-29/SB03-11.9'	MD-31/SS01-0.9'
		Date Sampled:	01/28/2013	01/29/2013	01/29/2013	01/29/2013	01/29/2013	01/28/2013
		Medium:	Subsurface Soil	Surface Soil	Subsurface Soil	Subsurface Soil	Subsurface Soil	Surface Soil
Parameter	**Units**	**Screening Level[1]**						
Volatile Organic Compounds								
cis-1,2-Dichloroethene	µg/kg	194,000	10 U	10 U	10 U	10 U	***15***	10 U
Tetrachloroethene	µg/kg	210,000	10 U	10 U	10 U	10 U	***23***	10 U
Trichloroethene	µg/kg	9,910	***170***	***51***	***105***	***169***	***6,700 J***	***400***

		Sample ID:	MD-31/SB01-3.0'	MD-31/SB02-7.5'	MD-31/SB03-10.0'	MD-32/SS01-1.0'	MD-32/SB01-3.0'	MD-32/SB02-6.0'
		Date Sampled:	01/28/2013	01/28/2013	01/28/2013	01/29/2013	01/29/2013	01/29/2013
		Medium:	Subsurface Soil	Subsurface Soil	Subsurface Soil	Surface Soil	Subsurface Soil	Subsurface Soil
Parameter	**Units**	**Screening Level[1]**						
Volatile Organic Compounds								
cis-1,2-Dichloroethene	µg/kg	194,000	10 U	***30***	***44***	10 U	10 U	10 U
Tetrachloroethene	µg/kg	210,000	10 U	***20***	***28***	***45***	10 U	10 U
Trichloroethene	µg/kg	9,910	***180***	***2,800 J***	***4,700 J***	***1,400 J***	***79***	***256***

		Sample ID:	MD-32/SB03-11.0'	MD-33/SS01-1.0'	MD-33/SB01-3.0'	MD-33/SB02-7.0'	MD-33/SB03-12.0'	MD-34/SS01-1.0'
		Date Sampled:	01/29/2013	01/30/2013	01/30/2013	01/30/2013	01/30/2013	01/30/2013
		Medium:	Subsurface Soil	Surface Soil	Subsurface Soil	Subsurface Soil	Subsurface Soil	Surface Soil
Parameter	**Units**	**Screening Level[1]**						
Volatile Organic Compounds								
cis-1,2-Dichloroethene	µg/kg	194,000	***16***	10 U	10 U	10 U	10 U	10 U
Tetrachloroethene	µg/kg	210,000	***43***	10 U	10 U	10 U	***10***	10 U
Trichloroethene	µg/kg	9,910	***4,600 J***	***109***	***201***	***155***	***6,200 J***	10 U

Notes:

[1] The source of screening levels (KDHE RSK or EPA RSL) is noted on Table 4-1.

Bold / Italics = compound was detected

Highlighted = Concentration exceeds screening level

GC = Gas Chromatograph

ID = Identification

J = estimated value

U = compound was not detected (or qualified as not detected during QA/QC review)

µg/kg = micrograms per kilogram

Table 4-2
Field GC Soil Results, Metal Debris Pits
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	MD-34/SB01-12.0'	MD-35/SS01-1.0'	MD-35/SB01-7.0'	MD-36/SS01-1.0'	MD-36/SB01-6.0'	MD-37/SS01-1.0'
		Date Sampled:	01/30/2013	01/30/2013	01/30/2013	01/30/2013	01/30/2013	01/30/2013
		Medium:	Subsurface Soil	Surface Soil	Subsurface Soil	Surface Soil	Subsurface Soil	Surface Soil
Parameter	**Units**	**Screening Level[1]**						
Volatile Organic Compounds								
cis-1,2-Dichloroethene	µg/kg	194,000	10 U	10 U	10 U	10 U	10 U	10 U
Tetrachloroethene	µg/kg	210,000	10 U	10 U	10 U	10 U	10 U	10 U
Trichloroethene	µg/kg	9,910	10 U	10 U	10 U	10 U	10 U	10 U

		Sample ID:	MD-37/SB01-3.0'	MD-37/SB02-7.8'	MD-38/SS01-0.9'	MD-38/SB01-3.0'	MD-38/SB02-8.0'	MD-39/SS01-0.9'
		Date Sampled:	01/30/2013	01/30/2013	01/30/2013	01/30/2013	01/30/2013	01/30/2013
		Medium:	Subsurface Soil	Subsurface Soil	Surface Soil	Subsurface Soil	Subsurface Soil	Surface Soil
Parameter	**Units**	**Screening Level[1]**						
Volatile Organic Compounds								
cis-1,2-Dichloroethene	µg/kg	194,000	10 U	10 U	10 U	10 U	10 U	10 U
Tetrachloroethene	µg/kg	210,000	10 U	10 U	10 U	10 U	10 U	10 U
Trichloroethene	µg/kg	9,910	10 U	10 U	10 U	10 U	***86***	10 U

		Sample ID:	MD-39/SB01-7.0'	MD-39/SB02-11.5'
		Date Sampled:	01/30/2013	01/30/2013
		Medium:	Subsurface Soil	Subsurface Soil
Parameter	**Units**	**Screening Level[1]**		
Volatile Organic Compounds				
cis-1,2-Dichloroethene	µg/kg	194,000	10 U	10 U
Tetrachloroethene	µg/kg	210,000	10 U	10 U
Trichloroethene	µg/kg	9,910	10 U	***35***

Notes:

[1] The source of screening levels (KDHE RSK or EPA RSL) is noted on Table 4-1.

Bold / Italics = compound was detected

Highlighted = Concentration exceeds screening level

GC = Gas Chromatograph

ID = Identification

J = estimated value

U = compound was not detected (or qualified as not detected during QA/QC review)

µg/kg = micrograms per kilogram

Table 4-3
Surface Soil Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	BDSS-01/SS01	BDSS-02/SS01	BDSS-03/SS01	BDSS-04/SS01	BDSS-05/SS01	BDSS-06/SS01	BDSS-07/SS01	BDSS-08/SS01	BDSS-09/SS01	BDSS-10/SS01	BDSS-11/SS01	BDSS-12/SS01	BDSS-13/SS01
		Lab Number(s):	G1L210482-001	G1L210482-002	G1L210482-005	G1L210482-004	G1L210482-003	G1L160529-002	G1L160529-003	G1L160529-004	G1L160529-001	G1L160527-015	G1L190422-005	G1L190422-003	G1L190422-006
		Date(s) Sampled:	12/19/2011	12/19/2011	12/19/2011	12/19/2011	12/19/2011	12/14/2011	12/14/2011	12/14/2011	12/14/2011	12/14/2011	12/16/2011	12/16/2011	12/16/2011
		Depth (feet bgs):	0.5 - 1.5	1.0 - 2.0	1.0 - 2.0	1.0 - 2.0	1.0 - 2.0	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	1.0 - 2.0	0.0 - 1.0	0.5 - 1.5
Parameter	**Units**	**Screening Level[1]**													
Volatile Organic Compounds															
1,1,1,2-Tetrachloroethane	µg/kg	48,800	6.3 U	6.3 U	6.2 U	6.1 U	6.2 U	6.4 U J	6.4 U	6.6 U J	6.5 U	6.4 U J	6 U J	6.3 U J	6.8 U
1,1,2,2-Tetrachloroethane	µg/kg	15,200	6.3 U	6.3 U	6.2 U	6.1 U	6.2 U	6.4 U J	6.4 U	6.6 U J	6.5 U	6.4 U J	6 U J	***29 J***	6.8 U
1,1,2-Trichloroethane	µg/kg	27,600	6.3 U	6.3 U	6.2 U	6.1 U	6.2 U	6.4 U J	6.4 U	6.6 U J	6.5 U	6.4 U J	6 U J	6.3 U J	6.8 U
1,2,4-Trimethylbenzene	µg/kg	126,000	6.3 U	6.3 U	6.2 U	6.1 U	6.2 U	6.4 U J	6.4 U	6.6 U J	6.5 U	6.4 U J	6 U J	6.3 U J	6.8 U
1,3-Dichlorobenzene	µg/kg	NA	6.3 U	6.3 U	6.2 U	6.1 U	6.2 U J	6.4 U J	6.4 U	6.6 U J	6.5 U	6.4 U J	6 U J	6.3 U J	6.8 U
Acetone	µg/kg	406,000,000	25 U	25 U	25 U	25 U	25 U	26 U J	26 U	26 U J	26 U	25 U J	24 U J	25 U J	27 U
Bromochloromethane	µg/kg	680,000	6.3 U	6.3 U	6.2 U	6.1 U	6.2 U	6.4 U J	6.4 U	6.6 U J	6.5 U	6.4 U J	6 U J	6.3 U J	6.8 U
Chlorobenzene	µg/kg	740,000	6.3 U	6.3 U	6.2 U	6.1 U	6.2 U	6.4 U J	6.4 U	6.6 U J	6.5 U	6.4 U J	6 U J	6.3 U J	6.8 U
cis-1,2-Dichloroethene	µg/kg	194,000	6.3 U	6.3 U	6.2 U	6.1 U	6.2 U	6.4 U J	6.4 U	6.6 U J	6.5 U	6.4 U J	6 U J	***2.6 J***	6.8 U
Isopropylbenzene	µg/kg	5,680,000	6.3 U	6.3 U	6.2 U	6.1 U	6.2 U	6.4 U J	6.4 U	6.6 U J	6.5 U	6.4 U J	6 U J	6.3 U J	6.8 U
p-Isopropyltoluene	µg/kg	NA	6.3 U	6.3 U	6.2 U	6.1 U	6.2 U J	***1.1 J***	6.4 U	6.6 U J	***2 J***	6.4 U J	6 U J	6.3 U J	6.8 U
sec-Butylbenzene	µg/kg	654,000	6.3 U	6.3 U	6.2 U	6.1 U	6.2 U	6.4 U J	6.4 U	6.6 U J	6.5 U	6.4 U J	6 U J	6.3 U J	6.8 U
tert-Butylbenzene	µg/kg	NA	6.3 U	6.3 U	6.2 U	6.1 U	6.2 U	6.4 U J	6.4 U	6.6 U J	6.5 U	6.4 U J	6 U J	6.3 U J	6.8 U
Tetrachloroethene	µg/kg	210,000	6.3 U	6.3 U	6.2 U	6.1 U	6.2 U	6.4 U J	6.4 U	6.6 U J	6.5 U	6.4 U J	6 U J	***2.6 J***	6.8 U
Toluene	µg/kg	29,800,000	6.3 U	6.3 U	6.2 U	6.1 U	6.2 U	6.4 U J	6.4 U	6.6 U J	6.5 U	6.4 U J	6 U J	6.3 U J	6.8 U
trans-1,2-Dichloroethene	µg/kg	333,000	6.3 U	6.3 U	6.2 U	6.1 U	6.2 U	6.4 U J	6.4 U	6.6 U J	6.5 U	6.4 U J	6 U J	***1.2 J***	6.8 U
Trichloroethene	µg/kg	9,910	6.3 U	6.3 U	6.2 U	6.1 U	6.2 U	***2.2 J***	***2 J***	***2.3 J***	***2.1 J***	6.4 U J	6 U J	***79 J***	6.8 U
Semivolatile Organic Compounds															
2,4-Dinitrotoluene	µg/kg	79,600	400 U	420 U	400 U	400 U	400 U	***2,100***	***3,700***	420 U	410 U	***5,900***	***37,000***	***19,000***	450 U
2,6-Dinitrotoluene	µg/kg	881,000	400 U	420 U	400 U	400 U	400 U	420 U	***150 J***	420 U	410 U	***130 J***	***2,800***	***290 J***	450 U
Di-n-butyl phthalate	µg/kg	62,000,000	400 U	420 U	400 U	400 U	400 U	***2,000***	***3,300***	***490***	***1,400***	***6,600***	***29,000***	***8,400***	450 U
N-Nitrosodiphenylamine	µg/kg	350,000	400 U	420 U	400 U	400 U	400 U	***350 J***	***410***	420 U	***280 J***	***980***	***1,300***	***1,700 J***	450 U
Perchlorate															
Perchlorate	µg/kg	1,430,000	6.2 U	6 U	6 U	6.1 U	***0.4 J***	6.3 U	***0.33 J***	***0.34 J***	6.3 U	***2.4 J***	***0.74 J***	***0.42 J***	6.6 U
Explosives															
2,4,6-Trinitrotoluene	mg/kg	440	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	***0.027 J***	***0.043 J***	0.25 U
2,4-Dinitrotoluene	mg/kg	79.6	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	***0.025 J***	***0.034 J***	0.25 U	0.25 U	***0.022 J***	***0.45***	***0.043 J***	0.25 U
4-Amino-2,6-dinitrotoluene	mg/kg	1,900	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	***0.16 J***	0.25 U
HMX	mg/kg	44,000	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	***0.04 J***	0.25 U
Nitroglycerin	mg/kg	62	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	***0.31 J***	0.5 U	0.5 U	***0.98***	***11***	0.5 U	0.5 U
RDX	mg/kg	224	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	***0.064 J***	0.25 U
Metals															
Antimony	mg/kg	817	***0.32 J***	***0.27 J***	***0.26 J***	***0.3 J***	***0.31 J***	***0.92***	***0.77***	***0.45 J***	***0.94***	***1.6***	***1.3***	***6.2***	0.81 U
Arsenic	mg/kg	38	***5.3***	***4.8***	***5.1***	***5.1***	***5.7 J***	***4.9***	***5.3***	***4.6***	***4.7***	***8.8***	***4.5***	***6.6***	***3.6***
Beryllium	mg/kg	3,650	***0.91***	***0.94***	***0.85***	***0.87***	***0.95***	***0.72***	***0.86***	***0.81***	***0.8***	***0.63***	***0.75***	***1***	***1.3***
Cadmium	mg/kg	965	***0.58***	***0.54***	***1***	***0.88***	***0.87 J***	***0.53***	***1.1***	***0.67***	***0.74***	***0.79***	***3.1***	***16.8***	***0.45***
Chromium	mg/kg	111	***19.7***	***20.9***	***18.3***	***20.1***	***18.9***	***24.5***	***29.4***	***27.5***	***30.1***	***23.3***	***22.2***	***33.4***	***22.6***
Copper	mg/kg	81,700	***20.7***	***11.3***	***11.6***	***11.5***	***11.4 J***	***37.4***	***48.5***	***33.9***	***36.5***	***47.4***	***68.7***	***207***	***14.3***
Lead	mg/kg	1,000	***14.4***	***13.2***	***16.5***	***16.4***	***18.3 J***	***33***	***45.5***	***24***	***48.2***	***59.6***	***54.9***	***231***	***13.4***
Mercury	mg/kg	20	***0.015 J***	0.05 U	***0.012 J***	0.049 U	***0.013 J***	***0.025 J***	***0.023 J***	***0.011 J***	***0.011 J***	***0.03 J***	***0.036 J***	***0.023 J***	***0.019 J***
Nickel	mg/kg	32,400	***12.8***	***14.8***	***24.7***	***17.5***	***19.2 J***	***20.2***	***25.2***	***22.4***	***22.4***	***17.3***	***18.2***	***20.7***	***27.5***
Selenium	mg/kg	10,200	***0.52***	***0.59***	***0.34 J***	***0.53***	***0.51***	***0.93***	***0.9***	***0.78***	***0.71***	***0.51***	***0.54***	***0.45***	***0.55***
Silver	mg/kg	10,200	***0.3***	***0.12 J***	***0.11 J***	***0.093 J***	***0.12***	***0.087 J***	***0.14***	***0.095 J***	***0.095 J***	***0.073 J***	***0.27***	***0.19***	***0.1 J***
Thallium	mg/kg	10	***0.26***	***0.25***	***0.33***	***0.31***	***0.33 J***	***0.16 J***	***0.2***	***0.17 J***	***0.16 J***	***0.13 J***	***0.22***	***0.24***	***0.33***
Zinc	mg/kg	613,000	***41.9***	***34.5***	***30.4***	***42.9***	***31.5 J***	***899***	***155***	***286***	***109***	***191***	***116***	***500***	***44.7***

Notes:

Bold / Italics = compound was detected

Highlighted = Concentration exceeds screening level

bgs = below ground surface

ID = Identification

J = estimated value

mg/kg = milligrams per kilogram

NA = Not analyzed

NS = Not sampled

U = compound was not detected (or qualified as not detected during QA/QC review)

µg/kg = micrograms per kilogram

[1] For source of screening level, see Table 4-1.

Table 4-3
Surface Soil Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	BDSS-14/SS01	BDSS-15/SS01	BDSS-16/SS01	BDSS-17/SS01	BDSS-18/SS01	BDSS-19/SS01	BDSS-20/SS01	BDSS-21/SS01	BDSS-22/SS01	BDSS-23/SS01	BDSS-24/SS01	MD-25/SB01	MD-34/SS01
		Lab Number(s):	G1L190422-004	G1L190420-014	G1L190422-001	G1L190422-002	G1L190420-009	G1L190420-010	G1L160505-007	G1L160522-012	G1L160505-001	G1L160522-010	G1L160522-011	13011888	13012081
		Date(s) Sampled:	12/16/2011	12/16/2011	12/16/2011	12/16/2011	12/16/2011	12/16/2011	12/13/2011	12/13/2011	12/13/2011	12/13/2011	12/13/2011	1/28/2013	1/30/2013
		Depth (feet bgs):	1.0 - 2.0	0.0 - 1.0	0.0 - 1.0	1.0 -2.0	0.0 - 0.5	0.0 - 1.0	1.5 - 2.5	1.0 -2.0	1.0 -2.0	1.5 - 2.5	1.0 - 2.0	2.0	1.0
Parameter	**Units**	**Screening Level[1]**													
Volatile Organic Compounds															
1,1,1,2-Tetrachloroethane	µg/kg	48,800	6.4 U	6.9 U	6.5 U J	***2 J***	6.7 U	6.1 U	6.3 U	6.3 U	5.8 U	6.4 U	6.3 U	30 U	6.3 U J
1,1,2,2-Tetrachloroethane	µg/kg	15,200	6.4 U	6.9 U	6.5 U J	***3,100 J***	6.7 U	6.1 U	6.3 U	6.3 U	5.8 U	6.4 U	6.3 U	***2,080***	6.3 U J
1,1,2-Trichloroethane	µg/kg	27,600	6.4 U	6.9 U	6.5 U J	***3.7 J***	6.7 U	6.1 U	6.3 U	6.3 U	5.8 U	6.4 U	6.3 U	30 U	6.3 U J
1,2,4-Trimethylbenzene	µg/kg	126,000	6.4 U	6.9 U	6.5 U J	6.3 U J	6.7 U	6.1 U	6.3 U	6.3 U	5.8 U	6.4 U	6.3 U	30 U	6.3 U J
1,3-Dichlorobenzene	µg/kg	NA	6.4 U	6.9 U	6.5 U J	6.3 U J	6.7 U	6.1 U	6.3 U	***0.42 J***	5.8 U	6.4 U	6.3 U	30 U	6.3 U J
Acetone	µg/kg	406,000,000	26 U	28 U	26 U J	25 U J	27 U	24 U	25 U	25 U	23 U	25 U	25 U	600 U	31 U J
Bromochloromethane	µg/kg	680,000	6.4 U	6.9 U	6.5 U J	6.3 U J	6.7 U	6.1 U	6.3 U	6.3 U	5.8 U	6.4 U	6.3 U	***10 J***	***10 J***
Chlorobenzene	µg/kg	740,000	6.4 U	6.9 U	6.5 U J	***2 J***	6.7 U	6.1 U	6.3 U	6.3 U	5.8 U	6.4 U	6.3 U	30 U	6.3 U J
cis-1,2-Dichloroethene	µg/kg	194,000	6.4 U	6.9 U	6.5 U J	***160 J***	6.7 U	6.1 U	6.3 U	6.3 U	5.8 U	6.4 U	6.3 U	***9 J***	6.3 U J
Isopropylbenzene	µg/kg	5,680,000	6.4 U	6.9 U	6.5 U J	6.3 U J	6.7 U	6.1 U	6.3 U	6.3 U	5.8 U	6.4 U	6.3 U	30 U	6.3 U J
p-Isopropyltoluene	µg/kg	NA	6.4 U	6.9 U	6.5 U J	6.3 U J	6.7 U	6.1 U	6.3 U	6.3 U	5.8 U	6.4 U	6.3 U	30 U	6.3 U J
sec-Butylbenzene	µg/kg	654,000	6.4 U	6.9 U	6.5 U J	6.3 U J	6.7 U	6.1 U	6.3 U	6.3 U	5.8 U	6.4 U	6.3 U	30 U	6.3 U J
tert-Butylbenzene	µg/kg	NA	6.4 U	6.9 U	6.5 U J	6.3 U J	6.7 U	6.1 U	6.3 U	6.3 U	5.8 U	6.4 U	6.3 U	30 U	6.3 U J
Tetrachloroethene	µg/kg	210,000	***1.6 J***	6.9 U	6.5 U J	***140 J***	6.7 U	6.1 U	6.3 U	6.3 U	5.8 U	***1.7 J***	***1.2 J***	***10 J***	6.3 U J
Toluene	µg/kg	29,800,000	6.4 U	6.9 U	6.5 U J	6.3 U J	6.7 U	6.1 U	6.3 U	6.3 U	5.8 U	6.4 U	6.3 U	5.9 J U	5 J U
trans-1,2-Dichloroethene	µg/kg	333,000	6.4 U	6.9 U	6.5 U J	***35 J***	6.7 U	6.1 U	6.3 U	6.3 U	5.8 U	6.4 U	6.3 U	30 U	6.3 U J
Trichloroethene	µg/kg	9,910	***21***	6.9 U	6.5 U J	***1,700 J***	6.7 U	6.1 U	6.3 U	6.3 U	5.8 U	6.4 U	6.3 U	***93***	***30 J***
Semivolatile Organic Compounds															
2,4-Dinitrotoluene	µg/kg	79,600	420 U	460 U	***3,600 J***	***2,200***	440 U	400 U	410 U	***670***	380 U	410 U	410 U	NS	NS
2,6-Dinitrotoluene	µg/kg	881,000	420 U	460 U	430 U	410 U	440 U	400 U	410 U	420 U	380 U	410 U	410 U	NS	NS
Di-n-butyl phthalate	µg/kg	62,000,000	420 U	460 U	***4,000 J***	***10,000***	440 U	400 U	410 U	***1,900***	380 U	410 U	410 U	NS	NS
N-Nitrosodiphenylamine	µg/kg	350,000	420 U	460 U	***480***	***1,300 J***	440 U	400 U	410 U	***480***	380 U	410 U	410 U	NS	NS
Perchlorate															
Perchlorate	µg/kg	1,430,000	6.3 U	6.6 U	6.3 U	***0.39 J***	6.5 U	***0.71 J***	***5.3 J***	***1.5 J***	***0.69 J***	***25***	***1.2 J***	NS	NS
Explosives															
2,4,6-Trinitrotoluene	mg/kg	440	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	***0.072 J***	0.25 U	0.25 U	0.25 U	NS	NS
2,4-Dinitrotoluene	mg/kg	79.6	0.25 U	0.25 U	***0.03 J***	***0.24 J***	***0.093 J***	0.25 U	0.25 U	***1.1***	0.25 U	0.25 U	0.25 U	NS	NS
4-Amino-2,6-dinitrotoluene	mg/kg	1,900	0.25 U	0.25 U	0.25 U	***0.032 J***	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	NS	NS
HMX	mg/kg	44,000	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	***0.069 J***	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	NS	NS
Nitroglycerin	mg/kg	62	0.5 U	0.5 U	***0.57***	0.5 U	0.5 U	0.5 U	0.5 U	***4.1***	0.5 U	0.5 U	0.5 U	NS	NS
RDX	mg/kg	224	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	NS	NS
Metals															
Antimony	mg/kg	817	0.77 U	***0.64 J***	***0.66 J***	***0.55 J***	***0.47 J***	***0.64 J***	***0.4 J***	***0.72 J***	***0.3 J***	0.76 U	***0.68 J***	NS	NS
Arsenic	mg/kg	38	***3.8***	***9.2***	***5.5 J***	***3.6***	***5.3***	***6.5***	***6.3***	***5.4***	***5.1***	***4.8***	***6***	NS	NS
Beryllium	mg/kg	3,650	***1.1***	***1.7***	***1.2***	***0.96***	***1.6***	***1.1***	***1.1***	***0.97***	***0.93***	***1***	***1***	NS	NS
Cadmium	mg/kg	965	***0.45***	***1***	***1.1***	***1.1***	***1***	***1***	***0.91***	***1***	***1.2***	***0.57***	***0.89***	NS	NS
Chromium	mg/kg	111	***25***	***51.1***	***29.3 J***	***27.1***	***45.9***	***30.8***	***24.1***	***20.7***	***21.1***	***19.2***	***22.1***	NS	NS
Copper	mg/kg	81,700	***11.9***	***17.7***	***37.2***	***23.7***	***39.7***	***17.8***	***14.7***	***52.6***	***10.7***	***11.2***	***32.1***	NS	NS
Lead	mg/kg	1,000	***12.1***	***17.9***	***26.6***	***15.2***	***17.4***	***15.9***	***18.3***	***29.6***	***13.6***	***14.4***	***40.4***	NS	NS
Mercury	mg/kg	20	***0.019 J***	***0.029 J***	***0.03 J***	***0.023 J***	***0.02 J***	***0.027 J***	***0.014 J***	***0.025 J***	***0.015 J***	***0.021 J***	***0.018 J***	NS	NS
Nickel	mg/kg	32,400	***18.3***	***36.7***	***22.9***	***21.8***	***55.6***	***28.4***	***18.5***	***18.4***	***20.5***	***18.4***	***20***	NS	NS
Selenium	mg/kg	10,200	***0.5***	***1.1***	***0.55***	***0.53***	***0.77***	***0.77***	***1.1***	***0.68***	***0.53***	***0.62***	***0.76***	NS	NS
Silver	mg/kg	10,200	***0.11 J***	***0.23***	***0.17***	***0.14***	***0.17***	***0.16***	***0.19***	***0.18***	***0.2***	***0.15***	***0.18***	NS	NS
Thallium	mg/kg	10	***0.25***	***0.42***	***0.27***	***0.17 J***	***0.28***	***0.35***	***0.33***	***0.32***	***0.34***	***0.31***	***0.33***	NS	NS
Zinc	mg/kg	613,000	***35.3***	***81***	***82.7***	***60.3***	***116***	***52.6***	***46.7***	***59.7***	***31.1***	***33.2***	***220***	NS	NS

Notes:
Bold / Italics = compound was detected
Highlighted = Concentration exceeds screening level
bgs = below ground surface
ID = Identification
J = estimated value
mg/kg = milligrams per kilogram
NA = Not analyzed
NS = Not sampled
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/kg = micrograms per kilogram
[1] For source of screening level, see Table 4-1.

Table 4-3
Surface Soil Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	RISS-01/SS01	RISS-02/SS01	RISS-03/SS01	RISS-04/SS01	RISS-05/SS01	RISS-06/SS01	RISS-07/SS01	RISS-08/SS01	RISS-09/SS01	RISS-10/SS01	RISS-11/SS01	RISS-12/SS01	RISS-13/SS01
		Lab Number(s):	G1L160529-007	G1L160513-010	G1L160518-001	G1L210484-007	G1L210484-004	G1L210484-001	G1L210482-009	G1L160527-010	G1L160527-009	G1L160527-008	G1L160527-014	G1L190420-005	G1L190420-004
		Date(s) Sampled:	12/15/2011	12/12/2011	12/12/2011	12/19/2011	12/19/2011	12/19/2011	12/19/2011	12/14/2011	12/14/2011	12/14/2011	12/14/2011	12/15/2011	12/15/2011
		Depth (feet bgs):	1.5 - 2.5	1.0 -2.0	1.5 - 2.5	1.0 -2.0	1.0 -2.0	1.0 -2.0	1.0 -2.0	0.5 - 1.5	0.5 - 1.5	1.0-2.5	1.0 -2.0	1.0 -2.0	1.0 -2.0
Parameter	**Units**	**Screening Level[1]**													
Volatile Organic Compounds															
1,1,1,2-Tetrachloroethane	µg/kg	48,800	6.4 U	6.3 U J	6.5 U J	6.4 U J	6.4 U	6.2 U	6.1 U J	6.5 U J	6.9 U	6.3 U J	6.1 U	6.3 U	6.4 U
1,1,2,2-Tetrachloroethane	µg/kg	15,200	6.4 U	6.3 U J	6.5 U J	6.4 U J	6.4 U	6.2 U	6.1 U J	6.5 U J	6.9 U	6.3 U J	6.1 U	6.3 U	6.4 U
1,1,2-Trichloroethane	µg/kg	27,600	6.4 U	6.3 U J	6.5 U J	6.4 U J	6.4 U	6.2 U	6.1 U J	6.5 U J	6.9 U	6.3 U J	6.1 U	6.3 U	6.4 U
1,2,4-Trimethylbenzene	µg/kg	126,000	6.4 U	6.3 U J	6.5 U J	***0.83 J***	6.4 U	6.2 U	6.1 U J	6.5 U J	6.9 U	6.3 U J	6.1 U	6.3 U	6.4 U
1,3-Dichlorobenzene	µg/kg	NA	6.4 U	6.3 U J	6.5 U J	6.4 U J	6.4 U	6.2 U	6.1 U J	6.5 U J	6.9 U	6.3 U J	6.1 U	6.3 U	6.4 U
Acetone	µg/kg	406,000,000	26 U	***5.6 J***	26 U J	25 U J	25 U	25 U	24 U J	26 U J	27 U	25 U J	24 U	25 U	26 U
Bromochloromethane	µg/kg	680,000	6.4 U	6.3 U J	6.5 U J	6.4 U J	6.4 U	6.2 U	6.1 U J	6.5 U J	6.9 U	6.3 U J	6.1 U	6.3 U	6.4 U
Chlorobenzene	µg/kg	740,000	6.4 U	6.3 U J	6.5 U J	6.4 U J	6.4 U	6.2 U	6.1 U J	6.5 U J	6.9 U	6.3 U J	6.1 U	6.3 U	6.4 U
cis-1,2-Dichloroethene	µg/kg	194,000	6.4 U	6.3 U J	6.5 U J	6.4 U J	6.4 U	6.2 U	6.1 U J	6.5 U J	6.9 U	6.3 U J	6.1 U	6.3 U	6.4 U
Isopropylbenzene	µg/kg	5,680,000	6.4 U	6.3 U J	6.5 U J	6.4 U J	6.4 U	6.2 U	6.1 U J	6.5 U J	6.9 U	6.3 U J	6.1 U	6.3 U	6.4 U
p-Isopropyltoluene	µg/kg	NA	6.4 U	6.3 U J	6.5 U J	6.4 U J	6.4 U	6.2 U	6.1 U J	6.5 U J	6.9 U	6.3 U J	6.1 U	6.3 U	6.4 U
sec-Butylbenzene	µg/kg	654,000	6.4 U	6.3 U J	6.5 U J	6.4 U J	6.4 U	6.2 U	6.1 U J	6.5 U J	6.9 U	6.3 U J	6.1 U	6.3 U	6.4 U
tert-Butylbenzene	µg/kg	NA	6.4 U	6.3 U J	6.5 U J	6.4 U J	6.4 U	6.2 U	6.1 U J	6.5 U J	6.9 U	6.3 U J	6.1 U	6.3 U	6.4 U
Tetrachloroethene	µg/kg	210,000	6.4 U	6.3 U J	6.5 U J	6.4 U J	6.4 U	6.2 U	6.1 U J	6.5 U J	6.9 U	6.3 U J	6.1 U	6.3 U	6.4 U
Toluene	µg/kg	29,800,000	6.4 U	6.3 U J	6.5 U J	***0.78 J***	6.4 U	6.2 U	6.1 U J	6.5 U J	6.9 U	6.3 U J	6.1 U	6.3 U	6.4 U
trans-1,2-Dichloroethene	µg/kg	333,000	6.4 U	6.3 U J	6.5 U J	6.4 U J	6.4 U	6.2 U	6.1 U J	6.5 U J	6.9 U	6.3 U J	6.1 U	6.3 U	6.4 U
Trichloroethene	µg/kg	9,910	6.4 U	6.3 U J	6.5 U J	6.4 U J	6.4 U	6.2 U	6.1 U J	6.5 U J	6.9 U	6.3 U J	6.1 U	6.3 U	6.4 U
Semivolatile Organic Compounds															
2,4-Dinitrotoluene	µg/kg	79,600	420 U	420 U	420 U	410 U	420 U	410 U	400 U	420 U	450 U	410 U	400 U	410 U	420 U
2,6-Dinitrotoluene	µg/kg	881,000	420 U	420 U	420 U	410 U	420 U	410 U	400 U	420 U	450 U	410 U	400 U	410 U	420 U
Di-n-butyl phthalate	µg/kg	62,000,000	420 U	420 U	420 U	410 U	420 U	410 U	400 U	420 U	450 U	410 U	***390 J***	410 U	420 U
N-Nitrosodiphenylamine	µg/kg	350,000	420 U	420 U	420 U	410 U	420 U	410 U	400 U	420 U	450 U	410 U	400 U	410 U	420 U
Perchlorate															
Perchlorate	µg/kg	1,430,000	6.4 U	6.3 U	6.4 U	6.2 U	6.4 U	6 U	6 U	***0.56 J***	6.9 U	6.2 U	5.9 U	6.3 U	0.7 J U
Explosives															
2,4,6-Trinitrotoluene	mg/kg	440	0.25 U	0.25 U	0.25 U	0.24 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U
2,4-Dinitrotoluene	mg/kg	79.6	0.25 U	0.25 U	0.25 U	0.24 U	0.25 U	0.25 U	0.25 U	0.25 U	***0.033 J***	0.25 U	0.25 U	0.25 U	0.25 U
4-Amino-2,6-dinitrotoluene	mg/kg	1,900	0.25 U	0.25 U	0.25 U	0.24 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U
HMX	mg/kg	44,000	0.25 U	0.25 U	0.25 U	0.24 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U
Nitroglycerin	mg/kg	62	0.5 U	0.5 U	0.5 U	0.48 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
RDX	mg/kg	224	0.25 U	0.25 U	0.25 U	0.24 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U
Metals															
Antimony	mg/kg	817	***0.28 J***	***0.32 J***	***0.3 J***	0.76 U	0.76 U	0.74 U	***0.36 J***	0.78 U	***0.34 J***	***0.25 J***	***0.41 J***	***0.47 J***	***0.29 J***
Arsenic	mg/kg	38	***6.8***	***5.1***	***3.6***	***1.2***	***3.5***	***4.7***	***5.3***	***5.5***	***9.1***	***5.7***	***4.1***	***7.4***	***6.2***
Beryllium	mg/kg	3,650	***1.3***	***0.96***	***0.59***	***0.76***	***0.8***	***0.89***	***0.92***	***0.97***	***1.3***	***1.1***	***0.63***	***1***	***1.3***
Cadmium	mg/kg	965	***1.1***	***0.85***	***0.6***	***0.52***	***0.54***	***0.44***	***0.73***	***0.74***	***1.1***	***0.76***	***0.84***	***0.72***	***0.59***
Chromium	mg/kg	111	***35.6***	***23.4***	***15.7***	***19.7***	***18.8***	***15.2***	***21.7***	***23.8***	***34***	***31.9***	***20.5***	***30.1***	***37***
Copper	mg/kg	81,700	***12.7***	***9.9***	***11.5***	***9.4***	***9.5***	***10.6***	***11***	***13.4***	***21.3***	***13.1***	***18.8***	***18***	***20.6***
Lead	mg/kg	1,000	***14***	***12***	***14.8***	***10.4***	***10.5***	***11.4***	***15.9***	***14.3***	***21.6***	***14***	***14.9***	***32.4***	***15.5***
Mercury	mg/kg	20	0.051 U	0.051 U	***0.014 J***	0.051 U	0.051 U	***0.015 J***	***0.015 J***	***0.011 J***	***0.036 J***	***0.016 J***	***0.024 J***	***0.034 J***	***0.018 J***
Nickel	mg/kg	32,400	***24.8***	***18.2***	***11.4***	***12***	***13.3***	***11.9***	***16.8***	***21.7***	***35.6***	***21.4***	***13.5***	***28.4***	***32.7***
Selenium	mg/kg	10,200	***0.78***	***0.7***	***0.61***	***0.44***	***0.47***	***0.74***	***0.55***	***0.75***	***1.1***	***0.6***	***0.71***	***0.92***	***0.95***
Silver	mg/kg	10,200	***0.22***	***0.13***	***0.096 J***	***0.1 J***	***0.066 J***	***0.13***	***0.15***	***0.13***	***0.17***	***0.15***	***0.11 J***	***0.13***	***0.19***
Thallium	mg/kg	10	***0.31***	***0.25***	***0.21***	***0.2***	***0.22***	***0.25***	***0.27***	***0.25***	***0.5***	***0.32***	***0.2***	***0.25***	***0.28***
Zinc	mg/kg	613,000	***63.3***	***50.8***	***40.1***	***37.7***	***34.9***	***29.8***	***34.2***	***42.5***	***60.6***	***49.1***	***47.8***	***49.2***	***47.1***

Notes:

Bold / Italics = compound was detected

Highlighted = Concentration exceeds screening level

bgs = below ground surface

ID = Identification

J = estimated value

mg/kg = milligrams per kilogram

NA = Not analyzed

NS = Not sampled

U = compound was not detected (or qualified as not detected during QA/QC review)

µg/kg = micrograms per kilogram

[1] For source of screening level, see Table 4-1.

Table 4-3
Surface Soil Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	RISS-14/SS01	RISS-15/SS01	RISS-16/SS01	RISS-17/SS01	RISS-18/SS01	RISS-19/SS01	RISS-20/SS01	RISS-21/SS01	RISS-22/SS01	RISS-23/SS01	RISS-24/SS01	RISS-25/SS01	RISS-26/SS01
		Lab Number(s):	G1L190420-003	G1L190420-002	G1L190420-012	G1L160505-004	G1L160522-003	G1L160522-008	G1L160518-009	G1L190420-006	G1L160513-002	G1L160529-012	G1L190420-001	G1L190420-013	G1L160529-006
		Date(s) Sampled:	12/15/2011	12/15/2011	12/16/2011	12/13/2011	12/13/2011	12/13/2011	12/12/2011	12/15/2011	12/12/2011	12/15/2011	12/15/2011	12/16/2011	12/15/2011
		Depth (feet bgs):	1.0 -2.0	0.0-1.0	1.0 -2.0	1.0 -2.0	1.0 -2.0	1.0 -2.0	1.0 -2.0	1.0 -2.0	1.0 -2.0	1.0 -2.5	0.5 - 1.5	1.0 -2.0	1.0 -2.0
Parameter	**Units**	**Screening Level[1]**													
Volatile Organic Compounds															
1,1,1,2-Tetrachloroethane	µg/kg	48,800	6.5 U	6.6 U	6.4 U	6.2 U J	6.2 U	6.4 U	6.3 U J	6.3 U	6.4 U J	5.9 U	6.6 U	6.3 U	6.5 U
1,1,2,2-Tetrachloroethane	µg/kg	15,200	6.5 U	6.6 U	6.4 U	6.2 U J	6.2 U	6.4 U	6.3 U J	6.3 U	6.4 U J	5.9 U	6.6 U	6.3 U	6.5 U
1,1,2-Trichloroethane	µg/kg	27,600	6.5 U	6.6 U	6.4 U	6.2 U J	6.2 U	6.4 U	6.3 U J	6.3 U	6.4 U J	5.9 U	6.6 U	6.3 U	6.5 U
1,2,4-Trimethylbenzene	µg/kg	126,000	6.5 U	6.6 U	6.4 U	6.2 U J	6.2 U	6.4 U	6.3 U J	6.3 U	6.4 U J	5.9 U	6.6 U	6.3 U	6.5 U
1,3-Dichlorobenzene	µg/kg	NA	6.5 U	6.6 U	6.4 U	6.2 U J	6.2 U	6.4 U	6.3 U J	6.3 U	6.4 U J	5.9 U	6.6 U	6.3 U	6.5 U
Acetone	µg/kg	406,000,000	26 U	26 U	26 U	25 U J	25 U	25 U	25 U J	25 U	***7.3 J***	24 U	26 U	25 U	26 U
Bromochloromethane	µg/kg	680,000	6.5 U	6.6 U	6.4 U	6.2 U J	6.2 U	6.4 U	6.3 U J	6.3 U	6.4 U J	5.9 U	6.6 U	6.3 U	6.5 U
Chlorobenzene	µg/kg	740,000	6.5 U	6.6 U	6.4 U	6.2 U J	6.2 U	6.4 U	6.3 U J	6.3 U	6.4 U J	5.9 U	6.6 U	6.3 U	6.5 U
cis-1,2-Dichloroethene	µg/kg	194,000	6.5 U	6.6 U	6.4 U	6.2 U J	6.2 U	6.4 U	6.3 U J	6.3 U	6.4 U J	5.9 U	6.6 U	6.3 U	6.5 U
Isopropylbenzene	µg/kg	5,680,000	6.5 U	6.6 U	6.4 U	6.2 U J	6.2 U	6.4 U	6.3 U J	6.3 U	6.4 U J	5.9 U	6.6 U	6.3 U	6.5 U
p-Isopropyltoluene	µg/kg	NA	6.5 U	6.6 U	6.4 U	6.2 U J	6.2 U	6.4 U	***1.2 J***	6.3 U	6.4 U J	5.9 U	6.6 U	6.3 U	6.5 U
sec-Butylbenzene	µg/kg	654,000	6.5 U	6.6 U	6.4 U	6.2 U J	6.2 U	6.4 U	6.3 U J	6.3 U	6.4 U J	5.9 U	6.6 U	6.3 U	6.5 U
tert-Butylbenzene	µg/kg	NA	6.5 U	6.6 U	6.4 U	6.2 U J	6.2 U	6.4 U	6.3 U J	6.3 U	6.4 U J	5.9 U	6.6 U	6.3 U	6.5 U
Tetrachloroethene	µg/kg	210,000	6.5 U	6.6 U	6.4 U	6.2 U J	6.2 U	6.4 U	6.3 U J	6.3 U	6.4 U J	5.9 U	6.6 U	6.3 U	6.5 U
Toluene	µg/kg	29,800,000	6.5 U	6.6 U	6.4 U	6.2 U J	6.2 U	6.4 U	6.3 U J	6.3 U	6.4 U J	5.9 U	6.6 U	6.3 U	6.5 U
trans-1,2-Dichloroethene	µg/kg	333,000	6.5 U	6.6 U	6.4 U	6.2 U J	6.2 U	6.4 U	6.3 U J	6.3 U	6.4 U J	5.9 U	6.6 U	6.3 U	6.5 U
Trichloroethene	µg/kg	9,910	6.5 U	6.6 U	6.4 U	6.2 U J	6.2 U	6.4 U	6.3 U J	6.3 U	6.4 U J	5.9 U	6.6 U	6.3 U	6.5 U
Semivolatile Organic Compounds															
2,4-Dinitrotoluene	µg/kg	79,600	420 U	430 U	420 U	400 U	400 U	420 U	410 U	410 U	410 U	380 U	420 U	410 U	420 U
2,6-Dinitrotoluene	µg/kg	881,000	420 U	430 U	420 U	400 U	400 U	420 U	410 U	410 U	410 U	380 U	420 U	410 U	420 U
Di-n-butyl phthalate	µg/kg	62,000,000	420 U	430 U	420 U	400 U	400 U	420 U	410 U	410 U	410 U	380 U	420 U	***200 J***	420 U
N-Nitrosodiphenylamine	µg/kg	350,000	420 U	430 U	420 U	400 U	400 U	420 U	410 U	410 U	410 U	380 U	420 U	***140 J***	420 U
Perchlorate															
Perchlorate	µg/kg	1,430,000	6.4 U	6.5 U	6.2 U	***2.5 J***	6.3 U	***2.4 J***	6.1 U	0.35 J U	6 U	5.9 U	0.35 J U	***1.2 J***	6.5 U
Explosives															
2,4,6-Trinitrotoluene	mg/kg	440	0.25 U	0.25 U	0.25 U J	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U
2,4-Dinitrotoluene	mg/kg	79.6	0.25 U	0.25 U	0.25 U J	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U
4-Amino-2,6-dinitrotoluene	mg/kg	1,900	0.25 U	0.25 U	0.25 U J	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U
HMX	mg/kg	44,000	0.25 U	0.25 U	0.25 U J	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U
Nitroglycerin	mg/kg	62	0.5 U	0.5 U	0.5 U J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
RDX	mg/kg	224	0.25 U	0.25 U	0.25 U J	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U
Metals															
Antimony	mg/kg	817	***0.54 J***	***0.41 J***	***0.46 J***	***0.47 J***	***0.28 J***	0.76 U	0.75 U	***0.46 J***	***0.38 J***	***0.42 J***	***0.45 J***	***0.54 J***	0.78 U
Arsenic	mg/kg	38	***3.1***	***3.9***	***7.4***	***5.7 J***	***6.8***	***5.2***	***6***	***5.9***	***4.7***	***5***	***6.5 J***	***3.9***	***6.1***
Beryllium	mg/kg	3,650	***0.67***	***0.76***	***1.3***	***1***	***0.98***	***0.94***	***0.86***	***1***	***0.87***	***0.87***	***1.4***	***1.2***	***1.3***
Cadmium	mg/kg	965	***1.3***	***1.1***	***0.77***	***1.4***	***1.1***	***0.6***	***0.64***	***0.63***	***0.61***	***2.2***	***0.82 J***	***0.86***	***0.69***
Chromium	mg/kg	111	***19.8***	***24.4***	***36.6***	***23.9***	***19.4***	***20.6***	***18***	***25.7***	***18.7***	***22.6***	***36.9***	***38.9***	***29.2***
Copper	mg/kg	81,700	***28.4***	***16.5***	***13.8***	***18.8 J***	***12.6***	***11.5***	***12.9***	***12.8***	***10.8***	***27.9***	***13.4 J***	***14.6***	***15***
Lead	mg/kg	1,000	***31.3***	***21.7***	***16.7***	***21.2 J***	***13.5***	***13.6***	***15***	***14.9***	***13.6***	***24.8***	***15.6 J***	***12.2***	***14.4***
Mercury	mg/kg	20	***0.032 J***	***0.024 J***	***0.02 J***	***0.013 J***	***0.02 J***	***0.017 J***	***0.017 J***	***0.018 J***	***0.015 J***	***0.021 J***	***0.018 J***	0.051 U	***0.014 J***
Nickel	mg/kg	32,400	***16.7***	***19***	***27.7***	***22.6 J***	***30.4***	***16.1***	***16.1***	***18***	***14.9***	***18.5***	***29 J***	***31.8***	***23.2***
Selenium	mg/kg	10,200	***0.34 J***	***0.55***	***0.83***	***0.58***	***0.64***	***0.52***	***0.63***	***0.75***	***0.69***	***0.71***	***0.46 J***	***0.68***	***0.76***
Silver	mg/kg	10,200	***0.16***	***0.31***	***0.17***	***0.18***	***0.16***	***0.16***	***0.12 J***	***0.14***	***0.12 J***	***0.22***	***0.14***	***0.19***	***0.17***
Thallium	mg/kg	10	***0.13 J***	***0.17 J***	***0.32***	***0.41***	***0.36***	***0.33***	***0.33***	***0.28***	***0.25***	***0.2***	***0.28***	***0.21***	***0.32***
Zinc	mg/kg	613,000	***72.7***	***69.7***	***52.8***	***83.2 J***	***16.5***	***33.4***	***33.3***	***41***	***29***	***69.7***	***50.3***	***55.6***	***41.7***

Notes:

Bold / Italics = compound was detected

Highlighted = Concentration exceeds screening level

bgs = below ground surface

ID = Identification

J = estimated value

mg/kg = milligrams per kilogram

NA = Not analyzed

NS = Not sampled

U = compound was not detected (or qualified as not detected during QA/QC review)

µg/kg = micrograms per kilogram

[1] For source of screening level, see Table 4-1.

Table 4-3
Surface Soil Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	RISS-27/SS01	RISS-28/SS01	RISS-29/SS01	RISS-30/SS01	RISS-31/SS01	RISS-32/SS01	RISS-33/SS01	RISS-34/SS01	RISS-35/SS01	RISS-36/SS01	RISS-37/SS01	RISS-38/SS01	RISS-39/SS01
		Lab Number(s):	G1L160529-005	G1L160527-012	G1L160513-007	G1L160513-006	G1L160513-005	G1L160513-004	G1L160513-001	G1L160529-011	G1L160518-004	G1L160518-007	G1L160518-005	G1L160518-008	G1L160527-005
		Date(s) Sampled:	12/15/2011	12/14/2011	12/12/2011	12/12/2011	12/12/2011	12/12/2011	12/12/2011	12/15/2011	12/12/2011	12/12/2011	12/12/2011	12/12/2011	12/14/2011
		Depth (feet bgs):	1.0 -2.0	1.0 -2.0	1.0 -2.0	1.0 -2.0	1.0 -2.0	1.0 -2.0	1.0 -2.0	1.0 -2.0	1.0 -2.0	1.0 -2.0	1.0 -2.0	1.0 -2.0	1.0 -2.0
Parameter	**Units**	**Screening Level[1]**													
Volatile Organic Compounds															
1,1,1,2-Tetrachloroethane	µg/kg	48,800	6.5 U	6.2 U	6.3 U J	6.2 U J	6.3 U J	6.3 U J	6.7 U J	7.4 U J	6.2 U	6.3 U	6.4 U	6.6 U	6.2 U
1,1,2,2-Tetrachloroethane	µg/kg	15,200	6.5 U	6.2 U	6.3 U J	6.2 U J	6.3 U J	6.3 U J	6.7 U J	7.4 U J	6.2 U	6.3 U	6.4 U	6.6 U	6.2 U
1,1,2-Trichloroethane	µg/kg	27,600	6.5 U	6.2 U	6.3 U J	6.2 U J	6.3 U J	6.3 U J	6.7 U J	7.4 U J	6.2 U	6.3 U	6.4 U	6.6 U	6.2 U
1,2,4-Trimethylbenzene	µg/kg	126,000	6.5 U	6.2 U	6.3 U J	6.2 U J	6.3 U J	6.3 U J	6.7 U J	7.4 U J	6.2 U	6.3 U	6.4 U	6.6 U	6.2 U
1,3-Dichlorobenzene	µg/kg	NA	6.5 U	6.2 U	6.3 U J	6.2 U J	0.39 J J	6.3 U J	***0.42 J***	7.4 U J	6.2 U	6.3 U	6.4 U	6.6 U	6.2 U
Acetone	µg/kg	406,000,000	26 U	25 U	25 U J	***6.4 J***	25 U J	***6.1 J***	***5.5 J***	30 U J	25 U	25 U	25 U	26 U	25 U
Bromochloromethane	µg/kg	680,000	6.5 U	6.2 U	6.3 U J	6.2 U J	6.3 U J	6.3 U J	6.7 U J	7.4 U J	6.2 U	6.3 U	6.4 U	6.6 U	6.2 U
Chlorobenzene	µg/kg	740,000	6.5 U	6.2 U	6.3 U J	6.2 U J	6.3 U J	6.3 U J	6.7 U J	7.4 U J	6.2 U	6.3 U	6.4 U	6.6 U	6.2 U
cis-1,2-Dichloroethene	µg/kg	194,000	6.5 U	6.2 U	6.3 U J	6.2 U J	6.3 U J	6.3 U J	6.7 U J	7.4 U J	6.2 U	6.3 U	6.4 U	6.6 U	6.2 U
Isopropylbenzene	µg/kg	5,680,000	6.5 U	6.2 U	6.3 U J	6.2 U J	6.3 U J	6.3 U J	6.7 U J	7.4 U J	6.2 U	6.3 U	6.4 U	***1.4 J***	6.2 U
p-Isopropyltoluene	µg/kg	NA	6.5 U	6.2 U	6.3 U J	6.2 U J	6.3 U J	6.3 U J	6.7 U J	7.4 U J	6.2 U	6.3 U	6.4 U	***16***	***2 J***
sec-Butylbenzene	µg/kg	654,000	6.5 U	6.2 U	6.3 U J	6.2 U J	6.3 U J	6.3 U J	6.7 U J	7.4 U J	6.2 U	6.3 U	6.4 U	***2.7 J***	6.2 U
tert-Butylbenzene	µg/kg	NA	6.5 U	6.2 U	6.3 U J	6.2 U J	6.3 U J	6.3 U J	6.7 U J	7.4 U J	6.2 U	6.3 U	6.4 U	***1.1 J***	6.2 U
Tetrachloroethene	µg/kg	210,000	6.5 U	6.2 U	6.3 U J	6.2 U J	6.3 U J	6.3 U J	6.7 U J	7.4 U J	6.2 U	6.3 U	6.4 U	6.6 U	6.2 U
Toluene	µg/kg	29,800,000	6.5 U	6.2 U	6.3 U J	6.2 U J	6.3 U J	6.3 U J	***2.4 J***	7.4 U J	6.2 U	6.3 U	6.4 U	6.6 U	6.2 U
trans-1,2-Dichloroethene	µg/kg	333,000	6.5 U	6.2 U	6.3 U J	6.2 U J	6.3 U J	6.3 U J	6.7 U J	7.4 U J	6.2 U	6.3 U	6.4 U	6.6 U	6.2 U
Trichloroethene	µg/kg	9,910	6.5 U	6.2 U	6.3 U J	6.2 U J	6.3 U J	6.3 U J	6.7 U J	7.4 U J	6.2 U	6.3 U	6.4 U	6.6 U	6.2 U
Semivolatile Organic Compounds															
2,4-Dinitrotoluene	µg/kg	79,600	420 U	400 U	410 U	410 U	420 U	400 U	450 U	490 U	400 U	410 U	420 U	420 U	400 U
2,6-Dinitrotoluene	µg/kg	881,000	420 U	400 U	410 U	410 U	420 U	400 U	450 U	490 U	400 U	410 U	420 U	420 U	400 U
Di-n-butyl phthalate	µg/kg	62,000,000	420 U	400 U	410 U	410 U	420 U	400 U	450 U	490 U	400 U	410 U	420 U	420 U	400 U
N-Nitrosodiphenylamine	µg/kg	350,000	420 U	400 U	410 U	410 U	420 U	400 U	450 U	490 U	400 U	410 U	420 U	420 U	400 U
Perchlorate															
Perchlorate	µg/kg	1,430,000	6.3 U	***0.6 J***	***0.51 J***	6.2 U	6 U	6.3 U	6.6 U	7.4 U	6.2 U	6.3 U	***0.86 J***	***0.47 J***	***0.64 J***
Explosives															
2,4,6-Trinitrotoluene	mg/kg	440	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U
2,4-Dinitrotoluene	mg/kg	79.6	0.25 U	***0.14 J***	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U
4-Amino-2,6-dinitrotoluene	mg/kg	1,900	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U
HMX	mg/kg	44,000	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U
Nitroglycerin	mg/kg	62	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
RDX	mg/kg	224	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U
Metals															
Antimony	mg/kg	817	0.78 U	***0.35 J***	0.76 U	***0.35 J***	***0.4 J***	***0.33 J***	***0.55 J***	0.89 U	***0.35 J***	***0.38 J***	0.76 U	***0.26 J***	***0.25 J***
Arsenic	mg/kg	38	***6.4***	***5.3***	***2***	***5.3***	***5.4***	***5.8***	***8.2***	***6.4***	***5.9***	***5.2***	***3.3***	***6.9***	***5.2***
Beryllium	mg/kg	3,650	***1.3***	***1***	***0.72***	***0.92***	***0.91***	***1.1***	***1.3***	***1.1***	***1.1***	***0.9***	***1.6***	***1.1***	***1***
Cadmium	mg/kg	965	***0.74***	***0.67***	***0.58***	***0.67***	***0.63***	***0.6***	***0.72***	***1***	***0.72***	***0.62***	***0.67***	***0.6***	***0.74***
Chromium	mg/kg	111	***35.2***	***25***	***19.1***	***21.1***	***20.2***	***21.7***	***31.1***	***29***	***22.3***	***21.1***	***24***	***21.7***	***23***
Copper	mg/kg	81,700	***17.9***	***12.6***	***10***	***11.1***	***12.1***	***12.1***	***15.2***	***13.3***	***12.9***	***9.7***	***14.4***	***14.3***	***15.2***
Lead	mg/kg	1,000	***16.8***	***13.8***	***11.5***	***13.3***	***12.2***	***16.7***	***22.1***	***13.9***	***13.9***	***13.5***	***14.1***	***13.2***	***14.7***
Mercury	mg/kg	20	***0.015 J***	***0.02 J***	***0.014 J***	***0.018 J***	***0.011 J***	***0.014 J***	***0.026 J***	0.059 U	***0.018 J***	0.051 U	0.051 U	***0.014 J***	***0.016 J***
Nickel	mg/kg	32,400	***30***	***18.6***	***14.2***	***16.6***	***15.1***	***17***	***25.7***	***22.3***	***19.5***	***15.7***	***21.6***	***19.5***	***20.7***
Selenium	mg/kg	10,200	***0.77***	***0.74***	***0.43***	***0.73***	***0.6***	***0.75***	***0.55***	***0.98***	***0.73***	***0.96***	***0.47***	***0.96***	***0.8***
Silver	mg/kg	10,200	***0.17***	***0.15***	***0.097 J***	***0.12***	***0.13***	***0.17***	***0.16***	***0.16***	***0.19***	***0.13***	***0.15***	***0.19***	***0.15***
Thallium	mg/kg	10	***0.3***	***0.29***	***0.22***	***0.27***	***0.29***	***0.34***	***0.35***	***0.26***	***0.32***	***0.29***	***0.48***	***0.33***	***0.32***
Zinc	mg/kg	613,000	***40.7***	***46.6***	***37***	***43.8***	***38.9***	***32.9***	***27.7***	***67.6***	***23.4***	***29.9***	***47.9***	***37.9***	***55.1***

Notes:

Bold / Italics = compound was detected
Highlighted = Concentration exceeds screening level
bgs = below ground surface
ID = Identification
J = estimated value
mg/kg = milligrams per kilogram

NA = Not analyzed
NS = Not sampled
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/kg = micrograms per kilogram
[1] For source of screening level, see Table 4-1.

Table 4-3
Surface Soil Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	RISS-40/SS01	RISS-41/SS01	RISS-42/SS01
		Lab Number(s):	G1L160527-001	G1L160518-006	G1L160522-009
		Date(s) Sampled:	12/14/2011	12/12/2011	12/13/2011
		Depth (feet bgs):	1.0 -2.0	1.0 -2.0	1.0 -2.0
Parameter	**Units**	**Screening Level**[1]			
Volatile Organic Compounds					
1,1,1,2-Tetrachloroethane	µg/kg	48,800	6.3 U	6.3 U J	6.2 U
1,1,2,2-Tetrachloroethane	µg/kg	15,200	6.3 U	6.3 U J	6.2 U
1,1,2-Trichloroethane	µg/kg	27,600	6.3 U	6.3 U J	6.2 U
1,2,4-Trimethylbenzene	µg/kg	126,000	6.3 U	6.3 U J	6.2 U
1,3-Dichlorobenzene	µg/kg	NA	***0.39 J***	6.3 U J	6.2 U
Acetone	µg/kg	406,000,000	25 U	25 U J	25 U
Bromochloromethane	µg/kg	680,000	6.3 U	6.3 U J	6.2 U
Chlorobenzene	µg/kg	740,000	6.3 U	6.3 U J	6.2 U
cis-1,2-Dichloroethene	µg/kg	194,000	6.3 U	6.3 U J	6.2 U
Isopropylbenzene	µg/kg	5,680,000	6.3 U	6.3 U J	6.2 U
p-Isopropyltoluene	µg/kg	NA	6.3 U	6.3 U J	6.2 U
sec-Butylbenzene	µg/kg	654,000	6.3 U	6.3 U J	6.2 U
tert-Butylbenzene	µg/kg	NA	6.3 U	6.3 U J	6.2 U
Tetrachloroethene	µg/kg	210,000	6.3 U	6.3 U J	6.2 U
Toluene	µg/kg	29,800,000	6.3 U	6.3 U J	6.2 U
trans-1,2-Dichloroethene	µg/kg	333,000	6.3 U	6.3 U J	6.2 U
Trichloroethene	µg/kg	9,910	6.3 U	6.3 U J	6.2 U
Semivolatile Organic Compounds					
2,4-Dinitrotoluene	µg/kg	79,600	410 U	420 U	***690***
2,6-Dinitrotoluene	µg/kg	881,000	410 U	420 U	410 U
Di-n-butyl phthalate	µg/kg	62,000,000	***130 J***	420 U	***820***
N-Nitrosodiphenylamine	µg/kg	350,000	410 U	420 U	410 U
Perchlorate					
Perchlorate	µg/kg	1,430,000	***0.5 J***	6.2 U	***6.8***
Explosives					
2,4,6-Trinitrotoluene	mg/kg	440	0.25 U	0.25 U	0.25 U
2,4-Dinitrotoluene	mg/kg	79.6	0.25 U	0.25 U	0.25 U
4-Amino-2,6-dinitrotoluene	mg/kg	1,900	0.25 U	0.25 U	0.25 U
HMX	mg/kg	44,000	0.25 U	0.25 U	0.25 U
Nitroglycerin	mg/kg	62	0.5 U	0.5 U	***0.23 J***
RDX	mg/kg	224	0.25 U	0.25 U	0.25 U
Metals					
Antimony	mg/kg	817	***0.39 J***	***0.29 J***	***0.93***
Arsenic	mg/kg	38	***6.2***	***4.7 J***	***6.4***
Beryllium	mg/kg	3,650	***1***	***0.92***	***1.1***
Cadmium	mg/kg	965	***1.1***	***0.54***	***0.76***
Chromium	mg/kg	111	***28.4***	***20.4***	***24.9***
Copper	mg/kg	81,700	***23***	***11.5 J***	***32.7***
Lead	mg/kg	1,000	***15***	***10.7 J***	***37.8***
Mercury	mg/kg	20	***0.018 J***	***0.017 J***	***0.022 J***
Nickel	mg/kg	32,400	***25.7***	***13.2 J***	***19.4***
Selenium	mg/kg	10,200	***0.84***	***0.86***	***0.76***
Silver	mg/kg	10,200	***0.16***	***0.15***	***0.18***
Thallium	mg/kg	10	***0.3***	***0.29***	***0.35***
Zinc	mg/kg	613,000	***52.5***	***29.5 J***	***56.8 J***

Notes:
Bold / Italics = compound was detected
Highlighted = Concentration exceeds screening level
bgs = below ground surface
ID = Identification
J = estimated value
mg/kg = milligrams per kilogram
NA = Not analyzed
NS = Not sampled
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/kg = micrograms per kilogram
[1] For source of screening level, see Table 4-1.

Table 4-4
MIS Soil Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	MIS-01/SS01	MIS-02/SS01	MIS-03/SS01	MIS-04/SS01
		Lab Number(s):	G2B030499-001	G2B030499-002	G2B030499-003	G2B030499-004
		Date(s) Sampled:	2/1/2012	2/1/2012	2/1/2012	2/1/2012
		Depth (feet bgs):	0.00 - 0.25	0.00 - 0.25	0.00 - 0.25	0.00 - 0.25
Parameter	**Units**	**Screening Level[1]**				
Explosives						
2,4,6-Trinitrotoluene	mg/kg	440	0.25 U	***0.08 J***	***0.34 J***	***1.1 J***
2,4-Dinitrotoluene	mg/kg	79.6	***10***	***9.4***	***15***	***32***
2,6-Dinitrotoluene	mg/kg	881	***0.27***	***0.38 J***	***0.1 J***	***0.71 J***
4-Nitrotoluene	mg/kg	110	0.25 U	0.25 U	***0.024 J***	0.25 U
HMX	mg/kg	44,000	0.25 U	***0.27***	0.24 U	***0.59***
Nitroglycerin	mg/kg	62	***11 J***	***2.8 J***	***1.1 J***	***26 J***
RDX	mg/kg	224	0.25 U	***0.044 J***	0.24 U J	***1.9 J***

Notes:
Bold / Italics = compound was detected
Highlighted = Concentration exceeds screening level
bgs = below ground surface
ID = Identification
J = estimated value
mg/kg = milligrams per kilogram
U = compound was not detected (or qualified as not detected during QA/QC review)
[1] For source of screening level, see Table 4-1.

Table 4-5
Subsurface Soil Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	BDSS-03/SB01	BDSS-03/SB02	BDSS-13/SB01	BDSS-20/SB01	BDSS-20/SB02	BDSS-22/SB01	BDSS-22/SB02	MD-16/SB02	MD-25/SB03	MD-26/SB03	MD-31/SB03	MD-33/SB03
		Lab Number(s):	G1L210482-006	G1L210482-007	G1L190422-007	G1L160505-008	G1L160505-009	G1L160505-002	G1L160505-003	13012083	13011890	13011891	13011887	13012082
		Date(s) Sampled:	12/19/2011	12/19/2011	12/16/2011	12/13/2011	12/13/2011	12/13/2011	12/13/2011	1/30/2013	1/28/2013	1/28/2013	1/28/2013	1/30/2013
		Depth (feet bgs):	5.0 - 6.0	9.0 - 10.0	3.0 - 4.0	5.5 - 6.5	9.0 - 10.0	5.5 - 6.5	8.5 - 9.5	6.0	10.0	11.5	10.0	3.0
Parameter	**Units**	**Screening Level[1]**												
Volatile Organic Compounds														
1,1,2,2-Tetrachloroethane	µg/kg	15,200	6.1 U	6.2 U	6.2 U	6 U	6 U J	5.8 U	6.1 U J	6.0 U	***3,200 J***	***200 J***	***250***	***1,060***
1,1,2-Trichloroethane	µg/kg	27,600	6.1 U	6.2 U	6.2 U	6 U	6 U J	5.8 U	6.1 U J	6.0 U	***270 J***	***78 J***	***7.9 J***	40 U
Acetone	µg/kg	406,000,000	25 U	25 U	25 U	24 U	24 U J	23 U	24 U J	***6 J***	8,000 U	8,000 U	800 U	700 U
Bromochloromethane	µg/kg	680,000	6.1 U	6.2 U	6.2 U	6 U	6 U J	5.8 U	6.1 U J	***10 J***	***100 J***	***100 J***	***10 J***	***7 J***
Chloroform	µg/kg	7,140	6.1 U	6.2 U	6.2 U	6 U	6 U J	5.8 U	6.1 U J	6.0 U	***300 J***	***300 J***	10 J U	10 J U
cis-1,2-Dichloroethene	µg/kg	194,000	6.1 U	6.2 U	6.2 U	6 U	6 U J	5.8 U	6.1 U J	***0.4 J***	***2,600***	***300 J***	***60***	40 U
Methylene chloride	µg/kg	267,000	6.1 U	6.2 U	6.2 U	6 U	6 U J	5.8 U	6.1 U J	6.0 U	***110 J***	***100 J***	10 J U	8.6 J U
Styrene	µg/kg	20,400,000	6.1 U	6.2 U	6.2 U	6 U	6 U J	5.8 U	6.1 U J	6.0 U	***72 J***	***70 J***	40 U	40 U
Tetrachloroethene	µg/kg	210,000	6.1 U	6.2 U	6.2 U	6 U	6 U J	5.8 U	6.1 U J	6.0 U	***600***	***500***	***30 J***	40 U
Toluene	µg/kg	29,800,000	6.1 U	6.2 U	6.2 U	6 U	6 U J	5.8 U	6.1 U J	6.0 U	***190 J***	***190 J***	8.6 J U	7.3 J U
trans-1,2-Dichloroethene	µg/kg	333,000	6.1 U	6.2 U	6.2 U	6 U	6 U J	5.8 U	6.1 U J	6.0 U	***700 J***	***100 J***	***20 J***	40 U
Trichloroethene	µg/kg	9,910	6.1 U	***1.1 J***	6.2 U	6 U	6 U J	5.8 U	6.1 U J	***40***	***181,000***	***84,500***	***4,550***	***1,450***
Semivolatile Organic Compounds														
	µg/kg		ND	ND	ND	ND	ND	ND	ND	NS	NS	NS	NS	ND
Perchlorate														
Perchlorate	µg/kg	1,430,000	6 U	***0.87 J***	***1.3 J***	***8.7***	***14***	***1.8 J***	***5.4 J***	NS	NS	NS	NS	NS
Explosives														
HMX	mg/kg	44,000	0.25 U	0.25 U	***0.035 J***	0.25 U	0.25 U	0.25 U	0.25 U	NS	NS	NS	NS	NS
Metals														
Antimony	mg/kg	817	***0.34 J***	***0.26 J***	***1.2***	***0.33 J***	***0.24 J***	***0.25 J***	***0.32 J***	NS	NS	NS	NS	NS
Arsenic	mg/kg	38	***5.9***	***4.7***	***6.3***	***4.9***	***3.8***	***2.9***	***3.6***	NS	NS	NS	NS	NS
Beryllium	mg/kg	3,650	***1***	***0.97***	***1.5***	***0.95***	***0.88***	***0.68***	***0.79***	NS	NS	NS	NS	NS
Cadmium	mg/kg	965	***1***	***0.56***	***2.4***	***0.97***	***0.71***	***0.58***	***0.57***	NS	NS	NS	NS	NS
Chromium	mg/kg	111	***23.9***	***25.7***	***40.3***	***19.7***	***20.7***	***15***	***18.3***	NS	NS	NS	NS	NS
Copper	mg/kg	81,700	***13.9***	***11.6***	***61.1 J***	***10.1***	***10***	***7.1***	***7.5***	NS	NS	NS	NS	NS
Lead	mg/kg	1,000	***13.8***	***11.3***	***44.2***	***12.9***	***11.1***	***9.4***	***9.9***	NS	NS	NS	NS	NS
Mercury	mg/kg	20	***0.02 J***	***0.012 J***	***0.054 J***	***0.02 J***	0.048 U	***0.011 J***	0.048 U	NS	NS	NS	NS	NS
Nickel	mg/kg	32,400	***18.8***	***16.9***	***41.1***	***18***	***13.2***	***8.7***	***14.6***	NS	NS	NS	NS	NS
Selenium	mg/kg	10,200	***0.52***	***0.45***	***0.76***	***0.77***	***0.84***	***0.42***	***0.61***	NS	NS	NS	NS	NS
Silver	mg/kg	10,200	***0.16***	***0.1 J***	***0.25***	***0.18***	***0.13***	***0.12***	***0.12***	NS	NS	NS	NS	NS
Thallium	mg/kg	10	***0.31***	***0.2***	***0.37***	***0.23***	***0.24***	***0.15 J***	***0.23***	NS	NS	NS	NS	NS
Zinc	mg/kg	613,000	***43.1***	***38.8***	***113***	***22.9***	***27.7***	***23.9***	***32.5***	NS	NS	NS	NS	NS

Notes:
Bold / Italics = compound was detected
Highlighted = Concentration exceeds screening level
bgs = below ground surface
ID = Identification
J = estimated value
mg/kg = milligrams per kilogram
NA = Not analyzed
ND = Not Detected
NS = Not sampled
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/kg = micrograms per kilogram
[1] For source of screening level, see Table 4-1.

Table 4-5
Subsurface Soil Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	RISB-01/SB01	RISB-01/SB02	RISB-02/SB01	RISB-02/SB02	RISB-03/SB01	RISB-03/SB02	RISB-04/SB01	RISB-04/SB02	RISB-05/SB01	RISB-05/SB02	RISB-06/SB01
		Lab Number(s):	G1L160529-008	G1L160529-010	G1L160513-008	G1L160513-009	G1L160518-002	G1L160518-003	G1L210484-008	G1L210484-010	G1L210484-005	G1L210484-006	G1L210484-002
		Date(s) Sampled:	12/15/2011	12/15/2011	12/12/2011	12/12/2011	12/12/2011	12/12/2011	12/19/2011	12/19/2011	12/19/2011	12/19/2011	12/19/2011
		Depth (feet bgs):	4.5 - 5.5	8.0 - 9.0	5.0 - 6.0	8.0 - 9.0	6.0 - 8.0	9.0 - 10.0	5.0 - 6.0	9.0 - 10.0	5.0 - 6.0	9.0 - 10.0	5.0 - 6.0
Parameter	**Units**	**Screening Level[1]**											
Volatile Organic Compounds													
1,1,2,2-Tetrachloroethane	µg/kg	15,200	5.8 U	6 U	6 U J	6.2 U J	6.1 U	6.4 U	5.9 U	6.3 U	6 U	6.5 U	6.2 U
1,1,2-Trichloroethane	µg/kg	27,600	5.8 U	6 U	6 U J	6.2 U J	6.1 U	6.4 U	5.9 U	6.3 U	6 U	6.5 U	6.2 U
Acetone	µg/kg	406,000,000	2.5 J U	24 U	24 U J	***5.6 J***	24 U	26 U	24 U	***3.8 J***	24 U	26 U	25 U
Bromochloromethane	µg/kg	680,000	5.8 U	6 U	6 U J	6.2 U J	6.1 U	6.4 U	5.9 U	6.3 U	6 U	6.5 U	6.2 U
Chloroform	µg/kg	7,140	5.8 U	6 U	6 U J	6.2 U J	6.1 U	6.4 U	5.9 U	6.3 U	6 U	6.5 U	6.2 U
cis-1,2-Dichloroethene	µg/kg	194,000	5.8 U	6 U	6 U J	6.2 U J	6.1 U	6.4 U	5.9 U	6.3 U	6 U	6.5 U	6.2 U
Methylene chloride	µg/kg	267,000	5.8 U	6 U	6 U J	6.2 U J	6.1 U	6.4 U	5.9 U	6.3 U	6 U	6.5 U	6.2 U
Styrene	µg/kg	20,400,000	5.8 U	6 U	6 U J	6.2 U J	6.1 U	6.4 U	5.9 U	6.3 U	6 U	6.5 U	6.2 U
Tetrachloroethene	µg/kg	210,000	5.8 U	6 U	6 U J	6.2 U J	6.1 U	6.4 U	5.9 U	6.3 U	6 U	6.5 U	6.2 U
Toluene	µg/kg	29,800,000	5.8 U	6 U	6 U J	6.2 U J	6.1 U	6.4 U	5.9 U	6.3 U	6 U	6.5 U	6.2 U
trans-1,2-Dichloroethene	µg/kg	333,000	5.8 U	6 U	6 U J	6.2 U J	6.1 U	6.4 U	5.9 U	6.3 U	6 U	6.5 U	6.2 U
Trichloroethene	µg/kg	9,910	5.8 U	6 U	6 U J	6.2 U J	6.1 U	6.4 U	5.9 U	6.3 U	6 U	***1.3 J***	6.2 U
Semivolatile Organic Compounds													
	µg/kg		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Perchlorate													
Perchlorate	µg/kg	1,430,000	5.7 U	5.9 U	6 U	6 U	***0.32 J***	***1.6 J***	5.9 U	6.3 U	5.9 U	***1.1 J***	***1.4 J***
Explosives													
HMX	mg/kg	44,000	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.24 U	0.24 U	0.25 U	0.25 U	0.25 U
Metals													
Antimony	mg/kg	817	0.7 U	0.72 U	0.72 U	0.74 U	***0.24 J***	0.77 U	***0.32 J***	***0.34 J***	***0.32 J***	0.78 U	***0.37 J***
Arsenic	mg/kg	38	***6.6***	***4.7***	***3.7***	***3.6***	***4.3***	***4.3***	***7.6***	***5.6***	***5.3***	***6.1***	***5.5***
Beryllium	mg/kg	3,650	***1.1***	***1.1***	***0.78***	***0.7***	***0.71***	***0.79***	***0.91***	***0.97***	***1***	***1.1***	***1.1***
Cadmium	mg/kg	965	***1.3***	***1.1***	***0.69***	***0.65***	***0.78***	***0.78***	***1.5***	***0.92***	***0.66***	***0.58***	***1.1***
Chromium	mg/kg	111	***26.5***	***23.9***	***16.2***	***14.5***	***15.7***	***14.7***	***20.6***	***20.7***	***26.6***	***28.1***	***25.4***
Copper	mg/kg	81,700	***15***	***15.4***	***9.8***	***10.1***	***10.2***	***12.2***	***12***	***13.1***	***13.6***	***13.3***	***14.9***
Lead	mg/kg	1,000	***16.5***	***14.4***	***10.6***	***11.3***	***12.6***	***15.7***	***17.4***	***12.7***	***13.8***	***14.5***	***13.4***
Mercury	mg/kg	20	***0.014 J***	***0.017 J***	0.048 U	0.049 U	0.049 U	0.051 U	***0.012 J***	***0.02 J***	***0.022 J***	***0.013 J***	***0.021 J***
Nickel	mg/kg	32,400	***23.6***	***26.1***	***13.5***	***12.8***	***12.3***	***13.1***	***32.6***	***18.9***	***21.2***	***29***	***19.8***
Selenium	mg/kg	10,200	***0.55***	***0.59***	***0.47***	***0.48***	***0.44***	***0.49***	***0.37***	***0.51***	***0.49***	***0.46***	***0.58***
Silver	mg/kg	10,200	***0.21***	***0.19***	***0.12***	***0.11 J***	***0.14***	***0.12 J***	***0.17***	***0.16***	***0.12***	***0.093 J***	***0.22***
Thallium	mg/kg	10	***0.33***	***0.37***	***0.25***	***0.26***	***0.28***	***0.31***	***0.36***	***0.27***	***0.26***	***0.21***	***0.34***
Zinc	mg/kg	613,000	***46.8***	***45.4***	***28.8***	***31.6***	***34.7***	***38***	***34.8***	***42.9***	***38.9***	***36.2***	***42.8***

Notes:
Bold / Italics = compound was detected
Highlighted = Concentration exceeds screening level
bgs = below ground surface
ID = Identification
J = estimated value
mg/kg = milligrams per kilogram
NA = Not analyzed
ND = Not Detected
NS = Not sampled
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/kg = micrograms per kilogram
[1] For source of screening level, see Table 4-1.

Table 4-5
Subsurface Soil Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	RISB-06/SB02	RISB-07/SB01	RISB-07/SB02	RISB-08/SB01	RISS-17/SB01	RISS-17/SB02	RISB-18/SB01	RISB-18/SB02	RISB-19/SB01	RISB-19/SB02	RISB-20/SB01
		Lab Number(s):	G1L210484-003	G1L210482-010	G1L210482-011	G1L160527-011	G1L160505-005	G1L160505-006	G1L160522-004	G1L160522-005	G1L160522-006	G1L160522-007	G1L160513-011
		Date(s) Sampled:	12/19/2011	12/19/2011	12/19/2011	12/14/2011	12/13/2011	12/13/2011	12/13/2011	12/13/2011	12/13/2011	12/13/2011	12/12/2011
		Depth (feet bgs):	8.0 - 9.5	5.0 - 6.0	9.0 - 10.0	4.0 - 5.0	5.0 - 6.0	8.5 - 9.0	4.0 - 5.0	8.0 - 9.0	4.0 - 5.0	8.5 - 9.0	5.0 - 6.0
Parameter	**Units**	**Screening Level[1]**											
Volatile Organic Compounds													
1,1,2,2-Tetrachloroethane	µg/kg	15,200	6.4 U J	6 U	6.3 U	***3.4 J***	5.9 U J	6.2 U	6 U	6 U	5.9 U	5.9 U	6.1 U J
1,1,2-Trichloroethane	µg/kg	27,600	6.4 U J	6 U	6.3 U	6 U J	5.9 U J	6.2 U	6 U	6 U	5.9 U	5.9 U	6.1 U J
Acetone	µg/kg	406,000,000	26 U J	24 U	25 U	24 U J	24 U J	25 U	24 U	24 U	***3.3 J***	24 U	***7.9 J***
Bromochloromethane	µg/kg	680,000	6.4 U J	6 U	6.3 U	6 U J	5.9 U J	6.2 U	6 U	6 U	5.9 U	5.9 U	6.1 U J
Chloroform	µg/kg	7,140	6.4 U J	6 U	6.3 U	6 U J	5.9 U J	6.2 U	6 U	6 U	5.9 U	5.9 U	6.1 U J
cis-1,2-Dichloroethene	µg/kg	194,000	6.4 U J	6 U	6.3 U	6 U J	5.9 U J	6.2 U	6 U	6 U	5.9 U	5.9 U	6.1 U J
Methylene chloride	µg/kg	267,000	6.4 U J	6 U	6.3 U	6 U J	5.9 U J	6.2 U	6 U	6 U	5.9 U	5.9 U	6.1 U J
Styrene	µg/kg	20,400,000	6.4 U J	6 U	6.3 U	6 U J	5.9 U J	6.2 U	6 U	6 U	5.9 U	5.9 U	6.1 U J
Tetrachloroethene	µg/kg	210,000	6.4 U J	6 U	6.3 U	6 U J	5.9 U J	6.2 U	6 U	6 U	5.9 U	5.9 U	6.1 U J
Toluene	µg/kg	29,800,000	6.4 U J	6 U	6.3 U	6 U J	5.9 U J	6.2 U	6 U	6 U	5.9 U	5.9 U	6.1 U J
trans-1,2-Dichloroethene	µg/kg	333,000	6.4 U J	6 U	6.3 U	6 U J	5.9 U J	6.2 U	6 U	6 U	5.9 U	5.9 U	6.1 U J
Trichloroethene	µg/kg	9,910	6.4 U J	6 U	6.3 U	***3.4 J***	5.9 U J	***10***	6 U	6 U	5.9 U	5.9 U	6.1 U J
Semivolatile Organic Compounds													
	µg/kg		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Perchlorate													
Perchlorate	µg/kg	1,430,000	***3 J***	6 U	***0.53 J***	***0.7 J***	***75***	***450***	***1.5 J***	***0.7 J***	***340***	***800***	6.1 U
Explosives													
HMX	mg/kg	44,000	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U
Metals													
Antimony	mg/kg	817	***0.42 J***	***0.26 J***	***0.29 J***	0.72 U	***0.31 J***	***0.29 J***	***0.29 J***	***0.27 J***	0.71 U	0.71 U	***0.32 J***
Arsenic	mg/kg	38	***5.9 J***	***5.7***	***4.3***	***8.7***	***4.1***	***4***	***3.7***	***3.3***	***4.8***	***3.3***	***7.2***
Beryllium	mg/kg	3,650	***1.1***	***0.94***	***1.2***	***1***	***0.98***	***0.85***	***0.75***	***0.68***	***0.94***	***0.67***	***1.2***
Cadmium	mg/kg	965	***0.72 J***	***0.91***	***0.61***	***0.98***	***0.8***	***0.64***	***0.7***	***0.58***	***0.56***	***0.56***	***0.82***
Chromium	mg/kg	111	***22.3***	***19.5***	***31.1***	***23.6***	***23.2***	***20***	***17***	***14.9***	***18.2***	***14.2***	***19.3***
Copper	mg/kg	81,700	***13.2 J***	***13.2***	***13.5***	***22.1***	***10.7***	***7.7***	***10.1***	***8***	***9.7***	***7.9***	***11.5***
Lead	mg/kg	1,000	***11.9 J***	***16***	***12.5***	***16.7***	***12***	***10.1***	***10.7***	***11.6***	***18***	***9.6***	***14***
Mercury	mg/kg	20	***0.015 J***	***0.019 J***	***0.019 J***	***0.022 J***	0.048 U	0.05 U	***0.016 J***	0.048 U	***0.021 J***	***0.011 J***	***0.018 J***
Nickel	mg/kg	32,400	***19.4 J***	***26.8***	***20.2***	***21.8***	***16.2***	***16.9***	***14.1***	***15.1***	***15.7***	***10.3***	***13.8***
Selenium	mg/kg	10,200	***0.38 J***	***0.45***	***0.54***	***0.54***	***0.82***	***0.65***	***0.39***	***0.34 J***	***0.67***	***0.45***	***0.57***
Silver	mg/kg	10,200	***0.13***	***0.12***	***0.11 J***	***0.21***	***0.15***	***0.12***	***0.14***	***0.1 J***	***0.12***	***0.11 J***	***0.16***
Thallium	mg/kg	10	***0.26 J***	***0.35***	***0.25***	***0.36***	***0.25***	***0.23***	***0.21***	***0.23***	***0.29***	***0.17 J***	***0.28***
Zinc	mg/kg	613,000	***37.7 J***	***32.1***	***42***	***56.8***	***26.8***	***35.5***	***29.2***	***24.3***	***25.3***	***23.9***	***32.6***

Notes:
Bold / Italics = compound was detected
Highlighted = Concentration exceeds screening level
bgs = below ground surface
ID = Identification
J = estimated value
mg/kg = milligrams per kilogram
NA = Not analyzed
ND = Not Detected
NS = Not sampled
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/kg = micrograms per kilogram
[1] For source of screening level, see Table 4-1.

Table 4-5
Subsurface Soil Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	RISB-20/SB02	RISB-21/SB01	RISB-22/SB01	RISB-23/SB01	RISB-23/SB02	RISB-24/SB01	RISB-24/SB02	RISB-39/SB01	RISB-39/SB02	RISB-40/SB01	RISB-40/SB02
		Lab Number(s):	G1L160518-010	G1L190420-007	G1L160513-003	G1L160529-013	G1L160529-014	G1L160522-001	G1L160522-002	G1L160527-006	G1L160527-007	G1L160527-003	G1L160527-004
		Date(s) Sampled:	12/12/2011	12/15/2011	12/12/2011	12/15/2011	12/15/2011	12/13/2011	12/13/2011	12/14/2011	12/14/2011	12/14/2011	12/14/2011
		Depth (feet bgs):	9.0 - 10.0	5.0 - 6.0	3.0 - 4.0	4.5 - 5.0	8.0 - 9.0	4.6 - 5.4	8.0 - 9.0	4.0 - 5.0	8.0 -9.0	4.0 - 5.0	8.0 -9.0
Parameter	**Units**	**Screening Level[1]**											
Volatile Organic Compounds													
1,1,2,2-Tetrachloroethane	µg/kg	15,200	6 U J	6.3 U	5.8 U J	5.9 U	6 U	6.3 U J	6.3 U	5.8 U	6.4 U J	5.9 U	5.8 U
1,1,2-Trichloroethane	µg/kg	27,600	6 U J	6.3 U	5.8 U J	5.9 U	6 U	6.3 U J	6.3 U	5.8 U	6.4 U J	5.9 U	5.8 U
Acetone	µg/kg	406,000,000	24 U J	25 U	***2.7 J***	24 U	24 U	***12 J***	25 U	23 U	25 U J	24 U	23 U
Bromochloromethane	µg/kg	680,000	6 U J	6.3 U	5.8 U J	5.9 U	6 U	6.3 U J	6.3 U	5.8 U	6.4 U J	5.9 U	5.8 U
Chloroform	µg/kg	7,140	6 U J	6.3 U	5.8 U J	5.9 U	6 U	6.3 U J	6.3 U	5.8 U	6.4 U J	5.9 U	5.8 U
cis-1,2-Dichloroethene	µg/kg	194,000	6 U J	6.3 U	5.8 U J	5.9 U	6 U	6.3 U J	6.3 U	5.8 U	6.4 U J	5.9 U	5.8 U
Methylene chloride	µg/kg	267,000	6 U J	6.3 U	5.8 U J	5.9 U	6 U	6.3 U J	6.3 U	5.8 U	6.4 U J	5.9 U	5.8 U
Styrene	µg/kg	20,400,000	6 U J	6.3 U	5.8 U J	5.9 U J	6 U	6.3 U J	6.3 U	5.8 U	6.4 U J	5.9 U	5.8 U
Tetrachloroethene	µg/kg	210,000	6 U J	6.3 U	5.8 U J	5.9 U	6 U	6.3 U J	6.3 U	5.8 U	6.4 U J	5.9 U	5.8 U
Toluene	µg/kg	29,800,000	6 U J	6.3 U	5.8 U J	5.9 U	6 U	6.3 U J	6.3 U	5.8 U	6.4 U J	5.9 U	5.8 U
trans-1,2-Dichloroethene	µg/kg	333,000	6 U J	6.3 U	5.8 U J	5.9 U	6 U	6.3 U J	6.3 U	5.8 U	6.4 U J	5.9 U	5.8 U
Trichloroethene	µg/kg	9,910	6 U J	6.3 U	5.8 U J	5.9 U	6 U	6.3 U J	6.3 U	5.8 U	6.4 U J	5.9 U	5.8 U
Semivolatile Organic Compounds													
	µg/kg		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Perchlorate													
Perchlorate	µg/kg	1,430,000	5.8 U	***160***	5.7 U	5.8 U	***0.43 J***	6.1 U	6.3 U	***1.3 J***	***9.8***	5.9 U	***240***
Explosives													
HMX	mg/kg	44,000	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U
Metals													
Antimony	mg/kg	817	0.72 U	***0.34 J***	***0.33 J***	0.71 U J	0.72 U	0.76 U J	0.75 U	***0.36 J***	0.76 U	***0.29 J***	***0.32 J***
Arsenic	mg/kg	38	***3.1***	***3.1***	***4.1***	***5***	***4.6***	***2.4***	***2.1***	***4.6***	***2.2***	***5.1***	***3.5***
Beryllium	mg/kg	3,650	***0.71***	***1***	***0.61***	***1***	***1.1***	***0.8***	***0.7***	***0.94***	***1***	***0.94***	***0.69***
Cadmium	mg/kg	965	***0.37***	***1.1***	***0.56***	***0.7***	***0.46***	***0.28***	***0.46***	***0.81***	***0.62***	***0.92***	***0.56***
Chromium	mg/kg	111	***15.4***	***26.9***	***16.7***	***27 J***	***23.1***	***15.8***	***16.6***	***21.7***	***29.3***	***21.4***	***18.2***
Copper	mg/kg	81,700	***7.7***	***12.1***	***8.6***	***14.1***	***14***	***7.3 J***	***5.6***	***12.8***	***10.9***	***13.4***	***8.9***
Lead	mg/kg	1,000	***8.8***	***13.2***	***10.5***	***13.5***	***11.6***	***10.1***	***8.5***	***12.6***	***10.9***	***12.9***	***10.5***
Mercury	mg/kg	20	0.048 U	***0.024 J***	***0.012 J***	0.047 U	***0.01 J***	0.051 U	0.05 U	***0.015 J***	0.051 U	***0.014 J***	0.046 U
Nickel	mg/kg	32,400	***11.4***	***31.6***	***13.5***	***24.5***	***19.1***	***13 J***	***11.5***	***18.8***	***23.7***	***16.6***	***12.6***
Selenium	mg/kg	10,200	***0.49***	***0.6***	***0.43***	***0.48***	***0.36***	***0.33 J***	***0.28 J***	***0.57***	***0.44***	***0.67***	***0.52***
Silver	mg/kg	10,200	***0.079 J***	***0.16***	***0.096 J***	***0.11 J***	***0.094 J***	***0.056 J***	***0.083 J***	***0.15***	***0.099 J***	***0.18***	***0.11 J***
Thallium	mg/kg	10	***0.19***	***0.39***	***0.21***	***0.22***	***0.18***	***0.22***	***0.19***	***0.25***	***0.32***	***0.27***	***0.19***
Zinc	mg/kg	613,000	***24.1***	***63.4***	***24.9***	***42.3***	***39.5***	***17.9***	***19.7***	***38.7***	***40.5***	***33.5***	***29.8***

Notes:
Bold / Italics = compound was detected
Highlighted = Concentration exceeds screening level
bgs = below ground surface
ID = Identification
J = estimated value
mg/kg = milligrams per kilogram
NA = Not analyzed
ND = Not Detected
NS = Not sampled
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/kg = micrograms per kilogram
[1] For source of screening level, see Table 4-1.

Table 4-6
Sediment Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID: Date(s) Sampled:	SD-01/SS01 12/7/2011	SD-02/SS01 12/7/2011	SD-03/SS01 12/7/2011	SD-04/SS01 12/7/2011	SD-05/SS01 12/7/2011	SD-06/SS01 12/7/2011
Parameter	**Units**	**Screening Level[1]**						
Volatile Organic Compounds								
Tetrachloroethene	µg/kg	210,000	6.3 U	7 U J	***0.9 J***	6.3 U	6.5 U J	7.5 U J
Toluene	µg/kg	29,800,000	6.3 U	7 U J	6.6 U	6.3 U	***1.1 J***	7.5 U J
Semivolatile Organic Compounds								
	µg/kg		ND	ND	ND	ND	ND	ND
Perchlorate								
	µg/kg		ND	ND	ND	ND	ND	ND
Explosives								
	mg/kg		ND	ND	ND	ND	ND	ND
Metals								
Antimony	mg/kg	817	0.76 U	0.84 U	0.79 U	0.76 U	0.78 U	0.9 U
Arsenic	mg/kg	38	***6.8***	***6.7***	***6.9***	***5.2***	***6.8***	***7.7***
Beryllium	mg/kg	3,650	***1.5***	***1***	***1.1***	***0.91***	***1.1***	***0.96***
Cadmium	mg/kg	965	***0.65***	***1.1***	***1***	***0.65***	***0.9***	***0.92***
Chromium	mg/kg	111	***40***	***23.4***	***25.7***	***21.9***	***27.3***	***23.5***
Copper	mg/kg	81,700	***21.8***	***14***	***13.5***	***12.5***	***12.5***	***13***
Lead	mg/kg	1,000	***13.7***	***19.3***	***21***	***13.1***	***17.4***	***20.3***
Mercury	mg/kg	20	***0.017 J***	***0.017 J***	***0.012 J***	***0.016 J***	***0.011 J***	***0.013 J***
Nickel	mg/kg	32,400	***42.3***	***23.7***	***26.8***	***20.2***	***22.1***	***23***
Selenium	mg/kg	10,200	***0.68***	***0.65***	***0.69***	***0.56***	***0.78***	***0.82***
Silver	mg/kg	10,200	***0.1 J***	***0.15***	***0.14***	***0.1 J***	***0.14***	***0.12 J***
Thallium	mg/kg	10	***0.2***	***0.31***	***0.32***	***0.27***	***0.27***	***0.27***
Zinc	mg/kg	613,000	***51.1***	***50.5***	***49.3***	***44.7***	***55.2***	***39.3***

Notes:

[1] For source of screening levels, see Table 4-1.

Bold / Italics = compound was detected

Highlighted = Detection is equal to or exceeds screening level

ID = identification

J = estimated value

mg/kg = milligrams per kilogram

U = compound was not detected
(or qualified as not detected during QA/QC review)

µg/kg = micrograms per kilogram

ND = not detected

Table 4-6
Sediment Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID: Date(s) Sampled:	SD-07/SS01 12/7/2011	SD-08/SS01 12/7/2011	SD-09/SS01 12/7/2011	SD-10/SS01 12/7/2011	SD-11/SS01 12/7/2011	SD-12/SS01 12/7/2011
Parameter	**Units**	**Screening Level[1]**						
Volatile Organic Compounds								
Tetrachloroethene	µg/kg	210,000	6.2 U J	7 U	6.9 U J	6.3 U	6.3 U J	6.5 U J
Toluene	µg/kg	29,800,000	6.2 U J	7 U	6.9 U J	6.3 U	***1.6 J***	6.5 U J
Semivolatile Organic Compounds								
	µg/kg		ND	ND	ND	ND	ND	ND
Perchlorate								
	µg/kg		ND	ND	ND	ND	ND	ND
Explosives								
	mg/kg		ND	ND	ND	ND	ND	ND
Metals								
Antimony	mg/kg	817	0.74 U	0.84 U	0.83 U	***0.25 J***	0.76 U J	0.78 U
Arsenic	mg/kg	38	***7.3***	***4.1***	***4.3***	***6.9***	***4.5***	***5.1***
Beryllium	mg/kg	3,650	***0.92***	***0.92***	***0.84***	***0.97***	***0.85***	***0.89***
Cadmium	mg/kg	965	***1.3***	***0.7***	***0.8***	***0.81***	***0.63***	***0.84***
Chromium	mg/kg	111	***21.5***	***23.7***	***20.5***	***21.2***	***18.7***	***20.5***
Copper	mg/kg	81,700	***12.1***	***12.3***	***35.4***	***11.4***	***9.2 J***	***12***
Lead	mg/kg	1,000	***20.8***	***12.2***	***19.5***	***19.1***	***11.8***	***17.7***
Mercury	mg/kg	20	0.049 U	***0.012 J***	***0.032 J***	***0.021 J***	***0.014 J***	***0.018 J***
Nickel	mg/kg	32,400	***25.3***	***18.3***	***16.4***	***20.2***	***13.6***	***18.1***
Selenium	mg/kg	10,200	***0.82***	***0.59***	***0.87***	***0.64***	***0.54***	***0.66***
Silver	mg/kg	10,200	***0.12 J***	***0.12 J***	***0.12 J***	***0.13***	***0.11 J***	***0.13***
Thallium	mg/kg	10	***0.27***	***0.26***	***0.25***	***0.29***	***0.25***	***0.26***
Zinc	mg/kg	613,000	***33***	***49.7***	***66.4***	***43.2***	***45.5***	***59***

Notes:

[1] For source of screening levels, see Table 4-1.

Bold / Italics = compound was detected

Highlighted = Detection is equal to or exceeds screening level

ID = identification

J = estimated value

mg/kg = milligrams per kilogram

U = compound was not detected
(or qualified as not detected during QA/QC review)

µg/kg = micrograms per kilogram

ND = not detected

Table 4-6
Sediment Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID: Date(s) Sampled:	SD-13/SS01 12/7/2011	SD-14/SS01 12/7/2011
Parameter	**Units**	**Screening Level[1]**		
Volatile Organic Compounds				
Tetrachloroethene	µg/kg	210,000	6.1 U J	6.6 U J
Toluene	µg/kg	29,800,000	6.1 U J	6.6 U J
Semivolatile Organic Compounds				
	µg/kg		ND	ND
Perchlorate				
	µg/kg		ND	ND
Explosives				
	mg/kg		ND	ND
Metals				
Antimony	mg/kg	817	0.74 U	***0.31 J***
Arsenic	mg/kg	38	***4.6***	***7.4***
Beryllium	mg/kg	3,650	***0.61***	***0.98***
Cadmium	mg/kg	965	***0.73***	***1.5***
Chromium	mg/kg	111	***12.7***	***21.4***
Copper	mg/kg	81,700	***7.5***	***11.8***
Lead	mg/kg	1,000	***14.8***	***28.1***
Mercury	mg/kg	20	0.049 U	***0.015 J***
Nickel	mg/kg	32,400	***16.4***	***33.6***
Selenium	mg/kg	10,200	***0.53***	***0.63***
Silver	mg/kg	10,200	***0.072 J***	***0.12 J***
Thallium	mg/kg	10	***0.18***	***0.33***
Zinc	mg/kg	613,000	***26.6***	***36.3***

Notes:

[1] For source of screening levels, see Table 4-1.

Bold / Italics = compound was detected

Highlighted = Detection is equal to or exceeds screening level

ID = identification

J = estimated value

mg/kg = milligrams per kilogram

U = compound was not detected
(or qualified as not detected during QA/QC review)

µg/kg = micrograms per kilogram

ND = not detected

Table 4-7
Surface Water Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	Stream-01/SW01	Stream-07/SW01	Stream-08/SW01	Stream-09/SW01	Stream-10/SW01
		Lab Number:	G1L090461-001 G1L090463-001 G1L120448-002	G1L090463-002 G1L120448-003	G1L090461-002 G1L090463-004 G1L120448-005	G1L090463-003 G1L120448-001	G1L090462-001 G1L090463-005 G1L120448-006
		Date Sampled:	12/8/2011	12/8/2011	12/8/2011	12/8/2011	12/8/2011
Parameter	**Units**	**Screening Level**[1]					
Volatile Organic Compounds							
1,1,2,2-Tetrachloroethane	µg/L	1.28	1 U	1 U	1 U	1 U	1 U
2-Butanone (MEK)	µg/L	11,800	2 U	2 U	2 U	2 U	2 U
Acetone	µg/L	45,500	10 U	10 U	***3.1 J***	10 U	10 U
cis-1,2-Dichloroethene	µg/L	70	1 U	1 U	1 U	1 U	1 U
m-Xylene & p-Xylene	µg/L	190	1 U	1 U	1 U	***0.2 J***	1 U
Tetrachloroethene	µg/L	5	1 U	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene	µg/L	100	1 U	1 U	1 U	1 U	1 U
Trichloroethene	µg/L	5	1 U	***0.18 J***	1 U	1 U	1 U
Semivolatile Organic Compounds							
Benzo(a)pyrene	µg/L	0.2	9.9 U	9.6 U	9.7 U	9.6 U	9.9 U
bis(2-Ethylhexyl)phthalate	µg/L	6	***1.2 J***	9.6 U	***1.3 J***	9.6 U	***1.1 J***
Perchlorate							
Perchlorate	µg/L	70.9	***0.44 J***	***0.23 J***	0.5 U	***0.22 J***	***0.54***
Explosives							
4-Amino-2,6-dinitrotoluene	µg/L	30	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Metals							
Beryllium	µg/L	4	1 U	1 U	***0.2 J***	1 U	1 U
Copper	µg/L	1,300	***2.2 J***	3 U	***5.4***	3 U	***1.3 J***
Lead	µg/L	15	2.5 U	2.5 U	***3.1***	2.5 U	2.5 U
Mercury	µg/L	2	0.2 U	***0.18 J***	0.2 U	***0.32***	0.2 U
Nickel	µg/L	2,040	3 U	3 U	***2.1 J***	3 U	3 U
Selenium	µg/L	50	***2.2 J***	3 U	3 U	3 U	3 U
Zinc	µg/L	30,500	12 U	12 U J	***4.9 J***	12 U	12 U

Notes:
[1] For source of screening levels, see Table 4-1.
Bold / Italics = compound was detected
Highlighted = Concentration exceeds screening level
ID = Identification
J = estimated value
mg/L = milligrams per liter
NA = Not analyzed
U = compound was not detected
µg/L = micrograms per liter

Table 4-7
Surface Water Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	Stream-11/SW01	Stream-12/SW01	Stream-13/SW01	Seep-03/SW01	Spring/SW02
		Lab Number:	G1L090463-007 G1L120448-008	G1L090463-008 G1L120448-009	G1L090463-009 G1L120448-010	G1L120448-011	G2C100418-005
		Date Sampled:	12/8/2011	12/8/2011	12/8/2011	12/9/2011	3/9/2012
Parameter	**Units**	**Screening Level[1]**					
Volatile Organic Compounds							
1,1,2,2-Tetrachloroethane	µg/L	1.28	1 U	1 U	1 U	1 U	***16***
2-Butanone (MEK)	µg/L	11,800	2 U	2 U	2 U	2 U	2 U
Acetone	µg/L	45,500	10 U	10 U	10 U	10 U	10 U
cis-1,2-Dichloroethene	µg/L	70	1 U	1 U	1 U	1 U	***1.4***
m-Xylene & p-Xylene	µg/L	190	1 U	1 U	1 U	1 U	1 U
Tetrachloroethene	µg/L	5	1 U	1 U	1 U	1 U	***1.8 J***
trans-1,2-Dichloroethene	µg/L	100	1 U	1 U	1 U	1 U	***0.19 J***
Trichloroethene	µg/L	5	1 U	1 U	1 U	1 U	***91 J***
Semivolatile Organic Compounds							
Benzo(a)pyrene	µg/L	0.2	***1.1 J***	9.9 U	10 U	9.4 U	9.4 U
bis(2-Ethylhexyl)phthalate	µg/L	6	***1.2 J***	***1.2 J***	***1.1 J***	9.4 U	9.4 U
Perchlorate							
Perchlorate	µg/L	70.9	***0.4 J***	***0.33 J***	***0.43 J***	***0.38 J***	***0.55***
Explosives							
4-Amino-2,6-dinitrotoluene	µg/L	30	0.2 U	0.2 U	0.2 U	0.2 U	***0.75 J***
Metals							
Beryllium	µg/L	4	1 U	***0.1 J***	1 U	1 U	1 U
Copper	µg/L	1,300	3 U	***1.8 J***	***1.2 J***	3 U	3 U
Lead	µg/L	15	2.5 U	***2.4 J***	2.5 U	2.5 U	2.5 U
Mercury	µg/L	2	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Nickel	µg/L	2,040	3 U	3 U	3 U	3 U	***1.1 J***
Selenium	µg/L	50	3 U	3 U	***2.9 J***	3 U	3 U
Zinc	µg/L	30,500	12 U	12 U	12 U	12 U	12 U

Notes:
[1] For source of screening levels, see Table 4-1.
Bold / Italics = compound was detected
Highlighted = Concentration exceeds screening level
ID = Identification
J = estimated value
mg/L = milligrams per liter
NA = Not analyzed
U = compound was not detected
µg/L = micrograms per liter

Table 4-7
Surface Water Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	Stream-01/SW02	Stream-02/SW02
		Lab Number:	G2C100418-004	G2C100418-002
		Date Sampled:	3/9/2012	3/9/2012
Parameter	**Units**	**Screening Level[1]**		
Volatile Organic Compounds				
1,1,2,2-Tetrachloroethane	µg/L	1.28	1 U	***0.74 J***
2-Butanone (MEK)	µg/L	11,800	2 U	***0.38 J***
Acetone	µg/L	45,500	10 U	***2.8 J***
cis-1,2-Dichloroethene	µg/L	70	1 U	***0.61 J***
m-Xylene & p-Xylene	µg/L	190	1 U	1 U
Tetrachloroethene	µg/L	5	1 U	***0.13 J***
trans-1,2-Dichloroethene	µg/L	100	1 U	1 U
Trichloroethene	µg/L	5	1 U	***7.2***
Semivolatile Organic Compounds				
Benzo(a)pyrene	µg/L	0.2	9.4 U	9.4 U
bis(2-Ethylhexyl)phthalate	µg/L	6	9.4 U	9.4 U
Perchlorate				
Perchlorate	µg/L	70.9	***0.84***	***29***
Explosives				
4-Amino-2,6-dinitrotoluene	µg/L	30	0.1 U	0.1 U
Metals				
Beryllium	µg/L	4	1 U	1 U
Copper	µg/L	1,300	***1.4 J***	***1.3 J***
Lead	µg/L	15	2.5 U	2.5 U
Mercury	µg/L	2	***0.11 J***	0.2 U
Nickel	µg/L	2,040	3 U	3 U
Selenium	µg/L	50	***1.2 J***	***1.1 J***
Zinc	µg/L	30,500	12 U	12 U

Notes:
[1] For source of screening levels, see Table 4-1.
Bold / Italics = compound was detected
Highlighted = Concentration exceeds screening level
ID = Identification
J = estimated value
mg/L = milligrams per liter
NA = Not analyzed
U = compound was not detected
µg/L = micrograms per liter

Table 4-8
Direct-Push Groundwater Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	GW-07/GW01	GW-08/GW01	GW-09/GW01	GW-10/GW01	GW-11/GW01	GW-12/GW01
		Laboratory Number(s):	G1L080501-002	G1L080501-003	G1L070484-004	G1L020426-003	G1L070484-005	G1L070488-003
		Date(s) Sampled:	12/6/2011	12/6/2011	12/5/2011	11/30/2011	12/5/2011	12/5/2011
Parameter	**Units**	**Screening Level[1]**						
Volatile Organic Compounds								
1,1,2,2-Tetrachloroethane	µg/L	1.28	***0.22 J***	***0.76 J***	***0.59 J***	***2.5***	***2.9***	***2.7***
1,2,3-Trichlorobenzene	µg/L	5.2	1 U	1 U	1 U	1 U	1 U	1 U
1,2,4-Trichlorobenzene	µg/L	70	1 U	1 U	1 U	1 U	1 U	1 U
1,2,4-Trimethylbenzene	µg/L	17.4	1 U	***0.13 J***	1 U	1 U	1 U	1 U
2-Butanone (MEK)	µg/L	11,800	***0.59 J***	2 U	2 U	2 U	2 U	2 U
Acetone	µg/L	45,500	10 U	10 U	10 U	***2.9 J***	10 U	10 U
Benzene	µg/L	5	***0.2 J***	***0.16 J***	1 U	***0.17 J***	***0.35 J***	***0.17 J***
Bromoform	µg/L	80	1 U	1 U	1 U	***1.6***	1 U	1 U
Carbon disulfide	µg/L	1,660	***0.2 J***	2 U	2 U	0.21 J U	2 U	2 U
cis-1,2-Dichloroethene	µg/L	70	1 U	***0.55 J***	***0.42 J***	***0.97 J***	***1.4***	***0.52 J***
Dibromochloromethane	µg/L	80	1 U	1 U	1 U	***1.2***	1 U	1 U
Ethylbenzene	µg/L	700	***0.17 J***	***0.18 J***	***0.13 J***	***0.19 J***	***0.29 J***	***0.23 J***
m-Xylene & p-Xylene	µg/L	190	***0.28 J***	***0.39 J***	1 U	***0.27 J***	***0.27 J***	1 U
Naphthalene	µg/L	2.11	1 U	1 U	1 U	0.66 J U	1 U	1 U
n-Propylbenzene	µg/L	1,910	1 U	1 U	1 U	1 U	1 U	1 U
o-Xylene	µg/L	190	***0.12 J***	***0.16 J***	1 U	***0.1 J***	***0.13 J***	1 U
Tetrachloroethene	µg/L	5	***0.18 J***	***0.14 J***	***0.36 J***	1 U	***0.33 J***	***0.42 J***
Toluene	µg/L	1,000	***0.46 J***	***0.72 J***	1 U	***0.88 J***	***0.78 J***	***0.41 J***
trans-1,2-Dichloroethene	µg/L	100	1 U	***0.52 J***	***0.44 J***	***0.27 J***	***0.18 J***	1 U
Trichloroethene	µg/L	5	***6.2***	***8.4***	***11***	***12***	***23***	***26 J***
Perchlorate								
Perchlorate	µg/L	70.9	***3.1***	***4***	***1.2***	***7.3***	***9***	***6.1***
Explosives								
2,4-Dinitrotoluene	µg/L	8.98	0.1 U	0.1 U	0.12 U	0.097 U	0.12 U	0.1 U
HMX	µg/L	5,110	0.1 U	0.1 U	0.12 U	***0.11 J***	0.12 U	0.1 U J
Nitroglycerin	µg/L	1.5	0.65 U	0.65 U	0.78 U	0.63 U	0.79 U	0.65 U J
RDX	µg/L	25.9	***0.12***	0.1 U	0.12 U	***0.13 J***	0.12 U	0.1 U
Tetryl	µg/L	407	0.1 U	0.1 U	0.12 U	0.097 U	0.12 U	0.1 U

Notes:

Bold / Italics = compound was detected

Highlighted = Detection is equal to or exceeds screening level

E = Estimated value; result outside of calibration range (lab qualifier)

ID = identification   NS = not sampled

J = estimated value µg/L = micrograms per liter

U = compound was not detected
(or qualified as not detected during QA/QC review)

[1] For source of screening levels, see Table 4-1.

* Samples were collected over two days due to low recovery.

Table 4-8
Direct-Push Groundwater Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	GW-13/GW01	GW-14/GW01	GW-18/GW01	GW-19/GW01	GW-20/GW01	GW-21/GW01
		Laboratory Number(s):	G1L070483-002	G1L070483-004	G1L030414-002	G1L030414-003	G1L030434-002	G1L020426-002
		Date(s) Sampled:	12/5/2011	12/5/2011	12/1/2011	12/1/2011	12/1/2011	11/29/2011
Parameter	**Units**	**Screening Level[1]**						
Volatile Organic Compounds								
1,1,2,2-Tetrachloroethane	µg/L	1.28	***0.78 J***	0.37 J U	***0.75 J***	***0.16 J***	1 U	***0.097 J***
1,2,3-Trichlorobenzene	µg/L	5.2	***0.41 J***	1 U	1 U	1 U	1 U	1 U
1,2,4-Trichlorobenzene	µg/L	70	***0.28 J***	1 U	1 U	1 U	1 U	1 U
1,2,4-Trimethylbenzene	µg/L	17.4	1 U	***0.18 J***	1 U	1 U	1 U	1 U
2-Butanone (MEK)	µg/L	11,800	***1.1 J***	2 U	2 U	***0.68 J***	2 U	2 U
Acetone	µg/L	45,500	10 U	10 U	10 U	10 U	10 U	***2.4 J***
Benzene	µg/L	5	***0.16 J***	***0.15 J***	1 U	***0.14 J***	1 U	1 U
Bromoform	µg/L	80	1 U	1 U	1 U J	1 U	1 U	1 U
Carbon disulfide	µg/L	1,660	2 U	2 U	2 U	2 U	0.25 J U	2 U
cis-1,2-Dichloroethene	µg/L	70	1 U	1 U	***0.24 J***	1 U	***0.24 J***	1 U
Dibromochloromethane	µg/L	80	1 U	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	µg/L	700	***0.27 J***	***0.41 J***	1 U	***0.17 J***	1 U	1 U
m-Xylene & p-Xylene	µg/L	190	1 U	***0.35 J***	1 U	***0.2 J***	1 U	1 U
Naphthalene	µg/L	2.11	***0.7 J***	1 U	1 U J	1 U	1 U	0.65 J U
n-Propylbenzene	µg/L	1,910	1 U	1 U	1 U	1 U	1 U	1 U
o-Xylene	µg/L	190	1 U	***0.16 J***	1 U	1 U	1 U	1 U
Tetrachloroethene	µg/L	5	***0.25 J***	***0.21 J***	***0.4 J***	1 U	***0.15 J***	***0.16 J***
Toluene	µg/L	1,000	***0.42 J***	***0.87 J***	1 U	***0.58 J***	1 U	***0.31 J***
trans-1,2-Dichloroethene	µg/L	100	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	µg/L	5	***11***	***7.4***	***22 J***	***5.2***	***6.3***	***7.3***
Perchlorate								
Perchlorate	µg/L	70.9	***1.3***	***2.2***	***6.4***	***5***	***0.64***	***3.7***
Explosives								
2,4-Dinitrotoluene	µg/L	8.98	0.12 U	0.16 U	0.11 U	0.1 U	0.13 U	0.11 U
HMX	µg/L	5,110	0.12 U	0.16 U	0.11 U	0.1 U	0.13 U	0.11 U
Nitroglycerin	µg/L	1.5	0.75 U	1 U	0.69 U	0.65 U	0.87 U	0.69 U
RDX	µg/L	25.9	0.12 U	0.16 U	0.11 U	0.1 U	0.13 U	0.11 U
Tetryl	µg/L	407	0.12 U	0.16 U	0.11 U	0.1 U	0.13 U	***0.069 J***

Notes:

Bold / Italics = compound was detected

Highlighted = Detection is equal to or exceeds screening level

E = Estimated value; result outside of calibration range (lab qualifier)

ID = identification NS = not sampled

J = estimated value µg/L = micrograms per liter

U = compound was not detected
(or qualified as not detected during QA/QC review)

[1] For source of screening levels, see Table 4-1.

* Samples were collected over two days due to low recovery.

Table 4-8
Direct-Push Groundwater Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	GW-22/GW01	GW-23/GW01	GW-24/GW01	GW-26/GW01	GW-28/GW01	GW-29/GW01
		Laboratory Number(s):	G1L070488-002 G1L080501-006	G1L070488-004	G1L080501-005	G1L050446-002	G1L020427-002	G1L050446-004
		Date(s) Sampled:	12/5/2011 12/6/2011*	12/5/2011	12/6/2011	12/2/2011	11/30/2011	12/2/2011
Parameter	**Units**	**Screening Level[1]**						
Volatile Organic Compounds								
1,1,2,2-Tetrachloroethane	µg/L	1.28	1 U	1 U	1 U	***29***	***0.87 J***	***0.12 J***
1,2,3-Trichlorobenzene	µg/L	5.2	1 U	1 U	1 U	1 U	1 U	1 U
1,2,4-Trichlorobenzene	µg/L	70	1 U	1 U	1 U	1 U	1 U	1 U
1,2,4-Trimethylbenzene	µg/L	17.4	***0.46 J***	1 U	1 U	***0.23 J***	1 U	1 U
2-Butanone (MEK)	µg/L	11,800	***1.6 J***	2 U	2 U	2 U	2 U	2 U
Acetone	µg/L	45,500	10 U	10 U	10 U	10 U	10 U	10 U
Benzene	µg/L	5	***0.3 J***	1 U	1 U	1 U	***0.18 J***	1 U
Bromoform	µg/L	80	1 U	1 U	1 U	1 U	1 U	1 U
Carbon disulfide	µg/L	1,660	2 U	2 U	2 U	2 U	2 U	***1.3 J***
cis-1,2-Dichloroethene	µg/L	70	1 U	***0.13 J***	***0.2 J***	***15***	***0.74 J***	1 U
Dibromochloromethane	µg/L	80	1 U	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	µg/L	700	***0.77 J***	1 U	1 U	***0.15 J***	***0.2 J***	***0.11 J***
m-Xylene & p-Xylene	µg/L	190	***0.61 J***	1 U	1 U	***0.36 J***	1 U	***0.19 J***
Naphthalene	µg/L	2.11	1 U	1 U	1 U	1 U	***0.63 J***	1 U
n-Propylbenzene	µg/L	1,910	***0.16 J***	1 U	1 U	1 U	1 U	1 U
o-Xylene	µg/L	190	***0.25 J***	1 U	1 U	***0.18 J***	1 U	1 U
Tetrachloroethene	µg/L	5	***0.21 J***	1 U	1 U	***2.1***	***0.65 J***	***0.16 J***
Toluene	µg/L	1,000	***1.9***	1 U	1 U	***0.42 J***	***0.48 J***	***0.54 J***
trans-1,2-Dichloroethene	µg/L	100	1 U	1 U	1 U	***0.54 J***	1 U	1 U
Trichloroethene	µg/L	5	***5.7***	***1.4***	***3.8***	***130***	***31***	***6***
Perchlorate								
Perchlorate	µg/L	70.9	***1.5***	0.5 U	NS	***63***	***6.4***	***7.5***
Explosives								
2,4-Dinitrotoluene	µg/L	8.98	0.1 U	0.1 U	NS	0.1 U	0.1 U	0.11 U
HMX	µg/L	5,110	0.1 U	0.1 U	NS	0.1 U	0.1 U	0.11 U
Nitroglycerin	µg/L	1.5	0.65 U	0.65 U	NS	0.68 U	0.65 U	0.7 U
RDX	µg/L	25.9	0.1 U	0.1 U	NS	***0.21***	0.1 U	0.11 U
Tetryl	µg/L	407	0.1 U	0.1 U	NS	0.1 U	0.1 U	0.11 U

Notes:

Bold / Italics = compound was detected

Highlighted = Detection is equal to or exceeds screening level

E = Estimated value; result outside of calibration range (lab qualifier)

ID = identification NS = not sampled

J = estimated value µg/L = micrograms per liter

U = compound was not detected
(or qualified as not detected during QA/QC review)

[1] For source of screening levels, see Table 4-1.

* Samples were collected over two days due to low recovery.

Table 4-8
Direct-Push Groundwater Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	GW-30/GW01	GW-31/GW01	GW-32/GW01	GW-33/GW01	GW-34/GW01	GW-41/GW01
		Laboratory Number(s):	G1L050446-005 G1L070483-005	G1L050444-002	G1L050444-003	G1L030434-003	G1L050444-004 G1L070484-003	G1L020426-004
		Date(s) Sampled:	12/2/2011 12/5/2011*	12/2/2011	12/2/2011	12/1/2011	12/2/2011 12/5/2011*	11/30/2011
Parameter	**Units**	**Screening Level[1]**						
Volatile Organic Compounds								
1,1,2,2-Tetrachloroethane	µg/L	1.28	1 U	1 U	1 U	1 U	1 U	1 U
1,2,3-Trichlorobenzene	µg/L	5.2	1 U	1 U	1 U	1 U	1 U	1 U
1,2,4-Trichlorobenzene	µg/L	70	1 U	1 U	1 U	1 U	1 U	1 U
1,2,4-Trimethylbenzene	µg/L	17.4	1 U	1 U	1 U	1 U	1 U	1 U
2-Butanone (MEK)	µg/L	11,800	***0.41 J***	2 U	2 U	***0.84 J***	2 U	***0.4 J***
Acetone	µg/L	45,500	***3.5 J***	10 U	10 U	10 U	10 U	***5.3 J***
Benzene	µg/L	5	1 U	1 U	***0.3 J***	1 U	1 U	1 U
Bromoform	µg/L	80	1 U	1 U	1 U	1 U	1 U	1 U
Carbon disulfide	µg/L	1,660	2 U	0.2 J U	0.2 J U	2 U	2 U	0.22 J U
cis-1,2-Dichloroethene	µg/L	70	1 U	***0.12 J***	1 U	1 U	1 U	1 U
Dibromochloromethane	µg/L	80	1 U	1 U	1 U	1 U	1 U	***1.1***
Ethylbenzene	µg/L	700	***0.13 J***	1 U	***0.33 J***	***0.12 J***	***0.12 J***	1 U
m-Xylene & p-Xylene	µg/L	190	***0.27 J***	***0.2 J***	1 U	1 U	***0.23 J***	1 U
Naphthalene	µg/L	2.11	1 U	1 U	1 U	1 U	***0.63 J***	0.64 J U
n-Propylbenzene	µg/L	1,910	1 U	1 U	1 U	1 U	1 U	1 U
o-Xylene	µg/L	190	***0.12 J***	1 U	1 U	1 U	***0.1 J***	1 U
Tetrachloroethene	µg/L	5	***0.1 J***	1 U	1 U	1 U	1 U	1 U
Toluene	µg/L	1,000	***0.69 J***	***0.41 J***	***0.68 J***	***0.26 J***	***0.4 J***	***0.46 J***
trans-1,2-Dichloroethene	µg/L	100	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	µg/L	5	***3.3***	***0.67 J***	***0.27 J***	1 U	1 U	1 U
Perchlorate								
Perchlorate	µg/L	70.9	***7.1***	0.5 U	***0.48 J***	***1.4***	***2.1***	0.5 U
Explosives								
2,4-Dinitrotoluene	µg/L	8.98	0.16 U	0.11 U	0.1 U	0.14 U	0.12 U	0.12 U J
HMX	µg/L	5,110	0.16 U	0.11 U	0.1 U	0.14 U	0.12 U	0.12 U J
Nitroglycerin	µg/L	1.5	1 U	0.69 U	0.68 U	0.91 U	0.79 U	0.78 U J
RDX	µg/L	25.9	0.16 U	0.11 U	0.1 U	0.14 U	0.12 U	0.12 U J
Tetryl	µg/L	407	0.16 U	0.11 U	0.1 U	0.14 U	0.12 U	***0.56 J***

Notes:

Bold / Italics = compound was detected

Highlighted = Detection is equal to or exceeds screening level

E = Estimated value; result outside of calibration range (lab qualifier)

ID = identification NS = not sampled

J = estimated value µg/L = micrograms per liter

U = compound was not detected
(or qualified as not detected during QA/QC review)

[1] For source of screening levels, see Table 4-1.

* Samples were collected over two days due to low recovery.

Table 4-8
Direct-Push Groundwater Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	GW-42/GW01	GW-45/GW01
		Laboratory Number(s):	G1L050446-003 G1L070484-002	G1L080501-008
		Date(s) Sampled:	12/2/2011 12/5/2011*	12/7/2011
Parameter	**Units**	**Screening Level[1]**		
Volatile Organic Compounds				
1,1,2,2-Tetrachloroethane	µg/L	1.28	***0.78 J***	***30***
1,2,3-Trichlorobenzene	µg/L	5.2	1 U	1 U
1,2,4-Trichlorobenzene	µg/L	70	1 U	1 U
1,2,4-Trimethylbenzene	µg/L	17.4	1 U	1 U
2-Butanone (MEK)	µg/L	11,800	2 U	***0.65 J***
Acetone	µg/L	45,500	10 U	10 U
Benzene	µg/L	5	1 U	1 U
Bromoform	µg/L	80	1 U	1 U
Carbon disulfide	µg/L	1,660	2 U	2 U
cis-1,2-Dichloroethene	µg/L	70	***15***	***1.8***
Dibromochloromethane	µg/L	80	1 U	1 U
Ethylbenzene	µg/L	700	1 U	***0.3 J***
m-Xylene & p-Xylene	µg/L	190	***0.19 J***	***0.37 J***
Naphthalene	µg/L	2.11	1 U	1 U
n-Propylbenzene	µg/L	1,910	1 U	1 U
o-Xylene	µg/L	190	***0.12 J***	***0.13 J***
Tetrachloroethene	µg/L	5	***0.63 J***	***0.31 J***
Toluene	µg/L	1,000	***0.49 J***	***0.56 J***
trans-1,2-Dichloroethene	µg/L	100	***0.34 J***	***0.38 J***
Trichloroethene	µg/L	5	***38***	***110 E J***
Perchlorate				
Perchlorate	µg/L	70.9	***3.9***	NS
Explosives				
2,4-Dinitrotoluene	µg/L	8.98	***0.055 J***	NS
HMX	µg/L	5,110	0.1 U	NS
Nitroglycerin	µg/L	1.5	***0.34 J***	NS
RDX	µg/L	25.9	0.1 U	NS
Tetryl	µg/L	407	0.1 U	NS

Notes:

Bold / Italics = compound was detected

Highlighted = Detection is equal to or exceeds screening level

E = Estimated value; result outside of calibration range (lab qualifier)

ID = identification NS = not sampled

J = estimated value µg/L = micrograms per liter

U = compound was not detected
(or qualified as not detected during QA/QC review)

[1] For source of screening levels, see Table 4-1.

* Samples were collected over two days due to low recovery.

Table 4-9
Core-Hole Groundwater Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID: Date Sampled: Comments:	CH-1/GW01 2/19/2012	CH-2/GW01 2/18/2012	CH-3/GW01 2/22/2012
Parameter	**Units**	**Screening Level[1]**			
Volatile Organic Compounds					
2-Butanone (MEK)	µg/L	11,800	***0.41 J***	2 U	***2***
2-Hexanone	µg/L	34	2 U	2 U	***0.3 J***
4-Methyl-2-pentanone (MIBK)	µg/L	4,170	2 U	2 U	***0.4 J***
Acetone	µg/L	45,500	***2.8 J***	10 U	***11***
Benzene	µg/L	5	***0.14 J***	1 U	***0.25 J***
Carbon disulfide	µg/L	1,660	2 U	2 U	***0.29 J***
Ethylbenzene	µg/L	700	1 U	1 U	***0.23 J***
m-Xylene & p-Xylene	µg/L	190	1 U	1 U	***0.38 J***
Naphthalene	µg/L	2.11	1 U	1 U	***0.2 J***
o-Xylene	µg/L	190	1 U	1 U	***0.13 J***
Toluene	µg/L	1,000	1 U	1 U	***0.45 J***
Explosives					
Nitroglycerin	µg/L	1.5	0.67 U J	0.72 U	***1.3***

Notes:
Bold / Italics = compound was detected
Highlighted = Concentration exceeds screening level
ID = identification
J = estimated value
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/L = micrograms per liter
[1] The source of screening levels (EPA MCL, KDHE RSK, or EPA RSL) is noted on Table 4-1.

Table 4-10
Monitoring Well Groundwater Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	OB-93-01/GW01	OB-93-01/GW02	OB-93-01/GW03	OB-93-01/GW04
		Date Sampled:	3/5/2012	6/19/2012	9/25/2012	12/17/2012
		Comment(s):	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Parameter	**Units**	**Screening Level[1]**				
Volatile Organic Compounds						
1,1,1,2-Tetrachloroethane	µg/L	9.91	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	µg/L	1.28	1 U	1 U	1 U	1 U
1,2,3-Trichlorobenzene	µg/L	5.2	1 U	1 U	1 U	1 U
2-Butanone (MEK)	µg/L	11,800	2 U	2 U	6 U	6 U
Acetone	µg/L	45,500	10 U	10 U	10 U	10 U J
cis-1,2-Dichloroethene	µg/L	70	1 U	1 U	1 U	1 U
Naphthalene	µg/L	2.11	1 U	1 U	1 U	1 U
Tetrachloroethene	µg/L	5	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene	µg/L	100	1 U	1 U	1 U	1 U
Trichloroethene	µg/L	5	1 U	1 U	1 U	1 U
Semivolatile Organic Compounds						
Benzo(a)pyrene	µg/L	0.2	9.5 U	9.9 U	9.5 U	9.7 U
Benzo(ghi)perylene	µg/L	NA	9.5 U	9.9 U	9.5 U	9.7 U
bis(2-Ethylhexyl)phthalate	µg/L	6	9.5 U	9.9 U	***1.1 J***	9.7 U
Perchlorate						
Perchlorate	µg/L	70.9	***0.22 J***	***0.25 J***	***0.31 J***	***0.31 J***
Explosives						
HMX	µg/L	5,110	0.099 U	0.1 U	0.1 U	0.1 U
RDX	µg/L	25.9	0.099 U	0.1 U	0.1 U	0.1 U
Metals						
Antimony	µg/L	6	6 U	6 U	6 U	6 U
Arsenic	µg/L	10	3 U	3 U	3 U	3 U
Beryllium	µg/L	4	1 U	1 U	1 U	1 U
Cadmium	µg/L	5	1.5 U	1.5 U	1.5 U	1.5 U
Chromium	µg/L	100	5 U	5 U	***1.5 J***	5 U
Copper	µg/L	1,300	***2.2 J***	3 U	3 U	3 U
Lead	µg/L	15	2.5 U	2.5 U	2.5 U	2.5 U
Mercury	µg/L	2	0.2 U	0.2 U	0.14 U	0.2 U
Nickel	µg/L	2,040	***2.6 J***	3 U	3 U	3 U
Selenium	µg/L	50	3 U	***1.1 J***	***1.1 J***	***1 J***
Silver	µg/L	508	1 U	1 U	1 U	1 U
Zinc	µg/L	30,500	12 U	12 U J	***21***	***17***
Groundwater Quality Package						
Ammonia	mg/L	NA	***0.28 J***	***0.073 J***	0.1 U	0.1 U
Chloride	mg/L	NA	***5***	***5***	***5.2***	***5.1***
Nitrate as N	mg/L	10	0.05 U	***0.12***	***0.045 J***	0.05 U J
Orthophosphate as P	mg/L	NA	0.2 U	0.2 U	0.2 U	0.2 U
Sulfate	mg/L	NA	***30.1***	***26.4***	***42***	***38***
Sulfide	mg/L	NA	4 U	4 U	4 U	***1.4 J***
Monitored Natural Attenuation Package						
Methane	µg/L	NA	5 U	5 U	***0.25 J***	5 U
Ethane	µg/L	NA	5 U	5 U J	5 U J	5 U J
Total Organic Carbon	mg/L	NA	***0.76 J***	***1.1 J***	***0.98 J***	***0.7 J***

Notes:
Bold / Italics = compound was detected
Highlighted = Concentration exceeds screening level
ID = Identification
J = estimated value
mg/L = milligrams per liter
NA = Not available / Not analyzed
NS = Not sampled
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/L = micrograms per liter
[1] For source of screening levels, see Table 4-1.

Table 4-10
Monitoring Well Groundwater Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	OB-93-02/GW01	OB-93-02/GW02	OB-93-02/GW03	OB-93-02/GW04
		Date Sampled:	3/7/2012	6/18/2012	9/25/2012	12/17/2012
		Comment(s):	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Parameter	**Units**	**Screening Level[1]**				
Volatile Organic Compounds						
1,1,1,2-Tetrachloroethane	µg/L	9.91	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	µg/L	1.28	1 U	1 U	1 U	1 U
1,2,3-Trichlorobenzene	µg/L	5.2	1 U	1 U	1 U	1 U
2-Butanone (MEK)	µg/L	11,800	2 U	2 U	6 U	6 U
Acetone	µg/L	45,500	10 U	10 U	10 U	10 U J
cis-1,2-Dichloroethene	µg/L	70	1 U	1 U	1 U	1 U
Naphthalene	µg/L	2.11	1 U	1 U	1 U	1 U
Tetrachloroethene	µg/L	5	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene	µg/L	100	1 U	1 U	1 U	1 U
Trichloroethene	µg/L	5	1 U	1 U	1 U	1 U
Semivolatile Organic Compounds						
Benzo(a)pyrene	µg/L	0.2	9.4 U	9.5 U	9.5 U	10 U
Benzo(ghi)perylene	µg/L	NA	9.4 U	9.5 U	9.5 U	10 U
bis(2-Ethylhexyl)phthalate	µg/L	6	***1.7 J***	1.8 J U	***1.7 J***	10 U
Perchlorate						
Perchlorate	µg/L	70.9	***0.34 J***	***0.32 J***	***0.36 J***	***0.24 J***
Explosives						
HMX	µg/L	5,110	0.099 U	0.1 U	0.1 U	0.1 U
RDX	µg/L	25.9	0.099 U	0.1 U	0.1 U	0.1 U
Metals						
Antimony	µg/L	6	6 U	6 U	6 U	6 U
Arsenic	µg/L	10	***1.2 J***	3 U	3 U	***1.2 J***
Beryllium	µg/L	4	1 U	1 U	1 U	1 U
Cadmium	µg/L	5	1.5 U	1.5 U	1.5 U	1.5 U
Chromium	µg/L	100	5 U	5 U	***1.5 J***	5 U
Copper	µg/L	1,300	3 U	3 U	3 U	1.1 J U
Lead	µg/L	15	2.5 U	2.5 U	***1.3 J***	2.5 U
Mercury	µg/L	2	***0.12 J***	0.2 U	0.14 U	0.2 U
Nickel	µg/L	2,040	3 U	3 U	3 U	3 U
Selenium	µg/L	50	***1 J***	3 U	3 U	3 U
Silver	µg/L	508	1 U	1 U	1 U	1 U
Zinc	µg/L	30,500	12 U	12 U	12 U	12 U
Groundwater Quality Package						
Ammonia	mg/L	NA	1 U	***0.079 J***	***0.044 J***	0.1 U
Chloride	mg/L	NA	***2.9***	***2.9***	***2.9***	***2.8***
Nitrate as N	mg/L	10	***0.88***	***1.1 J***	***0.92***	***0.62***
Orthophosphate as P	mg/L	NA	0.2 U	0.2 U	0.2 U	0.2 U
Sulfate	mg/L	NA	***34.6***	***35.2***	***37***	***46***
Sulfide	mg/L	NA	***1.3 J***	4 U	4 U	4 U
Monitored Natural Attenuation Package						
Methane	µg/L	NA	5 U	5 U	5 U	5 U
Ethane	µg/L	NA	***0.62 J***	5 U	5 U	5 U
Total Organic Carbon	mg/L	NA	***0.26 J***	***0.72 J***	***0.63 J***	***0.51 J***

Notes:
Bold / Italics = compound was detected
Highlighted = Concentration exceeds screening level
ID = Identification
J = estimated value
mg/L = milligrams per liter
NA = Not available / Not analyzed
NS = Not sampled
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/L = micrograms per liter
[1] For source of screening levels, see Table 4-1.

Table 4-10
Monitoring Well Groundwater Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	OB-93-03/GW01	OB-93-03/GW02	OB-93-03/GW03	OB-93-03/GW04
		Date Sampled:	3/5/2012	6/19/2012	9/24/2012	12/18/2012
		Comment(s):	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Parameter	**Units**	**Screening Level[1]**				
Volatile Organic Compounds						
1,1,1,2-Tetrachloroethane	µg/L	9.91	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	µg/L	1.28	1 U	1 U	1 U	1 U
1,2,3-Trichlorobenzene	µg/L	5.2	1 U	1 U	1 U	1 U
2-Butanone (MEK)	µg/L	11,800	2 U	2 U	6 U	6 U
Acetone	µg/L	45,500	10 U	10 U	10 U	10 U
cis-1,2-Dichloroethene	µg/L	70	1 U	***0.24 J***	1 U	1 U
Naphthalene	µg/L	2.11	1 U	1 U	1 U	1 U
Tetrachloroethene	µg/L	5	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene	µg/L	100	1 U	1 U	1 U	1 U
Trichloroethene	µg/L	5	1 U	***0.9 J***	***0.92 J***	***0.79 J***
Semivolatile Organic Compounds						
Benzo(a)pyrene	µg/L	0.2	9.4 U	9.5 U	9.5 U	***0.76 J***
Benzo(ghi)perylene	µg/L	NA	9.4 U	9.5 U	9.5 U	***1.3 J***
bis(2-Ethylhexyl)phthalate	µg/L	6	9.4 U	1.3 J U	9.5 U	***1.2 J***
Perchlorate						
Perchlorate	µg/L	70.9	0.5 U	0.5 U	0.5 U	0.5 U
Explosives						
HMX	µg/L	5,110	0.099 U	0.1 U	0.1 U	0.1 U
RDX	µg/L	25.9	0.099 U	0.1 U	0.1 U	0.1 U
Metals						
Antimony	µg/L	6	6 U	6 U	6 U	6 U
Arsenic	µg/L	10	3 U	3 U	3 U	***1.2 J***
Beryllium	µg/L	4	1 U	1 U	1 U	1 U
Cadmium	µg/L	5	1.5 U	1.5 U	1.5 U	1.5 U
Chromium	µg/L	100	5 U	5 U	5 U	5 U
Copper	µg/L	1,300	3 U	***1.6 J***	3 U	3 U
Lead	µg/L	15	2.5 U	2.5 U	2.5 U	2.5 U
Mercury	µg/L	2	***0.14 J***	***0.15 J***	0.14 U	0.2 U
Nickel	µg/L	2,040	3 U	3 U	3 U	3 U
Selenium	µg/L	50	3 U	3 U	3 U	3 U
Silver	µg/L	508	1 U	1 U	1 U	1 U
Zinc	µg/L	30,500	12 U	12 U	12 U	12 U
Groundwater Quality Package						
Ammonia	mg/L	NA	***0.49 J***	***0.34 J***	***0.16 J***	***0.17***
Chloride	mg/L	NA	***49***	***20.3***	***15***	***12***
Nitrate as N	mg/L	10	0.25 U	0.25 U	***0.14***	0.05 U
Orthophosphate as P	mg/L	NA	1 U	1 U	0.2 U	0.2 U
Sulfate	mg/L	NA	***1,020***	***356***	***260***	***180***
Sulfide	mg/L	NA	4 U	4 U	4 U J	4 U
Monitored Natural Attenuation Package						
Methane	µg/L	NA	***0.22 J***	***1.8 J***	***3 J***	***2.6 J***
Ethane	µg/L	NA	5 U	5 U	5 U	5 U
Total Organic Carbon	mg/L	NA	***0.56 J***	***0.86 J***	***0.75 J***	***0.52 J***

Notes:
Bold / Italics = compound was detected
Highlighted = Concentration exceeds screening level
ID = Identification
J = estimated value
mg/L = milligrams per liter
NA = Not available / Not analyzed
NS = Not sampled
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/L = micrograms per liter
[1] For source of screening levels, see Table 4-1.

Table 4-10
Monitoring Well Groundwater Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	OB-93-04/GW01	OB-93-04/GW02	OB-93-04/GW03	OB-93-04/GW04
		Date Sampled:	3/6/2012	6/20/2012	9/26/2012	12/18/2012
		Comment(s):	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Parameter	**Units**	**Screening Level[1]**				
Volatile Organic Compounds						
1,1,1,2-Tetrachloroethane	µg/L	9.91	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	µg/L	1.28	1 U	1 U	1 U	1 U
1,2,3-Trichlorobenzene	µg/L	5.2	1 U	1 U	1 U	1 U
2-Butanone (MEK)	µg/L	11,800	2 U	2 U	6 U	6 U
Acetone	µg/L	45,500	10 U	10 U	10 U	10 U
cis-1,2-Dichloroethene	µg/L	70	***0.17 J***	***0.18 J***	1 U	1 U
Naphthalene	µg/L	2.11	1 U	1 U	1 U	1 U
Tetrachloroethene	µg/L	5	***0.13 J***	***0.16 J***	1 U	1 U
trans-1,2-Dichloroethene	µg/L	100	1 U	1 U	1 U	1 U
Trichloroethene	µg/L	5	***5.5***	***5.8***	***6.2***	***5.7***
Semivolatile Organic Compounds						
Benzo(a)pyrene	µg/L	0.2	9.5 U	9.8 U	9.5 U	9.6 U
Benzo(ghi)perylene	µg/L	NA	9.5 U	9.8 U	9.5 U	9.6 U
bis(2-Ethylhexyl)phthalate	µg/L	6	9.5 U	9.8 U	9.5 U	9.6 U
Perchlorate						
Perchlorate	µg/L	70.9	***0.1 J***	***0.12 J***	***0.24 J***	0.5 U
Explosives						
HMX	µg/L	5,110	0.1 U	0.1 U	0.1 U	0.11 U
RDX	µg/L	25.9	0.1 U	0.1 U	0.1 U	0.11 U
Metals						
Antimony	µg/L	6	6 U	6 U	6 U	6 U
Arsenic	µg/L	10	3 U	15 U	3 U	3 U
Beryllium	µg/L	4	1 U	1 U	1 U	1 U
Cadmium	µg/L	5	1.5 U	1.5 U	1.5 U	1.5 U
Chromium	µg/L	100	5 U	***4.1 J***	5 U	5 U
Copper	µg/L	1,300	3 U	***2.8 J***	3 U	3 U
Lead	µg/L	15	2.5 U	2.5 U	2.5 U	2.5 U
Mercury	µg/L	2	0.2 U	0.2 U	0.14 U	0.2 U
Nickel	µg/L	2,040	3 U	***1.8 J***	3 U	3 U
Selenium	µg/L	50	3 U	***1.2 J***	3 U	3 U
Silver	µg/L	508	1 U	1 U	1 U	1 U
Zinc	µg/L	30,500	12 U	12 U J	12 U	12 U
Groundwater Quality Package						
Ammonia	mg/L	NA	***0.14 J***	***0.15 J***	0.1 U	***0.028 J***
Chloride	mg/L	NA	***9.3***	***8.3***	***6.7***	***6.8***
Nitrate as N	mg/L	10	0.1 U	0.25 U	0.05 U	0.05 U
Orthophosphate as P	mg/L	NA	0.4 U	1 U	0.2 U	0.2 U
Sulfate	mg/L	NA	***314***	***347 J***	***180***	***210***
Sulfide	mg/L	NA	4 U	4 U	4 U	4 U
Monitored Natural Attenuation Package						
Methane	µg/L	NA	5 U	5 U	***0.78 J***	***1.2 J***
Ethane	µg/L	NA	5 U	5 U	5 U	5 U
Total Organic Carbon	mg/L	NA	***0.57 J***	***0.65 J***	***0.86 J***	***0.65 J***

Notes:
Bold / Italics = compound was detected
Highlighted = Concentration exceeds screening level
ID = Identification
J = estimated value
mg/L = milligrams per liter
NA = Not available / Not analyzed
NS = Not sampled
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/L = micrograms per liter
[1] For source of screening levels, see Table 4-1.

Table 4-10
Monitoring Well Groundwater Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	OB-97-05/GW01	OB-97-05/GW02	OB-97-05/GW03	OB-97-05/GW04
		Date Sampled:	3/6/2012	6/19/2012	9/26/2012	12/18/2012
		Comment(s):	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Parameter	**Units**	**Screening Level[1]**				
Volatile Organic Compounds						
1,1,1,2-Tetrachloroethane	µg/L	9.91	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	µg/L	1.28	1 U	1 U	1 U	1 U
1,2,3-Trichlorobenzene	µg/L	5.2	1 U	1 U	1 U	1 U
2-Butanone (MEK)	µg/L	11,800	2 U	2 U	6 U	6 U
Acetone	µg/L	45,500	10 U	10 U	10 U	10 U
cis-1,2-Dichloroethene	µg/L	70	1 U	1 U	1 U	1 U
Naphthalene	µg/L	2.11	1 U	1 U	1 U	1 U
Tetrachloroethene	µg/L	5	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene	µg/L	100	1 U	1 U	1 U	1 U
Trichloroethene	µg/L	5	***0.3 J***	***0.23 J***	***0.22 J***	1 U
Semivolatile Organic Compounds						
Benzo(a)pyrene	µg/L	0.2	9.4 U	9.6 U	9.9 U	9.7 U
Benzo(ghi)perylene	µg/L	NA	9.4 U	9.6 U	9.9 U	9.7 U
bis(2-Ethylhexyl)phthalate	µg/L	6	9.4 U	9.6 U	9.9 U	***1.7 J***
Perchlorate						
Perchlorate	µg/L	70.9	0.5 U	0.5 U	***0.13 J***	0.5 U
Explosives						
HMX	µg/L	5,110	0.099 U	0.1 U	0.1 U	0.1 U
RDX	µg/L	25.9	0.099 U	0.1 U	0.1 U	0.1 U
Metals						
Antimony	µg/L	6	6 U	6 U	6 U	6 U
Arsenic	µg/L	10	3 U	3 U	3 U	***1.9 J***
Beryllium	µg/L	4	1 U	1 U	1 U	1 U
Cadmium	µg/L	5	1.5 U	1.5 U	1.5 U	1.5 U
Chromium	µg/L	100	5 U	5 U	5 U	5 U
Copper	µg/L	1,300	3 U	3 U	3 U	***2.2 J***
Lead	µg/L	15	2.5 U	2.5 U	2.5 U	2.5 U
Mercury	µg/L	2	0.2 U	0.2 U	0.14 U	0.2 U
Nickel	µg/L	2,040	3 U	***1.5 J***	3 U	3 U
Selenium	µg/L	50	3 U	3 U	3 U	3 U
Silver	µg/L	508	1 U	1 U	1 U	1 U
Zinc	µg/L	30,500	12 U	***5.4 J***	12 U	***6.5 J***
Groundwater Quality Package						
Ammonia	mg/L	NA	***0.11 J***	***0.15 J***	***0.044 J***	***0.067 J***
Chloride	mg/L	NA	***6.6***	***6.6***	***6.7***	***6.8***
Nitrate as N	mg/L	10	0.05 U	0.05 U	0.05 U	0.05 U J
Orthophosphate as P	mg/L	NA	0.2 U	0.2 U	0.2 U	0.2 U
Sulfate	mg/L	NA	***98.6***	***110***	***110***	***98 J***
Sulfide	mg/L	NA	4 U	4 U	4 U	4 U
Monitored Natural Attenuation Package						
Methane	µg/L	NA	***1.1 J***	***1.3 J***	***2.5 J***	***2.1 J***
Ethane	µg/L	NA	5 U	5 U	5 U	5 U
Total Organic Carbon	mg/L	NA	***0.57 J***	***0.69 J***	***0.73 J***	***0.63 J***

Notes:
Bold / Italics = compound was detected
Highlighted = Concentration exceeds screening level
ID = Identification
J = estimated value
mg/L = milligrams per liter
NA = Not available / Not analyzed
NS = Not sampled
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/L = micrograms per liter
[1] For source of screening levels, see Table 4-1.

Table 4-10
Monitoring Well Groundwater Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID: Date Sampled: Comment(s):	OB-97-06/GW01 3/5/2012 1st Quarter	OB-97-06/GW02 6/19/2012 2nd Quarter	OB-97-06/GW03 9/24/2012 3rd Quarter	OB-97-06/GW04 12/17/2012 4th Quarter
Parameter	**Units**	**Screening Level[1]**				
Volatile Organic Compounds						
1,1,1,2-Tetrachloroethane	µg/L	9.91	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	µg/L	1.28	1 U	1 U	1 U	1 U
1,2,3-Trichlorobenzene	µg/L	5.2	1 U	1 U	1 U	0.25 J U
2-Butanone (MEK)	µg/L	11,800	2 U	2 U	6 U	6 U
Acetone	µg/L	45,500	10 U	10 U	10 U	10 U J
cis-1,2-Dichloroethene	µg/L	70	1 U	1 U	1 U	1 U
Naphthalene	µg/L	2.11	1 U	1 U	1 U	0.26 J U
Tetrachloroethene	µg/L	5	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene	µg/L	100	1 U	1 U	1 U	1 U
Trichloroethene	µg/L	5	***0.57 J***	***0.24 J***	***0.31 J***	***0.22 J***
Semivolatile Organic Compounds						
Benzo(a)pyrene	µg/L	0.2	9.4 U	9.6 U	9.5 U	11 U
Benzo(ghi)perylene	µg/L	NA	9.4 U	9.6 U	9.5 U	11 U
bis(2-Ethylhexyl)phthalate	µg/L	6	9.4 U	1.7 J U	***2.2 J***	1.1 J U
Perchlorate						
Perchlorate	µg/L	70.9	***2.4***	***2.2***	***2.4***	***0.96***
Explosives						
HMX	µg/L	5,110	0.1 U	0.1 U	0.1 U	0.1 U
RDX	µg/L	25.9	0.1 U	0.1 U	0.1 U	0.1 U
Metals						
Antimony	µg/L	6	6 U	6 U	6 U	6 U
Arsenic	µg/L	10	3 U	3 U	3 U	3 U
Beryllium	µg/L	4	1 U	1 U	1 U	1 U
Cadmium	µg/L	5	1.5 U	1.5 U	1.5 U	1.5 U
Chromium	µg/L	100	5 U	5 U	5 U	5 U
Copper	µg/L	1,300	***1.2 J***	3 U	3 U	3 U
Lead	µg/L	15	2.5 U	2.5 U	2.5 U	2.5 U
Mercury	µg/L	2	0.2 U	0.2 U	0.14 U	0.2 U
Nickel	µg/L	2,040	3 U	3 U	3 U	3 U
Selenium	µg/L	50	3 U	3 U	3 U	***1.4 J***
Silver	µg/L	508	1 U	1 U	1 U	1 U
Zinc	µg/L	30,500	12 U	12 U	12 U	12 U
Groundwater Quality Package						
Ammonia	mg/L	NA	1 U	***0.071 J***	***0.064 J***	0.1 U
Chloride	mg/L	NA	***3.9***	***3.9***	***4***	***4.8***
Nitrate as N	mg/L	10	***0.29***	***0.48***	***0.37***	***0.094***
Orthophosphate as P	mg/L	NA	0.2 U	0.2 U	0.2 U	0.2 U
Sulfate	mg/L	NA	***18.1***	***20.4***	***23***	***25***
Sulfide	mg/L	NA	4 U	4 U	4 U J	4 U
Monitored Natural Attenuation Package						
Methane	µg/L	NA	5 U	5 U	5 U	5 U
Ethane	µg/L	NA	5 U	5 U	5 U	5 U
Total Organic Carbon	mg/L	NA	***0.57 J***	***0.69 J***	***0.78 J***	***0.52 J***

Notes:
Bold / Italics = compound was detected
Highlighted = Concentration exceeds screening level
ID = Identification
J = estimated value
mg/L = milligrams per liter
NA = Not available / Not analyzed
NS = Not sampled
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/L = micrograms per liter
[1] For source of screening levels, see Table 4-1.

Table 4-10
Monitoring Well Groundwater Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID: Date Sampled: Comment(s):	OB-97-07/GW01 3/6/2012 1st Quarter	OB-97-07/GW02 6/20/2012 2nd Quarter	OB-97-07/GW03 9/26/2012 3rd Quarter	OB-97-07/GW04 12/18/2012 4th Quarter
Parameter	**Units**	**Screening Level[1]**				
Volatile Organic Compounds						
1,1,1,2-Tetrachloroethane	µg/L	9.91	5 U	1 U	2 U	1 U
1,1,2,2-Tetrachloroethane	µg/L	1.28	***3.4 J***	***1***	***1.6 J***	***5.1***
1,2,3-Trichlorobenzene	µg/L	5.2	5 U	1 U	2 U	1 U
2-Butanone (MEK)	µg/L	11,800	10 U	2 U	12 U	6 U
Acetone	µg/L	45,500	50 U	10 U	20 U	10 U
cis-1,2-Dichloroethene	µg/L	70	***11***	***2.8***	***2.7***	***5.3***
Naphthalene	µg/L	2.11	5 U	***0.22 J***	2 U	1 U
Tetrachloroethene	µg/L	5	***3.1 J***	***0.94 J***	***1 J***	***2***
trans-1,2-Dichloroethene	µg/L	100	***0.6 J***	***0.21 J***	***0.39 J***	***0.45 J***
Trichloroethene	µg/L	5	***140***	***41***	***73***	***130***
Semivolatile Organic Compounds						
Benzo(a)pyrene	µg/L	0.2	9.4 U	9.6 U	9.6 U	10 U
Benzo(ghi)perylene	µg/L	NA	9.4 U	9.6 U	9.6 U	10 U
bis(2-Ethylhexyl)phthalate	µg/L	6	9.4 U	9.6 U	9.6 U	***1.1 J***
Perchlorate						
Perchlorate	µg/L	70.9	***16***	***7.3***	***9.5***	***15***
Explosives						
HMX	µg/L	5,110	0.1 U	0.1 U	0.1 U	0.1 U
RDX	µg/L	25.9	***0.068 J***	0.1 U	0.1 U	0.1 U
Metals						
Antimony	µg/L	6	6 U	6 U	6 U	6 U
Arsenic	µg/L	10	3 U	15 U	3 U	3 U
Beryllium	µg/L	4	1 U	1 U	***0.11 J***	1 U
Cadmium	µg/L	5	1.5 U	1.5 U	1.5 U	1.5 U
Chromium	µg/L	100	5 U	***4.2 J***	5 U	5 U
Copper	µg/L	1,300	3 U	***1.2 J***	3 U	3 U
Lead	µg/L	15	2.5 U	2.5 U	2.5 U	2.5 U
Mercury	µg/L	2	0.2 U	***0.17 J***	0.14 U	0.2 U
Nickel	µg/L	2,040	3 U	3 U	3 U	3 U
Selenium	µg/L	50	3 U	3 U	3 U	3 U
Silver	µg/L	508	1 U	1 U	1 U	1 U
Zinc	µg/L	30,500	12 U	12 U	***5.3 J***	12 U
Groundwater Quality Package						
Ammonia	mg/L	NA	1 U	***0.065 J***	0.1 U	0.1 U
Chloride	mg/L	NA	***4.9***	***4.5***	***4.4***	***5.4***
Nitrate as N	mg/L	10	***0.3***	***0.43***	***0.46***	***0.11***
Orthophosphate as P	mg/L	NA	0.2 U	0.2 U	0.2 U	0.2 U
Sulfate	mg/L	NA	***27.2***	***25.6***	***34***	***31***
Sulfide	mg/L	NA	***1.1 J***	***0.96 J***	4 U	4 U
Monitored Natural Attenuation Package						
Methane	µg/L	NA	***0.90 J***	***0.49 J***	***2.3 J***	***2.5 J***
Ethane	µg/L	NA	5 U	5 U	5 U	5 U
Total Organic Carbon	mg/L	NA	***0.52 J***	***0.78 J***	***0.88 J***	***0.62 J***

Notes:
Bold / Italics = compound was detected
Highlighted = Concentration exceeds screening level
ID = Identification
J = estimated value
mg/L = milligrams per liter
NA = Not available / Not analyzed
NS = Not sampled
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/L = micrograms per liter
[1] For source of screening levels, see Table 4-1.

Table 4-10
Monitoring Well Groundwater Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	OB-97-08/GW01	OB-97-08/GW02	OB-97-08/GW03	OB-97-08/GW04
		Date Sampled:	3/6/2012	6/20/2012	9/27/2012	12/19/2012
		Comment(s):	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Parameter	**Units**	**Screening Level[1]**				
Volatile Organic Compounds						
1,1,1,2-Tetrachloroethane	µg/L	9.91	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	µg/L	1.28	***6.6***	***4.5***	***1.5***	***1.1 J***
1,2,3-Trichlorobenzene	µg/L	5.2	1 U	1 U	1 U	1 U
2-Butanone (MEK)	µg/L	11,800	2 U	2 U	6 U	6 U
Acetone	µg/L	45,500	10 U	10 U	10 U	10 U
cis-1,2-Dichloroethene	µg/L	70	***1.5***	***2.4***	***5.4***	***4.2***
Naphthalene	µg/L	2.11	1 U	1 U	1 U	1 U
Tetrachloroethene	µg/L	5	***0.84 J***	***0.82 J***	***0.46 J***	***0.6 J***
trans-1,2-Dichloroethene	µg/L	100	***0.11 J***	***0.17 J***	1 U	1 U
Trichloroethene	µg/L	5	***40***	***45***	***28***	***26***
Semivolatile Organic Compounds						
Benzo(a)pyrene	µg/L	0.2	9.4 U	17 U	NS	NS
Benzo(ghi)perylene	µg/L	NA	9.4 U	17 U	NS	NS
bis(2-Ethylhexyl)phthalate	µg/L	6	9.4 U	***24***	NS	NS
Perchlorate						
Perchlorate	µg/L	70.9	***19***	***8.1***	***5.6***	***5.3***
Explosives						
HMX	µg/L	5,110	0.1 U	0.1 U	NS	NS
RDX	µg/L	25.9	0.1 U	0.1 U	NS	NS
Metals						
Antimony	µg/L	6	6 U	6 U	6 U	6 U
Arsenic	µg/L	10	3 U	3 U	3 U	***2.1 J***
Beryllium	µg/L	4	1 U	1 U	***0.29 J***	***0.19 J***
Cadmium	µg/L	5	1.5 U	1.5 U	1.5 U	1.5 U
Chromium	µg/L	100	5 U	***2.9 J***	***11***	***6.8***
Copper	µg/L	1,300	3 U	***2.2 J***	***5.1***	***4.2***
Lead	µg/L	15	2.5 U	***0.7 J***	***2.8***	***1.9 J***
Mercury	µg/L	2	0.2 U	0.2 U	0.14 U	0.2 U
Nickel	µg/L	2,040	3 U	***1.4 J***	***5.2***	***4.7***
Selenium	µg/L	50	***1.3 J***	3 U	3 U	***1.7 J***
Silver	µg/L	508	1 U	***0.83 J***	***1.1***	***0.53 J***
Zinc	µg/L	30,500	12 U	12 U	***19***	***17***
Groundwater Quality Package						
Ammonia	mg/L	NA	***0.36 J***	***0.099 J***	NS	NS
Chloride	mg/L	NA	***6.5***	***6***	NS	***5.5***
Nitrate as N	mg/L	10	***0.11***	***0.12***	NS	***0.049 J***
Orthophosphate as P	mg/L	NA	0.2 U	0.2 U	NS	0.2 U
Sulfate	mg/L	NA	***29.2***	***25.4***	NS	***26***
Sulfide	mg/L	NA	4 U	4 U	NS	NS
Monitored Natural Attenuation Package						
Methane	µg/L	NA	***0.31 J***	***4.9 J***	NS	NS
Ethane	µg/L	NA	5 U	5 U	NS	NS
Total Organic Carbon	mg/L	NA	***0.88 J***	***1.4 J***	NS	NS

Notes:
Bold / Italics = compound was detected
Highlighted = Concentration exceeds screening level
ID = Identification
J = estimated value
mg/L = milligrams per liter
NA = Not available / Not analyzed
NS = Not sampled
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/L = micrograms per liter
[1] For source of screening levels, see Table 4-1.

Table 4-10
Monitoring Well Groundwater Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	OBHD-97-14/GW01	OBHD-97-14/GW02	OBHD-97-14/GW03	OBHD-97-14/GW04
		Date Sampled:	3/6/2012	6/21/2012	9/27/2012	12/18/2012
		Comment(s):	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Parameter	**Units**	**Screening Level[1]**				
Volatile Organic Compounds						
1,1,1,2-Tetrachloroethane	µg/L	9.91	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	µg/L	1.28	***9.7***	***8.6***	***4.6***	***5.8***
1,2,3-Trichlorobenzene	µg/L	5.2	1 U	1 U	1 U	1 U
2-Butanone (MEK)	µg/L	11,800	2 U	2 U	6 U	6 U
Acetone	µg/L	45,500	10 U	10 U	10 U	10 U
cis-1,2-Dichloroethene	µg/L	70	***19***	***21***	***6.1***	***9.4***
Naphthalene	µg/L	2.11	1 U	1 U	1 U	1 U
Tetrachloroethene	µg/L	5	***0.96 J***	***0.78 J***	***0.75 J***	***1.1***
trans-1,2-Dichloroethene	µg/L	100	***0.48 J***	***0.49 J***	1 U	1 U
Trichloroethene	µg/L	5	***45***	***45***	***41***	***57***
Semivolatile Organic Compounds						
Benzo(a)pyrene	µg/L	0.2	9.7 U	10 U	9.5 U	10 U
Benzo(ghi)perylene	µg/L	NA	9.7 U	10 U	9.5 U	10 U
bis(2-Ethylhexyl)phthalate	µg/L	6	9.7 U	10 U	***3.6 J***	***3.3 J***
Perchlorate						
Perchlorate	µg/L	70.9	***19***	***7.9***	***11***	***13***
Explosives						
HMX	µg/L	5,110	0.1 U	0.1 U	0.1 U	0.11 U
RDX	µg/L	25.9	***0.072 J***	0.1 U	0.1 U	0.11 U
Metals						
Antimony	µg/L	6	6 U	6 U	6 U	6 U
Arsenic	µg/L	10	3 U	3 U	3 U	3 U
Beryllium	µg/L	4	1 U	1 U	1 U	1 U
Cadmium	µg/L	5	1.5 U	1.5 U	1.5 U	1.5 U
Chromium	µg/L	100	5 U	5 U	5 U	5 U
Copper	µg/L	1,300	***1.2 J***	3 U	***1.1 J***	3 U
Lead	µg/L	15	2.5 U	2.5 U	2.5 U	2.5 U
Mercury	µg/L	2	0.2 U	0.2 U	0.14 U	0.2 U
Nickel	µg/L	2,040	3 U	3 U	3 U	3 U
Selenium	µg/L	50	3 U	3 U	3 U	***1.1 J***
Silver	µg/L	508	1 U	1 U	1 U	1 U
Zinc	µg/L	30,500	12 U	12 U	12 U	12 U
Groundwater Quality Package						
Ammonia	mg/L	NA	***0.41 J***	***0.47 J***	0.1 U	0.1 U
Chloride	mg/L	NA	***7.5***	***6.5***	***5.4***	***5.4***
Nitrate as N	mg/L	10	0.05 U	0.05 U J	***0.14***	***0.072***
Orthophosphate as P	mg/L	NA	0.2 U	0.2 U J	0.2 U	0.2 U
Sulfate	mg/L	NA	***32.8***	***24***	***27***	***27***
Sulfide	mg/L	NA	***1.1 J***	4 U	4 U	4 U
Monitored Natural Attenuation Package						
Methane	µg/L	NA	***980***	***2,400***	***440***	***840***
Ethane	µg/L	NA	***0.59 J***	5 U	5 U	5 U
Total Organic Carbon	mg/L	NA	***1.1***	***1.1 J***	***1***	***0.69 J***

Notes:
Bold / Italics = compound was detected
Highlighted = Concentration exceeds screening level
ID = Identification
J = estimated value
mg/L = milligrams per liter
NA = Not available / Not analyzed
NS = Not sampled
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/L = micrograms per liter
[1] For source of screening levels, see Table 4-1.

Table 4-10
Monitoring Well Groundwater Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	OB-05-15/GW01	OB-05-15/GW02	OB-05-15/GW03	OB-05-15/GW04
		Date Sampled:	3/7/2012	6/21/2012	9/25/2012	12/19/2012
		Comment(s):	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Parameter	**Units**	**Screening Level[1]**				
Volatile Organic Compounds						
1,1,1,2-Tetrachloroethane	µg/L	9.91	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	µg/L	1.28	***1***	***0.58 J***	1 U	***0.38 J***
1,2,3-Trichlorobenzene	µg/L	5.2	1 U	1 U	1 U	1 U
2-Butanone (MEK)	µg/L	11,800	2 U	2 U	6 U	6 U
Acetone	µg/L	45,500	10 U	10 U	10 U	10 U
cis-1,2-Dichloroethene	µg/L	70	***0.73 J***	***0.34 J***	***0.22 J***	***0.43 J***
Naphthalene	µg/L	2.11	1 U	1 U	1 U	1 U
Tetrachloroethene	µg/L	5	***0.32 J***	***0.25 J***	***0.21 J***	***0.26 J***
trans-1,2-Dichloroethene	µg/L	100	***0.46 J***	***0.2 J***	1 U	***0.22 J***
Trichloroethene	µg/L	5	***18***	***8.7***	***7.3***	***9.3***
Semivolatile Organic Compounds						
Benzo(a)pyrene	µg/L	0.2	9.4 U	9.5 U	10 U	9.5 U
Benzo(ghi)perylene	µg/L	NA	9.4 U	9.5 U	10 U	9.5 U
bis(2-Ethylhexyl)phthalate	µg/L	6	***1.2 J***	9.5 U	***1.9 J***	9.5 U
Perchlorate						
Perchlorate	µg/L	70.9	***3.7***	***1.5***	***1.9***	***1.3***
Explosives						
HMX	µg/L	5,110	0.099 U	0.1 U	0.1 U	0.1 U
RDX	µg/L	25.9	0.099 U	0.1 U	0.1 U	0.1 U
Metals						
Antimony	µg/L	6	6 U	6 U	6 U	6 U
Arsenic	µg/L	10	3 U	3 U	3 U	3 U
Beryllium	µg/L	4	1 U	1 U	1 U	1 U
Cadmium	µg/L	5	1.5 U	1.5 U	1.5 U	1.5 U
Chromium	µg/L	100	5 U	5 U	***1.6 J***	5 U
Copper	µg/L	1,300	3 U	3 U	3 U	***4.2***
Lead	µg/L	15	2.5 U	2.5 U	2.5 U	2.5 U
Mercury	µg/L	2	0.2 U	0.2 U	0.14 U	0.2 U
Nickel	µg/L	2,040	3 U	3 U	3 U	3 U
Selenium	µg/L	50	***1.5 J***	***1 J***	***1.5 J***	***1.8 J***
Silver	µg/L	508	1 U	1 U	1 U	1 U
Zinc	µg/L	30,500	12 U	12 U	***8.4 J***	***4.3 J***
Groundwater Quality Package						
Ammonia	mg/L	NA	1 U	***0.082 J***	***0.054 J***	0.1 U
Chloride	mg/L	NA	***5.5***	***6.4***	***62***	***6.2***
Nitrate as N	mg/L	10	***0.082***	***0.084***	***0.68***	***0.055***
Orthophosphate as P	mg/L	NA	0.2 U	***0.13 J***	2 U	0.2 U
Sulfate	mg/L	NA	***45.9***	***33.3***	***360***	***41***
Sulfide	mg/L	NA	***0.80 J***	4 U	4 U	4 U
Monitored Natural Attenuation Package						
Methane	µg/L	NA	5 U	5 U	5 U	5 U
Ethane	µg/L	NA	5 U	5 U	5 U	5 U
Total Organic Carbon	mg/L	NA	***0.53 J***	***0.96 J***	***0.99 J***	***0.81 J***

Notes:
Bold / Italics = compound was detected
Highlighted = Concentration exceeds screening level
ID = Identification
J = estimated value
mg/L = milligrams per liter
NA = Not available / Not analyzed
NS = Not sampled
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/L = micrograms per liter
[1] For source of screening levels, see Table 4-1.

Table 4-10
Monitoring Well Groundwater Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	OB-12-15D/GW01	OB-12-15D/GW02	OB-12-15D/GW03	OB-12-15D/GW04
		Date Sampled:	3/9/2012	6/21/2012	9/27/2012	12/20/2012
		Comment(s):	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Parameter	**Units**	**Screening Level[1]**				
Volatile Organic Compounds						
1,1,1,2-Tetrachloroethane	µg/L	9.91	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	µg/L	1.28	1 U	1 U	1 U	1 U
1,2,3-Trichlorobenzene	µg/L	5.2	1 U	1 U	1 U	1 U
2-Butanone (MEK)	µg/L	11,800	2 U	2 U	6 U	6 U
Acetone	µg/L	45,500	10 U	10 U	10 U	10 U J
cis-1,2-Dichloroethene	µg/L	70	1 U	1 U	1 U	1 U
Naphthalene	µg/L	2.11	***0.17 J***	1 U	1 U	1 U
Tetrachloroethene	µg/L	5	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene	µg/L	100	1 U	1 U	1 U	1 U
Trichloroethene	µg/L	5	1 U	1 U	1 U	1 U
Semivolatile Organic Compounds						
Benzo(a)pyrene	µg/L	0.2	9.4 U	9.6 U	9.5 U	11 U
Benzo(ghi)perylene	µg/L	NA	9.4 U	9.6 U	9.5 U	11 U
bis(2-Ethylhexyl)phthalate	µg/L	6	9.4 U	***1.3 J***	9.5 U	11 U
Perchlorate						
Perchlorate	µg/L	70.9	0.5 U	0.5 U	0.5 U	0.5 U
Explosives						
HMX	µg/L	5,110	0.099 U	0.1 U	0.1 U	0.1 U
RDX	µg/L	25.9	0.099 U	0.1 U	0.1 U	0.1 U
Metals						
Antimony	µg/L	6	***2.4 J***	6 U	6 U	6 U
Arsenic	µg/L	10	***2.7 J***	***1.4 J***	3 U	***1.1 J***
Beryllium	µg/L	4	1 U	1 U	1 U	1 U J
Cadmium	µg/L	5	1.5 U	1.5 U	***0.5 J***	1.5 U
Chromium	µg/L	100	5 U	5 U	5 U	5 U
Copper	µg/L	1,300	3 U	3 U	3 U	3 U
Lead	µg/L	15	2.5 U	2.5 U	2.5 U	2.5 U
Mercury	µg/L	2	0.2 U	0.2 U	0.14 U	0.2 U
Nickel	µg/L	2,040	***5.4***	***1 J***	3 U	3 U
Selenium	µg/L	50	***1.5 J***	3 U	3 U	***1.6 J***
Silver	µg/L	508	1 U	1 U	1 U	1 U
Zinc	µg/L	30,500	12 U	12 U	12 U	12 U
Groundwater Quality Package						
Ammonia	mg/L	NA	***0.10 J***	***0.19 J***	***0.074 J***	***0.14***
Chloride	mg/L	NA	***4.1***	***3.7***	***3.9***	***3.9***
Nitrate as N	mg/L	10	0.05 U J	0.05 U	0.05 U	0.05 U J
Orthophosphate as P	mg/L	NA	0.2 U	0.2 U	0.2 U	0.2 U
Sulfate	mg/L	NA	***33.3***	***25.6***	***27***	***25***
Sulfide	mg/L	NA	4 U	4 U	4 U	4 U
Monitored Natural Attenuation Package						
Methane	µg/L	NA	***0.39 J***	***1.1 J***	***1.9 J***	***2.7 J***
Ethane	µg/L	NA	5 U	5 U	5 U	5 U
Total Organic Carbon	mg/L	NA	***1.3 J***	***0.46 J***	***0.55 J***	***0.5 J***

Notes:
Bold / Italics = compound was detected
Highlighted = Concentration exceeds screening level
ID = Identification
J = estimated value
mg/L = milligrams per liter
NA = Not available / Not analyzed
NS = Not sampled
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/L = micrograms per liter
[1] For source of screening levels, see Table 4-1.

Table 4-10
Monitoring Well Groundwater Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	OB-12-16/GW01	OB-12-16/GW02	OB-12-16/GW03	OB-12-16/GW04
		Date Sampled:	3/7/2012	6/20/2012	9/27/2012	12/19/2012
		Comment(s):	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Parameter	**Units**	**Screening Level[1]**				
Volatile Organic Compounds						
1,1,1,2-Tetrachloroethane	µg/L	9.91	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	µg/L	1.28	***0.6 J***	***0.91 J***	1 U	1 U
1,2,3-Trichlorobenzene	µg/L	5.2	1 U	1 U	1 U	1 U
2-Butanone (MEK)	µg/L	11,800	2 U	2 U	6 U	6 U
Acetone	µg/L	45,500	10 U	10 U	10 U	10 U
cis-1,2-Dichloroethene	µg/L	70	1 U	1 U	1 U	1 U
Naphthalene	µg/L	2.11	1 U	1 U	1 U	1 U
Tetrachloroethene	µg/L	5	1 U	***0.36 J***	***0.2 J***	***0.2 J***
trans-1,2-Dichloroethene	µg/L	100	1 U	1 U	1 U	1 U
Trichloroethene	µg/L	5	***6.3***	***12***	***7.2***	***5.5***
Semivolatile Organic Compounds						
Benzo(a)pyrene	µg/L	0.2	9.4 U	9.5 U	9.4 U	11 U
Benzo(ghi)perylene	µg/L	NA	9.4 U	9.5 U	9.4 U	11 U
bis(2-Ethylhexyl)phthalate	µg/L	6	***2.2 J***	9.5 U	9.4 U	***1.1 J***
Perchlorate						
Perchlorate	µg/L	70.9	***3.2***	***2.2***	***3.3***	***3.4***
Explosives						
HMX	µg/L	5,110	0.099 U	0.1 U	0.1 U	0.1 U
RDX	µg/L	25.9	0.099 U	0.1 U	0.1 U	0.1 U
Metals						
Antimony	µg/L	6	6 U	6 U	6 U	6 U
Arsenic	µg/L	10	3 U	3 U	3 U	3 U
Beryllium	µg/L	4	***0.13 J***	1 U	1 U	1 U
Cadmium	µg/L	5	1.5 U	1.5 U	1.5 U	1.5 U
Chromium	µg/L	100	***2.5 J***	5 U	5 U	5 U
Copper	µg/L	1,300	***2.2 J***	3 U	3 U	3 U
Lead	µg/L	15	***1.5 J***	2.5 U	2.5 U	2.5 U
Mercury	µg/L	2	0.2 U	0.2 U	0.14 U	0.2 U
Nickel	µg/L	2,040	***1.9 J***	3 U	3 U	3 U
Selenium	µg/L	50	***1.6 J***	3 U	3 U	***1.5 J***
Silver	µg/L	508	1 U	1 U	1 U	1 U
Zinc	µg/L	30,500	12 U	12 U	12 U	12 U
Groundwater Quality Package						
Ammonia	mg/L	NA	1 U	***0.066 J***	0.1 U	0.1 U
Chloride	mg/L	NA	***5.9***	***5.9***	***6.8***	***6.7***
Nitrate as N	mg/L	10	0.05 U	***0.081***	0.05 U	***0.1***
Orthophosphate as P	mg/L	NA	0.2 U	0.2 U	0.2 U	0.2 U
Sulfate	mg/L	NA	***39.1***	***34***	***29***	***26***
Sulfide	mg/L	NA	4 U	4 U	4 U	4 U
Monitored Natural Attenuation Package						
Methane	µg/L	NA	5 U	5 U	***0.29 J***	***1.6 J***
Ethane	µg/L	NA	5 U	5 U	5 U	5 U
Total Organic Carbon	mg/L	NA	***1.2 J***	***0.97 J***	***1***	***0.84 J***

Notes:
Bold / Italics = compound was detected
Highlighted = Concentration exceeds screening level
ID = Identification
J = estimated value
mg/L = milligrams per liter
NA = Not available / Not analyzed
NS = Not sampled
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/L = micrograms per liter
[1] For source of screening levels, see Table 4-1.

Table 4-10
Monitoring Well Groundwater Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	OB-12-17/GW01	OB-12-17/GW02	OB-12-17/GW03	OB-12-17/GW04
		Date Sampled:	3/8/2012	6/21/2012	9/26/2012	12/19/2012
		Comment(s):	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Parameter	**Units**	**Screening Level[1]**				
Volatile Organic Compounds						
1,1,1,2-Tetrachloroethane	µg/L	9.91	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	µg/L	1.28	***0.19 J***	***0.15 J***	***0.47 J***	***0.52 J***
1,2,3-Trichlorobenzene	µg/L	5.2	1 U	1 U	1 U	1 U
2-Butanone (MEK)	µg/L	11,800	2 U	2 U	6 U	6 U
Acetone	µg/L	45,500	10 U	10 U	10 U	10 U
cis-1,2-Dichloroethene	µg/L	70	1 U	1 U	1 U	1 U
Naphthalene	µg/L	2.11	1 U	1 U	1 U	1 U
Tetrachloroethene	µg/L	5	***0.16 J***	***0.22 J***	***0.21 J***	***0.22 J***
trans-1,2-Dichloroethene	µg/L	100	1 U	1 U	1 U	1 U
Trichloroethene	µg/L	5	***6.7***	***5.9***	***9.5***	***9.8***
Semivolatile Organic Compounds						
Benzo(a)pyrene	µg/L	0.2	9.5 U	9.5 U	10 U	10 U
Benzo(ghi)perylene	µg/L	NA	9.5 U	9.5 U	10 U	10 U
bis(2-Ethylhexyl)phthalate	µg/L	6	***1.4 J***	9.5 U	***7.3 J***	***2.1 J***
Perchlorate						
Perchlorate	µg/L	70.9	***3.6***	***4.8***	***6.2***	***6.7***
Explosives						
HMX	µg/L	5,110	0.1 U	0.1 U	0.1 U	0.1 U
RDX	µg/L	25.9	0.1 U	0.1 U	0.1 U	0.1 U
Metals						
Antimony	µg/L	6	6 U	6 U	6 U	6 U
Arsenic	µg/L	10	3 U	3 U	3 U	3 U
Beryllium	µg/L	4	1 U	1 U	***0.18 J***	1 U J
Cadmium	µg/L	5	1.5 U	1.5 U	1.5 U	1.5 U
Chromium	µg/L	100	5 U	5 U	***2.5 J***	5 U
Copper	µg/L	1,300	3 U	3 U	***2.2 J***	***1 J***
Lead	µg/L	15	2.5 U	2.5 U	***1.4 J***	2.5 U
Mercury	µg/L	2	0.2 U	0.2 U	0.14 U	***0.11 J***
Nickel	µg/L	2,040	3 U	3 U	3 U	3 U
Selenium	µg/L	50	3 U	***1 J***	3 U	3 U
Silver	µg/L	508	1 U	1 U	1 U	1 U
Zinc	µg/L	30,500	12 U	12 U	***9.7 J***	***4 J***
Groundwater Quality Package						
Ammonia	mg/L	NA	1 U	***0.068 J***	0.1 U	0.1 U
Chloride	mg/L	NA	***7.6***	***6.9***	***7.1***	***7***
Nitrate as N	mg/L	10	0.05 U	0.05 U J	***0.084***	***0.05***
Orthophosphate as P	mg/L	NA	0.2 U	0.2 U J	0.2 U	0.2 U
Sulfate	mg/L	NA	***23.7***	***22.7***	***26***	***26***
Sulfide	mg/L	NA	4 U	4 U	4 U	4 U
Monitored Natural Attenuation Package						
Methane	µg/L	NA	5 U	5 U	5 U	5 U
Ethane	µg/L	NA	5 U	5 U	5 U	5 U
Total Organic Carbon	mg/L	NA	***0.79 J***	***0.98 J***	***0.96 J***	***0.87 J***

Notes:
Bold / Italics = compound was detected
Highlighted = Concentration exceeds screening level
ID = Identification
J = estimated value
mg/L = milligrams per liter
NA = Not available / Not analyzed
NS = Not sampled
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/L = micrograms per liter
[1] For source of screening levels, see Table 4-1.

Table 4-10
Monitoring Well Groundwater Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	OB-12-18/GW01	OB-12-18/GW02	OB-12-18/GW03	OB-12-18/GW04
		Date Sampled:	3/8/2012	6/19/2012	9/26/2012	12/18/2012
		Comment(s):	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Parameter	**Units**	**Screening Level[1]**				
Volatile Organic Compounds						
1,1,1,2-Tetrachloroethane	µg/L	9.91	1 U	***0.13 J***	10 U	1 U
1,1,2,2-Tetrachloroethane	µg/L	1.28	***11***	***45***	***43***	***45***
1,2,3-Trichlorobenzene	µg/L	5.2	1 U	1 U	10 U	***2.3 J***
2-Butanone (MEK)	µg/L	11,800	2 U	2 U	60 U	6 U
Acetone	µg/L	45,500	10 U	10 U	***40 J***	10 U
cis-1,2-Dichloroethene	µg/L	70	***4.8***	***5.1***	***5 J***	***4.4 J***
Naphthalene	µg/L	2.11	1 U	***2.1 J***	10 U	***2.5 J***
Tetrachloroethene	µg/L	5	***0.87 J***	***4.7***	***3.2 J***	***3.8 J***
trans-1,2-Dichloroethene	µg/L	100	***0.29 J***	***0.48 J***	10 U	***0.3 J***
Trichloroethene	µg/L	5	***60***	***260***	***250***	***230***
Semivolatile Organic Compounds						
Benzo(a)pyrene	µg/L	0.2	9.4 U	9.9 U	9.6 U	10 U
Benzo(ghi)perylene	µg/L	NA	9.4 U	9.9 U	9.6 U	10 U
bis(2-Ethylhexyl)phthalate	µg/L	6	***1.9 J***	1 J U	***1.2 J***	10 U
Perchlorate						
Perchlorate	µg/L	70.9	***24***	***36***	***52***	***54***
Explosives						
HMX	µg/L	5,110	0.099 U	***0.097 J***	***0.1***	***0.14***
RDX	µg/L	25.9	***0.069 J***	***0.4***	***0.46***	***0.51***
Metals						
Antimony	µg/L	6	6 U	6 U	6 U	6 U
Arsenic	µg/L	10	3 U	3 U	3 U	3 U
Beryllium	µg/L	4	1 U	1 U	1 U	1 U
Cadmium	µg/L	5	1.5 U	1.5 U	1.5 U	1.5 U
Chromium	µg/L	100	***2.2 J***	***3.2 J***	***2.2 J***	5 U
Copper	µg/L	1,300	***3.6***	***1.6 J***	3 U	3 U
Lead	µg/L	15	2.5 U	2.5 U	2.5 U	2.5 U
Mercury	µg/L	2	0.2 U	0.2 U	0.14 U	0.2 U
Nickel	µg/L	2,040	***1.7 J***	***1.7 J***	3 U	3 U
Selenium	µg/L	50	***1.1 J***	3 U	3 U	***1.4 J***
Silver	µg/L	508	1 U	1 U	1 U	1 U
Zinc	µg/L	30,500	12 U	12 U	12 U	12 U
Groundwater Quality Package						
Ammonia	mg/L	NA	1 U	***0.068 J***	0.1 U	0.1 U
Chloride	mg/L	NA	***7.6***	***6.6***	***6.6***	***6.9***
Nitrate as N	mg/L	10	0.05 U	***0.15***	***0.23***	***0.09***
Orthophosphate as P	mg/L	NA	0.2 U	0.2 U	0.2 U	0.2 U
Sulfate	mg/L	NA	***34.5***	***26.9***	***27***	***27***
Sulfide	mg/L	NA	4 U	4 U	4 U	4 U
Monitored Natural Attenuation Package						
Methane	µg/L	NA	***0.29 J***	***1.9 J***	***2.2 J***	5 U
Ethane	µg/L	NA	5 U	5 U	5 U	5 U
Total Organic Carbon	mg/L	NA	***0.99 J***	***0.86 J***	***1.1***	***0.79 J***

Notes:
Bold / Italics = compound was detected
Highlighted = Concentration exceeds screening level
ID = Identification
J = estimated value
mg/L = milligrams per liter
NA = Not available / Not analyzed
NS = Not sampled
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/L = micrograms per liter
[1] For source of screening levels, see Table 4-1.

Table 4-10
Monitoring Well Groundwater Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	OB-12-19D/GW01	OB-12-19D/GW02	OB-12-19D/GW03	OB-12-19D/GW04
		Date Sampled:	3/7/2012	6/21/2012	9/24/2012	12/20/2012
		Comment(s):	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Parameter	**Units**	**Screening Level[1]**				
Volatile Organic Compounds						
1,1,1,2-Tetrachloroethane	µg/L	9.91	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	µg/L	1.28	1 U	1 U	1 U	1 U
1,2,3-Trichlorobenzene	µg/L	5.2	1 U	1 U	1 U	1 U
2-Butanone (MEK)	µg/L	11,800	2 U	2 U	6 U	6 U
Acetone	µg/L	45,500	10 U	10 U	10 U	10 U J
cis-1,2-Dichloroethene	µg/L	70	1 U	1 U	1 U	1 U
Naphthalene	µg/L	2.11	1 U	1 U	1 U	1 U
Tetrachloroethene	µg/L	5	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene	µg/L	100	1 U	1 U	1 U	1 U
Trichloroethene	µg/L	5	***1.1***	***1.7***	***1.1***	***1.1***
Semivolatile Organic Compounds						
Benzo(a)pyrene	µg/L	0.2	9.8 U	9.5 U	9.7 U	9.5 U
Benzo(ghi)perylene	µg/L	NA	9.8 U	9.5 U	9.7 U	9.5 U
bis(2-Ethylhexyl)phthalate	µg/L	6	***2.1 J***	9.5 U	***1.8 J***	9.5 U
Perchlorate						
Perchlorate	µg/L	70.9	***0.31 J***	***0.81***	***0.73***	***0.63***
Explosives						
HMX	µg/L	5,110	0.1 U	0.1 U	0.1 U	0.1 U
RDX	µg/L	25.9	0.1 U	0.1 U	0.1 U	0.1 U
Metals						
Antimony	µg/L	6	6 U	6 U	6 U	6 U
Arsenic	µg/L	10	***1.9 J***	3 U	3 U	3 U
Beryllium	µg/L	4	***0.29 J***	1 U	1 U	1 U J
Cadmium	µg/L	5	1.5 U	1.5 U	1.5 U	1.5 U
Chromium	µg/L	100	5 U	5 U	5 U	5 U
Copper	µg/L	1,300	***1.4 J***	3 U	3 U	***1.2 J***
Lead	µg/L	15	2.5 U	2.5 U	2.5 U	2.5 U
Mercury	µg/L	2	0.2 U	0.2 U	0.14 U	***0.1 J***
Nickel	µg/L	2,040	***12.6***	***11.1***	***3.5***	***1.5 J***
Selenium	µg/L	50	3 U	***1.6 J***	3 U	***2 J***
Silver	µg/L	508	1 U	1 U	1 U	1 U
Zinc	µg/L	30,500	12 U	12 U	12 U	12 U
Groundwater Quality Package						
Ammonia	mg/L	NA	1 U	***0.093 J***	***0.09 J***	0.1 U
Chloride	mg/L	NA	***4.9***	***5.5***	***4.5***	***4.2***
Nitrate as N	mg/L	10	0.05 U	***0.18***	***0.38***	***0.34***
Orthophosphate as P	mg/L	NA	0.2 U	0.2 U	0.2 U	0.2 U
Sulfate	mg/L	NA	***48.3***	***81.6***	***57***	***49***
Sulfide	mg/L	NA	4 U	4 U	4 U J	4 U
Monitored Natural Attenuation Package						
Methane	µg/L	NA	5 U	***0.29 J***	5 U	5 U
Ethane	µg/L	NA	5 U	5 U	5 U	5 U
Total Organic Carbon	mg/L	NA	***2.6***	***0.69 J***	***0.9 J***	***0.67 J***

Notes:
Bold / Italics = compound was detected
Highlighted = Concentration exceeds screening level
ID = Identification
J = estimated value
mg/L = milligrams per liter
NA = Not available / Not analyzed
NS = Not sampled
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/L = micrograms per liter
[1] For source of screening levels, see Table 4-1.

Table 4-10
Monitoring Well Groundwater Samples, Detected Analytes
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	OB-12-20D/GW01	OB-12-20D/GW02	OB-12-20D/GW03	OB-12-20D/GW04
		Date Sampled:	3/8/2012	6/20/2012	9/27/2012	12/19/2012
		Comment(s):	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Parameter	**Units**	**Screening Level[1]**				
Volatile Organic Compounds						
1,1,1,2-Tetrachloroethane	µg/L	9.91	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	µg/L	1.28	1 U	1 U	1 U	1 U J
1,2,3-Trichlorobenzene	µg/L	5.2	1 U	1 U	1 U	1 U
2-Butanone (MEK)	µg/L	11,800	***0.95 J***	2 U	6 U	6 U
Acetone	µg/L	45,500	10 U	10 U	10 U	10 U
cis-1,2-Dichloroethene	µg/L	70	1 U	1 U	1 U	1 U
Naphthalene	µg/L	2.11	1 U	***0.2 J***	1 U	1 U
Tetrachloroethene	µg/L	5	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene	µg/L	100	1 U	1 U	1 U	1 U
Trichloroethene	µg/L	5	***1.1***	***2.2***	***2.1***	***1.7***
Semivolatile Organic Compounds						
Benzo(a)pyrene	µg/L	0.2	9.4 U J	9.5 U	10 U	10 U
Benzo(ghi)perylene	µg/L	NA	9.4 U J	9.5 U	10 U	10 U
bis(2-Ethylhexyl)phthalate	µg/L	6	***1.6 J***	9.5 U	10 U	***1.3 J***
Perchlorate						
Perchlorate	µg/L	70.9	***0.65***	***1.1***	***0.94***	***0.71***
Explosives						
HMX	µg/L	5,110	0.099 U	0.1 U	0.1 U	0.1 U
RDX	µg/L	25.9	0.099 U	0.1 U	0.1 U	0.1 U
Metals						
Antimony	µg/L	6	6 U	6 U	6 U	6 U
Arsenic	µg/L	10	***1 J***	3 U	3 U	3 U
Beryllium	µg/L	4	1 U	1 U	1 U	1 U
Cadmium	µg/L	5	1.5 U	1.5 U	1.5 U	1.5 U
Chromium	µg/L	100	5 U	5 U	5 U	5 U
Copper	µg/L	1,300	***1.5 J***	3 U	3 U	3 U
Lead	µg/L	15	2.5 U	2.5 U	2.5 U	2.5 U
Mercury	µg/L	2	0.2 U J	0.2 U	0.14 U	0.2 U
Nickel	µg/L	2,040	***6.2***	***1.5 J***	3 U	3 U
Selenium	µg/L	50	***23.5***	***1.5 J***	***1.6 J***	***1.4 J***
Silver	µg/L	508	1 U	1 U	1 U	1 U
Zinc	µg/L	30,500	12 U	12 U	12 U	12 U
Groundwater Quality Package						
Ammonia	mg/L	NA	1 U	***0.095 J***	0.1 U	0.1 U
Chloride	mg/L	NA	***4.8***	***5.3***	***5.3***	***5.2***
Nitrate as N	mg/L	10	0.57 U J	***0.072***	***0.62***	***0.059***
Orthophosphate as P	mg/L	NA	0.2 U	0.2 U	0.2 U	0.2 U
Sulfate	mg/L	NA	***23.8***	***27.1***	***38***	***41***
Sulfide	mg/L	NA	4 U	***0.8 J***	4 U	4 U
Monitored Natural Attenuation Package						
Methane	µg/L	NA	5 U	5 U	5 U J	***0.23 J***
Ethane	µg/L	NA	5 U	5 U	5 U J	5 U
Total Organic Carbon	mg/L	NA	***1.4 J***	***0.82 J***	***0.94 J***	***0.74 J***

Notes:
Bold / Italics = compound was detected
Highlighted = Concentration exceeds screening level
ID = Identification
J = estimated value
mg/L = milligrams per liter
NA = Not available / Not analyzed
NS = Not sampled
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/L = micrograms per liter
[1] For source of screening levels, see Table 4-1.

Table 4-11
Exceedances by Medium
OB/OD RI Report
Fort Riley, Kansas

Contaminant	Surface Soil	Subsurface Soil	Sediment	Surface Water	Groundwater
Volatile Organic Compounds					
PCA				X	X
Naphthalene					X
TCE		X		X	X
Semivolatile Organic Compounds					
Benzo(a)pyrene				X	X
Bis(2-ethylhexyl)phthalate					X
Perchlorate					
Perchlorate					
Explosives					
Explosives					
Metals					
Metals					

PCA = 1,1,2,2-Tetrachloroethane
PCE = Tetrachloroethene
TCE = Trichloroethene

Table 5-1
Chemical Properties of Select Constituents
OB/OD RI Report
Fort Riley, Kansas

Contaminant	Molecular Weight (g/mol)	Henry's Law Constant (atm-m^3/mol)	Density (g/cm^3)	K_{oc} (L/kg)	Solubility (mg/L)
Volatile Organic Compounds					
PCA	167.85	3.67E-04	1.5953	94.94	2,830
Naphthalene	128.18	4.40E-04	1.0253	1,544	31
TCE	131.39	9.85E-03	1.4642	60.7	1,280
Semivolatile Organic Compounds					
Benzo(a)pyrene	252.32	4.57E-07	NA	587,400	0.00162
bis(2-Ethylhexyl)phthalate	390.57	2.70E-07	0.981	119,600	0.27

Notes:
g/mol - grams per mole
atm-m^3/mol - atmospheres-cubic meters per mole
g/cm^3 - grams per cubic centimeter
L/kg - liters per kilogram
mg/L - milligrams per liter
NA - not applcable
PCA = 1,1,2,2-tetrachloroethane
TCE = trichloroethene
K_{oc} = propensity for organic compounds to be absorbed by organic carbon in soil and sediment
Source of data is *USEPA Regional Screening Level (RSL) Table November 2012* .

Table 5-2
Monitored Natural Attenuation Parameters
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	OB-93-01/GW01	OB-93-01/GW02	OB-93-01/GW03	OB-93-01/GW04
		Date Sampled:	3/5/2012	6/19/2012	9/25/2012	12/17/2012
		Comment(s):	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Parameter	**Units**	**Geochemical Conditions[1]**				
Laboratory						
Methane	µg/L	>500	5 U	5 U	***0.25 J***	5 U
Ethane	µg/L	>10	5 U	5 U J	5 U J	5 U J
Ethene	µg/L	>10	5 U	5 U	5 U	5 U
Total Organic Carbon	mg/L	>20	***0.76 J***	***1.1 J***	***0.98 J***	***0.7 J***
Chloride	mg/L	>8[2]	***5***	***5***	***5.2***	***5.1***
Nitrate as N	mg/L	<1	0.05 U	***0.12***	***0.045 J***	0.05 U J
Sulfate	mg/L	<20	***30.1***	***26.4***	***42***	***38***
Sulfide	mg/L	>1	4 U	4 U	4 U	***1.4 J***
Field Measurements						
Temperature	°C	>20°C	13.09	13.80	13.47	13.30
pH	SU	5<x<9	6.98	6.65	6.80	6.96
Dissolved Oxygen	mg/L	<0.5	5.14	4.26	5.34	4.81
Oxidation/Reduction Potential	mV	<50	29.2	40.6	152.1	82.7
Iron (II), Ferrous	mg/L	>1	0.00	0.00	0.00	0.16

Notes:

[1] From USEPA, 1998. These geochemical conditions represent a range that is favorable for reductive dechlorination.

[2] Value represents two times the background value. Background value calculated as the average chloride value of Monitoring Wells OB-93-01 and OB-93-02.

Bold / Italics = compound was detected

Highlighted = Concentrations within favorable range.

°C = degrees Celsius
ID = Identification
J = estimated value
mg/L = milligrams per liter
mV = millivolt
NS = Not sampled
SU = standard unit
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/L = micrograms per liter

Table 5-2
Monitored Natural Attenuation Parameters
OB/OD RI Report
Fort Riley, Kansas

		Sample ID: Date Sampled: Comment(s):	OB-93-02/GW01 3/7/2012 1st Quarter	OB-93-02/GW02 6/18/2012 2nd Quarter	OB-93-02/GW03 9/25/2012 3rd Quarter	OB-93-02/GW04 12/17/2012 4th Quarter
Parameter	**Units**	**Geochemical Conditions[1]**				
Laboratory						
Methane	µg/L	>500	5 U	5 U	5 U	5 U
Ethane	µg/L	>10	***0.62 J***	5 U	5 U	5 U
Ethene	µg/L	>10	5 U	5 U	5 U	5 U
Total Organic Carbon	mg/L	>20	***0.26 J***	***0.72 J***	***0.63 J***	***0.51 J***
Chloride	mg/L	>8[2]	***2.9***	***2.9***	***2.9***	***2.8***
Nitrate as N	mg/L	<1	***0.88***	***1.1 J***	***0.92***	***0.62***
Sulfate	mg/L	<20	***34.6***	***35.2***	***37***	***46***
Sulfide	mg/L	>1	***1.3 J***	4 U	4 U	4 U
Field Measurements						
Temperature	°C	>20°C	13.66	14.92	14.32	13.87
pH	SU	5<x<9	6.82	6.27	6.91	7.13
Dissolved Oxygen	mg/L	<0.5	6.85	9.52	6.84	6.93
Oxidation/Reduction Potential	mV	<50	103.7	74.3	146.6	87.7
Iron (II), Ferrous	mg/L	>1	0.00	0.17	0.14	0.00

Notes:

[1] From USEPA, 1998. These geochemical conditions represent a range that is favorable for reductive dechlorination.

[2] Value represents two times the background value. Background value calculated as the average chloride value of Monitoring Wells OB-93-01 and OB-93-02.

Bold / Italics = compound was detected

Highlighted = Concentrations within favorable range.

°C = degrees Celsius

ID = Identification

J = estimated value

mg/L = milligrams per liter

mV = millivolt

NS = Not sampled

SU = standard unit

U = compound was not detected (or qualified as not detected during QA/QC review)

µg/L = micrograms per liter

Table 5-2
Monitored Natural Attenuation Parameters
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	OB-93-03/GW01	OB-93-03/GW02	OB-93-03/GW03	OB-93-03/GW04
		Date Sampled:	3/5/2012	6/19/2012	9/24/2012	12/18/2012
		Comment(s):	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Parameter	**Units**	**Geochemical Conditions[1]**				
Laboratory						
Methane	µg/L	>500	***0.22 J***	***1.8 J***	***3 J***	***2.6 J***
Ethane	µg/L	>10	5 U	5 U	5 U	5 U
Ethene	µg/L	>10	5 U	5 U	5 U	5 U
Total Organic Carbon	mg/L	>20	***0.56 J***	***0.86 J***	***0.75 J***	***0.52 J***
Chloride	mg/L	>8[2]	***49***	***20.3***	***15***	***12***
Nitrate as N	mg/L	<1	0.25 U	0.25 U	***0.14***	0.05 U
Sulfate	mg/L	<20	***1,020***	***356***	***260***	***180***
Sulfide	mg/L	>1	4 U	4 U	4 U J	4 U
Field Measurements						
Temperature	°C	>20°C	14.37	15.56	15.30	13.81
pH	SU	5<x<9	7.37	6.90	6.99	7.23
Dissolved Oxygen	mg/L	<0.5	0.48	0.42	5.94	2.71
Oxidation/Reduction Potential	mV	<50	-91.0	-63.5	55.3	54.7
Iron (II), Ferrous	mg/L	>1	0.11	0.32	0.12	0.18

Notes:

[1] From USEPA, 1998. These geochemical conditions represent a range that is favorable for reductive dechlorination.

[2] Value represents two times the background value. Background value calculated as the average chloride value of Monitoring Wells OB-93-01 and OB-93-02.

Bold / Italics = compound was detected

Highlighted = Concentrations within favorable range.

°C = degrees Celsius
ID = Identification
J = estimated value
mg/L = milligrams per liter
mV = millivolt
NS = Not sampled
SU = standard unit
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/L = micrograms per liter

Table 5-2
Monitored Natural Attenuation Parameters
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	OB-93-04/GW01	OB-93-04/GW02	OB-93-04/GW03	OB-93-04/GW04
		Date Sampled:	3/6/2012	6/20/2012	9/26/2012	12/18/2012
		Comment(s):	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Parameter	**Units**	**Geochemical Conditions[1]**				
Laboratory						
Methane	µg/L	>500	5 U	5 U	***0.78 J***	***1.2 J***
Ethane	µg/L	>10	5 U	5 U	5 U	5 U
Ethene	µg/L	>10	5 U	5 U	5 U	5 U
Total Organic Carbon	mg/L	>20	***0.57 J***	***0.65 J***	***0.86 J***	***0.65 J***
Chloride	mg/L	>8[2]	***9.3***	***8.3***	***6.7***	***6.8***
Nitrate as N	mg/L	<1	0.1 U	0.25 U	0.05 U	0.05 U
Sulfate	mg/L	<20	***314***	***347 J***	***180***	***210***
Sulfide	mg/L	>1	4 U	4 U	4 U	4 U
Field Measurements						
Temperature	°C	>20°C	13.37	14.89	14.12	13.90
pH	SU	5<x<9	6.70	6.65	6.74	7.05
Dissolved Oxygen	mg/L	<0.5	0.35	0.45	0.78	0.64
Oxidation/Reduction Potential	mV	<50	24.3	-46.8	58.3	51.9
Iron (II), Ferrous	mg/L	>1	0.01	0.05	0.02	0.08

Notes:

[1] From USEPA, 1998. These geochemical conditions represent a range that is favorable for reductive dechlorination.

[2] Value represents two times the background value. Background value calculated as the average chloride value of Monitoring Wells OB-93-01 and OB-93-02.

Bold / Italics = compound was detected

Highlighted = Concentrations within favorable range.

°C = degrees Celsius
ID = Identification
J = estimated value
mg/L = milligrams per liter
mV = millivolt
NS = Not sampled
SU = standard unit
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/L = micrograms per liter

Table 5-2
Monitored Natural Attenuation Parameters
OB/OD RI Report
Fort Riley, Kansas

		Sample ID: Date Sampled: Comment(s):	OB-97-05/GW01 3/6/2012 1st Quarter	OB-97-05/GW02 6/19/2012 2nd Quarter	OB-97-05/GW03 9/26/2012 3rd Quarter	OB-97-05/GW04 12/18/2012 4th Quarter
Parameter	**Units**	**Geochemical Conditions[1]**				
Laboratory						
Methane	µg/L	>500	***1.1 J***	***1.3 J***	***2.5 J***	***2.1 J***
Ethane	µg/L	>10	5 U	5 U	5 U	5 U
Ethene	µg/L	>10	5 U	5 U	5 U	5 U
Total Organic Carbon	mg/L	>20	***0.57 J***	***0.69 J***	***0.73 J***	***0.63 J***
Chloride	mg/L	>8[2]	***6.6***	***6.6***	***6.7***	***6.8***
Nitrate as N	mg/L	<1	0.05 U	0.05 U	0.05 U	0.05 U J
Sulfate	mg/L	<20	***98.6***	***110***	***110***	***98 J***
Sulfide	mg/L	>1	4 U	4 U	4 U	4 U
Field Measurements						
Temperature	°C	>20°C	13.98	14.78	14.42	13.90
pH	SU	5<x<9	7.02	6.76	6.91	7.22
Dissolved Oxygen	mg/L	<0.5	0.95	1.33	1.05	1.34
Oxidation/Reduction Potential	mV	<50	-97.9	-20.3	44.4	8.8
Iron (II), Ferrous	mg/L	>1	0.02	0.13	0.06	0.36

Notes:

[1] From USEPA, 1998. These geochemical conditions represent a range that is favorable for reductive dechlorination.

[2] Value represents two times the background value. Background value calculated as the average chloride value of Monitoring Wells OB-93-01 and OB-93-02.

Bold / Italics = compound was detected

Highlighted = Concentrations within favorable range.

°C = degrees Celsius
ID = Identification
J = estimated value
mg/L = milligrams per liter
mV = millivolt
NS = Not sampled
SU = standard unit
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/L = micrograms per liter

Table 5-2
Monitored Natural Attenuation Parameters
OB/OD RI Report
Fort Riley, Kansas

		Sample ID: Date Sampled: Comment(s):	OB-97-06/GW01 3/5/2012 1st Quarter	OB-97-06/GW02 6/19/2012 2nd Quarter	OB-97-06/GW03 9/24/2012 3rd Quarter	OB-97-06/GW04 12/17/2012 4th Quarter
Parameter	**Units**	**Geochemical Conditions[1]**				
Laboratory						
Methane	µg/L	>500	5 U	5 U	5 U	5 U
Ethane	µg/L	>10	5 U	5 U	5 U	5 U
Ethene	µg/L	>10	5 U	5 U	5 U	5 U
Total Organic Carbon	mg/L	>20	***0.57 J***	***0.69 J***	***0.78 J***	***0.52 J***
Chloride	mg/L	>8[2]	***3.9***	***3.9***	***4***	***4.8***
Nitrate as N	mg/L	<1	***0.29***	***0.48***	***0.37***	***0.094***
Sulfate	mg/L	<20	***18.1***	***20.4***	***23***	***25***
Sulfide	mg/L	>1	4 U	4 U	4 U J	4 U
Field Measurements						
Temperature	°C	>20°C	13.86	15.30	14.93	14.05
pH	SU	5<x<9	6.91	6.38	6.91	7.04
Dissolved Oxygen	mg/L	<0.5	4.62	4.40	4.95	7.09
Oxidation/Reduction Potential	mV	<50	-9.0	35.7	124.7	86.3
Iron (II), Ferrous	mg/L	>1	0.07	0.41	0.06	0.11

Notes:

[1] From USEPA, 1998. These geochemical conditions represent a range that is favorable for reductive dechlorination.

[2] Value represents two times the background value. Background value calculated as the average chloride value of Monitoring Wells OB-93-01 and OB-93-02.

Bold / Italics = compound was detected

Highlighted = Concentrations within favorable range.

°C = degrees Celsius
ID = Identification
J = estimated value
mg/L = milligrams per liter
mV = millivolt
NS = Not sampled
SU = standard unit
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/L = micrograms per liter

Table 5-2
Monitored Natural Attenuation Parameters
OB/OD RI Report
Fort Riley, Kansas

		Sample ID: Date Sampled: Comment(s):	OB-97-07/GW01 3/6/2012 1st Quarter	OB-97-07/GW02 6/20/2012 2nd Quarter	OB-97-07/GW03 9/26/2012 3rd Quarter	OB-97-07/GW04 12/18/2012 4th Quarter
Parameter	**Units**	**Geochemical Conditions[1]**				
Laboratory						
Methane	µg/L	>500	***0.90 J***	***0.49 J***	***2.3 J***	***2.5 J***
Ethane	µg/L	>10	5 U	5 U	5 U	5 U
Ethene	µg/L	>10	5 U	5 U	5 U	5 U
Total Organic Carbon	mg/L	>20	***0.52 J***	***0.78 J***	***0.88 J***	***0.62 J***
Chloride	mg/L	>8[2]	***4.9***	***4.5***	***4.4***	***5.4***
Nitrate as N	mg/L	<1	***0.3***	***0.43***	***0.46***	***0.11***
Sulfate	mg/L	<20	***27.2***	***25.6***	***34***	***31***
Sulfide	mg/L	>1	***1.1 J***	***0.96 J***	4 U	4 U
Field Measurements						
Temperature	°C	>20°C	13.37	13.66	14.26	14.50
pH	SU	5<x<9	6.81	6.54	6.85	7.02
Dissolved Oxygen	mg/L	<0.5	4.80	6.18	6.10	5.93
Oxidation/Reduction Potential	mV	<50	21.9	27.9	86.7	73.5
Iron (II), Ferrous	mg/L	>1	0.04	0.06	0.00	0.03

Notes:

[1] From USEPA, 1998. These geochemical conditions represent a range that is favorable for reductive dechlorination.

[2] Value represents two times the background value. Background value calculated as the average chloride value of Monitoring Wells OB-93-01 and OB-93-02.

Bold / Italics = compound was detected

Highlighted = Concentrations within favorable range.

°C = degrees Celsius

ID = Identification

J = estimated value

mg/L = milligrams per liter

mV = millivolt

NS = Not sampled

SU = standard unit

U = compound was not detected (or qualified as not detected during QA/QC review)

µg/L = micrograms per liter

Table 5-2
Monitored Natural Attenuation Parameters
OB/OD RI Report
Fort Riley, Kansas

Parameter	Units	Geochemical Conditions[1]	Sample ID: OB-97-08/GW01 Date Sampled: 3/6/2012 Comment(s): 1st Quarter	OB-97-08/GW02 6/20/2012 2nd Quarter	OB-97-08/GW03 9/27/2012 3rd Quarter	OB-97-08/GW04 12/19/2012 4th Quarter
Laboratory						
Methane	µg/L	>500	***0.31 J***	***4.9 J***	NS	NS
Ethane	µg/L	>10	5 U	5 U	NS	NS
Ethene	µg/L	>10	5 U	5 U	NS	NS
Total Organic Carbon	mg/L	>20	***0.88 J***	***1.4 J***	NS	NS
Chloride	mg/L	>8[2]	***6.5***	***6***	NS	***5.5***
Nitrate as N	mg/L	<1	***0.11***	***0.12***	NS	***0.049 J***
Sulfate	mg/L	<20	***29.2***	***25.4***	NS	***26***
Sulfide	mg/L	>1	4 U	4 U	NS	NS
Field Measurements						
Temperature	°C	>20°C	13.39	19.38	14.47	10.18
pH	SU	5<x<9	6.82	6.39	6.92	7.14
Dissolved Oxygen	mg/L	<0.5	4.77	2.55	4.96	5.39
Oxidation/Reduction Potential	mV	<50	1.3	9.5	105.9	130.0
Iron (II), Ferrous	mg/L	>1	0.03	NS	NS	NS

Notes:

[1] From USEPA, 1998. These geochemical conditions represent a range that is favorable for reductive dechlorination.

[2] Value represents two times the background value. Background value calculated as the average chloride value of Monitoring Wells OB-93-01 and OB-93-02.

Bold / Italics = compound was detected

Highlighted = Concentrations within favorable range.

°C = degrees Celsius
ID = Identification
J = estimated value
mg/L = milligrams per liter
mV = millivolt
NS = Not sampled
SU = standard unit
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/L = micrograms per liter

Table 5-2
Monitored Natural Attenuation Parameters
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	OBHD-97-14/GW01	OBHD-97-14/GW02	OBHD-97-14/GW03	OBHD-97-14/GW04
		Date Sampled:	3/6/2012	6/21/2012	9/27/2012	12/18/2012
		Comment(s):	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Parameter	**Units**	**Geochemical Conditions[1]**				
Laboratory						
Methane	µg/L	>500	***980***	***2,400***	***440***	***840***
Ethane	µg/L	>10	***0.59 J***	5 U	5 U	5 U
Ethene	µg/L	>10	5 U	5 U	5 U	5 U
Total Organic Carbon	mg/L	>20	***1.1***	***1.1 J***	***1***	***0.69 J***
Chloride	mg/L	>8[2]	***7.5***	***6.5***	***5.4***	***5.4***
Nitrate as N	mg/L	<1	0.05 U	0.05 U J	***0.14***	***0.072***
Sulfate	mg/L	<20	***32.8***	***24***	***27***	***27***
Sulfide	mg/L	>1	***1.1 J***	4 U	4 U	4 U
Field Measurements						
Temperature	°C	>20°C	12.88	12.83	13.90	14.37
pH	SU	5<x<9	6.64	6.77	6.97	6.95
Dissolved Oxygen	mg/L	<0.5	2.38	0.63	4.13	2.75
Oxidation/Reduction Potential	mV	<50	-117.9	-65.5	-33.9	34.6
Iron (II), Ferrous	mg/L	>1	0.00	0.31	0.00	0.00

Notes:

[1] From USEPA, 1998. These geochemical conditions represent a range that is favorable for reductive dechlorination.

[2] Value represents two times the background value. Background value calculated as the average chloride value of Monitoring Wells OB-93-01 and OB-93-02.

Bold / Italics = compound was detected

Highlighted = Concentrations within favorable range.

°C = degrees Celsius

ID = Identification

J = estimated value

mg/L = milligrams per liter

mV = millivolt

NS = Not sampled

SU = standard unit

U = compound was not detected (or qualified as not detected during QA/QC review)

µg/L = micrograms per liter

Table 5-2
Monitored Natural Attenuation Parameters
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	OB-05-15/GW01	OB-05-15/GW02	OB-05-15/GW03	OB-05-15/GW04
		Date Sampled:	3/7/2012	6/21/2012	9/25/2012	12/19/2012
		Comment(s):	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Parameter	**Units**	**Geochemical Conditions[1]**				
Laboratory						
Methane	µg/L	>500	5 U	5 U	5 U	5 U
Ethane	µg/L	>10	5 U	5 U	5 U	5 U
Ethene	µg/L	>10	5 U	5 U	5 U	5 U
Total Organic Carbon	mg/L	>20	***0.53 J***	***0.96 J***	***0.99 J***	***0.81 J***
Chloride	mg/L	>8[2]	***5.5***	***6.4***	***62***	***6.2***
Nitrate as N	mg/L	<1	***0.082***	***0.084***	***0.68***	***0.055***
Sulfate	mg/L	<20	***45.9***	***33.3***	***360***	***41***
Sulfide	mg/L	>1	***0.80 J***	4 U	4 U	4 U
Field Measurements						
Temperature	°C	>20°C	11.58	13.97	20.42	11.21
pH	SU	5<x<9	6.70	6.67	6.77	7.14
Dissolved Oxygen	mg/L	<0.5	4.46	4.25	3.81	4.73
Oxidation/Reduction Potential	mV	<50	41.8	11.1	121.3	75.7
Iron (II), Ferrous	mg/L	>1	0.00	0.06	0.06	0.02

Notes:

[1] From USEPA, 1998. These geochemical conditions represent a range that is favorable for reductive dechlorination.

[2] Value represents two times the background value. Background value calculated as the average chloride value of Monitoring Wells OB-93-01 and OB-93-02.

Bold / Italics = compound was detected

Highlighted = Concentrations within favorable range.

°C = degrees Celsius

ID = Identification

J = estimated value

mg/L = milligrams per liter

mV = millivolt

NS = Not sampled

SU = standard unit

U = compound was not detected (or qualified as not detected during QA/QC review)

µg/L = micrograms per liter

Table 5-2
Monitored Natural Attenuation Parameters
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	OB-12-15D/GW01	OB-12-15D/GW02	OB-12-15D/GW03	OB-12-15D/GW04
		Date Sampled:	3/9/2012	6/21/2012	9/27/2012	12/20/2012
		Comment(s):	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Parameter	**Units**	**Geochemical Conditions[1]**				
Laboratory						
Methane	µg/L	>500	***0.39 J***	***1.1 J***	***1.9 J***	***2.7 J***
Ethane	µg/L	>10	5 U	5 U	5 U	5 U
Ethene	µg/L	>10	5 U	5 U	5 U	5 U
Total Organic Carbon	mg/L	>20	***1.3 J***	***0.46 J***	***0.55 J***	***0.5 J***
Chloride	mg/L	>8[2]	***4.1***	***3.7***	***3.9***	***3.9***
Nitrate as N	mg/L	<1	0.05 U J	0.05 U	0.05 U	0.05 U J
Sulfate	mg/L	<20	***33.3***	***25.6***	***27***	***25***
Sulfide	mg/L	>1	4 U	4 U	4 U	4 U
Field Measurements						
Temperature	°C	>20°C	12.20	15.50	14.83	11.74
pH	SU	5<x<9	7.12	6.86	7.20	7.38
Dissolved Oxygen	mg/L	<0.5	1.01	0.44	0.98	0.43
Oxidation/Reduction Potential	mV	<50	45.0	-71.9	-62.5	56.9
Iron (II), Ferrous	mg/L	>1	0.17	0.10	0.00	0.20

Notes:

[1] From USEPA, 1998. These geochemical conditions represent a range that is favorable for reductive dechlorination.

[2] Value represents two times the background value. Background value calculated as the average chloride value of Monitoring Wells OB-93-01 and OB-93-02.

Bold / Italics = compound was detected

Highlighted = Concentrations within favorable range.

°C = degrees Celsius

ID = Identification

J = estimated value

mg/L = milligrams per liter

mV = millivolt

NS = Not sampled

SU = standard unit

U = compound was not detected (or qualified as not detected during QA/QC review)

µg/L = micrograms per liter

Table 5-2
Monitored Natural Attenuation Parameters
OB/OD RI Report
Fort Riley, Kansas

		Sample ID:	OB-12-16/GW01	OB-12-16/GW02	OB-12-16/GW03	OB-12-16/GW04
		Date Sampled:	3/7/2012	6/20/2012	9/27/2012	12/19/2012
		Comment(s):	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Parameter	**Units**	**Geochemical Conditions[1]**				
Laboratory						
Methane	µg/L	>500	5 U	5 U	***0.29 J***	***1.6 J***
Ethane	µg/L	>10	5 U	5 U	5 U	5 U
Ethene	µg/L	>10	5 U	5 U	5 U	5 U
Total Organic Carbon	mg/L	>20	***1.2 J***	***0.97 J***	***1***	***0.84 J***
Chloride	mg/L	>8[2]	***5.9***	***5.9***	***6.8***	***6.7***
Nitrate as N	mg/L	<1	0.05 U	***0.081***	0.05 U	***0.1***
Sulfate	mg/L	<20	***39.1***	***34***	***29***	***26***
Sulfide	mg/L	>1	4 U	4 U	4 U	4 U
Field Measurements						
Temperature	°C	>20°C	9.04	13.32	13.56	12.70
pH	SU	5<x<9	5.73	6.44	7.05	7.11
Dissolved Oxygen	mg/L	<0.5	5.26	1.34	4.22	3.40
Oxidation/Reduction Potential	mV	<50	57.1	-4.8	69.2	126.7
Iron (II), Ferrous	mg/L	>1	0.16	0.05	NS	0.06

Notes:

[1] From USEPA, 1998. These geochemical conditions represent a range that is favorable for reductive dechlorination.

[2] Value represents two times the background value. Background value calculated as the average chloride value of Monitoring Wells OB-93-01 and OB-93-02.

Bold / Italics = compound was detected

Highlighted = Concentrations within favorable range.

°C = degrees Celsius
ID = Identification
J = estimated value
mg/L = milligrams per liter
mV = millivolt
NS = Not sampled
SU = standard unit
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/L = micrograms per liter

Table 5-2
Monitored Natural Attenuation Parameters
OB/OD RI Report
Fort Riley, Kansas

		Sample ID: Date Sampled: Comment(s):	OB-12-17/GW01 3/8/2012 1st Quarter	OB-12-17/GW02 6/21/2012 2nd Quarter	OB-12-17/GW03 9/26/2012 3rd Quarter	OB-12-17/GW04 12/19/2012 4th Quarter
Parameter	**Units**	**Geochemical Conditions[1]**				
Laboratory						
Methane	µg/L	>500	5 U	5 U	5 U	5 U
Ethane	µg/L	>10	5 U	5 U	5 U	5 U
Ethene	µg/L	>10	5 U	5 U	5 U	5 U
Total Organic Carbon	mg/L	>20	***0.79 J***	***0.98 J***	***0.96 J***	***0.87 J***
Chloride	mg/L	>8[2]	***7.6***	***6.9***	***7.1***	***7***
Nitrate as N	mg/L	<1	0.05 U	0.05 U J	***0.084***	***0.05***
Sulfate	mg/L	<20	***23.7***	***22.7***	***26***	***26***
Sulfide	mg/L	>1	4 U	4 U	4 U	4 U
Field Measurements						
Temperature	°C	>20°C	11.94	14.62	14.92	13.53
pH	SU	5<x<9	6.10	6.68	6.77	7.12
Dissolved Oxygen	mg/L	<0.5	1.62	2.63	3.37	2.41
Oxidation/Reduction Potential	mV	<50	39.0	-22.8	107.2	123.0
Iron (II), Ferrous	mg/L	>1	0.23	0.07	0.38	0.16

Notes:

[1] From USEPA, 1998. These geochemical conditions represent a range that is favorable for reductive dechlorination.

[2] Value represents two times the background value. Background value calculated as the average chloride value of Monitoring Wells OB-93-01 and OB-93-02.

Bold / Italics = compound was detected

Highlighted = Concentrations within favorable range.

°C = degrees Celsius

ID = Identification

J = estimated value

mg/L = milligrams per liter

mV = millivolt

NS = Not sampled

SU = standard unit

U = compound was not detected (or qualified as not detected during QA/QC review)

µg/L = micrograms per liter

Table 5-2
Monitored Natural Attenuation Parameters
OB/OD RI Report
Fort Riley, Kansas

		Sample ID: Date Sampled: Comment(s):	OB-12-18/GW01 3/8/2012 1st Quarter	OB-12-18/GW02 6/19/2012 2nd Quarter	OB-12-18/GW03 9/26/2012 3rd Quarter	OB-12-18/GW04 12/18/2012 4th Quarter
Parameter	**Units**	**Geochemical Conditions[1]**				
Laboratory						
Methane	µg/L	>500	***0.29 J***	***1.9 J***	***2.2 J***	5 U
Ethane	µg/L	>10	5 U	5 U	5 U	5 U
Ethene	µg/L	>10	5 U	5 U	5 U	5 U
Total Organic Carbon	mg/L	>20	***0.99 J***	***0.86 J***	***1.1***	***0.79 J***
Chloride	mg/L	>8[2]	***7.6***	***6.6***	***6.6***	***6.9***
Nitrate as N	mg/L	<1	0.05 U	***0.15***	***0.23***	***0.09***
Sulfate	mg/L	<20	***34.5***	***26.9***	***27***	***27***
Sulfide	mg/L	>1	4 U	4 U	4 U	4 U
Field Measurements						
Temperature	°C	>20°C	12.31	15.77	14.45	14.27
pH	SU	5<x<9	6.31	6.34	6.80	6.90
Dissolved Oxygen	mg/L	<0.5	2.32	3.21	5.23	5.20
Oxidation/Reduction Potential	mV	<50	23.7	24.5	107.2	71.3
Iron (II), Ferrous	mg/L	>1	0.00	0.12	0.09	0.00

Notes:

[1] From USEPA, 1998. These geochemical conditions represent a range that is favorable for reductive dechlorination.

[2] Value represents two times the background value. Background value calculated as the average chloride value of Monitoring Wells OB-93-01 and OB-93-02.

Bold / Italics = compound was detected

Highlighted = Concentrations within favorable range.

°C = degrees Celsius

ID = Identification

J = estimated value

mg/L = milligrams per liter

mV = millivolt

NS = Not sampled

SU = standard unit

U = compound was not detected (or qualified as not detected during QA/QC review)

µg/L = micrograms per liter

Table 5-2
Monitored Natural Attenuation Parameters
OB/OD RI Report
Fort Riley, Kansas

		Sample ID: Date Sampled: Comment(s):	OB-12-19D/GW01 3/7/2012 1st Quarter	OB-12-19D/GW02 6/21/2012 2nd Quarter	OB-12-19D/GW03 9/24/2012 3rd Quarter	OB-12-19D/GW04 12/20/2012 4th Quarter
Parameter	**Units**	**Geochemical Conditions[1]**				
Laboratory						
Methane	µg/L	>500	5 U	***0.29 J***	5 U	5 U
Ethane	µg/L	>10	5 U	5 U	5 U	5 U
Ethene	µg/L	>10	5 U	5 U	5 U	5 U
Total Organic Carbon	mg/L	>20	***2.6***	***0.69 J***	***0.9 J***	***0.67 J***
Chloride	mg/L	>8[2]	***4.9***	***5.5***	***4.5***	***4.2***
Nitrate as N	mg/L	<1	0.05 U	***0.18***	***0.38***	***0.34***
Sulfate	mg/L	<20	***48.3***	***81.6***	***57***	***49***
Sulfide	mg/L	>1	4 U	4 U	4 U J	4 U
Field Measurements						
Temperature	°C	>20°C	14.40	15.17	15.41	13.39
pH	SU	5<x<9	5.74	6.47	6.87	7.19
Dissolved Oxygen	mg/L	<0.5	0.47	0.47	2.07	2.38
Oxidation/Reduction Potential	mV	<50	57.5	-63.2	48.3	36.8
Iron (II), Ferrous	mg/L	>1	0.19	0.00	0.07	0.00

Notes:

[1] From USEPA, 1998. These geochemical conditions represent a range that is favorable for reductive dechlorination.

[2] Value represents two times the background value. Background value calculated as the average chloride value of Monitoring Wells OB-93-01 and OB-93-02.

Bold / Italics = compound was detected

Highlighted = Concentrations within favorable range.

°C = degrees Celsius
ID = Identification
J = estimated value
mg/L = milligrams per liter
mV = millivolt
NS = Not sampled
SU = standard unit
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/L = micrograms per liter

Table 5-2
Monitored Natural Attenuation Parameters
OB/OD RI Report
Fort Riley, Kansas

		Sample ID: Date Sampled: Comment(s):	OB-12-20D/GW01 3/8/2012 1st Quarter	OB-12-20D/GW02 6/20/2012 2nd Quarter	OB-12-20D/GW03 9/27/2012 3rd Quarter	OB-12-20D/GW04 12/19/2012 4th Quarter
Parameter	**Units**	**Geochemical Conditions[1]**				
Laboratory						
Methane	µg/L	>500	5 U	5 U	5 U J	***0.23 J***
Ethane	µg/L	>10	5 U	5 U	5 U J	5 U
Ethene	µg/L	>10	5 U	5 U	5 U J	5 U
Total Organic Carbon	mg/L	>20	***1.4 J***	***0.82 J***	***0.94 J***	***0.74 J***
Chloride	mg/L	>8[2]	***4.8***	***5.3***	***5.3***	***5.2***
Nitrate as N	mg/L	<1	0.57 U J	***0.072***	***0.62***	***0.059***
Sulfate	mg/L	<20	***23.8***	***27.1***	***38***	***41***
Sulfide	mg/L	>1	4 U	***0.8 J***	4 U	4 U
Field Measurements						
Temperature	°C	>20°C	11.72	13.92	14.24	12.39
pH	SU	5<x<9	5.68	6.39	7.14	7.16
Dissolved Oxygen	mg/L	<0.5	0.45	1.29	1.38	1.09
Oxidation/Reduction Potential	mV	<50	83.3	-46.3	-16.2	26.3
Iron (II), Ferrous	mg/L	>1	0.11	0.07	0.08	0.54

Notes:

[1] From USEPA, 1998. These geochemical conditions represent a range that is favorable for reductive dechlorination.

[2] Value represents two times the background value. Background value calculated as the average chloride value of Monitoring Wells OB-93-01 and OB-93-02.

Bold / Italics = compound was detected

Highlighted = Concentrations within favorable range.

°C = degrees Celsius
ID = Identification
J = estimated value
mg/L = milligrams per liter
mV = millivolt
NS = Not sampled
SU = standard unit
U = compound was not detected (or qualified as not detected during QA/QC review)
µg/L = micrograms per liter

Table 6-1
Data Sets Used for Risk Assessment Calculations
OB/OD RI Report
Fort Riley, Kansas

Demolition Worker Soil Data Set (0-11.5')					
RISS-08	RISS-39	BDSS-14	MIS-01	RISB-39/SB02	MD-25/SB01
RISS-09	RISS-40	BDSS-15	MIS-02	RISB-40/SB01	MD-25/SB03
RISS-10	RISS-42	BDSS-16	MIS-03	RISB-40/SB02	MD-26/SB03
RISS-11	BDSS-06	BDSS-17	MIS-04	BDSS-03/SB01	MD-31/SB03
RISS-12	BDSS-07	BDSS-18	RISB-08/SB01	BDSS-03/SB02	MD-33/SB03
RISS-13	BDSS-08	BDSS-19	RISS-17/SB01	BDSS-13/SB01	MD-34/SS01
RISS-14	BDSS-09	BDSS-20	RISS-17/SB02	BDSS-20/SB01	
RISS-17	BDSS-10	BDSS-21	RISB-19/SB01	BDSS-20/SB02	
RISS-19	BDSS-11	BDSS-22	RISB-19/SB02	BDSS-22/SB01	
RISS-21	BDSS-12	BDSS-23	RISB-21/SB01	BDSS-22/SB02	
RISS-25	BDSS-13	BDSS-24	RISB-39/SB01	MD-16/SB02	

Comprehensive Soil Data Set					
RISS-01	RISS-21	RISS-41	BDSS-19	RISB-06/SB01	RISB-39/SB02
RISS-02	RISS-22	RISS-42	BDSS-20	RISB-06/SB02	RISB-40/SB01
RISS-03	RISS-23	BDSS-01	BDSS-21	RISB-07/SB01	RISB-40/SB02
RISS-04	RISS-24	BDSS-02	BDSS-22	RISB-07/SB02	BDSS-03/SB01
RISS-05	RISS-25	BDSS-03	BDSS-23	RISB-08/SB01	BDSS-03/SB02
RISS-06	RISS-26	BDSS-04	BDSS-24	RISS-17/SB01	BDSS-13/SB01
RISS-07	RISS-27	BDSS-05	MIS-01	RISS-17/SB02	BDSS-20/SB01
RISS-08	RISS-28	BDSS-06	MIS-02	RISB-18/SB01	BDSS-20/SB02
RISS-09	RISS-29	BDSS-07	MIS-03	RISB-18/SB02	BDSS-22/SB01
RISS-10	RISS-30	BDSS-08	MIS-04	RISB-19/SB01	BDSS-22/SB02
RISS-11	RISS-31	BDSS-09	RISB-01/SB01	RISB-19/SB02	MD-16/SB02
RISS-12	RISS-32	BDSS-10	RISB-01/SB02	RISB-20/SB01	MD-25/SB01
RISS-13	RISS-33	BDSS-11	RISB-02/SB01	RISB-20/SB02	MD-25/SB03
RISS-14	RISS-34	BDSS-12	RISB-02/SB02	RISB-21/SB01	MD-26/SB03
RISS-15	RISS-35	BDSS-13	RISB-03/SB01	RISB-22/SB01	MD-31/SB03
RISS-16	RISS-36	BDSS-14	RISB-03/SB02	RISB-23/SB01	MD-33/SB03
RISS-17	RISS-37	BDSS-15	RISB-04/SB01	RISB-23/SB02	MD-34/SS01
RISS-18	RISS-38	BDSS-16	RISB-04/SB02	RISB-24/SB02	
RISS-19	RISS-39	BDSS-17	RISB-05/SB01	RISB-24/SB02	
RISS-20	RISS-40	BDSS-18	RISB-05/SB02	RISB-39/SB01	

Table 6-1
Data Sets Used for Risk Assessment Calculations
OB/OD RI Report
Fort Riley, Kansas

Surface Water Data Set			
Sample-01/SW01 (12/8/11)	Sample-09/SW01 (12/8/11)	Sample-12/SW01 (12/8/11)	STREAM SAMPLE 01/SW02 (3/9/12)
Sample-07/SW01 (12/8/11)	Sample-10/SW01 (12/8/11)	Sample-13/SW01 (12/8/11)	STREAM SAMPLE 02/SW02 (3/9/12)
Sample-08/SW01 (12/8/11)	Sample-11/SW01 (12/8/11)	SPRING/SW02 (3/9/12)	

Groundwater Data Set					
OB-93-01/GW01 (3/5/12)	OB-93-03/GW04 (12/18/12)	OB-97-06/GW03 (9/24/12)	OBHD-97-14/GW02 (6/21/12)	OB-12-16/GW01 (3/7/12)	OB-12-18/GW04 (12/18/12)
OB-93-01/GW02 (6/19/12)	OB-93-04/GW01 (3/6/12)	OB-97-06/GW04 (12/17/12)	OBHD-97-14/GW03 (9/27/12)	OB-12-16/GW02 (6/20/12)	OB-12-19D/GW01 (3/7/12)
OB-93-01/GW03 (9/25/12)	OB-93-04/GW02 (6/20/12)	OB-97-07/GW01 (3/6/12)	OBHD-97-14/GW04 (12/18/12)	OB-12-16/GW03 (9/27/12)	OB-12-19D/GW02 (6/21/12)
OB-93-01/GW04 (12/17/12)	OB-93-04/GW03 (9/26/12)	OB-97-07/GW02 (6/20/12)	OB-05-15/GW01 (3/7/12)	OB-12-16/GW04 (12/19/12)	OB-12-19D/GW03 (9/24/12)
OB-93-02/GW01 (3/7/12)	OB-93-04/GW04 (12/18/12)	OB-97-07/GW03 (9/26/12)	OB-05-15/GW02 (6/21/12)	OB-12-17/GW01 (3/8/12)	OB-12-19D/GW04 (12/20/12)
OB-93-02/GW02 (6/18/12)	OB-97-05/GW01 (3/6/12)	OB-97-07/GW04 (12/18/12)	OB-05-15/GW03 (9/25/12)	OB-12-17/GW02 (6/21/12)	OB-12-20D/GW01 (3/8/12)
OB-93-02/GW03 (9/25/12)	OB-97-05/GW02 (6/19/12)	OB-97-08/GW01 (3/6/12)	OB-05-15/GW04 (12/19/12)	OB-12-17/GW03 (9/26/12)	OB-12-20D/GW02 (6/20/12)
OB-93-02/GW04 (12/17/12)	OB-97-05/GW03 (9/26/12)	OB-97-08/GW02 (6/20/12)	OB-12-15D/GW01 (3/9/12)	OB-12-17/GW04 (12/19/12)	OB-12-20D/GW03 (9/27/12)
OB-93-03/GW01 (3/5/12)	OB-97-05/GW04 (12/18/12)	OB-97-08/GW03 (9/27/12)	OB-12-15D/GW02 (6/21/12)	OB-12-18/GW01 (3/8/12)	OB-12-20D/GW04 (12/19/12)
OB-93-03/GW02 (6/19/12)	OB-97-06/GW01 (3/5/12)	OB-97-08/GW04 (12/19/12)	OB-12-15D/GW03 (9/27/12)	OB-12-18/GW02 (6/19/12)	
OB-93-03/GW03 (9/24/12)	OB-97-06/GW02 (6/19/12)	OBHD-97-14/GW01 (3/6/12)	OB-12-15D/GW04 (12/20/12)	OB-12-18/GW03 (9/26/12)	

Table 6-2
Summary of COPCs
OB/OD RI Report
Fort Riley, Kansas

	Demolition Worker Soil	Comprehensive Soil	Surface Water	Groundwater
Volatile Organic Compounds				
Naphthalene				X
1,1,2,2-Tetrachloroethane			X	X
Trichloroethene	X	X	X	X
Semivolatile Organic Compounds				
Benzo(a)pyrene			X	X
Bis(2-ethylhexyl)phthalate				X

Note:

COPC - Chemical of Potential Concern

Table 6-3
Noncancer Toxicity Information
for Chemicals of Potential Concern
OB/OD RI Report
Fort Riley, Kansas

Chemical	Oral RfD (mg/kg/day)	Source	Toxic Effect of Concern	Inhalation RfC (mg/m^3)	Source	Toxic Effect of Concern
Volatile Organic Compounds						
Naphthalene	2E-002	IRIS	Decreased mean terminal body weight in males	3E-003	IRIS	Nasal effects
1,1,2,2-Tetrachloroethane	2E-002	IRIS	Increased relative liver weight in rats			
Trichloroethene	5E-004	IRIS	Multiple - heart malformations, adult and developmental immunological effects	2E-003	IRIS	Multiple - heart malformations, adult and developmental immunological effects
Semivolatile Organic Compounds						
Benzo(a)pyrene						
Bis(2-ethylhexyl)phthalate	2E-002	IRIS	Increased relative liver weight			

Notes:
IRIS - Integrated Risk Information System (USEPA, 2013)
Blanks indicate that information is not available.
RfD - Reference Dose
RfC - Reference Concentration
mg/kg/day - milligrams per kilogram per day
mg/m^3 - milligrams per cubic meter

Table 6-4
Adjusted Oral Toxicity Values for Dermal Exposure
for Chemicals of Potential Concern
OB/OD RI Report
Fort Riley, Kansas

Chemical	Oral RfD (mg/kg/day)	Oral Slope Factor 1/(mg/kg/day)	Gastrointestinal Absorption Efficiency[1]	Adjustment Needed[2]	RfD for Dermal Exposure (mg/kg/day)	Slope Factor for Dermal Exposure 1/(mg/kg/day)
Volatile Organic Compounds						
Naphthalene	2E-002		> 50%	No	2E-002	
1,1,2,2-Tetrachloroethane	2E-002	2.0E-001	> 50%	No	2E-002	2.0E-001
Trichloroethene	5E-004	4.6E-002	> 50%	No	5E-004	4.6E-002
Semivolatile Organic Compounds						
Benzo(a)pyrene		7.3E+000	> 50%	No		7.3E+000
Bis(2-ethylhexyl)phthalate	2E-002	1.4E-002	> 50%	No	2E-002	1.4E-002

Notes:

[1] - Source: USEPA, 2004

[2] - Current guidance recommends that oral toxicity values be adjusted to reflect gastrointestinal absorption efficiency only when the absorption efficiency is less than 50 percent (USEPA, 2004)

mg/kg/day - milligrams per kilogram per day

Table 6-5
Cancer Toxicity Information
for Chemicals of Potential Concern
OB/OD RI Report
Fort Riley, Kansas

Chemical	Weight-of-Evidence Classification[1]	Oral Slope Factor 1/(mg/kg/day)	Source	Inhalation Unit Risk 1/(ug/m³)	Source	Site of Tumor
Volatile Organic Compounds						
Naphthalene	S			3.4E+001	CalEPA	
1,1,2,2-Tetrachloroethane	L	2.0E-001	IRIS	5.8E+001	CalEPA	Liver
Trichloroethene	C	4.6E-002	IRIS	4.1E+000	IRIS	Kidney and liver
Semivolatile Organic Compounds						
Benzo(a)pyrene	L	7.3E+000	IRIS	1.1E+003	CalEPA	Larynx and esophagus
Bis(2-ethylhexyl)phthalate	L	1.4E-002	IRIS	2.4E+000	CalEPA	Liver

Notes:

[1] - Weight of evidence classifications obtained from IRIS.
C - Carcinogenic to humans
I - Inadequate information to assess carcinogenic potential
IRIS - Integrated Risk Information System (USEPA, 2013)
L - Likely to be carcinogenic to humans
mg/kg/day - milligrams per kilogram per day
ug/m³ - micrograms per cubic meter
N - Not likely to be carcinogenic to humans
S - Suggestive evidence of carcinogenic potential
Blanks indicate that information is not available.

Table 6-6
Formula for Incidental Ingestion of Chemicals in Soil*
OB/OD RI Report
Fort Riley, Kansas

IN = CS x IR x CF x FI x EF x ED / (BW x AT)

Where:

IN	=	Intake (milligram per kilogram per day [mg/kg/day])
CS	=	Chemical concentration in soil and sediment (milligram per kilogram [mg/kg])
IR	=	Ingestion rate (milligram of soil per day [mg-soil/day])
CF	=	Conversion factor (10^{-6} kilogram per milligram [kg/mg])
FI	=	Fraction ingested from contaminated source (unitless)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kilogram [kg])
AT	=	Averaging time (days)

Current/Future Demolition Worker Variable Values:

CS	=	Chemical-specific (See Tables 6-15)
IR	=	330 mg/day (USEPA, 2002)
FI	=	1.0 (Assumed worst case value)
EF	=	120 days/year (Assumed 6 months of utility work)
ED	=	1 year
BW	=	70 kg (USEPA, 1989)
AT	=	180 days for noncancer effects (30 days/month x 6 months) 25,550 days for cancer effects [70 years (Lifetime) x 365 days/year] (USEPA, 1989)

* USEPA, 1989

Table 6-7
Formula for Dermal Absorption of Chemicals in Soil*
OB/OD RI Report
Fort Riley, Kansas

AD = CS x CF x SA x AF x ABS x EF x ED / (BW x AT)

Where:

AD	=	Absorbed dose (milligram per kilogram per day [mg/kg/day])
CS	=	Chemical concentration in soil (milligram per kilogram [mg/kg])
CF	=	Conversion factor (10^{-6} kilogram per milligram [kg/mg])
SA	=	Skin surface area available for contact (squared centimeters per day [cm^2/day])
AF	=	Soil to skin adherence factor (milligram per squared centimeter [mg/cm^2])
ABS	=	Absorption factor (unitless)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kilogram [kg])
AT	=	Averaging time (days)

Current/Future Demolition Worker Variable Values:

CS	=	Chemical-specific (See Table 6-14)
SA	=	3,300 cm^2 (Mean surface area of hands, forearms, and feet) (USEPA, 1997)
AF	=	0.3 mg/cm^2 (USEPA, 2002)
ABS	=	0.13 for polycyclic aromatic hydrocarbons (Based on benzo(a)pyrene), 0.03 for arsenic, 0.001 for cadmium, and 0 for volatiles and inorganics (USEPA, 2004)
EF	=	120 days/year (Assumed 6 months of utility work)
ED	=	1 year
BW	=	70 kg (USEPA, 1989)
AT	=	180 days for noncancer effects (30 days/month x 6 months) 25,550 days for cancer effects [70 years (Lifetime) x 365 days/year] (USEPA, 1989)

* USEPA, 2004

Table 6-8
Formula for Inhalation of Chemicals in Fugitive Dust*
OB/OD RI Report
Fort Riley, Kansas

C = CS x ET x EF x ED / (PEF x AT)

Where:

C	=	Chemical concentration in air (milligrams per cubic meter [mg/m^3])
CS	=	Chemical concentration in soil (milligram per kilogram [mg/kg])
ET	=	Exposure time (hours/day)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
PEF	=	Particulate emission factor (cubic meters per kilogram [m^3/kg])
AT	=	Averaging time (hours)

Current/Future Demolition Worker Variable Values:

CS	=	Chemical-specific (See Table 6-14)
ET	=	8 hrs/day (Standard working day)
EF	=	120 days/year (Assumed 6 months of utility work)
ED	=	1 year
PEF	=	1.316E+09 m^3/kg (USEPA, 2002)
AT	=	4,320 hours for noncancer effects [180 days x 24 hours/day] 613,200 hours for cancer effects [70 years (Lifetime) x 365 days/year x 24 hours/day] (USEPA, 2009)

* USEPA, 2009

Table 6-9
Formula for Inhalation of Vapor Phase Chemicals*
OB/OD RI Report
Fort Riley, Kansas

C = CA x ET x EF x ED / AT

Where:

C	=	Chemical concentration in air (milligrams per cubic meter [mg/m^3])
CA	=	Chemical concentrations in air (mg/m^3)
ET	=	Exposure time (hours/day)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
AT	=	Averaging time (hours)

Current/Future Site Worker Variable Values:

CA	=	Modeled from soil and/or groundwater concentrations (See Table 6-23)
ET	=	8 hrs/day (Standard working day)
EF	=	250 days/year (USEPA, 1991)
ED	=	25 years (USEPA, 1991)
AT	=	219,000 hours for noncancer effects [25 years (ED) x 365 days/year x 24 hours/day] (USEPA, 2009) 613,200 hours for cancer effects [70 years (Lifetime) x 365 days/year x 24 hours/day] (USEPA, 2009)

Current/Future Demolition Worker Variable Values:

CA	=	Modeled from soil and/or groundwater concentrations (See Table 6-24)
ET	=	8 hrs/day (Standard working day)
EF	=	120 days/year (Assumed 6 months of utility work)
ED	=	1 year
AT	=	4,320 hours for noncancer effects [180 days x 24 hours/day] 613,200 hours for cancer effects [70 years (Lifetime) x 365 days/year x 24 hours/day] (USEPA, 2009)

* USEPA, 2009

Table 6-10
Formula for Dermal Absorption of Chemicals in Surface Water*
OB/OD RI Report
Fort Riley, Kansas

$DAD = DA_{event} \times EV \times SA \times EF \times ED / (BW \times AT)$

Where:

DAD	=	Dermally absorbed dose (milligram per kilogram per day [mg/kg/day])
DA_{event}	=	Absorbed dose per event (milligrams per square centimeter event [mg/cm^2-event])
EV	=	Event frequency (events/day)
SA	=	Skin surface area available for contact (cm^2)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kilogram [kg])
AT	=	Averaging time (days)

Current/Future Site Worker Variable Values:

DA_{event}	=	Calculated (See Table 6-20)
EV	=	1 event/day (USEPA, 2004)
SA	=	3,300 cm^2 (Mean surface area of hands, forearms, and feet) (USEPA, 1997)
EF	=	250 days/year (USEPA, 1991)
ED	=	25 years (USEPA, 1991)
BW	=	70 kg (USEPA, 1989)
AT	=	9,125 days for noncancer effects [25 years (ED) x 365 days/year] (USEPA, 1989) 25,550 days for cancer effects [70 years (Lifetime) x 365 days/year] (USEPA, 1989)

Current/Future Demolition Worker Variable Values:

DA_{event}	=	Calculated (See Table 6-20)
EV	=	1 event/day (USEPA, 2004)
SA	=	3,300 cm^2 (Mean surface area of hands, forearms, and feet) (USEPA, 1997)
EF	=	120 days/year (Assumed 6 months of utility work)
ED	=	1 year
BW	=	70 kg (USEPA, 1989)
AT	=	180 days for noncancer effects (30 days/month x 6 months) 25,550 days for cancer effects [70 years (Lifetime) x 365 days/year] (USEPA, 1989)

* USEPA, 2004

Table 6-11
Formula for Ingestion of Chemicals in Groundwater*
OB/OD RI Report
Fort Riley, Kansas

IN = CW x IR x EF x ED / (BW x AT)

Where:

IN	=	Intake (milligram per kilogram per day [mg/kg/day])
CW	=	Chemical concentration in water (milligram per liter [mg/L])
IR	=	Ingestion rate (liters per day [L/day])
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kilogram [kg])
AT	=	Averaging time (days)

Future Site Worker Variable Values:

CW	=	(See Table 6-18)
IR	=	2.0 L/day (USEPA, 1991)
EF	=	250 days/year (USEPA, 1991)
ED	=	25 years (USEPA, 1991)
BW	=	70 kg (USEPA, 1989)
AT	=	9,125 days for noncancer effects [25 years (ED) x 365 days/year] (USEPA, 1989) 25,550 days for cancer effects [70 years (Lifetime) x 365 days/year] (USEPA, 1989)

Current/Future Demolition Worker Variable Values:

CW	=	(See Table 6-18)
IR	=	2.0 L/day (USEPA, 1991)
EF	=	120 days/year (Assumed 6 months of utility work)
ED	=	1 year
BW	=	70 kg (USEPA, 1989)
AT	=	180 days for noncancer effects (30 days/month x 6 months) 25,550 days for cancer effects [70 years (Lifetime) x 365 days/year] (USEPA, 1989)

* USEPA, 1989

Table 6-12
Formula for Dermal Absorption of Chemicals in Groundwater*
OB/OD RI Report
Fort Riley, Kansas

$DAD = DA_{event} \times EV \times SA \times EF \times ED / (BW \times AT)$

Where:

DAD	=	Dermally absorbed dose (milligram per kilogram per day [mg/kg/day])
DA_{event}	=	Absorbed dose per event (milligrams per square centimeter event [mg/cm^2-event])
EV	=	Event frequency (events/day)
SA	=	Skin surface area available for contact (cm^2)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kilogram [kg])
AT	=	Averaging time (days)

Future Site Worker Variable Values:

DA_{event}	=	Calculated (See Table 6-19)
EV	=	1 event/day (USEPA, 2004)
SA	=	3,300 cm^2 (Mean surface area of hands, forearms, and feet) (USEPA, 1997)
EF	=	250 days/year (USEPA, 1991)
ED	=	25 years (USEPA, 1991)
BW	=	70 kg (USEPA, 1989)
AT	=	9,125 days for noncancer effects [25 years (ED) x 365 days/year] (USEPA, 1989) 25,550 days for cancer effects [70 years (Lifetime) x 365 days/year] (USEPA, 1989)

Current/Future Demolition Worker Variable Values:

DA_{event}	=	Calculated (See Table 6-19)
EV	=	1 event/day (USEPA, 2004)
SA	=	3,300 cm^2 (Mean surface area of hands, forearms, and feet) (USEPA, 1997)
EF	=	120 days/year (Assumed 6 months of utility work)
ED	=	1 year
BW	=	70 kg (USEPA, 1989)
AT	=	180 days for noncancer effects (30 days/month x 6 months) 25,550 days for cancer effects [70 years (Lifetime) x 365 days/year] (USEPA, 1989)

* USEPA, 2004

Table 6-13
Formula for Inhalation of Vapor Phase Chemicals from Water Use*
OB/OD RI Report
Fort Riley, Kansas

CA = C x K x ET x EF x ED / AT

Where:

CA	=	Chemical concentration in air (milligrams per cubic meter [mg/m^3])
C	=	Chemical concentrations in water (milligrams per liter [mg/L])
K	=	Volatilization factor (liters per cubic meter [L/m^3])
ET	=	Exposure time (hours/day)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
AT	=	Averaging time (hours)

Future Site Worker Variable Values:

C	=	Chemical-specific (See Table ?)
K	=	0.5 L/m^3 (USEPA, 1991)
ET	=	8 hrs/day (Standard working day)
EF	=	250 days/year (USEPA, 1991)
ED	=	25 years (USEPA, 1991)
AT	=	219,000 hours for noncancer effects [25 years (ED) x 365 days/year x 24 hours/day] (USEPA, 2009) 613,200 hours for cancer effects [70 years (Lifetime) x 365 days/year x 24 hours/day] (USEPA, 2009)

* USEPA, 2009

Table 6-14
Exposure Point Concentrations
Demolition Soil
OB/OD RI Report
Fort Riley, Kansas

Chemical	Maximum Detected Concentration (mg/kg)	Upper Confidence Limit (mg/kg)	Exposure Point Concentration (mg/kg)
Volatile Organic Compounds			
Trichloroethene	181	41.7	41.7

Notes:

mg/kg - milligrams per kilogram

UCL values calculated using ProUCL Version 4.1 (See Appendix J).

Exposure point concentration is lower of maximum detected concentration or upper confidence limit.

Table 6-15
Exposure Point Concentrations
Comprehensive Soil
OB/OD RI Report
Fort Riley, Kansas

Chemical	Maximum Detected Concentration (mg/kg)	Upper Confidence Limit (mg/kg)	Exposure Point Concentration (mg/kg)
Volatile Organic Compounds			
Trichloroethene	181	13.7	13.7

Notes:

mg/kg - milligrams per kilogram

UCL values calculated using ProUCL Version 4.1 (See Appendix J).

Exposure point concentration is lower of maximum detected concentration or upper confidence limit.

Table 6-16
Exposure Point Concentrations
Surface Water
OB/OD RI Report
Fort Riley, Kansas

Chemical	Maximum Detected Concentration (mg/L)	Upper Confidence Limit (mg/L)	Exposure Point Concentration (mg/L)
Volatile Organic Compounds			
1,1,2,2-Tetrachloroethane	0.016	NC	0.016
Trichloroethene	0.091	NAp	0.091
Semivolatile Organic Compounds			
Benzo(a)pyrene	0.0011	NC	0.0011

Notes:

ug/L - micrograms per Liter

NAp - Not applicable due to less than four distinct detected data.

NC - Not calculated due to an insufficient number of samples.

UCL values calculated using ProUCL Version 4.1 (See Appendix J).

Exposure point concentration is lower of maximum detected concentration or upper confidence limit.

Table 6-17
Exposure Point Concentrations
Groundwater
OB/OD RI Report
Fort Riley, Kansas

Chemical	Maximum Detected Concentration (mg/L)	Exposure Point Concentration (mg/L)
Volatile Organic Compounds		
Naphthalene	0.0025	0.0025
1,1,2,2-Tetrachloroethane	0.045	0.045
Trichloroethene	0.26	0.26
Semivolatile Organic Compounds		
Benzo(a)pyrene	0.00076	0.00076
Bis(2-ethylhexyl)phthalate	0.024	0.024

Notes:

mg/L - milligrams per Liter

No UCL was calculated for groundwater samples, due to exposure being a point-source.

Table 6-18
Dermal Absorbed Dose per Event for Organic Compounds in Groundwater
OB/OD RI Report
Fort Riley, Kansas

Equations:

$$DAD = \frac{DA_{event} \times EV \times ED \times EF \times SA}{BW \times AT}$$

$$If\left(t_{event}\right) \leq t^*, then: DA_{event} = 2 \times FA \times K_p \times C_w \sqrt{\frac{6 \times T_{event} \times t_{event}}{\pi}}$$

or

$$If\left(t_{event}\right) \geq t^*, then: DA_{event} = FA \times K_p \times C_w \left[\frac{t_{event}}{1+B} + 2 \times T_{event}\left(\frac{1+3 \times B + 3 \times B^2}{(1+B)^2}\right)\right]$$

Variables:

DAD =	Dermally Absorbed Dose (milligrams per kilogram-day [mg/kg-day])
DAevent =	Absorbed dose per event (milligrams per square centimeters-event [mg/cm²-event])
EV =	Event frequency (events/day)
ED =	Exposure duration (years)
EF =	Exposure frequency (days/year)
SA =	Skin surface area available for contact (cm²)
BW =	Body weight [kilograms (kg)]
ATnc =	Averaging time - noncancer (days)
ATc =	Averaging time - cancer (days)
DAevent =	Absorbed dose per event (mg/cm²-event)
FA =	Fraction absorbed water (dimensionless)
Kp =	Dermal permeability coefficient of compound in water (centimeters per hour [cm/hour])
Cw =	Chemical concentration in water (milligrams per cubic centimeter [mg/cm³])
Tevent =	Lag time per event (hours/event)
tevent =	Event duration (hours/event)
t* =	Time to reach steady-state (hours) = 2.4 x Tevent
B =	Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis (ve) (dimensionless)

Table 6-18
Dermal Absorbed Dose per Event for Organic Compounds in Groundwater
OB/OD RI Report
Fort Riley, Kansas

Variable Values:

Current/Future Site Worker

DAD =	Caculated	
DAevent =	Chemical-specific	
EV =	1	events/day
ED =	25	years
EF =	250	days/year
SA =	3300	cm²
BW =	70	kg
ATnc =	9125	days
ATc =	25550	days
DAevent =	Calculated	
FA =	Chemical-specific (USEPA, 2004)	
Kp =	Chemical-specific (USEPA, 2004)	
Cw =	Site-specific (See Table 3-7)	
Tevent =	Chemical-specific (USEPA, 2004)	
tevent =	2	hours/event (USEPA, 2004)
t* =	Calculated	
B =	Chemical-specific (USEPA, 2004)	

Future Demolition Worker

DAD =	Caculated	
DAevent =	Chemical-specific	
EV =	1	events/day
ED =	1	years
EF =	120	days/year
SA =	3300	cm²
BW =	70	kg
ATnc =	168	days
ATc =	25550	days
DAevent =	Calculated	
FA =	Chemical-specific (USEPA, 2004)	
Kp =	Chemical-specific (USEPA, 2004)	
Cw =	Site-specific (See Table 3-7)	
Tevent =	Chemical-specific (USEPA, 2004)	
tevent =	2	hours/event (USEPA, 2004)
t* =	Calculated	
B =	Chemical-specific (USEPA, 2004)	

Noncancer

Chemical	FA (dimensionless)	Kp (cm/hour)	CW (mg/cm³)	Tevent (hours/event)	t* (hours)	B (dimensionless)	DAevent (mg/cm²-event)	DAD - Site Wkr (mg/kg-day)	DAD - Demolition (mg/kg-day)
Volatile Organic Compounds									
Naphthalene	1.0	4.70E-002	2.50E-006	0.56	1.34	0.2	4.17E-007	1.35E-005	1.41E-005
1,1,2,2-Tetrachloroethane	1.0	6.90E-003	4.50E-005	0.93	2.23	0.0	1.17E-006	3.78E-005	3.94E-005
Trichloroethene	1.0	1.20E-002	2.60E-004	0.58	1.39	0.1	1.05E-005	3.38E-004	3.52E-004
Semivolatile Organic Compounds									
Benzo(a)pyrene	1.0	7.00E-001	7.60E-007	2.69	6.46	4.3	3.41E-006	1.10E-004	1.15E-004
Bis(2-ethylhexyl)phthalate	NAv	NAv	2.40E-005	NAv	0.00	NAv	NC	NC	NC

Cancer

Chemical	FA (dimensionless)	Kp (cm/hour)	CW (mg/cm³)	Tevent (hours/event)	t* (hours)	B (dimensionless)	DAevent (mg/cm²-event)	DAD - Site Wkr (mg/kg-day)	DAD - Demolition (mg/kg-day)
Volatile Organic Compounds									
Naphthalene	1.0	4.70E-002	2.50E-006	0.56	1.34	0.2	4.17E-007	4.81E-006	9.24E-008
1,1,2,2-Tetrachloroethane	1.0	6.90E-003	4.50E-005	0.93	2.23	0.0	1.17E-006	1.35E-005	2.59E-007
Trichloroethene	1.0	1.20E-002	2.60E-004	0.58	1.39	0.1	1.05E-005	1.21E-004	2.32E-006
Semivolatile Organic Compounds									
Benzo(a)pyrene	1.0	7.00E-001	7.60E-007	2.69	6.46	4.3	3.41E-006	3.93E-005	7.55E-007
Bis(2-ethylhexyl)phthalate	NAv	NAv	2.40E-005	NAv	0.00	NAv	NC	NC	NC

Table 6-19
Dermal Absorbed Dose per Event for Organic Compounds in Surface Water
OB/OD RI Report
Fort Riley, Kansas

Equations:

$$DAD = \frac{DA_{event} \times EV \times ED \times EF \times SA}{BW \times AT}$$

$$If\left(t_{event}\right) \leq t^*, then: DA_{event} = 2 \times FA \times K_p \times C_w \sqrt{\frac{6 \times T_{event} \times t_{event}}{\pi}}$$

or

$$If\,(t_{event}) \geq t^*, then: DA_{event} = FA \times K_p \times C_w \left[\frac{t_{event}}{1+B} + 2 \times T_{event}\left(\frac{1+3 \times B + 3 \times B^2}{(1+B)^2}\right)\right]$$

Variables:

DAD = Dermally Absorbed Dose (milligrams per kilogram-day [mg/kg-day])
DAevent = Absorbed dose per event (milligrams per square centimeters-event [mg/cm²-event])
EV = Event frequency (events/day)
ED = Exposure duration (years)
EF = Exposure frequency (days/year)
SA = Skin surface area available for contact (cm²)
BW = Body weight [kilograms (kg)]
ATnc = Averaging time - noncancer (days)
ATc = Averaging time - cancer (days)
DAevent = Absorbed dose per event (mg/cm²-event)
FA = Fraction absorbed water (dimensionless)
Kp = Dermal permeability coefficient of compound in water (centimeters per hour [cm/hour])
Cw = Chemical concentration in water (milligrams per cubic centimeter [mg/cm³])
Tevent = Lag time per event (hours/event)
tevent = Event duration (hours/event)
t* = Time to reach steady-state (hours) = 2.4 x Tevent
B = Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis (ve) (dimensionless)

Table 6-19
Dermal Absorbed Dose per Event for Organic Compounds in Surface Water
OB/OD RI Report
Fort Riley, Kansas

Variable Values:

Current/Future Site Worker

DAD =	Caculated	
DAevent =	Chemical-specific	
EV =	1	events/day
ED =	25	years
EF =	250	days/year
SA =	3300	cm²
BW =	70	kg
ATnc =	9125	days
ATc =	25550	days
DAevent =	Calculated	
FA =	Chemical-specific (USEPA, 2004)	
Kp =	Chemical-specific (USEPA, 2004)	
Cw =	Site-specific (See Table 3-7)	
Tevent =	Chemical-specific (USEPA, 2004)	
tevent =	2	hours/event (USEPA, 2004)
t* =	Calculated	
B =	Chemical-specific (USEPA, 2004)	

Current/Future Demolition Worker

DAD =	Caculated	
DAevent =	Chemical-specific	
EV =	1	events/day
ED =	1	years
EF =	120	days/year
SA =	3300	cm²
BW =	70	kg
ATnc =	168	days
ATc =	25550	days
DAevent =	Calculated	
FA =	Chemical-specific (USEPA, 2004)	
Kp =	Chemical-specific (USEPA, 2004)	
Cw =	Site-specific (See Table 3-7)	
Tevent =	Chemical-specific (USEPA, 2004)	
tevent =	2	hours/event (USEPA, 2004)
t* =	Calculated	
B =	Chemical-specific (USEPA, 2004)	

Noncancer

Chemical	FA (dimensionless)	Kp (cm/hour)	CW (mg/cm³)	Tevent (hours/event)	t* (hours)	B (dimensionless)	DAevent (mg/cm²-event)	DAD - Site Wkr (mg/kg-day)	DAD - Demolition (mg/kg-day)
Volatile Organic Compounds									
1,1,2,2-Tetrachloroethane	1.0	6.90E-003	1.60E-005	0.93	2.23	0.0	4.16E-007	1.34E-005	1.40E-005
Trichloroethene	1.0	1.20E-002	9.10E-005	0.58	1.39	0.1	3.66E-006	1.18E-004	1.23E-004
Semivolatile Organic Compounds									
Benzo(a)pyrene	1.0	7.00E-001	1.10E-006	2.69	6.46	4.3	4.94E-006	1.59E-004	1.66E-004

Cancer

Chemical	FA (dimensionless)	Kp (cm/hour)	CW (mg/cm³)	Tevent (hours/event)	t* (hours)	B (dimensionless)	DAevent (mg/cm²-event)	DAD - Site Wkr (mg/kg-day)	DAD - Demolition (mg/kg-day)
Volatile Organic Compounds									
1,1,2,2-Tetrachloroethane	1.0	6.90E-003	1.60E-005	0.93	2.23	0.0	4.16E-007	4.80E-006	9.21E-008
Trichloroethene	1.0	1.20E-002	9.10E-005	0.58	1.39	0.1	3.66E-006	4.22E-005	8.11E-007
Semivolatile Organic Compounds									
Benzo(a)pyrene	1.0	7.00E-001	1.10E-006	2.69	6.46	4.3	4.94E-006	5.69E-005	1.09E-006

Table 6-20
Volatilization Factor to Outdoor Air from Soil *
Current/Future Site Worker Scenario
OB/OD RI Report
Fort Riley, Kansas

Equation:

$$\text{VFout} = \frac{Q/C \times (3.14 \times D_a \times T)^{1/2} \times UC}{(2 \times P_b \times D_a)}$$

Where

$$D_a = \frac{\left[\left(\Theta_{as}^{3.33} \times D^i \times H' + \Theta_{ws}^{3.33} \times D_w\right) / \Theta_t^2\right]}{P_b \times K_d + \Theta_{ws} + \Theta_{as} \times H'}$$

and

$$\frac{Q}{C}\left(g/m^2\text{-s per kg/m}^2\right) = A \times \exp\left[\frac{(\ln A_{site} - B)^2}{C}\right]$$

Where:

VFout = Volatilization factor from soil to outdoor air (cubic meters per kilogram [m³/kg])
Q/C = Inverse of the mean concentration at the center of a 55 acre square source (grams per squared meter-seconds per kilogram per cubic meter [g/m²-s per kg/m³])
Da = Apparent diffusivity (squared centimeters per second [cm²/s])
T = Exposure interval (seconds [s])
UC = Unit conversion (squared meters per squared centimeter [m²/cm²])
Pb = Dry soil bulk density (grams per cubic centimeter [g/cm³])
Oas = Air-filled porosity in vadose zone soil (liters per liter [L/L])
Di = Diffusion coefficient in air (cm²/s)
H' = Henry's law constant (unitless)
Ows = Water-filled porosity in vadose zone soil (L/L)
Dw = Diffusion coefficient in water (cm²/s)
Ot = Total soil porosity (L/L)
Kd = Soil-water sorption coefficient (cubic centimeters per gram [cm³/g]) (Koc x foc)
Koc = Carbon-water sorption coefficient (cm³/g)
foc = Fraction organic carbon (unitless)
A = Constant based on air dispersion modeling for specific climate zones [unitless]
Asite = Extent of the site or contamination [acres]
B = Constant based on air dispersion modeling for specific climate zones [unitless]
C = Constant based on air dispersion modeling for specific climate zones [unitless]

Variables:

VFout = Calculated
Da = Calculated
Q/C = 3.76E+001 g/m²-sec per kg/m³ (Calculated)
T = 8E+008 s (represents 25-year exposure duration)
UC = 1E-004 m²/cm²
Pb = 1.38 g/cm³ (USEPA, 2005)
Oas = 0.265 L/L (Ot - Ows)
Di = Chemical-specific (USEPA, 1996)
H' = Chemical-specific (USEPA, 1996)
Ows = 0.216 L/L (USEPA, 2005)
Dw = Chemical-specific (USEPA, 1996)
Ot = 0.481 L/L (USEPA, 2005)
Kd = Chemical-specific (calculated)
Koc = Chemical-specific (USEPA, 1996)
foc = 0.002 unitless (USEPA, 2005)
A = 14.1901 (represents Zone 5-Lincoln, NE) (USEPA, 2002)
Asite = 70 acres (total acreage of OB/OD)
B = 18.5634 (represents Zone 5-Lincoln, NE) (USEPA, 2002)
C = 210.5281 (represents Zone 5-Lincoln, NE) (USEPA, 2002)

Chemical	H' (unitless)	Koc (cm³/g)	Kd (cm³/g)	Di (cm²/s)	Dw (cm²/s)	Da (cm²/s)	VF (m³/kg)
Volatile Organic Compounds							
Trichloroethene	4.03E-001	6.07E+001	1.21E-001	6.87E-002	1.02E-005	2.93E-003	1.25E+003

Notes:
*USEPA, 2002

Table 6-21
Volatilization Factor to Outdoor Air from Soil *
Current/Future Demolition Worker Scenario
OB/OD RI Report
Fort Riley, Kansas

Equation:

$$VFout = \frac{Q/C \times (3.14 \times D_a \times T)^{1/2} \times UC}{(2 \times P_b \times D_a)}$$

Where

$$D_a = \frac{\left[\left(\Theta_{as}^{3.33} \times D^i \times H' + \Theta_{ws}^{3.33} \times D_w\right) / \Theta_t^2\right]}{P_b \times K_d + \Theta_{ws} + \Theta_{as} \times H'}$$

and

$$\frac{Q}{C}\left(g/m^2 - s \text{ per } kg/m^2\right) = A \times \exp\left[\frac{(\ln A_{site} - B)^2}{C}\right]$$

Where:

VFout = Volatilization factor from soil to outdoor air (cubic meters per kilogram [m³/kg])
Q/C = Inverse of the mean concentration at the center of a 55 acre square source
(grams per squared meter-seconds per kilogram per cubic meter [g/m²-s per kg/m³])
Da = Apparent diffusivity (squared centimeters per second [cm²/s])
T = Exposure interval (seconds [s])
UC = Unit conversion (squared meters per squared centimeter [m²/cm²])
Pb = Dry soil bulk density (grams per cubic centimeter [g/cm³])
Oas = Air-filled porosity in vadose zone soil (liters per liter [L/L])
Di = Diffusion coefficient in air (cm²/s)
H' = Henry's law constant (unitless)
Ows = Water-filled porosity in vadose zone soil (L/L)
Dw = Diffusion coefficient in water (cm²/s)
Ot = Total soil porosity (L/L)
Kd = Soil-water sorption coefficient (cubic centimeters per gram [cm³/g]) (Koc x foc)
Koc = Carbon-water sorption coefficient (cm³/g)
foc = Fraction organic carbon (unitless)
A = Constant based on air dispersion modeling for specific climate zones [unitless]
Asite = Extent of the site or contamination [acres]
B = Constant based on air dispersion modeling for specific climate zones [unitless]
C = Constant based on air dispersion modeling for specific climate zones [unitless]

Variables:

VFout = Calculated
Da = Calculated
Q/C = 6.07E+001 g/m²-sec per kg/m³ (Calculated)
T = 2E+007 s (represents 0.5-year exposure duration)
UC = 1E-004 m²/cm²
Pb = 1.38 g/cm³ (USEPA, 2005)
Oas = 0.265 L/L (Ot - Ows)
Di = Chemical-specific (USEPA, 1996)
H' = Chemical-specific (USEPA, 1996)
Ows = 0.216 L/L (USEPA, 2005)
Dw = Chemical-specific (USEPA, 1996)
Ot = 0.481 L/L (USEPA, 2005)
Kd = Chemical-specific (calculated)
Koc = Chemical-specific (USEPA, 1996)
foc = 0.002 unitless (USEPA, 2005)
A = 14.1901 (represents Zone 5-Lincoln, NE) (USEPA, 2002)
Asite = 2.93 acres (total acreage of active Site boundary)
B = 18.5634 (represents Zone 5-Lincoln, NE) (USEPA, 2002)
C = 210.5281 (represents Zone 5-Lincoln, NE) (USEPA, 2002)

Chemical	H' (unitless)	Koc (cm³/g)	Kd (cm³/g)	Di (cm²/s)	Dw (cm²/s)	Da (cm²/s)	VF (m³/kg)
Volatile Organic Compounds							
Trichloroethene	4.03E-001	6.07E+001	1.21E-001	6.87E-002	1.02E-005	2.93E-003	2.86E+002

Notes:
*USEPA, 2002

Table 6-22
Chemical Concentrations in Outdoor Air
Current/Future Site Worker Scenario
OB/OD RI Report
Fort Riley, Kansas

Chemical	Modeled Chemical Concentration for Outdoor Air				Concentration Used in Risk Assessment (mg/m^3)
	Based on Soil			Based on Groundwater (mg/m^3)	
	Concentration in Soil (mg/kg)	Volatilization Factor (m^3/kg)	Modeled Concentration (mg/m^3)		
Volatile Organic Compounds					
Naphthalene	--	--	--	9.52E-09	9.52E-09
1,1,2,2-Tetrachloroethane	--	--	--	1.16E-07	1.16E-07
Trichloroethene	1.37E+01	1.25E+03	1.10E-02	2.51E-05	1.10E-02
Semivolatile Organic Compounds					
Benzo(a)pyrene	--	--	--	NC	NC
Bis(2-ethylhexyl)phthalate	--	--	--	NC	NC

Notes:

Concentration used in risk assessment represents the higher of the modeled concentrations from soil or groundwater.

Table includes all organic COPCs in either soil or groundwater.

"--" - Value not calculated because constituent was not a COPC in that medium.

mg/kg - milligrams per kilogram

m^3/kg - cubic meters per kilogram

mg/m^3 - milligrams per cubic meter

NC - Not calculated, due to a lack of available data for chemical-specific properties.

Table 6-23
Chemical Concentrations in Outdoor Air
Current/Future Demolition Worker Scenario
OB/OD RI Report
Fort Riley, Kansas

Chemical	Modeled Chemical Concentration for Outdoor Air				Concentration Used in Risk Assessment (mg/m^3)
	Based on Soil			Based on Groundwater (mg/m^3)	
	Concentration in Soil (mg/kg)	Volatilization Factor (m^3/kg)	Modeled Concentration (mg/m^3)		
Volatile Organic Compounds					
Naphthalene	--	--	--	9.52E-09	9.52E-09
1,1,2,2-Tetrachloroethane	--	--	--	1.16E-07	1.16E-07
Trichloroethene	4.17E+01	2.86E+02	1.46E-01	2.51E-05	1.46E-01
Semivolatile Organic Compounds					
Benzo(a)pyrene	--	--	--	NC	NC
Bis(2-ethylhexyl)phthalate	--	--	--	NC	NC

Notes:

Concentration used in risk assessment represents the higher of the modeled concentrations from soil or groundwater.

Table includes all organic COPCs in either soil or groundwater.

"--" - Value not calculated because constituent was not a COPC in that medium.

mg/kg - milligrams per kilogram

m^3/kg - cubic meters per kilogram

mg/m^3 - milligrams per cubic meter

NC - Not calculated, due to a lack of available data for chemical-specific properties.

Table 6-24
Vapor Partitioning from Groundwater
Outdoor Scenarios
OB/OD RI Report
Fort Riley, Kansas

Equation:

Cvapor = Cgw x H'

Where:

Cvapor = Chemical vapor concentration at the source (milligrams per cubic meter [mg/m^3])
Cgw = Chemical concentration in groundwater (micrograms per liter [µg/L])
H' = Henry's law constant (dimensionless)

Variable Values:

Cvapor = Calculated
Cgw = Chemical-specific (See Table 6-18)
H' = Chemical-specific

Chemical	Cgw (µg/L)	H' (unitless)	Cvapor (mg/m^3)
Volatile Organic Compounds			
Naphthalene	2.50E+000	1.80E-002	4.50E-002
1,1,2,2-Tetrachloroethane	4.50E+001	1.50E-002	6.75E-001
Trichloroethene	2.60E+002	4.03E-001	1.05E+002
Semivolatile Organic Compounds			
Benzo(a)pyrene	7.60E-001	1.87E-005	1.42E-005
Bis(2-ethylhexyl)phthalate	2.40E+001	1.10E-005	2.64E-004

Notes:

mg/m^3 - milligrams per cubic meter
ug/L - micrograms per liter

Table 6-25
Vapor Emission Rate from Groundwater to Surface
Outdoor Scenarios
OB/OD RI Report
Fort Riley, Kansas

Equation:

ER = (A x (Cvapor - Csurface) x Deff x CF)/L

Where:

ER = Emission rate to the surface (milligrams per second [mg/s])
A = Cross-sectional area available for diffusion (square meters [m^2])
Cvapor = Chemical vapor concentration in soil at the source (milligrams per cubic meter [mg/m^3])
Csurface = Chemical vapor concentration in soil at the surface (mg/m^3)
Deff = Effective diffusion coefficient (square centimeters per second [cm^2/s])
Where:
Deff = Dair x ($Pa^{3.33}/Pt^2$) (Millington & Quirk, 1961)
Dair = Diffusion coefficient in air at 25°C (cm^2/s)
Pt = Total porosity (cubic centimeter per cubic centimeter [cm^3/cm^3])
Pa = Air-filled porosity (cm^3/cm^3)
L = Length of flow (meters [m])
CF = Conversion factor (square meters per square centimeter [m^2/cm^2])

Variable Values:

ER = Calculated
A = 114 (m^2)
Cvapor = Calculated (See Table 6-25)
Csurface = 0 (mg/m^3) (assumed)
Deff = Calculated
Dair = Chemical-specific (USEPA, 1996)
Pt = 0.481 (cm^3/cm^3) (USEPA, 2004)
Pa = 0.265 (cm^3/cm^3) (USEPA, 2004)
L = 9.22 (m) (30.25 ft.) (Average depth to GW from wells with COPCs)
CF = 1E-004 (m^2/cm^2)

Chemical	Cvapor (mg/m^3)	Dair (cm^2/s)	Deff (cm^2/s)	ER (mg/s)
Volatile Organic Compounds				
Naphthalene	4.50E-002	6.05E-002	3.14E-003	1.75E-007
1,1,2,2-Tetrachloroethane	6.75E-001	4.89E-002	2.54E-003	2.12E-006
Trichloroethene	1.05E+002	6.87E-002	3.56E-003	4.61E-004
Semivolatile Organic Compounds				
Benzo(a)pyrene	1.42E-005	NAv	NC	NC
Bis(2-ethylhexyl)phthalate	2.64E-004	NAv	NC	NC

Notes:
NAv - Not available
NC - Not calculated
mg/m^3 - milligrams per cubic meter
cm^2/s - square centimeters per second
mg/s - milligrams per second

Table 6-26
Vapor Concentration from Groundwater in Breathing Zone Air*
Outdoor Scenarios
OB/OD RI Report
Fort Riley, Kansas

Equation:

Cb = ER / (W x Hb x Um)

Where:

Cb = Vapor concentration in near field box (milligrams per cubic meter [mg/m^3])
ER = Emission rate (milligrams per second [mg/s])
W = Width of the area (meters [m])
Hb = Mixing zone height (m)
Um = Wind speed in mixing zone (meters per second [m/s])
Where:
Um = 0.22 x U10 x ln (2.5 x Hb)
U10 is the wind speed at 10 m elevation (m/s)

Variable Values:

Cb = Calculated
ER = Chemical-specific (See Table 6-26)
W = 10.7 (m) (35ft, assumed width of work area or excavation)
Hb = 1.4 (m) (based on box size) (GRI, 1988)
U10 = 4.3 (m/s) (NCDC, 2008)
Um = 1.2 (m/s) (calculated)

Parameter	ER (mg/s)	Cb (mg/m^3)
Volatile Organic Compounds		
Naphthalene	1.75E-007	9.52E-009
1,1,2,2-Tetrachloroethane	2.12E-006	1.16E-007
Trichloroethene	4.61E-004	2.51E-005
Semivolatile Organic Compounds		
Benzo(a)pyrene	NC	0.00E+000
Bis(2-ethylhexyl)phthalate	NC	0.00E+000

Notes:
NC - Not calculated
mg/m^3 - milligrams per cubic meter
mg/s - milligrams per second
*GRI, 1988

Table 6-27
Vapor Emission Rate from Surface Water to Outdoor Air
Outdoor Scenarios
OB/OD RI Report
Fort Riley, Kansas

Equation:

ER = A x Cvapor x KI x CF

KI = (1/klvoc+ (RT/(H x kgvoc)) x K)^(-1)

Where:

klvoc = klco2 x (44/MWvoc)^0.5 and kgvoc =kgH2O x (18/MWvoc)^0.5

Where:

ER =	Emission rate to the surface (milligrams per second [mg/s])
A =	Cross-sectional area available for diffusion (square meters [m²])
Cvapor =	Chemical vapor concentration in soil at the source (milligrams per cubic meter [mg/m³])
KI =	Overall mass transfer coefficient (centimeters per hour [cm/hr])
CF =	Conversion factor (meters per hour per centimeter per second [m-hr/cm-sec])
klvoc =	Liquid-film mass transfer coefficient of volatile organic constituent (cm/hr)
RT =	Gas constant (atmospheres per cubic meter per mole [atm-m³/mol])
H =	Henry's Law Constant (atmospheres per cubic meter per mole Kelvin [atm-m³/mol-K])
kgvoc =	Gas-film mass transfer coefficient of volatile organic constituent (cm/hr)
K =	Average temperature at the Site (K)
klco2 =	Liquid-film mass transfer coefficient of carbon dioxide (cm/hr)
MWvoc =	Molecular weight of volatile organic constituent (grams per mole [g/mol])
kgH2O =	Gas-film mass transfer coefficient of water (cm/hr)

Variable Values:

ER =	Calculated	
A =	114	m²
Cvapor =	Chemical-specific	
KI =	Calculated	
CF =	2.78E-007	m-hr/cm-sec
klvoc =	Calculated	
RT =	2.40E-002	atm-m³/mol
H =	Chemical-specific (USEPA, 2012)	
kgvoc =	Calculated	
K =	288	K (NOAA, 2013)
klco2 =	20	cm/hr
MWvoc =	Chemical-specific (USEPA, 2012)	
kgH2O =	3000	cm/hr

Table 6-27
Vapor Emission Rate from Surface Water to Outdoor Air
Outdoor Scenarios
OB/OD RI Report
Fort Riley, Kansas

Chemical	Cvapor (mg/m³)	H (atm-m³/mol)	MWvoc (g/mol)	klvoc (cm/hr)	kgvoc (cm/hr)	Kl (cm/hr)	ER (mg/s)
Volatile Organic Compounds							
1,1,2,2-Tetrachloroethane	1.60E+001	3.67E-004	1.68E+002	1.02E+001	9.82E+002	2.11E-002	1.07E-005
Trichloroethene	9.10E+001	9.85E-003	1.31E+002	1.16E+001	1.11E+003	3.92E-002	1.13E-004
Semivolatile Organic Compounds							
Benzo(a)pyrene	1.10E+000	4.57E-007	2.52E+002	8.35E+000	8.01E+002	5.29E-005	1.84E-009

Notes:
NAv - Not available
NC - Not calculated
mg/m³ - milligrams per cubic meter
cm²/s - square centimeters per second
mg/s - milligrams per second

Table 6-28
Vapor Concentration from Surface Water in Breathing Zone Air*
Outdoor Scenarios
OB/OD RI Report
Fort Riley, Kansas

Equation:

Cb = ER / (W x Hb x Um)

Where:

Cb = Vapor concentration in near field box (milligrams per cubic meter [mg/m^3])
ER = Emission rate (milligrams per second [mg/s])
W = Width of the area (meters [m])
Hb = Mixing zone height (m)
Um = Wind speed in mixing zone (meters per second [m/s])
Where:
Um = 0.22 x U10 x ln (2.5 x Hb)
U10 is the wind speed at 10 m elevation (m/s)

Variable Values:

Cb = Calculated
ER = Chemical-specific (See Table 6-28)
W = 10.7 (m) (35ft, assumed width of work area or excavation)
Hb = 1.4 (m) (based on box size) (GRI, 1988)
U10 = 4.3 (m/s) (NCDC, 2008)
Um = 1.2 (m/s) (calculated)

Parameter	ER (mg/s)	Cb (mg/m^3)
Volatile Organic Compounds		
1,1,2,2-Tetrachloroethane	1.07E-005	5.84E-007
Trichloroethene	1.13E-004	6.16E-006
Semivolatile Organic Compounds		
Benzo(a)pyrene	1.84E-009	1.00E-010

Notes:
NC - Not calculated
mg/m^3 - milligrams per cubic meter
mg/s - milligrams per second
*GRI, 1988

Table 6-29
Hazard Index Estimates for Current Worker Scenario
OB/OD RI Report
Fort Riley, Kansas

Chemical	**Daily Intake**	**RfD/RfC**	**Hazard Quotient**	**Pathway Hazard Index**	**Total Hazard Index**
Exposure Pathway: Inhalation of Outdoor Vapors					
Volatile Organic Compounds					
Naphthalene	2.17E-009	3E-003	0.000001		
1,1,2,2-Tetrachloroethane	9.06E-006	NAv	NAp		
Trichloroethene	2.51E-003	2E-003	1		
Semivolatile Organic Compounds					
Benzo(a)pyrene	0.00E+000	NAv	NAp		
Bis(2-ethylhexyl)phthalate	0.00E+000	NAv	NAp		
				1	
Exposure Pathway: Dermal Contact with Surface Water					
Volatile Organic Compounds					
1,1,2,2-Tetrachloroethane	1.79E-005	2E-002	0.001		
Trichloroethene	1.58E-004	5E-004	0.3		
Semivolatile Organic Compounds					
Benzo(a)pyrene	2.13E-004	NAv	NAp		
				0.3	
Exposure Pathway: Inhalation of Vapors from Surface Water					
Volatile Organic Compounds					
1,1,2,2-Tetrachloroethane	5.84E-007	NAv	NAp		
Trichloroethene	6.16E-006	2E-003	0.0007		
Semivolatile Organic Compounds					
Benzo(a)pyrene	1.00E-010	NAv	NAp		
				0.0007	
					1.3

Notes:

NAp - Not Applicable

NAv - Not Available

RfC - Reference Concentration

RfD - Reference Dose

Daily intakes and RfDs applicable to ingestion and dermal contact pathways are expressed in units of mg/kg/day.

Daily intakes and RfDs applicable to inhalation pathways are expressed in units of mg/m^3.

Table 6-30
Excess Lifetime Cancer Risk Estimate for
Current Worker Scenario
OB/OD RI Report
Fort Riley, Kansas

Chemical	Daily Intake	Slope Factor/ IUR	Excess Cancer Risk	Pathway Cancer Risk	Total Cancer Risk
Exposure Pathway: Inhalation of Outdoor Vapors					
Volatile Organic Compounds					
Naphthalene	8E-010	3E-002	3E-011		
1,1,2,2-Tetrachloroethane	3E-006	6E-002	2E-007		
Trichloroethene	9E-004	4E-003	4E-006		
Semivolatile Organic Compounds					
Benzo(a)pyrene	0E+000	1E+000	0E+000		
Bis(2-ethylhexyl)phthalate	0E+000	2E-003	0E+000		
				4E-006	
Exposure Pathway: Dermal Contact with Surface Water					
Volatile Organic Compounds					
1,1,2,2-Tetrachloroethane	6E-006	2E-001	1E-006		
Trichloroethene	6E-005	5E-002	3E-006		
Semivolatile Organic Compounds					
Benzo(a)pyrene	8E-005	7E+000	6E-004		
				6E-004	
Exposure Pathway: Inhalation of Vapors from Surface Water					
Volatile Organic Compounds					
1,1,2,2-Tetrachloroethane	5E-008	6E-002	3E-009		
Trichloroethene	5E-007	4E-003	2E-009		
Semivolatile Organic Compounds					
Benzo(a)pyrene	8E-012	1E+000	9E-012		
				5E-009	
					6E-004

Notes:
IUR - Inhalation Unit Risk
NAp - Not Applicable
NAv - Not Available
Daily intakes and Slope Factors applicable to ingestion and dermal contact pathways are expressed in units of mg/kg/day.
Daily intakes and IURs applicable to inhalation pathways are expressed in units of mg/m^3.

Table 6-31
Hazard Index Estimates for
Future Worker Scenario
OB/OD RI Report
Fort Riley, Kansas

Chemical	Daily Intake	RfD/RfC	Hazard Quotient	Pathway Hazard Index	Total Hazard Index
Exposure Pathway: Inhalation of Outdoor Vapors					
Volatile Organic Compounds					
Naphthalene	2.17E-009	3E-003	0.000001		
1,1,2,2-Tetrachloroethane	9.06E-006	NAv	NAp		
Trichloroethene	2.51E-003	2E-003	1		
Semivolatile Organic Compounds					
Benzo(a)pyrene	0.00E+000	NAv	NAp		
Bis(2-ethylhexyl)phthalate	0.00E+000	NAv	NAp		
				1	
Exposure Pathway: Dermal Contact with Surface Water					
Volatile Organic Compounds					
1,1,2,2-Tetrachloroethane	1.79E-005	2E-002	0.001		
Trichloroethene	1.58E-004	5E-004	0.3		
Semivolatile Organic Compounds					
Benzo(a)pyrene	2.13E-004	NAv	NAp		
				0.3	
Exposure Pathway: Inhalation of Vapors from Surface Water					
Volatile Organic Compounds					
1,1,2,2-Tetrachloroethane	5.84E-007	NAv	NAp		
Trichloroethene	6.16E-006	2E-003	0.0007		
Semivolatile Organic Compounds					
Benzo(a)pyrene	1.00E-010	NAv	NAp		
				0.0007	
Exposure Pathway: Ingestion of Groundwater					
Volatile Organic Compounds					
Naphthalene	4.89E-005	2E-002	0.002		
1,1,2,2-Tetrachloroethane	8.81E-004	2E-002	0.04		
Trichloroethene	5.09E-003	5E-004	10		
Semivolatile Organic Compounds					
Benzo(a)pyrene	1.49E-005	NAv	NAp		
Bis(2-ethylhexyl)phthalate	4.70E-004	2E-002	0.02		
				10	
Exposure Pathway: Dermal Contact with Groundwater					
Volatile Organic Compounds					
Naphthalene	1.4E-005	2E-002	0.0007		
1,1,2,2-Tetrachloroethane	3.8E-005	2E-002	0.002		
Trichloroethene	3.4E-004	5E-004	0.7		
Semivolatile Organic Compounds					
Benzo(a)pyrene	1.1E-004	NAv	NAp		
Bis(2-ethylhexyl)phthalate	0.0E+000	2E-002	NAp		
				0.7	
Exposure Pathway: Inhalation of Vapors from Groundwater Use					
Volatile Organic Compounds					
Naphthalene	7.1E-007	3E-003	0.0002		
1,1,2,2-Tetrachloroethane	2.3E-004	NAv	NAp		
Trichloroethene	7.7E-003	2E-003	4		
Semivolatile Organic Compounds					
Benzo(a)pyrene	6.6E-008	NAv	NAp		
Bis(2-ethylhexyl)phthalate	6.6E-005	NAv	NAp		
				4	
					16

Notes:
NAp - Not Applicable
NAv - Not Available
RfC - Reference Concentration
RfD - Reference Dose
Daily intakes and RfDs applicable to ingestion and dermal contact pathways are expressed in units of mg/kg/day.
Daily intakes and RfDs applicable to inhalation pathways are expressed in units of mg/m³.

Table 6-32
Excess Lifetime Cancer Risk Estimate for
Future Worker Scenario
OB/OD RI Report
Fort Riley, Kansas

Chemical	Daily Intake	Slope Factor/ IUR	Excess Cancer Risk	Pathway Cancer Risk	Total Cancer Risk
Exposure Pathway: Inhalation of Outdoor Vapors					
Volatile Organic Compounds					
Naphthalene	8E-010	3E-002	3E-011		
1,1,2,2-Tetrachloroethane	3E-006	6E-002	2E-007		
Trichloroethene	9E-004	4E-003	4E-006		
Semivolatile Organic Compounds					
Benzo(a)pyrene	0E+000	1E+000	0E+000		
Bis(2-ethylhexyl)phthalate	0E+000	2E-003	0E+000		
				4E-006	
Exposure Pathway: Dermal Contact with Surface Water					
Volatile Organic Compounds					
1,1,2,2-Tetrachloroethane	6E-006	2E-001	1E-006		
Trichloroethene	6E-005	5E-002	3E-006		
Semivolatile Organic Compounds					
Benzo(a)pyrene	8E-005	7E+000	6E-004		
				6E-004	
Exposure Pathway: Inhalation of Vapors from Surface Water					
Volatile Organic Compounds					
1,1,2,2-Tetrachloroethane	5E-008	6E-002	3E-009		
Trichloroethene	5E-007	4E-003	2E-009		
Semivolatile Organic Compounds					
Benzo(a)pyrene	8E-012	1E+000	9E-012		
				5E-009	
Exposure Pathway: Ingestion of Groundwater					
Volatile Organic Compounds					
Naphthalene	1.7E-005	NAv	NAp		
1,1,2,2-Tetrachloroethane	3.1E-004	2E-001	6E-005		
Trichloroethene	1.8E-003	5E-002	8E-005		
Semivolatile Organic Compounds					
Benzo(a)pyrene	5.3E-006	7E+000	4E-005		
Bis(2-ethylhexyl)phthalate	1.7E-004	1E-002	2E-006		
				2E-004	
Exposure Pathway: Dermal Contact with Groundwater					
Volatile Organic Compounds					
Naphthalene	4.8E-006	NAv	NAp		
1,1,2,2-Tetrachloroethane	1.4E-005	2E-001	3E-006		
Trichloroethene	1.2E-004	5E-002	6E-006		
Semivolatile Organic Compounds					
Benzo(a)pyrene	3.9E-005	7E+000	3E-004		
Bis(2-ethylhexyl)phthalate	0.0E+000	1E-002	0E+000		
				3E-004	
Exposure Pathway: Inhalation of Vapors from Groundwater Use					
Volatile Organic Compounds					
Naphthalene	2.5E-007	3E-002	9E-009		
1,1,2,2-Tetrachloroethane	8.3E-005	6E-002	5E-006		
Trichloroethene	2.8E-003	4E-003	1E-005		
Semivolatile Organic Compounds					
Benzo(a)pyrene	2.4E-008	1E+000	3E-008		
Bis(2-ethylhexyl)phthalate	2.3E-005	2E-003	6E-008		
				2E-005	
					1E-003

Notes:
IUR - Inhalation Unit Risk
NAp - Not Applicable
NAv - Not Available
Daily intakes and Slope Factors applicable to ingestion and dermal contact pathways are expressed in units of mg/kg/day.
Daily intakes and IURs applicable to inhalation pathways are expressed in units of mg/m^3.

Table 6-33
Hazard Index Estimates for
Current/Future Demolition Worker Scenario
OB/OD RI Report
Fort Riley, Kansas

Chemical	Daily Intake	RfD/RfC	Hazard Quotient	Pathway Hazard Index	Total Hazard Index
Exposure Pathway: Incidental Ingestion of Soil					
Volatile Organic Compounds					
Trichloroethene	1.4E-004	5E-004	0.3		
				0.3	
Exposure Pathway: Dermal Contact with Soil					
Volatile Organic Compounds					
Trichloroethene	0.0E+000	5E-004	NAp		
				NAp	
Exposure Pathway: Inhalation of Fugitive Dust					
Volatile Organic Compounds					
Trichloroethene	7.5E-009	2E-003	0.000004		
				0.000004	
Exposure Pathway: Inhalation of Outdoor Vapors					
Volatile Organic Compounds					
Naphthalene	2.3E-009	3E-003	0.000001		
1,1,2,2-Tetrachloroethane	5.9E-005	NAv	NAp		
Trichloroethene	3.5E-002	2E-003	17		
Semivolatile Organic Compounds					
Benzo(a)pyrene	0.0E+000	NAv	NAp		
Bis(2-ethylhexyl)phthalate	0.0E+000	NAv	NAp		
				17	
Exposure Pathway: Dermal Contact with Surface Water					
Volatile Organic Compounds					
1,1,2,2-Tetrachloroethane	1.9E-005	2E-002	0.001		
Trichloroethene	1.7E-004	5E-004	0.3		
Semivolatile Organic Compounds					
Benzo(a)pyrene	2.2E-004	NAv	NAp		
				0.3	
Exposure Pathway: Inhalation of Vapors from Surface Water					
Volatile Organic Compounds					
1,1,2,2-Tetrachloroethane	1.4E-007	NAv	NAp		
Trichloroethene	1.5E-006	2E-003	0.0007		
Semivolatile Organic Compounds					
Benzo(a)pyrene	2.4E-011	NAv	NAp		
				0.0007	
Exposure Pathway: Ingestion of Groundwater					
Volatile Organic Compounds					
Naphthalene	5.1E-005	2E-002	0.003		
1,1,2,2-Tetrachloroethane	9.2E-004	2E-002	0.05		
Trichloroethene	5.3E-003	5E-004	11		
Semivolatile Organic Compounds					
Benzo(a)pyrene	1.6E-005	NAv	NAp		
Bis(2-ethylhexyl)phthalate	4.9E-004	2E-002	0.02		
				11	
Exposure Pathway: Dermal Contact with Groundwater					
Volatile Organic Compounds					
Naphthalene	1.4E-005	2E-002	0.001		
1,1,2,2-Tetrachloroethane	3.9E-005	2E-002	0.002		
Trichloroethene	3.5E-004	5E-004	0.7		
Semivolatile Organic Compounds					
Benzo(a)pyrene	1.2E-004	NAv	NAp		
Bis(2-ethylhexyl)phthalate	0.0E+000	2E-002	NAp		
				0.7	
					30

Notes:
NAp - Not Applicable
NAv - Not Available
RfC - Reference Concentration
RfD - Reference Dose
Daily intakes and RfDs applicable to ingestion and dermal contact pathways are expressed in units of mg/kg/day.
Daily intakes and RfDs applicable to inhalation pathways are expressed in units of mg/m^3.

Table 6-34
Excess Lifetime Cancer Risk Estimate for Current/Future Demolition Worker Scenario
OB/OD RI Report
Fort Riley, Kansas

Chemical	Daily Intake	Slope Factor/ IUR	Excess Cancer Risk	Pathway Cancer Risk	Total Cancer Risk
Exposure Pathway: Incidental Ingestion of Soil					
Volatile Organic Compounds					
Trichloroethene	9.2E-007	5E-002	4E-008		
				4E-008	
Exposure Pathway: Dermal Contact with Soil					
Volatile Organic Compounds					
Trichloroethene	0.0E+000	5E-002	NAp		
				NAp	
Exposure Pathway: Inhalation of Fugitive Dust					
Volatile Organic Compounds					
Trichloroethene	5.0E-011	4E-003	2E-013		
				2E-013	
Exposure Pathway: Inhalation of Outdoor Vapors					
Volatile Organic Compounds					
Naphthalene	1.5E-011	3E-002	5E-013		
1,1,2,2-Tetrachloroethane	3.9E-007	6E-002	2E-008		
Trichloroethene	2.3E-004	4E-003	9E-007		
Semivolatile Organic Compounds					
Benzo(a)pyrene	0.0E+000	1E+000	0E+000		
Bis(2-ethylhexyl)phthalate	0.0E+000	2E-003	0E+000		
				1E-006	
Exposure Pathway: Dermal Contact with Surface Water					
Volatile Organic Compounds					
1,1,2,2-Tetrachloroethane	1.2E-007	2E-001	2E-008		
Trichloroethene	1.1E-006	5E-002	5E-008		
Semivolatile Organic Compounds					
Benzo(a)pyrene	1.5E-006	7E+000	1E-005		
				1E-005	
Exposure Pathway: Inhalation of Vapors from Surface Water					
Volatile Organic Compounds					
1,1,2,2-Tetrachloroethane	9.1E-010	6E-002	5E-011		
Trichloroethene	9.6E-009	4E-003	4E-011		
Semivolatile Organic Compounds					
Benzo(a)pyrene	1.6E-013	1E+000	2E-013		
				9E-011	
Exposure Pathway: Ingestion of Groundwater					
Volatile Organic Compounds					
Naphthalene	3.4E-007	NAv	NAp		
1,1,2,2-Tetrachloroethane	6.0E-006	2E-001	1E-006		
Trichloroethene	3.5E-005	5E-002	2E-006		
Semivolatile Organic Compounds					
Benzo(a)pyrene	1.0E-007	7E+000	7E-007		
Bis(2-ethylhexyl)phthalate	3.2E-006	1E-002	5E-008		
				4E-006	
Exposure Pathway: Dermal Contact with Groundwater					
Inorganic Compounds					
Naphthalene	9.3E-008	NAv	NAp		
1,1,2,2-Tetrachloroethane	2.6E-007	2E-001	5E-008		
Trichloroethene	2.3E-006	5E-002	1E-007		
Semivolatile Organic Compounds					
Benzo(a)pyrene	7.6E-007	7E+000	6E-006		
Bis(2-ethylhexyl)phthalate	0.0E+000	1E-002	0E+000		
				6E-006	
					2E-005

Notes:

IUR - Inhalation Unit Risk

NAp - Not Applicable

NAv - Not Available

Daily intakes and Slope Factors applicable to ingestion and dermal contact pathways are expressed in units of mg/kg/day.

Daily intakes and IURs applicable to inhalation pathways are expressed in units of mg/m³.

Table 6-35
Summary of Risk Results
OB/OD RI Report
Fort Riley, Kansas

Population	Noncancer	Cancer
Current Site Worker		
Inhalation of Outdoor Vapors	**1**	**4E-06**
Dermal Contact with Surface Water	0.3	**6E-04**
Inhalation of Vapors from Surface Water	0.0007	5E-09
Total	**1.3**	**6E-04**
Future Site Worker		
Inhalation of Outdoor Vapors	**1**	**4E-06**
Dermal Contact with Surface Water	0.3	**6E-04**
Inhalation of Vapors from Surface Water	0.0007	5E-09
Ingestion of Groundwater	**10**	**2E-04**
Dermal Contact with Groundwater	0.7	**3E-04**
Inhalation of Vapors from Groundwater Use	**4**	**2E-05**
Total	**16**	**1E-03**
Current/Future Demolition Worker		
Incidental Ingestion of Shallow and Subsurface Soil	0.3	4E-08
Dermal Contact with Shallow and Subsurface Soil	NAp	NAp
Inhalation of Fugitive Dust	0.000004	2E-13
Inhalation of Outdoor Vapors	**17**	**1E-06**
Dermal Contact with Surface Water	0.3	**1E-05**
Inhalation of Vapors from Surface Water	0.0007	9E-11
Ingestion of Groundwater	**11**	**4E-06**
Dermal Contact with Groundwater	0.7	**6E-06**
Total	**30**	**2E-05**

Table 7-1
Ecology
Surface Soil Detections
OB/OD RI Report
Fort Riley, Kansas

Parameter	Units	Screening Level[A]	Maximum Detected Result
Volatile Organic Compounds			
1,1,1,2-Tetrachloroethane	µg/kg	225,000	2
1,1,2,2-Tetrachloroethane	µg/kg	127	3,100
1,1,2-Trichloroethane	µg/kg	28,600	3.7
1,2,4-Trimethylbenzene	µg/kg	Not Available	0.83
1,3-Dichlorobenzene	µg/kg	37,700	0.42
Acetone	µg/kg	2,500	7.3
Bromochloromethane	µg/kg	540	10
Chlorobenzene	µg/kg	13,100	2
cis-1,2-Dichloroethene	µg/kg	200[B]	160
Isopropylbenzene	µg/kg	Not Available	1.4
p-Isopropyltoluene	µg/kg	Not Available	16
sec-Butylbenzene	µg/kg	Not Available	2.7
tert-Butylbenzene	µg/kg	Not Available	1.1
Tetrachloroethene	µg/kg	9,920	140
Toluene	µg/kg	5,450	2.4
trans-1,2-Dichloroethene	µg/kg	784	35
Trichloroethene	µg/kg	12,400	1,700
Semivolatile Organic Compounds			
2,4-Dinitrotoluene	µg/kg	1,280	37,000
2,6-Dinitrotoluene	µg/kg	32.8	2,800
Di-n-butyl phthalate	µg/kg	150	29,000
N-Nitrosodiphenylamine	µg/kg	545	1,700
Perchlorate			
Perchlorate	µg/kg	Not Available	25
Explosives			
2,4,6-Trinitrotoluene	mg/kg	16[C]	1.1
2,4-Dinitrotoluene	mg/kg	1.28	32
2,6-Dinitrotoluene	mg/kg	0.0328	0.71
4-Amino-2,6-dinitrotoluene	mg/kg	Not Available	0.16
4-Nitrotoluene	mg/kg	Not Available	0.024
HMX	mg/kg	600[C]	0.59
Nitroglycerin	mg/kg	Not Available	26
RDX	mg/kg	99[C]	1.9
Metals			
Antimony	mg/kg	0.27	6.2
Arsenic	mg/kg	18	9.2
Beryllium	mg/kg	21	1.7
Cadmium	mg/kg	0.36	16.8
Chromium	mg/kg	26	51.1
Copper	mg/kg	28	207
Lead	mg/kg	11	231
Mercury	mg/kg	0.1	0.036
Nickel	mg/kg	38	55.6
Selenium	mg/kg	0.52	1.1
Silver	mg/kg	4.2	0.31
Thallium	mg/kg	0.0569	0.5
Zinc	mg/kg	46	899

Notes:

[A] U.S. EPA, Region 7, Ecological Screeing Levels

[B] Savannah River National Laboratory Ecological Screening Values for Surface Water, Sediment, and Soil: 2005 Update

[C] Kuperman et. al. (2006)

Highlighted = Concentration exceeds screening level

mg/kg = milligrams per kilogram

µg/kg = micrograms per kilogram

Table 7-2
Ecology
Subsurface Soil Detections
OB/OD RI Report
Fort Riley, Kansas

Parameter	Units	Screening Level[A]	Maximum Detected Result
Volatile Organic Compounds			
1,1,2,2-Tetrachloroethane	µg/kg	127	3,200
1,1,2-Trichloroethane	µg/kg	28,600	270
Acetone	µg/kg	2,500	12
Bromochloromethane	µg/kg	540	100
Chloroform	µg/kg	1,190	300
cis-1,2-Dichloroethene	µg/kg	200[B]	2,600
Methylene chloride	µg/kg	4,050	110
Styrene	µg/kg	4,690	72
Tetrachloroethene	µg/kg	9,920	600
Toluene	µg/kg	5,450	190
trans-1,2-Dichloroethene	µg/kg	784	700
Trichloroethene	µg/kg	12,400	181,000
Semivolatile Organic Compounds			
	µg/kg		ND
Perchlorate			
Perchlorate	µg/kg	Not Available	800
Explosives			
HMX	mg/kg	600[C]	0.035
Metals			
Antimony	mg/kg	0.27	1.2
Arsenic	mg/kg	18	8.7
Beryllium	mg/kg	21	1.5
Cadmium	mg/kg	0.38	2.4
Chromium	mg/kg	26	40.3
Copper	mg/kg	28	61.1
Lead	mg/kg	11	44.2
Mercury	mg/kg	0.1	0.054
Nickel	mg/kg	38	41.1
Selenium	mg/kg	0.52	0.84
Silver	mg/kg	4.2	0.25
Thallium	mg/kg	0.0569	0.39
Zinc	mg/kg	46	113

Notes:

[A] U.S. EPA, Region 5, RCRA Ecological Screeing Levels (August 22, 2003)

[B] Savannah River National Laboratory Ecological Screening Values for Surface Water, Sediment, and Soil: 2005 Update

[C] Kuperman et. al. (2006)

Highlighted = Concentration exceeds screening level

mg/kg = milligrams per kilogram

ND = Not Detected

µg/kg = micrograms per kilogram

Table 7-3
Ecology
Surface Water Detections
OBOD RI Report
Fort Riley, Kansas

Parameter	Units	Screening Level[1]	Maximum Detected Result
Volatile Organic Compounds			
1,1,2,2-Tetrachloroethane	µg/L	380	16
2-Butanone (MEK)	µg/L	2,200	0.38
Acetone	µg/L	1,700	3.1
cis-1,2-Dichloroethene	µg/L	970	1.4
m-Xylene & p-Xylene	µg/L	27	0.2
Tetrachloroethene	µg/L	45	1.8
trans-1,2-Dichloroethene	µg/L	970	0.19
Trichloroethene	µg/L	47	91
Semivolatile Organic Compounds			
Benzo(a)pyrene	µg/L	0.014	1.1
bis(2-Ethylhexyl) phthalate	µg/L	0.3	1.3
Perchlorate			
Perchlorate	µg/L	Not Available	29
Explosives			
4-Amino-2,6-dinitrotoluene	µg/L	81	0.75
Metals			
Beryllium	µg/L	3.6	0.2
Copper	µg/L	1.58	5.4
Lead	µg/L	1.17	3.1
Mercury	mg/L	0.0000013	0.00032
Nickel	µg/L	28.9	2.1
Selenium	µg/L	5	2.9
Zinc	µg/L	65.7	4.9

Notes:

[1] The source of screening levels is U.S. EPA, Region 5, RCRA Ecological Screening Levels (August 22, 2003)

Highlighted = Concentration exceeds screening level

mg/L = milligrams per liter

µg/L = micrograms per liter

Table 7-4
Ecology
Sediment Sample Detections
OB/OD RI Report
Fort Riley, Kansas

Parameter	Units	Screening Level	Maximum Detected Result
Volatile Organic Compounds			
Tetrachloroethene	µg/kg	990[A]	0.9
Toluene	µg/kg	1220[A]	1.6
Semivolatile Organic Compounds			
	µg/kg		ND
Perchlorate			
	µg/kg		ND
Explosives			
	mg/kg		ND
Metals			
Antimony	mg/kg	2[B]	0.31
Arsenic	mg/kg	9.79[A]	7.7
Beryllium	mg/kg	1.1[B]	1.5
Cadmium	mg/kg	0.99[A]	1.5
Chromium	mg/kg	43.4[A]	40
Copper	mg/kg	31.6[A]	35.4
Lead	mg/kg	35.8[A]	28.1
Mercury	mg/kg	0.174[A]	0.032
Nickel	mg/kg	22.7[A]	42.3
Selenium	mg/kg	0.7[B]	0.87
Silver	mg/kg	0.5[A]	0.15
Thallium	mg/kg	1[B]	0.33
Zinc	mg/kg	121[A]	66.4

Notes:

[A] U.S. EPA, Region 5, RCRA Ecological Screening Levels (August 22, 2003)

[B] Savannah River National Laboratory Ecological Screening Values for Surface Water, Sediment, and Soil: 2005 Update

Highlighted = Concentration exceeds screening level

mg/kg = milligrams per kilogram

ND = Not Detected

µg/kg = micrograms per kilogram

Table 7-5
Body Mass and Food, Water, and Soil or Sediment Consumption Rates for Representative Wildlife Species
OB/OD RI Report
Fort Riley, Kansas

Representative Wildlife Species	Body Mass (kg)[a]	Food Intake (kg/day)[a]	Water Intake (L/day)[a]	Estimated Soil or Sediment Intake (kg/day)[b]
Short-tailed Shrew	1.50E-02	9.00E-03	3.30E-03	1.17E-03
White-footed Mouse	2.20E-02	3.40E-03	6.60E-03	6.80E-05
Meadow Vole	4.40E-02	5.00E-03	6.00E-03	1.20E-04[c]
Eastern Cottontail Rabbit	1.20E+00	2.37E-01	1.16E-01	1.49E-02[c]
Red Fox	4.50E+00	4.50E-01	3.80E-01	1.26E-02
Raccoon	5.20E+00[d]	2.37E-01[e]	3.83E-01[f]	2.22E-02[g]
White-tailed Deer	5.65E+01	1.74E+00	3.70E+00	3.50E-02
American Robin	7.70E-02	9.30E-02	1.06E-02	8.74E-03[h]
Red-tailed Hawk	1.13E+00	1.09E-01	6.40E-02	3.05E-03[i]

Notes:

[a]Based on reported body weights and food and water consumption rates for selected avian and mammalian wildlife species from ORNL (1996a) unless noted otherwise

[b]Based on reported soil ingestion rates from Efroymson et al. (1997a) unless noted otherwise

[c]Estimated fraction of soil or sediment in diet as reported in USEPA (1993) -- The fraction of soil in diet for the jackrabbit was substituted for the cottontail rabbit

[d] Minimum adult body mass reported in Mammals of Kansas (http://kufs.ku.edu/libres/Mammals_of_Kansas/list.html#procy; accessed May 3, 2013)

[e] Based on Food Intake (Kg/day) = 0.0687(Body Mass in Kilograms)$^{0.822}$ (ORNL 1996a and USEPA 1993)

[f] Based on Water Intake (L/day) = 0.099(Body Mass in Kilograms)$^{0.90}$ (ORNL 1996a and USEPA 1993)

[g] Assumes 9.4% of diet is sediment or soil as reported in USEPA (1993).

[h] Food Ingestion Rate x Percent of Soil in Diet (9.4) as reported in Beyer et al. (1994)

[i] Percent of soils comprising diet (2.8%) is assumed to be the same as for the Red Fox.

kg - kilograms

kg/day - kilograms per day

L/day - liters per day

Table 7-6
Assumed Percent Composition of Diet for Representative Wildlife Species
OB/OD RI Report
Fort Riley, Kansas

Representative Wildlife Species	Benthic Invertebrates	Aquatic Invertebrates	Soil Invertebrates (Earthworms)	Aquatic Plants	Terrestrial Plants	Fish	Small Mammal	Representing Cast
Short-tailed Shrew	0%	0%	100%	0%	0%	0%	0%	Insectivore
White-footed Mouse	0%	0%	0%	0%	100%	0%	0%	Herbivore
Meadow Vole	0%	0%	50%	0%	50%	0%	0%	Omnivore
Eastern Cottontail Rabbit	0%	0%	0%	0%	100%	0%	0%	Herbivore
Red Fox	0%	0%	0%	0%	0%	0%	100%	Carnivore
Raccoon	20%	0%	20%	0%	20%	20%	20%	Omnivore
White-tailed Deer	0%	0%	0%	0%	100%	0%	0%	Herbivore
American Robin	0%	0%	80%	0%	20%	0%	0%	Omnivore
Red-tailed Hawk	0%	0%	0%	0%	0%	0%	100%	Carnivore

Table 7-7

Home Range and Percent of Home Range Within Areas Evaluated for Representative Wildlife Species
OB/OD RI Report
Fort Riley, Kansas

Representative Wildlife Species	Home Range (acres)[a]	Percent of Home Range Within the 70-Acre OB/OD Site
Short-tailed Shrew	0.05	100
White-footed Mouse	0.05	100
Meadow Vole	0.05	100
Eastern Cottontail Rabbit	1	100
Red Fox	150	46.7
Raccoon	480	14.6
White-tailed Deer	320	21.9
American Robin	2	100
Red-tailed Hawk	940	7.4

Notes:

[a]Based on most conservative estimates of home range sizes as reported in Schwartz and Schwartz (1981) and USEPA (1993).

Table 7-8
Earthworms Evaluation Based on Maximum Surface Soil Detections
OB/OD RI Report
Fort Riley, Kansas

Parameter	Maximum Concentration Detected in Soil (mg/kg)	Earthworm Lowest Observable Effects Concentration (mg/kg)	Hazard Quotient	Refined COPECs for Soil Invertebrates
1,1,2,2-Tetrachloroethane	3.10E+00	None Reported	NA	NA
1,2,4-Trimethylbenzene	8.30E-04	None Reported	NA	NA
Isopropylbenzene	1.40E-03	None Reported	NA	NA
p-Isopropyltoluene	1.60E-02	None Reported	NA	NA
sec-Butylbenzene	2.70E-03	None Reported	NA	NA
tert-Butylbenzene	1.10E-03	None Reported	NA	NA
2,4-Dinitrotoluene	3.70E+01	40.9[a]	9.05E-01	HQ<1
2,6-Dinitrotoluene	2.80E+00	10[a]	2.80E-01	HQ<1
Di-n-butyl phthalate	2.90E+01	None Reported	NA	NA
N-Nitrosodiphenylamine	1.70E+00	1400[a]	1.21E-03	HQ<1
Perchlorate	2.50E-02	None Reported	NA	NA
4-Amino-2,6-dinitrotoluene	1.60E-01	None Reported	NA	NA
4-Nitrotoluene	2.40E-02	None Reported	NA	NA
Nitroglycerin	2.60E+01	None Reported	NA	NA
Antimony	6.20E+00	86[a]	7.21E-02	HQ<1
Arsenic	9.20E+00	200[a]	4.60E-02	HQ<1
Cadmium	1.68E+01	18[b]	9.33E-01	HQ<1
Chromium	5.11E+01	100[a]	5.11E-01	HQ<1
Copper	2.07E+02	455[a]	4.55E-01	HQ<1
Lead	2.31E+02	500[b]	4.62E-01	HQ<1
Mercury	3.60E-02	220[a]	1.64E-04	HQ<1
Nickel	5.56E+01	200[b]	2.78E-01	HQ<1
Selenium	1.10E+00	77[b]	1.43E-02	HQ<1
Thallium	5.00E-01	None Reported	NA	NA
Zinc	8.99E+02	1300[a]	6.92E-01	HQ<1
		EHI	**4.6E+00**	

Notes:

EHI - Ecological Hazard Index

mg/kg - milligrams per kilogram

NA - Not Analyzed

[a] USEPA ECOTOX Database (http://cfpub.epa.gov/ecotox/)

Table 7-9
Benthic Invertebrate Evaluation Based on MaximumSediment Detections
OB/OD RI Report
Fort Riley, Kansas

Parameter	Maximum Concentration Detected in Sediment (mg/kg)	Threshold Effect Concentration Benchmark for Freshwater Sediment[a] (mg/kg)	Hazard Quotient	Refined COPECs for Benthic Invertebrates
Antimony	3.10E-01	None Reported	NA	NA
Arsenic	7.70E+00	1.21E+01	6.36E-01	HQ<1
Beryllium	1.50E+00	None Reported	NA	NA
Cadmium	1.50E+00	5.92E-01	2.53E+00	Yes
Chromium	4.00E+01	5.60E+01	7.14E-01	HQ<1
Copper	3.54E+01	2.80E+01	1.26E+00	Yes
Lead	2.81E+01	3.42E+01	8.22E-01	HQ<1
Mercury	3.20E-02	2.00E-01	1.60E-01	HQ<1
Nickel	4.23E+01	3.96E+01	1.07E+00	Yes
Selenium	8.70E-01	None Reported	NA	NA
Zinc	6.64E+01	1.59E+02	4.18E-01	HQ<1
		EHI	**7.6E+00**	

Notes:

EHI - Ecological Hazard Index

mg/kg - milligrams per kilogram

NA - Not Analyzed

[a] Jones et. al., 1997 ES/ER/TM-95/R4

Table 7-10
Terrestrial Plant Evaluation Based on Maximum Surface Soil Detections
OB/OD RI Report
Fort Riley, Kansas

Parameter	Maximum Concentration Detected in Surface Soils (mg/kg)	Plant Lowest Observed Effect Concentration (mg/kg)	Hazard Quotient	Refined COPECs for Terrestiral Plants
1,1,2,2-Tetrachloroethane	3.10E+00	0.014[b]	2.21E+02	Yes
1,2,4-Trimethylbenzene	8.30E-04	None Reported	NA	NA
Isopropylbenzene	1.40E-03	None Reported	NA	NA
p-Isopropyltoluene	1.60E-02	140[b]	1.14E-04	HQ<1
sec-Butylbenzene	2.70E-03	None Reported	NA	NA
tert-Butylbenzene	1.10E-03	None Reported	NA	NA
2,4-Dinitrotoluene	3.70E+01	4[b]	9.25E+00	Yes
2,6-Dinitrotoluene	2.80E+00	4[b]	7.00E-01	HQ<1
Di-n-butyl phthalate	2.90E+01	200[a]	1.45E-01	HQ<1
N-Nitrosodiphenylamine	1.70E+00	None Reported	NA	NA
Perchlorate	2.50E-02	100[b]	2.50E-04	HQ<1
4-Amino-2,6-dinitrotoluene	1.60E-01	None Reported	NA	NA
4-Nitrotoluene	2.40E-02	None Reported	NA	NA
Nitroglycerin	2.60E+01	None Reported	NA	NA
Antimony	6.20E+00	5[a]	1.24E+00	Yes
Arsenic	9.20E+00	10[a]	9.20E-01	HQ<1
Cadmium	1.68E+01	2[a]	8.40E+00	Yes
Chromium	5.11E+01	1[a]	5.11E+01	Yes
Copper	2.07E+02	100[a]	2.07E+00	Yes
Lead	2.31E+02	50[a]	4.62E+00	Yes
Mercury	3.60E-02	0.3[a]	1.20E-01	HQ<1
Nickel	5.56E+01	30[a]	1.85E+00	Yes
Selenium	1.10E+00	1[a]	1.10E+00	Yes
Thallium	5.00E-01	1[a]	5.00E-01	HQ<1
Zinc	8.99E+02	50[a]	1.80E+01	Yes
		EHI	**3.2E+02**	

Notes:

EHI - Ecological Hazard Index

mg/kg - milligrams per kilogram

[a] Efroymson et al, 1997c ES/ER/TM-85/R3

[b] USEPA ECOTOX Database (http://cfpub.epa.gov/ecotox/)

Table 7-11
Terrestrial Plant Evaluation Based on Maximum Suburface Soil Detections
OB/OD RI Report
Fort Riley, Kansas

Parameter	Maximum Concentration Detected in Subsurface Soils (mg/kg)	Plant Lowest Observed Effect Concentration (mg/kg)	Hazard Quotient	Refined COPECs for Testrial Plants
1,1,2,2-Tetrachloroethane	3.20E+00	0.014[b]	2.29E+02	Yes
cis-1,2-Dichloroethene	2.60E+00	None Reported	NA	NA
Trichloroethylene	1.81E+02	1000[b]	1.81E-01	HQ<1
Perchlorate	8.00E-01	100[b]	8.00E-03	HQ<1
Antimony	1.20E+00	5[a]	2.40E-01	HQ<1
Arsenic	8.70E+00	10[a]	8.70E-01	HQ<1
Cadmium	2.40E+00	2[a]	1.20E+00	Yes
Chromium	4.03E+01	1[a]	4.03E+01	Yes
Copper	6.11E+01	100[a]	6.11E-01	HQ<1
Lead	4.42E+01	50[a]	8.84E-01	HQ<1
Mercury	5.40E-02	0.3[a]	1.80E-01	HQ<1
Nickel	4.11E+01	30[a]	1.37E+00	Yes
Selenium	8.40E-01	1[a]	8.40E-01	HQ<1
Thallium	3.90E-01	1[a]	3.90E-01	HQ<1
Zinc	1.13E+02	50[a]	2.26E+00	Yes
		EHI	**2.8E+02**	

Notes:

EHI - Ecological Hazard Index

mg/kg - milligrams per kilogram

[a] Efroymson et al, 1997c ES/ER/TM-85/R3

[b] USEPA ECOTOX Database (http://cfpub.epa.gov/ecotox/)

Table 7-12
Aquatic Plant Evaluation Based on Maximum Surface Water Detections
OB/OD RI Report
Fort Riley, Kansas

Parameter	Maximum Concentration Detected in Surface Water (mg/L)	Lowest Chronic Value for Aquatic Plants (mg/L)	Hazard Quotient	Refined COPECs for Aquatic Plants
Trichloroethene	9.10E-02	3.00E-02[a]	3.03E+00	Yes
Benzo(a)pyrene	1.10E-03	5.00E-02[b]	2.20E-02	HQ<1
bis(2-Ethylhexyl) phthalate	1.30E-03	1.00E-01[b]	1.30E-02	HQ<1
Perchlorate	2.90E-02	None Reported	NA	NA
Copper	5.40E-03	1.00E-03[a]	5.40E+00	Yes
Lead	3.10E-03	5.00E-01[a]	6.20E-03	HQ<1
Mercury	3.20E-04	5.00E-03[a]	6.40E-02	HQ<1
Nickel	2.10E-03	5.00E-03[a]	4.20E-01	HQ<1
Selenium	2.90E-03	1.00E-01[a]	2.90E-02	HQ<1
Zinc	4.90E-03	3.00E-02[a]	1.63E-01	HQ<1
		EHI	**9.2E+00**	

Notes:

EHI - Ecological Hazard Index

mg/L - milligrams per liter

NA - Not Analyzed

[a] ORNL, 1996a ES/ER/TM-96/R2

[b] USEPA ECOTOX Database (http://cfpub.epa.gov/ecotox/)

Table 7-13
Aquatic Invertebrate Evaluation Based on Maximum Surface Water Detections
OB/OD RI Report
Fort Riley, Kansas

Parameter	Maximum Concentration Detected in Surface Water (mg/L)	Lowest Chronic Value for Daphnids (mg/L)[a]	Hazard Quotient	Refined COPECs for Aquatic Invertebrates
Trichloroethene	9.10E-02	7.26E+00	1.25E-02	HQ<1
Benzo(a)pyrene	1.10E-03	3.00E-04	3.67E+00	Yes
bis(2-Ethylhexyl) phthalate	1.30E-03	9.12E-01	1.43E-03	HQ<1
Perchlorate	2.90E-02	None Reported	NA	NA
Copper	5.40E-03	2.30E-04	2.35E+01	Yes
Lead	3.10E-03	1.23E-02	2.53E-01	HQ<1
Mercury	3.20E-04	9.60E-04	3.33E-01	HQ<1
Nickel	2.10E-03	5.00E-03	4.20E-01	HQ<1
Selenium	2.90E-03	9.17E-02	3.16E-02	HQ<1
Zinc	4.90E-03	3.00E-02	1.63E-01	HQ<1
		EHI	**2.8E+01**	

Notes:

EHI - Ecological Hazard Index

mg/L - milligrams per liter

NA - Not Analyzed

[a] ORNL, 1996a ES/ER/TM-96/R2

Table 7-14

Fish Evaluation Based on Maximum Surface Water Detections
OB/OD RI Report
Fort Riley, Kansas

Parameter	Maximum Concentration Detected in Surface Water (mg/L)	Lowest Chronic Value for Fish (mg/L)[a]	Hazard Quotient	Refined COPECs for Fish
Trichloroethene	9.10E-02	1.11E+01	8.20E-03	HQ<1
Benzo(a)pyrene	1.10E-03	3.00E-01	3.67E-03	HQ<1
bis(2-Ethylhexyl) phthalate	1.30E-03	9.12E+02	1.43E-06	HQ<1
Perchlorate	2.90E-02	None Reported	NA	NA
Copper	5.40E-03	3.80E-03	1.42E+00	Yes
Lead	3.10E-03	1.89E-02	1.64E-01	HQ<1
Mercury	3.20E-04	2.30E-04	1.39E+00	Yes
Nickel	2.10E-03	3.50E-02	6.00E-02	HQ<1
Selenium	2.90E-03	8.83E-02	3.28E-02	HQ<1
Zinc	4.90E-03	3.64E-02	1.35E-01	HQ<1
		EHI	**3.2E+00**	

Notes:

EHI - Ecological Hazard Index

mg/L - milligrams per liter

NA - Not Analyzed

[a] ORNL, 1996a ES/ER/TM-96/R2

Toxicity data for the water flea (lowest chronic values) was used as a surrogate for Benzo(a)pyrene and bis(2-Ethylhexyl) phthalate, which lacked available toxicity data for fish.

Table 7-15

Chemical Intake for Representative Wildlife Species Based on Incidental Surface Soil Ingestion
OB/OD RI Report
Fort Riley, Kansas

Parameter	Maximum Concentration Detected in Soil (mg/kg)	Representative Wildlife Species	Consumption Rate of Soil (kg/day)	Dose Received from Soil (mg/day)
1,1,2,2-Tetrachloroethane	3.10E+00	Short-tailed Shrew	1.17E-03	3.63E-03
1,2,4-Trimethylbenzene	8.30E-04	Short-tailed Shrew	1.17E-03	9.71E-07
Isopropylbenzene	1.40E-03	Short-tailed Shrew	1.17E-03	1.64E-06
p-Isopropyltoluene	1.60E-02	Short-tailed Shrew	1.17E-03	1.87E-05
sec-Butylbenzene	2.70E-03	Short-tailed Shrew	1.17E-03	3.16E-06
tert-Butylbenzene	1.10E-03	Short-tailed Shrew	1.17E-03	1.29E-06
2,4-Dinitrotoluene	3.70E+01	Short-tailed Shrew	1.17E-03	4.33E-02
2,6-Dinitrotoluene	2.80E+00	Short-tailed Shrew	1.17E-03	3.28E-03
Di-n-butyl phthalate	2.90E+01	Short-tailed Shrew	1.17E-03	3.39E-02
N-Nitrosodiphenylamine	1.70E+00	Short-tailed Shrew	1.17E-03	1.99E-03
Perchlorate	2.50E-02	Short-tailed Shrew	1.17E-03	2.93E-05
4-Amino-2,6-dinitrotoluene	1.60E-01	Short-tailed Shrew	1.17E-03	1.87E-04
4-Nitrotoluene	2.40E-02	Short-tailed Shrew	1.17E-03	2.81E-05
Nitroglycerin	2.60E+01	Short-tailed Shrew	1.17E-03	3.04E-02
Antimony	6.20E+00	Short-tailed Shrew	1.17E-03	7.25E-03
Arsenic	9.20E+00	Short-tailed Shrew	1.17E-03	1.08E-02
Cadmium	1.68E+01	Short-tailed Shrew	1.17E-03	1.97E-02
Chromium	5.11E+01	Short-tailed Shrew	1.17E-03	5.98E-02
Copper	2.07E+02	Short-tailed Shrew	1.17E-03	2.42E-01
Lead	2.31E+02	Short-tailed Shrew	1.17E-03	2.70E-01
Mercury	3.60E-02	Short-tailed Shrew	1.17E-03	4.21E-05
Nickel	5.56E+01	Short-tailed Shrew	1.17E-03	6.51E-02
Selenium	1.10E+00	Short-tailed Shrew	1.17E-03	1.29E-03
Thallium	5.00E-01	Short-tailed Shrew	1.17E-03	5.85E-04
Zinc	8.99E+02	Short-tailed Shrew	1.17E-03	1.05E+00

Notes:
mg/kg - milligrams per kilogram
kg/day - kilograms per day
mg/day - milligrams per day

Table 7-15
Chemical Intake for Representative Wildlife Species Based on Incidental Surface Soil Ingestion
OB/OD RI Report
Fort Riley, Kansas

Parameter	Maximum Concentration Detected in Soil (mg/kg)	Representative Wildlife Species	Consumption Rate of Soil (kg/day)	Dose Received from Soil (mg/day)
1,1,2,2-Tetrachloroethane	3.10E+00	White-footed Mouse	6.80E-05	2.11E-04
1,2,4-Trimethylbenzene	8.30E-04	White-footed Mouse	6.80E-05	5.64E-08
Isopropylbenzene	1.40E-03	White-footed Mouse	6.80E-05	9.52E-08
p-Isopropyltoluene	1.60E-02	White-footed Mouse	6.80E-05	1.09E-06
sec-Butylbenzene	2.70E-03	White-footed Mouse	6.80E-05	1.84E-07
tert-Butylbenzene	1.10E-03	White-footed Mouse	6.80E-05	7.48E-08
2,4-Dinitrotoluene	3.70E+01	White-footed Mouse	6.80E-05	2.52E-03
2,6-Dinitrotoluene	2.80E+00	White-footed Mouse	6.80E-05	1.90E-04
Di-n-butyl phthalate	2.90E+01	White-footed Mouse	6.80E-05	1.97E-03
N-Nitrosodiphenylamine	1.70E+00	White-footed Mouse	6.80E-05	1.16E-04
Perchlorate	2.50E-02	White-footed Mouse	6.80E-05	1.70E-06
4-Amino-2,6-dinitrotoluene	1.60E-01	White-footed Mouse	6.80E-05	1.09E-05
4-Nitrotoluene	2.40E-02	White-footed Mouse	6.80E-05	1.63E-06
Nitroglycerin	2.60E+01	White-footed Mouse	6.80E-05	1.77E-03
Antimony	6.20E+00	White-footed Mouse	6.80E-05	4.22E-04
Arsenic	9.20E+00	White-footed Mouse	6.80E-05	6.26E-04
Cadmium	1.68E+01	White-footed Mouse	6.80E-05	1.14E-03
Chromium	5.11E+01	White-footed Mouse	6.80E-05	3.47E-03
Copper	2.07E+02	White-footed Mouse	6.80E-05	1.41E-02
Lead	2.31E+02	White-footed Mouse	6.80E-05	1.57E-02
Mercury	3.60E-02	White-footed Mouse	6.80E-05	2.45E-06
Nickel	5.56E+01	White-footed Mouse	6.80E-05	3.78E-03
Selenium	1.10E+00	White-footed Mouse	6.80E-05	7.48E-05
Thallium	5.00E-01	White-footed Mouse	6.80E-05	3.40E-05
Zinc	8.99E+02	White-footed Mouse	6.80E-05	6.11E-02

Notes:
mg/kg - milligrams per kilogram
kg/day - kilograms per day
mg/day - milligrams per day

Table 7-15

Chemical Intake for Representative Wildlife Species Based on Incidental Surface Soil Ingestion
OB/OD RI Report
Fort Riley, Kansas

Parameter	Maximum Concentration Detected in Soil (mg/kg)	Representative Wildlife Species	Consumption Rate of Soil (kg/day)	Dose Received from Soil (mg/day)
1,1,2,2-Tetrachloroethane	3.10E+00	Meadow Vole	1.20E-04	3.72E-04
1,2,4-Trimethylbenzene	8.30E-04	Meadow Vole	1.20E-04	9.96E-08
Isopropylbenzene	1.40E-03	Meadow Vole	1.20E-04	1.68E-07
p-Isopropyltoluene	1.60E-02	Meadow Vole	1.20E-04	1.92E-06
sec-Butylbenzene	2.70E-03	Meadow Vole	1.20E-04	3.24E-07
tert-Butylbenzene	1.10E-03	Meadow Vole	1.20E-04	1.32E-07
2,4-Dinitrotoluene	3.70E+01	Meadow Vole	1.20E-04	4.44E-03
2,6-Dinitrotoluene	2.80E+00	Meadow Vole	1.20E-04	3.36E-04
Di-n-butyl phthalate	2.90E+01	Meadow Vole	1.20E-04	3.48E-03
N-Nitrosodiphenylamine	1.70E+00	Meadow Vole	1.20E-04	2.04E-04
Perchlorate	2.50E-02	Meadow Vole	1.20E-04	3.00E-06
4-Amino-2,6-dinitrotoluene	1.60E-01	Meadow Vole	1.20E-04	1.92E-05
4-Nitrotoluene	2.40E-02	Meadow Vole	1.20E-04	2.88E-06
Nitroglycerin	2.60E+01	Meadow Vole	1.20E-04	3.12E-03
Antimony	6.20E+00	Meadow Vole	1.20E-04	7.44E-04
Arsenic	9.20E+00	Meadow Vole	1.20E-04	1.10E-03
Cadmium	1.68E+01	Meadow Vole	1.20E-04	2.02E-03
Chromium	5.11E+01	Meadow Vole	1.20E-04	6.13E-03
Copper	2.07E+02	Meadow Vole	1.20E-04	2.48E-02
Lead	2.31E+02	Meadow Vole	1.20E-04	2.77E-02
Mercury	3.60E-02	Meadow Vole	1.20E-04	4.32E-06
Nickel	5.56E+01	Meadow Vole	1.20E-04	6.67E-03
Selenium	1.10E+00	Meadow Vole	1.20E-04	1.32E-04
Thallium	5.00E-01	Meadow Vole	1.20E-04	6.00E-05
Zinc	8.99E+02	Meadow Vole	1.20E-04	1.08E-01

Notes:
mg/kg - milligrams per kilogram
kg/day - kilograms per day
mg/day - milligrams per day

Table 7-15

Chemical Intake for Representative Wildlife Species Based on Incidental Surface Soil Ingestion
OB/OD RI Report
Fort Riley, Kansas

Parameter	Maximum Concentration Detected in Soil (mg/kg)	Representative Wildlife Species	Consumption Rate of Soil (kg/day)	Dose Received from Soil (mg/day)
1,1,2,2-Tetrachloroethane	3.10E+00	Eastern Cottontail Rabbit	1.49E-02	4.62E-02
1,2,4-Trimethylbenzene	8.30E-04	Eastern Cottontail Rabbit	1.49E-02	1.24E-05
Isopropylbenzene	1.40E-03	Eastern Cottontail Rabbit	1.49E-02	2.09E-05
p-Isopropyltoluene	1.60E-02	Eastern Cottontail Rabbit	1.49E-02	2.38E-04
sec-Butylbenzene	2.70E-03	Eastern Cottontail Rabbit	1.49E-02	4.02E-05
tert-Butylbenzene	1.10E-03	Eastern Cottontail Rabbit	1.49E-02	1.64E-05
2,4-Dinitrotoluene	3.70E+01	Eastern Cottontail Rabbit	1.49E-02	5.51E-01
2,6-Dinitrotoluene	2.80E+00	Eastern Cottontail Rabbit	1.49E-02	4.17E-02
Di-n-butyl phthalate	2.90E+01	Eastern Cottontail Rabbit	1.49E-02	4.32E-01
N-Nitrosodiphenylamine	1.70E+00	Eastern Cottontail Rabbit	1.49E-02	2.53E-02
Perchlorate	2.50E-02	Eastern Cottontail Rabbit	1.49E-02	3.73E-04
4-Amino-2,6-dinitrotoluene	1.60E-01	Eastern Cottontail Rabbit	1.49E-02	2.38E-03
4-Nitrotoluene	2.40E-02	Eastern Cottontail Rabbit	1.49E-02	3.58E-04
Nitroglycerin	2.60E+01	Eastern Cottontail Rabbit	1.49E-02	3.87E-01
Antimony	6.20E+00	Eastern Cottontail Rabbit	1.49E-02	9.24E-02
Arsenic	9.20E+00	Eastern Cottontail Rabbit	1.49E-02	1.37E-01
Cadmium	1.68E+01	Eastern Cottontail Rabbit	1.49E-02	2.50E-01
Chromium	5.11E+01	Eastern Cottontail Rabbit	1.49E-02	7.61E-01
Copper	2.07E+02	Eastern Cottontail Rabbit	1.49E-02	3.08E+00
Lead	2.31E+02	Eastern Cottontail Rabbit	1.49E-02	3.44E+00
Mercury	3.60E-02	Eastern Cottontail Rabbit	1.49E-02	5.36E-04
Nickel	5.56E+01	Eastern Cottontail Rabbit	1.49E-02	8.28E-01
Selenium	1.10E+00	Eastern Cottontail Rabbit	1.49E-02	1.64E-02
Thallium	5.00E-01	Eastern Cottontail Rabbit	1.49E-02	7.45E-03
Zinc	8.99E+02	Eastern Cottontail Rabbit	1.49E-02	1.34E+01

Notes:

mg/kg - milligrams per kilogram

kg/day - kilograms per day

mg/day - milligrams per day

Table 7-15

Chemical Intake for Representative Wildlife Species Based on Incidental Surface Soil Ingestion
OB/OD RI Report
Fort Riley, Kansas

Parameter	Maximum Concentration Detected in Soil (mg/kg)	Representative Wildlife Species	Consumption Rate of Soil (kg/day)	Dose Received from Soil (mg/day)
1,1,2,2-Tetrachloroethane	3.10E+00	Red Fox	1.26E-02	3.91E-02
1,2,4-Trimethylbenzene	8.30E-04	Red Fox	1.26E-02	1.05E-05
Isopropylbenzene	1.40E-03	Red Fox	1.26E-02	1.76E-05
p-Isopropyltoluene	1.60E-02	Red Fox	1.26E-02	2.02E-04
sec-Butylbenzene	2.70E-03	Red Fox	1.26E-02	3.40E-05
tert-Butylbenzene	1.10E-03	Red Fox	1.26E-02	1.39E-05
2,4-Dinitrotoluene	3.70E+01	Red Fox	1.26E-02	4.66E-01
2,6-Dinitrotoluene	2.80E+00	Red Fox	1.26E-02	3.53E-02
Di-n-butyl phthalate	2.90E+01	Red Fox	1.26E-02	3.65E-01
N-Nitrosodiphenylamine	1.70E+00	Red Fox	1.26E-02	2.14E-02
Perchlorate	2.50E-02	Red Fox	1.26E-02	3.15E-04
4-Amino-2,6-dinitrotoluene	1.60E-01	Red Fox	1.26E-02	2.02E-03
4-Nitrotoluene	2.40E-02	Red Fox	1.26E-02	3.02E-04
Nitroglycerin	2.60E+01	Red Fox	1.26E-02	3.28E-01
Antimony	6.20E+00	Red Fox	1.26E-02	7.81E-02
Arsenic	9.20E+00	Red Fox	1.26E-02	1.16E-01
Cadmium	1.68E+01	Red Fox	1.26E-02	2.12E-01
Chromium	5.11E+01	Red Fox	1.26E-02	6.44E-01
Copper	2.07E+02	Red Fox	1.26E-02	2.61E+00
Lead	2.31E+02	Red Fox	1.26E-02	2.91E+00
Mercury	3.60E-02	Red Fox	1.26E-02	4.54E-04
Nickel	5.56E+01	Red Fox	1.26E-02	7.01E-01
Selenium	1.10E+00	Red Fox	1.26E-02	1.39E-02
Thallium	5.00E-01	Red Fox	1.26E-02	6.30E-03
Zinc	8.99E+02	Red Fox	1.26E-02	1.13E+01

Notes:
mg/kg - milligrams per kilogram
kg/day - kilograms per day
mg/day - milligrams per day

Table 7-15
Chemical Intake for Representative Wildlife Species Based on Incidental Surface Soil Ingestion
OB/OD RI Report
Fort Riley, Kansas

Parameter	Maximum Concentration Detected in Soil (mg/kg)	Representative Wildlife Species	Consumption Rate of Soil (kg/day)	Dose Received from Soil (mg/day)
1,1,2,2-Tetrachloroethane	3.10E+00	Raccoon	1.11E-02	3.44E-02
1,2,4-Trimethylbenzene	8.30E-04	Raccoon	1.11E-02	9.21E-06
Isopropylbenzene	1.40E-03	Raccoon	1.11E-02	1.55E-05
p-Isopropyltoluene	1.60E-02	Raccoon	1.11E-02	1.78E-04
sec-Butylbenzene	2.70E-03	Raccoon	1.11E-02	3.00E-05
tert-Butylbenzene	1.10E-03	Raccoon	1.11E-02	1.22E-05
2,4-Dinitrotoluene	3.70E+01	Raccoon	1.11E-02	4.11E-01
2,6-Dinitrotoluene	2.80E+00	Raccoon	1.11E-02	3.11E-02
Di-n-butyl phthalate	2.90E+01	Raccoon	1.11E-02	3.22E-01
N-Nitrosodiphenylamine	1.70E+00	Raccoon	1.11E-02	1.89E-02
Perchlorate	2.50E-02	Raccoon	1.11E-02	2.78E-04
4-Amino-2,6-dinitrotoluene	1.60E-01	Raccoon	1.11E-02	1.78E-03
4-Nitrotoluene	2.40E-02	Raccoon	1.11E-02	2.66E-04
Nitroglycerin	2.60E+01	Raccoon	1.11E-02	2.89E-01
Antimony	6.20E+00	Raccoon	1.11E-02	6.88E-02
Arsenic	9.20E+00	Raccoon	1.11E-02	1.02E-01
Cadmium	1.68E+01	Raccoon	1.11E-02	1.86E-01
Chromium	5.11E+01	Raccoon	1.11E-02	5.67E-01
Copper	2.07E+02	Raccoon	1.11E-02	2.30E+00
Lead	2.31E+02	Raccoon	1.11E-02	2.56E+00
Mercury	3.60E-02	Raccoon	1.11E-02	4.00E-04
Nickel	5.56E+01	Raccoon	1.11E-02	6.17E-01
Selenium	1.10E+00	Raccoon	1.11E-02	1.22E-02
Thallium	5.00E-01	Raccoon	1.11E-02	5.55E-03
Zinc	8.99E+02	Raccoon	1.11E-02	9.98E+00

Notes:

mg/kg - milligrams per kilogram

kg/day - kilograms per day

mg/day - milligrams per day

Consumption rate for raccoon takes into account that 1/2 of the raccoon's total sediment and soil intake is composed of surface soil.

Table 7-15

Chemical Intake for Representative Wildlife Species Based on Incidental Surface Soil Ingestion
OB/OD RI Report
Fort Riley, Kansas

Parameter	Maximum Concentration Detected in Soil (mg/kg)	Representative Wildlife Species	Consumption Rate of Soil (kg/day)	Dose Received from Soil (mg/day)
1,1,2,2-Tetrachloroethane	3.10E+00	White-tailed Deer	3.50E-02	1.09E-01
1,2,4-Trimethylbenzene	8.30E-04	White-tailed Deer	3.50E-02	2.91E-05
Isopropylbenzene	1.40E-03	White-tailed Deer	3.50E-02	4.90E-05
p-Isopropyltoluene	1.60E-02	White-tailed Deer	3.50E-02	5.60E-04
sec-Butylbenzene	2.70E-03	White-tailed Deer	3.50E-02	9.45E-05
tert-Butylbenzene	1.10E-03	White-tailed Deer	3.50E-02	3.85E-05
2,4-Dinitrotoluene	3.70E+01	White-tailed Deer	3.50E-02	1.30E+00
2,6-Dinitrotoluene	2.80E+00	White-tailed Deer	3.50E-02	9.80E-02
Di-n-butyl phthalate	2.90E+01	White-tailed Deer	3.50E-02	1.02E+00
N-Nitrosodiphenylamine	1.70E+00	White-tailed Deer	3.50E-02	5.95E-02
Perchlorate	2.50E-02	White-tailed Deer	3.50E-02	8.75E-04
4-Amino-2,6-dinitrotoluene	1.60E-01	White-tailed Deer	3.50E-02	5.60E-03
4-Nitrotoluene	2.40E-02	White-tailed Deer	3.50E-02	8.40E-04
Nitroglycerin	2.60E+01	White-tailed Deer	3.50E-02	9.10E-01
Antimony	6.20E+00	White-tailed Deer	3.50E-02	2.17E-01
Arsenic	9.20E+00	White-tailed Deer	3.50E-02	3.22E-01
Cadmium	1.68E+01	White-tailed Deer	3.50E-02	5.88E-01
Chromium	5.11E+01	White-tailed Deer	3.50E-02	1.79E+00
Copper	2.07E+02	White-tailed Deer	3.50E-02	7.25E+00
Lead	2.31E+02	White-tailed Deer	3.50E-02	8.09E+00
Mercury	3.60E-02	White-tailed Deer	3.50E-02	1.26E-03
Nickel	5.56E+01	White-tailed Deer	3.50E-02	1.95E+00
Selenium	1.10E+00	White-tailed Deer	3.50E-02	3.85E-02
Thallium	5.00E-01	White-tailed Deer	3.50E-02	1.75E-02
Zinc	8.99E+02	White-tailed Deer	3.50E-02	3.15E+01

Notes:

mg/kg - milligrams per kilogram

kg/day - kilograms per day

mg/day - milligrams per day

Table 7-15

Chemical Intake for Representative Wildlife Species Based on Incidental Surface Soil Ingestion
OB/OD RI Report
Fort Riley, Kansas

Parameter	Maximum Concentration Detected in Soil (mg/kg)	Representative Wildlife Species	Consumption Rate of Soil (kg/day)	Dose Received from Soil (mg/day)
1,1,2,2-Tetrachloroethane	3.10E+00	American Robin	8.74E-03	2.71E-02
1,2,4-Trimethylbenzene	8.30E-04	American Robin	8.74E-03	7.25E-06
Isopropylbenzene	1.40E-03	American Robin	8.74E-03	1.22E-05
p-Isopropyltoluene	1.60E-02	American Robin	8.74E-03	1.40E-04
sec-Butylbenzene	2.70E-03	American Robin	8.74E-03	2.36E-05
tert-Butylbenzene	1.10E-03	American Robin	8.74E-03	9.61E-06
2,4-Dinitrotoluene	3.70E+01	American Robin	8.74E-03	3.23E-01
2,6-Dinitrotoluene	2.80E+00	American Robin	8.74E-03	2.45E-02
Di-n-butyl phthalate	2.90E+01	American Robin	8.74E-03	2.53E-01
N-Nitrosodiphenylamine	1.70E+00	American Robin	8.74E-03	1.49E-02
Perchlorate	2.50E-02	American Robin	8.74E-03	2.19E-04
4-Amino-2,6-dinitrotoluene	1.60E-01	American Robin	8.74E-03	1.40E-03
4-Nitrotoluene	2.40E-02	American Robin	8.74E-03	2.10E-04
Nitroglycerin	2.60E+01	American Robin	8.74E-03	2.27E-01
Antimony	6.20E+00	American Robin	8.74E-03	5.42E-02
Arsenic	9.20E+00	American Robin	8.74E-03	8.04E-02
Cadmium	1.68E+01	American Robin	8.74E-03	1.47E-01
Chromium	5.11E+01	American Robin	8.74E-03	4.47E-01
Copper	2.07E+02	American Robin	8.74E-03	1.81E+00
Lead	2.31E+02	American Robin	8.74E-03	2.02E+00
Mercury	3.60E-02	American Robin	8.74E-03	3.15E-04
Nickel	5.56E+01	American Robin	8.74E-03	4.86E-01
Selenium	1.10E+00	American Robin	8.74E-03	9.61E-03
Thallium	5.00E-01	American Robin	8.74E-03	4.37E-03
Zinc	8.99E+02	American Robin	8.74E-03	7.86E+00

Notes:

mg/kg - milligrams per kilogram

kg/day - kilograms per day

mg/day - milligrams per day

Table 7-15

Chemical Intake for Representative Wildlife Species Based on Incidental Surface Soil Ingestion
OB/OD RI Report
Fort Riley, Kansas

Parameter	Maximum Concentration Detected in Soil (mg/kg)	Representative Wildlife Species	Consumption Rate of Soil (kg/day)	Dose Received from Soil (mg/day)
1,1,2,2-Tetrachloroethane	3.10E+00	Red-tailed Hawk	3.05E-03	9.46E-03
1,2,4-Trimethylbenzene	8.30E-04	Red-tailed Hawk	3.05E-03	2.53E-06
Isopropylbenzene	1.40E-03	Red-tailed Hawk	3.05E-03	4.27E-06
p-Isopropyltoluene	1.60E-02	Red-tailed Hawk	3.05E-03	4.88E-05
sec-Butylbenzene	2.70E-03	Red-tailed Hawk	3.05E-03	8.24E-06
tert-Butylbenzene	1.10E-03	Red-tailed Hawk	3.05E-03	3.36E-06
2,4-Dinitrotoluene	3.70E+01	Red-tailed Hawk	3.05E-03	1.13E-01
2,6-Dinitrotoluene	2.80E+00	Red-tailed Hawk	3.05E-03	8.55E-03
Di-n-butyl phthalate	2.90E+01	Red-tailed Hawk	3.05E-03	8.85E-02
N-Nitrosodiphenylamine	1.70E+00	Red-tailed Hawk	3.05E-03	5.19E-03
Perchlorate	2.50E-02	Red-tailed Hawk	3.05E-03	7.63E-05
4-Amino-2,6-dinitrotoluene	1.60E-01	Red-tailed Hawk	3.05E-03	4.88E-04
4-Nitrotoluene	2.40E-02	Red-tailed Hawk	3.05E-03	7.32E-05
Nitroglycerin	2.60E+01	Red-tailed Hawk	3.05E-03	7.94E-02
Antimony	6.20E+00	Red-tailed Hawk	3.05E-03	1.89E-02
Arsenic	9.20E+00	Red-tailed Hawk	3.05E-03	2.81E-02
Cadmium	1.68E+01	Red-tailed Hawk	3.05E-03	5.13E-02
Chromium	5.11E+01	Red-tailed Hawk	3.05E-03	1.56E-01
Copper	2.07E+02	Red-tailed Hawk	3.05E-03	6.32E-01
Lead	2.31E+02	Red-tailed Hawk	3.05E-03	7.05E-01
Mercury	3.60E-02	Red-tailed Hawk	3.05E-03	1.10E-04
Nickel	5.56E+01	Red-tailed Hawk	3.05E-03	1.70E-01
Selenium	1.10E+00	Red-tailed Hawk	3.05E-03	3.36E-03
Thallium	5.00E-01	Red-tailed Hawk	3.05E-03	1.53E-03
Zinc	8.99E+02	Red-tailed Hawk	3.05E-03	2.74E+00

Notes:

mg/kg - milligrams per kilogram

kg/day - kilograms per day

mg/day - milligrams per day

Table 7-16

Chemical Intake for Representative Wildlife Species Based on Ingestion of Surface Water
OB/OD RI Report
Fort Riley, Kansas

Parameter	Maximum Concentration Detected in Surface Water (mg/L)	Representative Wildlife Species	Consumption Rate of Water (L/day)	Dose Received from Surface Water (mg/day)
Trichloroethene	9.10E-02	Short-tailed Shrew	3.30E-03	3.00E-04
Benzo(a)pyrene	1.10E-03	Short-tailed Shrew	3.30E-03	3.63E-06
bis(2-Ethylhexyl) phthalate	1.30E-03	Short-tailed Shrew	3.30E-03	4.29E-06
Perchlorate	2.90E-02	Short-tailed Shrew	3.30E-03	9.57E-05
Copper	5.40E-03	Short-tailed Shrew	3.30E-03	1.78E-05
Lead	3.10E-03	Short-tailed Shrew	3.30E-03	1.02E-05
Mercury	3.20E-04	Short-tailed Shrew	3.30E-03	1.06E-06
Nickel	2.10E-03	Short-tailed Shrew	3.30E-03	6.93E-06
Selenium	2.90E-03	Short-tailed Shrew	3.30E-03	9.57E-06
Zinc	4.90E-03	Short-tailed Shrew	3.30E-03	1.62E-05
Trichloroethene	9.10E-02	White-footed Mouse	6.60E-03	6.01E-04
Benzo(a)pyrene	1.10E-03	White-footed Mouse	6.60E-03	7.26E-06
bis(2-Ethylhexyl) phthalate	1.30E-03	White-footed Mouse	6.60E-03	8.58E-06
Perchlorate	2.90E-02	White-footed Mouse	6.60E-03	1.91E-04
Copper	5.40E-03	White-footed Mouse	6.60E-03	3.56E-05
Lead	3.10E-03	White-footed Mouse	6.60E-03	2.05E-05
Mercury	3.20E-04	White-footed Mouse	6.60E-03	2.11E-06
Nickel	2.10E-03	White-footed Mouse	6.60E-03	1.39E-05
Selenium	2.90E-03	White-footed Mouse	6.60E-03	1.91E-05
Zinc	4.90E-03	White-footed Mouse	6.60E-03	3.23E-05
Trichloroethene	9.10E-02	Meadow Vole	6.00E-03	5.46E-04
Benzo(a)pyrene	1.10E-03	Meadow Vole	6.00E-03	6.60E-06
bis(2-Ethylhexyl) phthalate	1.30E-03	Meadow Vole	6.00E-03	7.80E-06
Perchlorate	2.90E-02	Meadow Vole	6.00E-03	1.74E-04
Copper	5.40E-03	Meadow Vole	6.00E-03	3.24E-05
Lead	3.10E-03	Meadow Vole	6.00E-03	1.86E-05
Mercury	3.20E-04	Meadow Vole	6.00E-03	1.92E-06
Nickel	2.10E-03	Meadow Vole	6.00E-03	1.26E-05
Selenium	2.90E-03	Meadow Vole	6.00E-03	1.74E-05
Zinc	4.90E-03	Meadow Vole	6.00E-03	2.94E-05

Notes:
mg/L - milligrams per liter
L/day - liter per day
mg/day - milligrams per day

Table 7-16

Chemical Intake for Representative Wildlife Species Based on Ingestion of Surface Water
OB/OD RI Report
Fort Riley, Kansas

Parameter	Maximum Concentration Detected in Surface Water (mg/L)	Representative Wildlife Species	Consumption Rate of Water (L/day)	Dose Received from Surface Water (mg/day)
Trichloroethene	9.10E-02	Eastern Cottontail Rabbit	1.16E-01	1.06E-02
Benzo(a)pyrene	1.10E-03	Eastern Cottontail Rabbit	1.16E-01	1.28E-04
bis(2-Ethylhexyl) phthalate	1.30E-03	Eastern Cottontail Rabbit	1.16E-01	1.51E-04
Perchlorate	2.90E-02	Eastern Cottontail Rabbit	1.16E-01	3.36E-03
Copper	5.40E-03	Eastern Cottontail Rabbit	1.16E-01	6.26E-04
Lead	3.10E-03	Eastern Cottontail Rabbit	1.16E-01	3.60E-04
Mercury	3.20E-04	Eastern Cottontail Rabbit	1.16E-01	3.71E-05
Nickel	2.10E-03	Eastern Cottontail Rabbit	1.16E-01	2.44E-04
Selenium	2.90E-03	Eastern Cottontail Rabbit	1.16E-01	3.36E-04
Zinc	4.90E-03	Eastern Cottontail Rabbit	1.16E-01	5.68E-04
Trichloroethene	9.10E-02	Red Fox	3.80E-01	3.46E-02
Benzo(a)pyrene	1.10E-03	Red Fox	3.80E-01	4.18E-04
bis(2-Ethylhexyl) phthalate	1.30E-03	Red Fox	3.80E-01	4.94E-04
Perchlorate	2.90E-02	Red Fox	3.80E-01	1.10E-02
Copper	5.40E-03	Red Fox	3.80E-01	2.05E-03
Lead	3.10E-03	Red Fox	3.80E-01	1.18E-03
Mercury	3.20E-04	Red Fox	3.80E-01	1.22E-04
Nickel	2.10E-03	Red Fox	3.80E-01	7.98E-04
Selenium	2.90E-03	Red Fox	3.80E-01	1.10E-03
Zinc	4.90E-03	Red Fox	3.80E-01	1.86E-03
Trichloroethene	9.10E-02	Raccoon	3.83E-01	3.49E-02
Benzo(a)pyrene	1.10E-03	Raccoon	3.83E-01	4.21E-04
bis(2-Ethylhexyl) phthalate	1.30E-03	Raccoon	3.83E-01	4.98E-04
Perchlorate	2.90E-02	Raccoon	3.83E-01	1.11E-02
Copper	5.40E-03	Raccoon	3.83E-01	2.07E-03
Lead	3.10E-03	Raccoon	3.83E-01	1.19E-03
Mercury	3.20E-04	Raccoon	3.83E-01	1.23E-04
Nickel	2.10E-03	Raccoon	3.83E-01	8.04E-04
Selenium	2.90E-03	Raccoon	3.83E-01	1.11E-03
Zinc	4.90E-03	Raccoon	3.83E-01	1.88E-03

Notes:

mg/L - milligrams per liter

L/day - liter per day

mg/day - milligrams per day

Table 7-16

Chemical Intake for Representative Wildlife Species Based on Ingestion of Surface Water
OB/OD RI Report
Fort Riley, Kansas

Parameter	Maximum Concentration Detected in Surface Water (mg/L)	Representative Wildlife Species	Consumption Rate of Water (L/day)	Dose Received from Surface Water (mg/day)
Trichloroethene	9.10E-02	White-tailed Deer	3.70E+00	3.37E-01
Benzo(a)pyrene	1.10E-03	White-tailed Deer	3.70E+00	4.07E-03
bis(2-Ethylhexyl) phthalate	1.30E-03	White-tailed Deer	3.70E+00	4.81E-03
Perchlorate	2.90E-02	White-tailed Deer	3.70E+00	1.07E-01
Copper	5.40E-03	White-tailed Deer	3.70E+00	2.00E-02
Lead	3.10E-03	White-tailed Deer	3.70E+00	1.15E-02
Mercury	3.20E-04	White-tailed Deer	3.70E+00	1.18E-03
Nickel	2.10E-03	White-tailed Deer	3.70E+00	7.77E-03
Selenium	2.90E-03	White-tailed Deer	3.70E+00	1.07E-02
Zinc	4.90E-03	White-tailed Deer	3.70E+00	1.81E-02
Trichloroethene	9.10E-02	American Robin	1.06E-02	9.65E-04
Benzo(a)pyrene	1.10E-03	American Robin	1.06E-02	1.17E-05
bis(2-Ethylhexyl) phthalate	1.30E-03	American Robin	1.06E-02	1.38E-05
Perchlorate	2.90E-02	American Robin	1.06E-02	3.07E-04
Copper	5.40E-03	American Robin	1.06E-02	5.72E-05
Lead	3.10E-03	American Robin	1.06E-02	3.29E-05
Mercury	3.20E-04	American Robin	1.06E-02	3.39E-06
Nickel	2.10E-03	American Robin	1.06E-02	2.23E-05
Selenium	2.90E-03	American Robin	1.06E-02	3.07E-05
Zinc	4.90E-03	American Robin	1.06E-02	5.19E-05
Trichloroethene	9.10E-02	Red-tailed Hawk	6.40E-02	5.82E-03
Benzo(a)pyrene	1.10E-03	Red-tailed Hawk	6.40E-02	7.04E-05
bis(2-Ethylhexyl) phthalate	1.30E-03	Red-tailed Hawk	6.40E-02	8.32E-05
Perchlorate	2.90E-02	Red-tailed Hawk	6.40E-02	1.86E-03
Copper	5.40E-03	Red-tailed Hawk	6.40E-02	3.46E-04
Lead	3.10E-03	Red-tailed Hawk	6.40E-02	1.98E-04
Mercury	3.20E-04	Red-tailed Hawk	6.40E-02	2.05E-05
Nickel	2.10E-03	Red-tailed Hawk	6.40E-02	1.34E-04
Selenium	2.90E-03	Red-tailed Hawk	6.40E-02	1.86E-04
Zinc	4.90E-03	Red-tailed Hawk	6.40E-02	3.14E-04

Notes:
mg/L - milligrams per liter
L/day - liter per day
mg/day - milligrams per day

Table 7-17
Chemical Intake For Representative Wildlife Species Based on Incidental Sediment Ingestion
OB/OD RI Report
Fort Riley, Kansas

Parameter	Maximum Concentration Detected in Pond Sediments (mg/kg)	Representative Wildlife Species	Consumption Rate of Sediment (kg/day)	Dose Received from Sediment (mg/day)
Antimony	3.10E-01	Raccoon	1.11E-02	3.44E-03
Arsenic	7.70E+00	Raccoon	1.11E-02	8.55E-02
Beryllium	1.50E+00	Raccoon	1.11E-02	1.67E-02
Cadmium	1.50E+00	Raccoon	1.11E-02	1.67E-02
Chromium	4.00E+01	Raccoon	1.11E-02	4.44E-01
Copper	3.54E+01	Raccoon	1.11E-02	3.93E-01
Lead	2.81E+01	Raccoon	1.11E-02	3.12E-01
Mercury	3.20E-02	Raccoon	1.11E-02	3.55E-04
Nickel	4.23E+01	Raccoon	1.11E-02	4.70E-01
Selenium	8.70E-01	Raccoon	1.11E-02	9.66E-03
Zinc	6.64E+01	Raccoon	1.11E-02	7.37E-01

Notes:

mg/kg - milligrams per kilogram

kg/day - kilograms per day

mg/day - milligrams per day

Consumption rate takes into account that 1/2 of the raccoon's total sediment and soil intake is composed of sediments.

Table 7-18
Exposure Rate Based on Maximum Concentration of COPEC in Benthic Invertebrates Due to Uptake
OB/OD RI Report
Fort Riley, Kansas

Parameter	Maximum Concentration Detected in Sediment (mg/kg)	Benthic Invert-Sediment Bioconcentration Factor[a]	Maximum Concentration of COPEC in Benthic Invert (mg/kg)	Representative Wildlife Species	Consumption Rate of Benthic Invertebrates Based on Diet Composition[b] (kg/day)	Dose Received from Benthic Inverts (mg/day)
Antimony	3.10E-01	9.00E-01	2.79E-01	Raccoon	4.74E-02	1.32E-02
Arsenic	7.70E+00	9.00E-01	6.93E+00	Raccoon	4.74E-02	3.28E-01
Beryllium	1.50E+00	9.00E-01	1.35E+00	Raccoon	4.74E-02	6.40E-02
Cadmium	1.50E+00	3.40E+00	5.10E+00	Raccoon	4.74E-02	2.42E-01
Chromium	4.00E+01	3.90E-01	1.56E+01	Raccoon	4.74E-02	7.39E-01
Copper	3.54E+01	3.00E-01	1.06E+01	Raccoon	4.74E-02	5.03E-01
Lead	2.81E+01	6.30E-01	1.77E+01	Raccoon	4.74E-02	8.39E-01
Mercury	3.20E-02	6.80E-02	2.18E-03	Raccoon	4.74E-02	1.03E-04
Nickel	4.23E+01	9.00E-01	3.81E+01	Raccoon	4.74E-02	1.80E+00
Selenium	8.70E-01	9.00E-01	7.83E-01	Raccoon	4.74E-02	3.71E-02
Zinc	6.64E+01	5.70E-01	3.78E+01	Raccoon	4.74E-02	1.79E+00

Notes:

mg/kg - milligrams per kilogram

kg/day - kilograms per day

mg/day - milligrams per day

[a] Sediment-to-Benthic invertebrate bioconcentration factors as reported in USEPA (1999b; EPA 530-D-99-001A)

[b] Consumption rate takes into account that 1/5 of the raccoon's diet is composed of benthic invertebrates.

Table 7-19
Exposure Rate Based on Maximum Concentration of COPEC in Soil Invertebrates Due to Uptake
OB/OD RI Report
Fort Riley, Kansas

Parameter	Maximum Concentration Detected in Soil (mg/kg)	Soil Invertebrate-Soil Bioconcentration Factor[a]	Maximum Concentration of COPEC in Soil Invertebrate Due to Uptake (mg/kg)	Representative Wildlife Species	Consumption Rate of Soil Invertebrates Based on Diet Composition[b] (kg/day)	Dose Received from Soil Invertebrates (mg/day)
1,1,2,2-Tetrachloroethane	3.10E+00	6.48E+00	2.01E+01	Short-tailed Shrew	9.00E-03	1.81E-01
1,2,4-Trimethylbenzene	8.30E-04	8.91E+01	7.39E-02	Short-tailed Shrew	9.00E-03	6.65E-04
Isopropylbenzene	1.40E-03	7.10E+01	9.95E-02	Short-tailed Shrew	9.00E-03	8.95E-04
p-Isopropyltoluene	1.60E-02	1.63E+02	2.61E+00	Short-tailed Shrew	9.00E-03	2.35E-02
sec-Butylbenzene	2.70E-03	3.95E+02	1.07E+00	Short-tailed Shrew	9.00E-03	9.60E-03
tert-Butylbenzene	1.10E-03	1.66E+02	1.83E-01	Short-tailed Shrew	9.00E-03	1.64E-03
2,4-Dinitrotoluene	3.70E+01	3.08E+00	1.14E+02	Short-tailed Shrew	9.00E-03	1.03E+00
2,6-Dinitrotoluene	2.80E+00	2.50E+00	7.00E+00	Short-tailed Shrew	9.00E-03	6.30E-02
Di-n-butyl phthalate	2.90E+01	3.95E+02	1.15E+04	Short-tailed Shrew	9.00E-03	1.03E+02
N-Nitrosodiphenylamine	1.70E+00	2.61E+01	4.45E+01	Short-tailed Shrew	9.00E-03	4.00E-01
Perchlorate	2.50E-02	1.27E-06	3.17E-08	Short-tailed Shrew	9.00E-03	2.86E-10
4-Amino-2,6-dinitrotoluene	1.60E-01	2.62E+00	4.19E-01	Short-tailed Shrew	9.00E-03	3.77E-03
4-Nitrotoluene	2.40E-02	6.24E+00	1.50E-01	Short-tailed Shrew	9.00E-03	1.35E-03
Nitroglycerin	2.60E+01	1.52E+00	3.94E+01	Short-tailed Shrew	9.00E-03	3.55E-01
Antimony	6.20E+00	2.20E-01	1.36E+00	Short-tailed Shrew	9.00E-03	1.23E-02
Arsenic	9.20E+00	1.10E-01	1.01E+00	Short-tailed Shrew	9.00E-03	9.11E-03
Cadmium	1.68E+01	9.60E-01	1.61E+01	Short-tailed Shrew	9.00E-03	1.45E-01
Chromium	5.11E+01	1.00E-02	5.11E-01	Short-tailed Shrew	9.00E-03	4.60E-03
Copper	2.07E+02	4.00E-02	8.28E+00	Short-tailed Shrew	9.00E-03	7.45E-02
Lead	2.31E+02	3.00E-02	6.93E+00	Short-tailed Shrew	9.00E-03	6.24E-02
Mercury	3.60E-02	4.00E-02	1.44E-03	Short-tailed Shrew	9.00E-03	1.30E-05
Nickel	5.56E+01	2.00E-02	1.11E+00	Short-tailed Shrew	9.00E-03	1.00E-02
Selenium	1.10E+00	2.20E-01	2.42E-01	Short-tailed Shrew	9.00E-03	2.18E-03
Thallium	5.00E-01	2.20E-01	1.10E-01	Short-tailed Shrew	9.00E-03	9.90E-04
Zinc	8.99E+02	5.60E-01	5.03E+02	Short-tailed Shrew	9.00E-03	4.53E+00

Notes:

COPEC - Chemical of Potential Ecological Concern
mg/kg - milligrams per kilogram
kg/day - kilograms per day
mg/kg/day - milligrams per kilograms per day

[a] Soil-to-soil invertebrate bioconcentration factors as reported in USEPA (1999b; EPA 530-D-99-001A) or calculated from log BCF = 0.819 log Kow - 1.146.

[b] Consumption rate takes into account that 1/2 of the meadow vole's diet, 4/5 of the American robin's diet, and 1/5 of the raccoon's diet is composed of soil invertebrates (earthworms).

Table 7-19
Exposure Rate Based on Maximum Concentration of COPEC in Soil Invertebrates Due to Uptake
OB/OD RI Report
Fort Riley, Kansas

Parameter	Maximum Concentration Detected in Soil (mg/kg)	Soil Invertebrate-Soil Bioconcentration Factor[a]	Maximum Concentration of COPEC in Soil Invertebrate Due to Uptake (mg/kg)	Representative Wildlife Species	Consumption Rate of Soil Invertebrates Based on Diet Composition[b] (kg/day)	Dose Received from Soil Invertebrates (mg/day)
1,1,2,2-Tetrachloroethane	3.10E+00	6.48E+00	2.01E+01	Meadow Vole	2.50E-03	5.02E-02
1,2,4-Trimethylbenzene	8.30E-04	8.91E+01	7.39E-02	Meadow Vole	2.50E-03	1.85E-04
Isopropylbenzene	1.40E-03	7.10E+01	9.95E-02	Meadow Vole	2.50E-03	2.49E-04
p-Isopropyltoluene	1.60E-02	1.63E+02	2.61E+00	Meadow Vole	2.50E-03	6.52E-03
sec-Butylbenzene	2.70E-03	3.95E+02	1.07E+00	Meadow Vole	2.50E-03	2.67E-03
tert-Butylbenzene	1.10E-03	1.66E+02	1.83E-01	Meadow Vole	2.50E-03	4.56E-04
2,4-Dinitrotoluene	3.70E+01	3.08E+00	1.14E+02	Meadow Vole	2.50E-03	2.85E-01
2,6-Dinitrotoluene	2.80E+00	2.50E+00	7.00E+00	Meadow Vole	2.50E-03	1.75E-02
Di-n-butyl phthalate	2.90E+01	3.95E+02	1.15E+04	Meadow Vole	2.50E-03	2.87E+01
N-Nitrosodiphenylamine	1.70E+00	2.61E+01	4.45E+01	Meadow Vole	2.50E-03	1.11E-01
Perchlorate	2.50E-02	1.27E-06	3.17E-08	Meadow Vole	2.50E-03	7.93E-11
4-Amino-2,6-dinitrotoluene	1.60E-01	2.62E+00	4.19E-01	Meadow Vole	2.50E-03	1.05E-03
4-Nitrotoluene	2.40E-02	6.24E+00	1.50E-01	Meadow Vole	2.50E-03	3.75E-04
Nitroglycerin	2.60E+01	1.52E+00	3.94E+01	Meadow Vole	2.50E-03	9.86E-02
Antimony	6.20E+00	2.20E-01	1.36E+00	Meadow Vole	2.50E-03	3.41E-03
Arsenic	9.20E+00	1.10E-01	1.01E+00	Meadow Vole	2.50E-03	2.53E-03
Cadmium	1.68E+01	9.60E-01	1.61E+01	Meadow Vole	2.50E-03	4.03E-02
Chromium	5.11E+01	1.00E-02	5.11E-01	Meadow Vole	2.50E-03	1.28E-03
Copper	2.07E+02	4.00E-02	8.28E+00	Meadow Vole	2.50E-03	2.07E-02
Lead	2.31E+02	3.00E-02	6.93E+00	Meadow Vole	2.50E-03	1.73E-02
Mercury	3.60E-02	4.00E-02	1.44E-03	Meadow Vole	2.50E-03	3.60E-06
Nickel	5.56E+01	2.00E-02	1.11E+00	Meadow Vole	2.50E-03	2.78E-03
Selenium	1.10E+00	2.20E-01	2.42E-01	Meadow Vole	2.50E-03	6.05E-04
Thallium	5.00E-01	2.20E-01	1.10E-01	Meadow Vole	2.50E-03	2.75E-04
Zinc	8.99E+02	5.60E-01	5.03E+02	Meadow Vole	2.50E-03	1.26E+00

Notes:
COPEC - Chemical of Potential Ecological Concern
mg/kg - milligrams per kilogram
kg/day - kilograms per day
mg/kg/day - milligrams per kilograms per day

[a] Soil-to-soil invertebrate bioconcentration factors as reported in USEPA (1999b; EPA 530-D-99-001A) or calculated from log BCF = 0.819 log Kow - 1.146.

[b] Consumption rate takes into account that 1/2 of the meadow vole's diet, 4/5 of the American robin's diet, and 1/5 of the raccoon's diet is composed of soil invertebrates (earthworms).

Table 7-19
Exposure Rate Based on Maximum Concentration of COPEC in Soil Invertebrates Due to Uptake
OB/OD RI Report
Fort Riley, Kansas

Parameter	Maximum Concentration Detected in Soil (mg/kg)	Soil Invertebrate-Soil Bioconcentration Factor[a]	Maximum Concentration of COPEC in Soil Invertebrate Due to Uptake (mg/kg)	Representative Wildlife Species	Consumption Rate of Soil Invertebrates Based on Diet Composition[b] (kg/day)	Dose Received from Soil Invertebrates (mg/day)
1,1,2,2-Tetrachloroethane	3.10E+00	6.48E+00	2.01E+01	Raccoon	4.74E-02	9.52E-01
1,2,4-Trimethylbenzene	8.30E-04	8.91E+01	7.39E-02	Raccoon	4.74E-02	3.50E-03
Isopropylbenzene	1.40E-03	7.10E+01	9.95E-02	Raccoon	4.74E-02	4.71E-03
p-Isopropyltoluene	1.60E-02	1.63E+02	2.61E+00	Raccoon	4.74E-02	1.24E-01
sec-Butylbenzene	2.70E-03	3.95E+02	1.07E+00	Raccoon	4.74E-02	5.06E-02
tert-Butylbenzene	1.10E-03	1.66E+02	1.83E-01	Raccoon	4.74E-02	8.65E-03
2,4-Dinitrotoluene	3.70E+01	3.08E+00	1.14E+02	Raccoon	4.74E-02	5.40E+00
2,6-Dinitrotoluene	2.80E+00	2.50E+00	7.00E+00	Raccoon	4.74E-02	3.32E-01
Di-n-butyl phthalate	2.90E+01	3.95E+02	1.15E+04	Raccoon	4.74E-02	5.43E+02
N-Nitrosodiphenylamine	1.70E+00	2.61E+01	4.45E+01	Raccoon	4.74E-02	2.11E+00
Perchlorate	2.50E-02	1.27E-06	3.17E-08	Raccoon	4.74E-02	1.50E-09
4-Amino-2,6-dinitrotoluene	1.60E-01	2.62E+00	4.19E-01	Raccoon	4.74E-02	1.99E-02
4-Nitrotoluene	2.40E-02	6.24E+00	1.50E-01	Raccoon	4.74E-02	7.10E-03
Nitroglycerin	2.60E+01	1.52E+00	3.94E+01	Raccoon	4.74E-02	1.87E+00
Antimony	6.20E+00	2.20E-01	1.36E+00	Raccoon	4.74E-02	6.47E-02
Arsenic	9.20E+00	1.10E-01	1.01E+00	Raccoon	4.74E-02	4.80E-02
Cadmium	1.68E+01	9.60E-01	1.61E+01	Raccoon	4.74E-02	7.64E-01
Chromium	5.11E+01	1.00E-02	5.11E-01	Raccoon	4.74E-02	2.42E-02
Copper	2.07E+02	4.00E-02	8.28E+00	Raccoon	4.74E-02	3.92E-01
Lead	2.31E+02	3.00E-02	6.93E+00	Raccoon	4.74E-02	3.28E-01
Mercury	3.60E-02	4.00E-02	1.44E-03	Raccoon	4.74E-02	6.83E-05
Nickel	5.56E+01	2.00E-02	1.11E+00	Raccoon	4.74E-02	5.27E-02
Selenium	1.10E+00	2.20E-01	2.42E-01	Raccoon	4.74E-02	1.15E-02
Thallium	5.00E-01	2.20E-01	1.10E-01	Raccoon	4.74E-02	5.21E-03
Zinc	8.99E+02	5.60E-01	5.03E+02	Raccoon	4.74E-02	2.39E+01

Notes:
COPEC - Chemical of Potential Ecological Concern
mg/kg - milligrams per kilogram
kg/day - kilograms per day
mg/kg/day - milligrams per kilograms per day

[a] Soil-to-soil invertebrate bioconcentration factors as reported in USEPA (1999b; EPA 530-D-99-001A) or calculated from log BCF = 0.819 log Kow - 1.146.

[b] Consumption rate takes into account that 1/2 of the meadow vole's diet, 4/5 of the American robin's diet, and 1/5 of the raccoon's diet is composed of soil invertebrates (earthworms).

Table 7-19
Exposure Rate Based on Maximum Concentration of COPEC in Soil Invertebrates Due to Uptake
OB/OD RI Report
Fort Riley, Kansas

Parameter	Maximum Concentration Detected in Soil (mg/kg)	Soil Invertebrate-Soil Bioconcentration Factor[a]	Maximum Concentration of COPEC in Soil Invertebrate Due to Uptake (mg/kg)	Representative Wildlife Species	Consumption Rate of Soil Invertebrates Based on Diet Composition[b] (kg/day)	Dose Received from Soil Invertebrates (mg/day)
1,1,2,2-Tetrachloroethane	3.10E+00	6.48E+00	2.01E+01	American Robin	7.44E-02	1.49E+00
1,2,4-Trimethylbenzene	8.30E-04	8.91E+01	7.39E-02	American Robin	7.44E-02	5.50E-03
Isopropylbenzene	1.40E-03	7.10E+01	9.95E-02	American Robin	7.44E-02	7.40E-03
p-Isopropyltoluene	1.60E-02	1.63E+02	2.61E+00	American Robin	7.44E-02	1.94E-01
sec-Butylbenzene	2.70E-03	3.95E+02	1.07E+00	American Robin	7.44E-02	7.94E-02
tert-Butylbenzene	1.10E-03	1.66E+02	1.83E-01	American Robin	7.44E-02	1.36E-02
2,4-Dinitrotoluene	3.70E+01	3.08E+00	1.14E+02	American Robin	7.44E-02	8.48E+00
2,6-Dinitrotoluene	2.80E+00	2.50E+00	7.00E+00	American Robin	7.44E-02	5.21E-01
Di-n-butyl phthalate	2.90E+01	3.95E+02	1.15E+04	American Robin	7.44E-02	8.53E+02
N-Nitrosodiphenylamine	1.70E+00	2.61E+01	4.45E+01	American Robin	7.44E-02	3.31E+00
Perchlorate	2.50E-02	1.27E-06	3.17E-08	American Robin	7.44E-02	2.36E-09
4-Amino-2,6-dinitrotoluene	1.60E-01	2.62E+00	4.19E-01	American Robin	7.44E-02	3.12E-02
4-Nitrotoluene	2.40E-02	6.24E+00	1.50E-01	American Robin	7.44E-02	1.11E-02
Nitroglycerin	2.60E+01	1.52E+00	3.94E+01	American Robin	7.44E-02	2.93E+00
Antimony	6.20E+00	2.20E-01	1.36E+00	American Robin	7.44E-02	1.01E-01
Arsenic	9.20E+00	1.10E-01	1.01E+00	American Robin	7.44E-02	7.53E-02
Cadmium	1.68E+01	9.60E-01	1.61E+01	American Robin	7.44E-02	1.20E+00
Chromium	5.11E+01	1.00E-02	5.11E-01	American Robin	7.44E-02	3.80E-02
Copper	2.07E+02	4.00E-02	8.28E+00	American Robin	7.44E-02	6.16E-01
Lead	2.31E+02	3.00E-02	6.93E+00	American Robin	7.44E-02	5.16E-01
Mercury	3.60E-02	4.00E-02	1.44E-03	American Robin	7.44E-02	1.07E-04
Nickel	5.56E+01	2.00E-02	1.11E+00	American Robin	7.44E-02	8.27E-02
Selenium	1.10E+00	2.20E-01	2.42E-01	American Robin	7.44E-02	1.80E-02
Thallium	5.00E-01	2.20E-01	1.10E-01	American Robin	7.44E-02	8.18E-03
Zinc	8.99E+02	5.60E-01	5.03E+02	American Robin	7.44E-02	3.75E+01

Notes:
COPEC - Chemical of Potential Ecological Concern
mg/kg - milligrams per kilogram
kg/day - kilograms per day
mg/kg/day - milligrams per kilograms per day

[a] Soil-to-soil invertebrate bioconcentration factors as reported in USEPA (1999b; EPA 530-D-99-001A) or calculated from log BCF = 0.819 log Kow - 1.146.

[b] Consumption rate takes into account that 1/2 of the meadow vole's diet, 4/5 of the American robin's diet, and 1/5 of the raccoon's diet is composed of soil invertebrates (earthworms).

Table 7-20
Exposure Rate Based on Maximum Concentration of COPEC in Plants Due to Uptake
OB/OD RI Report
Fort Riley, Kansas

Parameter	Maximum Concentration Detected in Surface or Subsurface Soil (mg/kg)	Plant Bioconcentration Factor[a]	Maximum Concentration of COPEC in Plants Due to Uptake (mg/kg)	Representative Wildlife Species	Consumption Rate of Plants Based on Diet Composition[b] (kg/day)	Dose Received from Plants (mg/day)
1,1,2,2-Tetrachloroethane	3.20E+00	1.61E+00	5.15E+00	White-footed Mouse	3.40E-03	1.75E-02
1,2,4-Trimethylbenzene	8.30E-04	2.53E-01	2.10E-04	White-footed Mouse	3.40E-03	7.14E-07
cis-1,2-Dichloroethene	2.60E+00	3.26E+00	8.47E+00	White-footed Mouse	3.40E-03	2.88E-02
Isopropylbenzene	1.40E-03	2.97E-01	4.16E-04	White-footed Mouse	3.40E-03	1.41E-06
p-Isopropyltoluene	1.60E-02	1.65E-01	2.64E-03	White-footed Mouse	3.40E-03	8.99E-06
sec-Butylbenzene	2.70E-03	8.84E-02	2.39E-04	White-footed Mouse	3.40E-03	8.12E-07
tert-Butylbenzene	1.10E-03	1.63E-01	1.79E-04	White-footed Mouse	3.40E-03	6.10E-07
Trichloroethene	1.81E+02	1.20E+00	2.17E+02	White-footed Mouse	3.40E-03	7.39E-01
2,4-Dinitrotoluene	3.70E+01	2.72E+00	1.01E+02	White-footed Mouse	3.40E-03	3.42E-01
2,6-Dinitrotoluene	2.80E+00	3.15E+00	8.82E+00	White-footed Mouse	3.40E-03	3.00E-02
Di-n-butyl phthalate	2.90E+01	8.84E-02	2.56E+00	White-footed Mouse	3.40E-03	8.72E-03
N-Nitrosodiphenylamine	1.70E+00	6.01E-01	1.02E+00	White-footed Mouse	3.40E-03	3.47E-03
Perchlorate	8.00E-01	8.72E+04	6.97E+04	White-footed Mouse	3.40E-03	2.37E+02
4-Amino-2,6-dinitrotoluene	1.60E-01	3.05E+00	4.88E-01	White-footed Mouse	3.40E-03	1.66E-03
4-Nitrotoluene	2.40E-02	1.65E+00	3.97E-02	White-footed Mouse	3.40E-03	1.35E-04
Nitroglycerin	2.60E+01	4.48E+00	1.17E+02	White-footed Mouse	3.40E-03	3.96E-01
Antimony	6.20E+00	2.00E-01	1.24E+00	White-footed Mouse	3.40E-03	4.22E-03
Arsenic	9.20E+00	3.60E-02	3.31E-01	White-footed Mouse	3.40E-03	1.13E-03
Cadmium	1.68E+01	3.64E-01	6.12E+00	White-footed Mouse	3.40E-03	2.08E-02
Chromium	5.11E+01	7.50E-03	3.83E-01	White-footed Mouse	3.40E-03	1.30E-03
Copper	2.07E+02	4.00E-01	8.28E+01	White-footed Mouse	3.40E-03	2.82E-01
Lead	2.31E+02	4.50E-02	1.04E+01	White-footed Mouse	3.40E-03	3.53E-02
Mercury	3.60E-02	3.75E-02	1.35E-03	White-footed Mouse	3.40E-03	4.59E-06
Nickel	5.56E+01	3.20E-02	1.78E+00	White-footed Mouse	3.40E-03	6.05E-03
Selenium	1.10E+00	1.60E-02	1.76E-02	White-footed Mouse	3.40E-03	5.98E-05
Thallium	5.00E-01	4.00E-03	2.00E-03	White-footed Mouse	3.40E-03	6.80E-06
Zinc	8.99E+02	1.20E-12	1.08E-09	White-footed Mouse	3.40E-03	3.67E-12

Notes:

COPEC - Chemical of Potential Ecological Concern

mg/kg - milligrams per kilogram

mg/day - millgrams per day

kg/day - kilograms per day

[a] Soil-to-plant bioconcentration factors as reported in USEPA (1999b; EPA 530-D-99-001A) or calculated from log BCF = 1.588 - 0.578 log Kow.

[b] Consumption rate takes into account that 1/2 of the meadow vole's diet, 1/2 of the American robin's diet, and 1/5 of the raccoon's diet is composed of vegetation.

Table 7-20
Exposure Rate Based on Maximum Concentration of COPEC in Plants Due to Uptake
OB/OD RI Report
Fort Riley, Kansas

Parameter	Maximum Concentration Detected in Surface or Subsurface Soil (mg/kg)	Plant Bioconcentration Factor[a]	Maximum Concentration of COPEC in Plants Due to Uptake (mg/kg)	Representative Wildlife Species	Consumption Rate of Plants Based on Diet Composition[b] (kg/day)	Dose Received from Plants (mg/day)
1,1,2,2-Tetrachloroethane	3.20E+00	1.61E+00	5.15E+00	Meadow Vole	2.50E-03	1.29E-02
1,2,4-Trimethylbenzene	8.30E-04	2.53E-01	2.10E-04	Meadow Vole	2.50E-03	5.25E-07
cis-1,2-Dichloroethene	2.60E+00	3.26E+00	8.47E+00	Meadow Vole	2.50E-03	2.12E-02
Isopropylbenzene	1.40E-03	2.97E-01	4.16E-04	Meadow Vole	2.50E-03	1.04E-06
p-Isopropyltoluene	1.60E-02	1.65E-01	2.64E-03	Meadow Vole	2.50E-03	6.61E-06
sec-Butylbenzene	2.70E-03	8.84E-02	2.39E-04	Meadow Vole	2.50E-03	5.97E-07
tert-Butylbenzene	1.10E-03	1.63E-01	1.79E-04	Meadow Vole	2.50E-03	4.49E-07
Trichloroethene	1.81E+02	1.20E+00	2.17E+02	Meadow Vole	2.50E-03	5.43E-01
2,4-Dinitrotoluene	3.70E+01	2.72E+00	1.01E+02	Meadow Vole	2.50E-03	2.52E-01
2,6-Dinitrotoluene	2.80E+00	3.15E+00	8.82E+00	Meadow Vole	2.50E-03	2.21E-02
Di-n-butyl phthalate	2.90E+01	8.84E-02	2.56E+00	Meadow Vole	2.50E-03	6.41E-03
N-Nitrosodiphenylamine	1.70E+00	6.01E-01	1.02E+00	Meadow Vole	2.50E-03	2.55E-03
Perchlorate	8.00E-01	8.72E+04	6.97E+04	Meadow Vole	2.50E-03	1.74E+02
4-Amino-2,6-dinitrotoluene	1.60E-01	3.05E+00	4.88E-01	Meadow Vole	2.50E-03	1.22E-03
4-Nitrotoluene	2.40E-02	1.65E+00	3.97E-02	Meadow Vole	2.50E-03	9.92E-05
Nitroglycerin	2.60E+01	4.48E+00	1.17E+02	Meadow Vole	2.50E-03	2.91E-01
Antimony	6.20E+00	2.00E-01	1.24E+00	Meadow Vole	2.50E-03	3.10E-03
Arsenic	9.20E+00	3.60E-02	3.31E-01	Meadow Vole	2.50E-03	8.28E-04
Cadmium	1.68E+01	3.64E-01	6.12E+00	Meadow Vole	2.50E-03	1.53E-02
Chromium	5.11E+01	7.50E-03	3.83E-01	Meadow Vole	2.50E-03	9.58E-04
Copper	2.07E+02	4.00E-01	8.28E+01	Meadow Vole	2.50E-03	2.07E-01
Lead	2.31E+02	4.50E-02	1.04E+01	Meadow Vole	2.50E-03	2.60E-02
Mercury	3.60E-02	3.75E-02	1.35E-03	Meadow Vole	2.50E-03	3.38E-06
Nickel	5.56E+01	3.20E-02	1.78E+00	Meadow Vole	2.50E-03	4.45E-03
Selenium	1.10E+00	1.60E-02	1.76E-02	Meadow Vole	2.50E-03	4.40E-05
Thallium	5.00E-01	4.00E-03	2.00E-03	Meadow Vole	2.50E-03	5.00E-06
Zinc	8.99E+02	1.20E-12	1.08E-09	Meadow Vole	2.50E-03	2.70E-12

Notes:

COPEC - Chemical of Potential Ecological Concern

mg/kg - milligrams per kilogram

mg/day - millgrams per day

kg/day - kilograms per day

[a] Soil-to-plant bioconcentration factors as reported in USEPA (1999b; EPA 530-D-99-001A) or calculated from log BCF = 1.588 - 0.578 log Kow.

[b] Consumption rate takes into account that 1/2 of the meadow vole's diet, 1/2 of the American robin's diet, and 1/5 of the raccoon's diet is composed of vegetation.

Table 7-20
Exposure Rate Based on Maximum Concentration of COPEC in Plants Due to Uptake
OB/OD RI Report
Fort Riley, Kansas

Parameter	Maximum Concentration Detected in Surface or Subsurface Soil (mg/kg)	Plant Bioconcentration Factor[a]	Maximum Concentration of COPEC in Plants Due to Uptake (mg/kg)	Representative Wildlife Species	Consumption Rate of Plants Based on Diet Composition[b] (kg/day)	Dose Received from Plants (mg/day)
1,1,2,2-Tetrachloroethane	3.20E+00	1.61E+00	5.15E+00	Eastern Cottontail Rabbit	2.37E-01	1.22E+00
1,2,4-Trimethylbenzene	8.30E-04	2.53E-01	2.10E-04	Eastern Cottontail Rabbit	2.37E-01	4.98E-05
cis-1,2-Dichloroethene	2.60E+00	3.26E+00	8.47E+00	Eastern Cottontail Rabbit	2.37E-01	2.01E+00
Isopropylbenzene	1.40E-03	2.97E-01	4.16E-04	Eastern Cottontail Rabbit	2.37E-01	9.85E-05
p-Isopropyltoluene	1.60E-02	1.65E-01	2.64E-03	Eastern Cottontail Rabbit	2.37E-01	6.27E-04
sec-Butylbenzene	2.70E-03	8.84E-02	2.39E-04	Eastern Cottontail Rabbit	2.37E-01	5.66E-05
tert-Butylbenzene	1.10E-03	1.63E-01	1.79E-04	Eastern Cottontail Rabbit	2.37E-01	4.25E-05
Trichloroethene	1.81E+02	1.20E+00	2.17E+02	Eastern Cottontail Rabbit	2.37E-01	5.15E+01
2,4-Dinitrotoluene	3.70E+01	2.72E+00	1.01E+02	Eastern Cottontail Rabbit	2.37E-01	2.39E+01
2,6-Dinitrotoluene	2.80E+00	3.15E+00	8.82E+00	Eastern Cottontail Rabbit	2.37E-01	2.09E+00
Di-n-butyl phthalate	2.90E+01	8.84E-02	2.56E+00	Eastern Cottontail Rabbit	2.37E-01	6.08E-01
N-Nitrosodiphenylamine	1.70E+00	6.01E-01	1.02E+00	Eastern Cottontail Rabbit	2.37E-01	2.42E-01
Perchlorate	8.00E-01	8.72E+04	6.97E+04	Eastern Cottontail Rabbit	2.37E-01	1.65E+04
4-Amino-2,6-dinitrotoluene	1.60E-01	3.05E+00	4.88E-01	Eastern Cottontail Rabbit	2.37E-01	1.16E-01
4-Nitrotoluene	2.40E-02	1.65E+00	3.97E-02	Eastern Cottontail Rabbit	2.37E-01	9.40E-03
Nitroglycerin	2.60E+01	4.48E+00	1.17E+02	Eastern Cottontail Rabbit	2.37E-01	2.76E+01
Antimony	6.20E+00	2.00E-01	1.24E+00	Eastern Cottontail Rabbit	2.37E-01	2.94E-01
Arsenic	9.20E+00	3.60E-02	3.31E-01	Eastern Cottontail Rabbit	2.37E-01	7.85E-02
Cadmium	1.68E+01	3.64E-01	6.12E+00	Eastern Cottontail Rabbit	2.37E-01	1.45E+00
Chromium	5.11E+01	7.50E-03	3.83E-01	Eastern Cottontail Rabbit	2.37E-01	9.08E-02
Copper	2.07E+02	4.00E-01	8.28E+01	Eastern Cottontail Rabbit	2.37E-01	1.96E+01
Lead	2.31E+02	4.50E-02	1.04E+01	Eastern Cottontail Rabbit	2.37E-01	2.46E+00
Mercury	3.60E-02	3.75E-02	1.35E-03	Eastern Cottontail Rabbit	2.37E-01	3.20E-04
Nickel	5.56E+01	3.20E-02	1.78E+00	Eastern Cottontail Rabbit	2.37E-01	4.22E-01
Selenium	1.10E+00	1.60E-02	1.76E-02	Eastern Cottontail Rabbit	2.37E-01	4.17E-03
Thallium	5.00E-01	4.00E-03	2.00E-03	Eastern Cottontail Rabbit	2.37E-01	4.74E-04
Zinc	8.99E+02	1.20E-12	1.08E-09	Eastern Cottontail Rabbit	2.37E-01	2.56E-10

Notes:
COPEC - Chemical of Potential Ecological Concern
mg/kg - milligrams per kilogram
mg/day - millgrams per day
kg/day - kilograms per day
[a] Soil-to-plant bioconcentration factors as reported in USEPA (1999b; EPA 530-D-99-001A) or calculated from log BCF = 1.588 - 0.578 log Kow.
[b] Consumption rate takes into account that 1/2 of the meadow vole's diet, 1/2 of the American robin's diet, and 1/5 of the raccoon's diet is composed of vegetation.

Table 7-20
Exposure Rate Based on Maximum Concentration of COPEC in Plants Due to Uptake
OB/OD RI Report
Fort Riley, Kansas

Parameter	Maximum Concentration Detected in Surface or Subsurface Soil (mg/kg)	Plant Bioconcentration Factor[a]	Maximum Concentration of COPEC in Plants Due to Uptake (mg/kg)	Representative Wildlife Species	Consumption Rate of Plants Based on Diet Composition[b] (kg/day)	Dose Received from Plants (mg/day)
1,1,2,2-Tetrachloroethane	3.20E+00	1.61E+00	5.15E+00	Raccoon	4.74E-02	2.44E-01
1,2,4-Trimethylbenzene	8.30E-04	2.53E-01	2.10E-04	Raccoon	4.74E-02	9.95E-06
cis-1,2-Dichloroethene	2.60E+00	3.26E+00	8.47E+00	Raccoon	4.74E-02	4.01E-01
Isopropylbenzene	1.40E-03	2.97E-01	4.16E-04	Raccoon	4.74E-02	1.97E-05
p-Isopropyltoluene	1.60E-02	1.65E-01	2.64E-03	Raccoon	4.74E-02	1.25E-04
sec-Butylbenzene	2.70E-03	8.84E-02	2.39E-04	Raccoon	4.74E-02	1.13E-05
tert-Butylbenzene	1.10E-03	1.63E-01	1.79E-04	Raccoon	4.74E-02	8.50E-06
Trichloroethene	1.81E+02	1.20E+00	2.17E+02	Raccoon	4.74E-02	1.03E+01
2,4-Dinitrotoluene	3.70E+01	2.72E+00	1.01E+02	Raccoon	4.74E-02	4.77E+00
2,6-Dinitrotoluene	2.80E+00	3.15E+00	8.82E+00	Raccoon	4.74E-02	4.18E-01
Di-n-butyl phthalate	2.90E+01	8.84E-02	2.56E+00	Raccoon	4.74E-02	1.22E-01
N-Nitrosodiphenylamine	1.70E+00	6.01E-01	1.02E+00	Raccoon	4.74E-02	4.84E-02
Perchlorate	8.00E-01	8.72E+04	6.97E+04	Raccoon	4.74E-02	3.31E+03
4-Amino-2,6-dinitrotoluene	1.60E-01	3.05E+00	4.88E-01	Raccoon	4.74E-02	2.31E-02
4-Nitrotoluene	2.40E-02	1.65E+00	3.97E-02	Raccoon	4.74E-02	1.88E-03
Nitroglycerin	2.60E+01	4.48E+00	1.17E+02	Raccoon	4.74E-02	5.53E+00
Antimony	6.20E+00	2.00E-01	1.24E+00	Raccoon	4.74E-02	5.88E-02
Arsenic	9.20E+00	3.60E-02	3.31E-01	Raccoon	4.74E-02	1.57E-02
Cadmium	1.68E+01	3.64E-01	6.12E+00	Raccoon	4.74E-02	2.90E-01
Chromium	5.11E+01	7.50E-03	3.83E-01	Raccoon	4.74E-02	1.82E-02
Copper	2.07E+02	4.00E-01	8.28E+01	Raccoon	4.74E-02	3.92E+00
Lead	2.31E+02	4.50E-02	1.04E+01	Raccoon	4.74E-02	4.93E-01
Mercury	3.60E-02	3.75E-02	1.35E-03	Raccoon	4.74E-02	6.40E-05
Nickel	5.56E+01	3.20E-02	1.78E+00	Raccoon	4.74E-02	8.43E-02
Selenium	1.10E+00	1.60E-02	1.76E-02	Raccoon	4.74E-02	8.34E-04
Thallium	5.00E-01	4.00E-03	2.00E-03	Raccoon	4.74E-02	9.48E-05
Zinc	8.99E+02	1.20E-12	1.08E-09	Raccoon	4.74E-02	5.11E-11

Notes:

COPEC - Chemical of Potential Ecological Concern

mg/kg - milligrams per kilogram

mg/day - millgrams per day

kg/day - kilograms per day

[a] Soil-to-plant bioconcentration factors as reported in USEPA (1999b; EPA 530-D-99-001A) or calculated from log BCF = 1.588 - 0.578 log Kow.

[b] Consumption rate takes into account that 1/2 of the meadow vole's diet, 1/2 of the American robin's diet, and 1/5 of the raccoon's diet is composed of vegetation.

Table 7-20
Exposure Rate Based on Maximum Concentration of COPEC in Plants Due to Uptake
OB/OD RI Report
Fort Riley, Kansas

Parameter	Maximum Concentration Detected in Surface or Subsurface Soil (mg/kg)	Plant Bioconcentration Factor[a]	Maximum Concentration of COPEC in Plants Due to Uptake (mg/kg)	Representative Wildlife Species	Consumption Rate of Plants Based on Diet Composition[b] (kg/day)	Dose Received from Plants (mg/day)
1,1,2,2-Tetrachloroethane	3.20E+00	1.61E+00	5.15E+00	White-tailed Deer	1.74E+00	8.96E+00
1,2,4-Trimethylbenzene	8.30E-04	2.53E-01	2.10E-04	White-tailed Deer	1.74E+00	3.65E-04
cis-1,2-Dichloroethene	2.60E+00	3.26E+00	8.47E+00	White-tailed Deer	1.74E+00	1.47E+01
Isopropylbenzene	1.40E-03	2.97E-01	4.16E-04	White-tailed Deer	1.74E+00	7.23E-04
p-Isopropyltoluene	1.60E-02	1.65E-01	2.64E-03	White-tailed Deer	1.74E+00	4.60E-03
sec-Butylbenzene	2.70E-03	8.84E-02	2.39E-04	White-tailed Deer	1.74E+00	4.15E-04
tert-Butylbenzene	1.10E-03	1.63E-01	1.79E-04	White-tailed Deer	1.74E+00	3.12E-04
Trichloroethene	1.81E+02	1.20E+00	2.17E+02	White-tailed Deer	1.74E+00	3.78E+02
2,4-Dinitrotoluene	3.70E+01	2.72E+00	1.01E+02	White-tailed Deer	1.74E+00	1.75E+02
2,6-Dinitrotoluene	2.80E+00	3.15E+00	8.82E+00	White-tailed Deer	1.74E+00	1.53E+01
Di-n-butyl phthalate	2.90E+01	8.84E-02	2.56E+00	White-tailed Deer	1.74E+00	4.46E+00
N-Nitrosodiphenylamine	1.70E+00	6.01E-01	1.02E+00	White-tailed Deer	1.74E+00	1.78E+00
Perchlorate	8.00E-01	8.72E+04	6.97E+04	White-tailed Deer	1.74E+00	1.21E+05
4-Amino-2,6-dinitrotoluene	1.60E-01	3.05E+00	4.88E-01	White-tailed Deer	1.74E+00	8.49E-01
4-Nitrotoluene	2.40E-02	1.65E+00	3.97E-02	White-tailed Deer	1.74E+00	6.90E-02
Nitroglycerin	2.60E+01	4.48E+00	1.17E+02	White-tailed Deer	1.74E+00	2.03E+02
Antimony	6.20E+00	2.00E-01	1.24E+00	White-tailed Deer	1.74E+00	2.16E+00
Arsenic	9.20E+00	3.60E-02	3.31E-01	White-tailed Deer	1.74E+00	5.76E-01
Cadmium	1.68E+01	3.64E-01	6.12E+00	White-tailed Deer	1.74E+00	1.06E+01
Chromium	5.11E+01	7.50E-03	3.83E-01	White-tailed Deer	1.74E+00	6.67E-01
Copper	2.07E+02	4.00E-01	8.28E+01	White-tailed Deer	1.74E+00	1.44E+02
Lead	2.31E+02	4.50E-02	1.04E+01	White-tailed Deer	1.74E+00	1.81E+01
Mercury	3.60E-02	3.75E-02	1.35E-03	White-tailed Deer	1.74E+00	2.35E-03
Nickel	5.56E+01	3.20E-02	1.78E+00	White-tailed Deer	1.74E+00	3.10E+00
Selenium	1.10E+00	1.60E-02	1.76E-02	White-tailed Deer	1.74E+00	3.06E-02
Thallium	5.00E-01	4.00E-03	2.00E-03	White-tailed Deer	1.74E+00	3.48E-03
Zinc	8.99E+02	1.20E-12	1.08E-09	White-tailed Deer	1.74E+00	1.88E-09

Notes:

COPEC - Chemical of Potential Ecological Concern

mg/kg - milligrams per kilogram

mg/day - millgrams per day

kg/day - kilograms per day

[a] Soil-to-plant bioconcentration factors as reported in USEPA (1999b; EPA 530-D-99-001A) or calculated from log BCF = 1.588 - 0.578 log Kow.

[b] Consumption rate takes into account that 1/2 of the meadow vole's diet, 1/2 of the American robin's diet, and 1/5 of the raccoon's diet is composed of vegetation.

Table 7-20
Exposure Rate Based on Maximum Concentration of COPEC in Plants Due to Uptake
OB/OD RI Report
Fort Riley, Kansas

Parameter	Maximum Concentration Detected in Surface or Subsurface Soil (mg/kg)	Plant Bioconcentration Factor[a]	Maximum Concentration of COPEC in Plants Due to Uptake (mg/kg)	Representative Wildlife Species	Consumption Rate of Plants Based on Diet Composition[b] (kg/day)	Dose Received from Plants (mg/day)
1,1,2,2-Tetrachloroethane	3.20E+00	1.61E+00	5.15E+00	American Robin	1.86E-02	9.58E-02
1,2,4-Trimethylbenzene	8.30E-04	2.53E-01	2.10E-04	American Robin	1.86E-02	3.91E-06
cis-1,2-Dichloroethene	2.60E+00	3.26E+00	8.47E+00	American Robin	1.86E-02	1.58E-01
Isopropylbenzene	1.40E-03	2.97E-01	4.16E-04	American Robin	1.86E-02	7.73E-06
p-Isopropyltoluene	1.60E-02	1.65E-01	2.64E-03	American Robin	1.86E-02	4.92E-05
sec-Butylbenzene	2.70E-03	8.84E-02	2.39E-04	American Robin	1.86E-02	4.44E-06
tert-Butylbenzene	1.10E-03	1.63E-01	1.79E-04	American Robin	1.86E-02	3.34E-06
Trichloroethene	1.81E+02	1.20E+00	2.17E+02	American Robin	1.86E-02	4.04E+00
2,4-Dinitrotoluene	3.70E+01	2.72E+00	1.01E+02	American Robin	1.86E-02	1.87E+00
2,6-Dinitrotoluene	2.80E+00	3.15E+00	8.82E+00	American Robin	1.86E-02	1.64E-01
Di-n-butyl phthalate	2.90E+01	8.84E-02	2.56E+00	American Robin	1.86E-02	4.77E-02
N-Nitrosodiphenylamine	1.70E+00	6.01E-01	1.02E+00	American Robin	1.86E-02	1.90E-02
Perchlorate	8.00E-01	8.72E+04	6.97E+04	American Robin	1.86E-02	1.30E+03
4-Amino-2,6-dinitrotoluene	1.60E-01	3.05E+00	4.88E-01	American Robin	1.86E-02	9.07E-03
4-Nitrotoluene	2.40E-02	1.65E+00	3.97E-02	American Robin	1.86E-02	7.38E-04
Nitroglycerin	2.60E+01	4.48E+00	1.17E+02	American Robin	1.86E-02	2.17E+00
Antimony	6.20E+00	2.00E-01	1.24E+00	American Robin	1.86E-02	2.31E-02
Arsenic	9.20E+00	3.60E-02	3.31E-01	American Robin	1.86E-02	6.16E-03
Cadmium	1.68E+01	3.64E-01	6.12E+00	American Robin	1.86E-02	1.14E-01
Chromium	5.11E+01	7.50E-03	3.83E-01	American Robin	1.86E-02	7.13E-03
Copper	2.07E+02	4.00E-01	8.28E+01	American Robin	1.86E-02	1.54E+00
Lead	2.31E+02	4.50E-02	1.04E+01	American Robin	1.86E-02	1.93E-01
Mercury	3.60E-02	3.75E-02	1.35E-03	American Robin	1.86E-02	2.51E-05
Nickel	5.56E+01	3.20E-02	1.78E+00	American Robin	1.86E-02	3.31E-02
Selenium	1.10E+00	1.60E-02	1.76E-02	American Robin	1.86E-02	3.27E-04
Thallium	5.00E-01	4.00E-03	2.00E-03	American Robin	1.86E-02	3.72E-05
Zinc	8.99E+02	1.20E-12	1.08E-09	American Robin	1.86E-02	2.01E-11

Notes:

COPEC - Chemical of Potential Ecological Concern

mg/kg - milligrams per kilogram

mg/day - millgrams per day

kg/day - kilograms per day

[a] Soil-to-plant bioconcentration factors as reported in USEPA (1999b; EPA 530-D-99-001A) or calculated from log BCF = 1.588 - 0.578 log Kow.

[b] Consumption rate takes into account that 1/2 of the meadow vole's diet, 1/2 of the American robin's diet, and 1/5 of the raccoon's diet is composed of vegetation.

Table 7-21
Exposure Rate Based on Maximum Concentration of COPEC in Fish Due to Uptake
OB/OD RI Report
Fort Riley, Kansas

Parameter	Maximum Concentration Detected in Surface Water (mg/L)	Surface Water to Fish Bioconcentration Factor[a]	Maximum Concentration of COPC in Fish (mg/kg)	Representative Wildlife Species	Consumption Rate of Fish[b] (kg/day)	Dose Received from Consumed Whole Fish (mg/day)
Trichloroethene	9.10E-02	3.88E+01	3.53E+00	Raccoon	4.74E-02	1.67E-01
Benzo(a)pyrene	1.10E-03	5.00E+02	5.50E-01	Raccoon	4.74E-02	2.61E-02
bis(2-Ethylhexyl) phthalate	1.30E-03	7.00E+01	9.10E-02	Raccoon	4.74E-02	4.31E-03
Perchlorate	2.90E-02	8.62E-07	2.50E-08	Raccoon	4.74E-02	1.18E-09
Copper	5.40E-03	7.10E+02	3.83E+00	Raccoon	4.74E-02	1.82E-01
Lead	3.10E-03	9.00E-02	2.79E-04	Raccoon	4.74E-02	1.32E-05
Mercury	3.20E-04	3.53E+03	1.13E+00	Raccoon	4.74E-02	5.35E-02
Nickel	2.10E-03	7.80E+01	1.64E-01	Raccoon	4.74E-02	7.76E-03
Selenium	2.90E-03	1.29E+02	3.74E-01	Raccoon	4.74E-02	1.77E-02
Zinc	4.90E-03	2.06E+03	1.01E+01	Raccoon	4.74E-02	4.78E-01

Notes:

mg/L - milligrams per liter

mg/kg - milligrams per kilograms

kg/day - kilograms per day

mg/day - milligrams per day

[a] Surface Water-to-Fish bioconcentration factors as reported in USEPA (1999b; EPA 530-D-99-001A)

[b] Consumption rate takes into account that 1/5 of the raccoon's diet is composed of fish.

Table 7-22
Chemical Intake Based on Ingestion of Small Mammal Prey by Representative Wildlife Species
OB/OD RI Report
Fort Riley, Kansas

Parameter	Representative Wildlife Species	Total Dose Received from Short-tailed Shrew (mg/day)	Total Dose Received from White-footed Mouse (mg/day)	Total Dose Received from Meadow Vole (mg/day)	Total Dose Received from Eastern Cottontail Rabbit (mg/day)	Average Dose Received from Consuming Small Mammals (mg/day)	Average Mass of Small Mammal Prey (kg)	Predator Consumption Rate of Small Mammal Prey (kg/day)	Number of Small Mammal Prey Consumed Each Day	Dose Received from Small Mammal Prey (mg/day)
1,1,2,2-Tetrachloroethane	Red Fox	1.84E-01	1.77E-02	6.34E-02	1.27E+00	3.83E-01	3.20E-01	4.50E-01	1.41E+00	5.38E-01
1,2,4-Trimethylbenzene	Red Fox	6.66E-04	7.70E-07	1.85E-04	6.21E-05	2.29E-04	3.20E-01	4.50E-01	1.41E+00	3.21E-04
cis-1,2-Dichloroethene	Red Fox	0.00E+00	2.88E-02	2.12E-02	2.01E+00	5.14E-01	3.20E-01	4.50E-01	1.41E+00	7.23E-01
Isopropylbenzene	Red Fox	8.97E-04	1.51E-06	2.50E-04	1.19E-04	3.17E-04	3.20E-01	4.50E-01	1.41E+00	4.45E-04
p-Isopropyltoluene	Red Fox	2.35E-02	1.01E-05	6.52E-03	8.65E-04	7.72E-03	3.20E-01	4.50E-01	1.41E+00	1.08E-02
sec-Butylbenzene	Red Fox	9.61E-03	9.95E-07	2.67E-03	9.68E-05	3.09E-03	3.20E-01	4.50E-01	1.41E+00	4.35E-03
tert-Butylbenzene	Red Fox	1.64E-03	6.85E-07	4.57E-04	5.89E-05	5.40E-04	3.20E-01	4.50E-01	1.41E+00	7.59E-04
Trichloroethene	Red Fox	3.00E-04	7.40E-01	5.44E-01	5.15E+01	1.32E+01	3.20E-01	4.50E-01	1.41E+00	1.85E+01
Benzo(a)pyrene	Red Fox	3.63E-06	7.26E-06	6.60E-06	1.28E-04	3.63E-05	3.20E-01	4.50E-01	1.41E+00	5.10E-05
bis(2-Ethylhexyl) phthalate	Red Fox	4.29E-06	8.58E-06	7.80E-06	1.51E-04	4.29E-05	3.20E-01	4.50E-01	1.41E+00	6.02E-05
2,4-Dinitrotoluene	Red Fox	1.07E+00	3.45E-01	5.41E-01	2.44E+01	6.59E+00	3.20E-01	4.50E-01	1.41E+00	9.26E+00
2,6-Dinitrotoluene	Red Fox	6.63E-02	3.02E-02	3.99E-02	2.13E+00	5.67E-01	3.20E-01	4.50E-01	1.41E+00	7.97E-01
Di-n-butyl phthalate	Red Fox	1.03E+02	1.07E-02	2.87E+01	1.04E+00	3.32E+01	3.20E-01	4.50E-01	1.41E+00	4.67E+01
N-Nitrosodiphenylamine	Red Fox	4.02E-01	3.59E-03	1.14E-01	2.67E-01	1.97E-01	3.20E-01	4.50E-01	1.41E+00	2.76E-01
Perchlorate	Red Fox	1.25E-04	2.37E+02	1.74E+02	1.65E+04	4.24E+03	3.20E-01	4.50E-01	1.41E+00	5.95E+03
4-Amino-2,6-dinitrotoluene	Red Fox	3.96E-03	1.67E-03	2.29E-03	1.18E-01	3.15E-02	3.20E-01	4.50E-01	1.41E+00	4.42E-02
4-Nitrotoluene	Red Fox	1.38E-03	1.36E-04	4.77E-04	9.76E-03	2.94E-03	3.20E-01	4.50E-01	1.41E+00	4.13E-03
Nitroglycerin	Red Fox	3.85E-01	3.98E-01	3.93E-01	2.80E+01	7.30E+00	3.20E-01	4.50E-01	1.41E+00	1.03E+01
Antimony	Red Fox	1.95E-02	4.64E-03	7.25E-03	3.86E-01	1.04E-01	3.20E-01	4.50E-01	1.41E+00	1.47E-01
Arsenic	Red Fox	1.99E-02	1.75E-03	4.46E-03	2.16E-01	6.04E-02	3.20E-01	4.50E-01	1.41E+00	8.49E-02
Cadmium	Red Fox	1.65E-01	2.19E-02	5.76E-02	1.70E+00	4.86E-01	3.20E-01	4.50E-01	1.41E+00	6.83E-01
Chromium	Red Fox	6.44E-02	4.78E-03	8.37E-03	8.52E-01	2.32E-01	3.20E-01	4.50E-01	1.41E+00	3.27E-01
Copper	Red Fox	3.17E-01	2.96E-01	2.53E-01	2.27E+01	5.89E+00	3.20E-01	4.50E-01	1.41E+00	8.28E+00
Lead	Red Fox	3.33E-01	5.11E-02	7.11E-02	5.91E+00	1.59E+00	3.20E-01	4.50E-01	1.41E+00	2.23E+00
Mercury	Red Fox	5.61E-05	9.15E-06	1.32E-05	8.93E-04	2.43E-04	3.20E-01	4.50E-01	1.41E+00	3.41E-04
Nickel	Red Fox	7.51E-02	9.84E-03	1.39E-02	1.25E+00	3.37E-01	3.20E-01	4.50E-01	1.41E+00	4.74E-01
Selenium	Red Fox	3.47E-03	1.54E-04	7.98E-04	2.09E-02	6.33E-03	3.20E-01	4.50E-01	1.41E+00	8.90E-03
Thallium	Red Fox	1.58E-03	4.08E-05	3.40E-04	7.92E-03	2.47E-03	3.20E-01	4.50E-01	1.41E+00	3.47E-03
Zinc	Red Fox	5.58E+00	6.12E-02	1.37E+00	1.34E+01	5.10E+00	3.20E-01	4.50E-01	1.41E+00	7.17E+00

Notes:
mg/day - milligrams per day
kg - kilograms
kg/day - kilogram per day

Table 7-22
Chemical Intake Based on Ingestion of Small Mammal Prey by Representative Wildlife Species
OB/OD RI Report
Fort Riley, Kansas

Parameter	Representative Wildlife Species	Total Dose Received from Short-tailed Shrew (mg/day)	Total Dose Received from White-footed Mouse (mg/day)	Total Dose Received from Meadow Vole (mg/day)	Total Dose Received from Eastern Cottontail Rabbit (mg/day)	Average Dose Received from Consuming Small Mammals (mg/day)	Average Mass of Small Mammal Prey (kg)	Predator Consumption Rate of Small Mammal Prey (kg/day)	Number of Small Mammal Prey Consumed Each Day	Dose Received from Small Mammal Prey (mg/day)
1,1,2,2-Tetrachloroethane	Raccoon	1.84E-01	1.77E-02	6.34E-02	1.27E+00	3.83E-01	3.20E-01	4.74E-02	1.48E-01	5.67E-02
1,2,4-Trimethylbenzene	Raccoon	6.66E-04	7.70E-07	1.85E-04	6.21E-05	2.29E-04	3.20E-01	4.74E-02	1.48E-01	3.39E-05
cis-1,2-Dichloroethene	Raccoon	0.00E+00	2.88E-02	2.12E-02	2.01E+00	5.14E-01	3.20E-01	4.74E-02	1.48E-01	7.61E-02
Isopropylbenzene	Raccoon	8.97E-04	1.51E-06	2.50E-04	1.19E-04	3.17E-04	3.20E-01	4.74E-02	1.48E-01	4.69E-05
p-Isopropyltoluene	Raccoon	2.35E-02	1.01E-05	6.52E-03	8.65E-04	7.72E-03	3.20E-01	4.74E-02	1.48E-01	1.14E-03
sec-Butylbenzene	Raccoon	9.61E-03	9.95E-07	2.67E-03	9.68E-05	3.09E-03	3.20E-01	4.74E-02	1.48E-01	4.58E-04
tert-Butylbenzene	Raccoon	1.64E-03	6.85E-07	4.57E-04	5.89E-05	5.40E-04	3.20E-01	4.74E-02	1.48E-01	8.00E-05
Trichloroethene	Raccoon	3.00E-04	7.40E-01	5.44E-01	5.15E+01	1.32E+01	3.20E-01	4.74E-02	1.48E-01	1.95E+00
Benzo(a)pyrene	Raccoon	3.63E-06	7.26E-06	6.60E-06	1.28E-04	3.63E-05	3.20E-01	4.74E-02	1.48E-01	5.37E-06
bis(2-Ethylhexyl) phthalate	Raccoon	4.29E-06	8.58E-06	7.80E-06	1.51E-04	4.29E-05	3.20E-01	4.74E-02	1.48E-01	6.34E-06
2,4-Dinitrotoluene	Raccoon	1.07E+00	3.45E-01	5.41E-01	2.44E+01	6.59E+00	3.20E-01	4.74E-02	1.48E-01	9.75E-01
2,6-Dinitrotoluene	Raccoon	6.63E-02	3.02E-02	3.99E-02	2.13E+00	5.67E-01	3.20E-01	4.74E-02	1.48E-01	8.39E-02
Di-n-butyl phthalate	Raccoon	1.03E+02	1.07E-02	2.87E+01	1.04E+00	3.32E+01	3.20E-01	4.74E-02	1.48E-01	4.92E+00
N-Nitrosodiphenylamine	Raccoon	4.02E-01	3.59E-03	1.14E-01	2.67E-01	1.97E-01	3.20E-01	4.74E-02	1.48E-01	2.91E-02
Perchlorate	Raccoon	1.25E-04	2.37E+02	1.74E+02	1.65E+04	4.24E+03	3.20E-01	4.74E-02	1.48E-01	6.27E+02
4-Amino-2,6-dinitrotoluene	Raccoon	3.96E-03	1.67E-03	2.29E-03	1.18E-01	3.15E-02	3.20E-01	4.74E-02	1.48E-01	4.66E-03
4-Nitrotoluene	Raccoon	1.38E-03	1.36E-04	4.77E-04	9.76E-03	2.94E-03	3.20E-01	4.74E-02	1.48E-01	4.35E-04
Nitroglycerin	Raccoon	3.85E-01	3.98E-01	3.93E-01	2.80E+01	7.30E+00	3.20E-01	4.74E-02	1.48E-01	1.08E+00
Antimony	Raccoon	1.95E-02	4.64E-03	7.25E-03	3.86E-01	1.04E-01	3.20E-01	4.74E-02	1.48E-01	1.55E-02
Arsenic	Raccoon	1.99E-02	1.75E-03	4.46E-03	2.16E-01	6.04E-02	3.20E-01	4.74E-02	1.48E-01	8.94E-03
Cadmium	Raccoon	1.65E-01	2.19E-02	5.76E-02	1.70E+00	4.86E-01	3.20E-01	4.74E-02	1.48E-01	7.19E-02
Chromium	Raccoon	6.44E-02	4.78E-03	8.37E-03	8.52E-01	2.32E-01	3.20E-01	4.74E-02	1.48E-01	3.44E-02
Copper	Raccoon	3.17E-01	2.96E-01	2.53E-01	2.27E+01	5.89E+00	3.20E-01	4.74E-02	1.48E-01	8.72E-01
Lead	Raccoon	3.33E-01	5.11E-02	7.11E-02	5.91E+00	1.59E+00	3.20E-01	4.74E-02	1.48E-01	2.35E-01
Mercury	Raccoon	5.61E-05	9.15E-06	1.32E-05	8.93E-04	2.43E-04	3.20E-01	4.74E-02	1.48E-01	3.60E-05
Nickel	Raccoon	7.51E-02	9.84E-03	1.39E-02	1.25E+00	3.37E-01	3.20E-01	4.74E-02	1.48E-01	4.99E-02
Selenium	Raccoon	3.47E-03	1.54E-04	7.98E-04	2.09E-02	6.33E-03	3.20E-01	4.74E-02	1.48E-01	9.37E-04
Thallium	Raccoon	1.58E-03	4.08E-05	3.40E-04	7.92E-03	2.47E-03	3.20E-01	4.74E-02	1.48E-01	3.66E-04
Zinc	Raccoon	5.58E+00	6.12E-02	1.37E+00	1.34E+01	5.10E+00	3.20E-01	4.74E-02	1.48E-01	7.55E-01

Notes:

mg/day - milligrams per day

kg - kilograms

kg/day - kilogram per day

Table 7-22
Chemical Intake Based on Ingestion of Small Mammal Prey by Representative Wildlife Species
OB/OD RI Report
Fort Riley, Kansas

Parameter	Representative Wildlife Species	Total Dose Received from Short-tailed Shrew (mg/day)	Total Dose Received from White-footed Mouse (mg/day)	Total Dose Received from Meadow Vole (mg/day)	Total Dose Received from Eastern Cottontail Rabbit (mg/day)	Average Dose Received from Consuming Small Mammals (mg/day)	Average Mass of Small Mammal Prey (kg)	Predator Consumption Rate of Small Mammal Prey (kg/day)	Number of Small Mammal Prey Consumed Each Day	Dose Received from Small Mammal Prey (mg/day)
1,1,2,2-Tetrachloroethane	Red-tailed Hawk	1.84E-01	1.77E-02	6.34E-02	1.27E+00	3.83E-01	3.20E-01	1.09E-01	3.40E-01	1.30E-01
1,2,4-Trimethylbenzene	Red-tailed Hawk	6.66E-04	7.70E-07	1.85E-04	6.21E-05	2.29E-04	3.20E-01	1.09E-01	3.40E-01	7.78E-05
cis-1,2-Dichloroethene	Red-tailed Hawk	0.00E+00	2.88E-02	2.12E-02	2.01E+00	5.14E-01	3.20E-01	1.09E-01	3.40E-01	1.75E-01
Isopropylbenzene	Red-tailed Hawk	8.97E-04	1.51E-06	2.50E-04	1.19E-04	3.17E-04	3.20E-01	1.09E-01	3.40E-01	1.08E-04
p-Isopropyltoluene	Red-tailed Hawk	2.35E-02	1.01E-05	6.52E-03	8.65E-04	7.72E-03	3.20E-01	1.09E-01	3.40E-01	2.63E-03
sec-Butylbenzene	Red-tailed Hawk	9.61E-03	9.95E-07	2.67E-03	9.68E-05	3.09E-03	3.20E-01	1.09E-01	3.40E-01	1.05E-03
tert-Butylbenzene	Red-tailed Hawk	1.64E-03	6.85E-07	4.57E-04	5.89E-05	5.40E-04	3.20E-01	1.09E-01	3.40E-01	1.84E-04
Trichloroethene	Red-tailed Hawk	3.00E-04	7.40E-01	5.44E-01	5.15E+01	1.32E+01	3.20E-01	1.09E-01	3.40E-01	4.49E+00
Benzo(a)pyrene	Red-tailed Hawk	3.63E-06	7.26E-06	6.60E-06	1.28E-04	3.63E-05	3.20E-01	1.09E-01	3.40E-01	1.23E-05
bis(2-Ethylhexyl) phthalate	Red-tailed Hawk	4.29E-06	8.58E-06	7.80E-06	1.51E-04	4.29E-05	3.20E-01	1.09E-01	3.40E-01	1.46E-05
2,4-Dinitrotoluene	Red-tailed Hawk	1.07E+00	3.45E-01	5.41E-01	2.44E+01	6.59E+00	3.20E-01	1.09E-01	3.40E-01	2.24E+00
2,6-Dinitrotoluene	Red-tailed Hawk	6.63E-02	3.02E-02	3.99E-02	2.13E+00	5.67E-01	3.20E-01	1.09E-01	3.40E-01	1.93E-01
Di-n-butyl phthalate	Red-tailed Hawk	1.03E+02	1.07E-02	2.87E+01	1.04E+00	3.32E+01	3.20E-01	1.09E-01	3.40E-01	1.13E+01
N-Nitrosodiphenylamine	Red-tailed Hawk	4.02E-01	3.59E-03	1.14E-01	2.67E-01	1.97E-01	3.20E-01	1.09E-01	3.40E-01	6.70E-02
Perchlorate	Red-tailed Hawk	1.25E-04	2.37E+02	1.74E+02	1.65E+04	4.24E+03	3.20E-01	1.09E-01	3.40E-01	1.44E+03
4-Amino-2,6-dinitrotoluene	Red-tailed Hawk	3.96E-03	1.67E-03	2.29E-03	1.18E-01	3.15E-02	3.20E-01	1.09E-01	3.40E-01	1.07E-02
4-Nitrotoluene	Red-tailed Hawk	1.38E-03	1.36E-04	4.77E-04	9.76E-03	2.94E-03	3.20E-01	1.09E-01	3.40E-01	9.99E-04
Nitroglycerin	Red-tailed Hawk	3.85E-01	3.98E-01	3.93E-01	2.80E+01	7.30E+00	3.20E-01	1.09E-01	3.40E-01	2.48E+00
Antimony	Red-tailed Hawk	1.95E-02	4.64E-03	7.25E-03	3.86E-01	1.04E-01	3.20E-01	1.09E-01	3.40E-01	3.55E-02
Arsenic	Red-tailed Hawk	1.99E-02	1.75E-03	4.46E-03	2.16E-01	6.04E-02	3.20E-01	1.09E-01	3.40E-01	2.06E-02
Cadmium	Red-tailed Hawk	1.65E-01	2.19E-02	5.76E-02	1.70E+00	4.86E-01	3.20E-01	1.09E-01	3.40E-01	1.65E-01
Chromium	Red-tailed Hawk	6.44E-02	4.78E-03	8.37E-03	8.52E-01	2.32E-01	3.20E-01	1.09E-01	3.40E-01	7.91E-02
Copper	Red-tailed Hawk	3.17E-01	2.96E-01	2.53E-01	2.27E+01	5.89E+00	3.20E-01	1.09E-01	3.40E-01	2.01E+00
Lead	Red-tailed Hawk	3.33E-01	5.11E-02	7.11E-02	5.91E+00	1.59E+00	3.20E-01	1.09E-01	3.40E-01	5.41E-01
Mercury	Red-tailed Hawk	5.61E-05	9.15E-06	1.32E-05	8.93E-04	2.43E-04	3.20E-01	1.09E-01	3.40E-01	8.27E-05
Nickel	Red-tailed Hawk	7.51E-02	9.84E-03	1.39E-02	1.25E+00	3.37E-01	3.20E-01	1.09E-01	3.40E-01	1.15E-01
Selenium	Red-tailed Hawk	3.47E-03	1.54E-04	7.98E-04	2.09E-02	6.33E-03	3.20E-01	1.09E-01	3.40E-01	2.15E-03
Thallium	Red-tailed Hawk	1.58E-03	4.08E-05	3.40E-04	7.92E-03	2.47E-03	3.20E-01	1.09E-01	3.40E-01	8.41E-04
Zinc	Red-tailed Hawk	5.58E+00	6.12E-02	1.37E+00	1.34E+01	5.10E+00	3.20E-01	1.09E-01	3.40E-01	1.74E+00

Notes:
mg/day - milligrams per day
kg - kilograms
kg/day - kilogram per day

Table 7-23
Total Exposure for Representative Wildlife Species Based on Consumption of Surface Water, Soils, Surface Water Sediments, and Food
OB/OD RI Report
Fort Riley, Kansas

Parameter	Representative Wildlife Species	Maximum Dose Received from Consuming Soil (mg/day)	Maximum Dose Received from Consuming Sediments (mg/day)	Maximum Dose Received from Consuming Surface Water (mg/day)	Maximum Dose Received from Consuming Benthic Invertebrates (mg/day)	Maximum Dose Received from Consuming Soil Invertebrates (mg/day)	Maximum Dose Received from Consuming Terrestrial Plants (mg/day)	Maximum Dose Received from Consuming Whole Fish (mg/day)	Maximum Dose Received from Consuming Small Mammals (mg/day)	Total Dose Received (mg/day)
1,1,2,2-Tetrachloroethane	Short-tailed Shrew	3.63E-03	0.00E+00	0.00E+00	0.00E+00	1.81E-01	0.00E+00	0.00E+00	0.00E+00	1.84E-01
1,2,4-Trimethylbenzene	Short-tailed Shrew	9.71E-07	0.00E+00	0.00E+00	0.00E+00	6.65E-04	0.00E+00	0.00E+00	0.00E+00	6.66E-04
cis-1,2-Dichloroethene	Short-tailed Shrew	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Isopropylbenzene	Short-tailed Shrew	1.64E-06	0.00E+00	0.00E+00	0.00E+00	8.95E-04	0.00E+00	0.00E+00	0.00E+00	8.97E-04
p-Isopropyltoluene	Short-tailed Shrew	1.87E-05	0.00E+00	0.00E+00	0.00E+00	2.35E-02	0.00E+00	0.00E+00	0.00E+00	2.35E-02
sec-Butylbenzene	Short-tailed Shrew	3.16E-06	0.00E+00	0.00E+00	0.00E+00	9.60E-03	0.00E+00	0.00E+00	0.00E+00	9.61E-03
tert-Butylbenzene	Short-tailed Shrew	1.29E-06	0.00E+00	0.00E+00	0.00E+00	1.64E-03	0.00E+00	0.00E+00	0.00E+00	1.64E-03
Trichloroethene	Short-tailed Shrew	0.00E+00	0.00E+00	3.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.00E-04
Benzo(a)pyrene	Short-tailed Shrew	0.00E+00	0.00E+00	3.63E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.63E-06
bis(2-Ethylhexyl) phthalate	Short-tailed Shrew	0.00E+00	0.00E+00	4.29E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.29E-06
2,4-Dinitrotoluene	Short-tailed Shrew	4.33E-02	0.00E+00	0.00E+00	0.00E+00	1.03E+00	0.00E+00	0.00E+00	0.00E+00	1.07E+00
2,6-Dinitrotoluene	Short-tailed Shrew	3.28E-03	0.00E+00	0.00E+00	0.00E+00	6.30E-02	0.00E+00	0.00E+00	0.00E+00	6.63E-02
Di-n-butyl phthalate	Short-tailed Shrew	3.39E-02	0.00E+00	0.00E+00	0.00E+00	1.03E+02	0.00E+00	0.00E+00	0.00E+00	1.03E+02
N-Nitrosodiphenylamine	Short-tailed Shrew	1.99E-03	0.00E+00	0.00E+00	0.00E+00	4.00E-01	0.00E+00	0.00E+00	0.00E+00	4.02E-01
Perchlorate	Short-tailed Shrew	2.93E-05	0.00E+00	9.57E-05	0.00E+00	2.86E-10	0.00E+00	0.00E+00	0.00E+00	1.25E-04
4-Amino-2,6-dinitrotoluene	Short-tailed Shrew	1.87E-04	0.00E+00	0.00E+00	0.00E+00	3.77E-03	0.00E+00	0.00E+00	0.00E+00	3.96E-03
4-Nitrotoluene	Short-tailed Shrew	2.81E-05	0.00E+00	0.00E+00	0.00E+00	1.35E-03	0.00E+00	0.00E+00	0.00E+00	1.38E-03
Nitroglycerin	Short-tailed Shrew	3.04E-02	0.00E+00	0.00E+00	0.00E+00	3.55E-01	0.00E+00	0.00E+00	0.00E+00	3.85E-01
Antimony	Short-tailed Shrew	7.25E-03	0.00E+00	0.00E+00	0.00E+00	1.23E-02	0.00E+00	0.00E+00	0.00E+00	1.95E-02
Arsenic	Short-tailed Shrew	1.08E-02	0.00E+00	0.00E+00	0.00E+00	9.11E-03	0.00E+00	0.00E+00	0.00E+00	1.99E-02
Cadmium	Short-tailed Shrew	1.97E-02	0.00E+00	0.00E+00	0.00E+00	1.45E-01	0.00E+00	0.00E+00	0.00E+00	1.65E-01
Chromium	Short-tailed Shrew	5.98E-02	0.00E+00	0.00E+00	0.00E+00	4.60E-03	0.00E+00	0.00E+00	0.00E+00	6.44E-02
Copper	Short-tailed Shrew	2.42E-01	0.00E+00	1.78E-05	0.00E+00	7.45E-02	0.00E+00	0.00E+00	0.00E+00	3.17E-01
Lead	Short-tailed Shrew	2.70E-01	0.00E+00	1.02E-05	0.00E+00	6.24E-02	0.00E+00	0.00E+00	0.00E+00	3.33E-01
Mercury	Short-tailed Shrew	4.21E-05	0.00E+00	1.06E-06	0.00E+00	1.30E-05	0.00E+00	0.00E+00	0.00E+00	5.61E-05
Nickel	Short-tailed Shrew	6.51E-02	0.00E+00	6.93E-06	0.00E+00	1.00E-02	0.00E+00	0.00E+00	0.00E+00	7.51E-02
Selenium	Short-tailed Shrew	1.29E-03	0.00E+00	9.57E-06	0.00E+00	2.18E-03	0.00E+00	0.00E+00	0.00E+00	3.47E-03
Thallium	Short-tailed Shrew	5.85E-04	0.00E+00	0.00E+00	0.00E+00	9.90E-04	0.00E+00	0.00E+00	0.00E+00	1.58E-03
Zinc	Short-tailed Shrew	1.05E+00	0.00E+00	1.62E-05	0.00E+00	4.53E+00	0.00E+00	0.00E+00	0.00E+00	5.58E+00

Notes:

mg/day - milligrams per day

A value of 0.00E+00 indicates that the chemical was not ingested by the receptor species because it was not encountered due to a species life history.

Table 7-23
Total Exposure for Representative Wildlife Species Based on Consumption of Surface Water, Soils, Surface Water Sediments, and Food
OB/OD RI Report
Fort Riley, Kansas

Parameter	Representative Wildlife Species	Maximum Dose Received from Consuming Soil (mg/day)	Maximum Dose Received from Consuming Sediments (mg/day)	Maximum Dose Received from Consuming Surface Water (mg/day)	Maximum Dose Received from Consuming Benthic Invertebrates (mg/day)	Maximum Dose Received from Consuming Soil Invertebrates (mg/day)	Maximum Dose Received from Consuming Terrestrial Plants (mg/day)	Maximum Dose Received from Consuming Whole Fish (mg/day)	Maximum Dose Received from Consuming Small Mammals (mg/day)	Total Dose Received (mg/day)
1,1,2,2-Tetrachloroethane	White-footed Mouse	2.11E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.75E-02	0.00E+00	0.00E+00	1.77E-02
1,2,4-Trimethylbenzene	White-footed Mouse	5.64E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.14E-07	0.00E+00	0.00E+00	7.70E-07
cis-1,2-Dichloroethene	White-footed Mouse	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.88E-02	0.00E+00	0.00E+00	2.88E-02
Isopropylbenzene	White-footed Mouse	9.52E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.41E-06	0.00E+00	0.00E+00	1.51E-06
p-Isopropyltoluene	White-footed Mouse	1.09E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.99E-06	0.00E+00	0.00E+00	1.01E-05
sec-Butylbenzene	White-footed Mouse	1.84E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.12E-07	0.00E+00	0.00E+00	9.95E-07
tert-Butylbenzene	White-footed Mouse	7.48E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.10E-07	0.00E+00	0.00E+00	6.85E-07
Trichloroethene	White-footed Mouse	0.00E+00	0.00E+00	6.01E-04	0.00E+00	0.00E+00	7.39E-01	0.00E+00	0.00E+00	7.40E-01
Benzo(a)pyrene	White-footed Mouse	0.00E+00	0.00E+00	7.26E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.26E-06
bis(2-Ethylhexyl) phthalate	White-footed Mouse	0.00E+00	0.00E+00	8.58E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.58E-06
2,4-Dinitrotoluene	White-footed Mouse	2.52E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.42E-01	0.00E+00	0.00E+00	3.45E-01
2,6-Dinitrotoluene	White-footed Mouse	1.90E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.00E-02	0.00E+00	0.00E+00	3.02E-02
Di-n-butyl phthalate	White-footed Mouse	1.97E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.72E-03	0.00E+00	0.00E+00	1.07E-02
N-Nitrosodiphenylamine	White-footed Mouse	1.16E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.47E-03	0.00E+00	0.00E+00	3.59E-03
Perchlorate	White-footed Mouse	1.70E-06	0.00E+00	1.91E-04	0.00E+00	0.00E+00	2.37E+02	0.00E+00	0.00E+00	2.37E+02
4-Amino-2,6-dinitrotoluene	White-footed Mouse	1.09E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.66E-03	0.00E+00	0.00E+00	1.67E-03
4-Nitrotoluene	White-footed Mouse	1.63E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.35E-04	0.00E+00	0.00E+00	1.36E-04
Nitroglycerin	White-footed Mouse	1.77E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.96E-01	0.00E+00	0.00E+00	3.98E-01
Antimony	White-footed Mouse	4.22E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.22E-03	0.00E+00	0.00E+00	4.64E-03
Arsenic	White-footed Mouse	6.26E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.13E-03	0.00E+00	0.00E+00	1.75E-03
Cadmium	White-footed Mouse	1.14E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.08E-02	0.00E+00	0.00E+00	2.19E-02
Chromium	White-footed Mouse	3.47E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.30E-03	0.00E+00	0.00E+00	4.78E-03
Copper	White-footed Mouse	1.41E-02	0.00E+00	3.56E-05	0.00E+00	0.00E+00	2.82E-01	0.00E+00	0.00E+00	2.96E-01
Lead	White-footed Mouse	1.57E-02	0.00E+00	2.05E-05	0.00E+00	0.00E+00	3.53E-02	0.00E+00	0.00E+00	5.11E-02
Mercury	White-footed Mouse	2.45E-06	0.00E+00	2.11E-06	0.00E+00	0.00E+00	4.59E-06	0.00E+00	0.00E+00	9.15E-06
Nickel	White-footed Mouse	3.78E-03	0.00E+00	1.39E-05	0.00E+00	0.00E+00	6.05E-03	0.00E+00	0.00E+00	9.84E-03
Selenium	White-footed Mouse	7.48E-05	0.00E+00	1.91E-05	0.00E+00	0.00E+00	5.98E-05	0.00E+00	0.00E+00	1.54E-04
Thallium	White-footed Mouse	3.40E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.80E-06	0.00E+00	0.00E+00	4.08E-05
Zinc	White-footed Mouse	6.11E-02	0.00E+00	3.23E-05	0.00E+00	0.00E+00	3.67E-12	0.00E+00	0.00E+00	6.12E-02

Notes:

mg/day - milligrams per day

A value of 0.00E+00 indicates that the chemical was not ingested by the receptor species because it was not encountered due to a species life history.

Table 7-23
Total Exposure for Representative Wildlife Species Based on Consumption of Surface Water, Soils, Surface Water Sediments, and Food
OB/OD RI Report
Fort Riley, Kansas

Parameter	Representative Wildlife Species	Maximum Dose Received from Consuming Soil (mg/day)	Maximum Dose Received from Consuming Sediments (mg/day)	Maximum Dose Received from Consuming Surface Water (mg/day)	Maximum Dose Received from Consuming Benthic Invertebrates (mg/day)	Maximum Dose Received from Consuming Soil Invertebrates (mg/day)	Maximum Dose Received from Consuming Terrestrial Plants (mg/day)	Maximum Dose Received from Consuming Whole Fish (mg/day)	Maximum Dose Received from Consuming Small Mammals (mg/day)	Total Dose Received (mg/day)
1,1,2,2-Tetrachloroethane	Meadow Vole	3.72E-04	0.00E+00	0.00E+00	0.00E+00	5.02E-02	1.29E-02	0.00E+00	0.00E+00	6.34E-02
1,2,4-Trimethylbenzene	Meadow Vole	9.96E-08	0.00E+00	0.00E+00	0.00E+00	1.85E-04	5.25E-07	0.00E+00	0.00E+00	1.85E-04
cis-1,2-Dichloroethene	Meadow Vole	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.12E-02	0.00E+00	0.00E+00	2.12E-02
Isopropylbenzene	Meadow Vole	1.68E-07	0.00E+00	0.00E+00	0.00E+00	2.49E-04	1.04E-06	0.00E+00	0.00E+00	2.50E-04
p-Isopropyltoluene	Meadow Vole	1.92E-06	0.00E+00	0.00E+00	0.00E+00	6.52E-03	6.61E-06	0.00E+00	0.00E+00	6.52E-03
sec-Butylbenzene	Meadow Vole	3.24E-07	0.00E+00	0.00E+00	0.00E+00	2.67E-03	5.97E-07	0.00E+00	0.00E+00	2.67E-03
tert-Butylbenzene	Meadow Vole	1.32E-07	0.00E+00	0.00E+00	0.00E+00	4.56E-04	4.49E-07	0.00E+00	0.00E+00	4.57E-04
Trichloroethene	Meadow Vole	0.00E+00	0.00E+00	5.46E-04	0.00E+00	0.00E+00	5.43E-01	0.00E+00	0.00E+00	5.44E-01
Benzo(a)pyrene	Meadow Vole	0.00E+00	0.00E+00	6.60E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.60E-06
bis(2-Ethylhexyl) phthalate	Meadow Vole	0.00E+00	0.00E+00	7.80E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.80E-06
2,4-Dinitrotoluene	Meadow Vole	4.44E-03	0.00E+00	0.00E+00	0.00E+00	2.85E-01	2.52E-01	0.00E+00	0.00E+00	5.41E-01
2,6-Dinitrotoluene	Meadow Vole	3.36E-04	0.00E+00	0.00E+00	0.00E+00	1.75E-02	2.21E-02	0.00E+00	0.00E+00	3.99E-02
Di-n-butyl phthalate	Meadow Vole	3.48E-03	0.00E+00	0.00E+00	0.00E+00	2.87E+01	6.41E-03	0.00E+00	0.00E+00	2.87E+01
N-Nitrosodiphenylamine	Meadow Vole	2.04E-04	0.00E+00	0.00E+00	0.00E+00	1.11E-01	2.55E-03	0.00E+00	0.00E+00	1.14E-01
Perchlorate	Meadow Vole	3.00E-06	0.00E+00	1.74E-04	0.00E+00	7.93E-11	1.74E+02	0.00E+00	0.00E+00	1.74E+02
4-Amino-2,6-dinitrotoluene	Meadow Vole	1.92E-05	0.00E+00	0.00E+00	0.00E+00	1.05E-03	1.22E-03	0.00E+00	0.00E+00	2.29E-03
4-Nitrotoluene	Meadow Vole	2.88E-06	0.00E+00	0.00E+00	0.00E+00	3.75E-04	9.92E-05	0.00E+00	0.00E+00	4.77E-04
Nitroglycerin	Meadow Vole	3.12E-03	0.00E+00	0.00E+00	0.00E+00	9.86E-02	2.91E-01	0.00E+00	0.00E+00	3.93E-01
Antimony	Meadow Vole	7.44E-04	0.00E+00	0.00E+00	0.00E+00	3.41E-03	3.10E-03	0.00E+00	0.00E+00	7.25E-03
Arsenic	Meadow Vole	1.10E-03	0.00E+00	0.00E+00	0.00E+00	2.53E-03	8.28E-04	0.00E+00	0.00E+00	4.46E-03
Cadmium	Meadow Vole	2.02E-03	0.00E+00	0.00E+00	0.00E+00	4.03E-02	1.53E-02	0.00E+00	0.00E+00	5.76E-02
Chromium	Meadow Vole	6.13E-03	0.00E+00	0.00E+00	0.00E+00	1.28E-03	9.58E-04	0.00E+00	0.00E+00	8.37E-03
Copper	Meadow Vole	2.48E-02	0.00E+00	3.24E-05	0.00E+00	2.07E-02	2.07E-01	0.00E+00	0.00E+00	2.53E-01
Lead	Meadow Vole	2.77E-02	0.00E+00	1.86E-05	0.00E+00	1.73E-02	2.60E-02	0.00E+00	0.00E+00	7.11E-02
Mercury	Meadow Vole	4.32E-06	0.00E+00	1.92E-06	0.00E+00	3.60E-06	3.38E-06	0.00E+00	0.00E+00	1.32E-05
Nickel	Meadow Vole	6.67E-03	0.00E+00	1.26E-05	0.00E+00	2.78E-03	4.45E-03	0.00E+00	0.00E+00	1.39E-02
Selenium	Meadow Vole	1.32E-04	0.00E+00	1.74E-05	0.00E+00	6.05E-04	4.40E-05	0.00E+00	0.00E+00	7.98E-04
Thallium	Meadow Vole	6.00E-05	0.00E+00	0.00E+00	0.00E+00	2.75E-04	5.00E-06	0.00E+00	0.00E+00	3.40E-04
Zinc	Meadow Vole	1.08E-01	0.00E+00	2.94E-05	0.00E+00	1.26E+00	2.70E-12	0.00E+00	0.00E+00	1.37E+00

Notes:

mg/day - milligrams per day

A value of 0.00E+00 indicates that the chemical was not ingested by the receptor species because it was not encountered due to a species life history.

Table 7-23
Total Exposure for Representative Wildlife Species Based on Consumption of Surface Water, Soils, Surface Water Sediments, and Food
OB/OD RI Report
Fort Riley, Kansas

Parameter	Representative Wildlife Species	Maximum Dose Received from Consuming Soil (mg/day)	Maximum Dose Received from Consuming Sediments (mg/day)	Maximum Dose Received from Consuming Surface Water (mg/day)	Maximum Dose Received from Consuming Benthic Invertebrates (mg/day)	Maximum Dose Received from Consuming Soil Invertebrates (mg/day)	Maximum Dose Received from Consuming Terrestrial Plants (mg/day)	Maximum Dose Received from Consuming Whole Fish (mg/day)	Maximum Dose Received from Consuming Small Mammals (mg/day)	Total Dose Received (mg/day)
1,1,2,2-Tetrachloroethane	Eastern Cottontail Rabbit	4.62E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.22E+00	0.00E+00	0.00E+00	1.27E+00
1,2,4-Trimethylbenzene	Eastern Cottontail Rabbit	1.24E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.98E-05	0.00E+00	0.00E+00	6.21E-05
cis-1,2-Dichloroethene	Eastern Cottontail Rabbit	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.01E+00	0.00E+00	0.00E+00	2.01E+00
Isopropylbenzene	Eastern Cottontail Rabbit	2.09E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.85E-05	0.00E+00	0.00E+00	1.19E-04
p-Isopropyltoluene	Eastern Cottontail Rabbit	2.38E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.27E-04	0.00E+00	0.00E+00	8.65E-04
sec-Butylbenzene	Eastern Cottontail Rabbit	4.02E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.66E-05	0.00E+00	0.00E+00	9.68E-05
tert-Butylbenzene	Eastern Cottontail Rabbit	1.64E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.25E-05	0.00E+00	0.00E+00	5.89E-05
Trichloroethene	Eastern Cottontail Rabbit	0.00E+00	0.00E+00	1.06E-02	0.00E+00	0.00E+00	5.15E+01	0.00E+00	0.00E+00	5.15E+01
Benzo(a)pyrene	Eastern Cottontail Rabbit	0.00E+00	0.00E+00	1.28E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.28E-04
bis(2-Ethylhexyl) phthalate	Eastern Cottontail Rabbit	0.00E+00	0.00E+00	1.51E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.51E-04
2,4-Dinitrotoluene	Eastern Cottontail Rabbit	5.51E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.39E+01	0.00E+00	0.00E+00	2.44E+01
2,6-Dinitrotoluene	Eastern Cottontail Rabbit	4.17E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.09E+00	0.00E+00	0.00E+00	2.13E+00
Di-n-butyl phthalate	Eastern Cottontail Rabbit	4.32E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.08E-01	0.00E+00	0.00E+00	1.04E+00
N-Nitrosodiphenylamine	Eastern Cottontail Rabbit	2.53E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.42E-01	0.00E+00	0.00E+00	2.67E-01
Perchlorate	Eastern Cottontail Rabbit	3.73E-04	0.00E+00	3.36E-03	0.00E+00	0.00E+00	1.65E+04	0.00E+00	0.00E+00	1.65E+04
4-Amino-2,6-dinitrotoluene	Eastern Cottontail Rabbit	2.38E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.16E-01	0.00E+00	0.00E+00	1.18E-01
4-Nitrotoluene	Eastern Cottontail Rabbit	3.58E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.40E-03	0.00E+00	0.00E+00	9.76E-03
Nitroglycerin	Eastern Cottontail Rabbit	3.87E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.76E+01	0.00E+00	0.00E+00	2.80E+01
Antimony	Eastern Cottontail Rabbit	9.24E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.94E-01	0.00E+00	0.00E+00	3.86E-01
Arsenic	Eastern Cottontail Rabbit	1.37E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.85E-02	0.00E+00	0.00E+00	2.16E-01
Cadmium	Eastern Cottontail Rabbit	2.50E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.45E+00	0.00E+00	0.00E+00	1.70E+00
Chromium	Eastern Cottontail Rabbit	7.61E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.08E-02	0.00E+00	0.00E+00	8.52E-01
Copper	Eastern Cottontail Rabbit	3.08E+00	0.00E+00	6.26E-04	0.00E+00	0.00E+00	1.96E+01	0.00E+00	0.00E+00	2.27E+01
Lead	Eastern Cottontail Rabbit	3.44E+00	0.00E+00	3.60E-04	0.00E+00	0.00E+00	2.46E+00	0.00E+00	0.00E+00	5.91E+00
Mercury	Eastern Cottontail Rabbit	5.36E-04	0.00E+00	3.71E-05	0.00E+00	0.00E+00	3.20E-04	0.00E+00	0.00E+00	8.93E-04
Nickel	Eastern Cottontail Rabbit	8.28E-01	0.00E+00	2.44E-04	0.00E+00	0.00E+00	4.22E-01	0.00E+00	0.00E+00	1.25E+00
Selenium	Eastern Cottontail Rabbit	1.64E-02	0.00E+00	3.36E-04	0.00E+00	0.00E+00	4.17E-03	0.00E+00	0.00E+00	2.09E-02
Thallium	Eastern Cottontail Rabbit	7.45E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.74E-04	0.00E+00	0.00E+00	7.92E-03
Zinc	Eastern Cottontail Rabbit	1.34E+01	0.00E+00	5.68E-04	0.00E+00	0.00E+00	2.56E-10	0.00E+00	0.00E+00	1.34E+01

Notes:

mg/day - milligrams per day

A value of 0.00E+00 indicates that the chemical was not ingested by the receptor species because it was not encountered due to a species life history.

Table 7-23
Total Exposure for Representative Wildlife Species Based on Consumption of Surface Water, Soils, Surface Water Sediments, and Food
OB/OD RI Report
Fort Riley, Kansas

Parameter	Representative Wildlife Species	Maximum Dose Received from Consuming Soil (mg/day)	Maximum Dose Received from Consuming Sediments (mg/day)	Maximum Dose Received from Consuming Surface Water (mg/day)	Maximum Dose Received from Consuming Benthic Invertebrates (mg/day)	Maximum Dose Received from Consuming Soil Invertebrates (mg/day)	Maximum Dose Received from Consuming Terrestrial Plants (mg/day)	Maximum Dose Received from Consuming Whole Fish (mg/day)	Maximum Dose Received from Consuming Small Mammals (mg/day)	Total Dose Received (mg/day)
1,1,2,2-Tetrachloroethane	Red Fox	3.91E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.38E-01	5.77E-01
1,2,4-Trimethylbenzene	Red Fox	1.05E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.21E-04	3.32E-04
cis-1,2-Dichloroethene	Red Fox	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.23E-01	7.23E-01
Isopropylbenzene	Red Fox	1.76E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.45E-04	4.63E-04
p-Isopropyltoluene	Red Fox	2.02E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.08E-02	1.10E-02
sec-Butylbenzene	Red Fox	3.40E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.35E-03	4.38E-03
tert-Butylbenzene	Red Fox	1.39E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.59E-04	7.73E-04
Trichloroethene	Red Fox	0.00E+00	0.00E+00	3.46E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.85E+01	1.86E+01
Benzo(a)pyrene	Red Fox	0.00E+00	0.00E+00	4.18E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.10E-05	4.69E-04
bis(2-Ethylhexyl) phthalate	Red Fox	0.00E+00	0.00E+00	4.94E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.02E-05	5.54E-04
2,4-Dinitrotoluene	Red Fox	4.66E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.26E+00	9.73E+00
2,6-Dinitrotoluene	Red Fox	3.53E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.97E-01	8.32E-01
Di-n-butyl phthalate	Red Fox	3.65E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.67E+01	4.71E+01
N-Nitrosodiphenylamine	Red Fox	2.14E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.76E-01	2.98E-01
Perchlorate	Red Fox	3.15E-04	0.00E+00	1.10E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.95E+03	5.95E+03
4-Amino-2,6-dinitrotoluene	Red Fox	2.02E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.42E-02	4.62E-02
4-Nitrotoluene	Red Fox	3.02E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.13E-03	4.43E-03
Nitroglycerin	Red Fox	3.28E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.03E+01	1.06E+01
Antimony	Red Fox	7.81E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.47E-01	2.25E-01
Arsenic	Red Fox	1.16E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.49E-02	2.01E-01
Cadmium	Red Fox	2.12E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.83E-01	8.95E-01
Chromium	Red Fox	6.44E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.27E-01	9.70E-01
Copper	Red Fox	2.61E+00	0.00E+00	2.05E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.28E+00	1.09E+01
Lead	Red Fox	2.91E+00	0.00E+00	1.18E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.23E+00	5.15E+00
Mercury	Red Fox	4.54E-04	0.00E+00	1.22E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.41E-04	9.17E-04
Nickel	Red Fox	7.01E-01	0.00E+00	7.98E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.74E-01	1.18E+00
Selenium	Red Fox	1.39E-02	0.00E+00	1.10E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.90E-03	2.39E-02
Thallium	Red Fox	6.30E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.47E-03	9.77E-03
Zinc	Red Fox	1.13E+01	0.00E+00	1.86E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.17E+00	1.85E+01

Notes:

mg/day - milligrams per day

A value of 0.00E+00 indicates that the chemical was not ingested by the receptor species because it was not encountered due to a species life history.

Table 7-23
Total Exposure for Representative Wildlife Species Based on Consumption of Surface Water, Soils, Surface Water Sediments, and Food
OB/OD RI Report
Fort Riley, Kansas

Parameter	Representative Wildlife Species	Maximum Dose Received from Consuming Soil (mg/day)	Maximum Dose Received from Consuming Sediments (mg/day)	Maximum Dose Received from Consuming Surface Water (mg/day)	Maximum Dose Received from Consuming Benthic Invertebrates (mg/day)	Maximum Dose Received from Consuming Soil Invertebrates (mg/day)	Maximum Dose Received from Consuming Terrestrial Plants (mg/day)	Maximum Dose Received from Consuming Whole Fish (mg/day)	Maximum Dose Received from Consuming Small Mammals (mg/day)	Total Dose Received (mg/day)
1,1,2,2-Tetrachloroethane	Raccoon	3.44E-02	0.00E+00	0.00E+00	0.00E+00	9.52E-01	2.44E-01	0.00E+00	5.67E-02	1.29E+00
1,2,4-Trimethylbenzene	Raccoon	9.21E-06	0.00E+00	0.00E+00	0.00E+00	3.50E-03	9.95E-06	0.00E+00	3.39E-05	3.56E-03
cis-1,2-Dichloroethene	Raccoon	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.01E-01	0.00E+00	7.61E-02	4.78E-01
Isopropylbenzene	Raccoon	1.55E-05	0.00E+00	0.00E+00	0.00E+00	4.71E-03	1.97E-05	0.00E+00	4.69E-05	4.80E-03
p-Isopropyltoluene	Raccoon	1.78E-04	0.00E+00	0.00E+00	0.00E+00	1.24E-01	1.25E-04	0.00E+00	1.14E-03	1.25E-01
sec-Butylbenzene	Raccoon	3.00E-05	0.00E+00	0.00E+00	0.00E+00	5.06E-02	1.13E-05	0.00E+00	4.58E-04	5.11E-02
tert-Butylbenzene	Raccoon	1.22E-05	0.00E+00	0.00E+00	0.00E+00	8.65E-03	8.50E-06	0.00E+00	8.00E-05	8.76E-03
Trichloroethene	Raccoon	0.00E+00	0.00E+00	3.49E-02	0.00E+00	0.00E+00	1.03E+01	1.67E-01	1.95E+00	1.25E+01
Benzo(a)pyrene	Raccoon	0.00E+00	0.00E+00	4.21E-04	0.00E+00	0.00E+00	0.00E+00	2.61E-02	5.37E-06	2.65E-02
bis(2-Ethylhexyl) phthalate	Raccoon	0.00E+00	0.00E+00	4.98E-04	0.00E+00	0.00E+00	0.00E+00	4.31E-03	6.34E-06	4.82E-03
2,4-Dinitrotoluene	Raccoon	4.11E-01	0.00E+00	0.00E+00	0.00E+00	5.40E+00	4.77E+00	0.00E+00	9.75E-01	1.16E+01
2,6-Dinitrotoluene	Raccoon	3.11E-02	0.00E+00	0.00E+00	0.00E+00	3.32E-01	4.18E-01	0.00E+00	8.39E-02	8.65E-01
Di-n-butyl phthalate	Raccoon	3.22E-01	0.00E+00	0.00E+00	0.00E+00	5.43E+02	1.22E-01	0.00E+00	4.92E+00	5.49E+02
N-Nitrosodiphenylamine	Raccoon	1.89E-02	0.00E+00	0.00E+00	0.00E+00	2.11E+00	4.84E-02	0.00E+00	2.91E-02	2.20E+00
Perchlorate	Raccoon	2.78E-04	0.00E+00	1.11E-02	0.00E+00	1.50E-09	3.31E+03	1.18E-09	6.27E+02	3.93E+03
4-Amino-2,6-dinitrotoluene	Raccoon	1.78E-03	0.00E+00	0.00E+00	0.00E+00	1.99E-02	2.31E-02	0.00E+00	4.66E-03	4.94E-02
4-Nitrotoluene	Raccoon	2.66E-04	0.00E+00	0.00E+00	0.00E+00	7.10E-03	1.88E-03	0.00E+00	4.35E-04	9.68E-03
Nitroglycerin	Raccoon	2.89E-01	0.00E+00	0.00E+00	0.00E+00	1.87E+00	5.53E+00	0.00E+00	1.08E+00	8.76E+00
Antimony	Raccoon	6.88E-02	3.44E-03	0.00E+00	1.32E-02	6.47E-02	5.88E-02	0.00E+00	1.55E-02	2.24E-01
Arsenic	Raccoon	1.02E-01	8.55E-02	0.00E+00	3.28E-01	4.80E-02	1.57E-02	0.00E+00	8.94E-03	5.89E-01
Beryllium	Raccoon	0.00E+00	1.67E-02	0.00E+00	6.40E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.06E-02
Cadmium	Raccoon	1.86E-01	1.67E-02	0.00E+00	2.42E-01	7.64E-01	2.90E-01	0.00E+00	7.19E-02	1.57E+00
Chromium	Raccoon	5.67E-01	4.44E-01	0.00E+00	7.39E-01	2.42E-02	1.82E-02	0.00E+00	3.44E-02	1.83E+00
Copper	Raccoon	2.30E+00	3.93E-01	2.07E-03	5.03E-01	3.92E-01	3.92E+00	1.82E-01	8.72E-01	8.57E+00
Lead	Raccoon	2.56E+00	3.12E-01	1.19E-03	8.39E-01	3.28E-01	4.93E-01	1.32E-05	2.35E-01	4.77E+00
Mercury	Raccoon	4.00E-04	3.55E-04	1.23E-04	1.03E-04	6.83E-05	6.40E-05	5.35E-02	3.60E-05	5.47E-02
Nickel	Raccoon	6.17E-01	4.70E-01	8.04E-04	1.80E+00	5.27E-02	8.43E-02	7.76E-03	4.99E-02	3.09E+00
Selenium	Raccoon	1.22E-02	9.66E-03	1.11E-03	3.71E-02	1.15E-02	8.34E-04	1.77E-02	9.37E-04	9.11E-02
Thallium	Raccoon	5.55E-03	0.00E+00	0.00E+00	0.00E+00	5.21E-03	9.48E-05	0.00E+00	3.66E-04	1.12E-02
Zinc	Raccoon	9.98E+00	7.37E-01	1.88E-03	1.79E+00	2.39E+01	5.11E-11	4.78E-01	7.55E-01	3.76E+01

Notes:

mg/day - milligrams per day

A value of 0.00E+00 indicates that the chemical was not ingested by the receptor species because it was not encountered due to a species life history.

Table 7-23
Total Exposure for Representative Wildlife Species Based on Consumption of Surface Water, Soils, Surface Water Sediments, and Food
OB/OD RI Report
Fort Riley, Kansas

Parameter	Representative Wildlife Species	Maximum Dose Received from Consuming Soil (mg/day)	Maximum Dose Received from Consuming Sediments (mg/day)	Maximum Dose Received from Consuming Surface Water (mg/day)	Maximum Dose Received from Consuming Benthic Invertebrates (mg/day)	Maximum Dose Received from Consuming Soil Invertebrates (mg/day)	Maximum Dose Received from Consuming Terrestrial Plants (mg/day)	Maximum Dose Received from Consuming Whole Fish (mg/day)	Maximum Dose Received from Consuming Small Mammals (mg/day)	Total Dose Received (mg/day)
1,1,2,2-Tetrachloroethane	White-tailed Deer	1.09E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.96E+00	0.00E+00	0.00E+00	9.07E+00
1,2,4-Trimethylbenzene	White-tailed Deer	2.91E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.65E-04	0.00E+00	0.00E+00	3.94E-04
cis-1,2-Dichloroethene	White-tailed Deer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.47E+01	0.00E+00	0.00E+00	1.47E+01
Isopropylbenzene	White-tailed Deer	4.90E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.23E-04	0.00E+00	0.00E+00	7.72E-04
p-Isopropyltoluene	White-tailed Deer	5.60E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.60E-03	0.00E+00	0.00E+00	5.16E-03
sec-Butylbenzene	White-tailed Deer	9.45E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.15E-04	0.00E+00	0.00E+00	5.10E-04
tert-Butylbenzene	White-tailed Deer	3.85E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.12E-04	0.00E+00	0.00E+00	3.51E-04
Trichloroethene	White-tailed Deer	0.00E+00	0.00E+00	3.37E-01	0.00E+00	0.00E+00	3.78E+02	0.00E+00	0.00E+00	3.78E+02
Benzo(a)pyrene	White-tailed Deer	0.00E+00	0.00E+00	4.07E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.07E-03
bis(2-Ethylhexyl) phthalate	White-tailed Deer	0.00E+00	0.00E+00	4.81E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.81E-03
2,4-Dinitrotoluene	White-tailed Deer	1.30E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.75E+02	0.00E+00	0.00E+00	1.76E+02
2,6-Dinitrotoluene	White-tailed Deer	9.80E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.53E+01	0.00E+00	0.00E+00	1.54E+01
Di-n-butyl phthalate	White-tailed Deer	1.02E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.46E+00	0.00E+00	0.00E+00	5.48E+00
N-Nitrosodiphenylamine	White-tailed Deer	5.95E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.78E+00	0.00E+00	0.00E+00	1.84E+00
Perchlorate	White-tailed Deer	8.75E-04	0.00E+00	1.07E-01	0.00E+00	0.00E+00	1.21E+05	0.00E+00	0.00E+00	1.21E+05
4-Amino-2,6-dinitrotoluene	White-tailed Deer	5.60E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.49E-01	0.00E+00	0.00E+00	8.54E-01
4-Nitrotoluene	White-tailed Deer	8.40E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.90E-02	0.00E+00	0.00E+00	6.98E-02
Nitroglycerin	White-tailed Deer	9.10E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.03E+02	0.00E+00	0.00E+00	2.04E+02
Antimony	White-tailed Deer	2.17E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.16E+00	0.00E+00	0.00E+00	2.37E+00
Arsenic	White-tailed Deer	3.22E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.76E-01	0.00E+00	0.00E+00	8.98E-01
Cadmium	White-tailed Deer	5.88E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.06E+01	0.00E+00	0.00E+00	1.12E+01
Chromium	White-tailed Deer	1.79E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.67E-01	0.00E+00	0.00E+00	2.46E+00
Copper	White-tailed Deer	7.25E+00	0.00E+00	2.00E-02	0.00E+00	0.00E+00	1.44E+02	0.00E+00	0.00E+00	1.51E+02
Lead	White-tailed Deer	8.09E+00	0.00E+00	1.15E-02	0.00E+00	0.00E+00	1.81E+01	0.00E+00	0.00E+00	2.62E+01
Mercury	White-tailed Deer	1.26E-03	0.00E+00	1.18E-03	0.00E+00	0.00E+00	2.35E-03	0.00E+00	0.00E+00	4.79E-03
Nickel	White-tailed Deer	1.95E+00	0.00E+00	7.77E-03	0.00E+00	0.00E+00	3.10E+00	0.00E+00	0.00E+00	5.05E+00
Selenium	White-tailed Deer	3.85E-02	0.00E+00	1.07E-02	0.00E+00	0.00E+00	3.06E-02	0.00E+00	0.00E+00	7.99E-02
Thallium	White-tailed Deer	1.75E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.48E-03	0.00E+00	0.00E+00	2.10E-02
Zinc	White-tailed Deer	3.15E+01	0.00E+00	1.81E-02	0.00E+00	0.00E+00	1.88E-09	0.00E+00	0.00E+00	3.15E+01

Notes:

mg/day - milligrams per day

A value of 0.00E+00 indicates that the chemical was not ingested by the receptor species because it was not encountered due to a species life history.

Table 7-23
Total Exposure for Representative Wildlife Species Based on Consumption of Surface Water, Soils, Surface Water Sediments, and Food
OB/OD RI Report
Fort Riley, Kansas

Parameter	Representative Wildlife Species	Maximum Dose Received from Consuming Soil (mg/day)	Maximum Dose Received from Consuming Sediments (mg/day)	Maximum Dose Received from Consuming Surface Water (mg/day)	Maximum Dose Received from Consuming Benthic Invertebrates (mg/day)	Maximum Dose Received from Consuming Soil Invertebrates (mg/day)	Maximum Dose Received from Consuming Terrestrial Plants (mg/day)	Maximum Dose Received from Consuming Whole Fish (mg/day)	Maximum Dose Received from Consuming Small Mammals (mg/day)	Total Dose Received (mg/day)
1,1,2,2-Tetrachloroethane	American Robin	2.71E-02	0.00E+00	0.00E+00	0.00E+00	1.49E+00	9.58E-02	0.00E+00	0.00E+00	1.62E+00
1,2,4-Trimethylbenzene	American Robin	7.25E-06	0.00E+00	0.00E+00	0.00E+00	5.50E-03	3.91E-06	0.00E+00	0.00E+00	5.51E-03
cis-1,2-Dichloroethene	American Robin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.58E-01	0.00E+00	0.00E+00	1.58E-01
Isopropylbenzene	American Robin	1.22E-05	0.00E+00	0.00E+00	0.00E+00	7.40E-03	7.73E-06	0.00E+00	0.00E+00	7.42E-03
p-Isopropyltoluene	American Robin	1.60E-02	0.00E+00	0.00E+00	0.00E+00	1.94E-01	4.92E-05	0.00E+00	0.00E+00	2.10E-01
sec-Butylbenzene	American Robin	2.36E-05	0.00E+00	0.00E+00	0.00E+00	7.94E-02	4.44E-06	0.00E+00	0.00E+00	7.94E-02
tert-Butylbenzene	American Robin	9.61E-06	0.00E+00	0.00E+00	0.00E+00	1.36E-02	3.34E-06	0.00E+00	0.00E+00	1.36E-02
Trichloroethene	American Robin	0.00E+00	0.00E+00	9.65E-04	0.00E+00	0.00E+00	4.04E+00	0.00E+00	0.00E+00	4.04E+00
Benzo(a)pyrene	American Robin	0.00E+00	0.00E+00	1.17E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-05
bis(2-Ethylhexyl) phthalate	American Robin	0.00E+00	0.00E+00	1.38E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.38E-05
2,4-Dinitrotoluene	American Robin	3.23E-01	0.00E+00	0.00E+00	0.00E+00	8.48E+00	1.87E+00	0.00E+00	0.00E+00	1.07E+01
2,6-Dinitrotoluene	American Robin	2.45E-02	0.00E+00	0.00E+00	0.00E+00	5.21E-01	1.64E-01	0.00E+00	0.00E+00	7.09E-01
Di-n-butyl phthalate	American Robin	2.53E-01	0.00E+00	0.00E+00	0.00E+00	8.53E+02	4.77E-02	0.00E+00	0.00E+00	8.53E+02
N-Nitrosodiphenylamine	American Robin	1.49E-02	0.00E+00	0.00E+00	0.00E+00	3.31E+00	1.90E-02	0.00E+00	0.00E+00	3.34E+00
Perchlorate	American Robin	2.19E-04	0.00E+00	3.07E-04	0.00E+00	2.36E-09	1.30E+03	0.00E+00	0.00E+00	1.30E+03
4-Amino-2,6-dinitrotoluene	American Robin	1.40E-03	0.00E+00	0.00E+00	0.00E+00	3.12E-02	9.07E-03	0.00E+00	0.00E+00	4.17E-02
4-Nitrotoluene	American Robin	2.10E-04	0.00E+00	0.00E+00	0.00E+00	1.11E-02	7.38E-04	0.00E+00	0.00E+00	1.21E-02
Nitroglycerin	American Robin	2.27E-01	0.00E+00	0.00E+00	0.00E+00	2.93E+00	2.17E+00	0.00E+00	0.00E+00	5.33E+00
Antimony	American Robin	5.42E-02	0.00E+00	0.00E+00	0.00E+00	1.01E-01	2.31E-02	0.00E+00	0.00E+00	1.79E-01
Arsenic	American Robin	8.04E-02	0.00E+00	0.00E+00	0.00E+00	7.53E-02	6.16E-03	0.00E+00	0.00E+00	1.62E-01
Cadmium	American Robin	1.47E-01	0.00E+00	0.00E+00	0.00E+00	1.20E+00	1.14E-01	0.00E+00	0.00E+00	1.46E+00
Chromium	American Robin	4.47E-01	0.00E+00	0.00E+00	0.00E+00	3.80E-02	7.13E-03	0.00E+00	0.00E+00	4.92E-01
Copper	American Robin	1.81E+00	0.00E+00	5.72E-05	0.00E+00	6.16E-01	1.54E+00	0.00E+00	0.00E+00	3.97E+00
Lead	American Robin	2.02E+00	0.00E+00	3.29E-05	0.00E+00	5.16E-01	1.93E-01	0.00E+00	0.00E+00	2.73E+00
Mercury	American Robin	3.15E-04	0.00E+00	3.39E-06	0.00E+00	1.07E-04	2.51E-05	0.00E+00	0.00E+00	4.50E-04
Nickel	American Robin	4.86E-01	0.00E+00	2.23E-05	0.00E+00	8.27E-02	3.31E-02	0.00E+00	0.00E+00	6.02E-01
Selenium	American Robin	9.61E-03	0.00E+00	3.07E-05	0.00E+00	1.80E-02	3.27E-04	0.00E+00	0.00E+00	2.80E-02
Thallium	American Robin	4.37E-03	0.00E+00	0.00E+00	0.00E+00	8.18E-03	3.72E-05	0.00E+00	0.00E+00	1.26E-02
Zinc	American Robin	7.86E+00	0.00E+00	5.19E-05	0.00E+00	3.75E+01	2.01E-11	0.00E+00	0.00E+00	4.53E+01

Notes:

mg/day - milligrams per day

A value of 0.00E+00 indicates that the chemical was not ingested by the receptor species because it was not encountered due to a species life history.

Table 7-23
Total Exposure for Representative Wildlife Species Based on Consumption of Surface Water, Soils, Surface Water Sediments, and Food
OB/OD RI Report
Fort Riley, Kansas

Parameter	Representative Wildlife Species	Maximum Dose Received from Consuming Soil (mg/day)	Maximum Dose Received from Consuming Sediments (mg/day)	Maximum Dose Received from Consuming Surface Water (mg/day)	Maximum Dose Received from Consuming Benthic Invertebrates (mg/day)	Maximum Dose Received from Consuming Soil Invertebrates (mg/day)	Maximum Dose Received from Consuming Terrestrial Plants (mg/day)	Maximum Dose Received from Consuming Whole Fish (mg/day)	Maximum Dose Received from Consuming Small Mammals (mg/day)	Total Dose Received (mg/day)
1,1,2,2-Tetrachloroethane	Red-tailed Hawk	9.46E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.30E-01	1.40E-01
1,2,4-Trimethylbenzene	Red-tailed Hawk	2.53E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E-05	8.04E-05
cis-1,2-Dichloroethene	Red-tailed Hawk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.75E-01	1.75E-01
Isopropylbenzene	Red-tailed Hawk	4.27E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.08E-04	1.12E-04
p-Isopropyltoluene	Red-tailed Hawk	4.88E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.63E-03	2.68E-03
sec-Butylbenzene	Red-tailed Hawk	8.24E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.05E-03	1.06E-03
tert-Butylbenzene	Red-tailed Hawk	3.36E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.84E-04	1.87E-04
Trichloroethene	Red-tailed Hawk	0.00E+00	0.00E+00	5.82E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.49E+00	4.50E+00
Benzo(a)pyrene	Red-tailed Hawk	0.00E+00	0.00E+00	7.04E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.23E-05	8.27E-05
bis(2-Ethylhexyl) phthalate	Red-tailed Hawk	0.00E+00	0.00E+00	8.32E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.46E-05	9.78E-05
2,4-Dinitrotoluene	Red-tailed Hawk	1.13E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.24E+00	2.36E+00
2,6-Dinitrotoluene	Red-tailed Hawk	8.55E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.93E-01	2.02E-01
Di-n-butyl phthalate	Red-tailed Hawk	8.85E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.13E+01	1.14E+01
N-Nitrosodiphenylamine	Red-tailed Hawk	5.19E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.70E-02	7.22E-02
Perchlorate	Red-tailed Hawk	7.63E-05	0.00E+00	1.86E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.44E+03	1.44E+03
4-Amino-2,6-dinitrotoluene	Red-tailed Hawk	4.88E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.07E-02	1.12E-02
4-Nitrotoluene	Red-tailed Hawk	7.32E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.99E-04	1.07E-03
Nitroglycerin	Red-tailed Hawk	7.94E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.48E+00	2.56E+00
Antimony	Red-tailed Hawk	1.89E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.55E-02	5.45E-02
Arsenic	Red-tailed Hawk	2.81E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.06E-02	4.86E-02
Cadmium	Red-tailed Hawk	5.13E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.65E-01	2.17E-01
Chromium	Red-tailed Hawk	1.56E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.91E-02	2.35E-01
Copper	Red-tailed Hawk	6.32E-01	0.00E+00	3.46E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.01E+00	2.64E+00
Lead	Red-tailed Hawk	7.05E-01	0.00E+00	1.98E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.41E-01	1.25E+00
Mercury	Red-tailed Hawk	1.10E-04	0.00E+00	2.05E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.27E-05	2.13E-04
Nickel	Red-tailed Hawk	1.70E-01	0.00E+00	1.34E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.15E-01	2.85E-01
Selenium	Red-tailed Hawk	3.36E-03	0.00E+00	1.86E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.15E-03	5.70E-03
Thallium	Red-tailed Hawk	1.53E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.41E-04	2.37E-03
Zinc	Red-tailed Hawk	2.74E+00	0.00E+00	3.14E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.74E+00	4.48E+00

Notes:

mg/day - milligrams per day

A value of 0.00E+00 indicates that the chemical was not ingested by the receptor species because it was not encountered due to a species life history.

Table 7-24
Chemical-Specific Risk Estimates for Representative Wildlife Species
OB/OD RI Report
Fort Riley, Kansas

Parameter	Representative Wildlife Species	Total Dose Received (mg/day)	Fraction of Home Range Within Area Site	Total Dose Received Based on Fraction of Area Within Home Range (mg/day)	Average Body Weight (kg)	No Observed Adverse Effects Level (NOAEL) (mg/kg/day)	Weight Normalized NOAEL (mg/day)	NOAEL Based Ecological Hazard Quotient	Refined COPECs for Wildlife
1,1,2,2-Tetrachloroethane	Short-tailed Shrew	1.84E-01	1	1.84E-01	1.50E-02	1.66	0.0249	7.4E+00	Yes
1,2,4-Trimethylbenzene	Short-tailed Shrew	6.66E-04	1	6.66E-04	1.50E-02	None	NA	NA	NA
cis-1,2-Dichloroethene	Short-tailed Shrew	0.00E+00	1	0.00E+00	1.50E-02	None	NA	NA	NA
Isopropylbenzene	Short-tailed Shrew	8.97E-04	1	8.97E-04	1.50E-02	None	NA	NA	NA
p-Isopropyltoluene	Short-tailed Shrew	2.35E-02	1	2.35E-02	1.50E-02	None	NA	NA	NA
sec-Butylbenzene	Short-tailed Shrew	9.61E-03	1	9.61E-03	1.50E-02	None	NA	NA	NA
tert-Butylbenzene	Short-tailed Shrew	1.64E-03	1	1.64E-03	1.50E-02	None	NA	NA	NA
Trichloroethene	Short-tailed Shrew	3.00E-04	1	3.00E-04	1.50E-02	0.832	0.01248	2.4E-02	HQ<1
Benzo(a)pyrene	Short-tailed Shrew	3.63E-06	1	3.63E-06	1.50E-02	1.19	0.01785	2.0E-04	HQ<1
bis(2-Ethylhexyl) phthalate	Short-tailed Shrew	4.29E-06	1	4.29E-06	1.50E-02	21.8	0.327	1.3E-05	HQ<1
2,4-Dinitrotoluene	Short-tailed Shrew	1.07E+00	1	1.07E+00	1.50E-02	463.79	6.95685	1.5E-01	HQ<1
2,6-Dinitrotoluene	Short-tailed Shrew	6.63E-02	1	6.63E-02	1.50E-02	463.79	6.95685	9.5E-03	HQ<1
Di-n-butyl phthalate	Short-tailed Shrew	1.03E+02	1	1.03E+02	1.50E-02	654	9.81	1.1E+01	Yes
N-Nitrosodiphenylamine	Short-tailed Shrew	4.02E-01	1	4.02E-01	1.50E-02	None	NA	NA	NA
Perchlorate	Short-tailed Shrew	1.25E-04	1	1.25E-04	1.50E-02	None	NA	NA	NA
4-Amino-2,6-dinitrotoluene	Short-tailed Shrew	3.96E-03	1	3.96E-03	1.50E-02	None	NA	NA	NA
4-Nitrotoluene	Short-tailed Shrew	1.38E-03	1	1.38E-03	1.50E-02	None	NA	NA	NA
Nitroglycerin	Short-tailed Shrew	3.85E-01	1	3.85E-01	1.50E-02	63.3	0.9495	4.1E-01	HQ<1
Antimony	Short-tailed Shrew	1.95E-02	1	1.95E-02	1.50E-02	0.149	0.002235	8.7E+00	Yes
Arsenic	Short-tailed Shrew	1.99E-02	1	1.99E-02	1.50E-02	0.15	0.00225	8.8E+00	Yes
Cadmium	Short-tailed Shrew	1.65E-01	1	1.65E-01	1.50E-02	2.12	0.0318	5.2E+00	Yes
Chromium	Short-tailed Shrew	6.44E-02	1	6.44E-02	1.50E-02	7.21	0.10815	6.0E-01	HQ<1
Copper	Short-tailed Shrew	3.17E-01	1	3.17E-01	1.50E-02	33.4	0.501	6.3E-01	HQ<1
Lead	Short-tailed Shrew	3.33E-01	1	3.33E-01	1.50E-02	17.58	0.2637	1.3E+00	Yes
Mercury	Short-tailed Shrew	5.61E-05	1	5.61E-05	1.50E-02	0.07	0.00105	5.3E-02	HQ<1
Nickel	Short-tailed Shrew	7.51E-02	1	7.51E-02	1.50E-02	87.91	1.31865	5.7E-02	HQ<1
Selenium	Short-tailed Shrew	3.47E-03	1	3.47E-03	1.50E-02	0.44	0.0066	5.3E-01	HQ<1
Thallium	Short-tailed Shrew	1.58E-03	1	1.58E-03	1.50E-02	0.44	0.0066	2.4E-01	HQ<1
Zinc	Short-tailed Shrew	5.58E+00	1	5.58E+00	1.50E-02	351.7	5.2755	1.1E+00	Yes
							EHI	**4.6E+01**	

Notes:
EHI - Ecological Hazard Index
kg - kilogram
mg/kg - milligrams per kilogram
mg/kg/day - milligrams per kilograms per day
NA - Not Analyzed

Table 7-24
Chemical-Specific Risk Estimates for Representative Wildlife Species
OB/OD RI Report
Fort Riley, Kansas

Parameter	Representative Wildlife Species	Total Dose Received (mg/day)	Fraction of Home Range Within Area Site	Total Dose Received Based on Fraction of Area Within Home Range (mg/day)	Average Body Weight (kg)	No Observed Adverse Effects Level (NOAEL) (mg/kg/day)	Weight Normalized NOAEL (mg/day)	NOAEL Based Ecological Hazard Quotient	Refined COPECs for Wildlife
1,1,2,2-Tetrachloroethane	White-footed Mouse	1.77E-02	1	1.77E-02	2.20E-02	1.51	0.03322	5.3E-01	HQ<1
1,2,4-Trimethylbenzene	White-footed Mouse	7.70E-07	1	7.70E-07	2.20E-02	None	NA	NA	NA
cis-1,2-Dichloroethene	White-footed Mouse	2.88E-02	1	2.88E-02	2.20E-02	None	NA	NA	NA
Isopropylbenzene	White-footed Mouse	1.51E-06	1	1.51E-06	2.20E-02	None	NA	NA	NA
p-Isopropyltoluene	White-footed Mouse	1.01E-05	1	1.01E-05	2.20E-02	None	NA	NA	NA
sec-Butylbenzene	White-footed Mouse	9.95E-07	1	9.95E-07	2.20E-02	None	NA	NA	NA
tert-Butylbenzene	White-footed Mouse	6.85E-07	1	6.85E-07	2.20E-02	None	NA	NA	NA
Trichloroethene	White-footed Mouse	7.40E-01	1	7.40E-01	2.20E-02	0.756	0.016632	4.4E+01	Yes
Benzo(a)pyrene	White-footed Mouse	7.26E-06	1	7.26E-06	2.20E-02	1.08	0.02376	3.1E-04	HQ<1
bis(2-Ethylhexyl) phthalate	White-footed Mouse	8.58E-06	1	8.58E-06	2.20E-02	19.8	0.4356	2.0E-05	HQ<1
2,4-Dinitrotoluene	White-footed Mouse	3.45E-01	1	3.45E-01	2.20E-02	421.44	9.27168	3.7E-02	HQ<1
2,6-Dinitrotoluene	White-footed Mouse	3.02E-02	1	3.02E-02	2.20E-02	421.44	9.27168	3.3E-03	HQ<1
Di-n-butyl phthalate	White-footed Mouse	1.07E-02	1	1.07E-02	2.20E-02	594	13.068	8.2E-04	HQ<1
N-Nitrosodiphenylamine	White-footed Mouse	3.59E-03	1	3.59E-03	2.20E-02	None	NA	NA	NA
Perchlorate	White-footed Mouse	2.37E+02	1	2.37E+02	2.20E-02	None	NA	NA	NA
4-Amino-2,6-dinitrotoluene	White-footed Mouse	1.67E-03	1	1.67E-03	2.20E-02	None	NA	NA	NA
4-Nitrotoluene	White-footed Mouse	1.36E-04	1	1.36E-04	2.20E-02	None	NA	NA	NA
Nitroglycerin	White-footed Mouse	3.98E-01	1	3.98E-01	2.20E-02	57.52	1.26544	3.1E-01	HQ<1
Antimony	White-footed Mouse	4.64E-03	1	4.64E-03	2.20E-02	0.135	0.00297	1.6E+00	Yes
Arsenic	White-footed Mouse	1.75E-03	1	1.75E-03	2.20E-02	0.136	0.002992	5.9E-01	HQ<1
Cadmium	White-footed Mouse	2.19E-02	1	2.19E-02	2.20E-02	1.926	0.042372	5.2E-01	HQ<1
Chromium	White-footed Mouse	4.78E-03	1	4.78E-03	2.20E-02	6.55	0.1441	3.3E-02	HQ<1
Copper	White-footed Mouse	2.96E-01	1	2.96E-01	2.20E-02	30.4	0.6688	4.4E-01	HQ<1
Lead	White-footed Mouse	5.11E-02	1	5.11E-02	2.20E-02	15.98	0.35156	1.5E-01	HQ<1
Mercury	White-footed Mouse	9.15E-06	1	9.15E-06	2.20E-02	0.064	0.001408	6.5E-03	HQ<1
Nickel	White-footed Mouse	9.84E-03	1	9.84E-03	2.20E-02	79.89	1.75758	5.6E-03	HQ<1
Selenium	White-footed Mouse	1.54E-04	1	1.54E-04	2.20E-02	0.399	0.008778	1.8E-02	HQ<1
Thallium	White-footed Mouse	4.08E-05	1	4.08E-05	2.20E-02	0.399	0.008778	4.6E-03	HQ<1
Zinc	White-footed Mouse	6.12E-02	1	6.12E-02	2.20E-02	319.5	7.029	8.7E-03	HQ<1
							EHI	**4.9E+01**	

Notes:
EHI - Ecological Hazard Index
kg - kilogram
mg/kg - milligrams per kilogram
mg/kg/day - milligrams per kilograms per day
NA - Not Analyzed

Table 7-24
Chemical-Specific Risk Estimates for Representative Wildlife Species
OB/OD RI Report
Fort Riley, Kansas

Parameter	Representative Wildlife Species	Total Dose Received (mg/day)	Fraction of Home Range Within Area Site	Total Dose Received Based on Fraction of Area Within Home Range (mg/day)	Average Body Weight (kg)	No Observed Adverse Effects Level (NOAEL) (mg/kg/day)	Weight Normalized NOAEL (mg/day)	NOAEL Based Ecological Hazard Quotient	Refined COPECs for Wildlife
1,1,2,2-Tetrachloroethane	Meadow Vole	6.34E-02	1	6.34E-02	4.40E-02	1.27	0.05588	1.1E+00	Yes
1,2,4-Trimethylbenzene	Meadow Vole	1.85E-04	1	1.85E-04	4.40E-02	None	NA	NA	NA
cis-1,2-Dichloroethene	Meadow Vole	2.12E-02	1	2.12E-02	4.40E-02	None	NA	NA	NA
Isopropylbenzene	Meadow Vole	2.50E-04	1	2.50E-04	4.40E-02	None	NA	NA	NA
p-Isopropyltoluene	Meadow Vole	6.52E-03	1	6.52E-03	4.40E-02	None	NA	NA	NA
sec-Butylbenzene	Meadow Vole	2.67E-03	1	2.67E-03	4.40E-02	None	NA	NA	NA
tert-Butylbenzene	Meadow Vole	4.57E-04	1	4.57E-04	4.40E-02	None	NA	NA	NA
Trichloroethene	Meadow Vole	5.44E-01	1	5.44E-01	4.40E-02	0.636	0.027984	1.9E+01	Yes
Benzo(a)pyrene	Meadow Vole	6.60E-06	1	6.60E-06	4.40E-02	0.91	0.04004	1.6E-04	HQ<1
bis(2-Ethylhexyl) phthalate	Meadow Vole	7.80E-06	1	7.80E-06	4.40E-02	16.6	0.7304	1.1E-05	HQ<1
2,4-Dinitrotoluene	Meadow Vole	5.41E-01	1	5.41E-01	4.40E-02	354.39	15.59316	3.5E-02	HQ<1
2,6-Dinitrotoluene	Meadow Vole	3.99E-02	1	3.99E-02	4.40E-02	354.39	15.59316	2.6E-03	HQ<1
Di-n-butyl phthalate	Meadow Vole	2.87E+01	1	2.87E+01	4.40E-02	500	22	1.3E+00	Yes
N-Nitrosodiphenylamine	Meadow Vole	1.14E-01	1	1.14E-01	4.40E-02	None	NA	NA	NA
Perchlorate	Meadow Vole	1.74E+02	1	1.74E+02	4.40E-02	None	NA	NA	NA
4-Amino-2,6-dinitrotoluene	Meadow Vole	2.29E-03	1	2.29E-03	4.40E-02	None	NA	NA	NA
4-Nitrotoluene	Meadow Vole	4.77E-04	1	4.77E-04	4.40E-02	None	NA	NA	NA
Nitroglycerin	Meadow Vole	3.93E-01	1	3.93E-01	4.40E-02	48.37	2.12828	1.8E-01	HQ<1
Antimony	Meadow Vole	7.25E-03	1	7.25E-03	4.40E-02	0.114	0.005016	1.4E+00	Yes
Arsenic	Meadow Vole	4.46E-03	1	4.46E-03	4.40E-02	0.114	0.005016	8.9E-01	HQ<1
Cadmium	Meadow Vole	5.76E-02	1	5.76E-02	4.40E-02	16.2	0.7128	8.1E-02	HQ<1
Chromium	Meadow Vole	8.37E-03	1	8.37E-03	4.40E-02	5.51	0.24244	3.5E-02	HQ<1
Copper	Meadow Vole	2.53E-01	1	2.53E-01	4.40E-02	25.5	1.122	2.3E-01	HQ<1
Lead	Meadow Vole	7.11E-02	1	7.11E-02	4.40E-02	13.44	0.59136	1.2E-01	HQ<1
Mercury	Meadow Vole	1.32E-05	1	1.32E-05	4.40E-02	0.054	0.002376	5.6E-03	HQ<1
Nickel	Meadow Vole	1.39E-02	1	1.39E-02	4.40E-02	67.18	2.95592	4.7E-03	HQ<1
Selenium	Meadow Vole	7.98E-04	1	7.98E-04	4.40E-02	0.336	0.014784	5.4E-02	HQ<1
Thallium	Meadow Vole	3.40E-04	1	3.40E-04	4.40E-02	0.336	0.014784	2.3E-02	HQ<1
Zinc	Meadow Vole	1.37E+00	1	1.37E+00	4.40E-02	268.7	11.8228	1.2E-01	HQ<1
							EHI	**2.5E+01**	

Notes:
EHI - Ecological Hazard Index
kg - kilogram
mg/kg - milligrams per kilogram
mg/kg/day - milligrams per kilograms per day
NA - Not Analyzed

Table 7-24
Chemical-Specific Risk Estimates for Representative Wildlife Species
OB/OD RI Report
Fort Riley, Kansas

Parameter	Representative Wildlife Species	Total Dose Received (mg/day)	Fraction of Home Range Within Area Site	Total Dose Received Based on Fraction of Area Within Home Range (mg/day)	Average Body Weight (kg)	No Observed Adverse Effects Level (NOAEL) (mg/kg/day)	Weight Normalized NOAEL (mg/day)	NOAEL Based Ecological Hazard Quotient	Refined COPECs for Wildlife
1,1,2,2-Tetrachloroethane	Eastern Cottontail Rabbit	1.27E+00	1	1.27E+00	1.20E+00	0.56	0.672	1.9E+00	Yes
1,2,4-Trimethylbenzene	Eastern Cottontail Rabbit	6.21E-05	1	6.21E-05	1.20E+00	None	NA	NA	NA
cis-1,2-Dichloroethene	Eastern Cottontail Rabbit	2.01E+00	1	2.01E+00	1.20E+00	None	NA	NA	NA
Isopropylbenzene	Eastern Cottontail Rabbit	1.19E-04	1	1.19E-04	1.20E+00	None	NA	NA	NA
p-Isopropyltoluene	Eastern Cottontail Rabbit	8.65E-04	1	8.65E-04	1.20E+00	None	NA	NA	NA
sec-Butylbenzene	Eastern Cottontail Rabbit	9.68E-05	1	9.68E-05	1.20E+00	None	NA	NA	NA
tert-Butylbenzene	Eastern Cottontail Rabbit	5.89E-05	1	5.89E-05	1.20E+00	None	NA	NA	NA
Trichloroethene	Eastern Cottontail Rabbit	5.15E+01	1	5.15E+01	1.20E+00	0.278	0.3336	1.5E+02	Yes
Benzo(a)pyrene	Eastern Cottontail Rabbit	1.28E-04	1	1.28E-04	1.20E+00	0.4	0.48	2.7E-04	HQ<1
bis(2-Ethylhexyl) phthalate	Eastern Cottontail Rabbit	1.51E-04	1	1.51E-04	1.20E+00	7.3	8.76	1.7E-05	HQ<1
2,4-Dinitrotoluene	Eastern Cottontail Rabbit	2.44E+01	1	2.44E+01	1.20E+00	155.08	186.096	1.3E-01	HQ<1
2,6-Dinitrotoluene	Eastern Cottontail Rabbit	2.13E+00	1	2.13E+00	1.20E+00	155.08	186.096	1.1E-02	HQ<1
Di-n-butyl phthalate	Eastern Cottontail Rabbit	1.04E+00	1	1.04E+00	1.20E+00	219	262.8	4.0E-03	HQ<1
N-Nitrosodiphenylamine	Eastern Cottontail Rabbit	2.67E-01	1	2.67E-01	1.20E+00	None	NA	NA	NA
Perchlorate	Eastern Cottontail Rabbit	1.65E+04	1	1.65E+04	1.20E+00	None	NA	NA	NA
4-Amino-2,6-dinitrotoluene	Eastern Cottontail Rabbit	1.18E-01	1	1.18E-01	1.20E+00	None	NA	NA	NA
4-Nitrotoluene	Eastern Cottontail Rabbit	9.76E-03	1	9.76E-03	1.20E+00	None	NA	NA	NA
Nitroglycerin	Eastern Cottontail Rabbit	2.80E+01	1	2.80E+01	1.20E+00	21.16	25.392	1.1E+00	Yes
Antimony	Eastern Cottontail Rabbit	3.86E-01	1	3.86E-01	1.20E+00	0.05	0.06	6.4E+00	Yes
Arsenic	Eastern Cottontail Rabbit	2.16E-01	1	2.16E-01	1.20E+00	0.05	0.06	3.6E+00	Yes
Cadmium	Eastern Cottontail Rabbit	1.70E+00	1	1.70E+00	1.20E+00	0.709	0.8508	2.0E+00	Yes
Chromium	Eastern Cottontail Rabbit	8.52E-01	1	8.52E-01	1.20E+00	2.41	2.892	2.9E-01	HQ<1
Copper	Eastern Cottontail Rabbit	2.27E+01	1	2.27E+01	1.20E+00	11.2	13.44	1.7E+00	Yes
Lead	Eastern Cottontail Rabbit	5.91E+00	1	5.91E+00	1.20E+00	5.88	7.056	8.4E-01	HQ<1
Mercury	Eastern Cottontail Rabbit	8.93E-04	1	8.93E-04	1.20E+00	0.024	0.0288	3.1E-02	HQ<1
Nickel	Eastern Cottontail Rabbit	1.25E+00	1	1.25E+00	1.20E+00	29.4	35.28	3.5E-02	HQ<1
Selenium	Eastern Cottontail Rabbit	2.09E-02	1	2.09E-02	1.20E+00	0.147	0.1764	1.2E-01	HQ<1
Thallium	Eastern Cottontail Rabbit	7.92E-03	1	7.92E-03	1.20E+00	0.147	0.1764	4.5E-02	HQ<1
Zinc	Eastern Cottontail Rabbit	1.34E+01	1	1.34E+01	1.20E+00	117.6	141.12	9.5E-02	HQ<1
							EHI	**1.7E+02**	

Notes:
EHI - Ecological Hazard Index
kg - kilogram
mg/kg - milligrams per kilogram
mg/kg/day - milligrams per kilograms per day
NA - Not Analyzed

Table 7-24
Chemical-Specific Risk Estimates for Representative Wildlife Species
OB/OD RI Report
Fort Riley, Kansas

Parameter	Representative Wildlife Species	Total Dose Received (mg/day)	Fraction of Home Range Within Area Site	Total Dose Received Based on Fraction of Area Within Home Range (mg/day)	Average Body Weight (kg)	No Observed Adverse Effects Level (NOAEL) (mg/kg/day)	Weight Normalized NOAEL (mg/day)	NOAEL Based Ecological Hazard Quotient	Refined COPECs for Wildlife
1,1,2,2-Tetrachloroethane	Red Fox	5.77E-01	0.467	2.70E-01	4.50E+00	0.4	1.8	1.5E-01	HQ<1
1,2,4-Trimethylbenzene	Red Fox	3.32E-04	0.467	1.55E-04	4.50E+00	None	NA	NA	NA
cis-1,2-Dichloroethene	Red Fox	7.23E-01	0.467	3.38E-01	4.50E+00	None	NA	NA	NA
Isopropylbenzene	Red Fox	4.63E-04	0.467	2.16E-04	4.50E+00	None	NA	NA	NA
p-Isopropyltoluene	Red Fox	1.10E-02	0.467	5.16E-03	4.50E+00	None	NA	NA	NA
sec-Butylbenzene	Red Fox	4.38E-03	0.467	2.05E-03	4.50E+00	None	NA	NA	NA
tert-Butylbenzene	Red Fox	7.73E-04	0.467	3.61E-04	4.50E+00	None	NA	NA	NA
Trichloroethene	Red Fox	1.86E+01	0.467	8.68E+00	4.50E+00	0.2	0.9	9.6E+00	Yes
Benzo(a)pyrene	Red Fox	4.69E-04	0.467	2.19E-04	4.50E+00	0.29	1.305	1.7E-04	HQ<1
bis(2-Ethylhexyl) phthalate	Red Fox	5.54E-04	0.467	2.59E-04	4.50E+00	5.2	23.4	1.1E-05	HQ<1
2,4-Dinitrotoluene	Red Fox	9.73E+00	0.467	4.54E+00	4.50E+00	111.44	501.48	9.1E-03	HQ<1
2,6-Dinitrotoluene	Red Fox	8.32E-01	0.467	3.89E-01	4.50E+00	111.44	501.48	7.7E-04	HQ<1
Di-n-butyl phthalate	Red Fox	4.71E+01	0.467	2.20E+01	4.50E+00	157	706.5	3.1E-02	HQ<1
N-Nitrosodiphenylamine	Red Fox	2.98E-01	0.467	1.39E-01	4.50E+00	None	NA	NA	NA
Perchlorate	Red Fox	5.95E+03	0.467	2.78E+03	4.50E+00	None	NA	NA	NA
4-Amino-2,6-dinitrotoluene	Red Fox	4.62E-02	0.467	2.16E-02	4.50E+00	None	NA	NA	NA
4-Nitrotoluene	Red Fox	4.43E-03	0.467	2.07E-03	4.50E+00	None	NA	NA	NA
Nitroglycerin	Red Fox	1.06E+01	0.467	4.94E+00	4.50E+00	15.21	68.445	7.2E-02	HQ<1
Antimony	Red Fox	2.25E-01	0.467	1.05E-01	4.50E+00	0.036	0.162	6.5E-01	HQ<1
Arsenic	Red Fox	2.01E-01	0.467	9.38E-02	4.50E+00	0.036	0.162	5.8E-01	HQ<1
Cadmium	Red Fox	8.95E-01	0.467	4.18E-01	4.50E+00	0.509	2.2905	1.8E-01	HQ<1
Chromium	Red Fox	9.70E-01	0.467	4.53E-01	4.50E+00	1.73	7.785	5.8E-02	HQ<1
Copper	Red Fox	1.09E+01	0.467	5.09E+00	4.50E+00	8	36	1.4E-01	HQ<1
Lead	Red Fox	5.15E+00	0.467	2.40E+00	4.50E+00	4.22	18.99	1.3E-01	HQ<1
Mercury	Red Fox	9.17E-04	0.467	4.28E-04	4.50E+00	0.01	0.045	9.5E-03	HQ<1
Nickel	Red Fox	1.18E+00	0.467	5.49E-01	4.50E+00	21.12	95.04	5.8E-03	HQ<1
Selenium	Red Fox	2.39E-02	0.467	1.11E-02	4.50E+00	0.106	0.477	2.3E-02	HQ<1
Thallium	Red Fox	9.77E-03	0.467	4.56E-03	4.50E+00	0.106	0.477	9.6E-03	HQ<1
Zinc	Red Fox	1.85E+01	0.467	8.64E+00	4.50E+00	84.5	380.25	2.3E-02	HQ<1
							EHI	**1.2E+01**	

Notes:
EHI - Ecological Hazard Index
kg - kilogram
mg/kg - milligrams per kilogram
mg/kg/day - milligrams per kilograms per day
NA - Not Analyzed

Table 7-24
Chemical-Specific Risk Estimates for Representative Wildlife Species
OB/OD RI Report
Fort Riley, Kansas

Parameter	Representative Wildlife Species	Total Dose Received (mg/day)	Fraction of Home Range Within Area Site	Total Dose Received Based on Fraction of Area Within Home Range (mg/day)	Average Body Weight (kg)	No Observed Adverse Effects Level (NOAEL) (mg/kg/day)	Weight Normalized NOAEL (mg/day)	NOAEL Based Ecological Hazard Quotient	Refined COPECs for Wildlife
1,1,2,2-Tetrachloroethane	Raccoon	1.29E+00	0.146	1.88E-01	5.20E+00	0.35	1.82	1.0E-01	HQ<1
1,2,4-Trimethylbenzene	Raccoon	3.56E-03	0.146	5.19E-04	5.20E+00	None	NA	NA	NA
cis-1,2-Dichloroethene	Raccoon	4.78E-01	0.146	6.97E-02	5.20E+00	None	NA	NA	NA
Isopropylbenzene	Raccoon	4.80E-03	0.146	7.00E-04	5.20E+00	None	NA	NA	NA
p-Isopropyltoluene	Raccoon	1.25E-01	0.146	1.82E-02	5.20E+00	None	NA	NA	NA
sec-Butylbenzene	Raccoon	5.11E-02	0.146	7.46E-03	5.20E+00	None	NA	NA	NA
tert-Butylbenzene	Raccoon	8.76E-03	0.146	1.28E-03	5.20E+00	None	NA	NA	NA
Trichloroethene	Raccoon	1.25E+01	0.146	1.82E+00	5.20E+00	0.173	0.8996	2.0E+00	Yes
Benzo(a)pyrene	Raccoon	2.65E-02	0.146	3.87E-03	5.20E+00	0.25	1.3	3.0E-03	HQ<1
bis(2-Ethylhexyl) phthalate	Raccoon	4.82E-03	0.146	7.03E-04	5.20E+00	4.5	23.4	3.0E-05	HQ<1
2,4-Dinitrotoluene	Raccoon	1.16E+01	0.146	1.69E+00	5.20E+00	107.48	558.896	3.0E-03	HQ<1
2,6-Dinitrotoluene	Raccoon	8.65E-01	0.146	1.26E-01	5.20E+00	107.48	558.896	2.3E-04	HQ<1
Di-n-butyl phthalate	Raccoon	5.49E+02	0.146	8.01E+01	5.20E+00	136	707.2	1.1E-01	HQ<1
N-Nitrosodiphenylamine	Raccoon	2.20E+00	0.146	3.22E-01	5.20E+00	None	NA	NA	NA
Perchlorate	Raccoon	3.93E+03	0.146	5.74E+02	5.20E+00	None	NA	NA	NA
4-Amino-2,6-dinitrotoluene	Raccoon	4.94E-02	0.146	7.22E-03	5.20E+00	None	NA	NA	NA
4-Nitrotoluene	Raccoon	9.68E-03	0.146	1.41E-03	5.20E+00	None	NA	NA	NA
Nitroglycerin	Raccoon	8.76E+00	0.146	1.28E+00	5.20E+00	14.67	76.284	1.7E-02	HQ<1
Antimony	Raccoon	2.24E-01	0.146	3.28E-02	5.20E+00	0.031	0.1612	2.0E-01	HQ<1
Arsenic	Raccoon	5.89E-01	0.146	8.59E-02	5.20E+00	0.031	0.1612	5.3E-01	HQ<1
Beryllium	Raccoon	8.06E-02	0.146	1.18E-02	5.20E+00	0.3	1.56	7.5E-03	HQ<1
Cadmium	Raccoon	1.57E+00	0.146	2.29E-01	5.20E+00	0.441	2.2932	1.0E-01	HQ<1
Chromium	Raccoon	1.83E+00	0.146	2.67E-01	5.20E+00	1.5	7.8	3.4E-02	HQ<1
Copper	Raccoon	8.57E+00	0.146	1.25E+00	5.20E+00	7	36.4	3.4E-02	HQ<1
Lead	Raccoon	4.77E+00	0.146	6.97E-01	5.20E+00	3.66	19.032	3.7E-02	HQ<1
Mercury	Raccoon	5.47E-02	0.146	7.98E-03	5.20E+00	0.009	0.0468	1.7E-01	HQ<1
Nickel	Raccoon	3.09E+00	0.146	4.51E-01	5.20E+00	18.29	95.108	4.7E-03	HQ<1
Selenium	Raccoon	9.11E-02	0.146	1.33E-02	5.20E+00	0.091	0.4732	2.8E-02	HQ<1
Thallium	Raccoon	1.12E-02	0.146	1.64E-03	5.20E+00	0.091	0.4732	3.5E-03	HQ<1
Zinc	Raccoon	3.76E+01	0.146	5.49E+00	5.20E+00	73.2	380.64	1.4E-02	HQ<1
							EHI	**3.4E+00**	

Notes:
EHI - Ecological Hazard Index
kg - kilogram
mg/kg - milligrams per kilogram
mg/kg/day - milligrams per kilograms per day
NA - Not Analyzed

Table 7-24
Chemical-Specific Risk Estimates for Representative Wildlife Species
OB/OD RI Report
Fort Riley, Kansas

Parameter	Representative Wildlife Species	Total Dose Received (mg/day)	Fraction of Home Range Within Area Site	Total Dose Received Based on Fraction of Area Within Home Range (mg/day)	Average Body Weight (kg)	No Observed Adverse Effects Level (NOAEL) (mg/kg/day)	Weight Normalized NOAEL (mg/day)	NOAEL Based Ecological Hazard Quotient	Refined COPECs for Wildlife
1,1,2,2-Tetrachloroethane	White-tailed Deer	9.07E+00	0.219	1.99E+00	5.65E+01	0.21	11.865	1.7E-01	HQ<1
1,2,4-Trimethylbenzene	White-tailed Deer	3.94E-04	0.219	8.64E-05	5.65E+01	None	NA	NA	NA
cis-1,2-Dichloroethene	White-tailed Deer	1.47E+01	0.219	3.23E+00	5.65E+01	None	NA	NA	NA
Isopropylbenzene	White-tailed Deer	7.72E-04	0.219	1.69E-04	5.65E+01	None	NA	NA	NA
p-Isopropyltoluene	White-tailed Deer	5.16E-03	0.219	1.13E-03	5.65E+01	None	NA	NA	NA
sec-Butylbenzene	White-tailed Deer	5.10E-04	0.219	1.12E-04	5.65E+01	None	NA	NA	NA
tert-Butylbenzene	White-tailed Deer	3.51E-04	0.219	7.68E-05	5.65E+01	None	NA	NA	NA
Trichloroethene	White-tailed Deer	3.78E+02	0.219	8.29E+01	5.65E+01	0.106	5.989	1.4E+01	Yes
Benzo(a)pyrene	White-tailed Deer	4.07E-03	0.219	8.91E-04	5.65E+01	0.15	8.475	1.1E-04	HQ<1
bis(2-Ethylhexyl) phthalate	White-tailed Deer	4.81E-03	0.219	1.05E-03	5.65E+01	2.8	158.2	6.7E-06	HQ<1
2,4-Dinitrotoluene	White-tailed Deer	1.76E+02	0.219	3.86E+01	5.65E+01	59.2	3344.8	1.2E-02	HQ<1
2,6-Dinitrotoluene	White-tailed Deer	1.54E+01	0.219	3.38E+00	5.65E+01	59.2	3344.8	1.0E-03	HQ<1
Di-n-butyl phthalate	White-tailed Deer	5.48E+00	0.219	1.20E+00	5.65E+01	83	4689.5	2.6E-04	HQ<1
N-Nitrosodiphenylamine	White-tailed Deer	1.84E+00	0.219	4.02E-01	5.65E+01	None	NA	NA	NA
Perchlorate	White-tailed Deer	1.21E+05	0.219	2.66E+04	5.65E+01	None	NA	NA	NA
4-Amino-2,6-dinitrotoluene	White-tailed Deer	8.54E-01	0.219	1.87E-01	5.65E+01	None	NA	NA	NA
4-Nitrotoluene	White-tailed Deer	6.98E-02	0.219	1.53E-02	5.65E+01	None	NA	NA	NA
Nitroglycerin	White-tailed Deer	2.04E+02	0.219	4.46E+01	5.65E+01	8.08	456.52	9.8E-02	HQ<1
Antimony	White-tailed Deer	2.37E+00	0.219	5.20E-01	5.65E+01	0.019	1.0735	4.8E-01	HQ<1
Arsenic	White-tailed Deer	8.98E-01	0.219	1.97E-01	5.65E+01	0.019	1.0735	1.8E-01	HQ<1
Cadmium	White-tailed Deer	1.12E+01	0.219	2.46E+00	5.65E+01	0.271	15.3115	1.6E-01	HQ<1
Chromium	White-tailed Deer	2.46E+00	0.219	5.38E-01	5.65E+01	0.92	51.98	1.0E-02	HQ<1
Copper	White-tailed Deer	1.51E+02	0.219	3.31E+01	5.65E+01	4.3	242.95	1.4E-01	HQ<1
Lead	White-tailed Deer	2.62E+01	0.219	5.73E+00	5.65E+01	2.24	126.56	4.5E-02	HQ<1
Mercury	White-tailed Deer	4.79E-03	0.219	1.05E-03	5.65E+01	0.009	0.5085	2.1E-03	HQ<1
Nickel	White-tailed Deer	5.05E+00	0.219	1.11E+00	5.65E+01	11.22	633.93	1.7E-03	HQ<1
Selenium	White-tailed Deer	7.99E-02	0.219	1.75E-02	5.65E+01	0.056	3.164	5.5E-03	HQ<1
Thallium	White-tailed Deer	2.10E-02	0.219	4.59E-03	5.65E+01	0.056	3.164	1.5E-03	HQ<1
Zinc	White-tailed Deer	3.15E+01	0.219	6.89E+00	5.65E+01	44.9	2536.85	2.7E-03	HQ<1
							EHI	**1.5E+01**	

Notes:
EHI - Ecological Hazard Index
kg - kilogram
mg/kg - milligrams per kilogram
mg/kg/day - milligrams per kilograms per day
NA - Not Analyzed

Table 7-24
Chemical-Specific Risk Estimates for Representative Wildlife Species
OB/OD RI Report
Fort Riley, Kansas

Parameter	Representative Wildlife Species	Total Dose Received (mg/day)	Fraction of Home Range Within Area Site	Total Dose Received Based on Fraction of Area Within Home Range (mg/day)	Average Body Weight (kg)	No Observed Adverse Effects Level (NOAEL) (mg/kg/day)	Weight Normalized NOAEL (mg/day)	NOAEL Based Ecological Hazard Quotient	Refined COPECs for Wildlife
1,1,2,2-Tetrachloroethane	American Robin	1.62E+00	1	1.62E+00	7.70E-02	None	NA	NA	NA
1,2,4-Trimethylbenzene	American Robin	5.51E-03	1	5.51E-03	7.70E-02	None	NA	NA	NA
cis-1,2-Dichloroethene	American Robin	1.58E-01	1	1.58E-01	7.70E-02	None	NA	NA	NA
Isopropylbenzene	American Robin	7.42E-03	1	7.42E-03	7.70E-02	None	NA	NA	NA
p-Isopropyltoluene	American Robin	2.10E-01	1	2.10E-01	7.70E-02	None	NA	NA	NA
sec-Butylbenzene	American Robin	7.94E-02	1	7.94E-02	7.70E-02	None	NA	NA	NA
tert-Butylbenzene	American Robin	1.36E-02	1	1.36E-02	7.70E-02	None	NA	NA	NA
Trichloroethene	American Robin	4.04E+00	1	4.04E+00	7.70E-02	None	NA	NA	NA
Benzo(a)pyrene	American Robin	1.17E-05	1	1.17E-05	7.70E-02	2	0.154	7.6E-05	HQ<1
bis(2-Ethylhexyl) phthalate	American Robin	1.38E-05	1	1.38E-05	7.70E-02	1.1	0.0847	1.6E-04	HQ<1
2,4-Dinitrotoluene	American Robin	1.07E+01	1	1.07E+01	7.70E-02	100	7.7	1.4E+00	Yes
2,6-Dinitrotoluene	American Robin	7.09E-01	1	7.09E-01	7.70E-02	100	7.7	9.2E-02	HQ<1
Di-n-butyl phthalate	American Robin	8.53E+02	1	8.53E+02	7.70E-02	0.11	0.00847	1.0E+05	Yes
N-Nitrosodiphenylamine	American Robin	3.34E+00	1	3.34E+00	7.70E-02	None	NA	NA	NA
Perchlorate	American Robin	1.30E+03	1	1.30E+03	7.70E-02	None	NA	NA	NA
4-Amino-2,6-dinitrotoluene	American Robin	4.17E-02	1	4.17E-02	7.70E-02	None	NA	NA	NA
4-Nitrotoluene	American Robin	1.21E-02	1	1.21E-02	7.70E-02	None	NA	NA	NA
Nitroglycerin	American Robin	5.33E+00	1	5.33E+00	7.70E-02	None	NA	NA	NA
Antimony	American Robin	1.79E-01	1	1.79E-01	7.70E-02	None	NA	NA	NA
Arsenic	American Robin	1.62E-01	1	1.62E-01	7.70E-02	5.1	0.3927	4.1E-01	HQ<1
Cadmium	American Robin	1.46E+00	1	1.46E+00	7.70E-02	1.45	0.11165	1.3E+01	Yes
Chromium	American Robin	4.92E-01	1	4.92E-01	7.70E-02	1	0.077	6.4E+00	Yes
Copper	American Robin	3.97E+00	1	3.97E+00	7.70E-02	47	3.619	1.1E+00	Yes
Lead	American Robin	2.73E+00	1	2.73E+00	7.70E-02	1.13	0.08701	3.1E+01	Yes
Mercury	American Robin	4.50E-04	1	4.50E-04	7.70E-02	0.006	0.000462	9.7E-01	HQ<1
Nickel	American Robin	6.02E-01	1	6.02E-01	7.70E-02	77.4	5.9598	1.0E-01	HQ<1
Selenium	American Robin	2.80E-02	1	2.80E-02	7.70E-02	0.5	0.0385	7.3E-01	HQ<1
Thallium	American Robin	1.26E-02	1	1.26E-02	7.70E-02	0.5	0.0385	3.3E-01	HQ<1
Zinc	American Robin	4.53E+01	1	4.53E+01	7.70E-02	14.5	1.1165	4.1E+01	Yes
							EHI	**1.0E+05**	

Notes:
EHI - Ecological Hazard Index
kg - kilogram
mg/kg - milligrams per kilogram
mg/kg/day - milligrams per kilograms per day
NA - Not Analyzed
LOAEL benchmarks for Benzo(a)pyrene were used as a surrogate NOAEL benchmarks for the American robin.

Table 7-24
Chemical-Specific Risk Estimates for Representative Wildlife Species
OB/OD RI Report
Fort Riley, Kansas

Parameter	Representative Wildlife Species	Total Dose Received (mg/day)	Fraction of Home Range Within Area Site	Total Dose Received Based on Fraction of Area Within Home Range (mg/day)	Average Body Weight (kg)	No Observed Adverse Effects Level (NOAEL) (mg/kg/day)	Weight Normalized NOAEL (mg/day)	NOAEL Based Ecological Hazard Quotient	Refined COPECs for Wildlife
1,1,2,2-Tetrachloroethane	Red-tailed Hawk	1.40E-01	0.074	1.03E-02	1.13E+00	None	NA	NA	NA
1,2,4-Trimethylbenzene	Red-tailed Hawk	8.04E-05	0.074	5.95E-06	1.13E+00	None	NA	NA	NA
cis-1,2-Dichloroethene	Red-tailed Hawk	1.75E-01	0.074	1.30E-02	1.13E+00	None	NA	NA	NA
Isopropylbenzene	Red-tailed Hawk	1.12E-04	0.074	8.30E-06	1.13E+00	None	NA	NA	NA
p-Isopropyltoluene	Red-tailed Hawk	2.68E-03	0.074	1.98E-04	1.13E+00	None	NA	NA	NA
sec-Butylbenzene	Red-tailed Hawk	1.06E-03	0.074	7.85E-05	1.13E+00	None	NA	NA	NA
tert-Butylbenzene	Red-tailed Hawk	1.87E-04	0.074	1.39E-05	1.13E+00	None	NA	NA	NA
Trichloroethene	Red-tailed Hawk	4.50E+00	0.074	3.33E-01	1.13E+00	None	NA	NA	NA
Benzo(a)pyrene	Red-tailed Hawk	8.27E-05	0.074	6.12E-06	1.13E+00	2	2.252	2.7E-06	HQ<1
bis(2-Ethylhexyl) phthalate	Red-tailed Hawk	9.78E-05	0.074	7.24E-06	1.13E+00	1.1	1.2386	5.8E-06	HQ<1
2,4-Dinitrotoluene	Red-tailed Hawk	2.36E+00	0.074	1.74E-01	1.13E+00	100	112.6	1.5E-03	HQ<1
2,6-Dinitrotoluene	Red-tailed Hawk	2.02E-01	0.074	1.49E-02	1.13E+00	100	112.6	1.3E-04	HQ<1
Di-n-butyl phthalate	Red-tailed Hawk	1.14E+01	0.074	8.43E-01	1.13E+00	0.11	0.12386	6.8E+00	Yes
N-Nitrosodiphenylamine	Red-tailed Hawk	7.22E-02	0.074	5.34E-03	1.13E+00	None	NA	NA	NA
Perchlorate	Red-tailed Hawk	1.44E+03	0.074	1.07E+02	1.13E+00	None	NA	NA	NA
4-Amino-2,6-dinitrotoluene	Red-tailed Hawk	1.12E-02	0.074	8.29E-04	1.13E+00	None	NA	NA	NA
4-Nitrotoluene	Red-tailed Hawk	1.07E-03	0.074	7.94E-05	1.13E+00	None	NA	NA	NA
Nitroglycerin	Red-tailed Hawk	2.56E+00	0.074	1.90E-01	1.13E+00	None	NA	NA	NA
Antimony	Red-tailed Hawk	5.45E-02	0.074	4.03E-03	1.13E+00	None	NA	NA	NA
Arsenic	Red-tailed Hawk	4.86E-02	0.074	3.60E-03	1.13E+00	5.1	5.7426	6.3E-04	HQ<1
Cadmium	Red-tailed Hawk	2.17E-01	0.074	1.60E-02	1.13E+00	1.45	1.6327	9.8E-03	HQ<1
Chromium	Red-tailed Hawk	2.35E-01	0.074	1.74E-02	1.13E+00	1	1.126	1.5E-02	HQ<1
Copper	Red-tailed Hawk	2.64E+00	0.074	1.95E-01	1.13E+00	47	52.922	3.7E-03	HQ<1
Lead	Red-tailed Hawk	1.25E+00	0.074	9.22E-02	1.13E+00	1.13	1.27238	7.2E-02	HQ<1
Mercury	Red-tailed Hawk	2.13E-04	0.074	1.58E-05	1.13E+00	0.006	0.006756	2.3E-03	HQ<1
Nickel	Red-tailed Hawk	2.85E-01	0.074	2.11E-02	1.13E+00	77.4	87.1524	2.4E-04	HQ<1
Selenium	Red-tailed Hawk	5.70E-03	0.074	4.22E-04	1.13E+00	0.5	0.563	7.5E-04	HQ<1
Thallium	Red-tailed Hawk	2.37E-03	0.074	1.75E-04	1.13E+00	0.5	0.563	3.1E-04	HQ<1
Zinc	Red-tailed Hawk	4.48E+00	0.074	3.32E-01	1.13E+00	14.5	16.327	2.0E-02	HQ<1
							EHI	**6.9E+00**	

Notes:

EHI - Ecological Hazard Index
kg - kilogram
mg/kg - milligrams per kilogram
mg/kg/day - milligrams per kilograms per day
NA - Not Analyzed
LOAEL benchmarks for Benzo(a)pyrene were used as a surrogate NOAEL benchmarks for the red-tailed hawk.

Table 7-25

Ecological Hazard Index for Representative Wildlife Species
OB/OD RI Report
Fort Riley, Kansas

Representative Wildlife Species	Ecological Hazard Index (EHI)
Terrestrial Invertebrate (i.e., Earthworm)	4.6E+00
Benthic Invertebrate	7.6E+00
Terrestrial Plant (Surface Soil Exposure)	3.2E+02
Terrestrial Plant (Subsurface Soil Exposure)	2.8E+02
Aquatic Plant	9.2E+00
Aquatic Invertebrate	2.8E+01
Fish	3.2E+00
Short-tailed Shrew	4.6E+01
White-footed Mouse	4.9E+01
Meadow Vole	2.5E+01
Eastern Cottontail Rabbit	1.7E+02
Red Fox	1.2E+01
Raccoon	3.4E+00
White-tailed Deer	1.5E+01
American Robin	1.0E+05
Red-tailed Hawk	6.9E+00

FIGURES

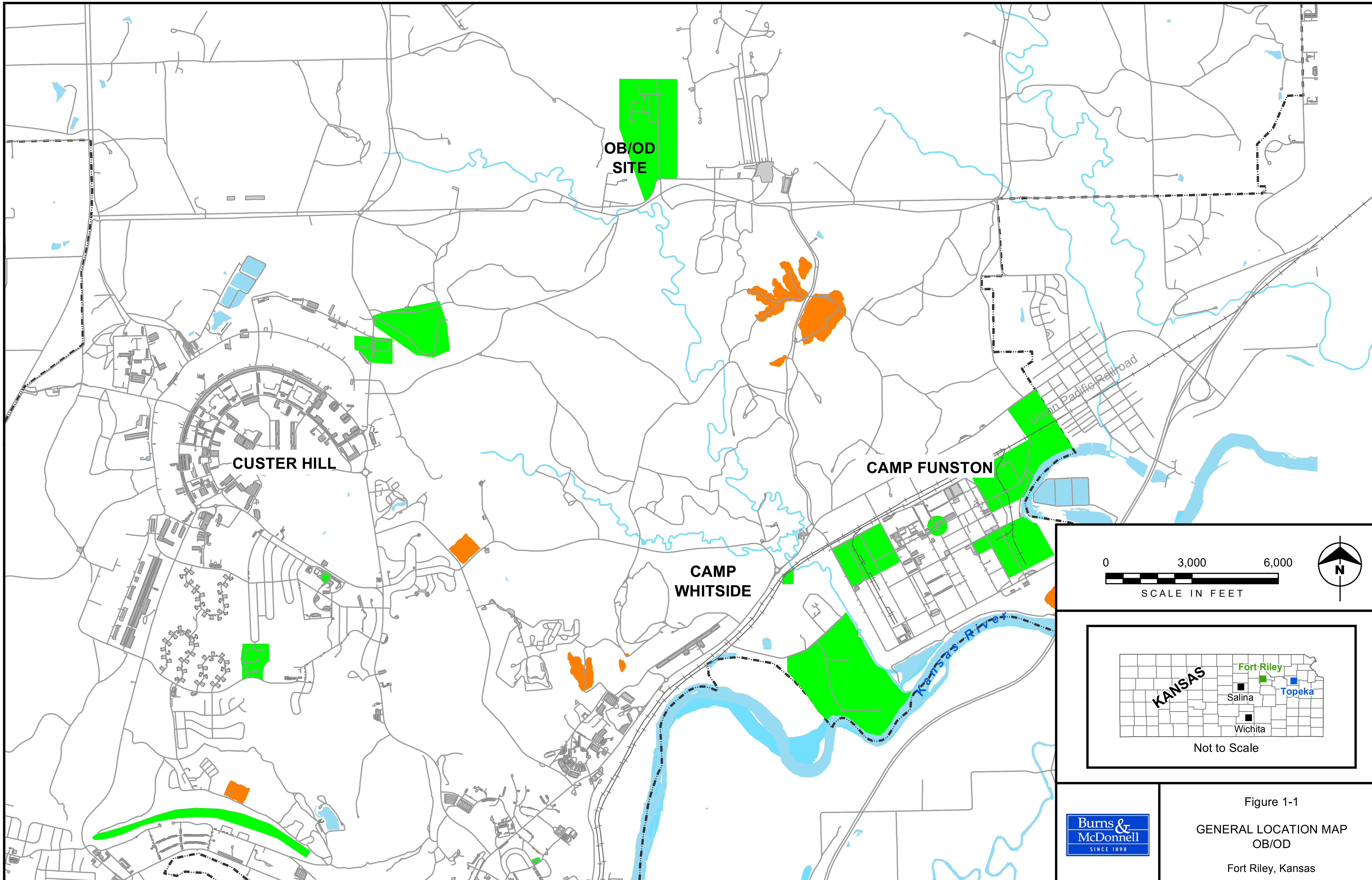
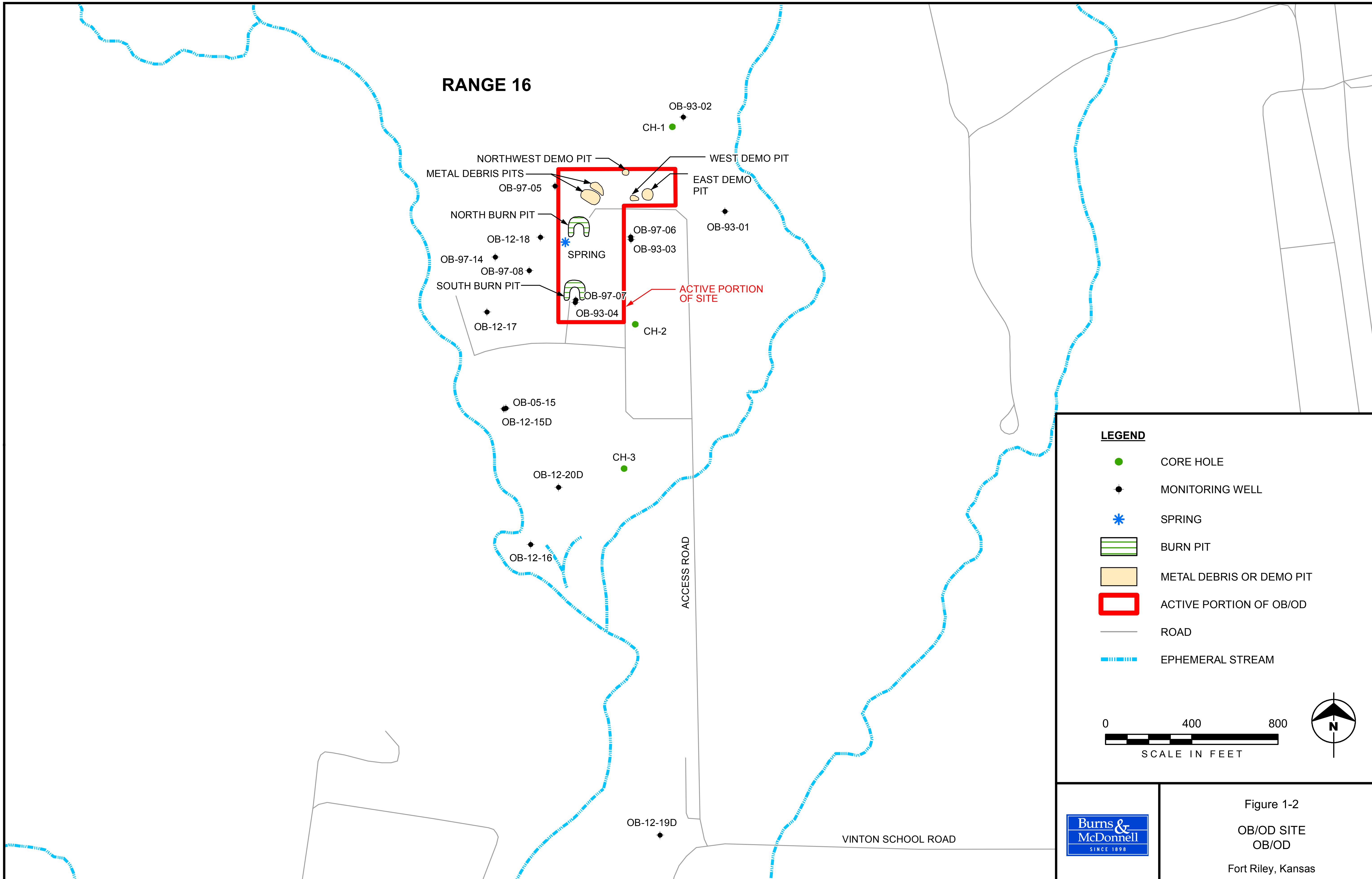


Figure 1-1

GENERAL LOCATION MAP
OB/OD

Fort Riley, Kansas

Name: Fig1-1_General_Location_Map_OBOD_REV1



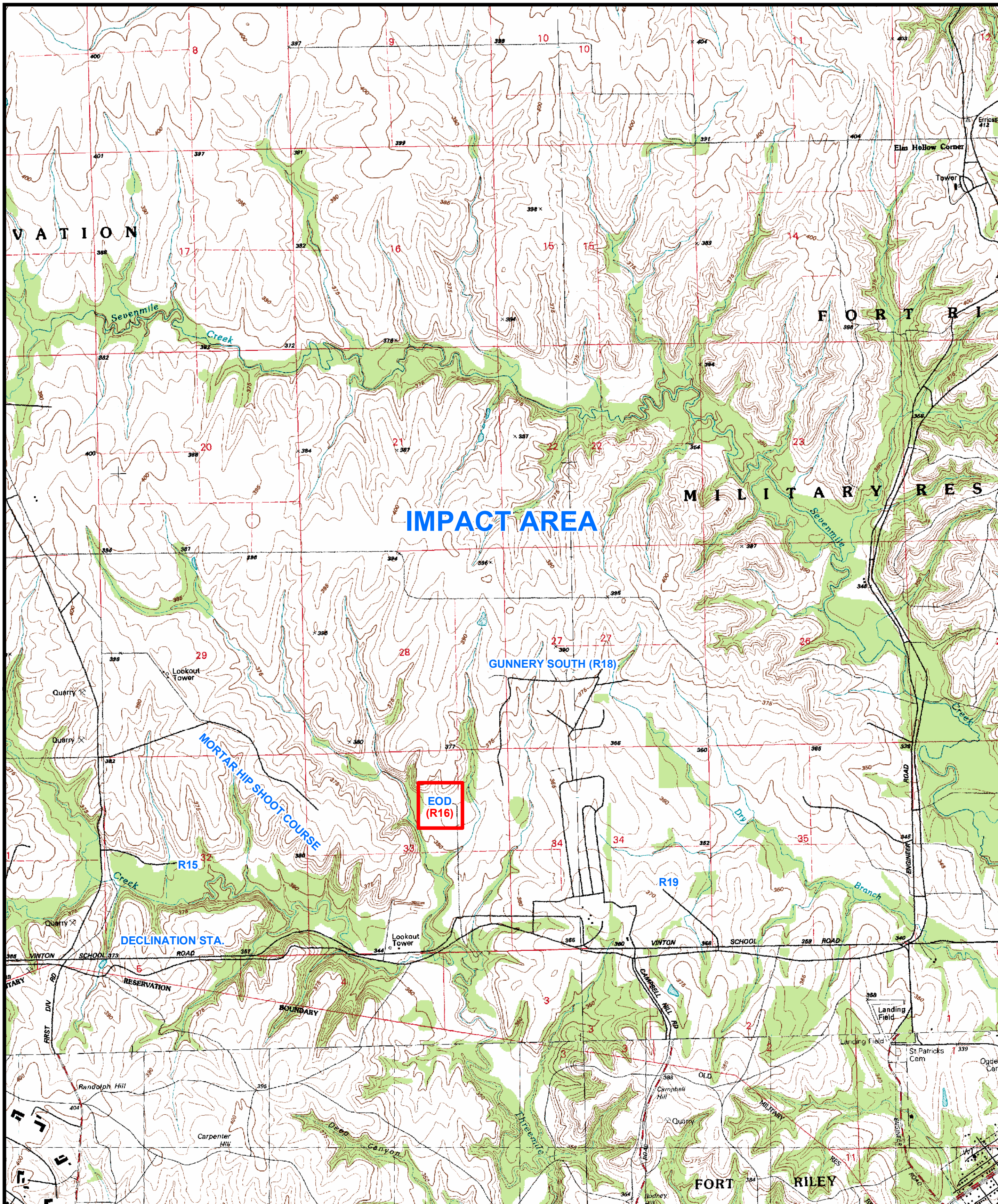
Burns & McDonnell SINCE 1898

Figure 1-2

OB/OD SITE
OB/OD

Fort Riley, Kansas

K:\ENV\LOUIS BERGER GROUP INC\site\63598\Deliver\GIS\2013\RI_Report2013\Fig1-2_OB-OD_Site_Location_OBOD.mxd sos June 19, 2013



LEGEND

OB/OD SITE BOUNDARY

0 3,500 7,000

SCALE IN FEET

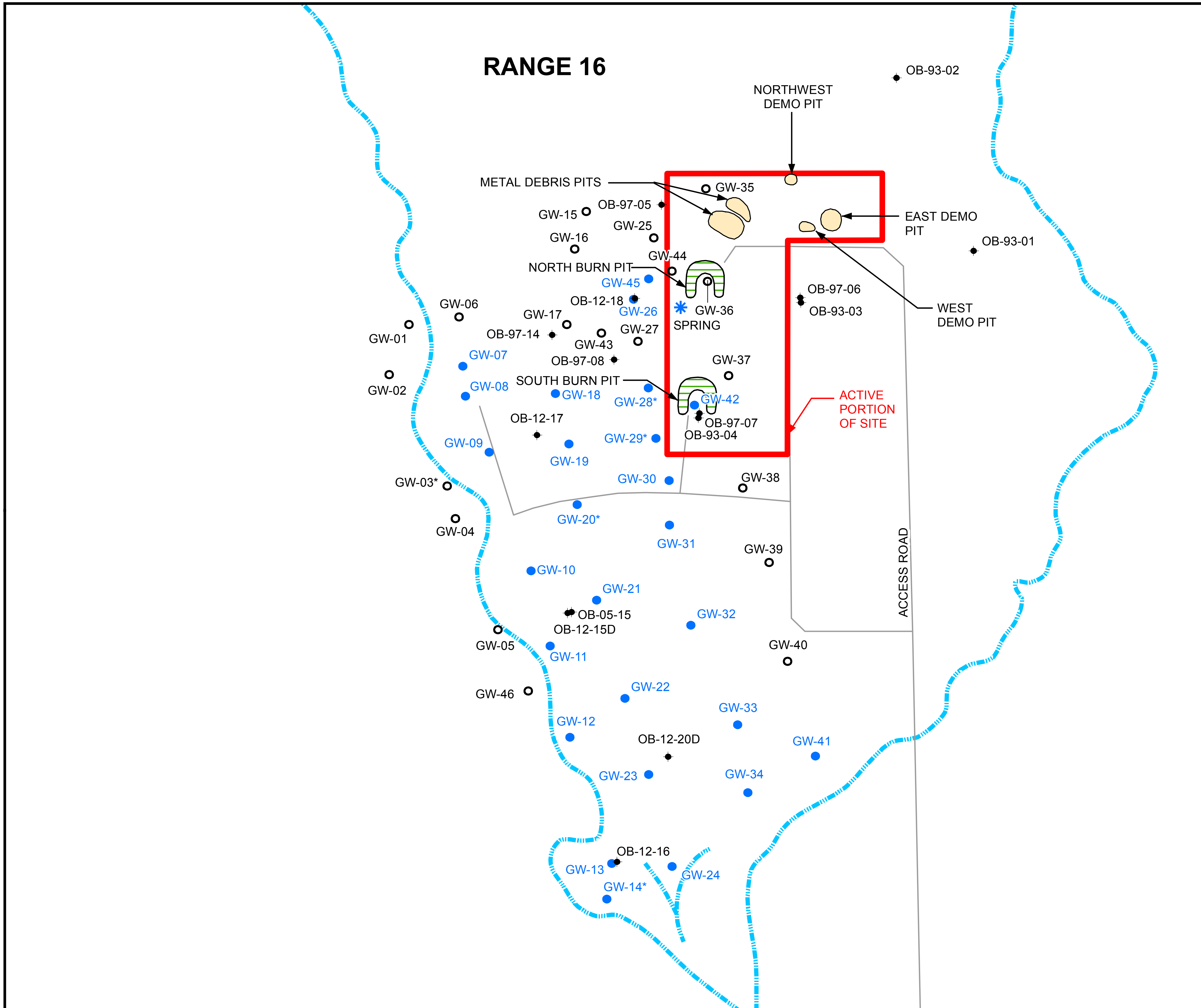
N

Burns & McDonnell SINCE 1898

Figure 1-3

IMPACT AREA
OB/OD

Fort Riley, Kansas



LEGEND

- MONITORING WELL
- SPRING
- DIRECT-PUSH GROUNDWATER SAMPLE LOCATIONS
- DIRECT-PUSH LOCATIONS - NO GROUNDWATER PRESENT
- BURN PIT
- METAL DEBRIS OR DEMO PIT
- ACTIVE PORTION OF OB/OD
- ROAD
- EPHEMERAL STREAM
- * LOCATION BASED ON FIELD MEASUREMENT

0 250 500
SCALE IN FEET

N

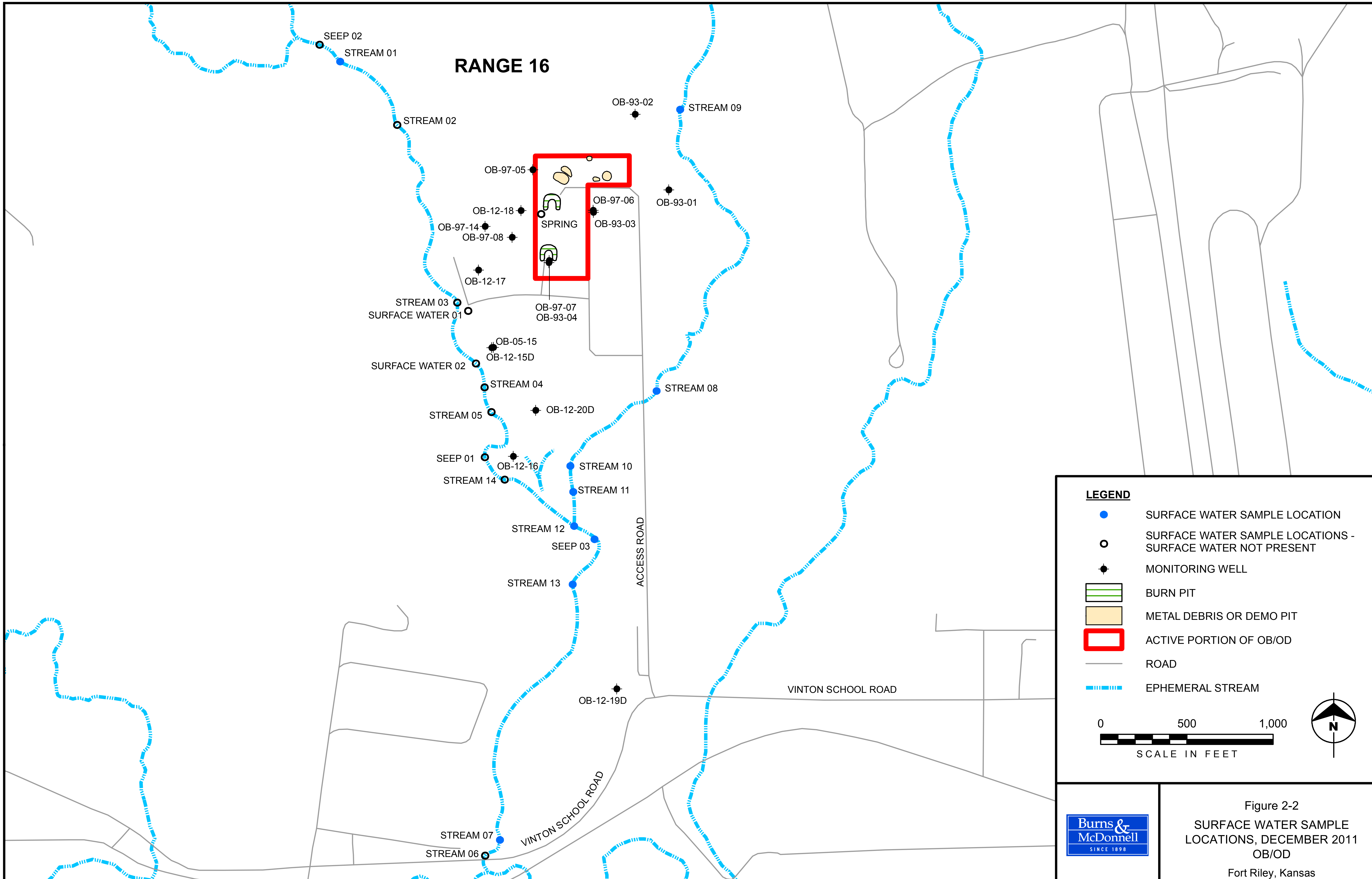
Burns & McDonnell SINCE 1898

Figure 2-1

DIRECT-PUSH GROUNDWATER SAMPLE LOCATIONS OB/OD

Fort Riley, Kansas

K:\ENV\LOUIS BERGER GROUP INC\site\63598\Deliver\GIS\2013\RI_Report2013\Fig2-1_Direct-Push_GW_OBOD.mxd sos June 19, 2013



Burns & McDonnell SINCE 1898

Figure 2-2
SURFACE WATER SAMPLE LOCATIONS, DECEMBER 2011
OB/OD
Fort Riley, Kansas

K:\ENV\LOUIS BERGER GROUP INC\site\63598\Deliver\GIS\2013\RI_Report2013\Fig2-2_Surface_Water_SampleS_OBOD.mxd sos jUNE 19, 2013

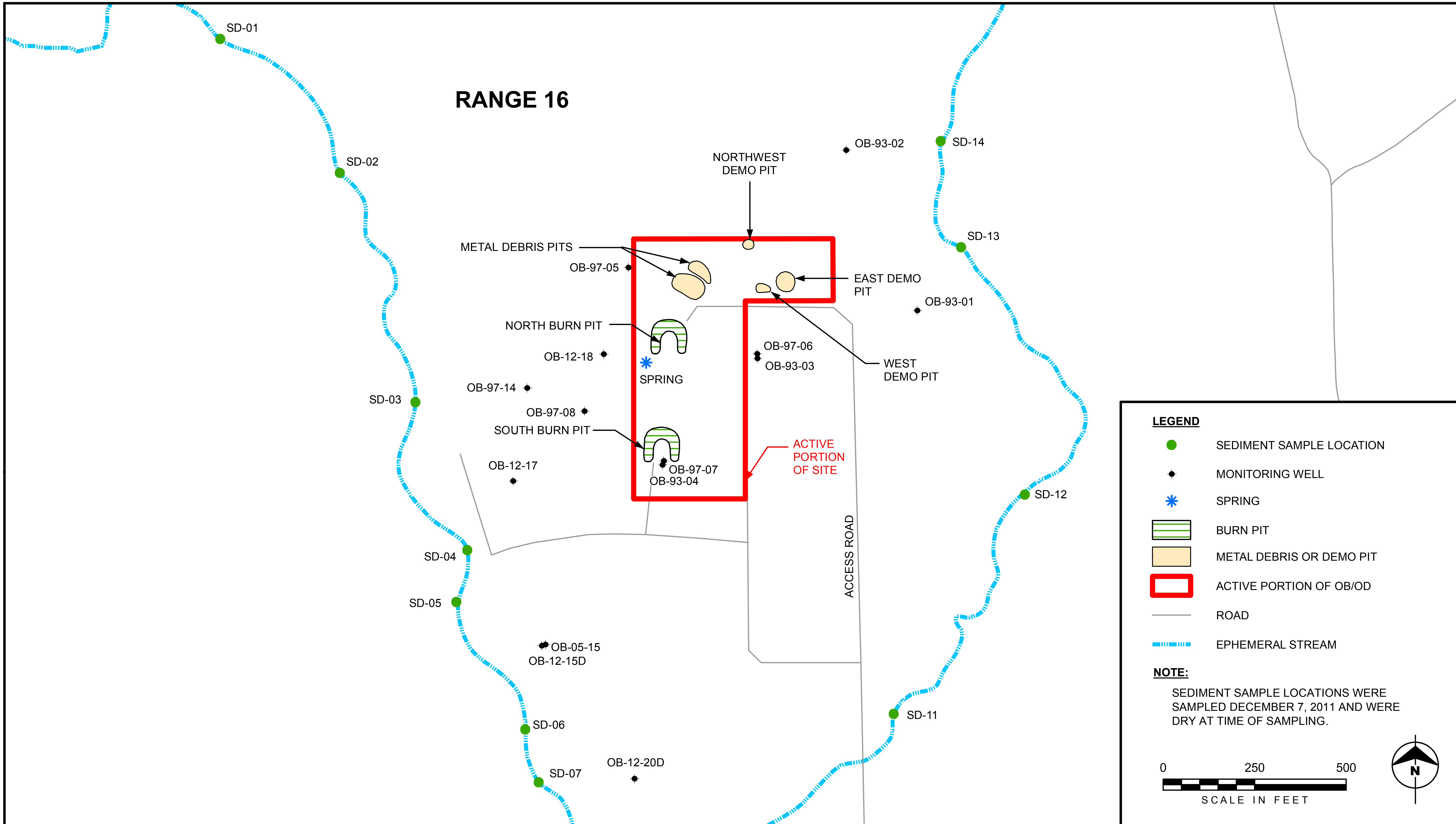
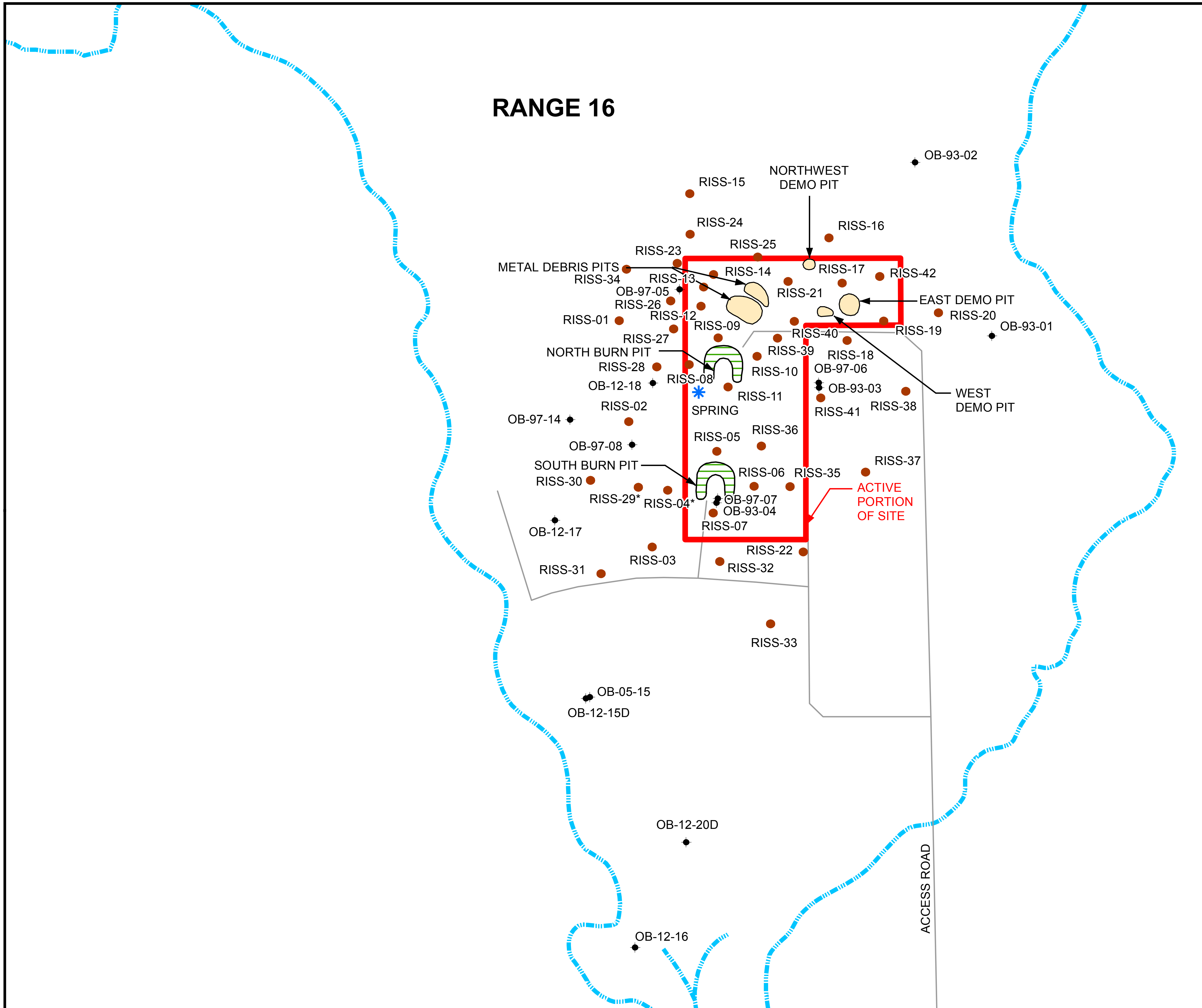


Figure 2-3

SEDIMENT SAMPLE LOCATIONS OB/OD

Fort Riley, Kansas

K:\ENV\LOUIS BERGER GROUP INC\site\63598\Deliver\GIS\2013\RI_Report2013\Fig2-3_Sediment_Samples_OBOD.mxd sos June 19, 2913



LEGEND

- RISS-33 SURFACE SOIL SAMPLE LOCATION
- MONITORING WELL
- SPRING
- BURN PIT
- METAL DEBRIS OR DEMO PIT
- ACTIVE PORTION OF OB/OD
- ROAD
- EPHEMERAL STREAM
- * LOCATION BASED ON FIELD MEASUREMENT

0 250 500
SCALE IN FEET

N

Burns & McDonnell SINCE 1898

Figure 2-4
SURFACE SOIL SAMPLE LOCATIONS
OB/OD
Fort Riley, Kansas

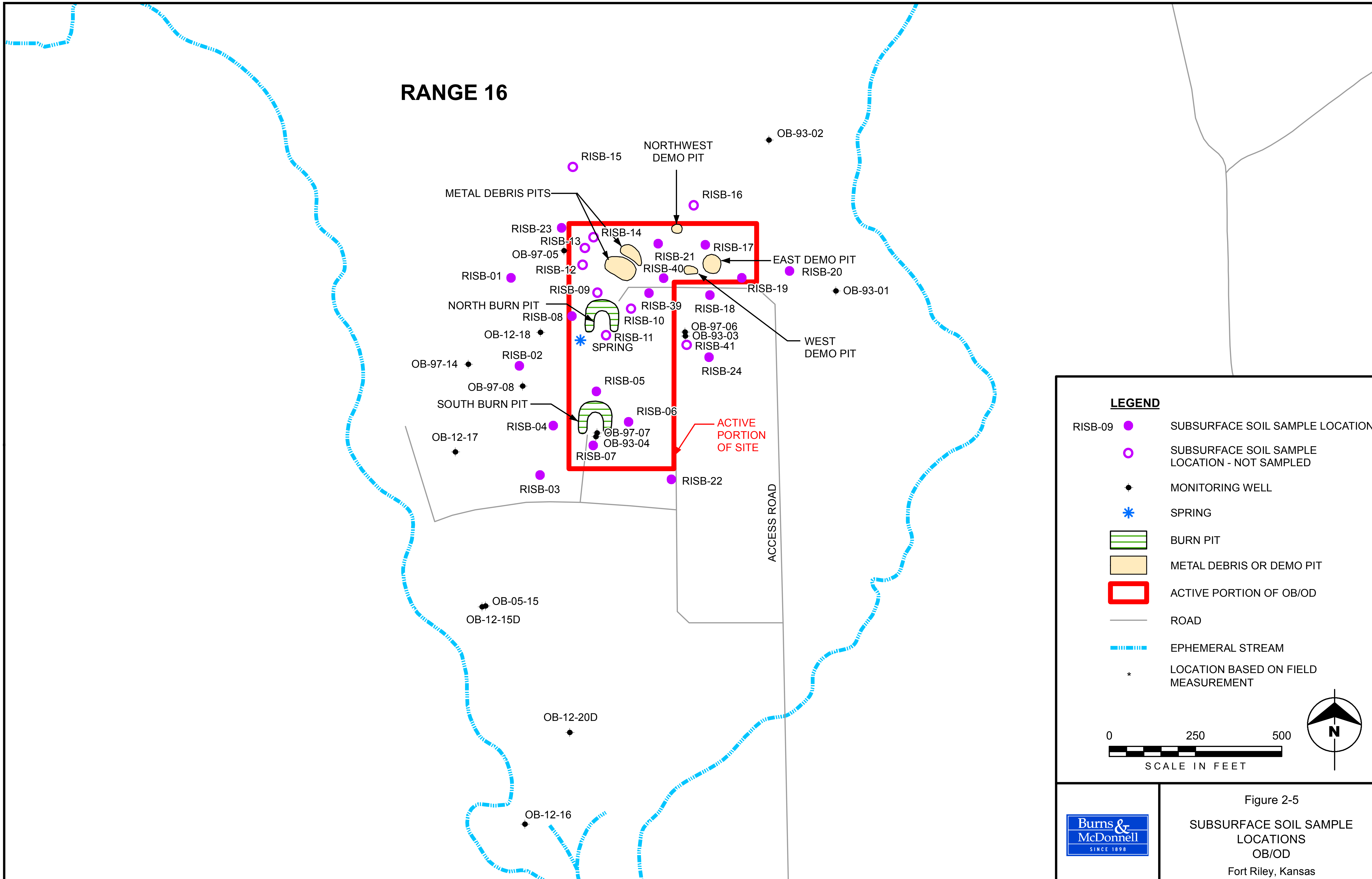


Figure 2-5
SUBSURFACE SOIL SAMPLE LOCATIONS
OB/OD
Fort Riley, Kansas

K:\ENV\LOUIS BERGER GROUP INC\site\63598\Deliver\GIS\2013\RI_Report2013\Fig2-5_Subsurface_Soil_Samples_OBOD.mxd sos June 19, 2013

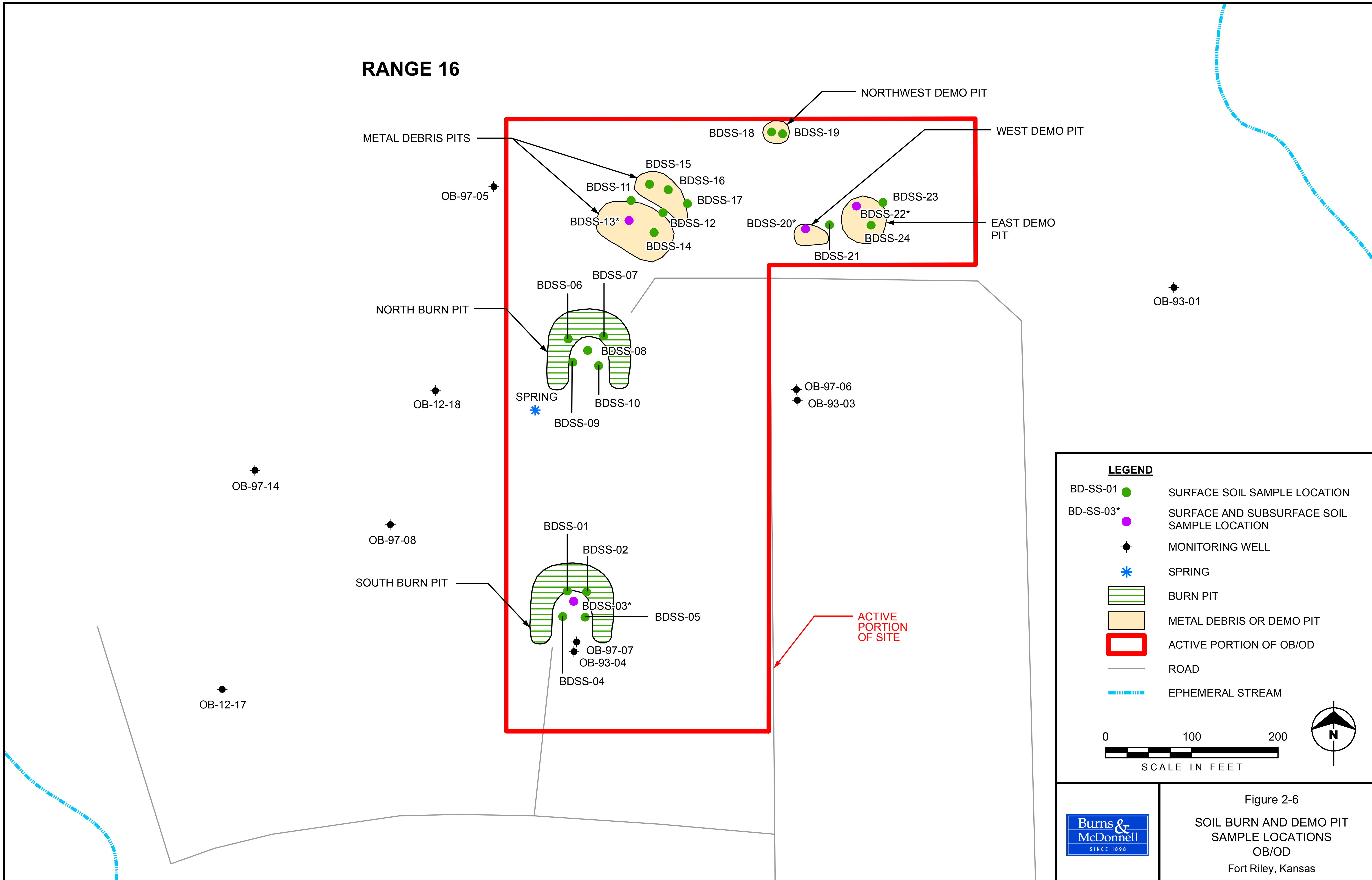


Figure 2-6
SOIL BURN AND DEMO PIT SAMPLE LOCATIONS OB/OD
Fort Riley, Kansas

K:\ENV\LOUIS BERGER GROUP INC\site\63598\Deliver\GIS\2013\RI_Report2013\Fig2-6_Soil_Burn_DemoPit_Locations.mxd sos June 19, 2013

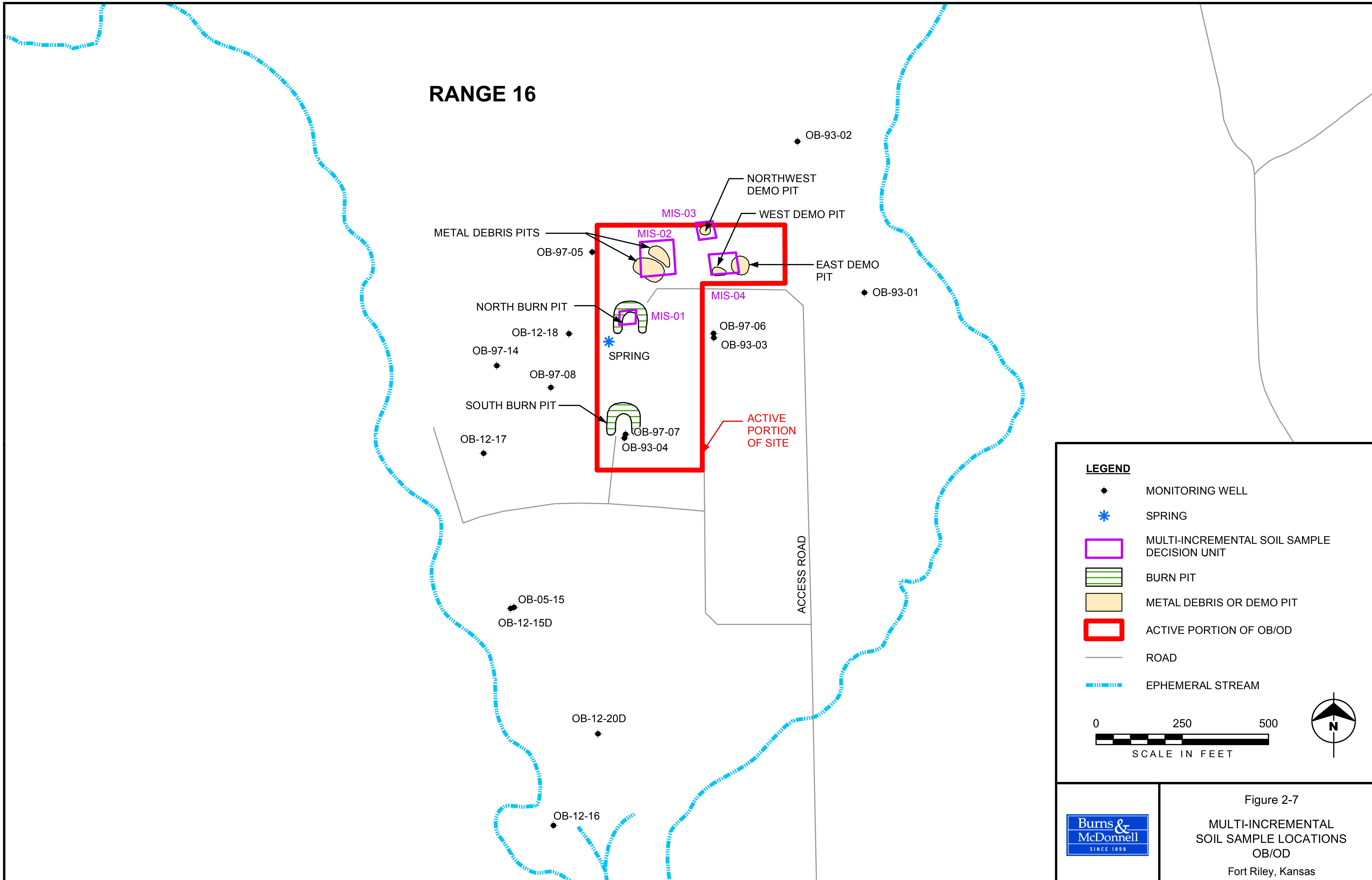


Figure 2-7
MULTI-INCREMENTAL SOIL SAMPLE LOCATIONS OB/OD
Fort Riley, Kansas

K:\ENV\LOUIS BERGER GROUP INC\site\63598\Deliver\GIS\2013\RI_Report2013\Fig2-7_Soil_Sample_OBOD.mxd sos June 19, 2013

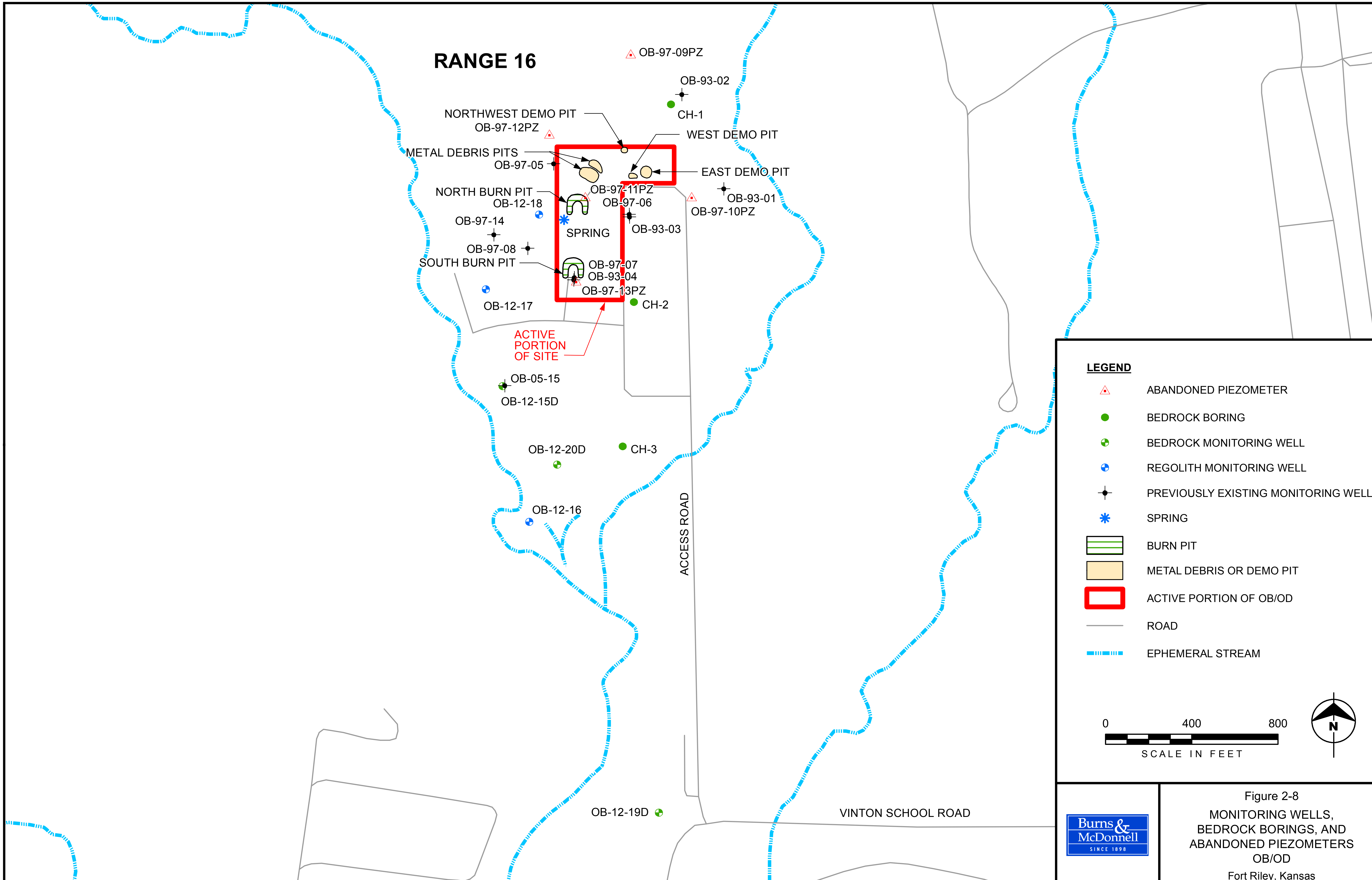
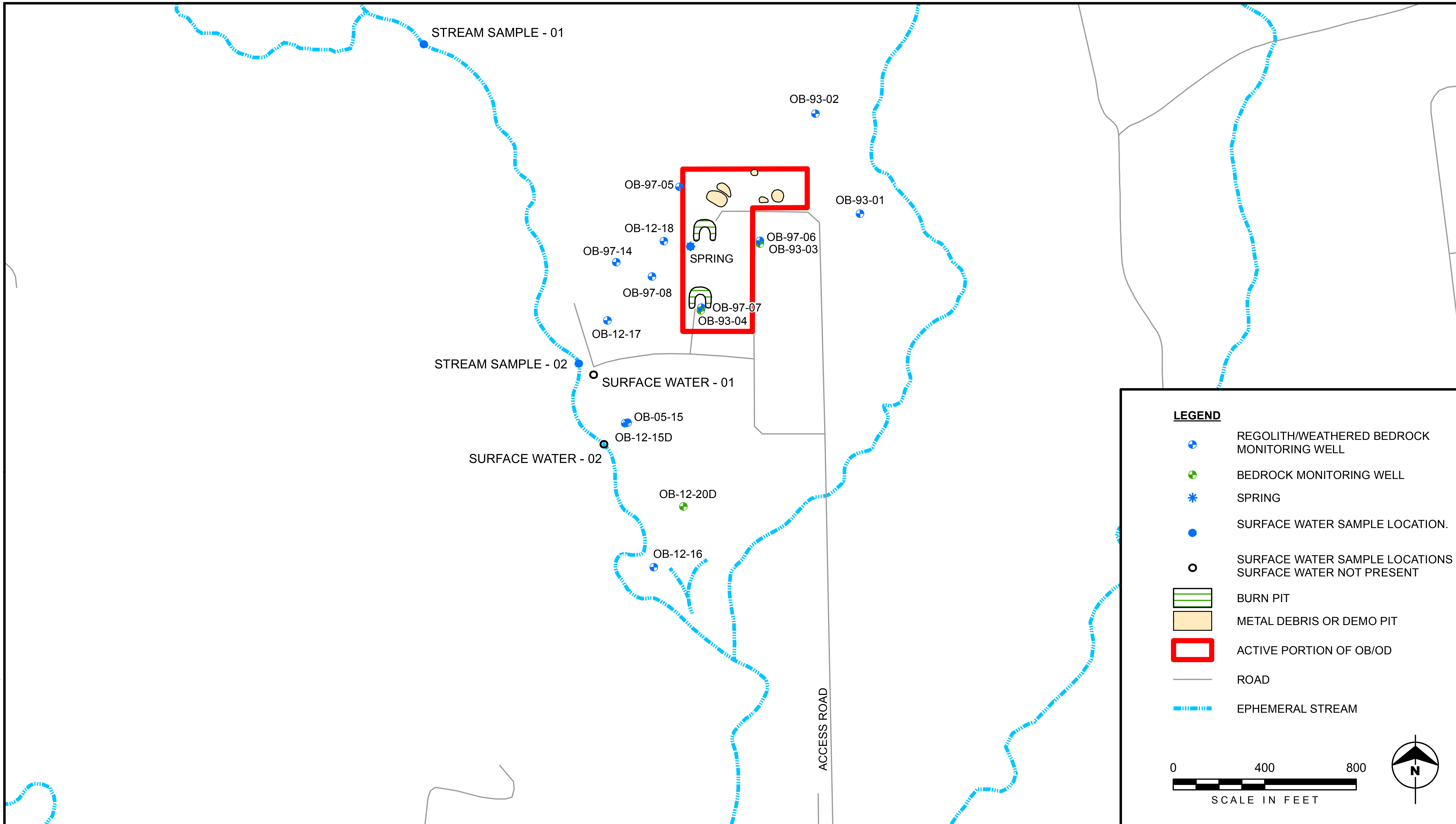


Figure 2-8
MONITORING WELLS, BEDROCK BORINGS, AND ABANDONED PIEZOMETERS OB/OD
Fort Riley, Kansas



Burns & McDonnell SINCE 1898

Figure 2-9
MONITORING WELLS AND SURFACE WATER LOCATIONS SAMPLED QUARTERLY
OB/OD
Fort Riley, Kansas

K:\ENV\LOUIS BERGER GROUP INC\site\63598\Deliver\GIS\2013\RI_Report2013\Fig2-9_MW_Sampled_Quarterly_OBOD.mxd sos June 19, 2013

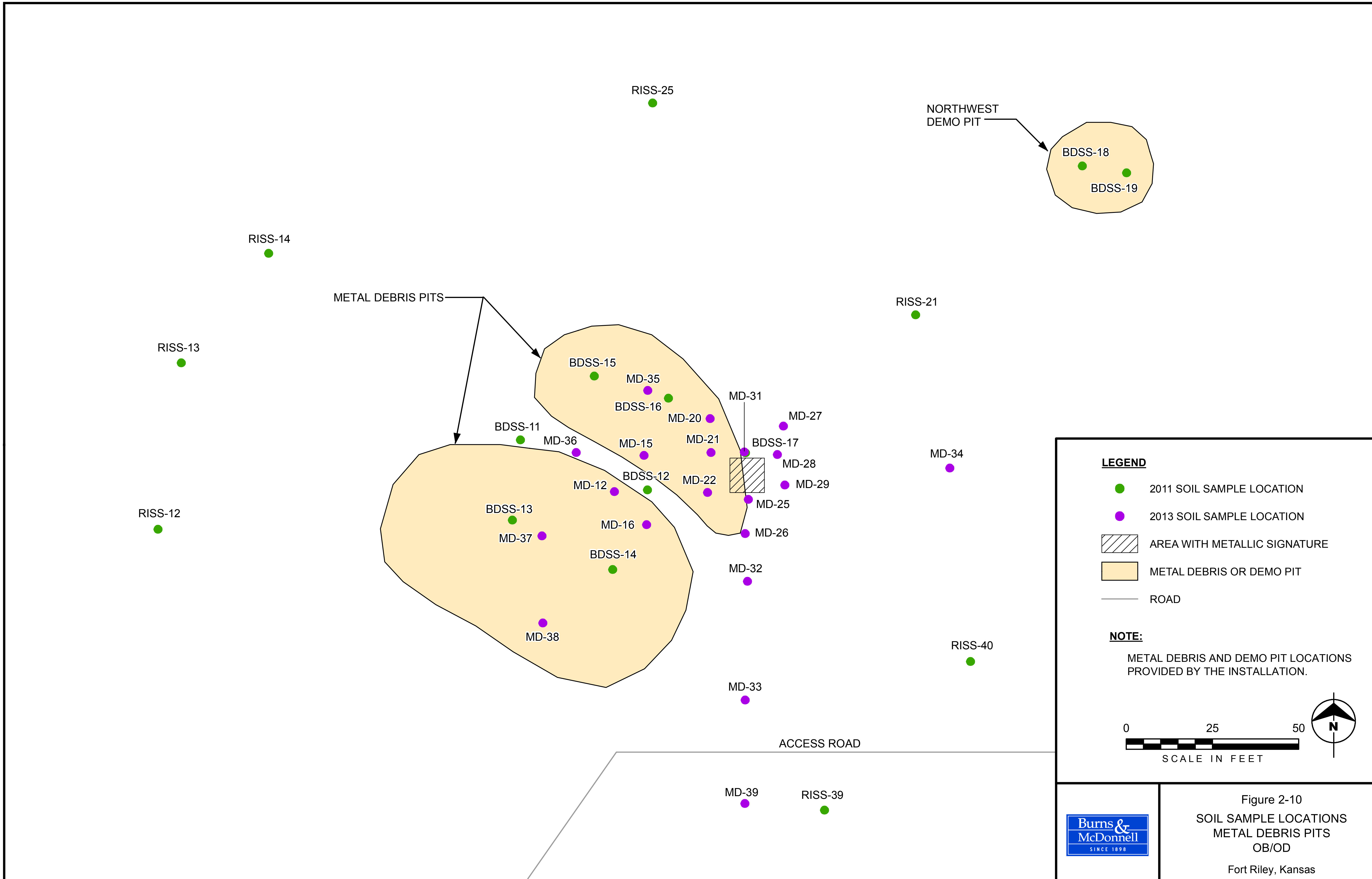
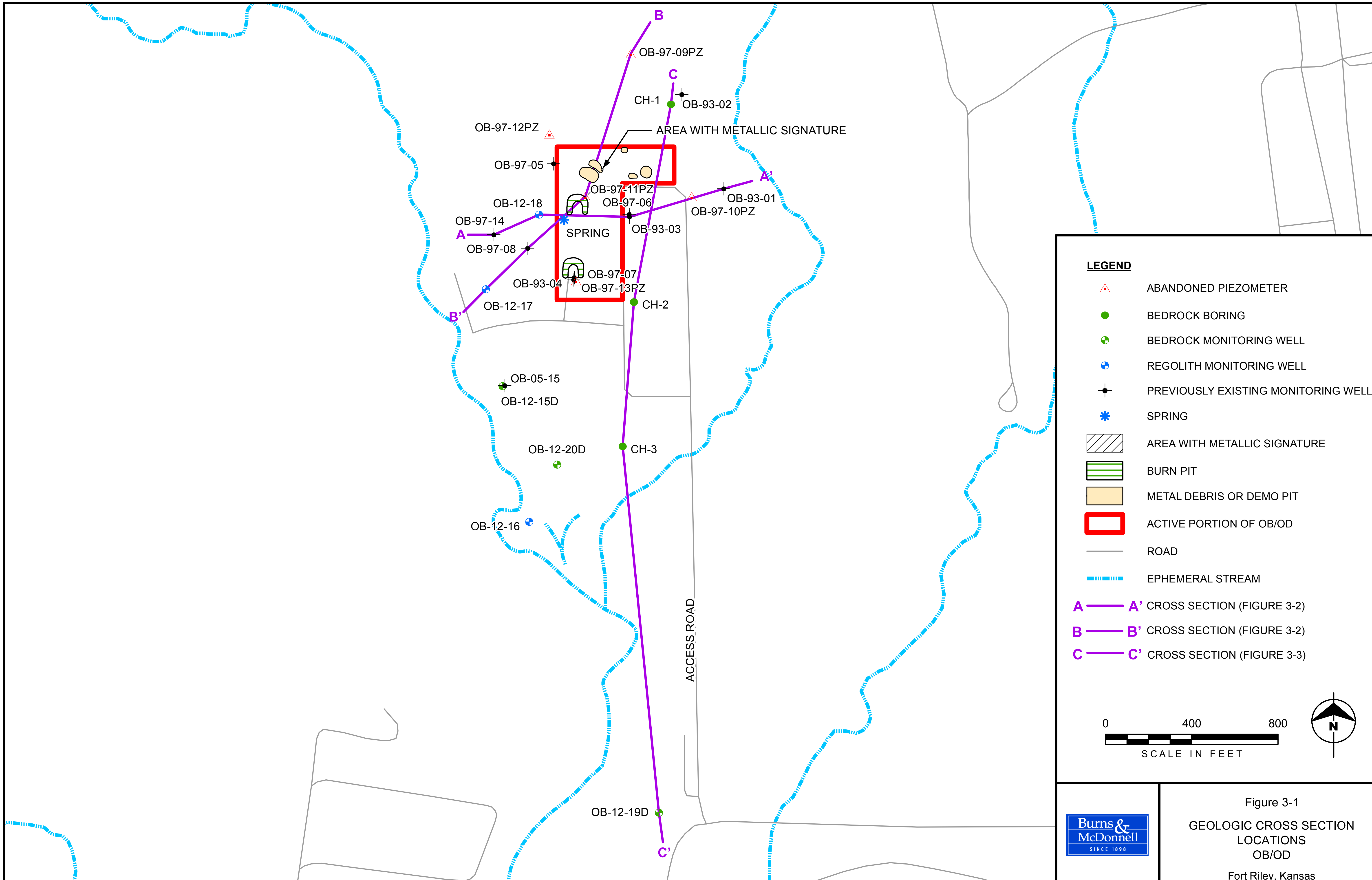


Figure 2-10
SOIL SAMPLE LOCATIONS
METAL DEBRIS PITS
OB/OD

Fort Riley, Kansas

K:\ENV\LOUIS BERGER GROUP INC\site\63598\Deliver\GIS\2013\RI_Report2013\Fig2-10_SoilSample_Metal_Debris_Pits_OBOD.mxd sos June 19, 2013



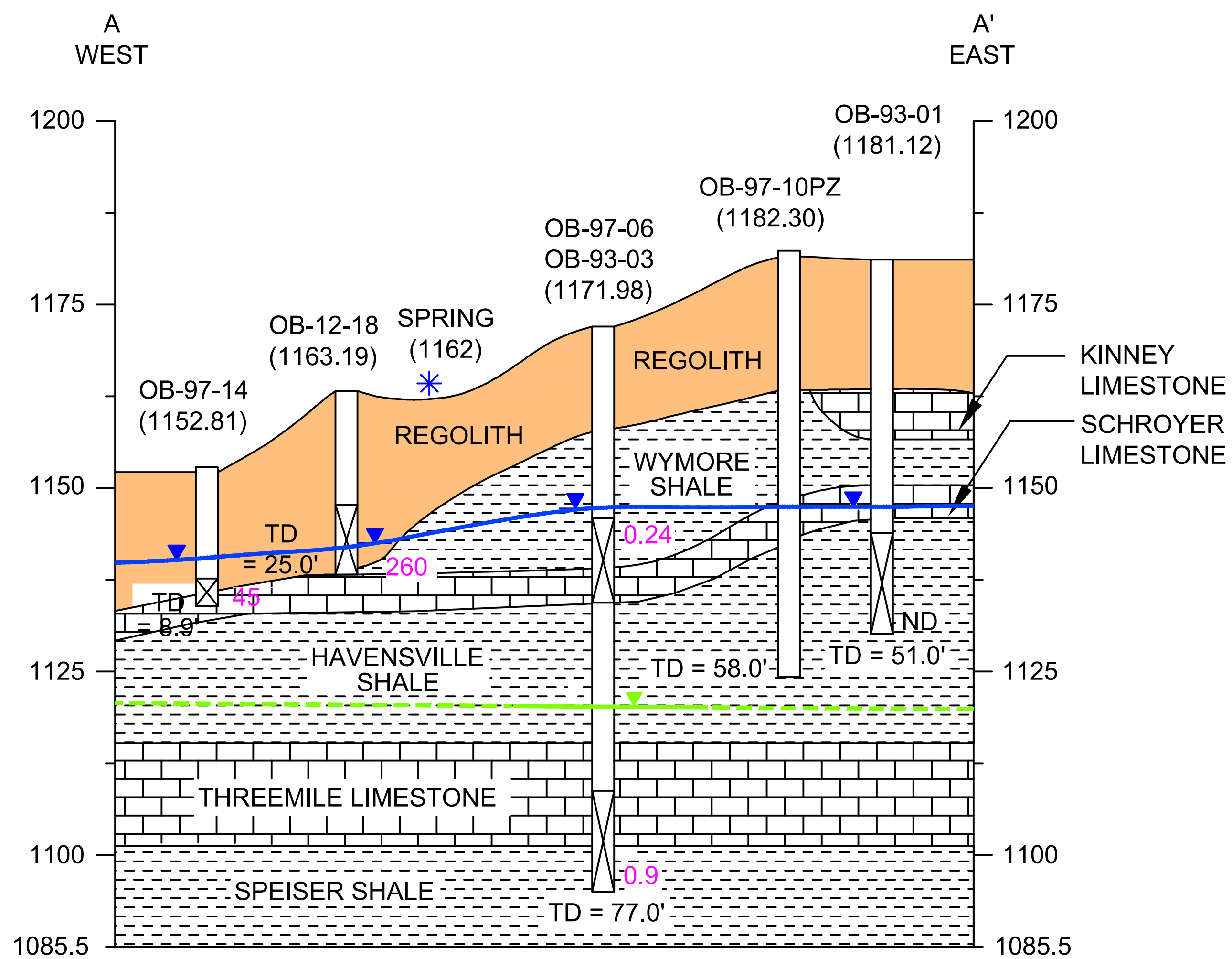
Burns & McDonnell SINCE 1898

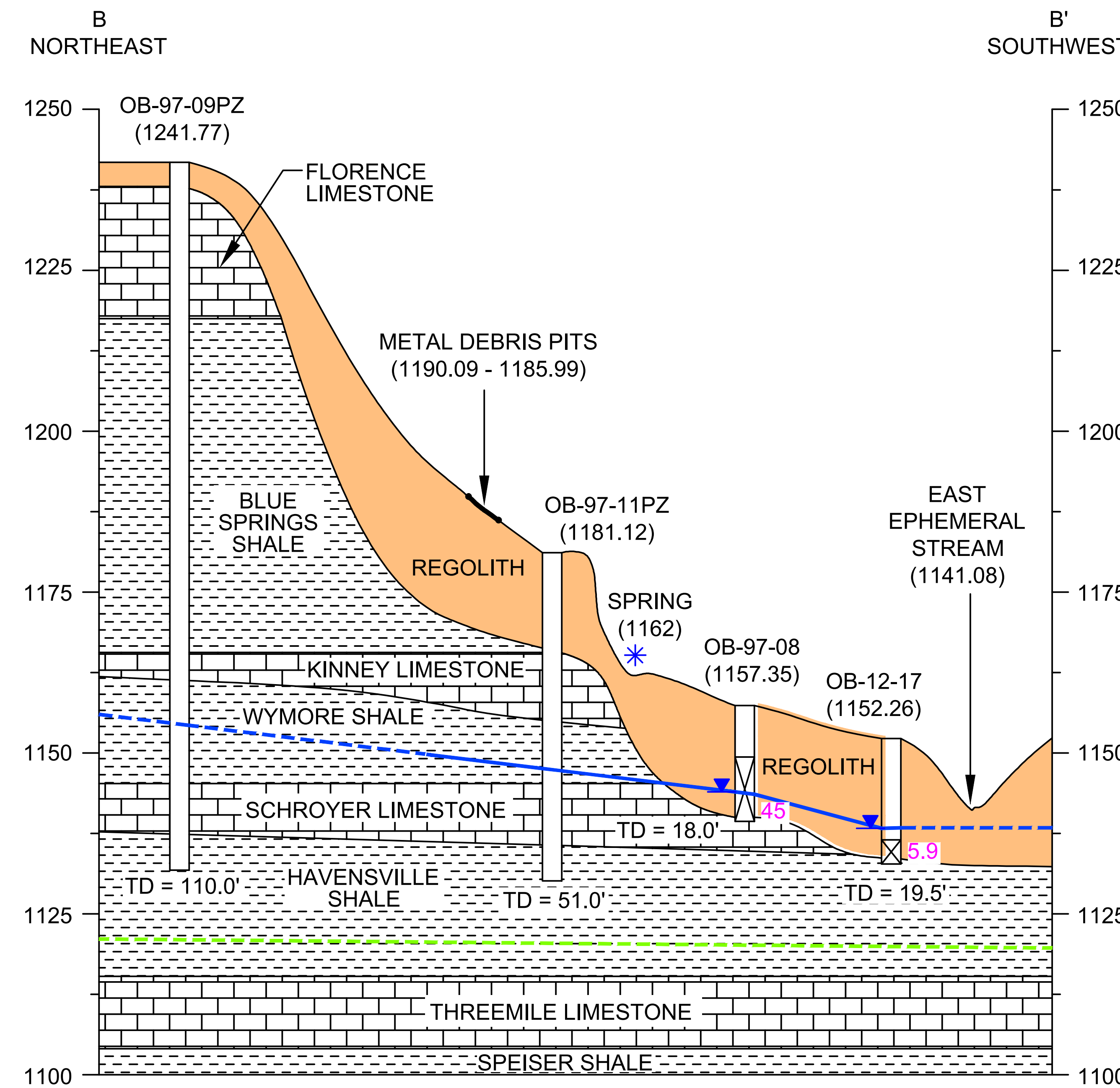
Figure 3-1

GEOLOGIC CROSS SECTION LOCATIONS OB/OD

Fort Riley, Kansas

K:\ENV\LOUIS BERGER GROUP INC\site\63598\Deliver\GIS\2013\RI_Report2013\Fig3-1_Geologic_X_Section_LINES_OBOD.mxd sos June 19, 2013





LEGEND:

- WELL OR BORING
- SCREEN INTERVAL
- 45 — TCE IN µg/L, JUNE 2012
- REGOLITH
- LIMESTONE
- SHALE
- OB-93-03 (1171.98) — GROUND SURFACE ELEVATION IN FT ABOVE MEAN SEA LEVEL (MSL)
- PIEZOMETRIC SURFACE - REGOLITH/WEATHERED BEDROCK (DASHED WHERE INFERRED)
- PIEZOMETRIC SURFACE - THREEMILE LIMESTONE (DASHED WHERE INFERRED)

NOTE:

1. WATER LEVELS OBSERVED FOR JUNE 2012.

HORIZONTAL 0 300' 600'
SCALE IN FEET

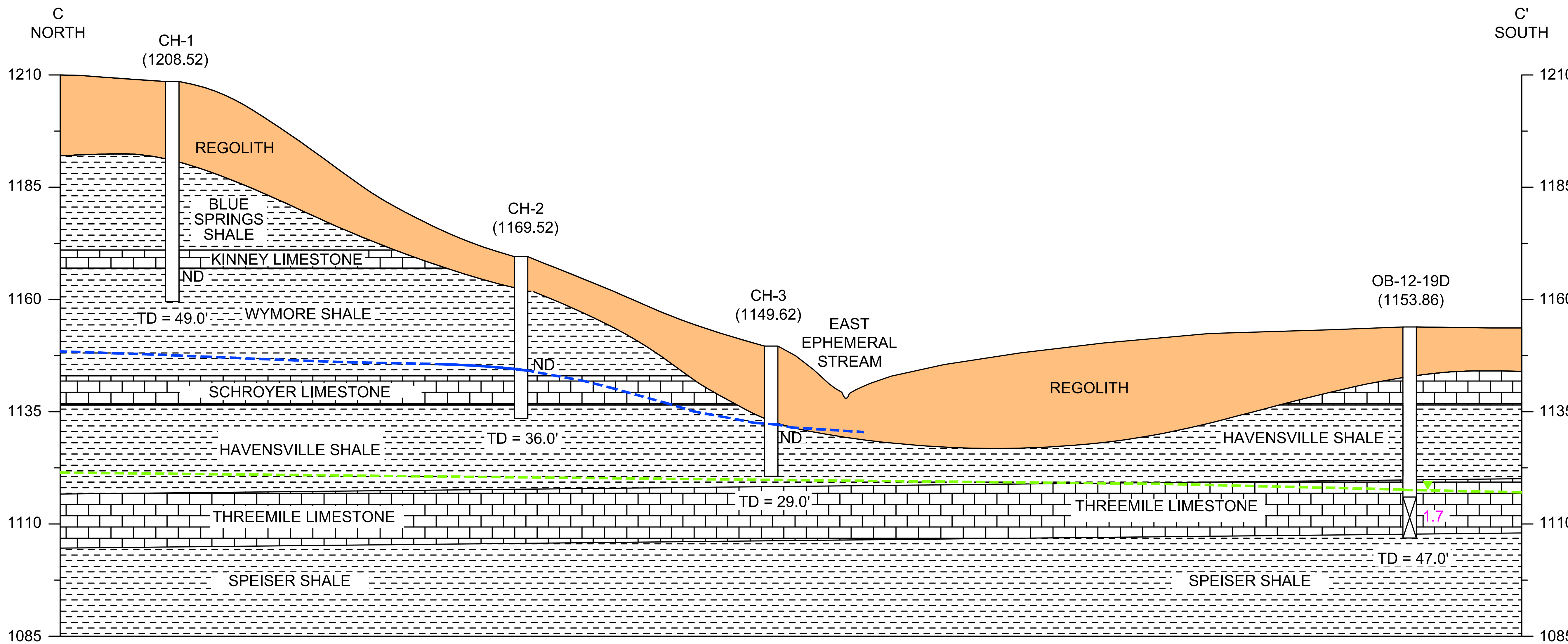
VERTICAL 0 25' 50'
SCALE IN FEET

Burns & McDonnell
SINCE 1898

Figure 3-2

GEOLOGIC CROSS SECTIONS
A - A' AND B - B'
OB/OD

Fort Riley, Kansas



LEGEND:

WELL OR BORING

SCREEN INTERVAL

45 TCE IN µg/L, JUNE 2012

REGOLITH

LIMESTONE

SHALE

CH-1 (1208.52) GROUND SURFACE ELEVATION IN FT ABOVE MEAN SEA LEVEL (MSL)

PIEZOMETRIC SURFACE - REGOLITH/WEATHERED BEDROCK (DASHED WHERE INFERRED)

PIEZOMETRIC SURFACE - THREEMILE LIMESTONE (DASHED WHERE INFERRED)

NOTE:

1. WATER LEVLELS OBSERVED FOR JUNE 2012.

HORIZONTAL 0 300' 600' SCALE IN FEET

VERTICAL 0 25' 50' SCALE IN FEET

Burns & McDonnell SINCE 1898

Figure 3-3

GEOLOGIC CROSS SECTION
C - C'
OB/OD
Fort Riley, Kansas

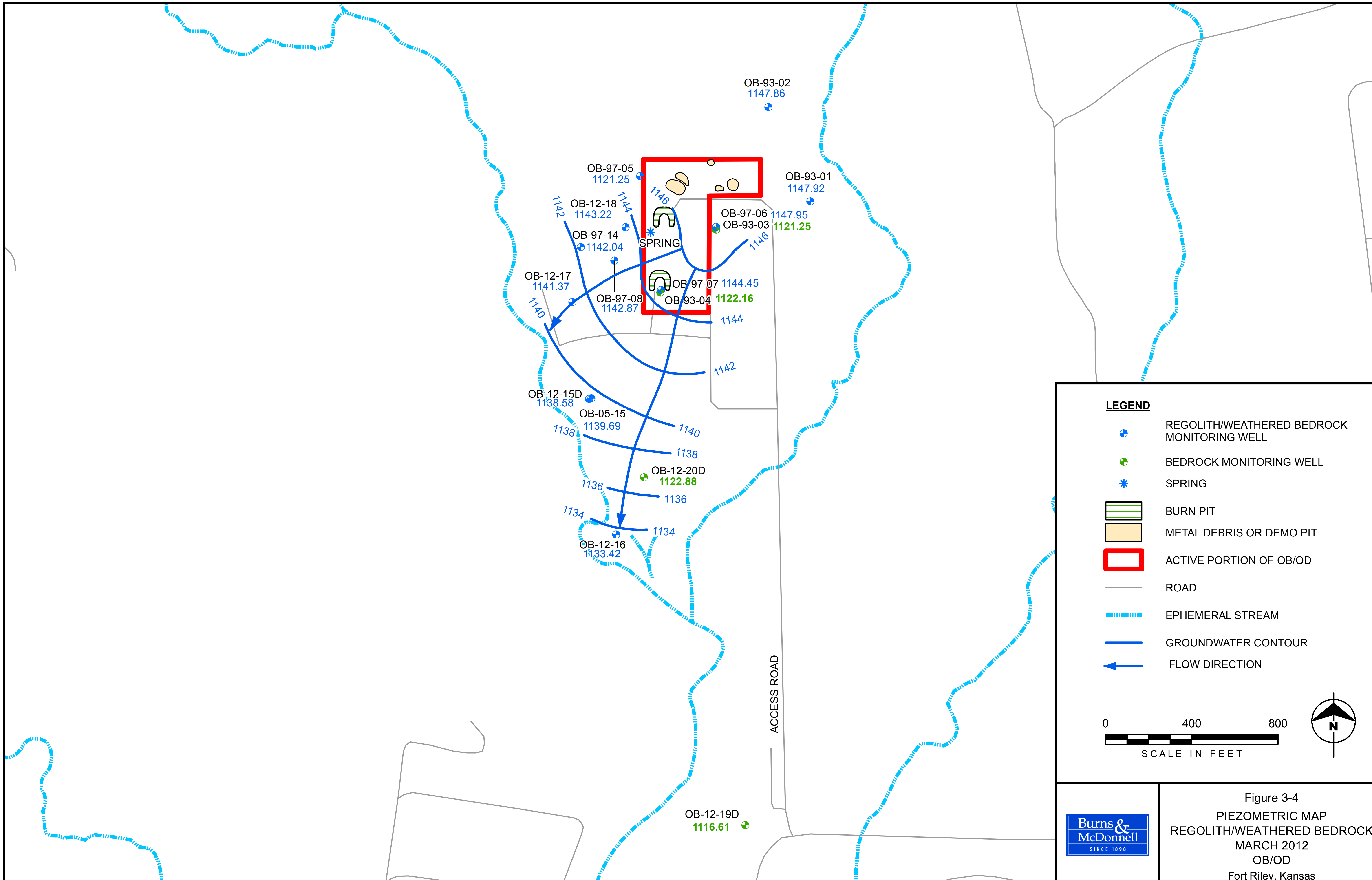
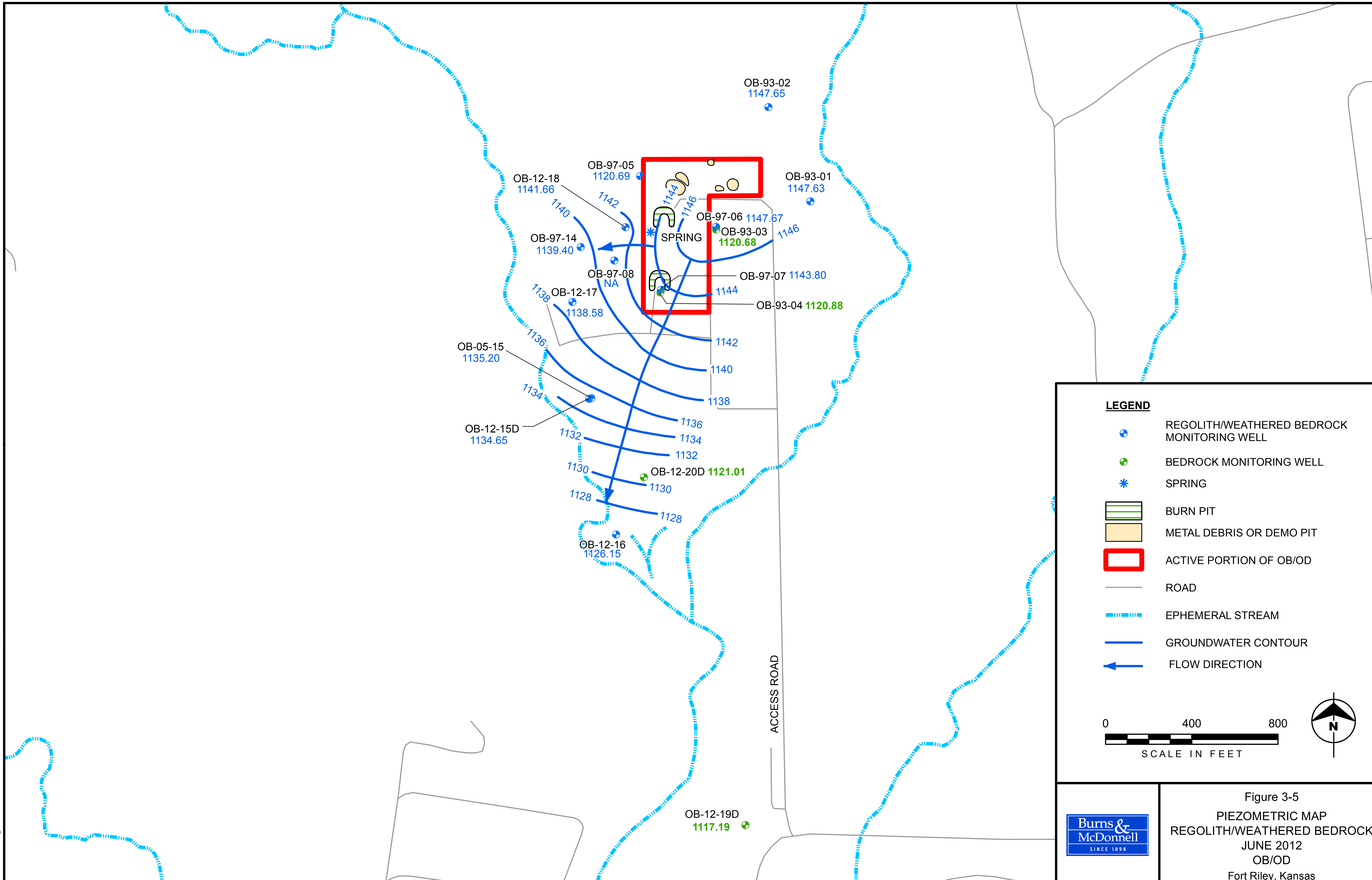


Figure 3-4
PIEZOMETRIC MAP
REGOLITH/WEATHERED BEDROCK
MARCH 2012
OB/OD
Fort Riley, Kansas

K:\ENV\LOUIS BERGER GROUP INC\site\63598\Deliver\GIS\2013\RI_Report2013\Fig3-4_Piezometric_Map_Mar2012_OBOD.mxd sos June 19, 2013



K:\ENV\LOUIS BERGER GROUP INC\site\63598\Deliver\GIS\2013\RI_Report2013\Fig3-5_Piezometric_Map_June2012_OBOD.mxd sos June 19, 2013

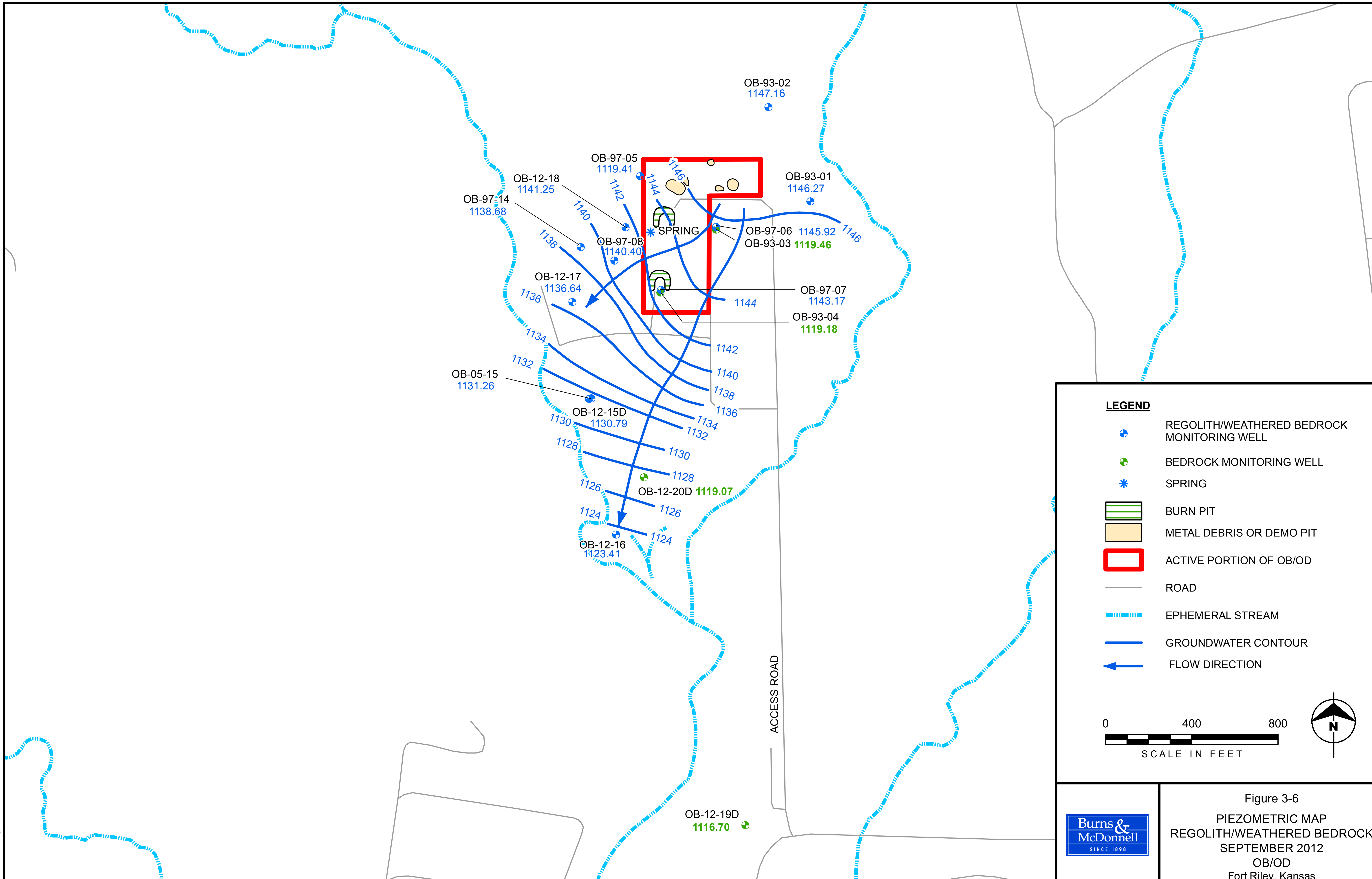


Figure 3-6

PIEZOMETRIC MAP
REGOLITH/WEATHERED BEDROCK
SEPTEMBER 2012
OB/OD
Fort Riley, Kansas

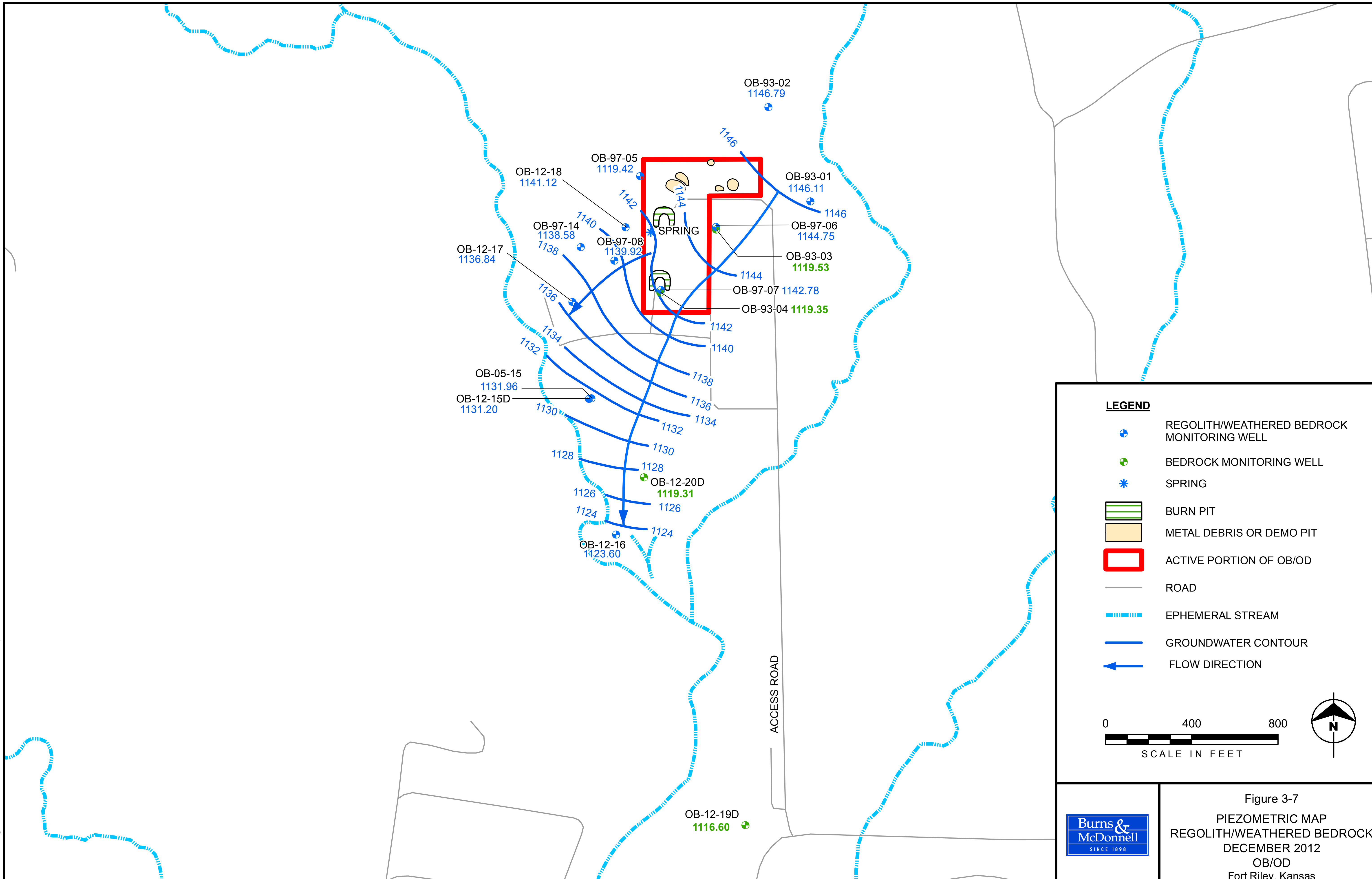
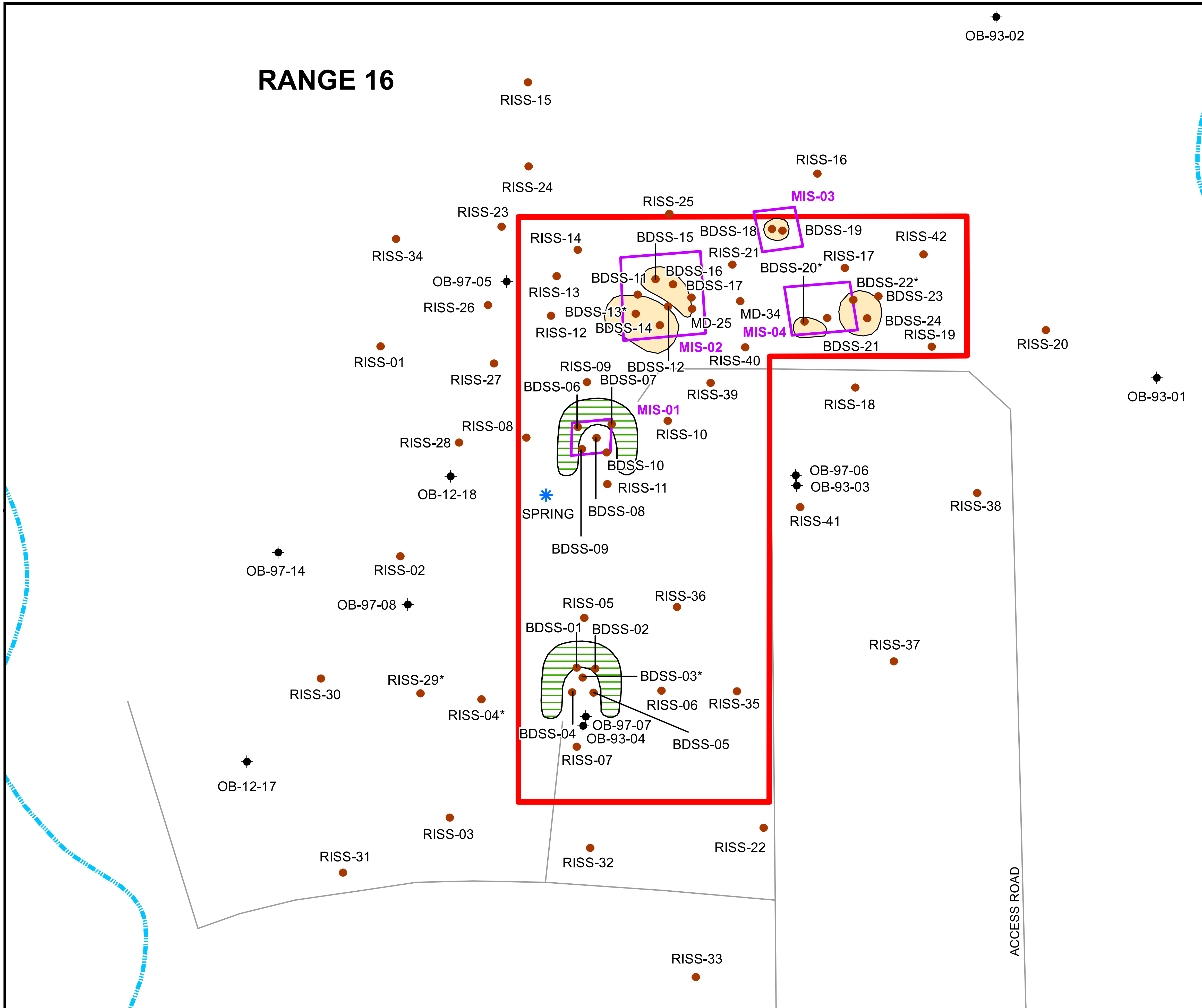


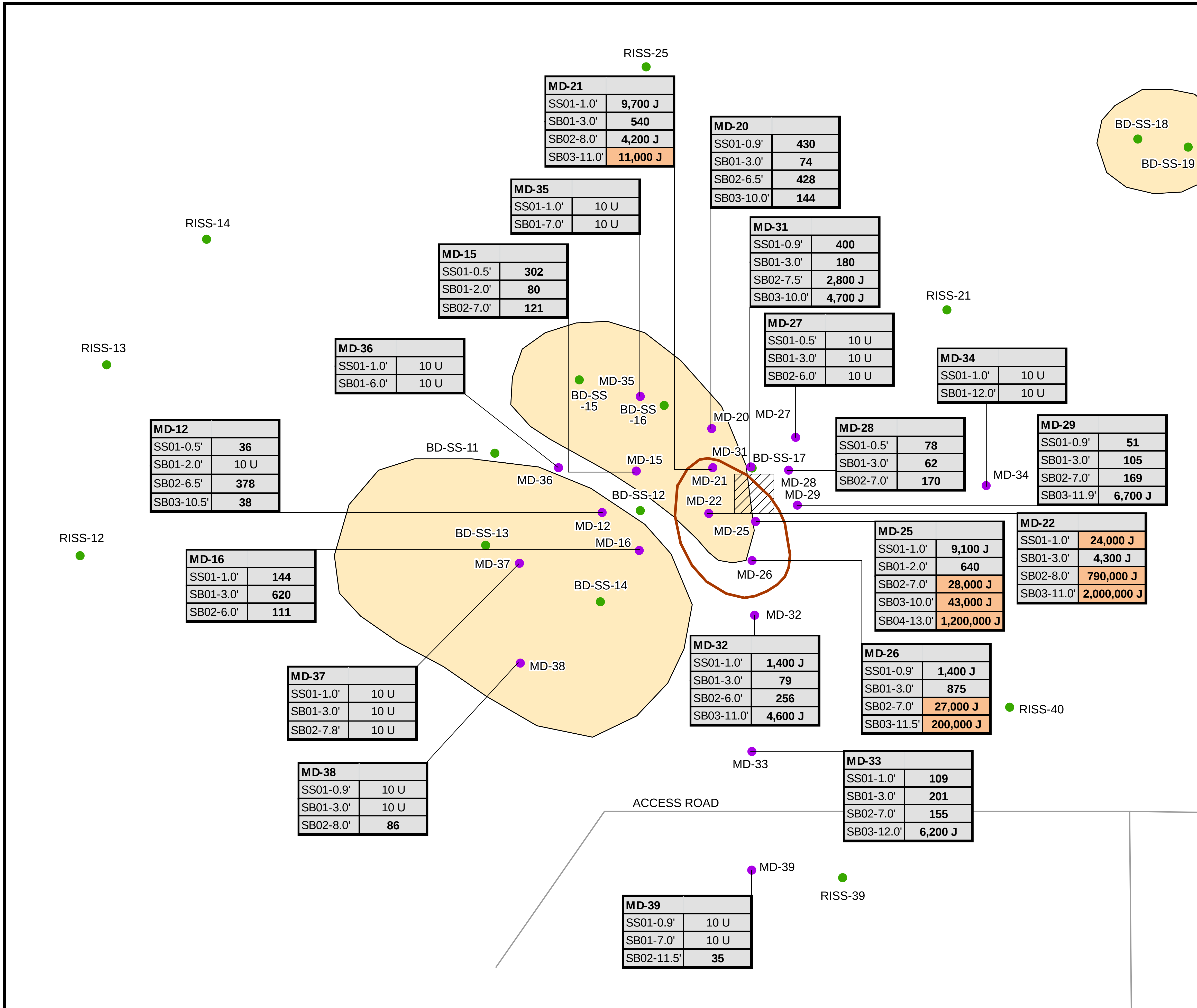
Figure 3-7
PIEZOMETRIC MAP
REGOLITH/WEATHERED BEDROCK
DECEMBER 2012
OB/OD
Fort Riley, Kansas



Burns & McDonnell SINCE 1898

Figure 4-1
SURFACE SOIL SAMPLE LOCATIONS
OB/OD
Fort Riley, Kansas

K:\ENV\LOUIS BERGER GROUP INC\site\63598\Deliver\GIS\2013\RI_Report2013\Fig4-1_Surface_Soil_Samples_OBOD_17x11.mxd sos September 18, 2013



MD-21	
SS01-1.0'	**9,700 J**
SB01-3.0'	**540**
SB02-8.0'	**4,200 J**
SB03-11.0'	**11,000 J**

MD-20	
SS01-0.9'	**430**
SB01-3.0'	**74**
SB02-6.5'	**428**
SB03-10.0'	**144**

MD-35	
SS01-1.0'	10 U
SB01-7.0'	10 U

MD-15	
SS01-0.5'	**302**
SB01-2.0'	**80**
SB02-7.0'	**121**

MD-31	
SS01-0.9'	**400**
SB01-3.0'	**180**
SB02-7.5'	**2,800 J**
SB03-10.0'	**4,700 J**

MD-27	
SS01-0.5'	10 U
SB01-3.0'	10 U
SB02-6.0'	10 U

MD-36	
SS01-1.0'	10 U
SB01-6.0'	10 U

MD-34	
SS01-1.0'	10 U
SB01-12.0'	10 U

MD-12	
SS01-0.5'	**36**
SB01-2.0'	10 U
SB02-6.5'	**378**
SB03-10.5'	**38**

MD-28	
SS01-0.5'	**78**
SB01-3.0'	**62**
SB02-7.0'	**170**

MD-29	
SS01-0.9'	**51**
SB01-3.0'	**105**
SB02-7.0'	**169**
SB03-11.9'	**6,700 J**

MD-25	
SS01-1.0'	**9,100 J**
SB01-2.0'	**640**
SB02-7.0'	**28,000 J**
SB03-10.0'	**43,000 J**
SB04-13.0'	**1,200,000 J**

MD-22	
SS01-1.0'	**24,000 J**
SB01-3.0'	**4,300 J**
SB02-8.0'	**790,000 J**
SB03-11.0'	**2,000,000 J**

MD-16	
SS01-1.0'	**144**
SB01-3.0'	**620**
SB02-6.0'	**111**

MD-32	
SS01-1.0'	**1,400 J**
SB01-3.0'	**79**
SB02-6.0'	**256**
SB03-11.0'	**4,600 J**

MD-26	
SS01-0.9'	**1,400 J**
SB01-3.0'	**875**
SB02-7.0'	**27,000 J**
SB03-11.5'	**200,000 J**

MD-37	
SS01-1.0'	10 U
SB01-3.0'	10 U
SB02-7.8'	10 U

MD-38	
SS01-0.9'	10 U
SB01-3.0'	10 U
SB02-8.0'	**86**

MD-33	
SS01-1.0'	**109**
SB01-3.0'	**201**
SB02-7.0'	**155**
SB03-12.0'	**6,200 J**

MD-39	
SS01-0.9'	10 U
SB01-7.0'	10 U
SB02-11.5'	**35**

LEGEND

- 2011 SOIL SAMPLE LOCATION
- 2013 SOIL SAMPLE LOCATION
- AREA WHERE TCE FIELD GC RESULTS > SL OF 9,910 ug/kg
- AREA WITH METALLIC SIGNATURE
- METAL DEBRIS OR DEMO PIT
- ROAD

Location Number	
Sample No - depth bgs	<SL
	>SL

NOTES:

1. ALL RESULTS IN ug/kg. DETECTIONS ARE BOLDED.
2. THE SCREENING LEVEL (SL) FOR TCE IN SOIL IS 9,910 ug/kg.

0 25 50
SCALE IN FEET
N

Burns & McDonnell SINCE 1898

Figure 4-2

TCE SOIL RESULTS
FIELD GC
METAL DEBRIS PITS
OB/OD

Fort Riley, Kansas

K:\ENV\LOUIS BERGER GROUP INC\site\63598\Deliver\GIS\2013\RI_Report2013\Fig4-2_TCE_Soil_Results_FieldGC_Metal_Debris_Pits.mxd sos September 18, 2013

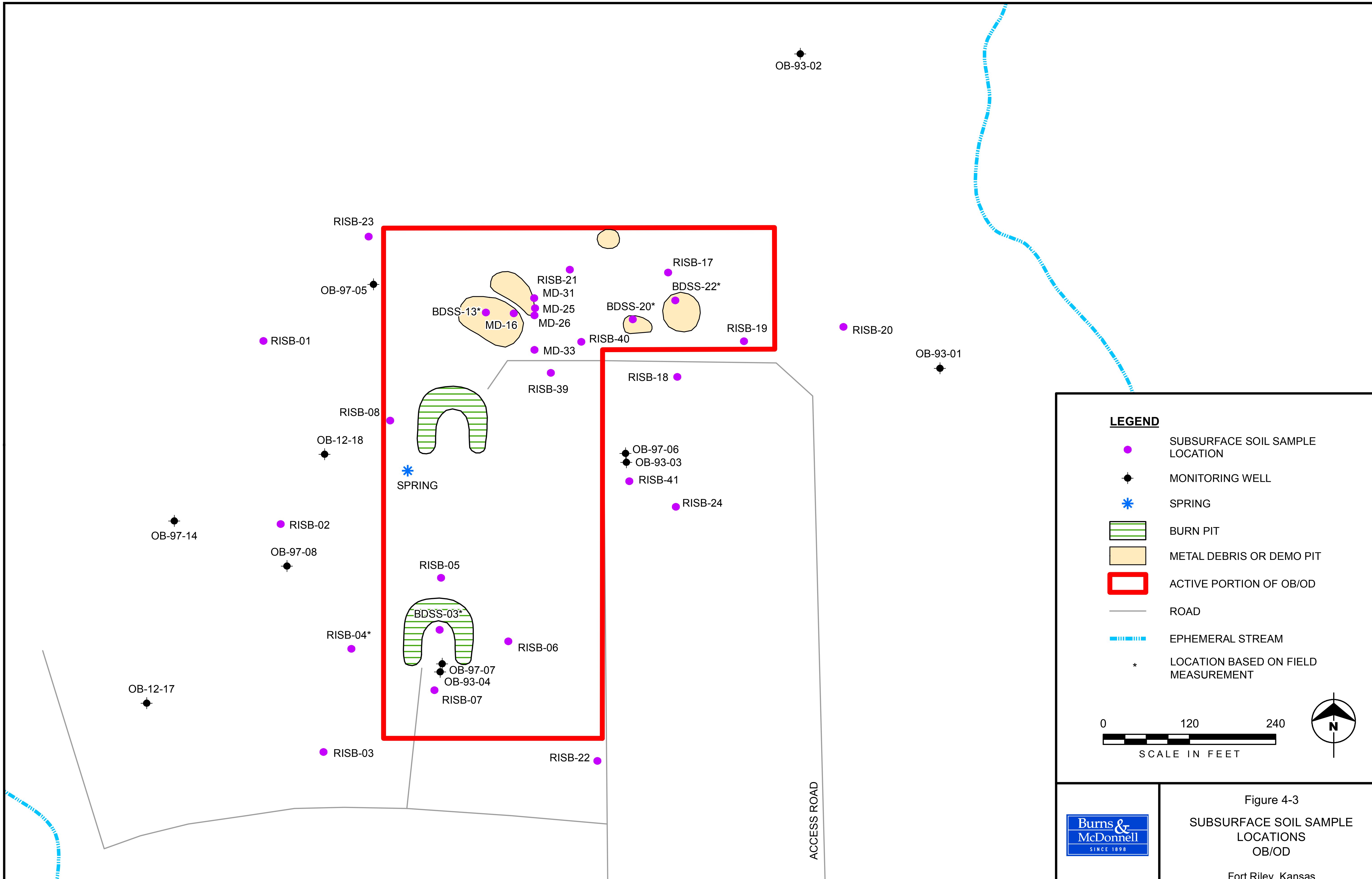
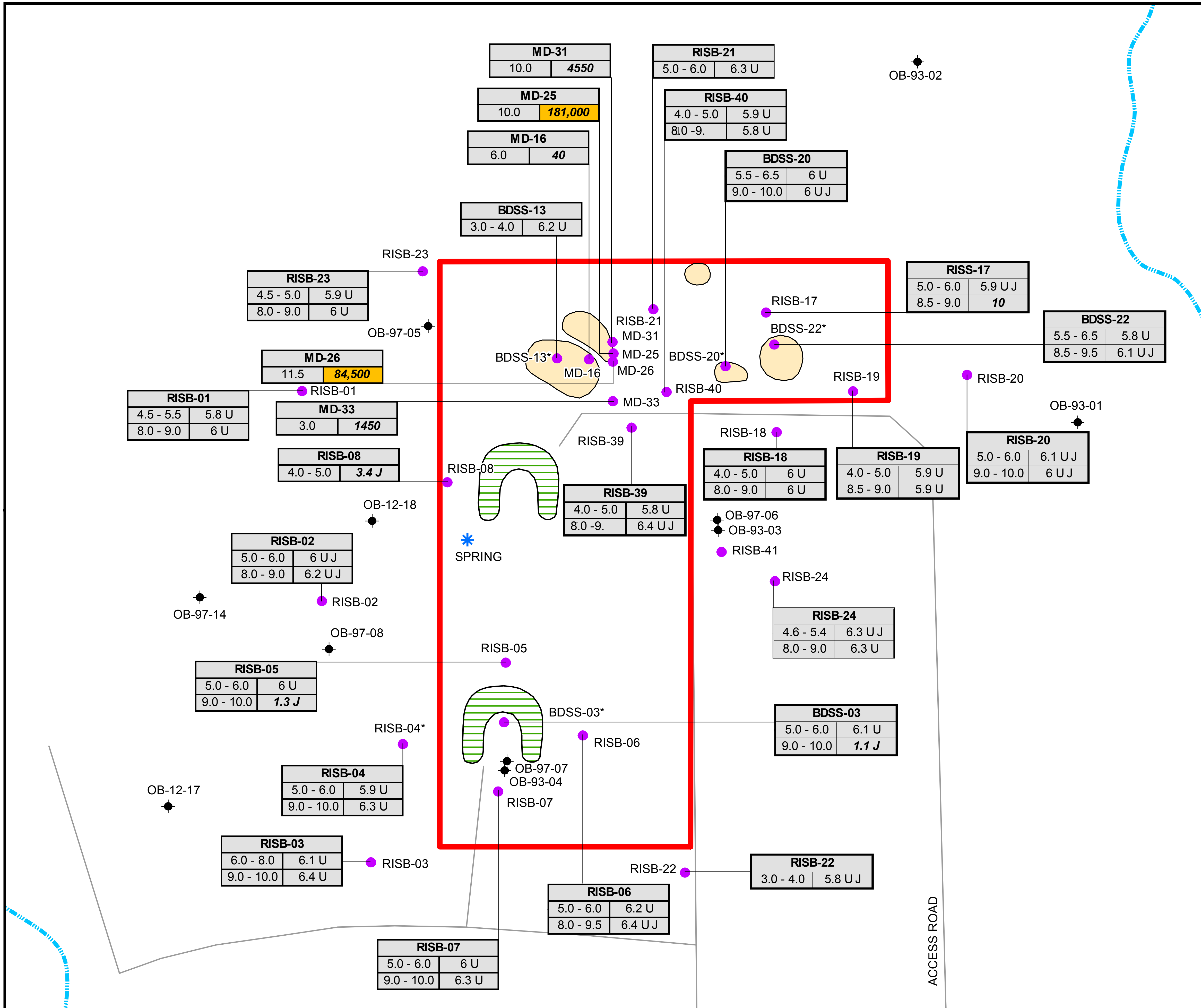


Figure 4-3

SUBSURFACE SOIL SAMPLE LOCATIONS OB/OD

Fort Riley, Kansas

K:\ENV\LOUIS BERGER GROUP INC\site\63598\Deliver\GIS\2013\RI_Report2013\Fig4-3_Subsurface_Soil_Samples_OBOD.mxd sos June 19, 2013



LEGEND

- SUBSURFACE SOIL SAMPLE LOCATION
- MONITORING WELL
- SPRING
- BURN PIT
- METAL DEBRIS OR DEMO PIT
- ACTIVE PORTION OF OB/OD
- ROAD
- EPHEMERAL STREAM
- * LOCATION BASED ON FIELD MEASUREMENT

Location ID	
Depth	<RL
Depth	**>SL**

NOTES:

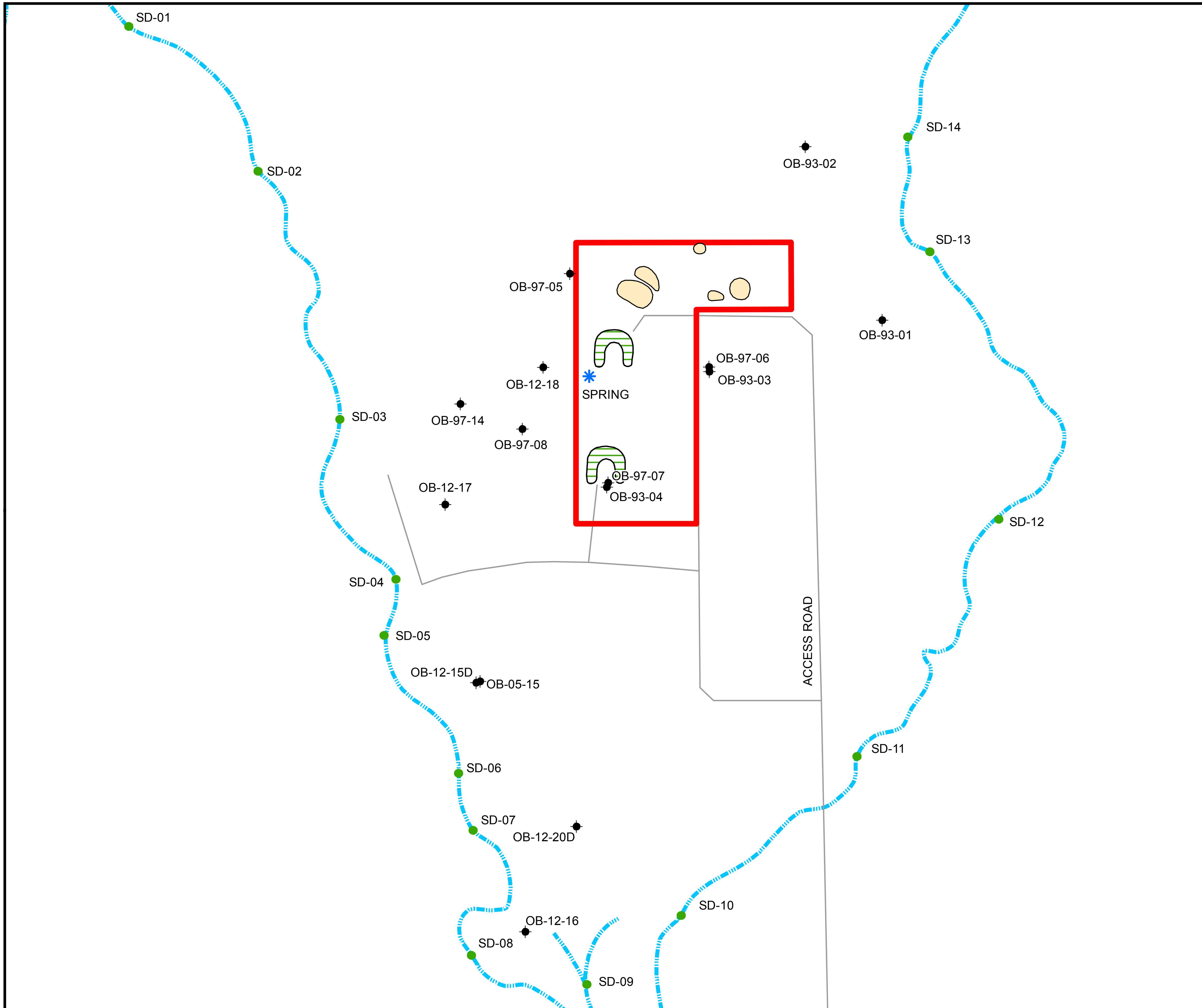
1. RESULTS IN u/kg. DETECTIONS ARE BOLDED.
2. TCE = TRICHLOROETHENE, SCREENING LEVEL (SL) = 9,910 ug/kg.

0 120 240
SCALE IN FEET
N

Burns & McDonnell SINCE 1898

Figure 4-4
TCE
SUBSURFACE SOIL RESULTS
OB/OD
Fort Riley, Kansas

K:\ENV\LOUIS BERGER GROUP INC\site\63598\Deliver\GIS\2013\RI_Report2013\Fig4-4_TCE_Subsurface_Soil_Results_OBOD.mxd sos September 18, 2013



LEGEND

- SEDIMENT SAMPLE LOCATION
- MONITORING WELL
- SPRING
- BURN PIT
- METAL DEBRIS OR DEMO PIT
- ACTIVE PORTION OF OB/OD
- ROAD
- EPHEMERAL STREAM

NOTE:

1. LOCATIONS WERE DRY AT TIME OF SAMPLING.
2. SEDIMENT SAMPLES WERE COLLECTED ON DECEMBER 7, 2011.

0 250 500
SCALE IN FEET

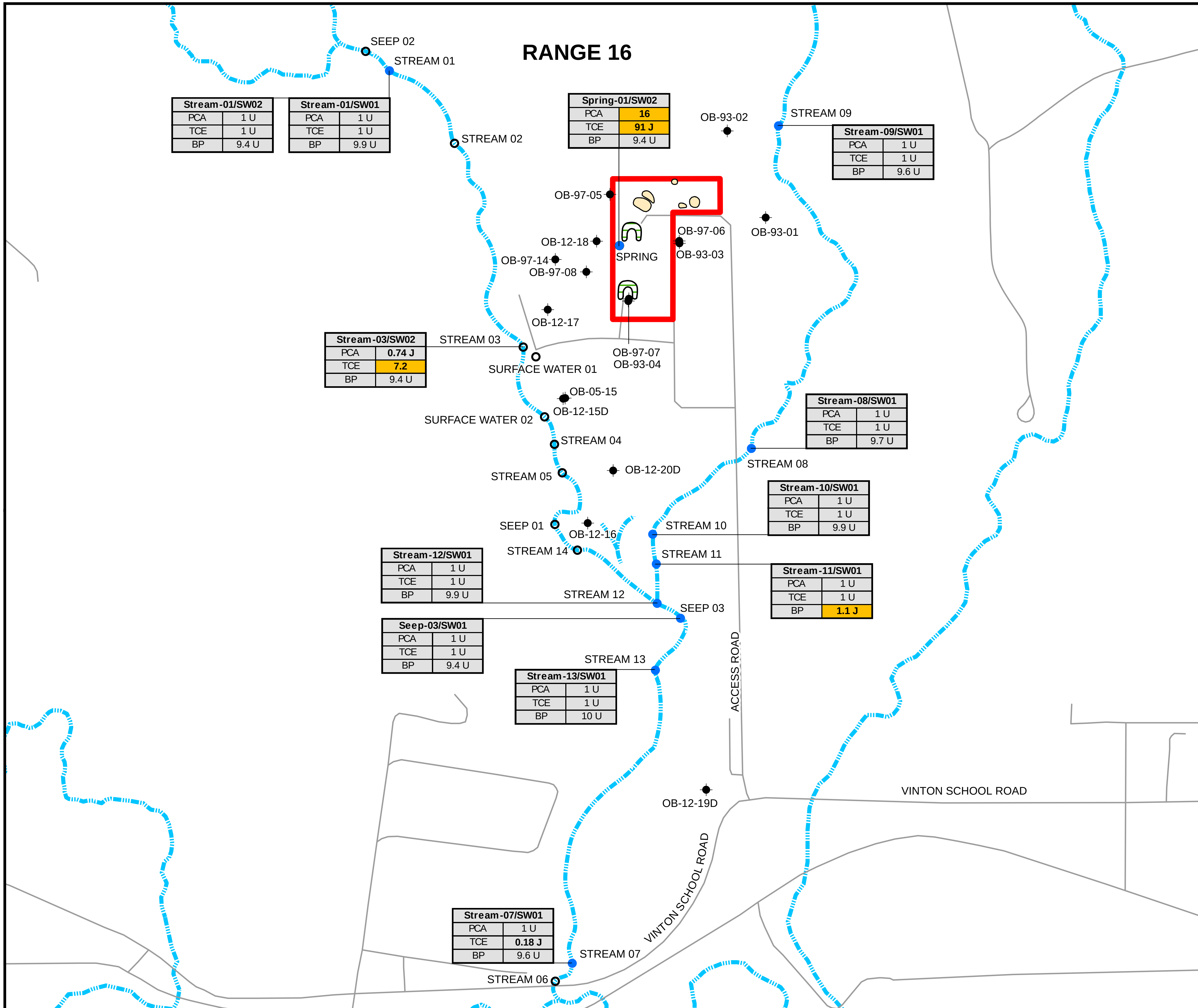
Burns & McDonnell SINCE 1898

Figure 4-5

SEDIMENT SAMPLE LOCATIONS OB/OD

Fort Riley, Kansas

K:\ENV\LOUIS BERGER GROUP INC\site\63598\Deliver\GIS\2013\RI_Report2013Fig4-5_Sediment_Samples_Locations_OBOD.mxd sos June 19, 2013



Stream-01/SW02	
PCA	1 U
TCE	1 U
BP	9.4 U

Stream-01/SW01	
PCA	1 U
TCE	1 U
BP	9.9 U

Spring-01/SW02	
PCA	**16**
TCE	**91 J**
BP	9.4 U

Stream-09/SW01	
PCA	1 U
TCE	1 U
BP	9.6 U

Stream-03/SW02	
PCA	**0.74 J**
TCE	**7.2**
BP	9.4 U

Stream-08/SW01	
PCA	1 U
TCE	1 U
BP	9.7 U

Stream-10/SW01	
PCA	1 U
TCE	1 U
BP	9.9 U

Stream-12/SW01	
PCA	1 U
TCE	1 U
BP	9.9 U

Stream-11/SW01	
PCA	1 U
TCE	1 U
BP	**1.1 J**

Seep-03/SW01	
PCA	1 U
TCE	1 U
BP	9.4 U

Stream-13/SW01	
PCA	1 U
TCE	1 U
BP	10 U

Stream-07/SW01	
PCA	1 U
TCE	**0.18 J**
BP	9.6 U

LEGEND

- SURFACE WATER SAMPLE LOCATION. NOTE STREAM 02 AND SPRING WERE DRY ON DECEMBER 8, 2011
- SURFACE WATER SAMPLE LOCATIONS - SURFACE WATER NOT PRESENT ON DECEMBER 8, 2011
- MONITORING WELL
- BURN PIT
- METAL DEBRIS OR DEMO PIT
- ACTIVE PORTION OF OB/OD
- ROAD
- EPHEMERAL STREAM

Sample Number	
Analyte	<SL
Analyte	>SL

NOTES:

1. RESULTS IN ug/L. DETECTIONS ARE BOLDED.
2. PCA = 1,1,2,2-TETRACHLOROETHANE, SCREENING LEVEL (SL) = 1.28.
3. TCE = TRICHLOROETHENE, SL = 5.
4. BP = BENZO(A)PYRENE, SL = 0.2.
5. SW01 SAMPLES COLLECTED DECEMBER 2011.
6. SW02 COLLECTED NOVEMBER 2012.

0 500 1,000
SCALE IN FEET
N

Burns & McDonnell SINCE 1898

Figure 4-6
SURFACE WATER SAMPLE EXCEEDANCES
DECEMBER 2011 AND MARCH 2012
OB/OD
Fort Riley, Kansas

K:\ENV\LOUIS BERGER GROUP INC\site\63598\Deliver\GIS\2013\RI_Report2013\Fig4-6_Surface_Water_Sample_Exceedances_OBOD.mxd sos June 19, 2013

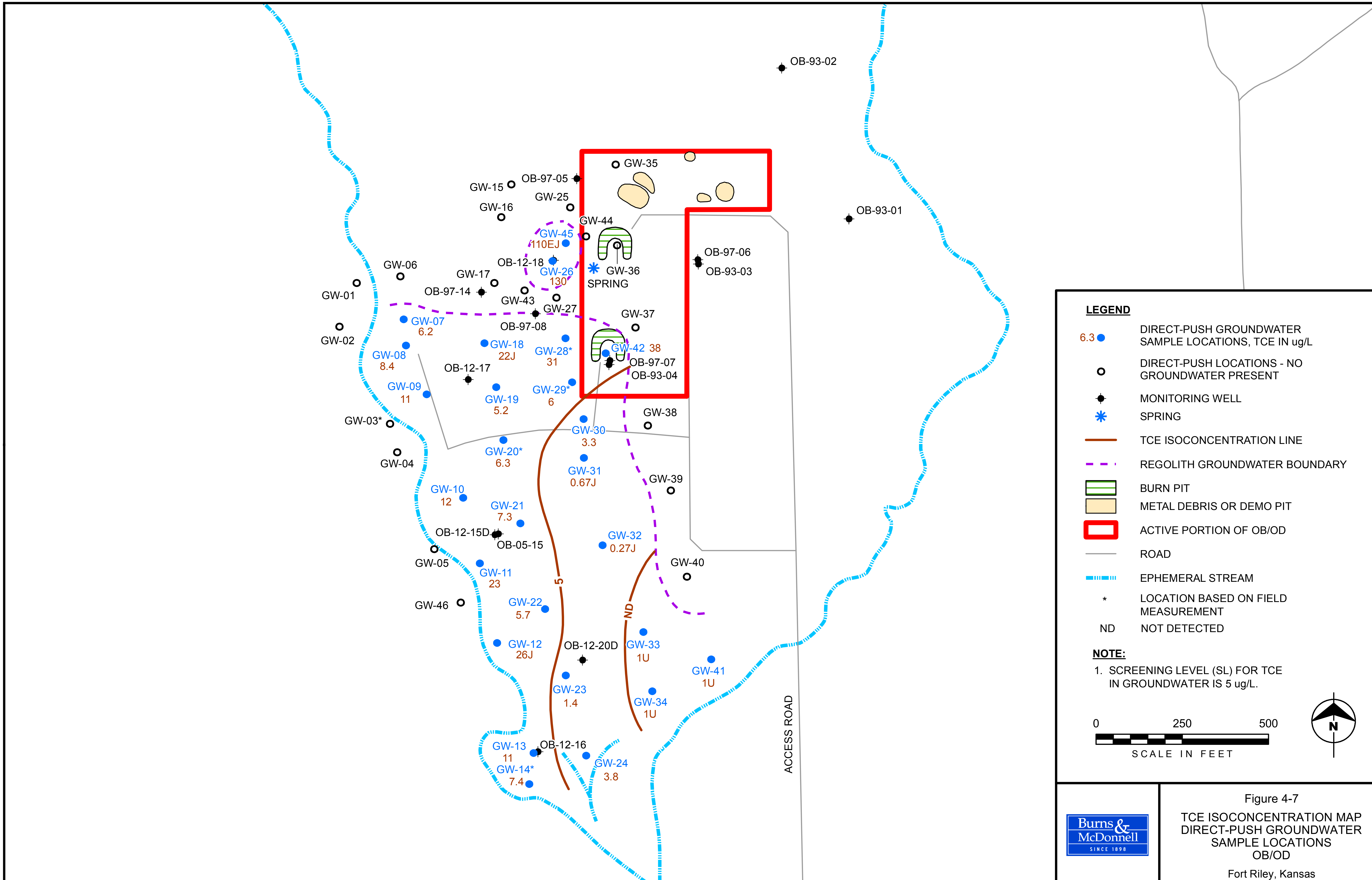


Figure 4-7

TCE ISOCONCENTRATION MAP
DIRECT-PUSH GROUNDWATER
SAMPLE LOCATIONS
OB/OD

Fort Riley, Kansas

K:\ENV\LOUIS BERGER GROUP INC\site\63598\Deliver\GIS\2013\RI_Report2013\Fig4-7_TCE_Isoconcentration_in_Direct-Push_GW_OBOD.mxd sos June 20, 2013

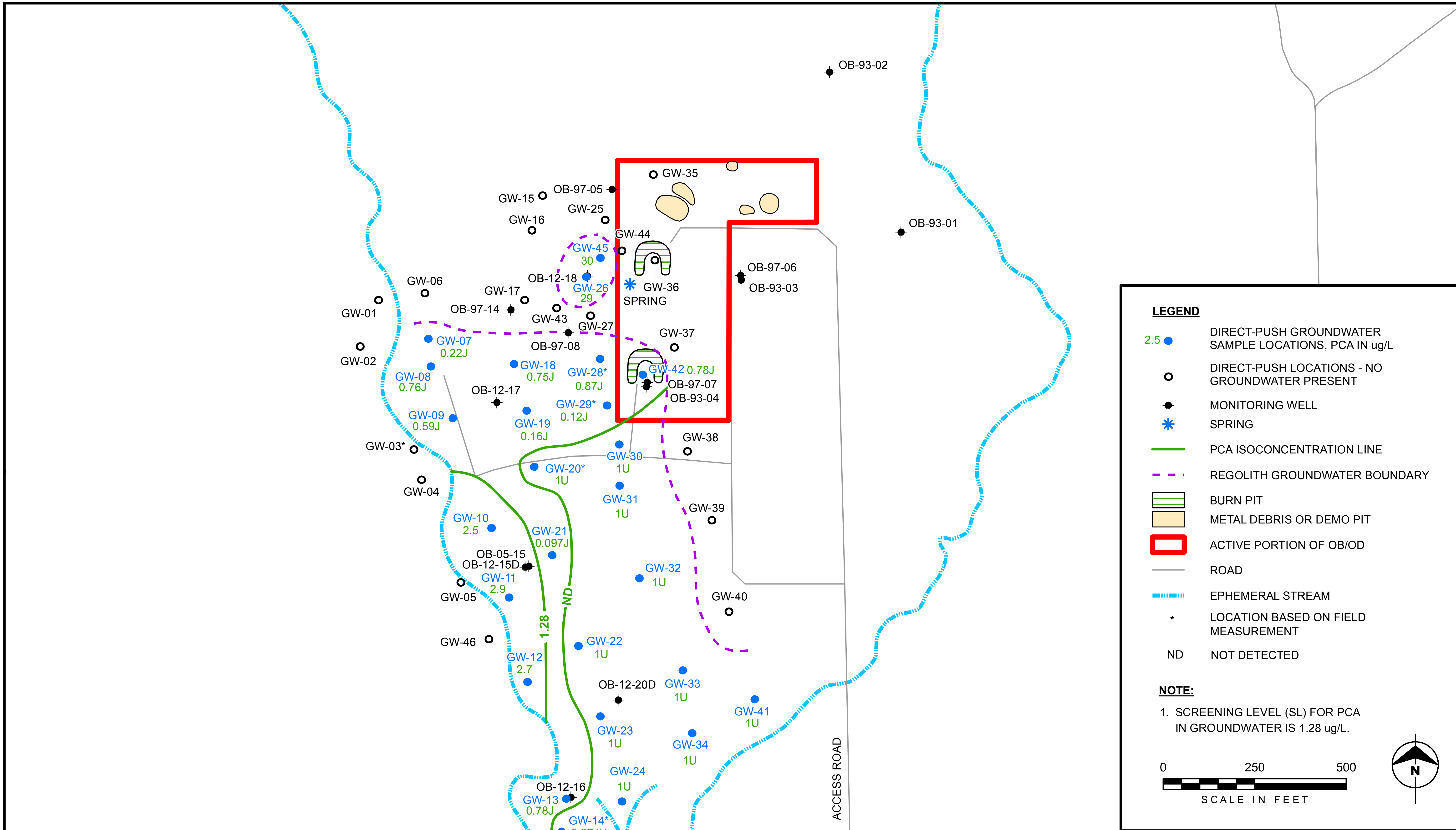
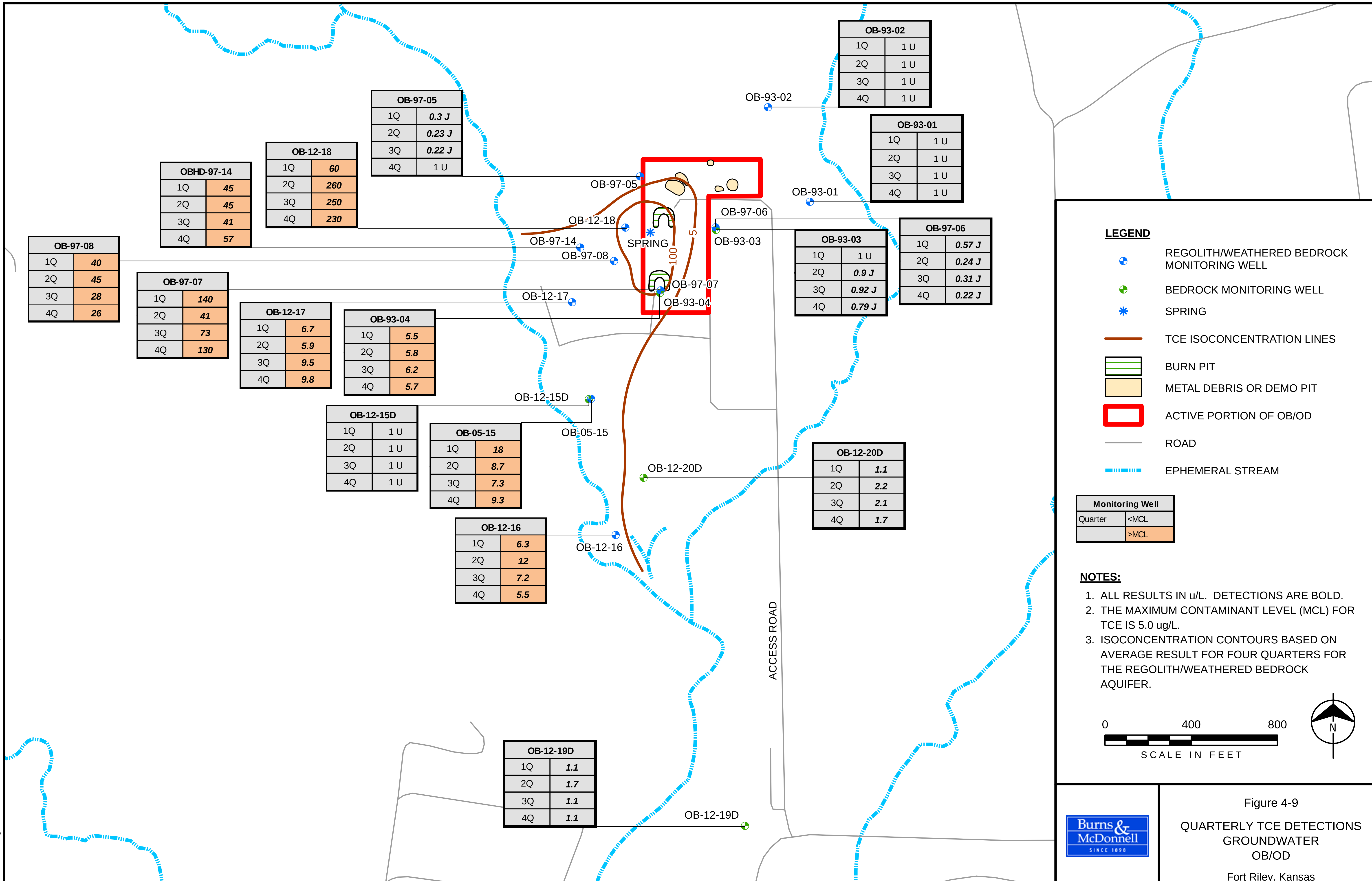


Figure 4-8

PCA ISOCONCENTRATION MAP
DIRECT-PUSH GROUNDWATER
SAMPLE LOCATIONS
OB/OD

Fort Riley, Kansas



OB-93-02	
1Q	1 U
2Q	1 U
3Q	1 U
4Q	1 U

OB-93-01	
1Q	1 U
2Q	1 U
3Q	1 U
4Q	1 U

OB-97-05	
1Q	**0.3 J**
2Q	**0.23 J**
3Q	**0.22 J**
4Q	1 U

OB-12-18	
1Q	**60**
2Q	**260**
3Q	**250**
4Q	**230**

OBHD-97-14	
1Q	**45**
2Q	**45**
3Q	**41**
4Q	**57**

OB-97-08	
1Q	**40**
2Q	**45**
3Q	**28**
4Q	**26**

OB-97-07	
1Q	**140**
2Q	**41**
3Q	**73**
4Q	**130**

OB-12-17	
1Q	**6.7**
2Q	**5.9**
3Q	**9.5**
4Q	**9.8**

OB-93-04	
1Q	**5.5**
2Q	**5.8**
3Q	**6.2**
4Q	**5.7**

OB-93-03	
1Q	1 U
2Q	**0.9 J**
3Q	**0.92 J**
4Q	**0.79 J**

OB-97-06	
1Q	**0.57 J**
2Q	**0.24 J**
3Q	**0.31 J**
4Q	**0.22 J**

OB-12-15D	
1Q	1 U
2Q	1 U
3Q	1 U
4Q	1 U

OB-05-15	
1Q	**18**
2Q	**8.7**
3Q	**7.3**
4Q	**9.3**

OB-12-20D	
1Q	**1.1**
2Q	**2.2**
3Q	**2.1**
4Q	**1.7**

OB-12-16	
1Q	**6.3**
2Q	**12**
3Q	**7.2**
4Q	**5.5**

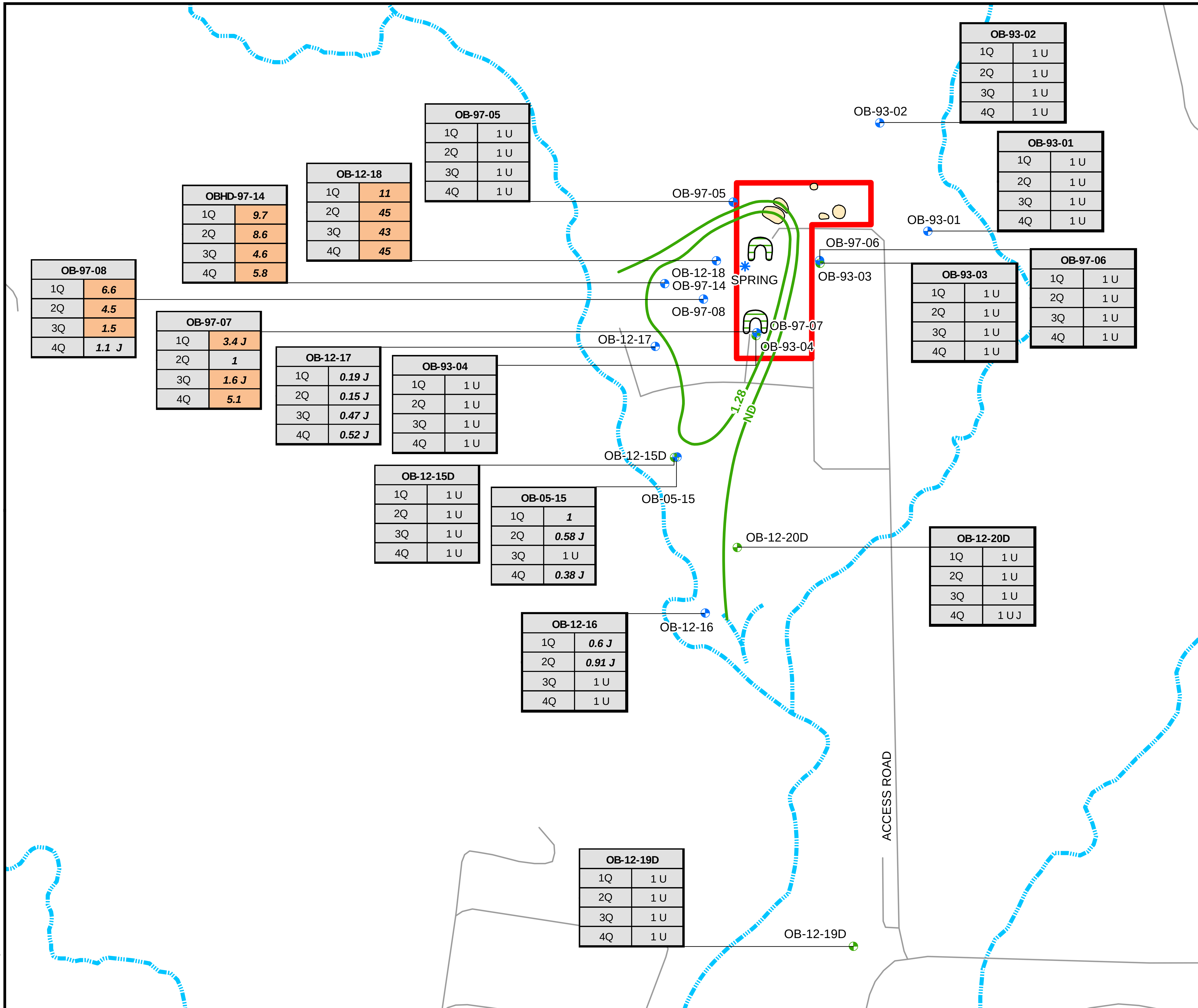
OB-12-19D	
1Q	**1.1**
2Q	**1.7**
3Q	**1.1**
4Q	**1.1**

Figure 4-9

QUARTERLY TCE DETECTIONS GROUNDWATER OB/OD

Fort Riley, Kansas

K:\ENV\LOUIS BERGER GROUP INC\site\63598\Deliver\GIS\2013\RI_Report2013\Fig4-9_Quarterly_TCE_Detections_GW_OBOD.mxd sos June 20, 2013



LEGEND

- REGOLITH/WEATHERED BEDROCK MONITORING WELL
- BEDROCK MONITORING WELL
- SPRING
- PCA ISOCONCENTRATION LINE
- BURN PIT
- METAL DEBRIS OR DEMO PIT
- ACTIVE PORTION OF OB/OD
- ROAD
- EPHEMERAL STREAM
- ND NOT DETECTED

Monitoring Well	
Quarter	<SL
	>SL

NOTES:

1. ALL RESULTS IN ug/L. DETECTIONS ARE BOLD.
2. THE SCREENING LEVEL (SL) FOR PCA IS 1.28 ug/L.
3. ISOCONCENTRATION CONTOURS BASED ON AVERAGE RESULT FOR FOUR QUARTERS FOR THE REGOLITH/WEATHERED BEDROCK AQUIFER.

0 400 800

SCALE IN FEET

N

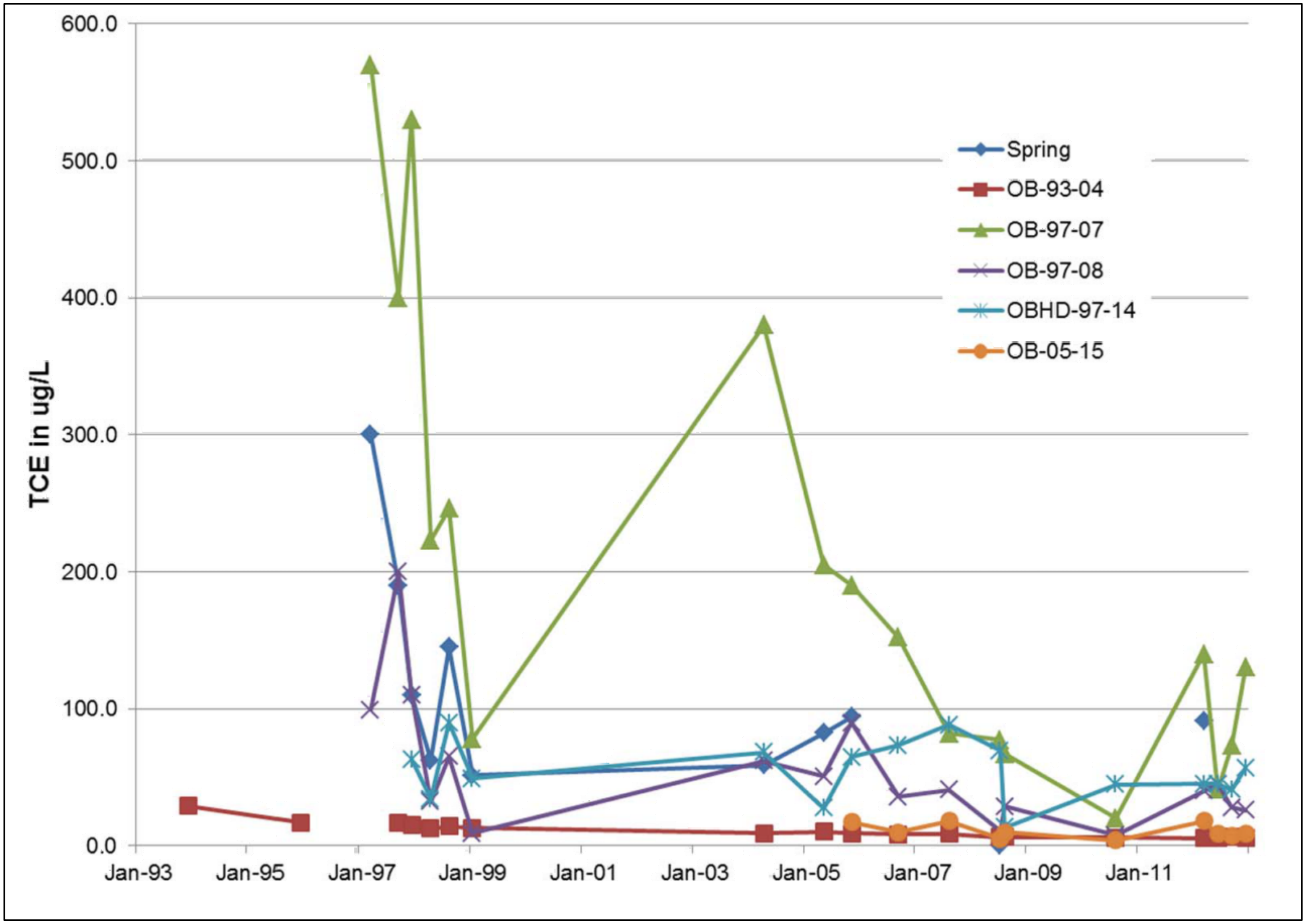
Burns & McDonnell SINCE 1898

Figure 4-10

QUARTERLY PCA DETECTIONS GROUNDWATER OB/OD

Fort Riley, Kansas

K:\ENV\LOUIS BERGER GROUP INC\site\63598\Deliver\GIS\2013\RI_Report2013\Fig4-10_Quarterly_PCA_Detections_GW_OBOD.mxd sos June 20, 2013

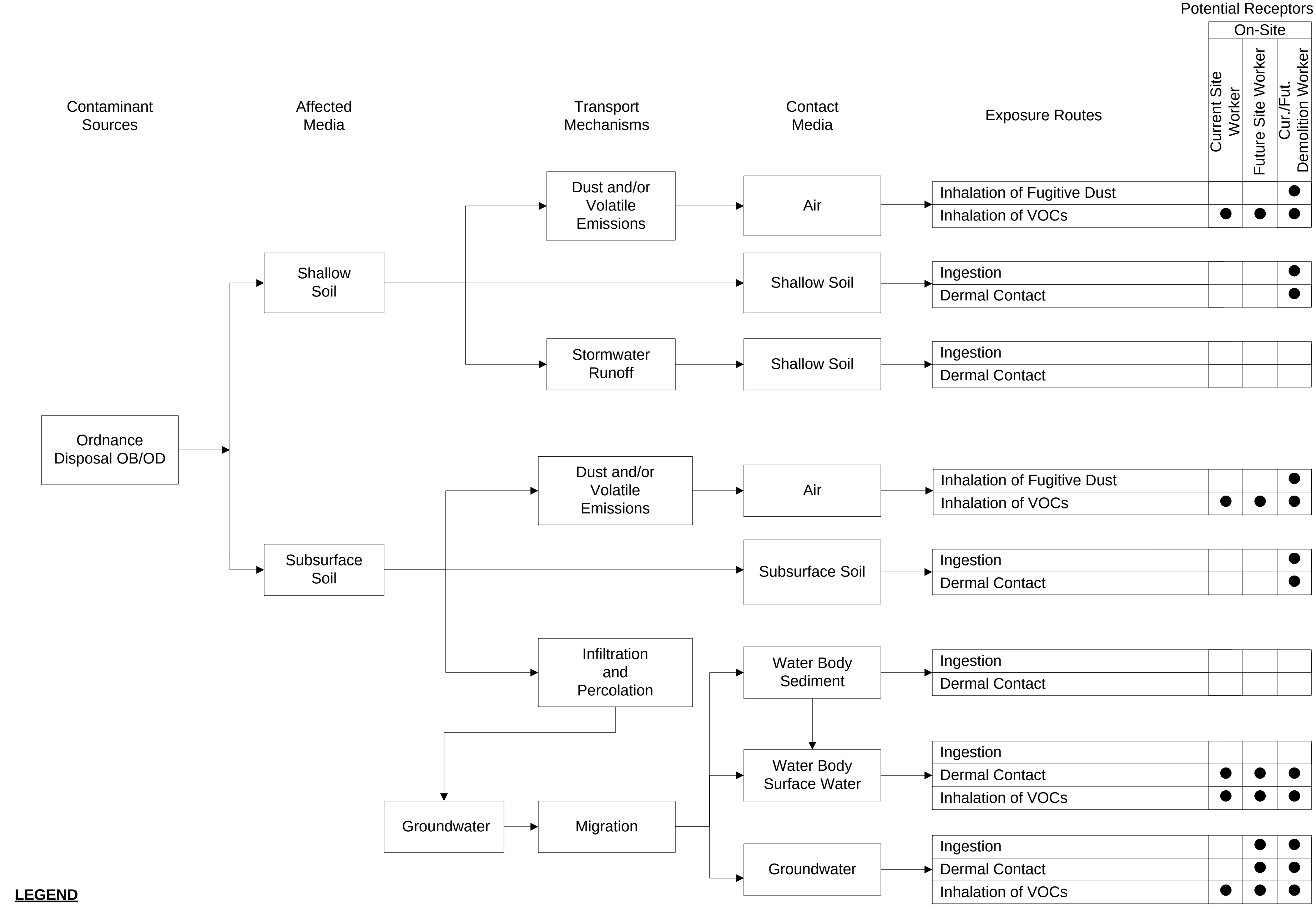


Burns & McDonnell SINCE 1898

Figure 4-11

TCE CONCENTRATIONS IN SELECTED WELLS OVER TIME OB/OD

Fort Riley, Kansas



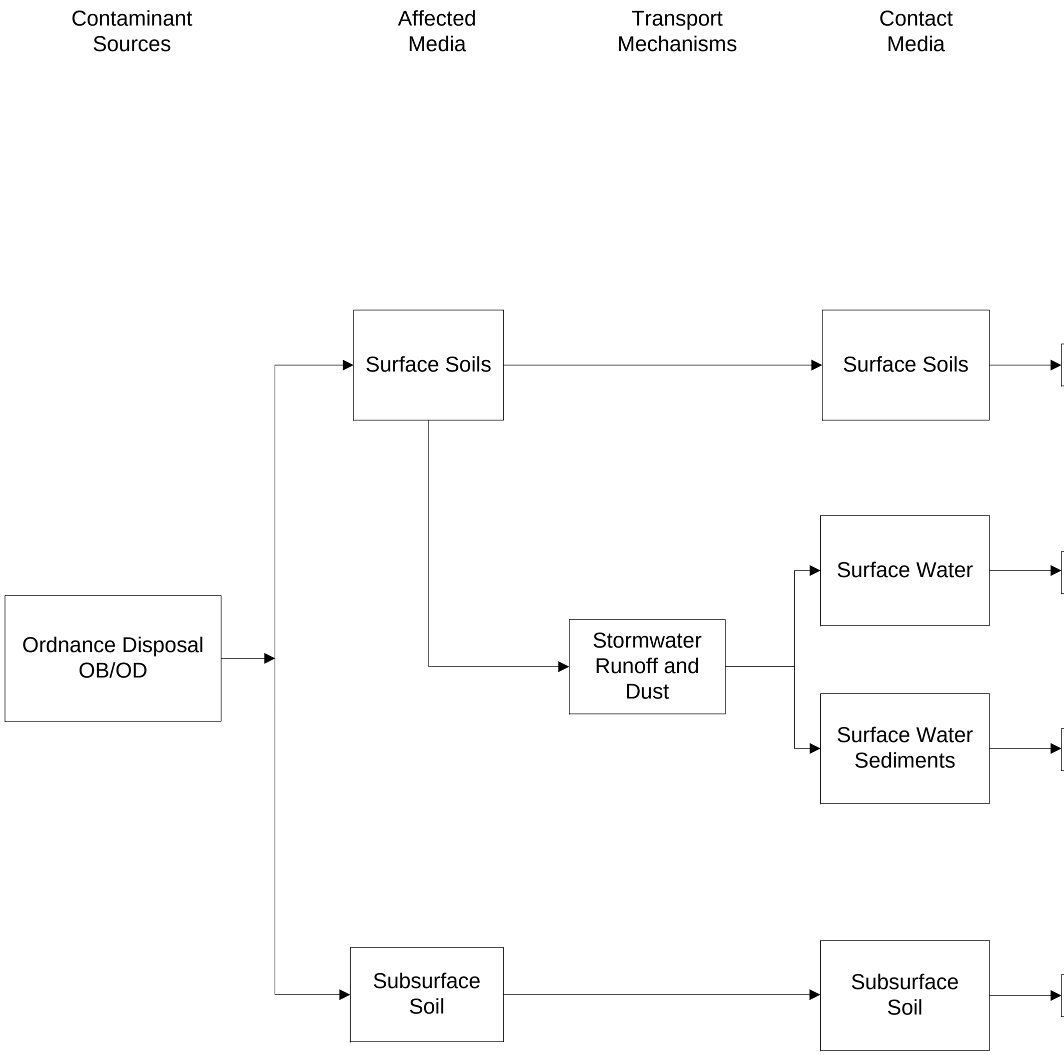
LEGEND

● Potentially Completed Pathway

☐ Not a completed pathway

Burns & McDonnell SINCE 1898

Figure 6-1
Human Health
Conceptual Site Model
OB/OD RI Report
Fort Riley, Kansas



Potential Receptors

Exposure Routes	Soil Invertebrates	Benthic and Aquatic Invertebrates	Terrestrial Plants	Aquatic Plants	Aquatic Vertebrates	Terrestrial Herbivores	Terrestrial Omnivores	Terrestrial Carnivores
Ingestion or Uptake (Surface Soils)	●		●			●	●	●
Ingestion or Uptake (Surface Water)		●		●	●	●	●	●
Ingestion or Uptake (Surface Water Sediments)		●					●	
Ingestion or Uptake (Subsurface Soil)			●					

LEGEND

● Potentially Completed Pathway

(empty box) Not a completed pathway

Burns & McDonnell SINCE 1898

Figure 7-1
ECOLOGICAL CONCEPTUAL SITE MODEL
OB/OD Pathways Analysis Report
Fort Riley, Kansas

APPENDICES
(Provided on CD)

Appendix A – Historical Investigation Data and Figures

Appendix B – Remedial Investigation/Feasibility Study Work Plan for the Open Burning-Open Detonation Ground (Range 16) Operable Unit 006 at Fort Riley, Kansas

Appendix C – Technical Memorandum Work Plan Addendum for the Direct Push Soil Investigation at the Metal Debris Pits, Open Burning-Open Detonation Ground (Range 16) Operable Unit 006 at Fort Riley, Kansas

Appendix D – Field Logbooks

Appendix E – HTW Drilling Logs, Monitoring Well Construction Diagrams, Well Development Forms, and KDHE WWP-5/WWC-5P Forms

Appendix F – In-Situ Testing Calculations

Appendix G – Groundwater Sampling Forms

Appendix H – Survey Data

Appendix I – Archeological Evaluation

Appendix J – Complete Analytical Tables

Appendix K – Screening Standards

Appendix L – Field GC Results

Appendix M – UCL Calculations