RCRA Facility Investigation – Remedial Investigation/ Corrective Measures Study – Feasibility Study Report for the Rocky Flats Environmental Technology Site Appendix A – Comprehensive Risk Assessment

Volume 13 of 15
Southeast Buffer Zone Area Exposure Unit

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ACRONYMS AND ABBREVIATIONS

µg/kg	microgram per kilogram
µg/L	microgram per liter
AEU	Aquatic Exposure Unit
AI	adequate intake
bgs	below ground surface
BZ	Buffer Zone
CAD/ROD	Corrective Action Decision/Record of Decision
CD	compact disc
CDPHE	Colorado Department of Public Health and Environment
cfs	cubic feet per second
CMS	Corrective Measures Study
CNHP	Colorado Natural Heritage Program
COC	contaminant of concern
CRA	Comprehensive Risk Assessment
DOE	U.S. Department of Energy
DQA	Data Quality Assessment
DQO	data quality objective
DRI	dietary reference intake
ECOC	ecological contaminant of concern
ECOI	ecological contaminant of interest
ECOPC	ecological contaminant of potential concern
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ERA	Ecological Risk Assessment

ESL	ecological screening level
EU	Exposure Unit
HHRA	Human Health Risk Assessment
HRR	Historical Release Report
IA	Industrial Area
IAG	Interagency Agreement
IHSS	Individual Hazardous Substance Site
kg	kilogram
LOAEL	lowest observed adverse effect level
LOEC	lowest effects concentration
LWOEU	Lower Woman Drainage Exposure Unit
MDC	maximum detected concentration
mg	milligram
mg/day	milligram per day
mg/kg	milligram per kilogram
mg/kg/BW/day	milligram per kilogram receptor body weight per day
mg/l	milligram per liter
mL	milliliter
mL/day	milliliter per day
N/A	not applicable or not available
NFA	No Further Action
NFAA	No Further Accelerated Action
NOAEL	no observed adverse effect level
OU	Operable Unit
PAC	Potential Area of Concern

PARC	precision, accuracy, representativeness, completeness, and comparability
PCB	polychlorinated biphenyl
pCi	picocurie
pCi/g	picocuries per gram
pCi/L	picocuries per liter
PCOC	potential contaminant of concern
PMJM	Preble's meadow jumping mouse
PRG	preliminary remediation goal
QAPjP	Quality Assurance Project Plan
QA/QC	quality assurance/quality control
RCEU	Rock Creek Drainage Exposure Unit
RCRA	Resource Conservation and Recovery Act
RDA	recommended daily allowance
RDI	recommended daily intake
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RI/FS	Remedial Investigation/Feasibility Study
SAP	Sampling and Analysis Plan
SCM	site conceptual model
SEEU	Southeast Buffer Zone Area Exposure Unit
SEP	Solar Evaporation Ponds
SWEU	Southwest Buffer Zone Area Exposure Unit
tESL	threshold ESL
TRV	toxicity reference value
UBC	Under Building Contamination

UCL	upper confidence limit
UL	upper limit daily intake
UT	uncertain toxicity
UTL	upper tolerance limit
VOC	volatile organic compound
WRS	Wilcoxon Rank Sum
WRV	wildlife refuge visitor
WRW	wildlife refuge worker

EXECUTIVE SUMMARY

This report presents the Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA) for the 579-acre Southeast Buffer Zone (BZ) Exposure Unit (EU) (SEEU) at the Rocky Flats Environmental Technology Site (RFETS). The purpose of this report is to assess potential risks to human health and ecological receptors posed by exposure to all identified contaminants of concern (COCs) and ecological contaminants of potential concern (ECOPCs), respectively, in the SEEU.

Results of the COC selection process for the HHRA indicate that no COCs were selected and there are no significant human health risks from RFETS-related operations at the SEEU. As a result, potential health risks for the wildlife refuge worker (WRW) and wildlife refuge visitor (WRV) are expected to be within the range of background risks. The estimated cancer risks for the WRW and WRV associated with potential exposure to background levels of naturally occurring metals in surface soil/surface sediment are both approximately 2E-06. The estimated noncancer hazard indices (HIs) associated with potential exposure to background levels of metals in surface soil/surface sediment are approximately 0.3 for the WRW and 0.1 for the WRV.

The ECOPC identification process streamlines the ecological risk characterization by focusing the assessment on ecological contaminants of interest (ECOIs) that are present in the SEEU. The ECOPC identification process is described in the Final Comprehensive Risk Assessment (CRA) Work Plan and Methodology (CRA Methodology) and additional details are provided in Appendix A, Volume 2 of the Resource Conservation and Recovery Act (RCRA) Facility Investigation-Remedial Investigation (RI)/Corrective Measures Study (CMS)-Feasibility Study (FS) Report (RI/FS Report). All ECOIs in surface soil for non-Preble's meadow jumping mouse (PMJM) receptors were eliminated from further consideration as ECOPCs based on comparisons of the maximum detected concentrations (MDCs) to no observed adverse effect level (NOAEL) ecological screening levels (ESLs), background comparisons, threshold ESL (tESL) comparisons, or professional judgment. Based on the weight-of-evidence, professional judgment described in Attachment 3, aluminum, boron, chromium, copper, lithium, manganese, molybdenum, nickel, vanadium, and zinc in surface soil at the SEEU were not considered ECOPCs for non-PMJM receptors and were not further evaluated quantitatively. Following a similar ECOPC identification process for burrowing receptors, no ECOIs in subsurface soil were evaluated in professional judgment (all ECOIs were eliminated in previous steps) and therefore, no ECOPCs were identified for burrowing receptors. No PMJM receptors were evaluated in the SEEU. The small areas of PMJM habitat were evaluated as part of the Southwest Buffer Zone Area Exposure Unit (SWEU) and the Lower Woman Drainage Exposure Unit (LWOEU).

Because this process did not identify any ECOPCs in the SEEU, no risk characterization was performed and site-related risks are likely to be minimal for the ecological receptors evaluated in the SEEU. In addition, data collected on wildlife abundance and diversity indicate that wildlife species richness remains high at RFETS. Because there are no significant risks to ecological receptors or high levels of uncertainty with the data, there are no ecological contaminants of concern (ECOCs) for the SEEU.

1.0 SOUTHEAST BUFFER ZONE EXPOSURE UNIT

This volume of the Comprehensive Risk Assessment (CRA) presents the Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA) for the Southeast Buffer Zone (BZ) Area Exposure Unit (EU) (SEEU) at the Rocky Flats Environmental Technology Site (RFETS) (Figure 1.1).

The HHRA and ERA methods and selection of receptors are described in detail in the Final CRA Work Plan and Methodology (DOE 2005a), hereafter referred to as the CRA Methodology. A summary of the risk assessment methods, including updates made in consultation with the regulatory agencies, are summarized in Appendix A, Volume 2, Section 2.0 of the Resource Conservation and Recovery Act (RCRA) Facility Investigation-Remedial Investigation (RI)/Corrective Measures Study (CMS)-Feasibility Study (FS) Report (hereafter referred to as the RI/FS Report). The anticipated future land use of RFETS is a wildlife refuge. Two human receptors, a wildlife refuge worker (WRW) and a wildlife refuge visitor (WRV), are evaluated in this risk assessment consistent with this land use. A variety of representative terrestrial and aquatic receptors are evaluated in the ERA including the Preble's meadow jumping mouse (PMJM), a federally listed threatened species present at the RFETS.

1.1 Southeast Buffer Zone Exposure Unit Description

This section provides a brief description of the SEEU, including its location at RFETS, historical activities in the area, topography, surface water features, vegetation, and ecological resources. A more detailed description of these features and additional information regarding the geology, hydrology, and soil types at RFETS is included in Section 2.0, Physical Characteristics of the Study Area, of the RI/FS Report.

The Historical Release Report (HRR) (DOE 1992) and its annual updates provide descriptions of known or suspected releases of hazardous substances that occurred at RFETS. The original HRR (DOE 1992) organized these known or suspected historical sources of contamination as Individual Hazardous Substance Sites (IHSSs), Potential Areas of Concern (PACs), or Under Building Contamination (UBC) sites (hereafter referred to as IHSSs). Individual historical IHSSs and groups of historical IHSSs were also designated as Operable Units (OUs). Over the course of cleanup under the 1991 Interagency Agreement (IAG) (IAG 1991) and the 1996 Rocky Flats Cleanup Agreement (RFCA) (RFCA 1996), the U.S. Department of Energy (DOE) has thoroughly investigated and characterized contamination associated with these IHSSs. IHSSs have been dispositioned through appropriate remedial actions or by determining that No Further Accelerated Action (NFAA) is required, pursuant to the applicable IAG and RFCA requirements. Some OUs have also been dispositioned in accordance with an OU-specific Corrective Action Decision/Record of Decision (CAD/ROD).

A more detailed description of the OU and IHSS history at RFETS is included in Section 1.0 of the RI/FS Report. This information is also briefly summarized in Appendix A, Volume 2 of the RI/FS Report.

The SEEU is located within the Buffer Zone (BZ) OU, southeast of the Industrial Area (IA) that was used for RFETS operations (Figure 1.1). A small portion of the historical IHSS, Roadway Spraying (PAC 000-501), is the only historical IHSS within the SEEU (Table 1.1 and Figure 1.2). Figure 1.2 in Appendix A, Volume 2 of the RI/FS Report shows the locations of the IHSSs in the buffer zone, including this IHSS in the SEEU. The roadway spray areas are roads that were sprayed with waste oil for dust control. Based on the historical summary presented for PAC 000-501 in the 2005 Annual Update to the Historical Release Report (DOE 2005b), the sources of oil for roadway spraying in the buffer zone would be one or both of the following: in October 1982, 120 liters of Number 2 diesel fuel from a tank spill on the northern side of Building 371 was used on roads; and in September 1983, 1,200 gallons of Mobil Number 634 gear lubrication oil from a Building 883 rolling mill lube system was used on plant gravel roads. These oils are not expected to contain polychlorinated biphenyls (PCBs), but could contain polynuclear aromatic hydrocarbons (PAHs). However, in this EU and other EUs, samples were collected near the road for PAH (and PCB) analysis, and PAHs (and PCBs) were not detected at detection limits near (two-three times) or below the ESLs. PAC 000-501 was one of 79 IHSSs/PACs proposed for No Further Action (NFA) by the NFA Working Group in 1991. The NFA was approved in 2002 (EPA et al. 2002) and is documented in the 2002 HRR Update (DOE 2002). In general, NFAs were based on human health considerations. The intent of the ecological component of the CRA is to evaluate any potential risk to ecological receptors associated with the residual contamination at the site.

1.1.1 Exposure Unit Characteristics and Location

The 579-acre SEEU is located in the southeastern portion of RFETS (Figure 1.1) and contains the following distinguishing features:

- The SEEU is located within the BZ OU and is outside areas that were used historically for operation of RFETS.
- No significant releases have occurred within the SEEU boundaries. A short stretch of gravel road in the SEEU makes up a small portion of PAC 000-501, which was approved for NFA. The SEEU is located generally crosswind and hydraulically cross-gradient relative to the Industrial Area (IA).
- The SEEU includes the Smart Ditch Drainage, a minor drainage that includes two small ponds in the far southern section of RFETS. The drainage does not receive runoff from the IA.

The SEEU is bounded by the SWEU to the west, the Lower Woman Drainage EU (LWOEU) to the north, and Indiana Street to the east. The property south of the SEEU is privately owned and is used for grazing.

1.1.2 Topography and Surface Water Hydrology

The SEEU is located on an eroded edge of an alluvial terrace. Natural surface water drainage is to the east. The principal surface water features in the SEEU are Smart Ditch

and Ponds D-1 and D-2 (Figures 1.2 and 1.3). Smart Ditch[1] is a privately owned irrigation ditch in the southern portion of the BZ OU. The ditch does not receive runoff from the IA. Water from Rocky Flats Lake, located off site and west of the RFETS boundary, flows through Smart Ditch to a splitter box located where the ditch first crosses the SEEU northern boundary. The splitter box diverts water toward the southeast, away from the main channel of Woman Creek, and into Ponds D-1 and D-2. Overland runoff is also intercepted and conveyed by Smart Ditch. Smart Ditch is typically dry, although it has an estimated capacity of 10 cubic feet per second (cfs). Because the ditch is hydrologically separated and far-removed from the IA, limited flow and water quality data exist for this conveyance. An additional ephemeral drainage known as Dogleg Draw is present in the southwestern portion of the SEEU.

The SEEU functioned mainly as a security buffer for the site. Gravel roads in the area are used for security patrols and provide access for surface water management and environmental monitoring activities.

1.1.3 Flora and Fauna

Vegetation in the SEEU is mainly comprised of grasslands. The major components are reclaimed grasslands and mesic mixed grasslands (Figure 1.4). Reclaimed grasslands are located in the southeastern half of the EU and are dominated by two introduced grass species, smooth brome (*Bromus inermis*) and intermediate wheatgrass (*Agropyron intermedium*). The mesic mixed grassland is comprised of western wheatgrass (*Agropyron smithii*), blue grama (*Bouteloua gracilis*), side-oats grama (*Bouteloua curtipendula*), prairie junegrass (*Koeleria pyramidata*), Canada bluegrass (*Poa compressa*), Kentucky bluegrass (*Poa pratensis*), green needlegrass (*Stipa virigula*), and little bluestem (*Andropogon scoparius*). Xeric grasslands occur on pediment areas and small areas of wetland and riparian woodland are found along Smart Ditch and the D-series ponds.

Grasslands are important to wildlife, and grassland conditions on the eastern side of RFETS including SEEU are considered good habitat, although weeds and introduced grass species have degraded grasslands in some areas (PTI 1997). Weed control, erosion control, and ongoing reclamation activities within the EU will continue to promote native grasslands.

No federally listed plant species are known to occur at RFETS. However, the xeric tallgrass prairie, tall upland shrubland, riparian shrubland, and plains cottonwood riparian woodland communities are considered rare and sensitive plant communities by the Colorado Natural Heritage Program (CNHP). RFETS also supports populations of four rare plant species that are listed as rare or imperiled by the CHNP. These include: forktip three-awn (*Aristida basiramea*), mountain-loving sedge (*Carex oreocharis*), carrionflower greenbriar (*Smilax herbacea var. lasioneuron*), and dwarf wild indigo (*Amorpha nana*). Forktip three-awn primarily occurs in disturbed habitat near the western

[1] Smart Ditch is referred to as Smart Ditch I. Smart Ditch II runs northeast of Rocky Flats Lake (located west of the SEEU) and is used to flood-irrigate a pasture west of RFETS.

edge of the IAEU. The other three species occur primarily along the piedmont slopes in the Rock Creek drainage (K-H 2002).

Numerous animal species have been observed at RFETS and the more common species are expected to be present in the SEEU. Common large and medium-sized mammals likely to live at or frequent the SEEU include mule deer (*Odocoileus hemionus*), white-tailed deer (*Odocoileus virginianus*), coyote (*Canis latrans*), raccoon (*Procyon lotor*), and desert cottontail (*Sylvilagus audubonii*). The most common reptile observed at RFETS is the western prairie rattlesnake (*Crotalis viridus)*. Common bird species include meadowlark (*Sturnella neglecta*) and vesper sparrow (*Pooecetes gramineus*). Herons and ducks frequent the D-1 and D-2 ponds. The most common small mammal species include deer mice (*Peromyscus maniculatus*), prairie voles (*Microtus ochrogaster*), meadow voles (*Microtus pennsylvanicus*), and two species of harvest mice (*Reithrodontomys* sp).

RFETS supports two wildlife species listed as threatened or endangered species under the Endangered Species Act (USFWS 2005) The Preble's meadow jumping mouse (PMJM; *Zapus hudsonius preblei*) and the bald eagle (*Haliaeetus leucocephalus*) are listed as threatened species. The PMJM could potentially reside in every major drainage at RFETS. The preferred habitat for the PMJM is the riparian corridors bordering streams, ponds, and wetlands at RFETS, with an adjacent thin band of upland grasslands. PMJM habitat occurs along Smart Ditch in the northwestern portion of the SEEU (Figure 1.5). No PMJM have ever been captured within the boundaries of SEEU. As shown on Figure 1.5, portions of three distinct habitat patches are located within the boundaries of the SEEU (#28, #29A, and #30). Because PMJM habitat extends into two bordering EUs, habitat patch #28 will be addressed in the Lower Woman Drainage EU (LWOEU) and habitat patches #29A and #30 will be addressed in the SWEU. The bald eagle occasionally forages at RFETS although no nests have been identified on site.

There are also a number of wildlife species that have been observed at RFETS that are species of concern by the State of Colorado (USFWS 2005). The plains sharp-tailed grouse (*Tympanuchus phasianellus jamesii*) is listed as endangered by the State and has been observed infrequently at RFETS. The western burrowing owl (*Athene cunicularia hypugea*) is listed as threatened by the State and is a known resident or regular visitor at RFETS. The ferruginous hawk (*Buteo regalis*), American peregrine falcon (*Falco peregrinus*), and northern leopard frog (*Rana pipiens*) are listed as species of special concern by the State and are considered known residents or regular visitors at RFETS. The following species are listed as species of special concern and are observed infrequently at RFETS: greater sandhill crane (*Grus canadensis tibida*), long-billed curlew (*Numenius americanus*), mountain plover (*Charadrius montanus*), and the common garter snake (*Thamnophis sirtalis*).

More detail on the species that use RFETS habitats and the methodology of creating sitewide PMJM habitat patches can be found in Appendix A, Volume 2, Section 3.2 of the RI/FS Report.

1.1.4 Data Description

Data have been collected at RFETS under regulatory agency-approved Work Plans, Sampling and Analysis Plans (SAPs), and Quality Assurance Project Plans (QAPjPs) to meet data quality objectives (DQOs) and appropriate U.S. Environmental Protection Agency (EPA) and Colorado Department of Public Health and Environment (CDPHE) guidance. Surface soil, subsurface soil, surface sediment, subsurface sediment, and groundwater samples were collected from the SEEU. The data set for the CRA was prepared in accordance with data processing steps described in Appendix A, Volume 2, Attachment 2 of the RI/FS Report. Surface soil/surface sediment, subsurface soil/subsurface sediment, surface soil, and subsurface soil are the media evaluated in the HHRA and ERA (Table 1.2). The sampling locations for these media are shown on Figures 1.6 and 1.7, and data summaries for detected analytes in each medium are provided in Tables 1.3 through 1.6. Potential contaminants of concern (PCOCs) and ecological contaminants of interest (ECOIs) that were analyzed for but not detected, or were detected in less than 5 percent of the samples, are presented in Attachment 1. Detection limits are compared to preliminary remediation goals (PRGs) and ecological screening levels (ESLs) and discussed in Attachment 1 (Tables A1.1 through A1.4). Only data from June 1991 to the present are used in the CRA because these data meet the approved analytical quality assurance/quality control (QA/QC) requirements.

In accordance with the CRA Methodology, only data collected on or after June 28, 1991, and data for subsurface soil and subsurface sediment samples with a start depth less than or equal to 8 feet below ground surface (bgs) are used in the CRA. Subsurface soil and subsurface sediment data are limited to this depth because it is not anticipated that the WRW or burrowing animals will dig to deeper depths. A detailed description of data storage and processing methods is provided in Appendix A, Volume 2 of the RI/FS Report. The CRA analytical data set for the SEEU is provided on a compact disc (CD) presented in Attachment 4. The CD includes the data used in the CRA as well as data not considered useable based on criteria presented in Appendix A, Volume 2 of the RI/FS Report.

The sampling data used for the SEEU HHRA and ERA are used as follows:

- Combined surface soil/surface sediment data (HHRA);
- Combined subsurface soil/subsurface sediment data (HHRA);
- Surface soil data (ERA); and,
- Subsurface soil data (ERA).

These data for these media are briefly described below.

Surface water and sediment are assessed for ecological receptors on an Aquatic Exposure Unit (AEU) basis in Appendix A, Volume 15B of the RI/FS Report. An assessment of the surface water, groundwater-to-surface water, and volatilization pathways for human health are presented in Appendix A, Volume 2 of the RI/FS Report.

Surface Soil/Surface Sediment

The combined surface soil/surface sediment data set for SEEU consists of up to 55 samples for various analyte groups. The SEEU surface soil/surface sediment samples were analyzed for inorganics (up to 22 samples), organics (up to one sample), and radionuclides (up to 55 samples) (Table 1.2). The surface soil/surface sediment data set includes data from three shallow sediment sampling locations shown on Figure 1.6. The sediment samples were collected to depths less than 0.5 feet from the sediment surface. All sample locations within the SEEU were not necessarily analyzed for all analyte groups (see Table 1.3). The surface soil/surface sediment samples were collected in the SEEU over several months from July 1991 through September 1994, and then again in March, April, and December of 2004, and January 2005. The samples collected in 2004 were located on a 30-acre grid, as described in SAP Addendum #04-01 (DOE 2004). For the grid sampling, five individual samples were collected from each 30-acre cell, one from each quadrant and one in the center, as described in the Addendum (DOE 2004). Most of the evenly spaced surface soil sampling locations on Figure 1.6 represent the 30-acre grid samples. These samples were analyzed for radionuclides and metals only.

The data summary for detected analytes in surface soil/surface sediment for the SEEU is presented in Table 1.3. Detected analytes include representatives from the inorganic, organic, and radionuclide analyte groups. A summary of analytes that were not detected or detected in less than 5 percent of surface soil/surface sediment samples in the SEEU is presented and discussed in Attachment 1.

Subsurface Soil/Subsurface Sediment

Subsurface soil samples used in the CRA are defined in the CRA Methodology as soil samples with a starting depth less than or equal to 8 feet bgs and an ending depth below 0.5 feet. The combined subsurface soil/subsurface sediment data set for SEEU consists of up to nine samples for various analyte groups. The subsurface soil/subsurface sediment data set includes data from one deep sediment sampling location shown on Figure 1.7. All sample locations within the SEEU were not necessarily analyzed for all analyte groups (see Table 1.4). The SEEU subsurface soil/subsurface sediment samples were analyzed for inorganics (up to seven samples), organics (up to seven samples), and radionuclides (up to nine samples). Subsurface soil/subsurface sediment samples were collected in the SEEU in February 1992, July and August 1994, and again in January 2005.

The data summary for detected analytes in subsurface soil/subsurface sediment for the SEEU is presented in Table 1.4. Detected analytes include representatives from the inorganic, organic, and radionuclide analyte groups. A summary of analytes that were not detected or detected in less than 5 percent of subsurface soil/subsurface sediment samples in the SEEU is presented and discussed in Attachment 1.

Surface Soil

The surface soil data set for SEEU consists of up to 52 samples for various analyte groups. The SEEU surface soil samples were analyzed for inorganics (up to 19 samples), organics (up to one sample), and radionuclides (up to 52 samples) (Table 1.2). Sample

locations are shown on Figure 1.6. All sample locations within the SEEU were not necessarily analyzed for all analyte groups (see Table 1.5). The samples were collected in the SEEU over several months from July 1991 through September 1994, and then again in March and April of 2004. The samples collected in 2004 were located on a 30-acre grid, as described in SAP Addendum #04-01 (DOE 2004). For the grid sampling, five individual samples were collected from each 30-acre cell, one from each quadrant and one in the center, as described in the Addendum (DOE 2004). Most of the evenly spaced surface soil sampling locations on Figure 1.6 represent the 30-acre grid samples. These samples were analyzed for radionuclides and metals only.

The data summary for detected analytes in SEEU surface soil is presented in Table 1.5. Radionuclides and inorganics were detected in SEEU surface soil samples. A summary of analytes that were either not detected, or detected in less than 5 percent of surface soil samples in the SEEU is presented and discussed in Attachment 1.

Subsurface Soil

Subsurface soil samples used in the CRA are defined in the CRA Methodology as soil samples with a starting depth less than or equal to 8 feet bgs and an ending depth below 0.5 feet. The subsurface soil data set for SEEU consists of up to six samples for various analyte groups. The SEEU subsurface soil samples were analyzed for inorganics (up to six samples), organics (up to seven samples), and radionuclides (up to eight samples) (Table 1.2). Sample locations are shown on Figure 1.7. All sample locations within the SEEU were not necessarily analyzed for all analyte groups (see Table 1.6). The samples were collected in the SEEU in February 1992, and again in July and August 1994.

The data summary for detected analytes in subsurface soil for the SEEU is presented in Table 1.6. Subsurface soil samples were analyzed for inorganics, organics, and radionuclides, and representatives from all three analyte groups were detected. A summary of analytes that were either not detected, or detected in less than 5 percent of subsurface soil samples in the SEEU is presented and discussed in Attachment 1.

1.2 Data Adequacy Assessment

A data adequacy assessment was performed to determine whether the available data set discussed in the previous section is adequate for risk assessment purposes. The data adequacy assessment rules are presented in the CRA Methodology, and a detailed data adequacy assessment for the data used in the CRA is presented in Appendix A, Volume 2, Attachment 3 of the RI/FS Report. The adequacy of the data was assessed by comparing the number of samples for each analyte group in each medium as well as the spatial and temporal distributions of the data to data adequacy guidelines. If the data do not meet the guidelines, other lines of evidence (e.g., information on potential historical sources of contamination, migration pathways, and the concentration levels in the media) are examined to determine if it is possible to make risk management decisions given the data limitations.

The findings from the data adequacy assessment applicable to all EUs are as follows:

- The radionuclide and inorganic surface soil data are adequate for the purposes of the CRA.

- For herbicides and pesticides, although the existing surface soil and sediment data may not meet the minimal data adequacy guidelines for each EU, there is considerable site-wide data, and pesticides and herbicides are infrequently detected at low concentrations, generally below PRGs and ESLs. This line of evidence indicates that it is possible to make risk management decisions without additional sampling for these analyte groups

- For dioxins, although the existing surface soil and sediment data do not meet the minimal data adequacy guidelines for each EU, sample locations were specifically targeted for dioxin analysis at historical IHSSs in and near the former Industrial Area where dioxins may have been released based on process knowledge. Some of the dioxin concentrations at the historical IHSSs exceed the PRG and/or ESL. Additional samples were collected in targeted locations that represented low-lying or depositional areas where dioxin contamination may have migrated via runoff from these specific IHSSs. Results indicate that dioxin concentrations are not above the minimum ESL in sediment and dioxins are not detected in surface water. Therefore, although the existing data do not meet the minimal data adequacy guidelines for each EU/AEU, it is possible to make risk management decisions without additional sampling. However, unlike pesticides and herbicides where there is considerably more site-wide data, there is greater uncertainty in the overall risk estimates because fewer samples were collected at the site for dioxins.

- Subsurface soil contamination is largely confined to historical IHSSs (that is, areas of known or suspected historical releases). These areas have been characterized to understand the nature and extent of potential releases. For historical IHSSs where subsurface soil samples were not collected for an analyte group, the presence of this type of subsurface contamination was not expected based on process knowledge. Therefore, the existing subsurface soil data are adequate for the purposes of the CRA.

The findings from the data adequacy report applicable to the SEEU are as follows:

- Only one surface soil sample from the SEEU was analyzed for VOCs, SVOCs, and PCBs, which does not meet the data adequacy guideline for number of samples. Sediment samples were not collected in the SEEU for VOC, SVOC, and PCB analysis. However, the single sample collected in the SEEU is one of a group of samples from five locations in and near historical IHSS 209, the other samples being located in the adjacent EU. No VOCs, SVOCs, or PCBs were detected in any of these samples, indicating that IHSS 209 is not a potential source of organic contamination in the SEEU. A small portion of historical IHSS 000-501, roadway spray areas, is also located in the SEEU. However, in other EUs that contain this IHSS, SVOCs and PCBs were not detected. The SEEU is

hydraulically isolated from potential historical source areas in and near the IA. Therefore, although the existing organic data do not meet the minimal data adequacy guidelines for the EU, available information on potential historical sources of contamination, contaminant migration pathways from potential sources in other EUs, and concentration levels in surface soil show that the constituents in these analyte groups are not likely to be present in surface soil or sediment for this EU, and it is possible to make risk management decisions without additional sampling.

- No surface soil or sediment samples were collected for dioxins in the SEEU. Although this does not meet the minimal data adequacy guideline, as noted above, dioxins are not expected to have been released in SEEU and it is possible to make risk management decisions without additional sampling.

- There is only one location in the SEEU where surface soil was sampled for organic analysis. Although the spatial distribution of sampling locations is very limited, the SEEU contains no historical IHSSs that were potential sources of organic contamination, and the SEEU is hydraulically isolated from potential historical source areas in and near the IA. Thus, the data are representative of the entire EU. Therefore, although the existing EU data do not meet the data adequacy guideline for spatial representativeness, it is possible to make risk management decisions without additional sampling.

- For analytes not detected or detected in less than 5 percent of the samples in surface soil/surface sediment, only three analytes have detection limits that exceed PRGs, and the exceedances are relatively low, i.e., the detection limits are of the same order of magnitude as the PRGs. This represents only minimal uncertainty in the overall risk estimates. All detection limits are below the PRGs/ESLs in subsurface soil/subsurface sediment and subsurface soil. There are 20 analytes in surface soil where some percent of the detection limits exceed the lowest ESL. With the exception of benzo(a)pyrene, analytes in surface soil that have detection limits that exceed the lowest ESLs contribute only minimal uncertainty to the overall risk estimates because either only a small fraction of the reported results are greater than the lowest ESL, or professional judgment indicates they are not likely to be present in SEEU surface soil. Although there is a potential for benzo(a)pyrene to be present in SEEU surface soil based on professional judgment, it does not present a potential for adverse ecological effects even if it was detected at its maximum detection limit. Consequently, the higher detection limit for benzo(a)pyrene also contributes minimal uncertainty in the overall risk estimates (see Appendix A, Volume 13, Attachment 1 of the RI/FS report for a more detailed discussion).

1.3 Data Quality Assessment

A Data Quality Assessment (DQA) of the SEEU data was conducted to determine whether the data were of sufficient quality for risk assessment use. The DQA is presented in Attachment 2, and an evaluation of the entire RFETS data set is presented in

Appendix A, Volume 2 of the RI/FS Report. The quality of the laboratory results were evaluated for compliance with the CRA Methodology data quality objectives (DQOs) through an overall review of precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters. This review concluded that the data are of sufficient quality for use in the CRA, and the CRA DQOs have been met.

2.0 SELECTION OF HUMAN HEALTH CONTAMINANTS OF CONCERN

The human health contaminant of concern (COC) screening process is described in Section 4.4 of the CRA Methodology and summarized in Appendix A, Volume 2 of the RI/FS Report (Section 2.2).

The human health COC selection process was conducted for surface soil/surface sediment and subsurface soil/subsurface sediment in the SEEU. Results of the COC selection process are summarized below.

2.1 Contaminant of Concern Selection for Surface Soil/Surface Sediment

Detected PCOCs in surface soil/surface sediment samples (Table 1.3) are screened in accordance with the CRA Methodology to identify the COCs.

2.1.1 Surface Soil/Surface Sediment Cation/Anion and Essential Nutrient Screen

The major cations and anions that do not have toxicity criteria are eliminated from assessments in surface soil/surface sediment in accordance with the CRA Methodology.

The essential nutrient screen for analytes detected in surface soil/surface sediment is presented in Table 2.1. The screen includes PCOCs that are essential for human health and do not have toxicity criteria available. Table 2.1 shows the maximum detected concentrations (MDCs) for essential nutrients, daily intake estimates based on the MDCs, and dietary reference intakes (DRIs). The DRIs are identified in the table as recommended daily allowances (RDAs), recommended daily intakes (RDIs), adequate intakes (AIs), and upper limit daily intakes (ULs). The estimated daily maximum intakes based on the nutrients' MDCs and a surface soil/surface sediment ingestion rate of 100 milligrams (mg) per day (mg/day)are less than the DRIs. Therefore, these PCOCs were not further evaluated as COCs for surface soil/surface sediment.

2.1.2 Surface Soil/Surface Sediment Preliminary Remediation Goals Screen

Table 2.2 compares the MDCs and upper confidence limits (UCLs) to the WRW PRGs for each PCOC. If the MDC and the UCL are greater than the PRG, the PCOC is retained for further screening; otherwise, is not further evaluated. Arsenic and manganese were the only analytes in surface soil/surface sediment that had an MDC and UCL that exceeded the PRG and were retained as PCOCs. Cesium-137 and radium-228 were also retained as a PCOC because the MDCs exceeded the PRGs. A comparison of the UCLs for cesium-137 and radium-228 could not be performed because an UCL could not be calculated based on the number of samples.

PRGs were not available for several PCOCs in surface soil/surface sediment. Analytes without PRGs are listed on Table 2.2 and their effect on the conclusions of the risk assessment results is discussed in the uncertainty section (Section 6.0).

2.1.3 Surface Soil/Surface Sediment Detection Frequency Screen

Arsenic and manganese were detected in more than 5 percent of surface soil/surface sediment samples (Table 1.3) and, therefore, were retained for further evaluation in the COC screen. A detection frequency screen was not performed for cesium-137 and radium-228 in surface soil/surface sediment because all reported values for radionuclides are considered detects.

2.1.4 Surface Soil/Surface Sediment Background Analysis

Results of the background statistical comparison for arsenic, manganese, cesium-137, and radium-228 are presented in Table 2.3 and discussed in Attachment 3. Box plots for arsenic and manganese (both SEEU and background) are provided in Attachment 3. Arsenic and manganese were statistically greater than background at the 0.1 significance level, and are evaluated further in the professional judgment section.

A background analysis could not be performed for cesium-137 and radium-228 based on the number of samples. Therefore, cesium-137 and radium-228 are evaluated further in the professional judgment section.

2.1.5 Surface Soil/Surface Sediment Professional Judgment Evaluation

Based on the weight of available evidence evaluated by professional judgment, PCOCs will either be included for further evaluation as COCs or excluded as COCs. The professional judgment evaluation takes into account process knowledge, spatial trends, pattern recognition, comparisons to RFETs background and other background data sets, and risk potential. As discussed in Section 1.2 and Attachment 2, the sample results are adequate for use in the professional judgment because they are of sufficient quality for use in the CRA.

Based on the weight of evidence described in Attachment 3, arsenic, manganese, cesium-137, and radium-228 in surface soil/surface sediment in the SEEU are not considered COCs because the weight of evidence supports the conclusion that arsenic, manganese, cesium-137, and radium-228 concentrations in surface soil/surface sediment in the SEEU are not a result of RFETS activities, but rather are representative of naturally occurring concentrations.

2.2 Contaminant of Concern Selection for Subsurface Soil/Subsurface Sediment

Detected PCOCs in subsurface soil/subsurface sediment samples (Table 1.4) are screened in accordance with the CRA Methodology to identify the COCs.

2.2.1 Subsurface Soil/Subsurface Sediment Cation/Anion and Essential Nutrient Screen

The major cations and anions that do not have toxicity criteria were eliminated from assessments in subsurface soil/subsurface sediment in accordance with the CRA Methodology.

Essential nutrients without toxicity criteria that were detected in subsurface soil/subsurface sediment at the SEEU were compared to DRIs in Table 2.4. The estimated daily maximum intakes for these PCOCs, based on the nutrient's MDCs and a subsurface soil/subsurface sediment ingestion rate of 100 mg/day, are less than the DRIs. Therefore, these PCOCs were not further evaluated as COCs for subsurface soil/subsurface sediment.

2.2.2 Subsurface Soil/Subsurface Sediment Preliminary Remediation Goal Screen

The PRG screen for detected analytes in subsurface soil/subsurface sediment is presented in Table 2.5. The MDC and UCL for radium-228 in subsurface soil/subsurface sediment were greater than the PRG and, therefore, radium-228 was retained for further evaluation in the COC selection process in the SEEU.

PRGs were not available for several PCOCs in subsurface soil/subsurface sediment. Analytes without PRGs are listed on Table 2.5 and their effect on the conclusions of the risk assessment results is discussed in the uncertainty section (Section 6.0).

2.2.3 Subsurface Soil/Subsurface Sediment Detection Frequency Screen

The detection frequency screen was not performed for radium-228 in subsurface soil/subsurface sediment because all reported values for radionuclides are considered detects.

2.2.4 Subsurface Soil/Subsurface Sediment Background Analysis

Analyses were conducted to asses whether radium-228 concentrations in SEEU subsurface soil/subsurface sediment are statistically higher than those in background subsurface soil/subsurface sediment at the 0.1 level of significance (1-p less than or equal to 0.1). The subsurface soil/subsurface sediment background data are described in detail in Appendix A, Volume 2 of the RI/FS Report.

The results of the statistical comparisons of the SEEU data to the background data indicate site activity for radium-228 is not statistically greater than background at the 0.1 significance level. The results are summarized in Table 2.3 and in Attachment 3. Box plots for radium-228 (both SEEU and background) are provided in Attachment 3. Radium-228 in subsurface soil/subsurface sediment is not further evaluated in the COC screening process.

2.2.5 Subsurface Soil/Subsurface Sediment Professional Judgment Evaluation

The professional judgment step was not performed for subsurface soil/subsurface sediment because there were no PCOCs with concentrations statistically greater than background concentrations.

2.3 Contaminant of Concern Selection Summary

A summary of the results of the COC screening process is presented in Table 2.6. No COCs were selected for any of the media at the SEEU.

3.0 HUMAN HEALTH EXPOSURE ASSESSMENT

The site conceptual model (SCM), presented in Figure 2.1 of the CRA Methodology and discussed in Appendix A, Volume 2 of the RI/FS Report, provides an overview of potential human exposures at RFETS for reasonably anticipated land use. However, all PCOCs were eliminated from further consideration as human health COCs for the SEEU based on comparisons of MDCs and UCLs to PRGs, background comparisons, or professional judgment (see Section 2.0). A quantitative risk characterization is not necessary for the SEEU and, therefore, an exposure assessment was not conducted.

4.0 HUMAN HEALTH TOXICITY ASSESSMENT

Procedures and assumptions for the toxicity assessment are presented in the CRA Methodology. All PCOCs were eliminated from further consideration as human health COCs for the SEEU based on comparisons of MDCs and UCLs to PRGs, background comparisons, or professional judgment (see Section 2.0). A quantitative risk characterization is not necessary for the SEEU and, therefore, a toxicity assessment was not conducted.

5.0 HUMAN HEALTH RISK CHARACTERIZATION

Information from the exposure assessment and the toxicity assessment is integrated in this section to characterize risk to the WRW and WRV receptors. All PCOCs were eliminated from further consideration as human health COCs based on comparisons of MDCs and UCLs to PRGs, background comparisons, or professional judgment (see Section 2.0). Therefore, a quantitative risk characterization was not performed for the SEEU.

6.0 UNCERTAINTIES ASSOCIATED WITH THE HUMAN HEALTH RISK ASSESSMENT

There are various types of uncertainties associated with steps of an HHRA. General uncertainties common to the EUs are discussed in Appendix A, Volume 2 of the RI/FS Report. Uncertainties specific to the EU are described below.

6.1 Uncertainties Associated With the Data

Data adequacy for this CRA is evaluated and discussed in Appendix A, Volume 2 of the RI/FS Report. Although there are some uncertainties associated with the sampling and analyses conducted for surface soil/surface sediment and subsurface soil/subsurface sediment at the SEEU, data are considered adequate for the characterization of risk at the EU. The environmental samples for the SEEU were collected from 1991 through 2004. The CRA sampling and analysis requirements for the BZ (DOE 2004, 2005a) specify that the minimum sampling density requirement for surface soil/surface sediment is one five-sample composite for every 30-acre grid cell. In surface soil/surface sediment, there are up to 55 samples in the SEEU. Although there is limited data for organics in surface soil/surface sediment, there are no known or suspected sources for organic contaminants in the SEEU. In subsurface soil/subsurface sediment, there are up to nine samples in the SEEU.

Another source of uncertainty in the data is the relationship of detection limits to the PRGs for analytes eliminated as COCs because they were not detected or had a low detection frequency (i.e., less than 5 percent). The detection limits were appropriate for the analytical methods used, and this is examined in greater detail in Attachment 1.

6.2 Uncertainties Associated With Screening Values

The COC screening analyses utilized RFETS-specific PRGs based on a WRW scenario. The assumptions used in the development of these values were conservative. For example, it is assumed that a future WRW will consume 100 mg of surface soil/surface sediment for 230 days per year for a period of 18.7 years. In addition, a WRW is assumed to be dermally exposed to and inhale surface soil and surface sediment particles in the air. These assumptions are likely to overestimate actual exposures to surface soil for WRWs in the SEEU because a WRW will not spend 100 percent of his or her time in this area. Exposure to subsurface soil and subsurface sediment is assumed to occur 20 days per year. The WRW PRGs for subsurface soil/subsurface sediment are also expected to conservatively estimate potential exposures because it is unlikely a WRW will excavate extensively in the SEEU.

6.2.1 Uncertainties Associated with Potential Contaminants of Concern without Preliminary Remediation Goals

PCOCs for the SEEU for which PRGs are not available are listed in Table 6.1.

Uncertainties associated with the lack of PRGs for analytes listed in Table 6.1 are considered small. The listed inorganics are not usually included in HHRAs because they are not expected to result in significant human health impacts. Radionuclide PRGs are available for all detected individual radionuclides. Therefore, the lack of PRGs for the gross alpha and gross beta activities is not expected to affect the results of the HHRA.

6.3 Uncertainties Associated with Eliminating Potential Contaminants of Concern Based on Professional Judgment

Arsenic, manganese, cesium-137, and radium-228 in surface soil/surface sediment were eliminated as COCs based on professional judgment. There is no identified source or pattern of release for these analytes in the SEEU and the slightly elevated median values of arsenic, manganese, cesium-137, and radium-228 in the SEEU are most likely due to natural variation. The weight of evidence presented in Attachment 3, Section 4.0 supports the conclusion that concentrations of arsenic, manganese, cesium-137, and radium-228 are naturally occurring and not due to site activities. Uncertainty associated with the elimination of these chemicals as COCs is low.

No PCOCs were eliminated in subsurface soil/subsurface sediment based on professional judgment in the SEEU.

6.4 Uncertainties Evaluation Summary

Evaluation of the uncertainties associated with the data and the COC screening processes indicates there is reasonable confidence in the conclusions of the SEEU risk characterization.

7.0 IDENTIFICATION OF ECOLOGICAL CONTAMINANTS OF POTENTIAL CONCERN

The ecological contaminant of potential concern (ECOPC) identification process streamlines the ecological risk characterization for each EU by focusing the assessment on ECOIs that are present in the SEEU. ECOIs are defined as any chemical detected in the SEEU and are assessed for surface soils and subsurface soils. ECOIs for sediments and surface water are assessed in Appendix A, Volume 15 of the RI/FS Report. The ECOPC process is described in the CRA Methodology and additional details are provided in Appendix A, Volume 2 of the RI/FS Report. A detailed discussion of the SCM, including the receptors of concern, exposure pathways, and endpoints used in the ERA for the SEEU, are also provided in Appendix A, Volume 2 of the RI/FS Report.

The process is based on the SCM presented in the CRA Methodology and described in detail in Appendix A, Volume 2 of the RI/FS Report. The SCM presents the pathways of potential exposure from documented historical source areas (IHSSs and PACs) to the receptors of concern. Generally, the most significant exposure pathways for wildlife at the SEEU are the ingestion of plant, invertebrate, or animal tissue that could have accumulated ECOIs from the source areas through direct uptake or dietary routes, as well as the direct contact or ingestion of potentially contaminated media. For terrestrial plants and invertebrates, the most significant pathway is direct contact with potentially contaminated soil.

The receptors of concern that were selected for assessment are listed in Table 7.1, and discussed in detail in Appendix A, Volume 2 of the RI/FS Report, and include representative birds and mammals in addition to the general plant and terrestrial

invertebrate communities. The receptors were selected based on several criteria, including their potential to be found in the various habitats present within RFETS, their potential to come into contact with ECOIs, and the amount of life history and behavioral information available.

The ECOPC process consists of two separate evaluations, one for the PMJM receptor and one for non-PMJM receptors. The ECOPC identification process for the PMJM is conducted separately from non-PMJM receptors because the PMJM is a federally listed threatened species under the Endangered Species Act (63 FR 26517).

7.1 Data Used in the Ecological Risk Assessment

The following SEEU data are used in the CRA:

- Fifty-two surface soil samples analyzed for inorganics (19 samples), organics (one sample), and radionuclides (52 samples); and
- Eight subsurface soil samples analyzed for inorganics (six samples), organics (seven samples), and radionuclides (eight samples).

A data summary is provided in Table 1.5 for surface soil and Table 1.6 for subsurface soil.

Sediment and surface water data for the SEEU also were collected (Section 1.1.4) and these data are evaluated for the ERA in Appendix A, Volume 15 of the RI/FS Report.

The SEEU has one sample location occurring in PMJM habitat (CT16-000 in Patch 29A) which is assessed as part of the SWEU PMJM evaluation.

7.2 Identification of Surface Soil Ecological Contaminants of Potential Concern

ECOPCs for surface soil were identified for non-PMJM and PMJM receptors in accordance with the sequence presented in the CRA Methodology.

7.2.1 Comparison with No Observed Adverse Effect Level (NOAEL) Ecological Screening Levels (ESLs)

In the first step of the ECOPC identification process, the MDCs of ECOIs in surface soil were compared to receptor-specific no observed adverse effect level (NOAEL) ESLs. NOAEL ESLs for surface soil were developed in the CRA Methodology for three receptor groups: terrestrial vertebrates, terrestrial invertebrates, and terrestrial plants.

Non-PMJM Receptors

The NOAEL ESLs for non-PMJM receptors are compared to MDCs in surface soil in Table 7.1. The results of the NOAEL ESL screening analyses for all receptor types are

summarized in Table 7.2. Analytes with a "Yes" in any of the "Exceedance" columns in Table 7.2 are evaluated further.

NOAEL ESLs were not available for several ECOI/receptor pairs (Tables 7.1 and 7.2). These ECOI/receptor pairs are discussed as ECOIs with uncertain toxicity (UT) in Section 10.0 along with the potential impacts to the risk assessment.

PMJM Receptors

No screening for PMJM receptors was conducted in the SEEU because the SEEU PMJM habitat is addressed as part of the SWEU and LWOEU PMJM evaluations.

7.2.2 Surface Soil Frequency of Detection Evaluation

The ECOPC identification process for non-PMJM receptors involves an evaluation of detection frequency for each ECOI retained after the NOAEL screening step. If the detection frequency is less than 5 percent, then population-level risks are considered highly unlikely and the ECOI is not further evaluated. None of the chemicals detected in surface soil at the SEEU that were retained after the NOAEL ESL screening step had a detection frequency less than 5 percent. Therefore, no ECOIs were excluded based on the detection frequency evaluation for surface soil in the SEEU.

7.2.3 Surface Soil Background Comparisons

The ECOIs retained after the NOAEL ESL screening and the detection frequency evaluation were then compared to site-specific background concentrations where available. The background comparisons are presented in Table 7.3 and discussed in Attachment 3. The statistical methods used for the background comparison are summarized in the Appendix A, Volume 2, Section 3.2 of the RI/FS Report.

Non-PMJM Receptors

The results of the background comparisons for the non-PMJM receptors are presented in Table 7.3. The analytes listed as being retained as ECOIs in Table 7.3 are evaluated further using upper-bound EPCs in the following section.

PMJM Receptors

No screening for PMJM receptors was conducted in the SEEU because the SEEU PMJM habitat is addressed as part of the LWOEU and SWEU PMJM evaluations.

7.2.4 Exposure Point Concentration Comparisons to Threshold ESLs

The ECOIs retained after completion of all previous evaluations for non-PMJM receptors were then compared to threshold ESLs (tESLs) using upper-bound exposure point concentrations (EPCs) specific to small and large home-range receptors. The calculation of upper-bound EPCs is described in Appendix A, Volume 2 of the RI/FS.

Statistical concentrations for each ECOI retained for the tESL screen are presented in Table 7.4. The EPC for small home-range receptors is the 95 percent UCL of the 90th percentile (upper tolerance limit [UTL]), or the MDC in the event that the UTL is greater

than the MDC. The EPC for large home-range receptors is the UCL, or the MDC in the event that the UCL is greater than the MDC.

Small home-range receptors include terrestrial plants, terrestrial invertebrates, mourning dove, American kestrel, deer mouse, and black-tailed prairie dog. These receptors are evaluated by comparing the small home-range EPC (UTL) for each ECOI to the limiting (or lowest) small home-range receptor tESL (if available). In the event that tESLs are not available, the limiting NOAEL ESL is used in accordance with the CRA Methodology.

Large home-range receptors, such as coyote and mule deer, are evaluated by comparing the large home-range EPC (UCL) for each ECOI to the limiting large home-range receptor tESL (if available). In the event that tESLs are not available, the limiting NOAEL ESL is used in accordance with the CRA Methodology.

The EPC comparison to limiting tESLs for small and large home-range receptors is presented in Table 7.5. Analytes that exceed the limiting tESLs are further evaluated by comparing them to the receptor-specific tESLs (if available) to identify receptors of potential concern. Analytes exceeding the limiting tESLs for small home-range receptors are compared to receptor-specific tESLs in Table 7.6, and analytes exceeding limiting tESLs for large home-range receptors are compared to receptor-specific tESLs in Table 7.7.

Chemicals that exceed any tESLs (if available) are assessed in the professional judgment evaluation. Any analyte/receptor pairs that are retained through professional judgment are identified as ECOPCs and are carried forward in the risk characterization.

7.2.5 Surface Soil Professional Judgment Evaluation

Non-PMJM Receptors

Based on the weight-of-evidence, professional judgment described in Attachment 3, aluminum, boron, chromium, copper, lithium, manganese, molybdenum, nickel, vanadium, and zinc in surface soil at the SEEU were not considered ECOPCs for non-PMJM receptors and are not further evaluated quantitatively.

PMJM Receptors

No professional judgment evaluation was conducted for PMJM receptors in the SEEU.

7.2.6 Summary of Surface Soil Ecological Contaminants of Potential Concern

The ECOPC screening process for surface soil is summarized below for non-PMJM receptors and PMJM receptors.

Non-PMJM Receptors

Inorganic and radionuclide surface soil ECOIs for non-PMJM receptors in the SEEU were eliminated from further consideration as ECOPCs based on one of the following: 1) the MDC of the ECOI was less than the lowest ESL; 2) no ESLs were available (these ECOIs are discussed in Section 10.0); 3) the concentration of the ECOI in SEEU surface

soils was not statistically greater than background surface soils; 4) the upper-bound EPC did not exceed the limiting tESL; or 5) the weight-of-evidence, professional judgment evaluation indicated that the ECOI was not a site-related contaminant of potential concern. No chemicals were retained as surface soil ECOPCs for the SEEU.

A summary of the ECOPC screening process for non-PMJM receptors is presented in Table 7.8.

PMJM Receptors

No ECOPC identification for PMJM receptors was conducted in the SEEU because the SEEU PMJM habitat is addressed as part of the LWOEU and SWEU PMJM evaluations.

7.3 Identification of Subsurface Soil Ecological Contaminants of Potential Concern

Subsurface soil sampling locations for soil collected at a starting depth of 0.5 to 8 feet bgs in the SEEU are identified on Figure 1.7. A data summary for subsurface soil less than 8 feet deep is presented in Table 1.5.

7.3.1 Comparison to No Observed Adverse Effect Level Ecological Screening Levels

The CRA Methodology indicates subsurface soil is evaluated for those ECOIs that have greater concentrations in subsurface soil than in surface soil. As a conservative screening step, subsurface soil is evaluated for all EUs regardless of the presence/absence of a change in concentrations from surface soil and subsurface soil. The MDCs of ECOIs in subsurface soil were compared to NOAEL ESLs for burrowing receptors (Table 7.9). ECOIs with MDCs greater than the NOAEL ESL for the prairie dog are further evaluated in the ECOPC identification process.

NOAEL ESLs are not available for some analytes, and these are identified as “UT” in Table 7.9. These constituents are considered ECOIs with UT and are discussed in the uncertainty analysis (Section 10.0).

7.3.2 Subsurface Soil Detection Frequency Evaluation

No detection frequency evaluation was performed because only eight subsurface soil samples are available in the SEEU. Therefore, the detection frequency for the analytes that reach this step will always be above 5 percent.

7.3.3 Subsurface Soil Background Comparison

The ECOIs retained after the ESL screening and detection frequency evaluation were compared to site-specific background concentrations where available. The background comparison was conducted in the same manner as that for surface soil non-PMJM receptors using statistical comparisons.

Analyses were conducted to assess whether arsenic in SEEU subsurface soil is statistically greater than those in sitewide background surface soil at the 0.1 level of significance.

The results of the statistical comparisons of the SEEU data to background data indicate that site concentrations of arsenic in SEEU subsurface soil are statistically greater than background concentrations. The results are summarized in Table 7.10.

7.3.4 Upper-Bound Exposure Point Concentration Comparisons to Threshold ESLs

ECOIs retained after all previous evaluations for burrowing receptors are compared to tESLs using upper-bound EPCs specific to small home-range receptors. The calculation of upper-bound EPCs is discussed in the Appendix A, Volume 2 of the RI/FS.

Only arsenic was retained following the background analysis step. Statistical concentrations for arsenic are presented in Table 7.11. The EPC comparison to tESLs for burrowing receptors is presented in Table 7.12. The subsurface soil UTL for arsenic is lower than the tESL for the prairie dog receptor; therefore, it was not evaluated further.

7.3.5 Subsurface Soil Professional Judgment

The professional judgment step was not performed for subsurface soils because no ECOIs were retained in the previous screening step.

7.3.6 Summary of Subsurface Soil Ecological Contaminants of Potential Concern

All subsurface soil ECOIs for burrowing receptors in the SEEU were eliminated from further consideration as ECOPCs based on one of the following: 1) the MDC of the ECOI was less than NOAEL ESL for the burrowing receptor; 2) no ESLs were available (these ECOIs are discussed in Section 10.0); 3) the concentration of the ECOI in SEEU subsurface soils was not statistically greater than background subsurface soils; or 4) the upper-bound EPC was less than the tESL. The results of the subsurface soil ECOPC identification process for burrowing receptors are summarized in Table 7.13.

7.4 Summary of Ecological Contaminants of Potential Concern

ECOIs in surface and subsurface soil in the SEEU were evaluated in the ECOPC identification process for non-PMJM receptors and burrowing receptors. No chemicals were identified as ECOPCs for non-PMJM receptors (Table 7.8). No chemicals were identified as ECOPCs for burrowing receptors (Table 7.13).

8.0 ECOLOGICAL EXPOSURE ASSESSMENT

The ECOPC identification steps did not identify any ECOPCs for either surface or subsurface soil in the SEEU. Therefore, no exposure assessment was performed for the SEEU.

9.0 ECOLOGICAL TOXICITY ASSESSMENT

The ECOPC identification steps did not identify any ECOPCs for either surface or subsurface soil in the SEEU. Therefore, no toxicity assessment for the SEEU was performed.

10.0 ECOLOGICAL RISK CHARACTERIZATION

Risk characterization includes risk estimation and risk description. Details of these components are described in the CRA Methodology and Appendix A, Volume 2 of the RI/FS Report. Predicted risks should be viewed in terms of the potential for the assumptions used in the risk characterization to occur in nature, the uncertainties associated with the assumptions, and in the potential for effects on the population of receptors that could inhabit the SEEU.

Because this process did not identify any ECOPCs in either surface or subsurface soil, no risk characterization was performed for the SEEU.

10.1 General Uncertainty Analysis

Quantitative evaluation of ecological risks is limited by uncertainties regarding the assumptions used to predict risk and the data available for quantifying risk. These limitations are usually addressed by making estimates based on the data available or by making assumptions based on professional judgment when data are limited. Because of these assumptions and estimates, the results of the risk calculations themselves are uncertain, and it is important for risk managers and the public to view the results of the risk assessment with this in mind. The following general uncertainties associated with the ERAs for all of the EUs may under- or overestimate risk to an unknown degree. A full discussion of these general uncertainties is provided in Volume 2 of Appendix A of the RI/FS Report:

- Uncertainties associated with data quality and adequacy;
- Uncertainties associated with the ECOPC identification process;
- Uncertainties associated with the selection of representative receptors;
- Uncertainties associated with exposure calculations;
- Uncertainties associated with the development of NOAEL ESLs;

- Uncertainties associated with the lack of toxicity data for ECOIs; and,
- Uncertainties associated with eliminating ECOIs based on professional judgment.

The following sections are potential sources of general uncertainty that are specific to the SEEU ERA.

10.1.1 Uncertainties Associated With Data Adequacy and Quality

Sections 1.2 and 1.3 summarize the general data adequacy and data quality for the SEEU, respectively. A more detailed discussion is presented in Appendix A, Volume 2, Attachments 2 and 3 of the RI/FS Report, and Attachment 2 of this volume. The data quality assessment indicates the data are of sufficient quality for use in the CRA. The adequacy of the SEEU data was assessed by comparing the number of samples for each analyte group in each medium as well as the spatial and temporal distributions of the data to data adequacy guidelines. The assessment indicates only one surface soil sample was collected for VOC, SVOC, and PCB analysis. Although a small portion of IHSS 000-501, Roadway Spray Areas, is located in the SEEU, in other EUs that contain this IHSS, VOCs, SVOCs, and PCBs were not detected at detections limits near or below the ESLs. The SEEU is also hydraulically isolated from potential historical source areas in and near the IA. Therefore, VOCs, SVOCs, and PCBs are not likely to be present in surface soil, and it is possible to make risk management decisions without additional sampling. Also, although there are no dioxin data for surface soil, based on process knowledge, it is unlikely that dioxins have been released in SEEU surface soil. Therefore, dioxins are not a concern for ecological receptors. Data used in the CRA must have detection limits to allow meaningful comparison to ESLs. When these detection limits exceed the respective ESLs, this is a source of uncertainty in the risk assessment. Attachment 1 to this volume provides a detection limit adequacy screen where detection limits for non-detected analytes as well as analytes detected in less than 5 percent of the samples are compared to ESLs. For surface soil, there are several analytes whose detection limits exceed the ESLs, and in some cases, the detection limits significantly exceed the ESLs. However, with the exception of benzo(a)pyrene, this contributes only minimal uncertainty to the overall risk estimates because either only a small fraction of the detection limits are greater than the lowest ESL, or process knowledge indicates they are not likely to be chemicals of concern for SEEU surface soil. Although there is a potential for benzo(a)pyrene to be a chemical of concern for SEEU surface soil based on process knowledge, it does not present a potential for adverse ecological effects even if it was detected at its maximum detection limit.

10.1.2 Uncertainties Associated with the Lack of Toxicity Data for Ecological Contaminants of Interest Detected at the Southeast Buffer Zone Area Exposure Unit

Several ECOIs detected in the SEEU do not have adequate toxicity data for the derivation of ESLs (CRA Methodology [DOE 2005a]). These ECOIs are listed in Tables 7.1 and 7.9 with a “UT” designation. Included as a subset of the ECOIs with a “UT” designation are the essential nutrients (calcium, iron, magnesium, potassium, and sodium). Although

these nutrients may be potentially toxic to certain ecological receptors at high concentrations, the uncertainty associated with the toxicity of these nutrients is expected to be low. Appendix B of the CRA Methodology outlines a detailed search process that was intended to provide high-quality toxicological information for a large portion of the chemicals detected at RFETS. Although the toxicity is uncertain for those ECOIs that do not have ESLs calculated due to a lack of identified toxicity data, the overall effect on the risk assessment is small because the primary chemicals historically used at RFETS have adequate toxicity data for use in the CRA. Therefore, while the potential for risk from these ECOPCs is uncertain and will tend to underestimate the overall risk calculated, the magnitude of underestimation is likely to be low.

10.1.3 Uncertainties Associated With Eliminating Ecological Contaminants of Interest Based on Professional Judgment

Several analytes in surface soil and subsurface soil were eliminated as ECOIs based on professional judgment. The professional judgment evaluation is intended to identify those ECOIs that have a limited potential for contamination in the SEEU. The weight-of-evidence approach indicates that the ECOI concentrations likely represent variations in the naturally occurring elements because there is no identified contaminant source or pattern of release in the SEEU, and the SEEU is hydraulically isolated from historical IHSSs in the former Industrial Area. Furthermore, the ECOI concentrations in the SEEU are unlikely to result in risk concerns for ecological receptors. Therefore, the professional judgment evaluation is unlikely to have a significant effect on the overall risk calculations.

10.1.4 Summary of Significant Sources of Uncertainty

The preceding discussion outlined the significant sources of uncertainty in the CRA process for assessing ecological risk. While some of the sources of uncertainty discussed tend to either underestimate risk or overestimate risk, many result in an unknown effect on the potential risks. However, the CRA Methodology outlines a tiered process of risk evaluation that includes conservative assumptions for the ECOPC identification process and more realistic assumptions, as appropriate, for risk characterization.

11.0 SUMMARY AND CONCLUSIONS

A summary of the results of this CRA for human health and ecological receptors in the SEEU is presented below.

11.1 Data Adequacy

The adequacy of the SEEU data was assessed by comparing the number of samples for each analyte group in each medium as well as the spatial and temporal distributions of the data to data adequacy guidelines. The assessment indicates the organic data for surface soil does not meet the data adequacy guideline for number of samples. However, other lines of evidence (e.g., information on potential historical sources of contamination, migration pathways, and the concentration levels in the media) indicate organics are not

likely to be present in SEEU surface soil. Therefore, it is possible to render risk management decisions using the existing data. In addition, for analytes that are not detected or detected at a frequency less than 5 percent, in surface soil there are several analytes whose detection limits exceed the ESLs, and in some cases, the detection limits significantly exceed the ESLs. However, based on professional judgment and ecological risk potential, the higher detection limits associated with these analytes contributes only minimal uncertainty to the overall risk estimates.

11.2 Human Health

The COC screening analyses compared MDCs and UCLs of chemicals and radionuclides in SEEU media to PRGs for the WRW receptor. Inorganic and radionuclide analytes with UCLs greater than the PRGs were statistically compared to the background concentration data set. Inorganic and radionuclide analytes that were statistically greater than background at the 0.1 significance level, and organics with UCL concentrations greater than the PRG, were carried forward to professional judgment evaluation. Based on the COC selection process, no COCs were selected for surface soil/surface sediment and subsurface soil/subsurface sediment in the SEEU, and a risk characterization was not performed for the SEEU.

11.3 Ecological Risk

The ECOPC identification process streamlines the ecological risk characterization by focusing the assessment on ECOIs that are present in the SEEU. The ECOPC identification process is described in the CRA methodology and additional details are provided in Appendix A, Volume 2 of the RI/FS Report. All ECOIs in surface soil for non-PMJM receptors were eliminated from further consideration as ECOPCs based on comparisons of MDCs to NOAEL ESLs, background comparisons, tESL comparisons, or professional judgment. Based on the weight-of-evidence, professional judgment described in Attachment 3, aluminum, boron, chromium, copper, lithium, manganese, molybdenum, nickel, vanadium, and zinc in surface soil at the SEEU were not considered ECOPCs for non-PMJM receptors and were not further evaluated quantitatively. Although there are no dioxin data for surface soil, the evaluation of site-wide data indicate dioxins are not expected to be present in SEEU surface soil. Therefore, dioxins are not a concern for ecological receptors. Following a similar ECOPC identification process for burrowing receptors, no ECOIs in subsurface soil were evaluated in professional judgment (all ECOIs were eliminated in preceding steps) and therefore, no ECOPCs were identified for burrowing receptors. No PMJM receptors were evaluated in the SEEU. The small areas of PMJM habitat were evaluated as part of the SWEU and the LWOEU.

Because this process did not identify any ECOPCs in the SEEU, no risk characterization was performed and site-related risks are likely to be minimal for the ecological receptors evaluated in the SEEU. In addition, data collected on wildlife abundance and diversity indicate that wildlife species richness remains high at RFETS. Because there are no

significant risks to ecological receptors or high levels of uncertainty with the data, there are no ecological contaminants of concern (ECOCs) for the SEEU.

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USFWS, 2005. Rocky Flats National Wildlife Refuge, Final Comprehensive Conservation Plan. U.S. Fish and Wildlife Service. April.

TABLES

Table 1.1
SEEU IHSSs

IHSS	OU	PAC	Title	Description	Disposition
--	BZ	000-501	Roadway Spraying	Roadways in the BZ OU were sprayed with waste oils for dust suppression; reverse osmosis brine solutions and footing drain water were also applied.[a]	NFA - 2005 HRR

[a] PAC 000-501 was one of 79 IHSS/PACs proposed for NFA by the NFA Working Group in 1991. The NFA was approved in 2002. (EPA et al. 2002).

Note: The FY2005 Final Historical Release Report (Appendix B to the RI/FS Report) provides the chemicals of potential concern for these IHSSs based on previous investigations.

Table 1.2
Number of Samples in Each Medium by Analyte Suite

Analyte Suite	Surface Soil/Surface Sediment[a]	Subsurface Soil/Subsurface Sediment[a]	Surface Soil[b]	Subsurface Soil[b]
Inorganic	22	7	19	6
Organic	1	7	1	7
Radionuclide	55	9	52	8

[a] Used in the HHRA.

[b] Used in the ERA.

Note: The total number of results (samples) in Tables 1.3 through 1.6 may differ from the total number of samples presented in Table 1.2 because not all analyses are necessarily performed for each sample.

Table 1.3
Summary of Detected Analytes in Surface Soil/Surface Sediment

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Inorganics (mg/kg)							
Aluminum		22	100	5,860	26,000	15,613	5,417
Antimony[c]	0.31 - 13.5	21	33.3	0.350	0.590	1.27	2.23
Arsenic		22	100	2.50	23	7.40	4.15
Barium		22	100	57	240	142	46.2
Beryllium	0.81 - 1	22	86.4	0.520	1.50	0.874	0.314
Boron		17	100	3.70	19	6.93	3.52
Cadmium	0.073 - 1	22	72.7	0.120	1	0.368	0.206
Calcium		22	100	1,760	55,000	9,195	11,667
Cesium[c]	6.8 - 7.8	3	33.3	14.5	14.5	7.27	6.27
Chromium		22	100	7.30	27	17.1	5.66
Cobalt		22	100	2.80	10.4	7.69	1.88
Copper		22	100	7.80	27	15.7	4.71
Iron		22	100	7,970	52,000	22,058	11,195
Lead		22	100	4.80	37	23.1	7.01
Lithium	6.7 - 6.7	19	94.7	5.20	23	13.6	5.62
Magnesium		22	100	1,360	7,100	3,236	1,316
Manganese		22	100	55	1,300	386	237
Mercury	0.0076 - 0.1	19	36.8	0.0140	0.0290	0.0155	0.0117
Molybdenum	0.86 - 4.7	21	81.0	0.260	1.90	1.08	0.591
Nickel		22	100	9.30	35	16.2	5.84
Potassium		22	100	1,200	5,200	3,066	873
Selenium	0.21 - 1.2	22	13.6	0.270	1.70	0.448	0.307
Silica		17	100	580	2,900	1,007	555
Silver	0.099 - 1.5	21	33.3	0.120	0.390	0.250	0.219
Sodium	56.5 - 130	22	22.7	54.8	510	79.0	98.2
Strontium		21	100	12.1	290	56.3	56.9
Thallium	0.21 - 1.1	22	9.09	2.30	2.60	0.575	0.632
Titanium		17	100	64	260	144	53.1
Uranium	1.3 - 1.7	17	23.5	1.60	2.80	1.09	0.640
Vanadium		22	100	22	140	50.0	25.7
Zinc		22	100	18	81	54.3	15.7
Radionuclides (pCi/g)[d]							
Americium-241		46	N/A	-0.00600	0.381	0.0466	0.0624
Cesium-137		1	N/A	0.661	0.661	0.661	N/A
Gross Beta		6	N/A	18	41	26.8	7.79
Plutonium-239/240		54	N/A	0.00205	4.60	0.251	0.628
Radium-226		1	N/A	2.02	2.02	2.02	N/A
Radium-228		1	N/A	1.59	1.59	1.59	N/A
Uranium-233/234		37	N/A	0.119	1.52	0.762	0.445
Uranium-235		37	N/A	-0.0564	0.344	0.0511	0.0725
Uranium-238		37	N/A	0.162	1.81	0.820	0.433
Cesium-134		1	N/A	-0.265	-0.265	-0.265	N/A
Gross Alpha		6	N/A	8.47	43	17.0	13.3
Strontium-89/90		3	N/A	0.110	0.171	0.140	0.0304

[a] Values in this column are reported results for nondetects (i.e., U-qualified results).

[b] For inorganics and organics, statistics are computed using one-half the reported value for nondetects.

[c] All detections are "J" qualified, signifying that the reported result is below the detection limit, but above the instrument detection limit.

[d] All radionuclide values are considered detects.

N/A = Not applicable.

Note: Organics were not detected.

Table 1.4
Summary of Detected Analytes in Subsurface Soil/Subsurface Sediment

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Inorganics (mg/kg)							
Aluminum		7	100	463	25,000	10,278	8,548
Arsenic		7	100	2.70	19.1	7.87	5.27
Barium		7	100	19	190	108	77.7
Beryllium	0.23 - 0.32	7	71.4	0.330	1.20	0.546	0.434
Boron		1	100	11	11	11	N/A
Cadmium	0.54 - 0.75	6	33.3	0.450	0.850	0.440	0.209
Calcium		7	100	1,350	20,000	11,787	6,877
Cesium[c]	81.6 - 114	6	33.3	1.80	2.70	33.8	25.1
Chromium		7	100	1.70	26	11.4	9.06
Cobalt		7	100	0.890	10.8	5.78	3.82
Copper	1.6 - 1.6	7	85.7	2.80	22	11.1	8.81
Iron		7	100	4,020	34,600	14,266	11,224
Lead		7	100	4.10	22	10.2	6.69
Lithium	0.39 - 0.39	7	85.7	2.10	21	9.33	8.06
Magnesium		7	100	135	8,920	3,439	3,124
Manganese		7	100	28.1	699	226	225
Mercury	0.06 - 0.11	7	14.3	0.0230	0.0230	0.0384	0.0116
Molybdenum	1.1 - 1.9	7	42.9	0.550	10.6	2.17	3.72
Nickel	2.7 - 2.7	7	85.7	3.60	29.2	14.0	9.96
Potassium	108 - 108	7	85.7	346	3,900	1,517	1,348
Selenium	0.44 - 0.88	7	57.1	0.430	2.40	0.911	0.901
Silica		1	100	1,900	1,900	1,900	N/A
Silicon[c]		2	100	85.1	147	116	43.8
Sodium	120 - 120	7	85.7	70.8	2,700	585	973
Strontium		7	100	18.7	172	74.8	61.0
Thallium	0.22 - 0.39	7	14.3	1.20	1.20	0.294	0.401
Titanium		1	100	260	260	260	N/A
Vanadium	2.4 - 2.4	7	85.7	5.90	60	30.8	23.0
Zinc		7	100	9	76.2	37.6	30.4
Organics (ug/kg)							
1,1,1-Trichloroethane	6 - 6	5	20	44	44	11.2	18.3
bis(2-Ethylhexyl)phthalate	360 - 360	3	66.7	49	75	101	69.4
Styrene	6 - 6	5	20	2	2	2.80	0.447
Toluene	6 - 6	5	40	9	19	7.40	6.99
Xylene	6 - 6	5	20	3	3	3	0
Radionuclides (pCi/g)[d]							
Americium-241		5	N/A	0.00129	0.0504	0.0154	0.0201
Cesium-134		4	N/A	-0.0766	-0.00366	-0.0334	0.0351
Cesium-137		4	N/A	0.00242	0.160	0.0699	0.0766

Table 1.4
Summary of Detected Analytes in Subsurface Soil/Subsurface Sediment

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Gross Alpha		8	N/A	7	20.4	12.9	4.20
Gross Beta		8	N/A	13.6	30.4	21.7	5.42
Plutonium-238		1	N/A	0	0	0	N/A
Plutonium-239/240		8	N/A	0	0.0277	0.0125	0.0107
Radium-226		4	N/A	-0.367	1.78	0.585	1.09
Radium-228		4	N/A	0.191	2.01	0.999	0.897
Strontium-89/90		6	N/A	0.0155	0.240	0.0796	0.0844
Uranium-233/234		7	N/A	1.10	1.78	1.43	0.267
Uranium-235		7	N/A	0.0191	0.0763	0.0439	0.0224
Uranium-238		7	N/A	1.31	1.83	1.46	0.179

[a] Values in this column are reported results for nondetects (i.e., U-qualified results).

[b] For inorganics and organics, statistics are computed using one-half the reported value for nondetects.

[c] All detections are "J" qualified, signifying that the reported result is below the detection limit, but above the instrument detection limit.

[d] All radionuclide values are considered detects.

N/A = Not applicable.

Table 1.5
Summary of Detected Analytes in Surface Soil (Non-PMJM)

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Inorganics (mg/kg)							
Aluminum		19	100	5,860	25,000	15,362	4,928
Antimony[c]	0.31 - 13.5	18	38.9	0.350	0.590	1.41	2.39
Arsenic		19	100	2.50	23	7.43	4.41
Barium		19	100	57	210	141	41.4
Beryllium	0.81 - 1	19	84.2	0.530	1.50	0.853	0.303
Boron		14	100	3.70	8.70	5.95	1.47
Cadmium	0.073 - 1	19	68.4	0.120	1	0.356	0.207
Calcium		19	100	1,760	23,000	6,731	5,808
Cesium[c]	6.8 - 7.8	3	33.3	14.5	14.5	7.27	6.27
Chromium		19	100	7.30	27	17.0	5.43
Cobalt		19	100	2.80	10.4	7.78	1.94
Copper		19	100	7.80	25	15.2	3.83
Iron		19	100	7,970	52,000	21,856	11,561
Lead		19	100	4.80	37	23.9	6.63
Lithium	6.7 - 6.7	16	93.8	5.20	23	13.3	5.29
Magnesium		19	100	1,360	5,000	3,084	1,009
Manganese		19	100	55	1,300	392	247
Mercury[c]	0.0076 - 0.1	16	25	0.0140	0.0210	0.0139	0.0119
Molybdenum	0.86 - 4.7	18	77.8	0.610	1.90	1.14	0.605
Nickel		19	100	9.30	35	16.3	6.03
Potassium		19	100	1,430	4,000	3,066	663
Selenium[c]	0.21 - 1.2	19	10.5	0.270	0.320	0.381	0.135
Silica[c]		14	100	580	990	817	126
Silver	0.18 - 1.5	18	38.9	0.120	0.390	0.281	0.222
Sodium	56.5 - 120	19	21.1	54.8	137	58.4	21.1
Strontium		18	100	12.1	90	43.8	20.0
Titanium[c]		14	100	83	210	137	39.5
Uranium	1.4 - 1.7	14	14.3	1.60	1.80	0.907	0.340
Vanadium		19	100	22.5	140	50.5	26.7
Zinc		19	100	18	71	53.6	15.1
Radionuclides (pCi/g)[d]							
Americium-241		43	N/A	-0.00600	0.381	0.0465	0.0644
Cesium-137		1	N/A	0.661	0.661	0.661	N/A
Gross Beta		6	N/A	18	41	26.8	7.79

Table 1.5
Summary of Detected Analytes in Surface Soil (Non-PMJM)

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Cesium-134		1	N/A	-0.265	-0.265	-0.265	N/A
Gross Alpha		6	N/A	8.47	43	17.0	13.3
Plutonium-239/240		51	N/A	0.00520	4.60	0.259	0.645
Radium-226		1	N/A	2.02	2.02	2.02	N/A
Radium-228		1	N/A	1.59	1.59	1.59	N/A
Strontium-89/90		3	N/A	0.110	0.171	0.140	0.0304
Uranium-233/234		34	N/A	0.119	1.47	0.714	0.425
Uranium-235		34	N/A	-0.0564	0.344	0.0464	0.0734
Uranium-238		34	N/A	0.162	1.50	0.784	0.415

[a] Values in this column are reported results for nondetects (i.e., U-qualified results).

[b] For inorganics and organics, statistics are computed using one-half the reported value for nondetects.

[c] All detections are "J" qualified, signifying that the reported result is below the detection limit, but above the instrument detection limit.

[d] All radionuclide values are considered detects.

N/A = Not applicable.

Note: Organics were not detected.

Table 1.6
Summary of Detected Analytes in Subsurface Soil

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Inorganics (mg/kg)							
Aluminum		6	100	463	15,300	7,824	6,091
Arsenic		6	100	2.70	19.1	8.10	5.74
Barium		6	100	19	185	94.1	75.3
Beryllium	0.23 - 0.32	6	66.7	0.330	1.10	0.438	0.356
Cadmium[c]	0.54 - 0.75	5	20	0.850	0.850	0.438	0.234
Calcium		6	100	1,350	20,000	10,918	7,101
Cesium[c]	81.6 - 114	6	33.3	1.80	2.70	33.8	25.1
Chromium		6	100	1.70	17.5	8.95	6.97
Cobalt		6	100	0.890	10.8	5.35	3.99
Copper	1.6 - 1.6	6	83.3	2.80	21.2	9.30	8.09
Iron		6	100	4,020	34,600	12,810	11,548
Lead		6	100	4.10	15.7	8.18	4.58
Lithium	0.39 - 0.39	6	83.3	2.10	16.1	7.38	6.80
Magnesium		6	100	135	8,920	3,162	3,326
Manganese		6	100	28.1	699	222	247
Molybdenum	1.1 - 1.9	6	33.3	0.930	10.6	2.44	4.00
Nickel	2.7 - 2.7	6	83.3	3.60	29.2	12.8	10.4
Potassium	108 - 108	6	83.3	346	2,610	1,120	925
Selenium	0.44 - 0.44	6	66.7	0.430	2.40	0.990	0.960
Silicon[c]		2	100	85.1	147	116	43.8
Sodium		6	100	70.8	2,700	672	1,035
Strontium		6	100	18.7	172	72.8	66.5
Vanadium	2.4 - 2.4	6	83.3	5.90	58.1	26.0	20.9
Zinc		6	100	9	76.2	31.5	28.2
Organics (ug/kg)							
1,1,1-Trichloroethane	6 - 6	5	20	44	44	11.2	18.3
bis(2-Ethylhexyl)phthalate	360 - 360	3	66.7	49	75	101	69.4
Styrene	6 - 6	5	20	2	2	2.80	0.447
Toluene	6 - 6	5	40	9	19	7.40	6.99
Xylene	6 - 6	5	20	3	3	3	0
Radionuclides (pCi/g)[d]							
Americium-241		4	N/A	0.00129	0.0136	0.00666	0.00514
Cesium-134		4	N/A	-0.0766	-0.00366	-0.0334	0.0351
Cesium-137		4	N/A	0.00242	0.160	0.0699	0.0766
Gross Alpha		8	N/A	7	20.4	12.9	4.20
Gross Beta		8	N/A	13.6	30.4	21.7	5.42
Plutonium-238		1	N/A	0	0	0	N/A
Plutonium-239/240		7	N/A	0	0.0277	0.0117	0.0113
Radium-226		4	N/A	-0.367	1.78	0.585	1.09
Radium-228		4	N/A	0.191	2.01	0.999	0.897
Strontium-89/90		6	N/A	0.0155	0.240	0.0796	0.0844
Uranium-233/234		6	N/A	1.23	1.78	1.49	0.245
Uranium-235		6	N/A	0.0191	0.0763	0.0454	0.0241
Uranium-238		6	N/A	1.33	1.83	1.49	0.181

[a] Values in this column are reported results for nondetects (i.e., U-qualified results).

[b] For blank entries, the detection frequency is 100% (i.e., there are no nondetect reported results).

[c] For inorganics and organics, statistics are computed using one-half the reported value for nondetects.

[d] All detections are "J" qualified, signifying that the reported result is below the detection limit, but above the instrument detection limit.

[e] All radionuclide values are considered detects.

N/A = Not applicable.

Table 2.1
Essential Nutrient Screen for Surface Soil/Surface Sediment

Analyte	MDC (mg/kg)	Estimated Maximum Daily Intake[a] (mg/day)	RDA/RDI/AI[b] (mg/day)	UL[b] (mg/day)	Retain for PRG Screen?
Calcium	55,000	5.50	500-1,200	2,500	No
Magnesium	7,100	0.710	80-420	65-110	No
Potassium	5,200	0.520	2,000-3,500	N/A	No
Sodium	510	0.0510	500-2,400	N/A	No

[a] Based on the MDC and a 100 mg/day soil ingestion rate for a WRW.

[b] RDA/RDI/AI/UL taken from NAS 2000 and 2002.

N/A = Not available.

Table 2.2
PRG Screen for Surface Soil/Surface Sediment

Analyte	PRG[a]	MDC	MDC Exceeds PRG?	UCL[b]	UCL Exceeds PRG?	Retain for Detection Frequency Screen?
Inorganics (mg/kg)						
Aluminum	24,774	26,000	Yes	17,600	No	No
Antimony	44.4	0.590	No	--	--	No
Arsenic	**2.41**	**23**	**Yes**	**8.90**	**Yes**	**Yes**
Barium	2,872	240	No	--	--	No
Beryllium	100	1.50	No	--	--	No
Boron	9,477	19	No	--	--	No
Cadmium	91.4	1	No	--	--	No
Calcium	N/A	55,000	No	--	--	UT
Cesium	N/A	14.5	No	--	--	UT
Chromium[c]	28.4	27	No	--	--	No
Cobalt	122	10.4	No	--	--	No
Copper	4,443	27	No	--	--	No
Iron	33,326	52,000	Yes	26,477	No	No
Lead	1,000	37	No	--	--	No
Lithium	2,222	23	No	--	--	No
Magnesium	N/A	7,100	No	--	--	UT
Manganese	**419**	**1,300**	**Yes**	**607**	**Yes**	**Yes**
Mercury	32.9	0.0290	No	--	--	No
Molybdenum	555	1.90	No	--	--	No
Nickel	2,222	35	No	--	--	No
Potassium	N/A	5,200	No	--	--	UT
Selenium	555	1.70	No	--	--	No
Silica	N/A	2,900	No	--	--	UT
Silver	555	0.390	No	--	--	No
Sodium	N/A	510	No	--	--	UT
Strontium	66,652	290	No	--	--	No
Thallium	7.78	2.60	No	--	--	No
Titanium	169,568	260	No	--	--	No
Uranium	333	2.80	No	--	--	No
Vanadium	111	140	No	59.5	No	No
Zinc	33,326	81	No	--	--	No
Radionuclides (pCi/g)						
Americium-241	7.69	0.381	No	--	--	No
Cesium-134	0.0800	-0.265	No	--	--	No
Cesium-137	**0.221**	**0.661**	**Yes**	**N/A**	**Yes**	**Yes**
Gross alpha	N/A	43	No	--	--	UT
Gross beta	N/A	41	No	--	--	UT

Table 2.2
PRG Screen for Surface Soil/Surface Sediment

Analyte	PRG[a]	MDC	MDC Exceeds PRG?	UCL[b]	UCL Exceeds PRG?	Retain for Detection Frequency Screen?
Plutonium-239/240	9.80	4.60	No	--	--	No
Radium-226	2.69	2.02	No	--	--	No
Radium-228	**0.111**	**1.59**	**Yes**	**N/A**	**Yes**	**Yes**
Strontium-89/90	13.2	0.171	No	--	--	No
Uranium-233/234	25.3	1.52	No	--	--	No
Uranium-235	1.05	0.344	No	--	--	No
Uranium-238	29.3	1.81	No	--	--	No

[a] The value shown is equal to the most stringent of the PRGs based on a risk of 1E-06 or an HQ of 0.1.

[b] UCL = 95% upper confidence limit on the mean, unless the MDC < UCL, then the MDC is used as the UCL.

[c] The PRG for chromium (VI) is used in the PRG screen because it is more conservative than the PRG for chromium (III).

N/A = Not available.

UT = Uncertain toxicity; no PRG available (assessed in Section 6.0)

-- = Screen not performed because analyte was eliminated from further consideration in a previous COC selection step.

Bold = Analyte retained for further consideration in the next COC selection step.

Table 2.3

Statistical Distributions and Comparison to Background for the SEEU Subsurface Soil/Subsurface Sediment[a]

Analyte	Statistical Distribution Testing Results						Background Comparison		
	Background			SEEU			Test	1 - p	Retain as PCOC?
	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)			
Surface Soil/Surface Sediment									
Arsenic	**73**	**GAMMA**	**91.8**	**22**	**GAMMA**	**100**	**WRS**	**1.28E-06**	**Yes**
Manganese	**73**	**GAMMA**	**100**	**22**	**NON-PARAMETRIC**	**100**	**WRS**	**5.28E-05**	**Yes**
Cesium-137	**105**	**NON-PARAMETRIC**	**100**	**1**	**N/A**	**N/A**	**WRS**	**N/A**	**Yes**
Radium-228	**40**	**GAMMA**	**100**	**1**	**N/A**	**N/A**	**WRS**	**N/A**	**Yes**
Subsurface Soil/Subsurface Sediment									
Radium-228	31	GAMMA	100	4	NORMAL	N/A	WRS	0.767	No

[a] EU data used for background comparisons do not include data from background locations.

WRS = Wilcoxon Rank Sum.

N/A = Not available or not applicable.

Bold = PCOCs retained for further consideration in the next COC selection step.

Table 2.4
Essential Nutrient Screen for Subsurface Soil/Subsurface Sediment

Analyte	MDC (mg/kg)	Estimated Maximum Daily Intake[a] (mg/day)	RDA/RDI/AI[b] (mg/day)	UL[b] (mg/day)	Retain for PRG Screen?
Calcium	20,000	2	500-1,200	2,500	No
Magnesium	8,920	0.892	80-420	65-110	No
Potassium	3,900	0.390	2,000-3,500	N/A	No
Sodium	2,700	0.270	500-2,400	N/A	No

[a] Based on the MDC and a 100 mg/day soil ingestion rate for a WRW.

[b] RDA/RDI/AI/UL taken from NAS 2000 and 2002.

N/A = Not available.

Table 2.5
PRG Screen for Subsurface Soil/Subsurface Sediment

Analyte	PRG[a]	MDC	MDC Greater Than PRG?	UCL[b]	UCL Greater Than PRG?	Retain for Detection Frequency Screen?
Inorganics (mg/kg)						
Aluminum	284,902	25,000	No	--	--	No
Arsenic	27.7	19.1	No	--	--	No
Barium	33,033	190	No	--	--	No
Beryllium	1,151	1.20	No	--	--	No
Boron	108,980	11	No	--	--	No
Cadmium	1,051	0.850	No	--	--	No
Calcium	N/A	20,000	UT	--	--	UT
Cesium	N/A	2.70	UT	--	--	UT
Chromium[c]	327	26	No	--	--	No
Cobalt	1,401	10.8	No	--	--	No
Copper	51,100	22	No	--	--	No
Iron	383,250	34,600	No	--	--	No
Lead	1,000	22	No	--	--	No
Lithium	25,550	21	No	--	--	No
Magnesium	N/A	8,920	UT	--	--	UT
Manganese	4,815	699	No	--	--	No
Mercury	379	0.0230	No	--	--	No
Molybdenum	6,388	10.6	No	--	--	No
Nickel	25,550	29.2	No	--	--	No
Potassium	N/A	3,900	UT	--	--	UT
Selenium	6,388	2.40	No	--	--	No
Silica	N/A	1,900	UT	--	--	UT
Silicon	N/A	147	UT	--	--	UT
Sodium	N/A	2,700	UT	--	--	UT
Strontium	766,500	172	No	--	--	No
Thallium	89.4	1.20	No	--	--	No
Titanium	1.95E+06	260	No	--	--	No
Vanadium	1,278	60	No	--	--	No
Zinc	383,250	76.2	No	--	--	No
Organics (ug/kg)						
1,1,1-Trichloroethane	1.06E+08	44	No	--	--	No
bis(2-Ethylhexyl)phthalate	2.46E+06	75	No	--	--	No
Styrene	1.59E+08	2	No	--	--	No
Toluene	3.56E+07	19	No	--	--	No
Xylene[d]	1.22E+07	3	No	--	--	No
Radionuclides (pCi/g)						
Americium-241	88.4	0.0504	No	--	--	No
Cesium-134	0.910	-0.00366	No	--	--	No
Cesium-137	2.54	0.160	No	--	--	No
Gross Alpha	N/A	20.4	UT	--	--	UT
Gross Beta	N/A	30.4	UT	--	--	UT
Plutonium-238	68.7	0	No	--	--	No
Plutonium-239/240	112	0.0277	No	--	--	No
Radium-226	31	1.78	No	--	--	No
Radium-228	**1.28**	**2.01**	**Yes**	**2.05**	**Yes**	**Yes**
Strontium-89/90	152	0.240	No	--	--	No
Uranium-233/234	291	1.78	No	--	--	No
Uranium-235	12.1	0.0763	No	--	--	No
Uranium-238	337	1.83	No	--	--	No

[a] The value shown is equal to the most stringent of the PRGs based on a risk of 1E-06 or an HQ of 0.1.

[b] UCL = 95% upper confidence limit on the mean, unless the MDC < UCL, then the MDC is used as the UCL.

[c] The PRG for chromium (VI) is used in the PRG screen because it is more conservative than the PRG for chromium (III).

[d] The PRG for total xylene is used.

N/A = Not available.

UT = Uncertain toxicity; no PRG available (assessed in Section 6.0).

-- = Screen not performed because analyte was eliminated from further consideration in a previous COC selection step.

Bold = Analyte retained for further consideration in the next COC selection step.

Table 2.6
Summary of the COC Selection Process

Analyte	MDC Exceeds PRG?	UCL Exceeds PRG?	Detection Frequency > 5%?[a]	Exceeds 30X the PRG?	Exceeds Background?	Professional Judgment - Retain?	Retain as COC?
Surface Soil/Surface Sediment							
Aluminum	Yes	No	--	--	--	--	--
Arsenic	Yes	Yes	Yes	N/A	Yes	No	No
Iron	Yes	No	--	--	--	--	--
Manganese	Yes	Yes	Yes	N/A	Yes	No	No
Vanadium	Yes	No	--	--	--	--	--
Cesium-137	Yes	Yes	N/A	N/A	N/A[b]	No	No
Radium-228	Yes	Yes	N/A	N/A	N/A[b]	No	No
Subsurface Soil/Subsurface Sediment							
Radium-228	Yes	Yes	N/A	N/A	No	--	No

[a] All radionuclide values are considered detects.

[b] The background analysis was not conducted, because only one sample was collected for this analyte at the SEEU.

N/A = Not applicable.

-- = Screen not performed because analyte was eliminated from further consideration in a previous COC selection step.

Table 6.1

Summary of Detected PCOCs Without PRGs[a]

Analyte	Surface Soil/Surface Sediment	Subsurface Soil/Subsurface Sediment
Inorganics		
Cesium	X[b]	X[b]
Silica	X	X
Silicon	N/A	X[b]
Radionuclides		
Gross Alpha	X	X
Gross Beta	X	X

[a] Does not include essential nutrients. Essential nutrients without PRGs were evaluated by comparing estimated intakes to recommended intakes.

[b] All detections are "J" qualified, signifying that the reported result is below the detection limit, but above the instrument detection limit.

N/A = Not applicable. Analyte not detected or not analyzed.

X = PRG is unavailable.

Table 7.1
Comparison of MDCs in Surface Soil to NOAEL ESLs for Terrestrial Plants, Invertebrates, and Vertebrates

Analyte	MDC	Terrestrial Plants		Terrestrial Invertebrates		Mourning Dove Herbivore		Mourning Dove Insectivore		American Kestrel		Deer Mouse Herbivore		Deer Mouse Insectivore		Prairie Dog		Mule Deer		Coyote Carnivore		Coyote Generalist		Coyote Insectivore		Terrestrial Receptor[a]		Most Sensitive Receptor	Retain for Further Analysis?
		NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	Results	
Inorganics (mg/kg)																													
Aluminum	25000	**50**	**Yes**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Plant	**Yes**
Antimony	0.590	5.00	No	78.0	No	N/A	N/A	N/A	N/A	N/A	N/A	9.89	No	0.905	No	18.7	No	57.6	No	138	No	13.2	No	3.85	No	N/A	N/A	Deer Mouse Insectivore	No
Arsenic	23.0	**10.0**	**Yes**	60.0	No	**20.0**	**Yes**	164	No	1,028	No	**2.57**	**Yes**	51.4	No	**9.35**	**Yes**	**13.0**	**Yes**	709	No	341	No	293	No	N/A	N/A	Deer Mouse Herbivore	**Yes**
Barium	210	500	No	330	No	**159**	**Yes**	357	No	1,317	No	930	No	4,427	No	3,224	No	4,766	No	24,896	No	19,838	No	18,369	No	N/A	N/A	Mourning Dove Herbivore	**Yes**
Beryllium	1.50	10.0	No	40.0	No	N/A	N/A	N/A	N/A	N/A	N/A	160	No	6.82	No	211	No	896	No	1,072	No	103	No	29.2	No	N/A	N/A	Deer Mouse Insectivore	No
Boron	8.70	**0.500**	**Yes**	N/A	N/A	30.3	No	115	No	167	No	62.1	No	422	No	237	No	314	No	929	No	6,070	No	1,816	No	N/A	N/A	Plant	**Yes**
Cadmium	1.00	32.0	No	140	No	28.1	No	**0.705**	**Yes**	15.0	No	59.9	No	1.56	No	198	No	723	No	1,360	No	51.2	No	9.75	No	N/A	N/A	Mourning Dove Insectivore	**Yes**
Calcium	23,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Cesium	14.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Chromium[b]	27.0	**1.00**	**Yes**	**0.400**	**Yes**	**24.6**	**Yes**	**1.34**	**Yes**	**14.0**	**Yes**	281	No	**15.9**	**Yes**	703	No	1,461	No	4,173	No	250	No	68.5	No	N/A	N/A	Invertebrate	**Yes**
Cobalt	10.4	13.0	No	N/A	N/A	278	No	87.0	No	440	No	1,476	No	363	No	2,461	No	7,902	No	3,785	No	2,492	No	1,519	No	N/A	N/A	Plant	No
Copper	25.0	100	No	50.0	No	28.9	No	**8.25**	**Yes**	164	No	295	No	605	No	838	No	4,119	No	5,459	No	3,000	No	4,641	No	N/A	N/A	Mourning Dove Insectivore	**Yes**
Iron	52,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Lead	37.0	110	No	1,700	No	49.9	No	**12.1**	**Yes**	95.8	No	1,344	No	242	No	1,850	No	9,798	No	8,927	No	3,066	No	1,393	No	N/A	N/A	Mourning Dove Insectivore	**Yes**
Lithium	23.0	**2.00**	**Yes**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1,882	No	610	No	3,178	No	10,173	No	18,431	No	5,608	No	2,560	No	N/A	N/A	Plant	**Yes**
Magnesium	5,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Manganese	1,300	**500**	**Yes**	N/A	N/A	**1,032**	**Yes**	2,631	No	9,917	No	**486**	**Yes**	4,080	No	1519	No	2,506	No	14,051	No	10,939	No	19,115	No	N/A	N/A	Deer Mouse Herbivore	**Yes**
Mercury	0.021	0.300	No	0.100	No	0.197	No	**1.00E-04**	**Yes**	1.57	No	0.439	No	0.179	No	3.15	No	7.56	No	8.18	No	8.49	No	37.3	No	N/A	N/A	Mourning Dove Insectivore	**Yes**
Molybdenum	1.90	2.00	No	N/A	N/A	44.4	No	6.97	No	76.7	No	8.68	No	**1.90**	**Yes**	27.1	No	44.3	No	275	No	28.9	No	8.18	No	N/A	N/A	Deer Mouse Insectivore	**Yes**
Nickel	35.0	**30.0**	**Yes**	200	No	44.1	No	**1.24**	**Yes**	**13.1**	**Yes**	**16.4**	**Yes**	**0.431**	**Yes**	38.3	No	124	No	90.9	No	**6.02**	**Yes**	**1.86**	**Yes**	N/A	N/A	Deer Mouse Insectivore	**Yes**
Potassium	4,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Selenium	0.320	1.00	No	70.0	No	1.61	No	1.00	No	8.48	No	0.872	No	0.754	No	2.80	No	3.82	No	32.5	No	12.2	No	5.39	No	N/A	N/A	Deer Mouse Insectivore	No
Silica	990	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Silver	0.390	2.00	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Plant	No
Sodium	137	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Strontium	90.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	940	No	13,578	No	3,519	No	4,702	No	584,444	No	144,904	No	57,298	No	N/A	N/A	Deer Mouse Herbivore	No
Titanium	210	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Uranium	1.80	5.00	No	N/A	N/A	685	No	446	No	2,792	No	970	No	569	No	1,226	No	5,472	No	7,299	No	3,106	No	2,272	No	N/A	N/A	Plant	No
Vanadium	140	**2.00**	**Yes**	N/A	N/A	503	No	274	No	1,514	No	**63.7**	**Yes**	**29.9**	**Yes**	**83.5**	**Yes**	358	No	341	No	164	No	**121**	**Yes**	N/A	N/A	Plant	**Yes**
Zinc	71.0	**50.0**	**Yes**	200	No	109	No	**0.646**	**Yes**	113	No	171	No	**5.29**	**Yes**	1,174	No	2,772	No	16,489	No	3,887	No	431	No	N/A	N/A	Mourning Dove Insectivore	**Yes**
Radionuclides (pCi/g)																													
Americium-241	0.381	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3,890	No	Terrestrial Receptors	No
Cesium-134	-0.265	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Cesium-137	0.661	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	20.8	No	Terrestrial Receptors	No
Gross Alpha	43.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Gross Beta	41.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Plutonium-239/240	4.60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6,110	No	Terrestrial Receptors	No
Radium-226	2.02	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	50.6	No	Terrestrial Receptors	No
Radium-228	1.59	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	43.9	No	Terrestrial Receptors	No
Strontium-89/90	0.171	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	22.5	No	Terrestrial Receptors	No
Uranium-233/234	1.47	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4,980	No	Terrestrial Receptors	No
Uranium-235	0.344	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2,770	No	Terrestrial Receptors	No
Uranium-238	1.50	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1,580	No	Terrestrial Receptors	No

[a] Radionuclide ESLs are not receptor-specific. They are considered protective of all terrestrial ecological species.
[b] ESLs for chromium were developed based on available toxicity data and are based on Chromium (III) (birds) and Chromium (VI) (plants, invertebrates, and mammals).
N/A = No ESL available for the ECOI/receptor pair.
UT = Uncertain toxicity; no ESL available (assessed in Section 10).
Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 7.2
Summary of Non-PMJM NOAEL ESL Screening Results for Surface Soil in the SEEU

Analyte	Terrestrial Plant Exceedance?	Terrestial Invertebrate Exceedance?	Terrestrial Vertebrate Exceedance?
Inorganics (mg/kg)			
Aluminum	**Yes**	UT	UT
Antimony	No	No	No
Arsenic	**Yes**	No	**Yes**
Barium	No	No	**Yes**
Beryllium	No	No	No
Boron	**Yes**	UT	No
Cadmium	No	No	**Yes**
Calcium	UT	UT	UT
Cesium	UT	UT	UT
Chromium	**Yes**	**Yes**	**Yes**
Cobalt	No	UT	No
Copper	No	No	**Yes**
Iron	UT	UT	UT
Lead	No	No	**Yes**
Lithium	**Yes**	UT	No
Magnesium	UT	UT	UT
Manganese	**Yes**	UT	**Yes**
Mercury	No	No	**Yes**
Molybdenum	No	UT	**Yes**
Nickel	**Yes**	No	**Yes**
Potassium	UT	UT	UT
Selenium	No	No	No
Silica	UT	UT	UT
Silver	No	UT	UT
Sodium	UT	UT	UT
Strontium	UT	UT	No
Titanium	UT	UT	UT
Uranium	No	UT	No
Vanadium	**Yes**	UT	**Yes**
Zinc	**Yes**	No	**Yes**
Radionuclides (pCi/g)			
Americium-241	UT	UT	No
Cesium-137	UT	UT	No
Gross Alpha	UT	UT	UT
Gross Beta	UT	UT	UT
Plutonium-239/240	UT	UT	No
Radium-226	UT	UT	No
Radium-228	UT	UT	No
Strontium-89/90	UT	UT	No
Uranium-233/234	UT	UT	No
Uranium-235	UT	UT	No
Uranium-238	UT	UT	No

UT = Uncertain toxicity; no ESL available (assessed in Section 10).
Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 7.3

Statistical Distributions and Comparison to Background for SEEU Surface Soil[a] (Non-PMJM)

Analyte	Statistical Distribution Testing Results						Background Comparison Test Results		
	Background			SEEU			Test	1 - p	Retain as ECOI?
	Total No. of Samples	Distribution Recommended by ProUCL	Detects (%)	Total No. of Samples	Distribution Recommended by ProUCL	Detects (%)			
Inorganics									
Aluminum	20	NORMAL	100	19	NORMAL	100	t-Test	2.09E-04	**Yes**
Arsenic	20	NORMAL	100	19	GAMMA	100	WRS	0.177	No
Barium	20	NORMAL	100	19	NORMAL	100	t-Test	3.17E-04	**Yes**
Boron	N/A	N/A	N/A	14	NORMAL	100	N/A	N/A	**Yes**[b]
Cadmium	20	NON-PARAMETRIC	65	19	GAMMA	68.4	WRS	0.997	No
Chromium	20	NORMAL	100	19	NORMAL	100	t-Test	8.45E-05	**Yes**
Copper	20	NON-PARAMETRIC	100	19	NORMAL	100	WRS	0.020	**Yes**
Lead	20	NORMAL	100	19	NORMAL	100	t-Test	0.999	No
Lithium	20	NORMAL	100	16	NORMAL	93.8	t-Test	4.11E-05	**Yes**
Manganese	20	NORMAL	100	19	NON-PARAMETRIC	100	WRS	2.10E-04	**Yes**
Mercury	20	NON-PARAMETRIC	40	16	GAMMA	25	WRS	1.000	No
Molybdenum	20	NORMAL	0	18	LOGNORMAL	77.8	N/A	N/A	**Yes**[b]
Nickel	20	NORMAL	100	19	GAMMA	100	WRS	2.91E-05	**Yes**
Vanadium	20	NORMAL	100	19	GAMMA	100	WRS	9.28E-05	**Yes**
Zinc	20	NORMAL	100	19	NON-PARAMETRIC	100	WRS	0.089	**Yes**

[a] EU data used for background comparisons do not include data from background locations.

[b] Statistical comparisons to background cannot be performed. The analyte is retained as an ECOI for further evaluation.

N/A = Not applicable. Background comparison was not performed because background data were not available or detection frequency of an analyte in EU or background data sets was less than 20 percent.

Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 7.4
Statistical Concentrations in Surface Soil

Analyte	Number of Samples	Mean	Median	75th Percentile	95th Percentile	95UCL	95UTL	Maximum[a]
Inorganics								
Aluminum	19	15,362	15,000	18,000	23,200	17,323	24,966	25,000
Barium	19	141	130	166	201	157	221	210
Boron	14	5.95	5.70	6.40	8.51	6.64	9.04	8.70
Chromium	19	17.0	16.0	20.5	26.1	19.1	27.5	27.0
Copper	19	15.2	15.9	17.5	19.6	16.7	22.7	25.0
Lithium	16	13.3	15.0	17.3	20.0	15.7	24.1	23.0
Manganese	19	392	340	399	670	639	1,300	1,300
Molybdenum	18	1.14	0.940	1.20	2.31	1.39	2.64	1.90
Nickel	19	16.3	16.0	19.0	23.3	18.7	35.0	35.0
Vanadium	19	50.5	43.2	62.5	84.2	61.1	140	140
Zinc	19	53.6	57.0	65.0	70.1	59.6	71.0	71.0

[a]Maximum = Maximum proxy result; may be MDC or reporting limit greater than MDC.

UCL = 95% upper confidence limit on the mean, unless the MDC < UCL, then the MDC is used as the UCL.

UTL = 95% upper confidence limit on the 90^{th} percentile value, unless the MDC < UTL, then the MDC is used as the UTL.

Table 7.5
Upper-Bound Exposure Point Concentration Comparison to Limiting ESLs in the SEEU Surface Soil

Analyte	Small Home Range Receptors			Large Home Range Receptors		
	EPC (95UTL)	Limiting ESL[a]	EPC>ESL?	EPC (95UCL)	Limiting ESL[b]	EPC>ESL?
Inorganics (mg/kg)						
Aluminum	24,966	50	**Yes**	17,323	N/A	N/A
Barium	210[c]	222	No	157	4,770	No
Boron	8.7[c]	0.5	**Yes**	6.64	314	No
Chromium	27[c]	0.4	**Yes**	19.1	68.5	No
Copper	22.7	8.25	**Yes**	16.7	3,000	No
Lithium	23.0	2	**Yes**	15.7	2,560	No
Manganese	1,300	486	**Yes**	639	2,510	No
Molybdenum	2.35[c]	1.90	**Yes**	1.39	8.18	No
Nickel	35.0	0.431	**Yes**	18.7	1.86	**Yes**
Vanadium	140	2	**Yes**	61.1	121	No
Zinc	71	0.646	**Yes**	59.6	431	No

[a]Threshold ESL, if available, for the plant, invertebrate, deer mouse, prairie dog, dove, or kestrel receptors.

[b]Threshold ESL, if available, for the coyote and mule deer receptors.

[c]The UTL was greater than the MDC so the MDC was used as the EPC.

If tESL was not available, then the NOAEL ESL was used.

N/A = Not applicable; ESL not available.

Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 7.6
Upper-Bound Exposure Point Concentration Comparison to Receptor-Specific ESLs for Small Home-Range Receptors in the SEEU Surface Soil

Analyte	Small Home Range Receptor 95th UTL	Receptor-Specific ESLs[a]							
		Terrestrial Plant	Terrestrial Invertebrate	American Kestrel	Mourning Dove (herbivore)	Mourning Dove (insectivore)	Deer Mouse (herbivore)	Deer Mouse (insectivore)	Prairie Dog
Inorganics (mg/kg)									
Aluminum	24,966	**50**	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Boron	8.70	**0.5**	N/A	167	30.3	115	62.1	422	237
Chromium	27.0	**1**	**0.4**	**14.2**	**24.6**	**1.34**	281	**15.9**	703
Copper	22.7	100	50.0	164	28.8	**8.25**	295	605	838
Lithium	23.0	**2**	N/A	N/A	N/A	N/A	1880	610	3180
Manganese	1,300	**500**	N/A	9920	**1030**	2630	**486**	4080	1519
Molybdenum	2.35	**2**	N/A	76.7	44.4	6.97	8.68	**1.90**	27.1
Nickel	35.0	**30**	200	89.9	320	**7.84**	**16.4**	**0.431**	38.3
Vanadium	140	**2**	N/A	1510	503	274	**63.7**	**29.9**	**83.5**
Zinc	71	**50**	200	113	109	**0.646**	171	**5.29**	1,174

[a]Threshold ESL, if available, for that receptor.

N/A = Not applicable; ESL not available.

Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 7.7

Upper-Bound Exposure Point Concentration Comparison to Receptor-Specific ESLs for Large Home-Range Receptors in the SEEU Surface Soil

Analyte	Large Home Range Receptor 95th UCL	Receptor-Specific ESLs[a]			
		Mule Deer	Coyote (carnivore)	Coyote (generalist)	Coyote (insectivore)
Inorganics (mg/kg)					
Nickel	18.7	124	90.9	**6.02**	**1.86**

[a]Threshold ESL, if available, for that receptor.

Bold = Receptors of potential concern.

Table 7.8
Summary of ECOPC Screening Steps for Surface Soil Non-PMJM Receptors

Analyte	Exceeds Any NOAEL ESL?	Detection Frequency >5%?	Exceeds Background?[a]	Upper-Bound EPC > Limiting ESL[b]	Professional Judgment - Retain?	ECOPC?	Receptor(s) of Potential Concern
Inorganics							
Aluminum	Yes	Yes	Yes	Yes	No	No	--
Antimony	No	--	--	--	--	No	--
Arsenic	Yes	Yes	No	--	--	No	--
Barium	Yes	Yes	Yes	No	--	No	--
Beryllium	No	--	--	--	--	No	--
Boron	Yes	Yes	N/A[c]	Yes	No	No	--
Cadmium	Yes	Yes	No	--	--	No	--
Calcium	UT	--	--	--	--	No	--
Cesium	UT	--	--	--	--	No	--
Chromium	Yes	Yes	Yes	Yes	No	No	--
Cobalt	No	--	--	--	--	No	--
Copper	Yes	Yes	Yes	Yes	No	No	--
Iron	UT	--	--	--	--	No	--
Lead	Yes	Yes	No	--	--	No	--
Lithium	Yes	Yes	Yes	Yes	No	No	--
Magnesium	UT	--	--	--	--	No	--
Manganese	Yes	Yes	Yes	Yes	No	No	--
Mercury	Yes	Yes	No	--	--	No	--
Molybdenum	Yes	Yes	N/A[d]	Yes	No	No	--
Nickel	Yes	Yes	Yes	Yes	No	No	--
Potassium	UT	--	--	--	--	No	--
Selenium	No	--	--	--	--	No	--
Silica	UT	--	--	--	--	No	--
Silver	No	--	--	--	--	No	--
Sodium	UT	--	--	--	--	No	--
Strontium	No	--	--	--	--	No	--
Titanium	UT	--	--	--	--	No	--
Uranium	No	--	--	--	--	No	--
Vanadium	Yes	Yes	Yes	Yes	No	No	--
Zinc	Yes	Yes	Yes	Yes	No	No	--
Radionuclides							
Americium-241	No	--	--	--	--	No	--
Cesium-137	No	--	--	--	--	No	--
Gross Alpha	UT	--	--	--	--	No	--
Gross Beta	UT	--	--	--	--	No	--
Plutonium-239/240	No	--	--	--	--	No	--
Radium-226	No	--	--	--	--	No	--
Radium-228	No	--	--	--	--	No	--
Strontium-89/90	No	--	--	--	--	No	--
Uranium-233/234	No	--	--	--	--	No	--
Uranium-235	No	--	--	--	--	No	--
Uranium-238	No	--	--	--	--	No	--

[a] Based on results of statistical analysis at the 0.1 level of significance.

[b] If tESL was not available, then the NOAEL ESL was used.

[c] Background boron data is not available so the analyte was retained as an ECOI for further evaluation.

[d] A statistical comparison to background could not be performed because all backgound data are nondetects. The analyte was retained as an ECOI for further evaluation.

-- = Screen not performed because analyte was eliminated from further consideration in a previous step.

UT = Uncertain toxicity; no ESL available (assessed in Section 10).

Table 7.9
Comparison of MDCs in SEEU Subsurface Soil to NOAEL
ESLs for Burrowing Receptors

Analyte	MDC	Prairie Dog NOAEL ESL	EPC> NOAEL ESL?
Inorganics (mg/kg)			
Aluminum	15,300	N/A	UT
Arsenic	19.1	9.35	**Yes**
Barium	185	3,224	No
Beryllium	1.10	211	No
Cadmium	0.850	198	No
Calcium	20,000	N/A	UT
Cesium	2.70	N/A	UT
Chromium	17.5	703	No
Cobalt	10.8	2,461	No
Copper	21.2	838	No
Iron	34,600	N/A	UT
Lead	15.7	1,850	No
Lithium	16.1	3,178	No
Magnesium	8,920	N/A	UT
Manganese	699	1519	No
Molybdenum	10.6	27.1	No
Nickel	29.2	38.3	No
Potassium	2,610	N/A	UT
Selenium	2.40	2.80	No
Silicon	147	N/A	UT
Sodium	2,700	N/A	UT
Strontium	172	3,519	No
Vanadium	58.1	83.5	No
Zinc	76.2	1,174	No
Organics (µg/kg)			
1,1,1-Trichloroethane	44.0	4.85E+07	No
bis(2-Ethylhexyl)phthalate	75.0	2.76E+06	No
Styrene	2.00	1.53E+06	No
Toluene	19.0	1.22E+06	No
Xylene	3.00	111,663	No
Radionuclides (pCi/g)			
Americium-241	0.014	3,890	No
Cesium-134	-0.004	N/A	UT
Cesium-137	0.160	20.8	No
Gross Alpha	20.4	N/A	UT
Gross Beta	30.4	N/A	UT
Plutonium-239/240	0.028	6,110	No
Radium-226	1.78	50.6	No
Radium-228	2.01	43.9	No
Strontium-89/90	0.240	22.5	No
Uranium-233/234	1.78	4,980	No
Uranium-235	0.076	2,770	No
Uranium-238	1.83	1,580	No

N/A = No ESL available.

UT = Uncertain toxicity; no ESL available (assessed in Section 10).

Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 7.10
Statistical Distributions and Comparison to Background for SEEU Subsurface Soil

Analyte	Statistical Distribution Testing Results						Background		
	Background			SEEU[a]			Test	1 - p	Retain as ECOI?
	Total No. of Samples	Distribution Recommended by ProUCL	Detects (%)	Total No. of Samples	Distribution Recommended by ProUCL	Detects (%)			
Arsenic	45	NON-PARAMETRIC	93	6	NORMAL	100	WRS	0.045	**Yes**

[a] SEEU data for background comparison do not include any background locations.

Bold = Analyte retained for further consideration in the next ECOPC selection step.

WRS = Wilcoxon Rate Sum Test.

Table 7.11
Statistical Concentrations in Subsurface Soil in the SEEU

Analyte	Number of Samples	Mean	Median	75th Percentile	95th Percentile	95UCL	95UTL	Maximum[a]
Inorganics								
Arsenic	6	8.10	7.40	7.48	16.2	12.8	25.3	19.1

[a]Maximum = Maximum proxy result; may be MDC or reporting limit greater than MDC.
UCL = 95% upper confidence limit on the mean, unless the MDC < UCL, then the MDC is used as the UCL.
UTL = 95% upper confidence limit on the 90th percentile value, unless the MDC < UTL, then the MDC is used as the UTL.

Table 7.12

Upper-Bound Exposure Point Concentrations Comparison to Receptor-Specific ESLs for Burrowing Receptors in the SEEU Subsurface Soil

Analyte	Small Home Range Receptor 95th UTL	Receptor-Specific ESLs[a]
		Prairie Dog
Inorganics (mg/kg)		
Arsenic	19.1[b]	35.9

[a]Threshold ESL, if available, for that receptor.

[b] The MDC was used as the EPC because the 95 UTL was greater than the MDC (MDC = maximum detected concentration or in some cases, maximum proxy results).

Table 7.13
Summary of ECOPC Screening Steps for Subsurface Soil

Analyte	Exceeds Prairie Dog NOAEL ESL?	Frequency of Detection >5%?	Exceeds Background?[a]	Upper Bound EPC > Limiting ESL?	Professional Judgment - Retain?	Retain as ECOPC?
Inorganics						
Aluminum	UT	--	--	--	--	No
Arsenic	Yes	Yes	Yes	No	--	No
Barium	No	--	--	--	--	No
Beryllium	No	--	--	--	--	No
Cadmium	No	--	--	--	--	No
Calcium	UT	--	--	--	--	No
Cesium	UT	--	--	--	--	No
Chromium	No	--	--	--	--	No
Cobalt	No	--	--	--	--	No
Copper	No	--	--	--	--	No
Iron	UT	--	--	--	--	No
Lead	No	--	--	--	--	No
Lithium	No	--	--	--	--	No
Magnesium	UT	--	--	--	--	No
Manganese	No	--	--	--	--	No
Molybdenum	No	--	--	--	--	No
Nickel	No	--	--	--	--	No
Potassium	UT	--	--	--	--	No
Selenium	No	--	--	--	--	No
Silicon	UT	--	--	--	--	No
Sodium	UT	--	--	--	--	No
Strontium	No	--	--	--	--	No
Vanadium	No	--	--	--	--	No
Zinc	No	--	--	--	--	No
Organics						
1,1,1-Trichoroethane	No	--	--	--	--	No
bis(2-Ethlylhexyl)phthalate	No	--	--	--	--	No
Styrene	No	--	--	--	--	No
Toluene	No	--	--	--	--	No
Xylene	No	--	--	--	--	No
Radionuclides						
Americium-241	No	--	--	--	--	No
Cesium-137	No	--	--	--	--	No
Gross Alpha	UT	--	--	--	--	No
Gross Beta	UT	--	--	--	--	No
Plutonium-239/240	No	--	--	--	--	No
Radium-226	No	--	--	--	--	No
Radium-228	No	--	--	--	--	No
Strontium-89/90	No	--	--	--	--	No
Uranium-233/234	No	--	--	--	--	No
Uranium-235	No	--	--	--	--	No
Uranium-238	No	--	--	--	--	No

[a] Based on results of statistical analysis at the 0.1 level of significance.

-- = Screen not performed because analyte was eliminated from further consideration in a previous step.

UT = Uncertain toxicity; no ESL available (assessed in Section 10).

FIGURES

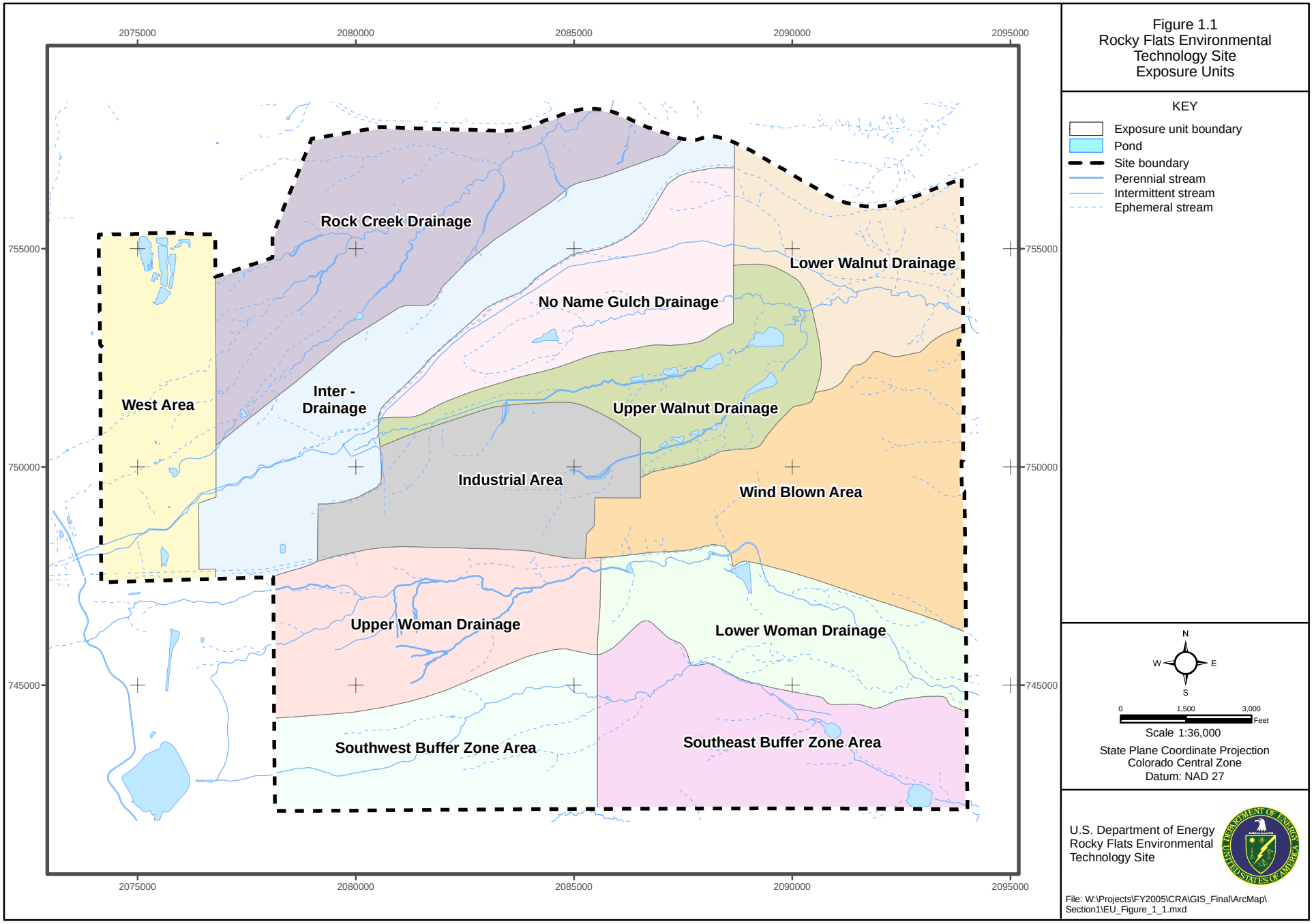

Figure 1.1
Rocky Flats Environmental
Technology Site
Exposure Units

KEY

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 1,500 3,000 Feet

Scale 1:36,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental
Technology Site

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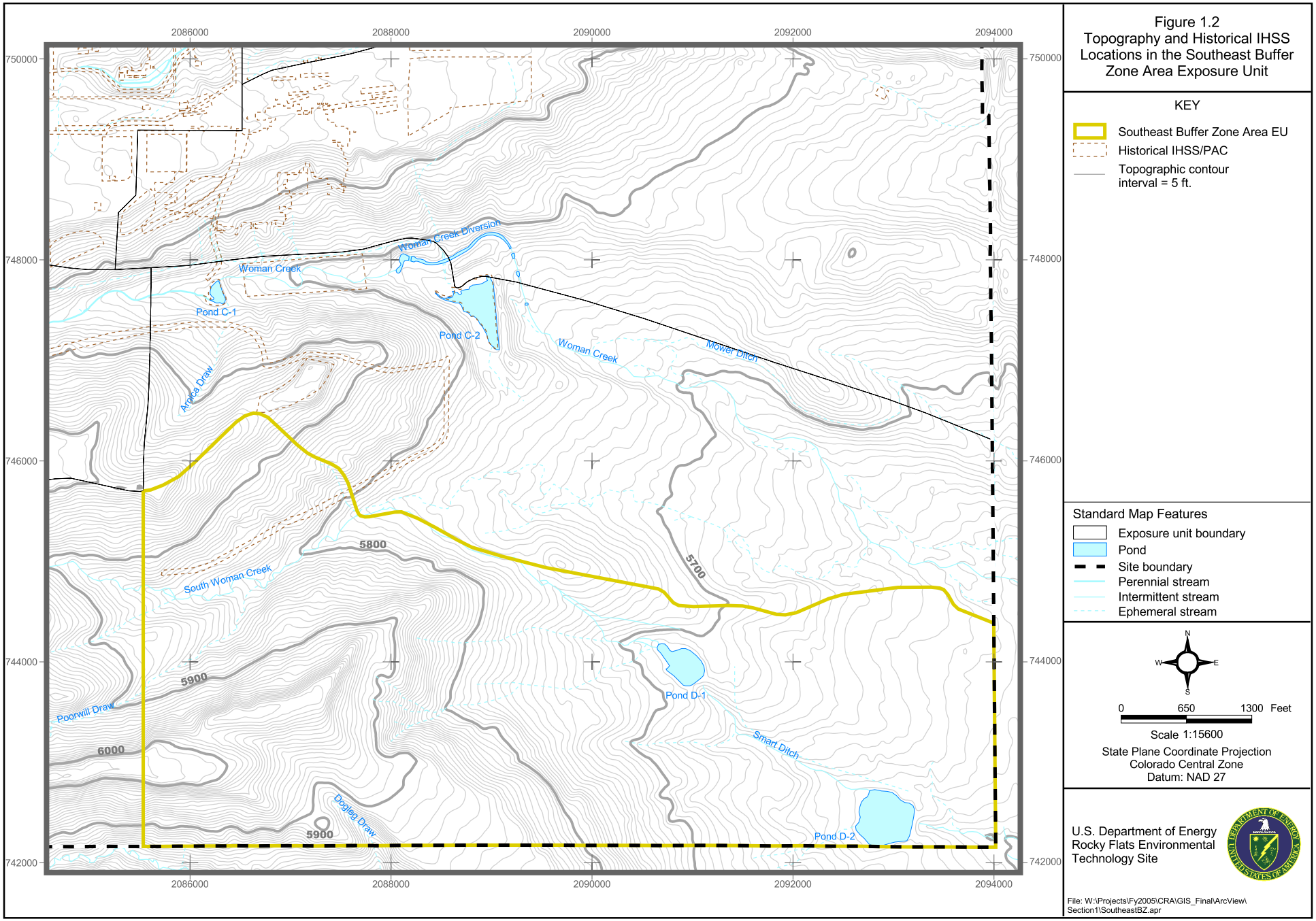

Figure 1.2
Topography and Historical IHSS Locations in the Southeast Buffer Zone Area Exposure Unit

KEY

- Southeast Buffer Zone Area EU
- Historical IHSS/PAC
- Topographic contour interval = 5 ft.

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 650 1300 Feet

Scale 1:15600

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

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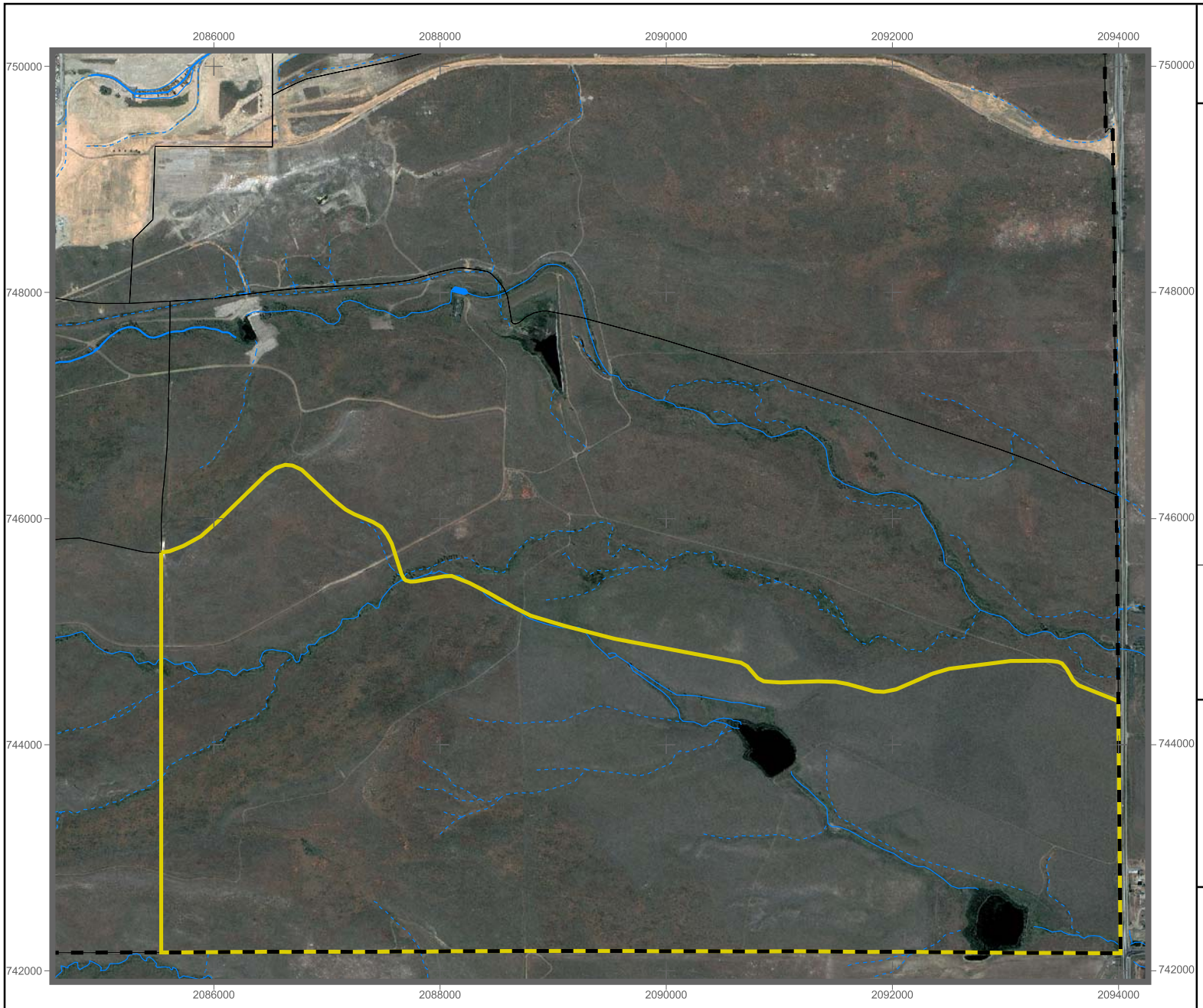

Figure 1.3
Aerial Photograph of the
Southeast Buffer Zone
Area Exposure Unit
July 2005

KEY

Southeast Buffer Zone Area EU

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 650 1300 Feet

Scale 1:15600

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Technology Site

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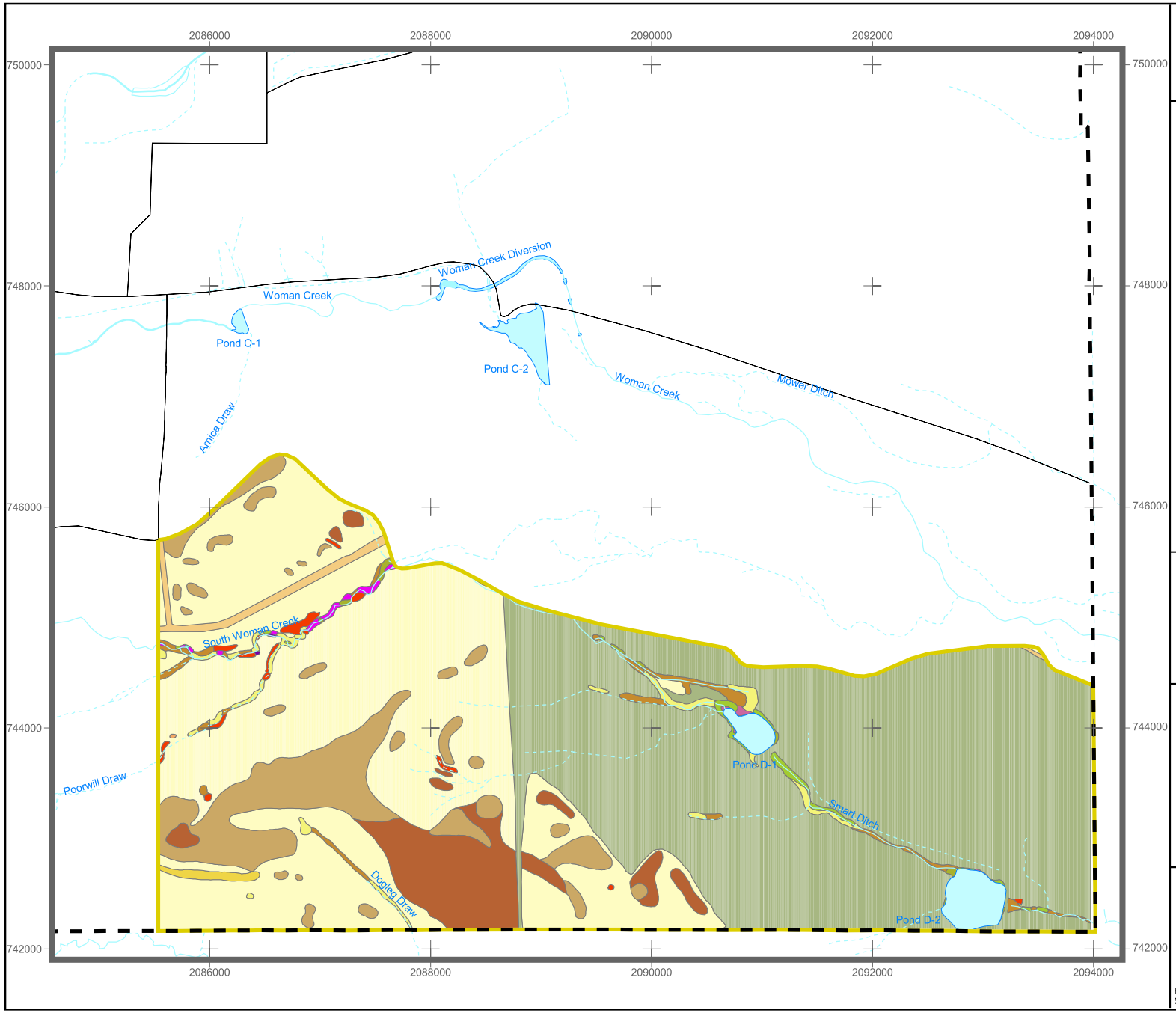

Figure 1.4
Vegetation in the Southeast Buffer Zone Area Exposure Unit

KEY

Southeast Buffer Zone Area EU

Vegetation, 2005

- Annual grass/forb community
- Disturbed areas
- Disturbed and revegetated areas
- Leadplant riparian shrubland
- Mesic mixed grassland
- Mudflats
- Open water
- Ponderosa woodland
- Reclaimed mixed grassland
- Riparian woodland
- Riprap, rock, and gravel piles
- Savannah shrubland
- Short grassland
- Short marsh
- Short upland shrubland
- Tall marsh
- Tall upland shrubland
- Tree plantings
- Wet meadow/marsh ecotone
- Willow riparian shrubland
- Xeric needle and thread grass prairie
- Xeric tallgrass prairie

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 650 1300 Feet

Scale 1:15600

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

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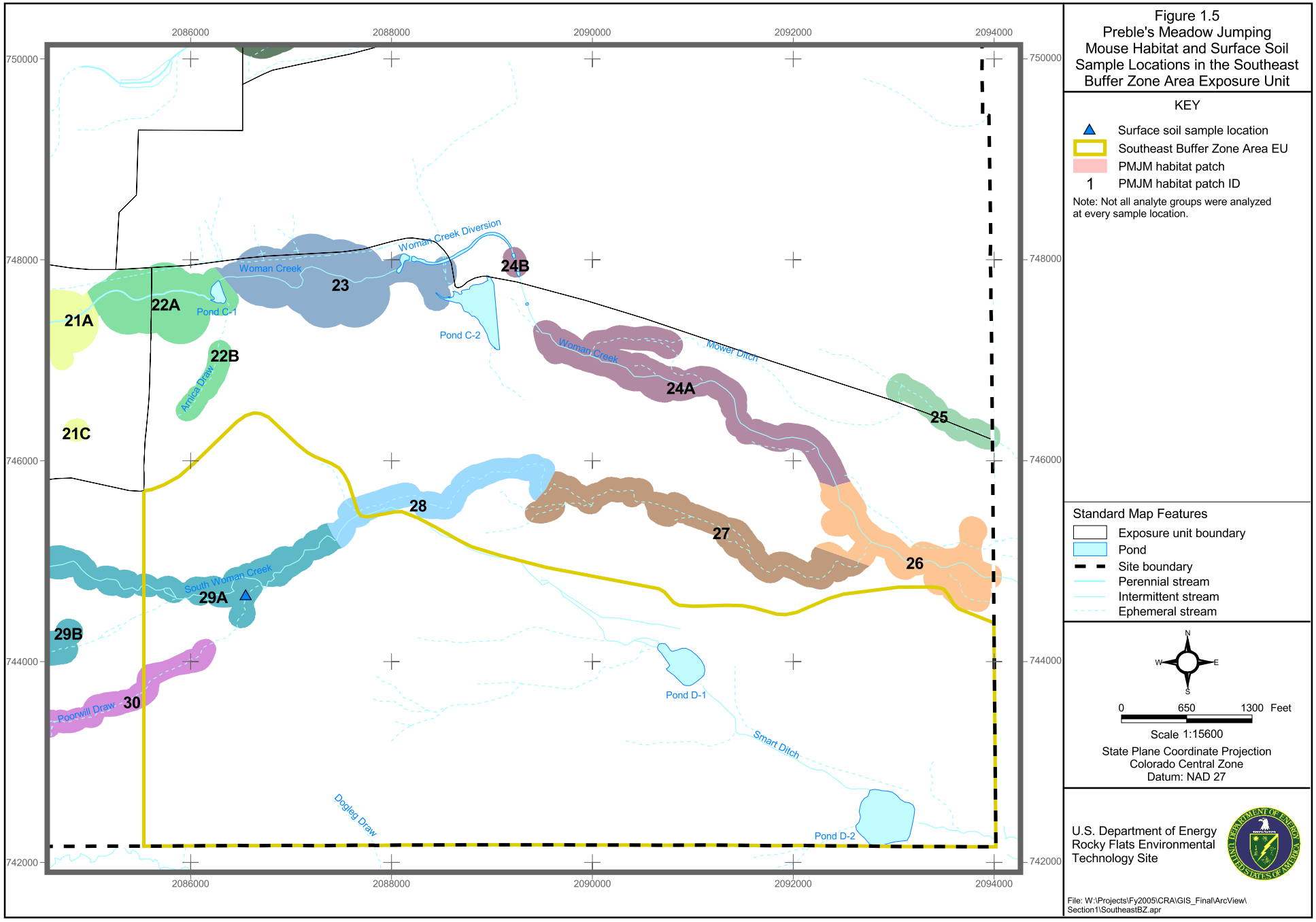

Figure 1.5
Preble's Meadow Jumping Mouse Habitat and Surface Soil Sample Locations in the Southeast Buffer Zone Area Exposure Unit

KEY

- Surface soil sample location
- Southeast Buffer Zone Area EU
- PMJM habitat patch
- 1 PMJM habitat patch ID

Note: Not all analyte groups were analyzed at every sample location.

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
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0 650 1300 Feet

Scale 1:15600

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
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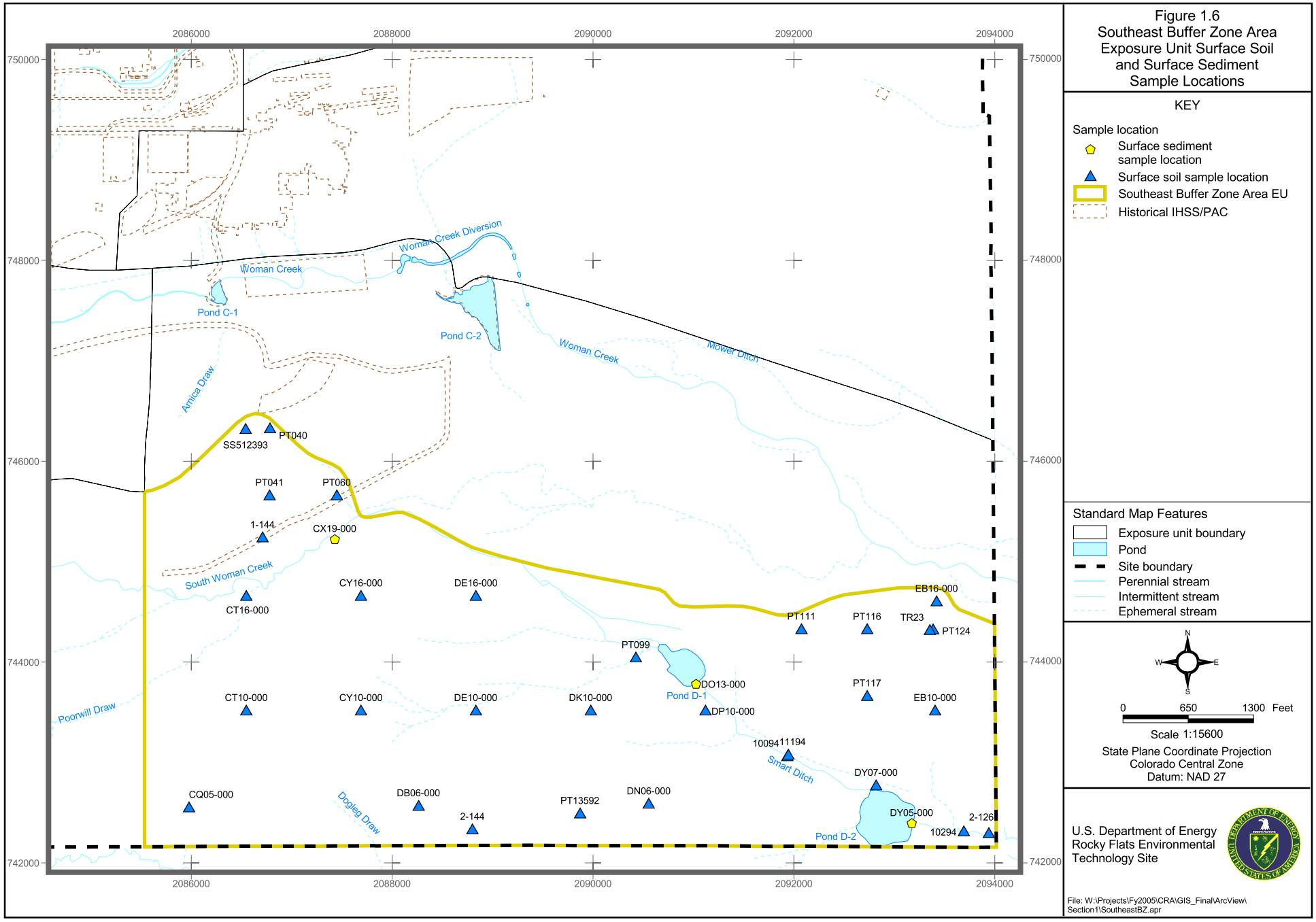

Figure 1.6
Southeast Buffer Zone Area
Exposure Unit Surface Soil
and Surface Sediment
Sample Locations

KEY

Sample location
- Surface sediment sample location
- Surface soil sample location
- Southeast Buffer Zone Area EU
- Historical IHSS/PAC

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W
E
S

0 650 1300 Feet

Scale 1:15600

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Technology Site

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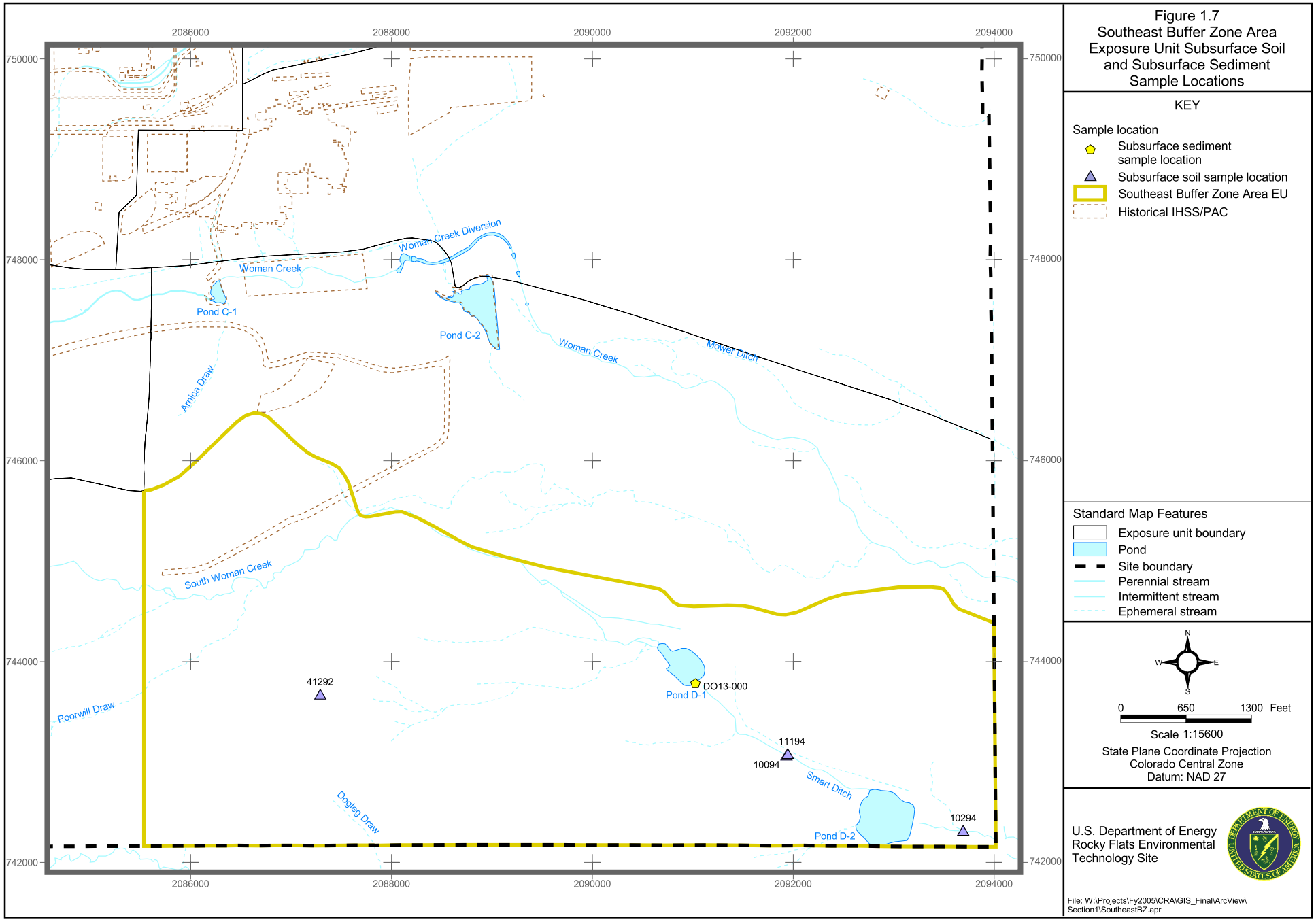

Figure 1.7
Southeast Buffer Zone Area
Exposure Unit Subsurface Soil
and Subsurface Sediment
Sample Locations

KEY

Sample location
- Subsurface sediment sample location
- Subsurface soil sample location
- Southeast Buffer Zone Area EU
- Historical IHSS/PAC

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 650 1300 Feet

Scale 1:15600

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental
Technology Site

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COMPREHENSIVE RISK ASSESSMENT

SOUTHEAST BUFFER ZONE AREA EXPOSURE UNIT

VOLUME 13: ATTACHMENT 1

Detection Limit Screen

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LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

µg/kg	micrograms per kilogram
µg/L	micrograms per liter
CD	compact disc
CRA	Comprehensive Risk Assessment
ESL	ecological screening level
IHSS	Individual Hazardous Substance Site
mg/kg	milligrams per kilogram
N/A	not available or not applicable
NOAEL	no observed adverse effect level
PAC	Potential Area of Concern
pCi/g	picocuries per gram
PRG	preliminary remediation goal
SEEU	Southeast Buffer Zone Area Exposure Unit
TIC	tentatively identified compound
VOC	volatile organic compound
WRW	wildlife refuge worker

1.0 EVALUATION OF ANALYTE DETECTION LIMITS FOR THE SOUTHEAST BUFFER ZONE AREA EXPOSURE UNIT

For the Southeast Buffer Zone Area Exposure Unit (EU) (SEEU), the detection limits for non-detected analytes as well as analytes detected in less than 5 percent of the samples are compared to human health preliminary remediation goals (PRGs) for the wildlife refuge worker (WRW) and the minimum ecological screening levels (ESLs). The comparisons are made in the tables to this attachment for potential contaminants of concern (PCOCs) in surface soil/surface sediment and subsurface soil/subsurface sediment, and ecological contaminants of interest (ECOIs) in surface soil and subsurface soil. The percent of the samples with detection limits that exceed the PRGs and ESLs are listed in these tables. When these detection limits exceed the respective PRGs and ESLs, this is a source of uncertainty in the risk assessment process, which is discussed herein.

Laboratory reported results for "U" qualified data (nondetects) are used to perform the detection limit screen rather than the detection limit identified in the detection limit field within the Soil Water Database (SWD). The basis for the detection limit is not always certain, i.e., Instrument Detection Limit (IDL), Method Detection Limit (MDL), Reporting Limit (RL), Sample Quantitation Limit (SQL), etc. Therefore, to be consistent in reporting, the "reported results" are presented in the tables to this attachment. Also, for statistical computations and risk estimations presented in the main text and tables to this volume, one-half the reported results are used as proxy values for nondetected data.

The term analyte as used in the following sections refers to analytes that are non-detected or detected in less than 5 percent of the samples. PRGs and ESLs do not exist for some of these analytes, which is also a source of uncertainty for the risk assessment. This uncertainty is discussed in Sections 6.2.1 and 10.1.1 of the main text of this volume.

1.1 Comparison of Reported Results to Preliminary Remediation Goals

1.1.1 Surface Soil/Surface Sediment

As shown in Table A1.1, there are only three analytes in surface soil/surface sediment where the reported results exceed the PRG: benzo(a)pyrene (100 percent), dibenz(a,h)anthracene (100 percent), and N-nitroso-di-n-propylamine (100 percent). In these three cases, the reported result (there is only one sample) is within a factor of 2 of the PRG. Therefore, because only three analytes have reported results that exceed the PRGs, and for these analytes, the reported results are the same order of magnitude as the PRGs, this represents only minimal uncertainty in the overall risk conclusions.

1.1.2 Subsurface Soil/Subsurface Sediment

All reported results are below the PRGs in subsurface soil/subsurface sediment (Table A1.2).

1.2 Comparison of Reported Results to Ecological Screening Levels

1.2.1 Surface Soil

As shown in Table A1.3, there are 20 analytes in surface soil where some percent of the reported results exceed the lowest ESL. For the metal analytes, more than 80 percent of the reported results are less than the lowest ESL. Consequently, for these analytes, there is minimal uncertainty in the overall risk estimates because of these higher reported results. Of the remaining 18 analytes, all of which are organics, there is only one sample collected, and for each analyte, the reported result exceeds the lowest ESL, and in some cases, the reported result is more than an order of magnitude higher than the lowest ESL. This condition requires further analysis using professional judgment and ecological risk potential to determine the extent of uncertainty in the overall risk estimates, i.e., ecological risks may be underestimated because these analyte may have been included as ECOPCs had they been detected more frequently using lower detection limits (lower reported results).

Professional judgment indicates whether the analytes are likely to be a site-related contaminant in the SEEU surface soil based on 1) a listing of the analytes (or classes of analytes) as constituents in wastes potentially released at historical Individual Hazardous Substance Sites (IHSSs) in the SEEU (DOE 2005a), 2) the historical inventory for the chemical at RFETS (CDH 1991), and 3) a comparison of the maximum detected concentration and detection frequency in the EU and sitewide surface soil (see Table A1.3 for sitewide surface soil summary statistics). The comparison of the EU and sitewide maximum detected concentrations and detection frequencies in surface soil is performed to assess if the EU observations are much higher, which may potentially also indicate a source for the analyte within the EU. Using professional judgment, the analytes can be grouped into four categories that represent an ascending order of uncertainty. Category 1 is for analytes that were not listed as waste constituents for the EU historical IHSSs, and are not detected in the EU or sitewide surface soil. Category 2 is for analytes that may or may not be listed as waste constituents for the EU historical IHSSs, but are nevertheless are not detected in the EU surface soil even though they were detected in other EU surface soil at RFETS at low maximum detected concentrations and low detection frequencies. Category 3 is for analytes that may or may not be listed as waste constituents for the EU historical IHSSs, and are detected in the EU (and therefore sitewide) surface soil, and the maximum detected concentrations in the EU surface soil are approximately the same order of magnitude as the ESL, and the detection frequencies are low. For these first three categories, the uncertainty with regard to the risk estimates because of the higher detection limits is considered small. Category 4 is for analytes that are detected in the EU (and therefore sitewide) surface soil at maximum concentrations that substantially exceed the ESLs and at detection frequencies generally higher than for Category 3, i.e., these analytes have the highest likelihood of being present in surface soil in the EU based on professional judgment, and there some uncertainty with regard to the risk estimates because of the higher detection limits.

The assessment of the ecological risk potential compares the maximum reported result to a Lowest Observed Adverse Effect Level (LOAEL)-based soil concentration. ESLs are

based on No Observed Adverse Effect Levels (NOAELs) (DOE 2005b). The LOAEL-based soil concentration is estimated by multiplying the lowest ESL by the LOAEL/NOAEL ratio for the mammal or the bird depending on whether a mammal or bird is the most sensitive terrestrial vertebrate receptor for the chemical (see Appendix B, Table B-2 of the Final CRA Work Plan and Methodology, Revision 1 (DOE 2005b) for the Lowest Bounded LOAELs and Final NOAELs for mammals and birds). A maximum reported result/LOAEL-based soil concentration ratio greater than one indicates a potential for an adverse ecological effect if the analyte was detected at the highest reported result.

As shown in Table A1.5, most of the 18 analytes assessed using professional judgment are in categories 1 through 3, and thus are not likely to be present in the SEEU surface soil based on professional judgment, which minimizes the uncertainty in the overall risk estimates because of their higher reported results. Benzo(a)pyrene is the only category 4 analyte, i.e., it may be present in the SEEU surface soil based on professional judgment.

As shown in Table A1.5, comparing the maximum reported results to the LOAEL-based soil concentrations indicates more than half of the above noted analytes, including benzo(a)pyrene, would not present a potential for adverse ecological effects if they were detected at the maximum reported results.

In conclusion, with the exception of benzo(a)pyrene, analytes in surface soil that have reported results that exceed the lowest ESLs contribute a low level of uncertainty to the overall risk estimates because professional judgment indicates they are not likely to be present in surface soil. Therefore, there is some uncertainty in the overall risk estimates associated with the high reported results for benzo(a)pyrene, i.e., ecological risks may be underestimated because this analyte may have been included as an ECOPC had it been detected more frequently using lower detection limits (lower reported results). However, benzo(a)pyrene does not have a potential for adverse ecological effects had it been detected at the maximum reported result.

1.2.2 Subsurface Soil

All reported results are below the ESLs in subsurface soil (Table A1.4).

2.0 REFERENCES

CDH, 1991. Colorado Department of Health Project Task 1 Report (Revised 1), Identification of Chemicals and Radionuclides Used at Rocky Flats. Prepared by ChemRisk. March.

DOE, 2005a, 2005 Annual Update to the Historical Release Report, Rocky Flats Environmental Technology Site, October.

DOE, 2005b. Final Comprehensive Risk Assessment Work Plan and Methodology, Revision 1, Rocky Flats Environmental Technology Site, Golden, Colorado. Revision 1. September.

TABLES

Table A1.1
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Surface Soil/Surface Sediment in the SEEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest PRG	Number of Nondetected Results > PRG	Percent of Nondetected Results > PRG	Analyte Detected?
Inorganic (mg/kg)								
Tin	0.860	-	22.4	21	66,652	0	0	No
Organic (ug/kg)								
1,2,4-Trichlorobenzene	710	-	710	1	151,360	0	0	No
1,2-Dichlorobenzene	710	-	710	1	2.89E+06	0	0	No
1,3-Dichlorobenzene	710	-	710	1	3.33E+06	0	0	No
1,4-Dichlorobenzene	710	-	710	1	91,315	0	0	No
2,4,5-Trichlorophenol	3,600	-	3,600	1	8.01E+06	0	0	No
2,4,6-Trichlorophenol	710	-	710	1	272,055	0	0	No
2,4-Dichlorophenol	710	-	710	1	240,431	0	0	No
2,4-Dimethylphenol	710	-	710	1	1.60E+06	0	0	No
2,4-Dinitrophenol	3,600	-	3,600	1	160,287	0	0	No
2,4-Dinitrotoluene	710	-	710	1	160,287	0	0	No
2,6-Dinitrotoluene	710	-	710	1	80,144	0	0	No
2-Chloronaphthalene	710	-	710	1	6.41E+06	0	0	No
2-Chlorophenol	710	-	710	1	555,435	0	0	No
2-Methylnaphthalene	710	-	710	1	320,574	0	0	No
2-Methylphenol	710	-	710	1	4.01E+06	0	0	No
2-Nitroaniline	3,600	-	3,600	1	192,137	0	0	No
2-Nitrophenol	710	-	710	1	N/A	0	0	No
3,3'-Dichlorobenzidine	1,400	-	1,400	1	6,667	0	0	No
3-Nitroaniline	3,600	-	3,600	1	N/A	0	0	No
4,4'-DDD	35	-	35	1	15,528	0	0	No
4,4'-DDE	35	-	35	1	10,961	0	0	No
4,4'-DDT	35	-	35	1	10,927	0	0	No
4,6-Dinitro-2-methylphenol	3,600	-	3,600	1	8,014	0	0	No
4-Bromophenyl-phenylether	710	-	710	1	N/A	0	0	No
4-Chloro-3-methylphenol	710	-	710	1	N/A	0	0	No
4-Chloroaniline	710	-	710	1	320,574	0	0	No
4-Chlorophenyl-phenyl ether	710	-	710	1	N/A	0	0	No
4-Methylphenol	710	-	710	1	400,718	0	0	No
4-Nitroaniline	3,600	-	3,600	1	207,917	0	0	No
4-Nitrophenol	3,600	-	3,600	1	641,148	0	0	No
Acenaphthene	710	-	710	1	4.44E+06	0	0	No
Acenaphthylene	710	-	710	1	N/A	0	0	No
Aldrin	17	-	17	1	176	0	0	No
alpha-BHC	17	-	17	1	570	0	0	No
alpha-Chlordane	170	-	170	1	10,261	0	0	No
Anthracene	710	-	710	1	2.22E+07	0	0	No
Benzo(a)anthracene	710	-	710	1	3,793	0	0	No
Benzo(a)pyrene	710	-	710	1	379	1	100	No
Benzo(b)fluoranthene	710	-	710	1	3,793	0	0	No
Benzo(g,h,i)perylene	710	-	710	1	N/A	0	0	No
Benzo(k)fluoranthene	710	-	710	1	37,927	0	0	No
Benzoic Acid	3,600	-	3,600	1	3.21E+08	0	0	No
Benzyl Alcohol	710	-	710	1	2.40E+07	0	0	No
beta-BHC	17	-	17	1	1,995	0	0	No
bis(2-Chloroethoxy) methane	710	-	710	1	N/A	0	0	No
bis(2-Chloroethyl) ether	710	-	710	1	3,767	0	0	No
bis(2-Chloroisopropyl) ether	710	-	710	1	59,301	0	0	No
bis(2-ethylhexyl)phthalate	710	-	710	1	213,750	0	0	No
Butylbenzylphthalate	710	-	710	1	1.60E+07	0	0	No
Chrysene	710	-	710	1	379,269	0	0	No
delta-BHC	17	-	17	1	570	0	0	No
Dibenz(a,h)anthracene	710	-	710	1	379	1	100	No
Dibenzofuran	710	-	710	1	222,174	0	0	No
Dieldrin	35	-	35	1	187	0	0	No

Table A1.1
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Surface Soil/Surface Sediment in the SEEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest PRG	Number of Nondetected Results > PRG	Percent of Nondetected Results > PRG	Analyte Detected?
Diethylphthalate	710	-	710	1	6.41E+07	0	0	No
Dimethylphthalate	710	-	710	1	8.01E+08	0	0	No
Di-n-butylphthalate	710	-	710	1	8.01E+06	0	0	No
Di-n-octylphthalate	710	-	710	1	3.21E+06	0	0	No
Endosulfan I	17	-	17	1	480,861	0	0	No
Endosulfan II	35	-	35	1	480,861	0	0	No
Endosulfan sulfate	35	-	35	1	480,861	0	0	No
Endrin	35	-	35	1	24,043	0	0	No
Endrin ketone	35	-	35	1	33,326	0	0	No
Fluoranthene	710	-	710	1	2.96E+06	0	0	No
Fluorene	710	-	710	1	3.21E+06	0	0	No
gamma-BHC (Lindane)	17	-	17	1	2,771	0	0	No
gamma-Chlordane	170	-	170	1	10,261	0	0	No
Heptachlor	17	-	17	1	665	0	0	No
Heptachlor epoxide	17	-	17	1	329	0	0	No
Hexachlorobenzene	710	-	710	1	1,870	0	0	No
Hexachlorobutadiene	710	-	710	1	22,217	0	0	No
Hexachlorocyclopentadiene	710	-	710	1	380,452	0	0	No
Hexachloroethane	710	-	710	1	111,087	0	0	No
Indeno(1,2,3-cd)pyrene	710	-	710	1	3,793	0	0	No
Isophorone	710	-	710	1	3.16E+06	0	0	No
Methoxychlor	170	-	170	1	400,718	0	0	No
Naphthalene	710	-	710	1	1.40E+06	0	0	No
Nitrobenzene	710	-	710	1	43,246	0	0	No
N-Nitroso-di-n-propylamine	710	-	710	1	429	1	100	No
N-nitrosodiphenylamine	710	-	710	1	612,250	0	0	No
PCB-1016	170	-	170	1	1,349	0	0	No
PCB-1221	170	-	170	1	1,349	0	0	No
PCB-1232	170	-	170	1	1,349	0	0	No
PCB-1242	170	-	170	1	1,349	0	0	No
PCB-1248	170	-	170	1	1,349	0	0	No
PCB-1254	350	-	350	1	1,349	0	0	No
PCB-1260	350	-	350	1	1,349	0	0	No
Pentachlorophenol	3,600	-	3,600	1	17,633	0	0	No
Phenanthrene	710	-	710	1	N/A	0	0	No
Phenol	710	-	710	1	2.40E+07	0	0	No
Pyrene	710	-	710	1	2.22E+06	0	0	No
Toxaphene	350	-	350	1	2,720	0	0	No

N/A = Not available.

Table A1.2
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Subsurface Soil/Subsurface Sediment in the SEEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest PRG	Number of Nondetected Results > PRG	Percent of Nondetected Results > PRG	Analyte Detected?
Inorganic (mg/kg)								
Antimony	0.730	-	9.70	3	511	0	0	No
Silver	0.0900	-	1.20	7	6,388	0	0	No
Tin	2.90	-	31.4	6	766,500	0	0	No
Uranium	1.30	-	1.30	1	3,833	0	0	No
Organic (ug/kg)								
1,1,2,2-Tetrachloroethane	6	-	6	5	120,551	0	0	No
1,1,2-Trichloroethane	6	-	6	5	322,253	0	0	No
1,1-Dichloroethane	6	-	6	5	3.12E+07	0	0	No
1,1-Dichloroethene	6	-	6	5	199,706	0	0	No
1,2,4-Trichlorobenzene	360	-	390	3	1.74E+06	0	0	No
1,2-Dichlorobenzene	360	-	390	3	3.32E+07	0	0	No
1,2-Dichloroethane	6	-	6	5	152,603	0	0	No
1,2-Dichloroethene	6	-	6	5	1.15E+07	0	0	No
1,2-Dichloropropane	6	-	6	5	441,907	0	0	No
1,3-Dichlorobenzene	360	-	390	3	3.83E+07	0	0	No
1,4-Dichlorobenzene	360	-	390	3	1.05E+06	0	0	No
2,4,5-Trichlorophenol	1,700	-	1,900	3	9.22E+07	0	0	No
2,4,6-Trichlorophenol	360	-	390	3	3.13E+06	0	0	No
2,4-Dichlorophenol	360	-	390	3	2.76E+06	0	0	No
2,4-Dimethylphenol	360	-	390	3	1.84E+07	0	0	No
2,4-Dinitrophenol	1,700	-	1,900	3	1.84E+06	0	0	No
2,4-Dinitrotoluene	360	-	390	3	1.84E+06	0	0	No
2,6-Dinitrotoluene	360	-	390	3	921,651	0	0	No
2-Butanone	11	-	12	5	5.33E+08	0	0	No
2-Chloronaphthalene	360	-	390	3	7.37E+07	0	0	No
2-Chlorophenol	360	-	390	3	6.39E+06	0	0	No
2-Hexanone	11	-	12	5	N/A	0	0	No
2-Methylnaphthalene	360	-	390	3	3.69E+06	0	0	No
2-Methylphenol	360	-	390	3	4.61E+07	0	0	No
2-Nitroaniline	1,700	-	1,900	3	2.21E+06	0	0	No
2-Nitrophenol	360	-	390	3	N/A	0	0	No
3,3'-Dichlorobenzidine	710	-	780	3	76,667	0	0	No
3-Nitroaniline	1,700	-	1,900	3	N/A	0	0	No
4,6-Dinitro-2-methylphenol	1,700	-	1,900	3	92,165	0	0	No
4-Bromophenyl-phenylether	360	-	390	3	N/A	0	0	No
4-Chloro-3-methylphenol	360	-	390	3	N/A	0	0	No
4-Chloroaniline	360	-	390	3	3.69E+06	0	0	No
4-Chlorophenyl-phenyl ether	360	-	390	3	N/A	0	0	No
4-Methyl-2-pentanone	11	-	12	5	9.57E+08	0	0	No
4-Methylphenol	360	-	390	3	4.61E+06	0	0	No
4-Nitroaniline	1,700	-	1,900	3	2.39E+06	0	0	No
4-Nitrophenol	1,700	-	1,900	3	7.37E+06	0	0	No
Acenaphthene	360	-	390	3	5.10E+07	0	0	No
Acenaphthylene	360	-	390	3	N/A	0	0	No
Acetone	11	-	12	5	1.15E+09	0	0	No
Anthracene	360	-	390	3	2.55E+08	0	0	No
Benzene	6	-	6	5	270,977	0	0	No
Benzo(a)anthracene	360	-	390	3	43,616	0	0	No
Benzo(a)pyrene	360	-	390	3	4,357	0	0	No
Benzo(b)fluoranthene	360	-	390	3	43,616	0	0	No
Benzo(g,h,i)perylene	360	-	390	3	N/A	0	0	No
Benzo(k)fluoranthene	360	-	390	3	436,159	0	0	No
Benzoic Acid	1,700	-	1,900	3	3.69E+09	0	0	No

Table A1.2
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Subsurface Soil/Subsurface Sediment in the SEEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest PRG	Number of Nondetected Results > PRG	Percent of Nondetected Results > PRG	Analyte Detected?
Benzyl Alcohol	360	-	390	3	2.76E+08	0	0	No
bis(2-Chloroethoxy) methane	360	-	390	3	N/A	0	0	No
bis(2-Chloroethyl) ether	360	-	390	3	43,315	0	0	No
bis(2-Chloroisopropyl) ether	360	-	390	3	681,967	0	0	No
Bromodichloromethane	6	-	6	5	771,304	0	0	No
Bromoform	6	-	6	5	4.83E+06	0	0	No
Bromomethane	11	-	12	5	241,033	0	0	No
Butylbenzylphthalate	360	-	390	3	1.84E+08	0	0	No
Carbon Disulfide	6	-	6	5	1.88E+07	0	0	No
Carbon Tetrachloride	6	-	6	5	97,124	0	0	No
Chlorobenzene	6	-	6	5	7.67E+06	0	0	No
Chloroethane	11	-	12	5	1.65E+07	0	0	No
Chloroform	6	-	6	5	90,270	0	0	No
Chloromethane	11	-	12	5	1.32E+06	0	0	No
Chrysene	360	-	390	3	4.36E+06	0	0	No
cis-1,3-Dichloropropene	6	-	6	5	223,462	0	0	No
Dibenz(a,h)anthracene	360	-	390	3	4,362	0	0	No
Dibenzofuran	360	-	390	3	2.56E+06	0	0	No
Dibromochloromethane	6	-	6	5	569,296	0	0	No
Diethylphthalate	360	-	390	3	7.37E+08	0	0	No
Dimethylphthalate	360	-	390	3	9.22E+09	0	0	No
Di-n-butylphthalate	360	-	390	3	9.22E+07	0	0	No
Di-n-octylphthalate	360	-	390	3	3.69E+07	0	0	No
Ethylbenzene	6	-	6	5	6.19E+07	0	0	No
Fluoranthene	360	-	390	3	3.40E+07	0	0	No
Fluorene	360	-	390	3	3.69E+07	0	0	No
Hexachlorobenzene	360	-	390	3	21,508	0	0	No
Hexachlorobutadiene	360	-	390	3	255,500	0	0	No
Hexachlorocyclopentadiene	360	-	390	3	4.38E+06	0	0	No
Hexachloroethane	360	-	390	3	1.28E+06	0	0	No
Indeno(1,2,3-cd)pyrene	360	-	390	3	43,616	0	0	No
Isophorone	360	-	390	3	3.63E+07	0	0	No
Methylene Chloride	6	-	6	5	3.13E+06	0	0	No
Naphthalene	360	-	390	3	1.61E+07	0	0	No
Nitrobenzene	360	-	390	3	497,333	0	0	No
N-Nitroso-di-n-propylamine	360	-	390	3	4,929	0	0	No
N-nitrosodiphenylamine	360	-	390	3	7.04E+06	0	0	No
Pentachlorophenol	1,700	-	1,900	3	202,777	0	0	No
Phenanthrene	360	-	390	3	N/A	0	0	No
Phenol	360	-	390	3	2.76E+08	0	0	No
Pyrene	360	-	390	3	2.55E+07	0	0	No
Tetrachloroethene	6	-	6	5	77,111	0	0	No
trans-1,3-Dichloropropene	6	-	6	5	239,434	0	0	No
Trichloroethene	6	-	6	5	20,354	0	0	No
Vinyl acetate	11	-	12	5	3.04E+07	0	0	No
Vinyl Chloride	11	-	12	5	24,948	0	0	No

N/A = Not available.

Table A1.3
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Surface Soil in the SEEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent of Nondetected Results > ESL	Analyte Detected?
Inorganic (mg/kg)								
Thallium	0.210	-	1.10	19	1	3	15.8	No
Tin	0.860	-	22.4	18	2.90	3	16.7	No
Organic (ug/kg)								
1,2,4-Trichlorobenzene	710	-	710	1	777	0	0	No
1,2-Dichlorobenzene	710	-	710	1	N/A	0	0	No
1,3-Dichlorobenzene	710	-	710	1	N/A	0	0	No
1,4-Dichlorobenzene	710	-	710	1	20,000	0	0	No
2,4,5-Trichlorophenol	3,600	-	3,600	1	4,000	0	0	No
2,4,6-Trichlorophenol	710	-	710	1	161	1	100	No
2,4-Dichlorophenol	710	-	710	1	2,744	0	0	No
2,4-Dimethylphenol	710	-	710	1	N/A	0	0	No
2,4-Dinitrophenol	3,600	-	3,600	1	20,000	0	0	No
2,4-Dinitrotoluene	710	-	710	1	32.1	1	100	No
2,6-Dinitrotoluene	710	-	710	1	6,186	0	0	No
2-Chloronaphthalene	710	-	710	1	N/A	0	0	No
2-Chlorophenol	710	-	710	1	281	1	100	No
2-Methylnaphthalene	710	-	710	1	2,769	0	0	No
2-Methylphenol	710	-	710	1	123,842	0	0	No
2-Nitroaniline	3,600	-	3,600	1	5,659	0	0	No
2-Nitrophenol	710	-	710	1	N/A	0	0	No
3,3'-Dichlorobenzidine	1,400	-	1,400	1	N/A	0	0	No
3-Nitroaniline	3,600	-	3,600	1	N/A	0	0	No
4,4'-DDD	35	-	35	1	13,726	0	0	No
4,4'-DDE	35	-	35	1	7.95	1	100	No
4,4'-DDT	35	-	35	1	1.20	1	100	No
4,6-Dinitro-2-methylphenol	3,600	-	3,600	1	560	1	100	No
4-Bromophenyl-phenylether	710	-	710	1	N/A	0	0	No
4-Chloro-3-methylphenol	710	-	710	1	N/A	0	0	No
4-Chloroaniline	710	-	710	1	716	0	0	No
4-Chlorophenyl-phenyl ether	710	-	710	1	N/A	0	0	No
4-Methylphenol	710	-	710	1	N/A	0	0	No
4-Nitroaniline	3,600	-	3,600	1	41,050	0	0	No
4-Nitrophenol	3,600	-	3,600	1	7,000	0	0	No
Acenaphthene	710	-	710	1	20,000	0	0	No
Acenaphthylene	710	-	710	1	N/A	0	0	No
Aldrin	17	-	17	1	47.0	0	0	No
alpha-BHC	17	-	17	1	18,662	0	0	No
alpha-Chlordane	170	-	170	1	289	0	0	No
Anthracene	710	-	710	1	N/A	0	0	No
Benzo(a)anthracene	710	-	710	1	N/A	0	0	No
Benzo(a)pyrene	710	-	710	1	631	1	100	No
Benzo(b)fluoranthene	710	-	710	1	N/A	0	0	No
Benzo(g,h,i)perylene	710	-	710	1	N/A	0	0	No
Benzo(k)fluoranthene	710	-	710	1	N/A	0	0	No
Benzoic Acid	3,600	-	3,600	1	N/A	0	0	No
Benzyl Alcohol	710	-	710	1	4,403	0	0	No
beta-BHC	17	-	17	1	207	0	0	No
bis(2-Chloroethoxy) methane	710	-	710	1	N/A	0	0	No
bis(2-Chloroethyl) ether	710	-	710	1	N/A	0	0	No
bis(2-Chloroisopropyl) ether	710	-	710	1	N/A	0	0	No
bis(2-ethylhexyl)phthalate	710	-	710	1	137	1	100	No
Butylbenzylphthalate	710	-	710	1	24,155	0	0	No
Chrysene	710	-	710	1	N/A	0	0	No
delta-BHC	17	-	17	1	25.9	0	0	No
Dibenz(a,h)anthracene	710	-	710	1	N/A	0	0	No
Dibenzofuran	710	-	710	1	21,200	0	0	No

Table A1.3
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Surface Soil in the SEEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent of Nondetected Results > ESL	Analyte Detected?
Dieldrin	35	-	35	1	7.40	1	100	No
Diethylphthalate	710	-	710	1	100,000	0	0	No
Dimethylphthalate	710	-	710	1	200,000	0	0	No
Di-n-butylphthalate	710	-	710	1	15.9	1	100	No
Di-n-octylphthalate	710	-	710	1	731,367	0	0	No
Endosulfan I	17	-	17	1	80.1	0	0	No
Endosulfan II	35	-	35	1	80.1	0	0	No
Endosulfan sulfate	35	-	35	1	80.1	0	0	No
Endrin	35	-	35	1	1.40	1	100	No
Endrin ketone	35	-	35	1	1.40	1	100	No
Fluoranthene	710	-	710	1	N/A	0	0	No
Fluorene	710	-	710	1	30,000	0	0	No
gamma-BHC (Lindane)	17	-	17	1	25.9	0	0	No
gamma-Chlordane	170	-	170	1	289	0	0	No
Heptachlor	17	-	17	1	63.3	0	0	No
Heptachlor epoxide	17	-	17	1	64.0	0	0	No
Hexachlorobenzene	710	-	710	1	7.73	1	100	No
Hexachlorobutadiene	710	-	710	1	431	1	100	No
Hexachlorocyclopentadiene	710	-	710	1	5,518	0	0	No
Hexachloroethane	710	-	710	1	366	1	100	No
Indeno(1,2,3-cd)pyrene	710	-	710	1	N/A	0	0	No
Isophorone	710	-	710	1	N/A	0	0	No
Methoxychlor	170	-	170	1	1,226	0	0	No
Naphthalene	710	-	710	1	27,048	0	0	No
Nitrobenzene	710	-	710	1	40,000	0	0	No
N-Nitroso-di-n-propylamine	710	-	710	1	N/A	0	0	No
N-nitrosodiphenylamine	710	-	710	1	20,000	0	0	No
PCB-1016	170	-	170	1	172	0	0	No
PCB-1221	170	-	170	1	172	0	0	No
PCB-1232	170	-	170	1	172	0	0	No
PCB-1242	170	-	170	1	172	0	0	No
PCB-1248	170	-	170	1	172	0	0	No
PCB-1254	350	-	350	1	172	1	100	No
PCB-1260	350	-	350	1	172	1	100	No
Pentachlorophenol	3,600	-	3,600	1	122	1	100	No
Phenanthrene	710	-	710	1	N/A	0	0	No
Phenol	710	-	710	1	23,090	0	0	No
Pyrene	710	-	710	1	N/A	0	0	No
Toxaphene	350	-	350	1	3,756	0	0	No

N/A = Not available.

Table A1.4
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Subsurface Soil in the SEEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent of Nondetected Results > ESL	Analyte Detected?
Inorganic (mg/kg)								
Antimony	9.50	-	9.70	2	18.7	0	0	No
Mercury	0.0600	-	0.110	6	3.15	0	0	No
Silver	0.340	-	1.20	6	N/A	0	0	No
Thallium	0.220	-	0.390	6	204	0	0	No
Tin	2.90	-	31.4	5	80.6	0	0	No
Organic (ug/kg)								
1,1,2,2-Tetrachloroethane	6	-	6	5	4.70E+06	0	0	No
1,1,2-Trichloroethane	6	-	6	5	N/A	0	0	No
1,1-Dichloroethane	6	-	6	5	215,360	0	0	No
1,1-Dichloroethene	6	-	6	5	1.28E+06	0	0	No
1,2,4-Trichlorobenzene	360	-	390	3	94,484	0	0	No
1,2-Dichlorobenzene	360	-	390	3	N/A	0	0	No
1,2-Dichloroethane	6	-	6	5	2.00E+06	0	0	No
1,2-Dichloroethene	6	-	6	5	1.87E+06	0	0	No
1,2-Dichloropropane	6	-	6	5	3.92E+06	0	0	No
1,3-Dichlorobenzene	360	-	390	3	N/A	0	0	No
1,4-Dichlorobenzene	360	-	390	3	5.93E+06	0	0	No
2,4,5-Trichlorophenol	1,700	-	1,900	3	N/A	0	0	No
2,4,6-Trichlorophenol	360	-	390	3	17,263	0	0	No
2,4-Dichlorophenol	360	-	390	3	249,324	0	0	No
2,4-Dimethylphenol	360	-	390	3	N/A	0	0	No
2,4-Dinitrophenol	1,700	-	1,900	3	4.90E+06	0	0	No
2,4-Dinitrotoluene	360	-	390	3	2,473	0	0	No
2,6-Dinitrotoluene	360	-	390	3	477,309	0	0	No
2-Butanone	11	-	12	5	4.94E+07	0	0	No
2-Chloronaphthalene	360	-	390	3	N/A	0	0	No
2-Chlorophenol	360	-	390	3	21,598	0	0	No
2-Hexanone	11	-	12	5	N/A	0	0	No
2-Methylnaphthalene	360	-	390	3	319,121	0	0	No
2-Methylphenol	360	-	390	3	9.26E+06	0	0	No
2-Nitroaniline	1,700	-	1,900	3	418,475	0	0	No
2-Nitrophenol	360	-	390	3	N/A	0	0	No
3,3'-Dichlorobenzidine	710	-	780	3	N/A	0	0	No
3-Nitroaniline	1,700	-	1,900	3	N/A	0	0	No
4,6-Dinitro-2-methylphenol	1,700	-	1,900	3	44,283	0	0	No
4-Bromophenyl-phenylether	360	-	390	3	N/A	0	0	No
4-Chloro-3-methylphenol	360	-	390	3	N/A	0	0	No
4-Chloroaniline	360	-	390	3	48,856	0	0	No
4-Chlorophenyl-phenyl ether	360	-	390	3	N/A	0	0	No
4-Methyl-2-pentanone	11	-	12	5	859,131	0	0	No
4-Methylphenol	360	-	390	3	N/A	0	0	No
4-Nitroaniline	1,700	-	1,900	3	2.62E+06	0	0	No
4-Nitrophenol	1,700	-	1,900	3	1.02E+06	0	0	No
Acenaphthene	360	-	390	3	N/A	0	0	No
Acenaphthylene	360	-	390	3	N/A	0	0	No
Acetone	11	-	12	5	247,687	0	0	No
Anthracene	360	-	390	3	N/A	0	0	No
Benzene	6	-	6	5	1.10E+06	0	0	No
Benzo(a)anthracene	360	-	390	3	N/A	0	0	No
Benzo(a)pyrene	360	-	390	3	502,521	0	0	No
Benzo(b)fluoranthene	360	-	390	3	N/A	0	0	No
Benzo(g,h,i)perylene	360	-	390	3	N/A	0	0	No
Benzo(k)fluoranthene	360	-	390	3	N/A	0	0	No
Benzoic Acid	1,700	-	1,900	3	N/A	0	0	No
Benzyl Alcohol	360	-	390	3	253,015	0	0	No
bis(2-Chloroethoxy) methane	360	-	390	3	N/A	0	0	No

Table A1.4
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Subsurface Soil in the SEEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent of Nondetected Results > ESL	Analyte Detected?
bis(2-Chloroethyl) ether	360	-	390	3	N/A	0	0	No
bis(2-Chloroisopropyl) ether	360	-	390	3	N/A	0	0	No
Bromodichloromethane	6	-	6	5	381,135	0	0	No
Bromoform	6	-	6	5	198,571	0	0	No
Bromomethane	11	-	12	5	N/A	0	0	No
Butylbenzylphthalate	360	-	390	3	3.37E+06	0	0	No
Carbon Disulfide	6	-	6	5	410,941	0	0	No
Carbon Tetrachloride	6	-	6	5	736,154	0	0	No
Chlorobenzene	6	-	6	5	413,812	0	0	No
Chloroethane	11	-	12	5	N/A	0	0	No
Chloroform	6	-	6	5	560,030	0	0	No
Chloromethane	11	-	12	5	N/A	0	0	No
Chrysene	360	-	390	3	N/A	0	0	No
cis-1,3-Dichloropropene	6	-	6	5	222,413	0	0	No
Dibenz(a,h)anthracene	360	-	390	3	N/A	0	0	No
Dibenzofuran	360	-	390	3	2.44E+06	0	0	No
Dibromochloromethane	6	-	6	5	389,064	0	0	No
Diethylphthalate	360	-	390	3	2.21E+08	0	0	No
Dimethylphthalate	360	-	390	3	1.35E+07	0	0	No
Di-n-butylphthalate	360	-	390	3	4.06E+07	0	0	No
Di-n-octylphthalate	360	-	390	3	2.58E+08	0	0	No
Ethylbenzene	6	-	6	5	N/A	0	0	No
Fluoranthene	360	-	390	3	N/A	0	0	No
Fluorene	360	-	390	3	N/A	0	0	No
Hexachlorobenzene	360	-	390	3	190,142	0	0	No
Hexachlorobutadiene	360	-	390	3	150,894	0	0	No
Hexachlorocyclopentadiene	360	-	390	3	799,679	0	0	No
Hexachloroethane	360	-	390	3	45,656	0	0	No
Indeno(1,2,3-cd)pyrene	360	-	390	3	N/A	0	0	No
Isophorone	360	-	390	3	N/A	0	0	No
Methylene Chloride	6	-	6	5	209,560	0	0	No
Naphthalene	360	-	390	3	1.60E+07	0	0	No
Nitrobenzene	360	-	390	3	N/A	0	0	No
N-Nitroso-di-n-propylamine	360	-	390	3	N/A	0	0	No
N-nitrosodiphenylamine	360	-	390	3	2.15E+06	0	0	No
Pentachlorophenol	1,700	-	1,900	3	18,373	0	0	No
Phenanthrene	360	-	390	3	N/A	0	0	No
Phenol	360	-	390	3	1.49E+06	0	0	No
Pyrene	360	-	390	3	N/A	0	0	No
Tetrachloroethene	6	-	6	5	72,494	0	0	No
trans-1,3-Dichloropropene	6	-	6	5	222,413	0	0	No
Trichloroethene	6	-	6	5	32,424	0	0	No
Vinyl acetate	11	-	12	5	730,903	0	0	No
Vinyl Chloride	11	-	12	5	6,494	0	0	No

N/A = Not available.

Table A1.5
Summary of Professional Judgment and Ecological Risk Potential

Analyte	SUMMARY OF PROFESSIONAL JUDGMENT								ECOLOGICAL RISK POTENTIAL						
	Listed as Waste Constituent for SEEU Historical IHSSs ?[1]	Historical RFETS Inventory [2] (1974/1988) (kg)	Maximum Conc. in Soil Sitewide (ug/kg)	Detection Frequency in Sitewide Soil (%)	Maximum Conc. in SEEU Soil (ug/kg)	Detection Frequency in SEEU Soil (%)	Potential for Detection Based on Professional Judgment?	Uncertainty Category[3]	Lowest ESL (ug/kg)	Most Sensitive Receptor [4]	LOAEL/ NOAEL [5]	LOAEL-Based Soil Conc. (ug/kg)	Maximum Reported Result for Non-detects in SEEU (ug/kg)	Maximum Reported Result/ LOAEL-Based Soil Conc. [6]	Potential for Adverse Effects if Detected at Reported Results Levels?
2,4,6-trichlorophenol	No	0/.01	950	.1	NA	0	No	2	160.5	Deer Mouse Insectivore	100	16050	710	0.04	No
2,4-dinitrotoluene	No	0/0	NA	0	NA	0	No	1	32.1	Deer Mouse Insectivore	10	321	710	2	Yes
2-chlorophenol	No	.12/.02	NA	0	NA	0	No	1	281.4	Deer Mouse Insectivore	100	28140	710	0.2	No
4,4'DDE	No	0/.001	7.2	1.5	NA	0	No	2	8	Mourning Dove Insectivore	10	80	35	0.4	No
4,4'DDT	No	0/.001	26	0.9	NA	0	No	2	1.2	Mourning Dove Insectivore	167	200	35	0.2	No
4,6-dinitro-2-methylphenol	No	0/0	390	0.1	NA	0	No	2	560	Deer Mouse Insectivore	20	11200	3600	0.3	No
benzo(a)pyrene	Yes(1)	0/.002	43000	41.2	NA	0	Yes	4	631	Deer Mouse Insectivore	25	15775	710	0.04	No
bis(2-ethylhexyl)phthalate	No	0/.01	75000	29.7	NA	0	No	3	137	Mourning Dove Insectivore	NVA	NVA	710	NVA	I
dieldrin	No	0/.003	92	2.4	NA	0	No	2	7.4	Preble's Meadow Jumping Mouse	2	14.8	35	2	Yes
di-n-butylphthalate	No	0/.005	10000	8.0	NA	0	No	3	15.9	Mourning Dove Insectivore	10	159	710	4	Yes
endrin	No	0/.004	17	1.3	NA	0	No	2	1.4	Mourning Dove Insectivore	10	14	35	2	Yes
endrin ketone	No	0/0	36	.2	NA	0	No	2	1.4	Mourning Dove Insectivore	10	14	35	2	Yes
hexachlorobenzene	No	1/1.005	380	0.3	NA	0	No	2	7.7	Mourning Dove Insectivore	40	308	710	2	Yes
hexachlorobutadiene	No	0/.005	2.2	0.1	NA	0	No	2	431	Mourning Dove Insectivore	NVA	NVA	710	NVA	I
hexachloroethane	No	0.02/0.02	NA	0	NA	0	No	1	366	Deer Mouse Insectivore	20	7320	710	0.1	No
PCB-1254	No	0/.02	8900	17.9	NA	0	No	3	172	Mourning Dove Insectivore	14.1	2425	350	0.1	No
PCB-1260	No	0/.02	7800	17.2	NA	0	No	3	172	Mourning Dove Insectivore	14.1	2425	350	0.1	No
pentachlorophenol	No	.02/.02	39000	1	NA	0	No	2	121.9	Deer Mouse Insectivore	10	1219	3600	3	Yes

[1] Includes listing of the class of compound, e.g., herbicides, pesticides, chlorinated solvents, polynuclear aromatic hydrocarbons, etc. Ref. DOE, 2005a.
[2] CDH, 1991.
[3] See text for explanation.
[4] Basis for the lowest ESL.
[5] LOAELs and NOAELs from Appendix B, Table B-2, "TRVs for Terrestrial Vertebrate Receptors", Ref. DOE 2005b.
[6] Ratios are rounded to one significant figure.
(1) Oils were spayed on PAC 000-501, Roadway Spraying. The oils are not expected to contain PCBs but could contain polynuclear aromatic hydrocarbons and phthalates.
CDH – Colorado Department of Health
DDE – dichlorodiphenyldichloroethylene
DDT – dichlorodiphenyltrichloroethane
DOE – Department of Energy
ESL – Ecological Screening Level
IHSS – Individual Hazardous Substance Site
LOAEL – Lowest Bounded Lowest Observed Adverse Effect Level
NOAEL – Final No Observed Adverse Effect Level
RFETS – Rocky Flats Environmental Technology Site
SEEU – Southeast Exposure Unit
NA – Not applicable
NVA – No Value Available
I – Inconclusive

COMPREHENSIVE RISK ASSESSMENT

SOUTHEAST BUFFER ZONE AREA EXPOSURE UNIT

VOLUME 13: ATTACHMENT 2

Data Quality Assessment

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ACRONYMS AND ABBREVIATIONS

AA	atomic absorption
ASD	Analytical Services Division
COC	contaminant of concern
CRA	Comprehensive Risk Assessment
CRDL	contract required detection limit
DAR	data adequacy report
DER	duplicate error ratio
DOE	U.S. Department of Energy
DQA	Data Quality Assessment
DQO	data quality objective
DRC	data review checklist
ECOPC	ecological contaminant of potential concern
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ESL	ecological screening level
EU	exposure unit
FD	field duplicate
IAG	Interagency Agreement
ICP	inductively couple plasma
IDL	instrument detection limit
LCS	laboratory control sample
MDA	minimum detectable activity

MDL	method detection limit
MS	matrix spike
MSA	method of standard additions
MSD	matrix spike duplicate
N/A	not applicable
PARCC	precision, accuracy, representativeness, completeness, and comparability
PPT	Pipette
PRG	preliminary remediation goal
PCB	polychlorinated biphenyl
QC	quality control
RDL	required detection limit
RFETS	Rocky Flats Environmental Technology Site
RI/FS	Remedial Investigation/Feasibility Study
RL	reporting limit
RPD	relative percent difference
SEEU	Southeast Buffer Zone Area Exposure Unit
SDP	standard data package
SOW	Statement of Work
SVOC	semi-volatile organic compound
SWD	Soil Water Database
TCLP	Toxicity Characteristic Leaching Procedure
TIC	tentatively identified compound
V&V	verification and validation
VOC	volatile organic compound

1.0 INTRODUCTION

This document provides an assessment of the quality of the data used in the human health and ecological risk assessments for the Southeast Buffer Zone Area Exposure Unit (SEEU). The data quality was evaluated against standard precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters by the data validator under the multiple work plans that guided the data collection over the past 15 years, as well as the requirements for the PARCC parameters provided in the Comprehensive Risk Assessment (CRA) Methodology (DOE 2005). The details of this data quality assessment (DQA) process are presented in the Sitewide DQA contained in Appendix A, Volume 2, Attachment 2 of the Remedial Investigation/Feasibility Study (RI/FS).

Of the 10,732 environmental sampling records in the RFETS database associated with the SEEU, 7,596 were used in the SEEU risk assessment based on the data processing rules described in Section 2.0 of the Sitewide DQA. Of the 7,596 analytical records existing in the SEEU CRA data set, 92 percent (6,991 records) have undergone verification or validation (V&V) (Table A2.1). The V&V review involved applying observation notes and qualifiers flags or observation notes without qualifier flags to the data.

PARCC parameter analysis was used to determine if the data quality could affect the risk assessment decisions (i.e., have significant impact on risk calculations or selection of contaminants of concern [COCs] for human health or ecological contaminants of potential concern [ECOPCs]). In consultation with the data users and project team, the primary ways in which the PARCC parameters could impact the risk assessment decisions were identified and these include the following:

- Detect results are falsely identified as nondetects;
- Nondetect results are falsely identified as detects;
- Issues that cause detection limit uncertainty;
- Issues that cause significant overestimation of detect results; and
- Issues that cause significant underestimation of detect results.

2.0 SUMMARY OF FINDINGS

2.1 PARCC Findings

A summary of V&V observations and the associated affected PARCC parameter is presented in Table A2.2 by analyte group and matrix (i.e., “soil” includes soil and sediment, and “water” includes surface water and groundwater). Table A2.3 presents the percentage of the SEEU V&V data that were qualified as estimated and/or undetected by

analyte group and matrix. Overall, approximately 15 percent of the SEEU CRA data were qualified as estimated or undetected. Less than 5 percent of the data reported as detected by the laboratory were qualified as undetected by the validator due to blank contamination (Table A2.4). In general, data qualified as estimated or undetected are marked as such because of various laboratory noncompliance issues that are not serious enough to render the data unusable. The precision between field duplicate (FD)/target sample analyte pairs is summarized in Table A2.5.

Of the 92 percent of the SEEU data set that underwent V&V, 81 percent were qualified as having no QC issues, and approximately 15 percent were qualified as estimated or undetected (Table A2.3). The remaining 4 percent of the V&V data are made up of records qualified with additional flags indicating acceptable and non-estimated data such as “A”, “C”, or “E”.

Approximately 3 percent of the entire data set was rejected during the V&V process (Table A2.6). Rejected data were removed from the SEEU CRA data set during the data processing as defined in Section 2.0 of the Sitewide DQA.

The general discussion below summarizes the data quality as presented by the data validator’s observations. The relationship between these observations and the PARCC parameters can be found in the Sitewide DQA. Several observations have no impact on data quality because they represent issues that were noted but corrected, or represent other general observations, such as missing documentation that was not required for data assessment. Approximately 12 percent of the SEEU V&V data were marked with these V&V observations that have no affect on any of the PARCC parameters.

Of the V&V data, approximately 2 percent were noted for observations related to precision. Of that 2 percent, 95 percent contained issues related to sample matrices. Result confirmation observations make up the other 5 percent.

Of the V&V data, 42 percent were noted for accuracy-related observations. Of that 42 percent, 98 percent was noted for laboratory practice-related observations, while sample-specific accuracy observations make up the other 2 percent. It is important to note that not all accuracy-related observations resulted in data qualification. Only 15 percent of the SEEU CRA data set was qualified as estimated and/or undetected (Table A2.3).

The data were determined to meet the representativeness parameter because sampling locations are spatially distributed such that contaminant randomness and bias considerations are addressed based on the site-specific history (see the Data Adequacy Report [DAR] in Appendix A, Volume 2, Attachment 3). Samples were also analyzed by the SW-846 or alpha-spectroscopy methods and results were documented as quality records according to approved procedures and guidelines (V&V).

Of the V&V data, approximately 40 percent were noted for observations related to representativeness. Of that 40 percent, 68 percent was marked for blank observations, 23 percent for failure to observe allowed holding times, 3 percent for documentation issues, 1 percent for sample preparation observations, and 2 percent for instrument sensitivity issues. Matrix, LCS, and other observations make up the other 3 percent of the data noted

for observations related to sample representativeness. Reportable levels of target analytes were not routinely detected in the laboratory blanks greater than the laboratory RLs and samples were generally stored and preserved properly.

The CRA Methodology specifies completeness criteria based on data adequacy and these criteria and the findings are discussed in the DAR in Appendix A, Volume 2, Attachment 3 of the RI/FS. Additionally, it should be noted that only approximately 3 percent of all V&V data associated with the SEEU were rejected.

Comparability of the SEEU CRA data set is ensured as all analytical results have been converted into common units. Comparability is addressed more specifically in Appendix A, Volume 2, Attachment 2 of the RI/FS.

2.2 PARCC Findings Potential Impact on Data Usability

PARCC parameter influence on data usability is discussed below with an emphasis on the risk assessment decisions as described in the Introduction to this document.

Table A2.3 summarizes the overall percentage of qualified data, independent of validation observation. The table is used for overall guidance in selecting analyte group and matrix combinations of interest in the analysis of the risk assessment decisions, the impact on data usability is better analyzed using Tables A2.5 through A2.7, as these can be more directly related to the 5 key risk assessment decision factors described in the introduction.

A summary of FD/target sample precision information can be found in Table A2.5. Where there are analyte group and matrix combinations failures that have the potential to impact risk assessment decisions, the data quality is discussed in further detail in the bulleted list below.

Table A2.7 lists V&V observations where the number of observations by analyte group and matrix exceeds 5 percent of the associated records (see column “Percent Observed”) with the exception of those observations that were determined to have no impact on any of the PARCC parameters. Such observations are identified in Table A2.2 by an “Affected PARCC Parameter” of not applicable (N/A). Additionally the analyte group and matrix is broken down further in the columns “Percent Qualified U” and “Percent Qualified J”. Data qualifications that are considered to have potential impact on risk assessment decisions were reviewed and are discussed in detail in the bulleted list below. Other issues are not considered to have the potential for significant impacts on the results of the risk assessments because the uncertainty associated with these data quality issues is assumed to be less than the overall uncertainty in the risk assessment process (e.g., uncertainties such as exposure assumptions, toxicity values, and statistical methods for calculating exposure point concentrations).

Data qualifications associated with the water matrix are not discussed below. Surface water data are used in the ecological risk assessment for an EU only for those analytes

identified as ECOPCs, and the surface water component of exposure contributes only minimally to the overall risk estimates. As described in the Sitewide DQA (Attachment 2 of Volume 2 of Appendix A of the RI/FS Report), groundwater data are not used in the ecological risk assessment and the groundwater evaluations for the human health portion of the risk assessment are performed on a sitewide basis. In addition, surface water is evaluated for the human health risk assessment on a sitewide basis. Therefore, data quality evaluations for groundwater and surface water are presented in the Sitewide DQA.

Issues that have the potential to impact the risk assessment decisions include the following:

- Approximately 18 percent of the volatile organic compound (VOC)/soil results associated with the SEEU were qualified as estimated and noted with the V&V observation that allowed sample holding times were exceeded. This V&V observation has the potential to affect the representativeness of associated data. Data representativeness related to sample holding times is important as false nondetect results have the potential to impact the ECOPC and COC selection processes. As all records associated with this V&V observation that were qualified as estimated data are nondetect results, the potential impact on risk assessment decisions was reviewed. The impact to the human health risk assessment is determined to be minimal as all of the nondetect VOC results associated with the SEEU were reported at levels well below human health preliminary remediation goals (PRGs). Although one hexachloroethane result was reported as nondetected at a concentration above the lowest associated ecological screening level (ESL), it is important to note that this was only one result and all other VOCs were reported at levels well below associated ESLs. The impact to the ecological risk assessment is also determined to be minimal.

- Several V&V observations related to the wet chemistry/soil analyte group and matrix combination resulted in data qualifications in notable percentages of the data set (Table A2.7). It is important to note, however, that this analyte group contains general chemistry parameters such as ions/anions and alkalinity that are not directly related to site characterization. Therefore, the impact of these qualifications on risk assessment results is determined to be minimal.

3.0 CONCLUSIONS

This review concludes that the quality of the SEEU data is acceptable and the CRA objectives for PARCC performance have generally been met. Where either CRA Methodology or V&V guidance have not been met, the data are either flagged by the V&V process, or for those instances where the frequency of issues may influence the risk assessment decisions, the data quality issues were reviewed for potential impact on risk assessment results.

Those elements of data quality that could affect risk assessment decisions in the SEEU have been analyzed and it was concluded that the noted deviations from the PARCC parameter criteria have minimal impact on risk assessment results related to the SEEU.

4.0 REFERENCES

DOE, 2002, Final Work Plan for the Development of the Remedial Investigation and Feasibility Study Report, Rocky Flats Environmental Technology Site, Golden, Colorado, March.

DOE, 2005. Final Comprehensive Risk Assessment Work Plan and Methodology, Environmental Restoration, Rocky Flats Environmental Technology Site, Golden, Colorado. Revision 1, September 2005.

TABLES

Table A2.1
CRA Data V&V Summary

Analyte Group	Matrix	Total No. of CRA V&V Records	Total No. of CRA Records	Percent V&V (%)
Dioxins and Furans	Water	1	1	100.00
Herbicide	Soil	4	4	100.00
Herbicide	Water	7	7	100.00
Metal	Soil	831	831	100.00
Metal	Water	1,647	1,857	88.69
PCB	Soil	7	7	100.00
PCB	Water	35	35	100.00
Pesticide	Soil	24	24	100.00
Pesticide	Water	115	115	100.00
Radionuclide	Soil	291	303	96.04
Radionuclide	Water	395	477	82.81
SVOC	Soil	236	236	100.00
SVOC	Water	308	330	93.33
VOC	Soil	186	186	100.00
VOC	Water	2,629	2,878	91.35
Wet Chem	Soil	18	18	100.00
Wet Chem	Water	257	287	89.55
	Total	**6,991**	**7,596**	**92.04%**

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Dioxins and Furans	Water	Documentation Issues	Record added by the validator	No	1	1	100.00	N/A
Herbicide	Water	Calibration	Continuing calibration verification criteria were not met	No	1	7	14.29	Accuracy
Metal	Soil	Blanks	Calibration verification blank contamination	No	48	831	5.78	Representativeness
Metal	Soil	Blanks	Calibration verification blank contamination	Yes	4	831	0.48	Representativeness
Metal	Soil	Blanks	Method, preparation, or reagent blank contamination	No	10	831	1.20	Representativeness
Metal	Soil	Blanks	Negative bias indicated in the blanks	No	1	831	0.12	Representativeness
Metal	Soil	Blanks	Negative bias indicated in the blanks	Yes	4	831	0.48	Representativeness
Metal	Soil	Calibration	Calibration correlation coefficient did not meet requirements	No	2	831	0.24	Accuracy
Metal	Soil	Documentation Issues	Transcription error	No	11	831	1.32	N/A
Metal	Soil	Documentation Issues	Transcription error	Yes	46	831	5.54	N/A
Metal	Soil	Holding Times	Holding times were exceeded	No	1	831	0.12	Representativeness
Metal	Soil	Instrument Set-up	Interference was indicated in the interference check sample	Yes	5	831	0.60	Accuracy
Metal	Soil	LCS	CRDL check sample recovery criteria were not met	No	4	831	0.48	Accuracy
Metal	Soil	LCS	CRDL check sample recovery criteria were not met	Yes	1	831	0.12	Accuracy
Metal	Soil	LCS	LCS recovery criteria were not met	No	7	831	0.84	Accuracy
Metal	Soil	LCS	LCS recovery criteria were not met	Yes	12	831	1.44	Accuracy
Metal	Soil	LCS	Low level check sample recovery criteria were not met	No	14	831	1.68	Accuracy
Metal	Soil	LCS	Low level check sample recovery criteria were not met	Yes	1	831	0.12	Accuracy
Metal	Soil	Matrices	Duplicate sample precision criteria were not met	Yes	6	831	0.72	Precision
Metal	Soil	Matrices	LCS/LCSD precision criteria were not met	Yes	1	831	0.12	Precision
Metal	Soil	Matrices	Post-digestion MS did not meet control criteria	No	6	831	0.72	Accuracy
Metal	Soil	Matrices	Post-digestion MS did not meet control criteria	Yes	5	831	0.60	Accuracy

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Metal	Soil	Matrices	Predigestion MS recovery criteria were not met	No	18	831	2.17	Accuracy
Metal	Soil	Matrices	Predigestion MS recovery criteria were not met	Yes	58	831	6.98	Accuracy
Metal	Soil	Matrices	Serial dilution criteria were not met	Yes	52	831	6.26	Accuracy
Metal	Soil	Other	IDL is older than 3 months from date of analysis	No	90	831	10.83	Accuracy
Metal	Soil	Other	IDL is older than 3 months from date of analysis	Yes	298	831	35.86	Accuracy
Metal	Soil	Other	Result obtained through dilution	Yes	1	831	0.12	N/A
Metal	Water	Blanks	Calibration verification blank contamination	No	57	1,647	3.46	Representativeness
Metal	Water	Blanks	Calibration verification blank contamination	Yes	12	1,647	0.73	Representativeness
Metal	Water	Blanks	Method, preparation, or reagent blank contamination	No	148	1,647	8.99	Representativeness
Metal	Water	Blanks	Method, preparation, or reagent blank contamination	Yes	11	1,647	0.67	Representativeness
Metal	Water	Blanks	Negative bias indicated in the blanks	No	16	1,647	0.97	Representativeness
Metal	Water	Blanks	Negative bias indicated in the blanks	Yes	7	1,647	0.43	Representativeness
Metal	Water	Calibration	Calibration correlation coefficient did not meet requirements	No	4	1,647	0.24	Accuracy
Metal	Water	Calibration	Calibration correlation coefficient did not meet requirements	Yes	5	1,647	0.30	Accuracy
Metal	Water	Calibration	Continuing calibration verification criteria were not met	Yes	1	1,647	0.06	Accuracy
Metal	Water	Documentation Issues	Key data fields incorrect	No	5	1,647	0.30	N/A
Metal	Water	Documentation Issues	Missing deliverables (not required for validation)	No	1	1,647	0.06	N/A
Metal	Water	Documentation Issues	Missing deliverables (not required for validation)	Yes	1	1,647	0.06	N/A
Metal	Water	Documentation Issues	Missing deliverables (required for validation)	No	10	1,647	0.61	Representativeness
Metal	Water	Documentation Issues	Missing deliverables (required for validation)	Yes	18	1,647	1.09	Representativeness
Metal	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	No	22	1,647	1.34	N/A

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Metal	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	31	1,647	1.88	N/A
Metal	Water	Documentation Issues	Transcription error	No	68	1,647	4.13	N/A
Metal	Water	Holding Times	Holding times were exceeded	No	2	1,647	0.12	Representativeness
Metal	Water	Instrument Set-up	Interference was indicated in the interference check sample	No	1	1,647	0.06	Accuracy
Metal	Water	Instrument Set-up	Interference was indicated in the interference check sample	Yes	3	1,647	0.18	Accuracy
Metal	Water	LCS	CRDL check sample recovery criteria were not met	No	4	1,647	0.24	Accuracy
Metal	Water	LCS	CRDL check sample recovery criteria were not met	Yes	6	1,647	0.36	Accuracy
Metal	Water	LCS	LCS recovery criteria were not met	No	2	1,647	0.12	Accuracy
Metal	Water	LCS	LCS recovery criteria were not met	Yes	8	1,647	0.49	Accuracy
Metal	Water	LCS	Low level check sample recovery criteria were not met	No	23	1,647	1.40	Accuracy
Metal	Water	LCS	Low level check sample recovery criteria were not met	Yes	22	1,647	1.34	Accuracy
Metal	Water	Matrices	Duplicate sample precision criteria were not met	No	2	1,647	0.12	Precision
Metal	Water	Matrices	Duplicate sample precision criteria were not met	Yes	3	1,647	0.18	Precision
Metal	Water	Matrices	LCS/LCSD precision criteria were not met	No	2	1,647	0.12	Precision
Metal	Water	Matrices	LCS/LCSD precision criteria were not met	Yes	2	1,647	0.12	Precision
Metal	Water	Matrices	MSA calibration correlation coefficient < 0.995	Yes	1	1,647	0.06	Accuracy
Metal	Water	Matrices	Post-digestion MS did not meet control criteria	No	14	1,647	0.85	Accuracy
Metal	Water	Matrices	Post-digestion MS did not meet control criteria	Yes	7	1,647	0.43	Accuracy
Metal	Water	Matrices	Predigestion MS recovery criteria were not met	No	23	1,647	1.40	Accuracy
Metal	Water	Matrices	Predigestion MS recovery criteria were not met	Yes	22	1,647	1.34	Accuracy
Metal	Water	Matrices	Predigestion MS recovery was < 30 percent	Yes	2	1,647	0.12	Accuracy

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Metal	Water	Matrices	Serial dilution criteria were not met	No	1	1,647	0.06	Accuracy
Metal	Water	Matrices	Serial dilution criteria were not met	Yes	41	1,647	2.49	Accuracy
Metal	Water	Other	IDL is older than 3 months from date of analysis	No	61	1,647	3.70	Accuracy
Metal	Water	Other	IDL is older than 3 months from date of analysis	Yes	55	1,647	3.34	Accuracy
Metal	Water	Other	See hard copy for further explanation	No	2	1,647	0.12	N/A
Metal	Water	Other	See hard copy for further explanation	Yes	7	1,647	0.43	N/A
Metal	Water	Sample Preparation	Samples were not properly preserved in the field	No	12	1,647	0.73	Representativeness
Metal	Water	Sample Preparation	Samples were not properly preserved in the field	Yes	15	1,647	0.91	Representativeness
Metal	Water	Sensitivity	IDL changed due to a significant figure discrepancy	No	7	1,647	0.43	Representativeness
PCB	Water	Documentation Issues	Transcription error	No	8	35	22.86	N/A
PCB	Water	Surrogates	Surrogate recovery criteria were not met	No	7	35	20.00	Accuracy
Pesticide	Water	Calibration	Continuing calibration verification criteria were not met	No	8	115	6.96	Accuracy
Pesticide	Water	Documentation Issues	Transcription error	No	2	115	1.74	N/A
Pesticide	Water	Surrogates	Surrogate recovery criteria were not met	No	21	115	18.26	Accuracy
Radionuclide	Soil	Blanks	Method, preparation, or reagent blank contamination	Yes	18	291	6.19	Representativeness
Radionuclide	Soil	Calibration	Continuing calibration verification criteria were not met	Yes	2	291	0.69	Accuracy
Radionuclide	Soil	Documentation Issues	Record added by the validator	Yes	32	291	11.00	N/A
Radionuclide	Soil	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	32	291	11.00	Representativeness
Radionuclide	Soil	Documentation Issues	Transcription error	Yes	19	291	6.53	N/A
Radionuclide	Soil	Instrument Set-up	Resolution criteria were not met	Yes	1	291	0.34	Representativeness
Radionuclide	Soil	LCS	LCS recovery > +/- 3 sigma	Yes	7	291	2.41	Accuracy
Radionuclide	Soil	LCS	LCS recovery criteria were not met	Yes	4	291	1.37	Accuracy
Radionuclide	Soil	LCS	LCS relative percent error criteria not met	No	1	291	0.34	Accuracy
Radionuclide	Soil	LCS	LCS relative percent error criteria not met	Yes	39	291	13.40	Accuracy

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Radionuclide	Soil	Matrices	Recovery criteria were not met	Yes	3	291	1.03	Accuracy
Radionuclide	Soil	Matrices	Replicate precision criteria were not met	Yes	9	291	3.09	Precision
Radionuclide	Soil	Matrices	Replicate recovery criteria were not met	Yes	2	291	0.69	Accuracy
Radionuclide	Soil	Other	Lab results not verified due to unsubmitted data	Yes	1	291	0.34	Representativeness
Radionuclide	Soil	Other	QC sample does not meet method requirements	No	27	291	9.28	Representativeness
Radionuclide	Soil	Other	QC sample does not meet method requirements	Yes	23	291	7.90	Representativeness
Radionuclide	Soil	Sensitivity	MDA exceeded the RDL	Yes	1	291	0.34	Representativeness
Radionuclide	Soil	Sensitivity	MDA was calculated by reviewer	Yes	50	291	17.18	N/A
Radionuclide	Water	Blanks	Method, preparation, or reagent blank contamination	No	3	395	0.76	Representativeness
Radionuclide	Water	Blanks	Method, preparation, or reagent blank contamination	Yes	16	395	4.05	Representativeness
Radionuclide	Water	Calculation Errors	Calculation error	Yes	2	395	0.51	N/A
Radionuclide	Water	Calibration	Calibration counting statistics did not meet criteria	No	3	395	0.76	Accuracy
Radionuclide	Water	Calibration	Continuing calibration verification criteria were not met	No	6	395	1.52	Accuracy
Radionuclide	Water	Calibration	Continuing calibration verification criteria were not met	Yes	63	395	15.95	Accuracy
Radionuclide	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	No	3	395	0.76	N/A
Radionuclide	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	3	395	0.76	N/A
Radionuclide	Water	Documentation Issues	Record added by the validator	Yes	8	395	2.03	N/A
Radionuclide	Water	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	34	395	8.61	Representativeness
Radionuclide	Water	Documentation Issues	Transcription error	No	24	395	6.08	N/A
Radionuclide	Water	Documentation Issues	Transcription error	Yes	16	395	4.05	N/A
Radionuclide	Water	Holding Times	Holding times were exceeded	No	1	395	0.25	Representativeness
Radionuclide	Water	Holding Times	Holding times were exceeded	Yes	1	395	0.25	Representativeness
Radionuclide	Water	Instrument Set-up	Transformed spectral index external site criteria were not met	No	3	395	0.76	Representativeness

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Radionuclide	Water	LCS	Expected LCS value not submitted/verifiable	No	1	395	0.25	Representativeness
Radionuclide	Water	LCS	Expected LCS value not submitted/verifiable	Yes	5	395	1.27	Representativeness
Radionuclide	Water	LCS	LCS data not submitted by the laboratory	Yes	3	395	0.76	Representativeness
Radionuclide	Water	LCS	LCS recovery > +/- 3 sigma	No	9	395	2.28	Accuracy
Radionuclide	Water	LCS	LCS recovery > +/- 3 sigma	Yes	11	395	2.78	Accuracy
Radionuclide	Water	LCS	LCS recovery criteria were not met	No	1	395	0.25	Accuracy
Radionuclide	Water	LCS	LCS recovery criteria were not met	Yes	2	395	0.51	Accuracy
Radionuclide	Water	LCS	LCS relative percent error criteria not met	No	4	395	1.01	Accuracy
Radionuclide	Water	LCS	LCS relative percent error criteria not met	Yes	18	395	4.56	Accuracy
Radionuclide	Water	Matrices	Recovery criteria were not met	No	1	395	0.25	Accuracy
Radionuclide	Water	Matrices	Recovery criteria were not met	Yes	6	395	1.52	Accuracy
Radionuclide	Water	Matrices	Replicate analysis was not performed	No	7	395	1.77	Precision
Radionuclide	Water	Matrices	Replicate analysis was not performed	Yes	6	395	1.52	Precision
Radionuclide	Water	Matrices	Replicate precision criteria were not met	No	1	395	0.25	Precision
Radionuclide	Water	Matrices	Replicate precision criteria were not met	Yes	26	395	6.58	Precision
Radionuclide	Water	Matrices	Replicate recovery criteria were not met	No	1	395	0.25	Accuracy
Radionuclide	Water	Matrices	Replicate recovery criteria were not met	Yes	2	395	0.51	Accuracy
Radionuclide	Water	Other	QC sample does not meet method requirements	No	3	395	0.76	Representativeness
Radionuclide	Water	Other	See hard copy for further explanation	Yes	21	395	5.32	N/A
Radionuclide	Water	Other	Tracer requirements were not met	No	1	395	0.25	Accuracy
Radionuclide	Water	Other	Tracer requirements were not met	Yes	9	395	2.28	Accuracy
Radionuclide	Water	Sensitivity	MDA exceeded the RDL	No	7	395	1.77	Representativeness
Radionuclide	Water	Sensitivity	MDA exceeded the RDL	Yes	16	395	4.05	Representativeness
Radionuclide	Water	Sensitivity	MDA was calculated by reviewer	Yes	111	395	28.10	N/A
SVOC	Water	Blanks	Method, preparation, or reagent blank contamination	No	3	308	0.97	Representativeness
SVOC	Water	Calibration	Continuing calibration verification criteria were not met	No	9	308	2.92	Accuracy
SVOC	Water	Calibration	Independent calibration verification criteria not met	No	1	308	0.32	Accuracy
SVOC	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	No	6	308	1.95	N/A
SVOC	Water	Documentation Issues	Transcription error	No	11	308	3.57	N/A

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
SVOC	Water	Documentation Issues	Transcription error	Yes	1	308	0.32	N/A
SVOC	Water	Holding Times	Holding times were exceeded	No	13	308	4.22	Representativeness
SVOC	Water	Instrument Set-up	Instrument tune criteria were not met	No	9	308	2.92	Accuracy
SVOC	Water	LCS	LCS recovery criteria were not met	No	3	308	0.97	Accuracy
SVOC	Water	Other	Sample results were not validated due to re-analysis	No	9	308	2.92	N/A
SVOC	Water	Other	Sample results were not validated due to re-analysis	Yes	1	308	0.32	N/A
SVOC	Water	Other	See hard copy for further explanation	No	8	308	2.60	N/A
VOC	Soil	Blanks	Method, preparation, or reagent blank contamination	No	3	186	1.61	Representativeness
VOC	Soil	Documentation Issues	Transcription error	No	1	186	0.54	N/A
VOC	Soil	Holding Times	Holding times were exceeded	No	34	186	18.28	Representativeness
VOC	Water	Blanks	Method, preparation, or reagent blank contamination	No	17	2,629	0.65	Representativeness
VOC	Water	Blanks	Method, preparation, or reagent blank contamination	Yes	2	2,629	0.08	Representativeness
VOC	Water	Calibration	Continuing calibration verification criteria were not met	No	29	2,629	1.10	Accuracy
VOC	Water	Calibration	Independent calibration verification criteria not met	No	2	2,629	0.08	Accuracy
VOC	Water	Confirmation	Results were not confirmed	No	2	2,629	0.08	Precision
VOC	Water	Confirmation	Results were not confirmed	Yes	1	2,629	0.04	Precision
VOC	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	No	109	2,629	4.15	N/A
VOC	Water	Documentation Issues	Record added by the validator	No	2	2,629	0.08	N/A
VOC	Water	Documentation Issues	Transcription error	No	87	2,629	3.31	N/A
VOC	Water	Holding Times	Holding times were exceeded	No	155	2,629	5.90	Representativeness
VOC	Water	Instrument Set-up	Instrument tune criteria were not met	No	162	2,629	6.16	Accuracy
VOC	Water	Instrument Set-up	Instrument tune criteria were not met	Yes	2	2,629	0.08	Accuracy
VOC	Water	LCS	LCS recovery criteria were not met	No	74	2,629	2.81	Accuracy
VOC	Water	LCS	LCS recovery criteria were not met	Yes	1	2,629	0.04	Accuracy
VOC	Water	Other	Sample results were not validated due to re-analysis	No	34	2,629	1.29	N/A
VOC	Water	Other	See hard copy for further explanation	No	1	2,629	0.04	N/A

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Wet Chem	Soil	Matrices	Predigestion MS recovery was < 30 percent	Yes	15	18	83.33	Accuracy
Wet Chem	Soil	Other	IDL is older than 3 months from date of analysis	Yes	17	18	94.44	Accuracy
Wet Chem	Water	Calibration	Calibration correlation coefficient did not meet requirements	Yes	1	257	0.39	Accuracy
Wet Chem	Water	Calibration	Continuing calibration verification criteria were not met	Yes	1	257	0.39	Accuracy
Wet Chem	Water	Documentation Issues	Missing deliverables (not required for validation)	No	1	257	0.39	N/A
Wet Chem	Water	Documentation Issues	Missing deliverables (not required for validation)	Yes	2	257	0.78	N/A
Wet Chem	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	No	3	257	1.17	N/A
Wet Chem	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	6	257	2.33	N/A
Wet Chem	Water	Documentation Issues	Transcription error	No	4	257	1.56	N/A
Wet Chem	Water	Documentation Issues	Transcription error	Yes	9	257	3.50	N/A
Wet Chem	Water	Holding Times	Holding times were exceeded	No	2	257	0.78	Representativeness
Wet Chem	Water	Holding Times	Holding times were exceeded	Yes	5	257	1.95	Representativeness
Wet Chem	Water	Holding Times	Holding times were grossly exceeded	No	1	257	0.39	Representativeness
Wet Chem	Water	Matrices	Predigestion MS recovery criteria were not met	Yes	2	257	0.78	Accuracy
Wet Chem	Water	Matrices	Site samples were not used for sample matrix QC	No	1	257	0.39	Representativeness
Wet Chem	Water	Matrices	Site samples were not used for sample matrix QC	Yes	2	257	0.78	Representativeness
Wet Chem	Water	Other	IDL is older than 3 months from date of analysis	Yes	3	257	1.17	Accuracy
Wet Chem	Water	Other	Lab results not verified due to unsubmitted data	Yes	2	257	0.78	Representativeness
Wet Chem	Water	Other	See hard copy for further explanation	No	1	257	0.39	N/A

Table A2.3
Summary of Data Estimated or Undetected Due to V&V Determinations

Analyte Group	Matrix	No. of CRA Data Records Qualified	Total No. of V&V CRA Records	Detect	Percent Qualified (%)
Herbicide	Water	1	7	No	14.29
Metal	Soil	101	831	No	12.15
Metal	Soil	130	831	Yes	15.64
Metal	Water	273	1,647	No	16.58
Metal	Water	138	1,647	Yes	8.38
PCB	Water	7	35	No	20.00
Pesticide	Water	28	115	No	24.35
Radionuclide	Soil	1	291	Yes	0.34
Radionuclide	Water	6	395	No	1.52
Radionuclide	Water	15	395	Yes	3.80
SVOC	Water	33	308	No	10.71
VOC	Soil	37	186	No	19.89
VOC	Water	264	2,629	No	10.04
VOC	Water	2	2,629	Yes	0.08
Wet Chem	Soil	15	18	Yes	83.33
Wet Chem	Water	3	257	No	1.17
Wet Chem	Water	11	257	Yes	4.28
	Total	**1,065**	**6,991**		**15.23%**

Table A2.4
Summary of Data Qualified as Undetected Due to Blank Contamination

Analyte Group	Matrix	No. of CRA Records Qualified as Undetected Due to Blank Contaimination	Total No. of CRA Records with Detected Results[a]	Percent Qualified as Undetected
Metal	Soil	34	633	5.37
Metal	Water	29	735	3.95
VOC	Water	1	15	6.67
	Total	**64**	**1,383**	**4.63%**

[a] As determined by the laboratory prior to V&V.

Table A2.5
Summary of RPDs/DERs of Field Duplicate Analyte Pairs

Analyte Group	Matrix	No. of Duplicates Failing RPD/DER Criteria	Total No. of Duplicate Pairs	Percent Failure (%)	Field Duplicate Frequency (%)
Metal	Soil	12	60	20.00	7.22
Metal	Water	12	221	5.43	11.90
Radionuclide	Soil	2	23	8.70	7.59
Radionuclide	Water	0	52	0.00	10.90
SVOC	Water	0	21	0.00	6.36
VOC	Water	0	395	0.00	13.72
Wet Chem	Soil	0	2	0.00	11.11
Wet Chem	Water	0	24	0.00	8.36

Table A2.6
Summary of Data Rejected During V&V

Analyte Group	Matrix	Total No. of Rejected Records	Total No. of V&V Records	Percent Rejected (%)
Dioxins and Furans	Water	0	1	0.00
Herbicide	Soil	0	5	0.00
Herbicide	Water	0	7	0.00
Metal	Soil	15	988	1.52
Metal	Water	46	2,233	2.06
PCB	Soil	0	7	0.00
PCB	Water	0	35	0.00
Pesticide	Soil	0	25	0.00
Pesticide	Water	0	115	0.00
Radionuclide	Soil	81	408	19.85
Radionuclide	Water	57	591	9.64
SVOC	Soil	0	295	0.00
SVOC	Water	9	349	2.58
VOC	Soil	11	496	2.22
VOC	Water	62	3,280	1.89
Wet Chem	Soil	0	18	0.00
Wet Chem	Water	7	397	1.76
	Total	**288**	**9,250**	**3.11%**

Table A2.7
Summary of Data Quality Issues Identified by V&V

Analyte Group	Matrix	Categories Description	V&V Observation	Detect	Percent Observed	Percent Qualified U[a]	Percent Qualified J[b]	PARCC Parameter Affected	Impacts Risk Assessment Decisions
Herbicide	Water	Calibration	Continuing calibration verification criteria were not met	No	14.29	0.00	14.29	Accuracy	No
Metal	Soil	Blanks	Calibration verification blank contamination	No	5.78	4.09	1.68	Representativeness	No
Metal	Water	Matrices	Predigestion MS recovery criteria were not met	Yes	6.98	0.00	6.98	Accuracy	No
Metal	Soil	Matrices	Serial dilution criteria were not met	Yes	6.26	0.00	6.26	Accuracy	No
Metal	Soil	Other	IDL is older than 3 months from date of analysis	No	10.83	3.49	2.05	Accuracy	No
Metal	Soil	Other	IDL is older than 3 months from date of analysis	Yes	35.86	0.00	3.61	Accuracy	No
Metal	Water	Blanks	Method, preparation, or reagent blank contamination	No	8.99	0.00	8.99	Representativeness	No
PCB	Water	Surrogates	Surrogate recovery criteria were not met	No	20.00	0.00	20.00	Accuracy	No
Pesticide	Water	Calibration	Continuing calibration verification criteria were not met	No	6.96	0.00	6.96	Accuracy	No
Pesticide	Water	Surrogates	Surrogate recovery criteria were not met	No	18.26	0.00	18.26	Accuracy	No
Radionuclide	Soil	Blanks	Method, preparation, or reagent blank contamination	Yes	6.19	0.00	0.00	Representativeness	No
Radionuclide	Soil	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	11.00	0.00	0.00	Representativeness	No
Radionuclide	Soil	LCS	LCS relative percent error criteria not met	Yes	13.40	0.00	0.00	Accuracy	No
Radionuclide	Soil	Other	QC sample does not meet method requirements	No	9.28	0.00	0.00	Representativeness	No
Radionuclide	Soil	Other	QC sample does not meet method requirements	Yes	7.90	0.00	0.00	Representativeness	No
Radionuclide	Water	Calibration	Continuing calibration verification criteria were not met	Yes	15.95	0.00	0.51	Accuracy	No
Radionuclide	Water	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	8.61	0.00	0.00	Representativeness	No
Radionuclide	Water	Matrices	Replicate precision criteria were not met	Yes	6.58	0.00	1.01	Precision	No
VOC	Soil	Holding Times	Holding times were exceeded	No	18.28	0.00	18.28	Representativeness	No
VOC	Water	Holding Times	Holding times were exceeded	No	5.90	4.79	1.10	Representativeness	No
VOC	Water	Instrument Set-up	Instrument tune criteria were not met	No	6.16	0.84	0.11	Accuracy	No
Wet Chem	Soil	Matrices	Predigestion MS recovery was < 30 percent	Yes	83.33	0.00	83.33	Accuracy	No
Wet Chem	Soil	N/A	IDL is older than 3 months from date of analysis	Yes	94.44	0.00	77.78	Accuracy	No

[a]Defined as validation qualifier codes containing "U"

[b]Defined as validation qualifier codes containing "J", except "UJ"

COMPREHENSIVE RISK ASSESSMENT

SOUTHEAST BUFFER ZONE AREA EXPOSURE UNIT

VOLUME 13: ATTACHMENT 3

Statistical Analyses and Professional Judgment

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ACRONYMS AND ABBREVIATIONS

BZ	Buffer Zone
COC	contaminant of concern
CRA	Comprehensive Risk Assessment
DOE	U.S. Department of Energy
ECOI	ecological contaminant of interest
EcoSSL	Ecological Soil Screening Level
ECOPC	ecological contaminant of potential concern
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ERA	Ecological Risk Assessment
ESL	ecological screening level
EU	Exposure Unit
HHRA	Human Health Risk Assessment
IHSS	Individual Hazardous Substance Site
MDC	maximum detected concentration
mg/kg	milligrams per kilogram
NCP	National Contingency Plan
NOAEL	no observed adverse effect level
PCOC	potential contaminant of concern
PMJM	Preble's meadow jumping mouse
PRG	preliminary remediation goal
RFETS	Rocky Flats Environmental Technology Site
RI/FS	Remedial Investigation/Feasibility Study

SEEU	Southeast Buffer Zone Area Exposure Unit
tESL	threshold ESL
UCL	upper confidence limit
UTL	upper tolerance limit
WRW	wildlife refuge worker

1.0 INTRODUCTION

This attachment presents the results for the statistical analyses and professional judgment evaluation used to select human health contaminants of concern (COCs) as part of the Human Health Risk Assessment (HHRA) and ecological contaminants of potential concern (ECOPCs) as part of the Ecological Risk Assessment (ERA) for the Southeast Buffer Zone (BZ) Area Exposure Unit (EU) (SEEU) at the Rocky Flats Environmental Technology Site (RFETS). The methods used to perform the statistical analysis and to develop the professional judgment sections are described in Appendix A, Volume 2, Section 2.0 of the Resource Conservation and Recovery Act (RCRA) Facility Investigation-Remedial Investigation/Corrective Measures Study (CMS)-Feasibility Study (RI/FS) Report (hereafter referred to as the RI/FS Report) and follow the Final Comprehensive Risk Assessment (CRA) Work Plan and Methodology (DOE 2005).

2.0 RESULTS OF STATISTICAL COMPARISONS TO BACKGROUND FOR THE SOUTHEAST BUFFER ZONE AREA EXPOSURE UNIT

The results of the statistical background comparisons for inorganic and radionuclide potential contaminants of concern (PCOCs) and ecological contaminants of interest (ECOIs) in surface soil/surface sediment, subsurface soil/subsurface sediment, surface soil, and subsurface soil samples collected from the SEEU are presented in this section. Box plots are provided for analytes that were carried forward into the statistical comparison step and are presented in Figures A3.2.1 to A3.2.17.[1] The box plots display several reference points: 1) the line inside the box is the median; 2) the lower edge of the box is the 25th percentile; 3) the upper edge of the box is the 75th percentile; 4) the upper lines (called whiskers) are drawn to the greatest value that is less than or equal to 1.5 times the inter-quartile range (the inter-quartile range is between the 75th and 25th percentiles); 5) the lower whiskers are drawn to the lowest value that is greater than or equal to 1.5 times the inter-quartile range; and 6) solid circles are data points greater or less than the whiskers.

ECOIs for surface soil (Preble's meadow jumping mouse [PMJM] receptor) and PCOCs with concentrations in the SEEU that are statistically greater than background (or those where background comparisons were not performed) are carried through to the professional judgment step of the COC/ECOPC selection processes. ECOIs (for non-PMJM receptors) with concentrations in the SEEU that are statistically greater than background (or those where background comparisons were not performed) are carried

[1] Statistical background comparisons are not performed for analytes if: (1) the background concentrations are nondetections; (2) background data are unavailable; (3) the analyte has low detection frequency in the SEEU or background data set (< 20 percent); or (4) the analyte is an organic compound. Box plots are not provided for these analytes. However, these analytes are carried forward into the professional judgment evaluation.

through to the exposure point concentration (EPC) – threshold Ecological Screening Level (tESL) comparison step of the ECOPC selection processes.

PCOCs and ECOIs with concentrations that are not statistically greater than background are not identified as COCs/ECOPCs and are not evaluated further.

2.1 Surface Soil/Surface Sediment Data Used in the HHRA

For the SEEU surface soil/surface sediment data set, the maximum detected concentrations (MDCs) and upper confidence limits on the mean (UCLs) for arsenic, manganese, cesium-137, and radium-228 exceed the wildlife refuge worker (WRW) preliminary remediation goals (PRGs) for the SEEU data set, and these PCOCs were carried forward into the statistical background comparison step. The results of the statistical comparison of the SEEU surface soil/surface sediment data to background data for these PCOCs are presented in Table A3.2.1 and the summary statistics for background and SEEU surface soil/surface sediment data are shown in Table A3.2.2. The SEEU data set shows that the background analysis for cesium-137 and radium-228 could not be conducted because only one sample was collected for these analytes at the SEEU.

The MDCs for aluminum, iron and vanadium exceeded their respective PRGs, but the UCLs for the SEEU data set for these analytes did not exceed the PRG. Consequently, these analytes were not evaluated further. The SEEU MDCs for all other PCOCs do not exceed the PRGs and were not evaluated further.

The results of the statistical comparisons of the SEEU surface soil/surface sediment data to background data indicate the following:

Analytes Statistically Greater than Background at the 0.1 Significance Level

- Arsenic
- Manganese

Analytes Not Statistically Greater than Background at the 0.1 Significance Level

- None

Background Comparison Not Performed[1]

- Cesium-137
- Radium-228

2.2 Subsurface Soil/Subsurface Sediment Data Used in the HHRA

For the SEEU PCOCs in subsurface soil/subsurface sediment, the MDC and UCL for radium-228 exceeded the PRG; therefore, radium-228 was carried forward into the statistical background comparison step. The results of the statistical comparison of the SEEU subsurface soil/subsurface sediment data to background data for radium-228 are

presented in Table A3.2.3 and the summary statistics for background and SEEU subsurface soil/subsurface sediment radium-228 data are shown in Table A3.2.4.

The results of the statistical comparison of the SEEU subsurface soil/subsurface sediment data to background data indicate the following:

Analytes Statistically Greater than Background at the 0.1 Significance Level

- None

Analytes Not Statistically Greater than Background at the 0.1 Significance Level

- Radium-228

Background Comparison Not Performed[1]

- None

2.3 Surface Soil Data Used in the ERA (Non-PMJM Receptors)

For the ECOIs in surface soil at SEEU, the MDCs for aluminum, arsenic, barium, boron, cadmium, chromium, copper, lead, lithium, manganese, mercury, molybdenum, nickel, vanadium, and zinc exceed a non-PMJM ESL, and these ECOIs were carried forward into the statistical background comparison step. The results of the statistical comparison of the SEEU surface soil data to background data are presented in Table A3.2.5 and the summary statistics for background and SEEU surface soil data are shown in Table A3.2.6.

The results of the statistical comparisons of the SEEU surface soil to background data indicate the following:

Analytes Statistically Greater than Background at the 0.1 Significance Level

- Aluminum
- Barium
- Chromium
- Copper
- Lithium
- Manganese
- Nickel
- Vanadium
- Zinc

Analytes Not Statistically Greater than Background at the 0.1 Significance Level

- Arsenic
- Cadmium
- Lead
- Mercury

Background Comparison not Performed[1]

- Boron
- Molybdenum

2.4 Surface Soil Data used in the ERA (PMJM Receptors)

Because viable habitat for PMJM within the SEEU is a small subset of two larger PMJM habitat patches in adjacent EUs, the assessment of risk to the PMJM receptors is addressed in the Lower Woman Drainage EU (LWOEU) and the Southwest Buffer Zone Area EU (SWEU). Therefore, any discussions of risks to PMJM receptors that are associated with the small PMJM habitat within the SEEU are presented in Volume 11 (LWOEU) and Volume 12 (SWEU) of Appendix A of the RI/FS Report.

2.5 Subsurface Soil Data used in the ERA

For the ECOIs in subsurface soil, the MDC for arsenic exceeds the prairie dog ESL, thus arsenic was carried forward into the statistical background comparison step. The MDCs for all other ECOIs did not exceed the prairie dog ESL. The results of the statistical comparison of the SEEU subsurface soil data to background data are presented in Table A3.2.7 and the summary statistics for background and SEEU subsurface soil data are shown in Table A3.2.8.

The results of the statistical comparisons of the surface soil data to background data indicate the following:

Analyte Statistically Greater than Background at the 0.1 Significance Level

- Arsenic

Analyte Not Statistically Greater than Background at the 0.1 Significance Level

- None

Background Comparison not Performed[1]

- None

3.0 UPPER-BOUND EXPOSURE POINT CONCENTRATION COMPARISON TO LIMITING ECOLOGICAL SCREENING LEVELS

ECOIs in surface soil and subsurface soil with concentrations that are statistically greater than background, or background comparisons were not performed, are evaluated further by comparing the SEEU upper-bound exposure point concentrations (EPCs) to the limiting threshold (tESLs). The EPCs are the 95 percent UCLs of the 90th percentile [upper tolerance limit (UTL)] for small home-range receptors, the UCL for large home-range receptors, or the MDC in the event that the UCL or UTL is greater than the MDC.

3.1 ECOIs in Surface Soil

Barium in surface soil (non-PMJM receptors) was eliminated from further consideration because its upper-bound EPC was not greater than the tESLs.

Aluminum, boron, chromium, copper, lithium, manganese, molybdenum, nickel, vanadium and zinc for soil surface (non-PMJM receptors) have upper-bound EPCs greater than the tESLs and are evaluated in the professional judgment evaluation screening step (Section 4.0).

3.2 ECOIs in Subsurface Soil

Arsenic in subsurface soil was eliminated from further consideration because its upper-bound EPC was not greater than the tESLs.

4.0 PROFESSIONAL JUDGMENT

This section presents the results of the professional judgment step of the COC and ECOPC selection processes for the HHRA and ERA, respectively. Based on the weight of evidence evaluated in the professional judgment step, PCOCs and ECOIs are either included for further evaluation as COCs/ECOPCs in the risk characterization step, or excluded from further evaluation.

The professional judgment evaluation takes into account the following lines of evidence: process knowledge, spatial trends, pattern recognition[2], comparison to RFETS

[2] The pattern recognition evaluation includes the use of probability plots. If two or more distinct populations are evident in the probability plot, this suggests that one or more local releases may have occurred. Conversely, if only one distinct low-concentration population is defined, likely representing a background population, a local release may or may not have occurred. Similar to all statistical methods, the probability plot has limitations in cases where there is inadequate sampling and the magnitude of the release is relatively small. Thus, absence of two clear populations in the probability plots is consistent with, but not definitive proof of, the hypothesis that no releases have occurred. However, if a release has occurred within the sampled area and has been included in the samples, then the elemental concentrations associated with that release are either within the background concentration range or the entire sampled population represents a release, a highly unlikely probability.

background and regional background data sets (see Table A3.4.1 for a summary of regional background data)[3], and risk potential. For PCOCs or ECOIs where the process knowledge and/or spatial trends indicate that the presence of the analyte in the EU may be a result of historical site-related activities, the professional judgment discussion includes only two of the lines of evidence listed above, and it is concluded that these analytes are COCs/ECOPCs and are carried forward into risk characterization. For the other PCOCs and ECOIs that are evaluated in the professional judgment step, each of the lines of evidence listed above are included in the discussion.

For metals, Appendix A, Volume 2, Attachment 8 of the RI/FS Report provides the details of the process knowledge and spatial trend evaluations. The conclusions from these evaluations are noted in this attachment.

The following PCOCs/ECOIs are evaluated further in the professional judgment step for SEEU:

- Surface soil/surface sediment (HHRA)
  - Arsenic
  - Manganese
  - Cesium-137
  - Radium-228
- Subsurface soil/subsurface sediment (HHRA)
  - No PCOCs in subsurface soil/subsurface sediment were carried into the professional judgment step.
- Surface soil for non-PMJM receptors (ERA)
  - Aluminum
  - Boron
  - Chromium
  - Copper
  - Lithium
  - Manganese

[3] The regional background data set for Colorado and the bordering states was extracted from data for the western United States (Shacklette and Boerngen 1984), and is composed of data from Colorado as well as Arizona, Kansas, Nebraska, New Mexico, Oklahoma, Utah, and Wyoming. Although the Colorado and bordering states background data set is not specific to Colorado's Front Range, it is useful for the professional judgment evaluation in the absence of a robust data set for the Front Range. Colorado's Front Range has highly variable terrain that changes elevation over short distances. Consequently, numerous soil types and geologic materials are present at RFETS, and the data set for Colorado and bordering states provides regional benchmarks for naturally-occurring metals in soil. The comparison of RFETS's soil data to these regional benchmarks is only performed for non-PMJM professional judgment because the PMJM habitat is restricted to the front range of Colorado.

  - Molybdenum
  - Nickel
  - Vanadium
  - Zinc
- Subsurface soil (ERA)
  - No ECOIs in subsurface soil were carried into the professional judgment evaluation step.

The following sections provide the professional judgment evaluations, by analyte and by medium, for the PCOCs/ECOIs listed above.

4.1 Aluminum

Aluminum has an EPC in surface soil (for non-PMJM receptors) greater than the tESL and, therefore, was carried forward to the professional judgment step. The lines of evidence used to determine if aluminum should be retained for risk characterization are summarized below.

4.1.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, because there was a large inventory of aluminum and it was present in wastes generated during former RFETS operations, aluminum may be present in RFETS soil as a result of historical site-related activities.

4.1.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that aluminum concentrations in SEEU surface soil reflect variations in naturally occurring aluminum.

4.1.3 Pattern Recognition

Surface Soil (Non-PMJM)

The probability plot for the natural log transformed data set for aluminum in surface soil within SEEU (Figure A3.4.1) suggests a single background population.

4.1.4 Comparison to RFETS Background and Other Background Data Sets

Surface Soil (Non-PMJM)

Aluminum concentrations in SEEU surface soil range from 5,860 to 25,000 milligrams per kilogram (mg/kg), with a mean concentration of 15,362 mg/kg and a standard deviation of 4,928 mg/kg. Aluminum concentrations in the background data set range

from 4,050 to 17,100 mg/kg, with a mean concentration of 10,203 mg/kg and a standard deviation of 3,256 mg/kg (Table A3.2.6). The maximum concentrations of aluminum in surface soil samples at the SEEU are elevated compared to background but the data populations overlap considerably.

Aluminum concentrations SEEU surface soil are well within the range for aluminum in soils of Colorado and the bordering states (5,000 to 100,000 mg/kg, with a mean concentration of 50,800 mg/kg and a standard deviation of 23,500 mg/kg) (Table A3.4.1).

4.1.5 Risk Potential for Plants and Wildlife

Surface Soil (Non-PMJM)

The MDC for aluminum in the SEEU (25,000 mg/kg) exceeds the NOAEL ESL for only one receptor group, terrestrial plants (50 mg/kg). However, EPA Ecological Soil Screening Level (EcoSSL) guidance (EPA 2003) for aluminum recommends that aluminum should not be considered an ECOPC for soils at sites where the soil pH exceeds 5.5 due to its limited bioavailability in non-acidic soils. The average pH value for RFETS surface soils is 8.2. Therefore, aluminum concentrations in SEEU surface soil are unlikely to result in risk concerns for wildlife populations.

4.1.6 Conclusion

The weight of evidence presented above shows that aluminum concentrations in SEEU surface soil (non-PMJM receptors) are not likely to be a result of historical site-related activities based on process knowledge, spatial distribution trend, and single data population indicative of naturally occurring aluminum. In addition, the aluminum concentrations within SEEU are well within regional background levels, and are unlikely to result in risk concerns for wildlife populations. Aluminum is not considered an ECOPC in surface soil for the SEEU and, therefore, is not further evaluated quantitatively.

4.2 Arsenic

Arsenic has concentrations statistically greater than background in surface soil/surface sediment and, therefore, was carried forward to the professional judgment step. The lines of evidence used to determine if arsenic should be retained for risk characterization are summarized below.

4.2.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates arsenic is unlikely to be present in SEEU soil as a result of historical site-related activities.

4.2.2 Evaluation of Spatial Trends

Surface Soil/Surface Sediment

As discussed in Appendix A, Volume 2 Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that arsenic concentrations in SEEU surface soil/surface sediment reflect variations in naturally occurring arsenic.

4.2.3 Pattern Recognition

Surface Soil/Surface Sediment

The probability plot for the natural log transformed data set for arsenic in surface soil/surface sediment within SEEU (Figure A3.4.2) suggests a single background population ranging from 2.5 to about 9.3 mg/kg but with two samples (both samples collected at sample location DN06-000; see Figure 1.6 in the main text of this volume) with anomalously elevated concentrations (12 and 23 mg/kg). The sample with the highest arsenic concentration also contains anomalous copper, manganese, molybdenum, nickel, and vanadium suggesting that it may or may not be part of the natural arsenic concentrations in this EU.

4.2.4 Comparison to RFETS Background and Other Background Data Sets

Surface Soil/Surface Sediment

Arsenic concentrations in SEEU surface soil/surface sediment range from 2.5 to 23.0 mg/kg, with a mean concentration of 7.40 mg/kg and a standard deviation of 4.15 mg/kg. Arsenic concentrations in the background data set range from 0.27 to 9.6 mg/kg, with a mean concentration of 3.42 mg/kg and a standard deviation of 2.55 mg/kg (Table A3.2.2). With the exception of two anomalous sample results (12.0 and 23.0 kg/mg), the range of concentrations of arsenic in the SEEU and background data set shows significant overlapping.

Arsenic concentrations SEEU surface soil/surface sediment are well within the range for arsenic in soils in Colorado and the bordering states (1.22 to 97 mg/kg, with a mean concentration of 6.9 mg/kg and a standard deviation of 7.64 mg/kg) (Table A3.4.1).

4.2.5 Risk Potential for HHRA

Surface Soil/Surface Sediment

The arsenic MDC for surface soil/surface sediment is 23.0 mg/kg and the UCL for surface soil/surface sediment is 8.9 mg/kg, which is only three to four times greater than the PRG (2.41 mg/kg). Because the PRG is based on an excess carcinogenic risk of 1E-06, the cancer risk based on the UCL concentration is less than 4E-06, and is well within the National Contingency Plan (NCP) risk range of 1E-06 to 1E-04. The background UCL for arsenic in surface soil/surface sediment is 4.03 mg/kg (Appendix A, Volume 2, Attachment 9 of the RI/FS Report), which equates to a cancer risk of 2E-06. Therefore, the excess cancer risks to the WRW from exposure to arsenic in surface soil/surface sediment in the SEEU is similar to background risk.

4.2.6 Conclusion

The weight of evidence presented above shows that arsenic concentrations in SEEU surface soil/surface sediment are not likely to be a result of historical site-related activities based on process knowledge, the spatial distribution trend and a single data population suggesting naturally occurring arsenic. The concentrations of arsenic within SEEU are well within regional background levels, and are unlikely to result in risks to humans significantly above background risks. Arsenic is not considered a COC in surface soil/surface sediment for the SEEU and, therefore, is not further evaluated quantitatively.

4.3 Boron

For boron in surface soil, a statistical comparison between SEEU and RFETS background data could not be performed because RFETS background surface soil samples were not analyzed for boron. Boron has an EPC in surface soil (for non-PMJM receptors) greater than the tESL and, therefore, was carried forward to the professional judgment step. The lines of evidence used to determine if boron should be retained for risk characterization are summarized below.

4.3.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates boron is unlikely to be present in RFETS soil as a result of historical site-related activities.

4.3.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that boron concentrations in SEEU surface soil reflect variations in naturally occurring boron.

4.3.3 Pattern Recognition

Surface Soil (Non-PMJM)

The probability plot for the natural log transformed data set for boron in surface soil within SEEU (Figure A3.4.3) indicates a single background population. The 14 sample points are probably not sufficient to document the true range of natural boron concentrations in this EU.

4.3.4 Comparison to RFETS Background and Other Background Data Sets

Surface Soil (Non-PMJM)

The reported range for boron in surface soil within Colorado and the bordering states is 20 to 150 mg/kg, with a mean concentration of 27.9 mg/kg and a standard deviation of 19.7 mg/kg (Table A3.4.1). Boron concentrations reported in surface soil samples at the

SEEU range from 3.70 to 8.70 mg/kg, with a mean concentration of 5.95 mg/kg and a standard deviation of 1.47 mg/kg (Table A3.2.6). The range of concentrations of boron in surface soil is well within the range for boron in soils of Colorado and the bordering states.

4.3.5 Risk Potential for Plants and Wildlife

Surface Soil (Non-PMJM)

The MDC for boron in the SEEU (8.70 mg/kg) exceeds the NOAEL ESL for only one receptor group, terrestrial plants (0.5 mg/kg). All other NOAEL ESLs were considerably greater than the MDC and ranged from 30 to 6,070 mg/kg. Site-specific background data for boron were not available, but the MDC did not exceed the low end of the range (20 mg/kg) of the background range presented in Shacklette and Boerngen (1984). This indicates the terrestrial plant NOAEL ESL (0.5 mg/kg) is well below expected background concentrations, and MDCs above the NOAEL ESL are not likely to be indicative of site-related risk to the terrestrial plant community in the SEEU. Kabata-Pendias and Pendias (1992) indicate soil with boron concentrations equal to 0.3 mg/kg is critically deficient in boron, and effects on plant reproduction would be expected. Additionally, the summary of boron toxicity in Efroymson et al. (1997) notes that the source of the 0.5-mg/kg NOAEL ESL indicates boron was toxic when added at 0.5 mg/kg to soil, but gives no indication of the boron concentration in the baseline soil before addition. The confidence placed by Efroymson et al. (1997) was low. No boron Eco-SSLs are currently available for any receptor. Because no NOAEL ESLs other than the terrestrial plant NOAEL ESL are exceeded by the MDC, boron is highly unlikely to present a risk to terrestrial receptor populations in the SEEU.

4.3.6 Conclusion

The weight of evidence presented above shows that boron concentrations in SEEU surface soil (non-PMJM receptors) are not likely to be a result of historical site-related activities based on process knowledge, the spatial distribution trend, and a single data population indicative of naturally occurring boron. In addition, boron concentrations in surface soil at SEEU are well within regional background levels, and are unlikely to result in risk concerns for wildlife populations. Boron is not considered an ECOPC in surface soil for the SEEU and, therefore, is not further evaluated quantitatively.

4.4 Cesium-137

Statistical background comparisons could not be performed for cesium-137 because there was a single sample result within the SEEU. Therefore, this analyte is carried forward into the professional judgment step. The lines of evidence used to determine if cesium-137 should be retained for risk characterization are summarized below.

4.4.1 Summary of Process Knowledge

The ChemRisk Task 1 Report did not identify cesium-137 as a radionuclide used at RFETS (CDH 1991) and no cesium-137 waste was reported to have been generated. It is unlikely that cesium-137 is present in soil at RFETS as a result of historical site-related activities.

4.4.2 Evaluation of Spatial Trends

Surface Soil/Surface Sediment

Figure A3.4.4 shows the location within SEEU where cesium-137 was sampled in surface soil/surface sediment. The cesium-137 activity was detected at 0.661 pCi/g and exceeded the cesium-137 PRG of 0.221 pCi/g. However, this activity does not exceed the background MDC of 1.80 pCi/g.

4.4.3 Pattern Recognition

Surface Soil/Surface Sediment

A probability plot for cesium-137 activity could not be generated because there was only a single sample result for the SEEU data set.

4.4.4 Comparison to RFETS Background and Other Background Data Sets

Surface Soil/Surface Sediment

There was a single sample result for cesium-137 in surface soil/surface sediment at SEEU and, therefore, a statistical background comparison could not be performed. However, the cesium-137 activity of 0.661 pCi/g did not exceed the background MDC of 1.80 pCi/g. Cesium-137 activity in the background data set ranges from -0.027 to 1.80 pCi/g, with a mean activity of 0.692 pCi/g and a standard deviation of 0.492 pCi/g (Table A3.2.2).

4.4.5 Risk Potential for HHRA

The cesium-137 MDC for surface soil/surface sediment is 0.661 pCi/g, which is approximately one-third of the background MDC of 1.8 pCi/g, but about three times greater than the PRG of 0.221 pCi/g. However, the PRG is based on an excess carcinogenic risk of 1E-06; therefore, the risk to human health is well within the NCP risk range of 1E-06 to 1E-04. Furthermore, because cesium-137 activity in the SEEU appear to represent naturally occurring levels and because cesium-137 was not used at the site, this risk is not likely associated with any releases from RFETS.

4.4.6 Conclusion

The weight of evidence presented above shows that the single cesium-137 activity in surface soil/surface sediment in the SEEU is not a result of RFETS activities. There is no evidence of a release from potential sources inside or outside the SEEU that would impact cesium-137 activity in surface soil/surface sediment. Cesium-137 was not used or

generated at RFETS and is, therefore, not considered a COC in surface soil/ surface sediment for the SEEU and not further evaluated quantitatively.

4.5 Chromium

Chromium had an EPC in surface soil (for non-PMJM receptors) greater than the tESL and, therefore, was carried forward to the professional judgment step per the CRA Methodology. The lines of evidence used to determine if chromium should be retained as an ECOPC are summarized below.

4.5.1 Summary of Process Knowledge

Based on process knowledge as detailed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, chromium may be present in RFETS soil as a result of historical site-related activities.

4.5.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

Based on the spatial trend evaluation detailed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, chromium concentrations in the SEEU appear to be variations of naturally occurring conditions. However, in order to determine if chromium should be retained as an ECOPC in SEEU, chromium is further evaluated by the other professional judgment lines of evidence, as presented below.

4.5.3 Pattern Recognition

Surface Soil (Non-PMJM)

The probability plot for the natural log transformed data set for chromium in surface soil within SEEU (Figure A3.4.5) suggests a single background population. The 19 sample points are probably not sufficient to document the true range of natural chromium concentrations in this EU. However, the samples with the highest concentrations indicate that, at least, the upper part of the distribution may be approaching an asymptotic chromium concentration of the background population.

4.5.4 Comparison to RFETS Background and Other Background Data Sets

Surface Soil (Non-PMJM)

Chromium was detected in each of the 19 surface soil samples collected in the SEEU. Chromium concentrations in surface soil samples at the SEEU range from 7.30 to 27.0 mg/kg, with a mean concentration of 17.0 mg/kg and a standard deviation of 5.43 mg/kg. Chromium concentrations in the background data set range from 5.50 to 16.9 mg/kg, with a mean concentration of 11.2 mg/kg and a standard deviation of 2.78 mg/kg (Table A3.2.6).

Chromium concentrations reported in surface soil samples at the SEEU are well within background chromium concentrations in soils in Colorado and the bordering states, which range from 3 to 500 mg/kg, with mean concentration of 48.2 mg/kg and a standard deviation of 41 mg/kg (Table A3.4.1).

4.5.5 Risk Potential for Plants and Wildlife

Surface Soil (Non-PMJM)

The UTL for chromium in the SEEU (27.5 mg/kg) exceeds the NOAEL ESLs for six receptor groups, the terrestrial invertebrate (0.4 mg/kg), terrestrial plant (1 mg/kg), insectivorous mourning dove (1.34 mg/kg), herbivorous mourning dove (24.6 mg/kg), American kestrel (13.96 mg/kg), and the insectivorous deer mouse (15.9 mg/kg). With the exception of the herbivorous mourning dove ESL of 24.6 mg/kg, all of the ESLs are less than the MDC in background soils (16.9 mg/kg). The ESLs for all other non-PMJM receptors were greater than the UTL (27.5 mg/kg) and range from 281.3 to 4,173 mg/kg.

The UTL of 27.5 mg/kg slightly exceeded the avian Eco-SSL for chromium III of 26 mg/kg but was less than the mammalian Eco-SSL for chromium III (34 mg/kg) and chromium VI (81 mg/kg) (EPA 2005a). No chromium Eco-SSLs are currently available for plants, invertebrates, or birds (chromium VI only).

4.5.6 Conclusion

The weight of evidence presented above shows that chromium concentrations in surface soil in the SEEU are not a result of RFETS activities, but rather are representative of naturally occurring concentrations. There is no evidence of a release from potential sources inside or outside the EU that would impact chromium concentrations in surface soil. In addition, the MDC for chromium is below the lowest reported value of the Colorado and the bordering states data set. Chromium is not considered an ECOPC in surface soil for the SEEU and is not further evaluated quantitatively.

4.6 Copper

Copper had an EPC in surface soil (for non-PMJM receptors) greater than the tESL so was carried forward to the professional judgment step in accordance with the CRA Methodology. The lines of evidence used to determine if copper should be retained as an ECOPC are summarized below.

4.6.1 Summary of Process Knowledge

Based on process knowledge as detailed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the potential for copper to be an ECOPC in the SEEU is low due to an exceedingly small inventory, and limited identification as a constituent in wastes generated at RFETS, and localized documented historical source areas remote from the SEEU.

4.6.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

Based on the spatial trend evaluation detailed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, copper concentrations in the SEEU appear to be variations of naturally occurring conditions.

4.6.3 Pattern Recognition

Surface Soil (Non-PMJM)

The probability plot for the natural log transformed data set for copper in surface soil within SEEU (Figure A3.4.6) indicates a single background population ranging from 7.8 to about 19 mg/kg but with one sample (sample location DN06-000; see Figure 1.6 in the main text of this volume) containing a higher copper concentration of 25 mg/kg. This sample is also anomalously high for manganese, molybdenum, nickel, vanadium and arsenic. Therefore it may or may not be part of the natural copper concentrations in this EU.

4.6.4 Comparison to RFETS Background and Other Background Data Sets

Surface Soil (Non-PMJM)

Copper was detected in each of the 19 surface soil samples collected in the SEEU. Copper concentrations in surface soil samples at the SEEU range from 7.80 to 25.0 mg/kg, with a mean concentration of 15.2 mg/kg and a standard deviation of 3.83 mg/kg. Copper concentrations in the background data set range from 5.20 to 16.0 mg/kg, with a mean concentration of 13.0 mg/kg and a standard deviation of 2.58 mg/kg (Table A3.2.6). Concentrations of copper in SEEU surface soil are higher than RFETS background concentrations, but lie within the copper background concentrations in surface soils in Colorado and bordering states, which range from 2 to 200 mg/kg, with a mean of 23.1 mg/kg and a standard deviation of 17.7 mg/kg (Table A3.4.1).

4.6.5 Risk Potential for Plants and Wildlife

Surface Soil (Non-PMJM)

The UTL for copper in SEEU (22.7 mg/kg) exceeds the NOAEL ESL for only one receptor, the insectivorous mourning dove (8.25 mg/kg). The mean background concentration also exceeds the NOAEL ESL for the insectivorous mourning dove. Because the ESL is within the range of background concentrations, risk is not expected to be at a level of concern. This indicates that this ESL may be overly conservative for use in the ECOPC identification process. No copper Eco-SSLs are currently available for any receptor (the copper Eco-SSL document is “pending”). Given the conservative nature of this ESL and the similarity between the SEEU and background data sets, it is highly unlikely that there would be population risks associated with these relatively low levels of copper.

4.6.6 Conclusion

The weight of evidence presented above shows that copper concentrations in surface soil in the SEEU are not a result of RFETS activities, but are representative of naturally occurring concentrations. Copper is not considered an ECOPC in surface soil for the SEEU; therefore, it is not further evaluated quantitatively.

4.7 Lithium

Lithium had an EPC in surface soil (for non-PMJM receptors) greater than the tESL so was carried forward to the professional judgment step per the CRA Methodology. The lines of evidence used to determine if lithium should be retained as an ECOPC are summarized below.

4.7.1 Summary of Process Knowledge

Based on process knowledge as detailed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, lithium may be present in RFETS soil as a result of historical site-related activities.

4.7.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

Based on the spatial trend evaluation detailed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, lithium concentrations in the SEEU appear to be variations of naturally occurring conditions.

4.7.3 Pattern Recognition

Surface Soil (Non-PMJM)

The probability plot for the natural log transformed data set for lithium in surface soil within SEEU (Figure A3.4.7) indicates a single background population.

4.7.4 Comparison to RFETS Background and Other Background Data Sets

Surface Soil (Non-PMJM)

Lithium was detected in 15 of the 16 surface soil samples collected at the SEEU. Lithium concentrations in surface soil samples at the SEEU range from 5.20 to 23.0 mg/kg, with a mean concentration of 13.3 mg/kg and a standard deviation of 5.29 mg/kg. Lithium concentrations in the background data set range from 4.80 to 11.6 mg/kg, with a mean concentration of 7.66 mg/kg and a standard deviation of 1.89 mg/kg (Table A3.2.6). The maximum concentrations of lithium in surface soil samples at the SEEU are elevated compared to background but the data populations do overlap.

Lithium concentrations reported in surface soil samples at the SEEU are well within the lithium background concentrations in surface soils in Colorado and the bordering states,

which range from 5 to 130 mg/kg, with mean concentration of 25.3 mg/kg and a standard deviation of 14.4 mg/kg (Table A3.4.1).

4.7.5 Risk Potential for Plants and Wildlife

Surface Soil (Non-PMJM)

The MDC for lithium in the SEEU (23 mg/kg) exceeds the NOAEL ESL for only one receptor, terrestrial plants (2 mg/kg), which is lower than the minimum detection of lithium in background surface soils (4.8 mg/kg). None of the NOAEL ESLs for mammalian receptors are exceeded by the MDC. The authors of the document from which the lithium NOAEL ESL was selected (Efroymson et al. 1997) placed a low confidence rating on the value. No lithium Eco-SSLs are currently available for any receptor. Lithium concentrations greater than the background in the SEEU are likely due to spatial variations of naturally occurring lithium in alluvial materials and are below available ESLs for vertebrate receptors. Therefore, concentrations of lithium are highly unlikely to present risks to wildlife populations in the SEEU.

4.7.6 Conclusion

The weight of evidence presented above shows that lithium concentrations in surface soil in the SEEU are not a result of RFETS activities, but are representative of naturally occurring concentrations. Concentrations of lithium detected in SEEU surface soils appear to be somewhat skewed versus RFETS background concentrations, but are well within the low end of the range in soils within Colorado and the bordering states. Lithium is not considered an ECOPC in surface soil for the SEEU; therefore, it is not further evaluated quantitatively.

4.8 Manganese

Manganese had concentrations statistically greater than background in surface soil/surface sediment and also had an EPC in surface soil (for non-PMJM receptors) greater than the tESL. Consequently, manganese was carried forward to the professional judgment step per the CRA Methodology. The lines of evidence used to determine if manganese should be retained as a COC in surface soil/surface sediment and an ECOPC in surface soil are summarized below.

4.8.1 Summary of Process Knowledge

Based on process knowledge as detailed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, manganese is unlikely to be present in RFETS soil as a result of historical site-related activities.

4.8.2 Evaluation of Spatial Trends

Surface Soil/Surface Sediment

Based on the spatial trend evaluation detailed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, manganese concentrations in surface soil/surface sediment in the SEEU appear to be variations of naturally occurring conditions.

Surface Soil (Non-PMJM)

Based on the spatial trend evaluation detailed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, manganese concentrations in surface soil in the SEEU appear to be variations of naturally occurring conditions.

4.8.3 Pattern Recognition

Surface Soil/Surface Sediment and Surface Soil

The probability plot for the natural log transformed data set for manganese in surface soil/surface sediment in SEEU (Figure A3.4.8) indicates a background population ranging from about 220 to 600 mg/kg but with a single sample representing an anomalously elevated concentration (sample location DN06-000; see Figure 1.6 in the main text of this volume) of 1,300 mg/kg. However this highest sample concentration is also anomalously elevated in copper, molybdenum, nickel, vanadium and arsenic suggesting that it may or may be not part of the natural manganese concentrations in this EU.

Surface Soil (Non-PMJM)

The probability plot for the natural log transformed data set for manganese in surface soil in SEEU (Figure A3.4.9) indicates a background population ranging from about 220 to 600 mg/kg but with a single sample representing an anomalously elevated concentration (sample location DN06-000) of 1,300 mg/kg and an anomalously low concentration (04F1269-005) of 55 mg/kg. The 17 samples forming the background population probably do not represent the full concentration range of the background population. However the highest sample concentration is also anomalously elevated in copper, molybdenum, nickel, vanadium and arsenic suggesting that it may or may be not part of the natural manganese concentrations in this EU.

4.8.4 Comparison to RFETS Background and Other Background Data Sets

Surface Soil/Surface Sediment

Manganese was detected in each of the 22 surface soil/surface sediment samples collected in the SEEU. Manganese concentrations in surface soil/surface sediment samples at the SEEU range from 55.0 to 1,300 mg/kg, with a mean concentration of 386 mg/kg and a standard deviation of 237 mg/kg. Background manganese concentrations range from 9.0 to 1,280 mg/kg, with a mean concentration of 241 mg/kg and a standard deviation of 189 mg/kg (Table A3.2.2). Concentrations of manganese in the SEEU surface soil/surface sediment are higher than RFETS background

concentrations, but within the range of surface soils in Colorado and the bordering states background concentrations, which range from 70 to 2,000 mg/kg, with a mean concentration of 414 mg/kg and a standard deviation of 272 mg/kg (Table A3.4.1).

Surface Soil (Non-PMJM)

Manganese was detected in each of the 19 surface soil samples collected in the SEEU. Manganese concentrations in surface soil samples at the SEEU range from 55 to 1,300 mg/kg, with a mean concentration of 392 mg/kg and a standard deviation of 247 mg/kg. Manganese concentrations in the background range from 129 to 357 mg/kg, with a mean concentration of 237 mg/kg and a standard deviation of 63.9 mg/kg (Table A3.2.6). 8 of the 19 surface soil samples are higher than RFETS background concentrations.

Manganese concentrations reported in surface soil samples at the SEEU are well within background manganese concentrations in soils of Colorado and the bordering states, which range from 70 to 2,000 mg/kg, with mean concentration of 414 mg/kg and a standard deviation of 272 mg/kg (Table A3.4.1).

4.8.5 Risk Potential for HHRA

Surface Soil/Surface Sediment

The manganese MDC for surface soil/surface sediment is 1,300 mg/kg and the UCL for surface soil/surface sediment is 607 mg/kg, which is only approximately 50 percent greater than the PRG (419 mg/kg). The PRG is based on a hazard quotient (HQ) of 0.1; therefore, the risk to human health is well below the EPA guideline of an HQ of 1. Furthermore, because manganese concentrations in the SEEU appear to represent naturally occurring manganese, this risk is unassociated with manganese releases from RFETS.

4.8.6 Risk Potential for Plants and Wildlife

Surface Soil (Non-PMJM)

The UTL for manganese in the SEEU (1,300 mg/kg) exceeds the NOAEL ESLs for three group receptors: terrestrial plants (500 mg/kg), herbivorous mourning dove (1,032 mg/kg), and herbivorous deer mouse (486 mg/kg). NOAEL ESLs for all other non-PMJM receptors were greater than the MDC and range from 1,519 to 19,115 mg/kg. No manganese Eco-SSLs are currently available for any receptor (the manganese Eco-SSL document is “pending”).

4.8.7 Conclusion

The weight of evidence presented above shows that manganese concentrations in surface soil/surface sediment and in surface soil in the SEEU are not a result of RFETS activities, but rather are representative of naturally occurring concentrations. There is no evidence of a release from potential sources inside or outside the EU that would impact manganese

concentrations in the soil. Manganese is not considered a COC or an ECOPC for the SEEU and, therefore, is not further evaluated quantitatively.

4.9 Molybdenum

Molybdenum had an upper-bound EPC in surface soil (for non-PMJM receptors) greater than the tESL so was carried forward to the professional judgment step per the CRA Methodology. The lines of evidence used to determine if molybdenum should be retained as a ECOPC are summarized below.

4.9.1 Summary of Process Knowledge

Based on process knowledge as detailed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, molybdenum is unlikely to be present in RFETS soil as a result of historical site-related activities.

4.9.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

Based on the spatial trend evaluation detailed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, molybdenum concentrations in the SEEU appear to be variations of naturally occurring conditions.

4.9.3 Pattern Recognition

Surface Soil (Non-PMJM)

The probability plot for the natural log transformed data set for molybdenum in surface soil in SEEU (Figure A3.4.10) indicate a background population ranging from 0.43 to about 1.20 mg/kg but with four anomalously high concentrations ranging from 1.9 to 2.35 mg/kg. Given the limited total number of molybdenum analyses (18) and limited range of these molybdenum concentrations, the background population may well include these four samples if more samples were collected and analyzed.

4.9.4 Comparison to RFETS Background and Other Background Data Sets

Surface Soil (Non-PMJM)

Molybdenum was detected in 78 percent of the 18 surface soil samples collected in the SEEU. Molybdenum concentrations in surface soil samples at the SEEU range from 0.610 to 1.90 mg/kg, with a mean concentration of 1.14 mg/kg and a standard deviation of 0.605 mg/kg (Table A3.2.6). Molybdenum concentrations in the RFETS background data set were not available, but the SEEU molybdenum concentrations were within the range of Colorado and bordering states background concentrations, which range from 3 to 7 mg/kg, with a mean concentration of 1.59 mg/kg and a standard deviation of 0.522 mg/kg (Table A3.4.1).

4.9.5 Risk Potential for Plants and Wildlife

Surface Soil (Non-PMJM)

The molybdenum UTL in the SEEU (1.9 mg/kg) exceeded the NOAEL ESL for two receptor groups, the insectivorous deer mouse receptor (1.90 mg/kg) and terrestrial plant receptors (2.0 mg/kg). The NOAEL ESLs for all other non-PMJM receptors were greater than the MDC and range from 8.68 to 275 mg/kg. The molybdenum UTL of 2.64 mg/kg is greater than the MDC of 1.90 mg/kg because the UTL calculation takes into consideration half of the nondetected concentrations, some of which may have had high detection limits. No molybdenum Eco-SSLs are currently available for any receptor. Molybdenum background concentrations in Colorado and bordering states range from 3 to 7 mg/kg, suggesting that the ESL for insectivorous deer mouse receptor (1.90 mg/kg) and terrestrial plant receptors (2.0 mg/kg) may be overly conservative for screening purposes.

4.9.6 Conclusion

The weight of evidence presented above shows that molybdenum concentrations in surface soil in the SEEU are not a result of RFETS activities, but rather are representative of naturally occurring concentrations. There is no evidence of a release from potential sources inside or outside the EU that would impact molybdenum concentrations in surface soil. In addition, the MDC for molybdenum is below the lowest reported value of the Colorado and the bordering states data set. Molybdenum is not considered an ECOPC in surface soil for the SEEU and is not further evaluated quantitatively.

4.10 Nickel

Nickel had an EPC in surface soil (for non-PMJM receptors) greater than the tESL so was carried forward to the professional judgment step per the CRA Methodology. The lines of evidence used to determine if nickel should be retained as an ECOPC are summarized below.

4.10.1 Summary of Process Knowledge

Based on process knowledge as detailed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, nickel may be present in RFETS soil as a result of historical site-related activities.

4.10.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

Based on the spatial trend evaluation detailed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, nickel concentrations in the SEEU appear to be variations of naturally occurring conditions.

4.10.3 Pattern Recognition

Surface Soil (Non-PMJM)

The probability plot for the natural log transformed data set for nickel in surface soil in SEEU (Figure A3.4.11) indicates a background population ranging from about 9.3 to 22 mg/kg but with a single sample (sample location DN06-000; see Figure 1.6 in the main text of this volume) with a elevated concentration of 35 mg/kg. The 18 samples forming the background population probably do not represent the full concentration range of the background population. However the highest sample concentration is also anomalously elevated in copper, manganese, molybdenum, vanadium and arsenic suggesting that it may or may not be part of the natural nickel concentrations in this EU.

4.10.4 Comparison to RFETS Background and Other Background Data Sets

Surface Soil (Non-PMJM)

Nickel was detected in each of the 19 surface soil samples collected in the SEEU. Nickel concentrations in surface soil samples at the SEEU range from 9.30 to 35.0 mg/kg, with a mean concentration of 16.3 mg/kg and a standard deviation of 6.03 mg/kg. Nickel concentrations in the background data set range from 3.80 to 14.0 mg/kg, with a mean of 9.60 mg/kg and a standard deviation of 2.59 mg/kg (Table A3.2.6). The reported range for nickel in surface soil within Colorado and the bordering states is 5 to 700 mg/kg, with a mean concentration of 18.8 mg/kg and a standard deviation of 39.8 mg/kg (Table A3.4.1). The range of concentrations of nickel in surface soil within SEEU is at the low end of the range for nickel in soils of Colorado and the bordering states.

4.10.5 Risk Potential for Plants and Wildlife

Surface Soil (Non-PMJM)

The UTL for nickel (35 mg/kg) exceeds NOAEL ESLs for seven receptor groups: the insectivorous mourning dove (1.24 mg/kg), insectivorous deer mouse (0.43 mg/kg), herbivorous deer mouse (16.4 mg/kg), insectivorous coyote (1.9 mg/kg), the generalist coyote (6.0 mg/kg), and the terrestrial plants. All of these ESLs except the herbivorous deer mouse and terrestrial plants are less than the MDC in background soils (14 mg/kg). No nickel Eco-SSLs are currently available for any receptor (the nickel Eco-SSL document is “pending”).

4.10.6 Conclusion

The weight of evidence presented above shows that nickel concentrations in surface soil in the SEEU are not a result of RFETS activities, but rather are representative of naturally occurring concentrations. There is no evidence of a release from potential sources inside or outside the EU that would impact nickel concentrations in surface soil. In addition, the range of concentrations of nickel in surface soil is within the range for nickel in soils of Colorado and the bordering states. Nickel is not considered an ECOPC in surface soil for the SEEU and is not further evaluated quantitatively.

4.11 Radium-228

A background comparison analysis could not be performed for radium-228 in surface soil/surface sediment in the SEEU because there was a single sample location within the EU. However, because the single radium activity (considered MDC) and its UCL exceeded the PRG, radium-228 was carried forward to the professional judgment step per the CRA Methodology. The lines of evidence used to determine if radium-228 should be retained as a COC in surface soil/surface sediment are summarized below.

4.11.1 Summary of Process Knowledge

The potential for radium-228 to be a COC in the SEEU is very low because it was not used at RFETS. The ChemRisk Task 1 Report did not identify radium-228 as a radionuclide used at RFETS (CDH 1991) and no radium-228 waste was reported to have been generated.

4.11.2 Evaluation of Spatial Trends

Surface Soil/Surface Sediment

Figure A3.4.12 shows the single location where radium-228 was sampled within SEEU. The single radium-228 concentration of 1.59 pCi/g exceeded the PRG of 0.111 pCi/g. This radium-228 concentration is similar to activities throughout the site and is less than that site background MDC of 4.10 pCi/g.

4.11.3 Pattern Recognition

Surface Soil/Surface Sediment

A probability plot for radium-228 activities in surface soil/surface sediment could not be generated because there was a single sample result for the SEEU data set.

4.11.4 Comparison to RFETS Background and Other Background Data Sets

There was a single sample result for radium-228 in surface soil/surface sediment at SEEU and, therefore, a statistical background comparison could not be performed. The radium-228 surface soil/surface sediment of 1.59 pCi/g does not exceed the site background MDC of 4.10 pCi/g. The site background activities for radium-228 in surface soil/surface sediment range from 0.200 pCi/g to 4.10 pCi/g, with a mean of 1.60 pCi/g (Table A3.2.2). Therefore, the concentration of radium-228 in surface soil/surface sediment at SEEU is well within site background activities.

4.11.5 Risk Potential for HHRA

Surface Soil/Surface Sediment

The radium-228 MDC for surface soil/surface sediment is 1.59 pCi/g and the PRG is 0.111 pCi/g. Site background activities range from 0.200 to 4.10 pCi/g, which indicates that all site background concentrations for radium-228 exceed the PRG. Because the PRG

is based on a IE-06 risk, the risk to human health in the SEEU from radium-228 is within the NCP risk range of IE-06 to IE-04. Furthermore, because radium-228 activities in the SEEU appear to represent naturally occurring and because radium-228 was not used at the site, this risk is not likely associated with any releases from RFETS.

4.11.6 Conclusion

The weight of evidence presented above shows that the single radium-228 activity in surface soil/surface sediment in the SEEU is not a result of RFETS activities. There is no evidence of a source or release from areas inside or outside the SEEU that would impact radium-228 activities in surface soil/surface sediment. In addition, the radium-228 activities in surface soil/surface. In addition, the radium-228 concentration in surface soil/surface sediment sample at the SEEU is much lower than the site background MDC. Radium-228 was not used or generated at RFETS and is, therefore, not considered a COC in surface soil/ surface sediment for the SEEU and not further evaluated quantitatively.

4.12 Vanadium

Vanadium had an EPC in surface soil (for non-PMJM receptors) greater than the tESL so was carried forward to the professional judgment step. The lines of evidence used to determine if vanadium should be retained as an ECOPC are summarized below.

4.12.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, vanadium was used in small quantities at RFETS, and was identified as a constituent of waste generated in only 2 buildings. Therefore, vanadium is unlikely to be present in RFETS soil as a result of historical site-related activities.

4.12.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

Based on the spatial trend evaluation detailed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, vanadium concentrations in the SEEU appear to be variations of naturally occurring conditions.

4.12.3 Pattern Recognition

Surface Soil (Non-PMJM)

The probability plot for the natural log transformed data set for vanadium in surface soil in SEEU (Figure A3.4.13) indicates a background population ranging from about 22.5 to 78 mg/kg but with a single sample (sample location DN06-000; see Figure 1.6 in the main text of this volume) with a high concentration of 140 mg/kg. The 18 samples forming the background population probably do not represent the full concentration range of the background population. However, the highest sample concentration is also

anomalously high in copper, manganese, molybdenum, nickel and arsenic suggesting that it may or may not be part of the natural manganese concentrations in this EU.

4.12.4 Comparison to RFETS Background and Other Background Data Sets

Surface Soil (Non-PMJM)

Vanadium was detected in each of the 19 surface soil samples collected in the SEEU. Vanadium concentrations in surface soil samples at the SEEU range from 22.5 to 140 mg/kg, with a mean concentration of 50.5 mg/kg and a standard deviation of 26.7 mg/kg. Vanadium concentrations in the RFETS background data set range from 10.8 to 45.8 mg/kg, with a mean of 27.7 mg/kg and a standard deviation of 7.68 mg/kg (Table A3.2.6). The reported range for vanadium in surface soil within Colorado and the bordering states is 7 to 300 mg/kg, with a mean concentration of 73 mg/kg and a standard deviation of 41.7 mg/kg (Table A3.4.1). Vanadium concentrations reported in surface soil samples in the SEEU are well within the range for vanadium in soils of Colorado and the bordering states.

4.12.5 Risk Potential for Plants and Wildlife

Surface Soil (Non-PMJM)

The UTL for vanadium in the SEEU (140 mg/kg) exceeded the NOAEL ESLs for five receptor groups: terrestrial plants (2 mg/kg), the herbivorous deer mouse (63.7 mg/kg), the insectivorous deer mouse receptor (29.9 mg/kg), the prairie dog (83.5 mg/kg), and the insectivorous coyote (121 mg/kg). The plant NOAEL ESL is lower than all background concentrations of vanadium. In addition, the confidence placed on the value by the source (Efroymson et al. 1997) is low. Other studies reported in the same reference (Efroymson et al. 1997) indicate no effects at concentrations up to 40 mg/kg and low effects at concentrations up to 60 mg/kg. No vanadium Eco-SSL is currently available for plants (EPA 2005b). The ESL for the insectivorous deer mouse is also less than the MDC in background soils (45.8 mg/kg) and approximately equal to the mean background concentration (27.7 mg/kg). In addition, the UTL of 140 mg/kg is less than the mammalian Eco-SSL of 280 mg/kg (EPA 2005b).

4.12.6 Conclusion

The weight of evidence presented above shows that vanadium concentrations in surface soil in the SEEU are not a result of RFETS activities, but rather are representative of naturally occurring concentrations. There is no evidence of a release from potential sources inside or outside the EU that would impact vanadium concentrations in surface soil. Vanadium is not considered an ECOPC in surface soil for the SEEU and, therefore, is not further evaluated quantitatively.

4.13 Zinc

Zinc had an EPC in surface soil (for non-PMJM receptors) greater than the tESL so was carried forward to the professional judgment step per the CRA Methodology. The lines of

evidence used to determine if zinc should be retained as an ECOPC are summarized below.

4.13.1 Summary of Process Knowledge

Based on process knowledge as detailed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, because zinc was present in moderate quantities in the historical metals inventory at RFETS, zinc may be present in RFETS soil as a result of historical site-related activities

4.13.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

Based on the spatial trend evaluation detailed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, zinc concentrations in the SEEU appear to be variations of naturally occurring conditions.

4.13.3 Pattern Recognition

Surface Soil (Non-PMJM)

The probability plot for the natural log transformed data set for zinc in surface soil in SEEU (Figure A3.4.14) indicates a single background population ranging from about 46 to 71 mg/kg but with three anomalously low zinc concentrations. The four anomalously low concentration samples (and their zinc concentrations) include 04F1269-005 (18 mg/kg), SS50082.AS (23.1 mg/kg), and 04F1269-006 (37 mg/kg). These four samples may represent part of the background population but more samples would need to be collected and analyzed to confirm this supposition.

4.13.4 Comparison to RFETS Background and Other Background Data Sets

Surface Soil (Non-PMJM)

The reported range for zinc in surface soil within Colorado and the bordering states is 10 to 2,080 mg/kg, with a mean concentration of 72.4 mg/kg and a standard deviation of 159 mg/kg (Table 3.4.1). Zinc concentrations reported in surface soil samples at the SEEU are 18.0 to 71 mg/kg, with a mean concentration of 53.6 mg/kg and a standard deviation of 15.1 mg/kg (Table A3.2.6). Zinc concentrations in the RFETS background data set range from 21.1 to 75.9 mg/kg, with a mean of 49.8 mg/kg and a standard deviation of 12.2 mg/kg (Table A3.2.6). The range of concentrations of zinc in surface soil within SEEU overlaps with the site background data set and falls within the lower range for zinc in soils of Colorado and the bordering states.

4.13.5 Risk Potential for Plants and Wildlife

Surface Soil (Non-PMJM)

The UTL for zinc in the SEEU (71.0 mg/kg) exceeds the NOAEL ESL for three receptor groups, terrestrial plants (50 mg/kg), mourning dove insectivore (0.65 mg/kg) and deer

mouse insectivore (5.29 mg/kg). All other NOAEL ESLs were greater than the MDC and ranged from 171 to 16,489 mg/kg. No zinc Eco-SSLs are currently available for any receptor (the zinc Eco-SSL document is "pending"). All of these ESLs are less than the MDC in background soils (75.9 mg/kg), indicating that they may be overly conservative because risks are not typically expected at background concentrations.

4.13.6 Conclusion

The weight of evidence presented above shows that zinc concentrations in surface soil in the SEEU are not a result of RFETS activities, but rather are representative of naturally occurring concentrations. There is no evidence of a release from potential sources inside or outside the EU that would impact zinc concentrations in surface soil. In addition, the zinc MDC in surface soil at SEEU does not exceed the site background MDC and is within the lower range for zinc in soils of Colorado and the bordering states. Zinc is not considered an ECOPC in surface soil for the SEEU and is not further evaluated quantitatively.

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TABLES

Table A3.2.1
Statistical Distribution and Comparison to Background for SEEU Surface Soil/Surface Sediment

Analyte	Unit	Statistical Distribution Testing Results						Background Comparison		
		Background			SEEU (Excluding Background Samples)			Test	1 - p	Statistically Greater than Background?
		Total No. of Samples	Distribution Recommended by ProUCL	Detects (%)	Total No. of Samples	Distribution Recommended by ProUCL	Detects (%)			
Arsenic	**mg/kg**	**73**	**GAMMA**	**91.8**	**22**	**GAMMA**	**100.00**	**WRS**	**1.28E-06**	**Yes**
Manganese	**mg/kg**	**73**	**GAMMA**	**100.0**	**22**	**NON-PARAMETRIC**	**100.00**	**WRS**	**5.28E-05**	**Yes**
Cesium-137	pCi/g	105	NON-PARAMETRIC	100.0	1	0	100.00	WRS	N/A	N/A
Radium-228	pCi/g	40	GAMMA	100.0	1	0	100.00	WRS	N/A	N/A

Test: WRS - Wilcoxon Rank Sum, t-Test_N - Student's t-test using normal data, t-Test-LN - Student's t-test using log-transformed data.

N/A = Not applicable; site and/or background detection frequency less than 20 percent.

Bold = Analyte retained for further consideration in the next COC selection step.

Table A3.2.2

Summary Statistics for SEEU Surface Soil/Surface Sediment[a]

Analyte	Unit	Background					SEEU (Excluding Background Samples)				
		Total No. of Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentration	Standard Deviation	Total No. of Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentration	Standard Deviation
Arsenic	mg/kg	73	0.270	9.60	3.42	2.55	22	2.50	23.0	7.40	4.15
Manganese	mg/kg	73	9.00	1,280	241	189	22	55.0	1,300	386	237
Cesium-137	pCi/g	105	-0.027	1.80	0.692	0.492	1	0.661	0.661	0.661	N/A
Radium-228	pCi/g	40	0.200	4.10	1.60	0.799	1	1.59	1.59	1.59	N/A

[a] Statistics are computed using one-half the reported value for nondetects.

N/A = Not applicable or not available.

Table A3.2.3
Statistical Distribution and Comparison to Background for SEEU Subsurface Soil/Subsurface Sediment

Analyte	Units	Statistical Distribution Testing Results						Background Comparison		
		Background			SEEU (Excluding Background Samples)			Test	1 - p	Statistically Greater than Background?
		Total No. of Samples	Distribution Recommended by ProUCL	Detects (%)	Total No. of Samples	Distribution Recommended by ProUCL	Detects (%)			
Radium-228	pCi/g	31	GAMMA	100.0	4	NORMAL	100.00	WRS	0.767	No

Test: WRS - Wilcoxon Rank Sum, t-Test_N - Student's t-test using normal data, t-Test-LN - Student's t-test using log-transformed data.

Table A3.2.4

Summary Statistics for SEEU Suburface Soil/Subsurface Sediment[a]

Analyte	Unit	Background					SEEU (Excluding Background Samples)				
		Total No. of Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentration	Standard Deviation	Total No. of Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentration	Standard Deviation
Radium-228	pCi/g	31	1.00	2.10	1.45	0.320	4	0.191	2.01	0.999	0.897

[a] Statistics are computed using one-half the reported value for nondetects.

Table A3.2.5

Statistical Distribution and Comparison to Background for SEEU Surface Soil[a]

Analyte	Unit	Statistical Distribution Testing Results						Background		
		Background			SEEU			Test	1 - p	Statistically Greater than Background?
		Total No. of Samples	Distribution Recommended by ProUCL	Detects (%)	Total No. of Samples	Distribution Recommended by ProUCL	Detects (%)			
Inorganics										
Aluminum	**mg/kg**	**20**	**NORMAL**	**100**	**19**	**NORMAL**	**100**	**t-Test**	**2.09E-04**	**Yes**
Arsenic	mg/kg	20	NORMAL	100	19	GAMMA	100	WRS	0.177	No
Barium	**mg/kg**	**20**	**NORMAL**	**100**	**19**	**NORMAL**	**100**	**t-Test**	**3.17E-04**	**Yes**
Boron	**mg/kg**	**N/A**	**N/A**	**N/A**	**14**	**NORMAL**	**100**	**N/A**	**N/A**	**N/A**
Cadmium	mg/kg	20	NON-PARAMETRIC	65	19	GAMMA	68.4	WRS	0.997	No
Chromium	**mg/kg**	**20**	**NORMAL**	**100**	**19**	**NORMAL**	**100**	**t-Test**	**8.45E-05**	**Yes**
Copper	**mg/kg**	**20**	**NON-PARAMETRIC**	**100**	**19**	**NORMAL**	**100**	**WRS**	**0.020**	**Yes**
Lead	mg/kg	20	NORMAL	100	19	NORMAL	100	t-Test	0.999	No
Lithium	**mg/kg**	**20**	**NORMAL**	**100**	**16**	**NORMAL**	**93.8**	**t-Test**	**4.11E-05**	**Yes**
Manganese	**mg/kg**	**20**	**NORMAL**	**100**	**19**	**NON-PARAMETRIC**	**100**	**WRS**	**2.10E-04**	**Yes**
Mercury	mg/kg	20	NON-PARAMETRIC	40	16	GAMMA	25	WRS	1.000	No
Molybdenum	**mg/kg**	**20**	**NORMAL**	**0**	**18**	**LOGNORMAL**	**77.8**	**N/A**	**N/A**	**N/A**
Nickel	**mg/kg**	**20**	**NORMAL**	**100**	**19**	**GAMMA**	**100**	**WRS**	**2.91E-05**	**Yes**
Vanadium	**mg/kg**	**20**	**NORMAL**	**100**	**19**	**GAMMA**	**100**	**WRS**	**9.28E-05**	**Yes**
Zinc	**mg/kg**	**20**	**NORMAL**	**100**	**19**	**NON-PARAMETRIC**	**100**	**WRS**	**0.089**	**Yes**

[a] EU data used for background comparisons do not include data from background locations.

Test: WRS - Wilcoxon Rank Sum, t-Test_N - Student's t-test using normal data, t-Test-LN - Student's t-test using log-transformed data.

N/A = Not applicable; background data not available or not detected. (Statistical comparisons to background cannot be performed. The analyte is retained as an ECOI for further evaluation).

Bold = Analyte retained for further consideration in the next COC selection step.

Table A3.2.6
Summary Statistics For SEEU Surface Soil[a]

		Background					SEEU (excluding background samples)				
Analyte	**Units**	**Total Samples**	**Minimum Detected Concentration**	**Maximum Detected Concentration**	**Mean**	**Standard Deviation**	**Total Samples**	**Minimum Detected Concentration**	**Maximum Detected Concentration**	**Mean**	**Standard Deviation**
Aluminum	mg/kg	20	4,050	17,100	10,203	3,256	19	5,860	25,000	15,362	4,928
Arsenic	mg/kg	20	2.30	9.60	6.09	2.00	19	2.50	23.0	7.43	4.41
Barium	mg/kg	20	45.7	134	102	19.4	19	57.0	210	141	41.4
Boron	mg/kg	N/A	N/A	N/A	N/A	N/A	14	3.70	8.70	5.95	1.47
Cadmium	mg/kg	20	0.670	2.30	0.708	0.455	19	0.120	1.00	0.356	0.207
Chromium	mg/kg	20	5.50	16.9	11.2	2.78	19	7.30	27.0	17.0	5.43
Copper	mg/kg	20	5.20	16.0	13.0	2.58	19	7.80	25.0	15.2	3.83
Lead	mg/kg	20	8.60	53.3	33.5	10.5	19	4.80	37.0	23.9	6.63
Lithium	mg/kg	20	4.80	11.6	7.66	1.89	16	5.20	23.0	13.3	5.29
Manganese	mg/kg	20	129	357	237	63.9	19	55.0	1,300	392	247
Mercury	mg/kg	20	0.090	0.120	0.072	0.031	16	0.014	0.021	0.014	0.012
Molybdenum	mg/kg	20	N/A	N/A	0.573	0.184	18	0.610	1.90	1.14	0.605
Nickel	mg/kg	20	3.80	14.0	9.60	2.59	19	9.30	35.0	16.3	6.03
Vanadium	mg/kg	20	10.8	45.8	27.7	7.68	19	22.5	140	50.5	26.7
Zinc	mg/kg	20	21.1	75.9	49.8	12.2	19	18.0	71.0	53.6	15.1

[a] Statistics are computed using one-half the reported value for nondetects.
N/A = Not applicable; background data not available or not detected.

Table A3.2.7
Statistical Distribution and Comparison to Background for SEEU Subsurface Soil

Analyte	Unit	Statistical Distribution Testing Results						Background		
		Background			SEEU[a]					
		Total No. of Samples	Distribution Recommended by ProUCL	Detects (%)	Total No. of Samples	Distribution Recommended by ProUCL	Detects (%)	Test	1 - p	Statistically Greater than Background?
Arsenic	**mg/kg**	**45**	**NON-PARAMETRIC**	**93**	**6**	**NORMAL**	**100**	**WRS**	**0.045**	**Yes**

[a] SEEU data for background comparison do not include any background locations.

WRS = Wildcoxon Rank Sum.

Bold = Analyte retained for further consideration in the next COC selection step.

Table A3.2.8
Summary Statistics For SEEU Suburface Soil[a]

		Background					SEEU (excluding background samples)				
Analyte	**Units**	**Total Samples**	**Minimum Detected Concentration**	**Maximum Detected Concentration**	**Mean**	**Standard Deviation**	**Total Samples**	**Minimum Detected Concentration**	**Maximum Detected Concentration**	**Mean**	**Standard Deviation**
Arsenic	mg/kg	45	1.70	41.8	5.48	6.02	6	2.70	19.1	8.10	5.74

[a] Statistics are computed using one-half the reported value for nondetects.

Table A3.4.1

Summary of Element Concentrations in Colorado and Bordering States Soil[a]

Analyte	Total Number of Results	Number of "G" qualified Results[b]	Number of Nondetects	Detection Frequency (%)	Minimum Detected Value (mg/kg)	Maximum Detected Value (mg/kg)	Range of Detected Values (mg/kg)	Average Detected Value (mg/kg)[c]	Standard Deviation (mg/kg)[c]
Aluminum	335	32		100%	10.0	100,000	10 - 100,000	45,900	26,900
Antimony	84		71	15%	1.04	2.53	1.038 - 2.531	0.647	0.378
Arsenic	307		2	99%	1.22	97.0	1.224 - 97	6.90	7.64
Barium	342			100%	100	3,000	100 - 3,000	642	330
Beryllium	342		219	36%	1.00	7.00	1 - 7	0.991	0.876
Boron	342		114	67%	20.0	150	20 - 150	27.9	19.7
Bromine	85		42	51%	0.504	3.52	0.5038 - 3.522	0.681	0.599
Calcium	342			100%	0.055	32.0	0.055 - 32	3.09	4.13
Carbon	85			100%	0.300	10.0	0.3 - 10	2.18	1.92
Cerium	291		244	16%	150	300	150 - 300	90.0	38.4
Chromium	342			100%	3.00	500	3 - 500	48.2	41.0
Cobalt	342		39	89%	3.00	30.0	3 - 30	8.09	5.03
Copper	342			100%	2.00	200	2 - 200	23.1	17.7
Fluorine	264		7	97%	10.0	1,900	10 - 1900	394	261
Gallium	340		3	99%	5.00	50.0	5 - 50	18.3	8.90
Germanium	85			100%	0.578	2.15	0.5777 - 2.146	1.18	0.316
Iodine	85		18	79%	0.516	3.49	0.516 - 3.487	1.07	0.708
Iron	342			100%	3,000	100,000	3,000 - 100,000	21,100	13,500
Lanthanum	341		115	66%	30.0	200	30 - 200	39.8	28.8
Lead	342		25	93%	10.0	700	10 - 700	24.8	41.5
Lithium	307			100%	5.00	130	5 - 130	25.3	14.4
Magnesium	342	1		100%	300	100,000	300 - 100,000	8,890	8,080
Manganese	342			100%	70.0	2,000	70 - 2,000	414	272
Mercury	309		3	99%	0.010	4.60	0.01 - 4.6	0.077	0.276
Molybdenum	340		328	4%	3.00	7.00	3 - 7	1.59	0.522
Neodymium	256		198	23%	70.0	300	70 - 300	47.1	31.7
Nickel	342		12	96%	5.00	700	5 - 700	18.8	39.8
Niobium	335		123	63%	10.0	100	10 - 100	11.4	8.68
Phosphorus	249			100%	40.0	4,497	40 - 4497	399	397
Potassium	341			100%	1,900	63,000	1,900 - 63,000	18,900	6,980
Rubidium	85			100%	35.0	140	35 - 140	75.8	25.0
Scandium	342		51	85%	5.00	30.0	5 - 30	8.64	4.69
Selenium	309		60	81%	0.102	4.32	0.1023 - 4.3183	0.349	0.415
Silicon	85			100%	149,340	413,260	149340 - 413260	302,000	61,500
Sodium	335			100%	500	70,000	500 - 70,000	10,400	6,260
Strontium	342			100%	10.0	2,000	10 - 2,000	243	212
Sulfur	85		71	16%	816	47,760	816 - 47,760	1,250	5,300
Thallium	76			100%	2.45	20.8	2.45 - 20.79	9.71	3.54
Tin	85		3	96%	0.117	5.00	0.117 - 5.001	1.15	0.772
Titanium	342			100%	500	7,000	500 - 7,000	2,290	1,350
Uranium	85			100%	1.11	5.98	1.11 - 5.98	2.87	0.883
Vanadium	342			100%	7.00	300	7 - 300	73.0	41.7
Ytterbium	330		3	99%	1.00	20.0	1 - 20	3.33	2.06
Yttrium	342		7	98%	10.0	150	10 - 150	26.9	18.1
Zinc	330			100%	10.0	2,080	10 - 2,080	72.4	159
Zirconium	342			100%	30.0	1,500	30 - 1,500	220	157

[a] The western U.S. background data set (Shacklette and Boerngen 1984) is composed of background values from Colorado, as well as all states bordering Colorado (Arizona, Kansas, Nebraska, New Mexico, Oklahoma, Utah, and Wyoming). See Section 4.0.

[b] The element was measured at a concentration greater than the upper determination limit for the technique.

[c] Average and standard deviation values were calculated using one-half the reported value for nondetects.

FIGURES

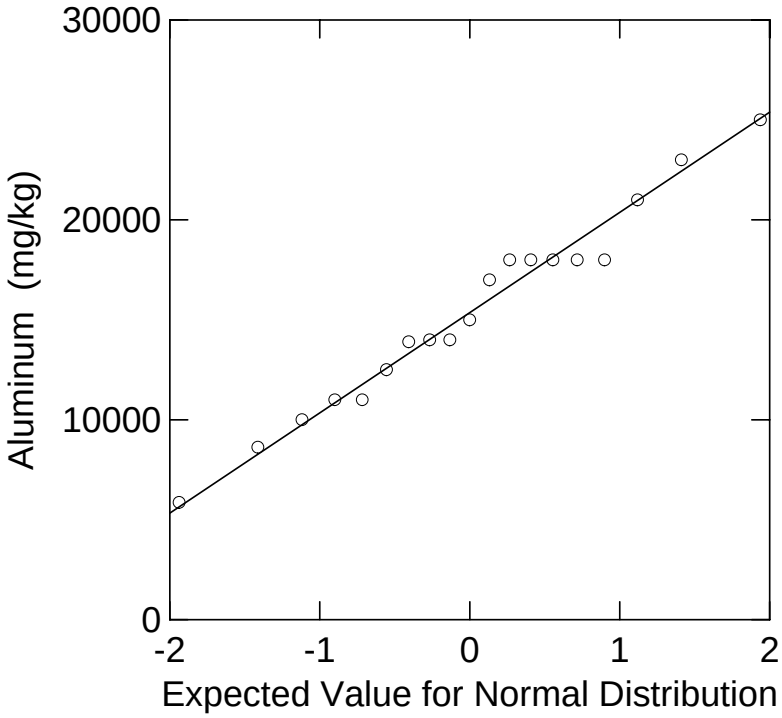

Figure A3.4.1. Probability Plot of Aluminum Concentrations (Natural Logarithm) in SEEU Surface Soil

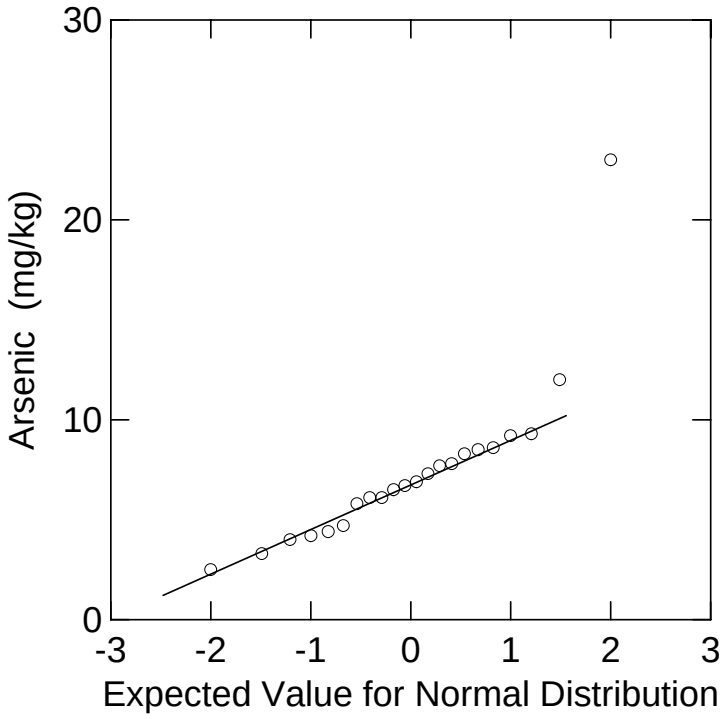

Figure A3.4.2. Probability Plot of Arsenic Concentrations (Natural Logarithm) in SEEU Surface Soil/Surface Sediment

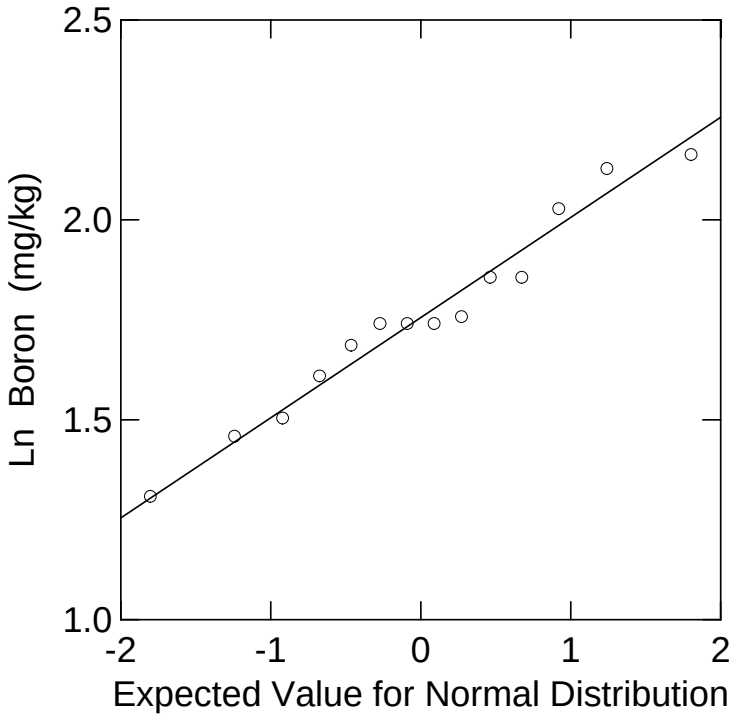

Figure A3.4.3. Probability Plot of Boron Concentrations (Natural Logarithm) in SEEU Surface Soil

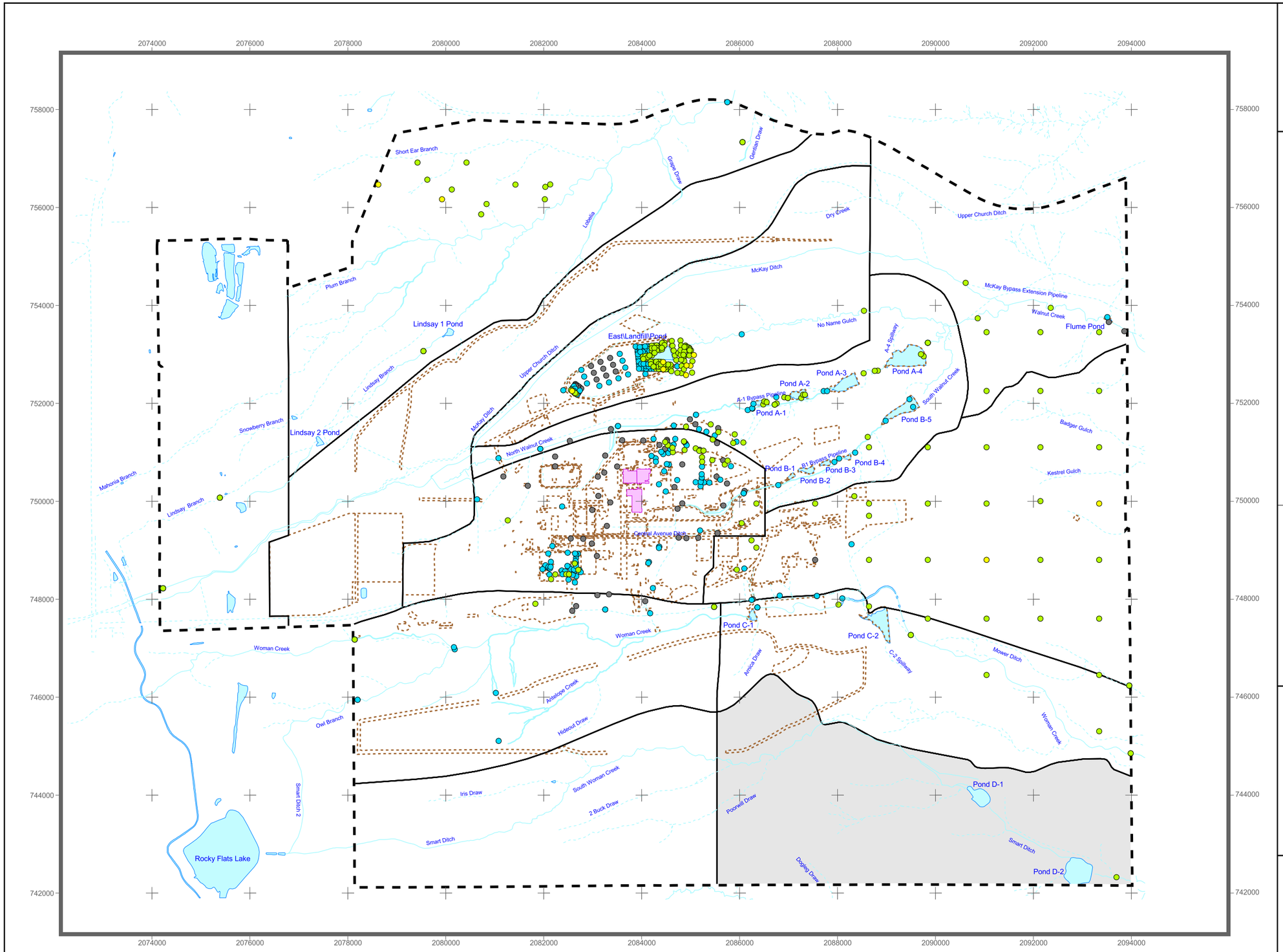

Figure A3.4.4

Cesium-137 Activity in Sitewide Surface Soil/Surface Sediment

KEY

- Concentration > 3x Background MDC
- Concentration > Background MDC and <= 3x Background MDC
- Concentration > WRW PRG and <= Background MDC
- Concentration <= WRW PRG
- Nondetect (ND)

WRW PRG = 0.221 pCi/g
Background MDC = 1.80 pCi/g
3 x Background MDC = 5.4 pCi/g

Standard Map Features

- Southeast Buffer Zone Area EU
- Exposure Unit boundaries
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Ephemeral stream
- Intermittent stream
- Perennial stream
- Site boundary

N
W E
S

0 1000 2000 Feet

Scale 1:24,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

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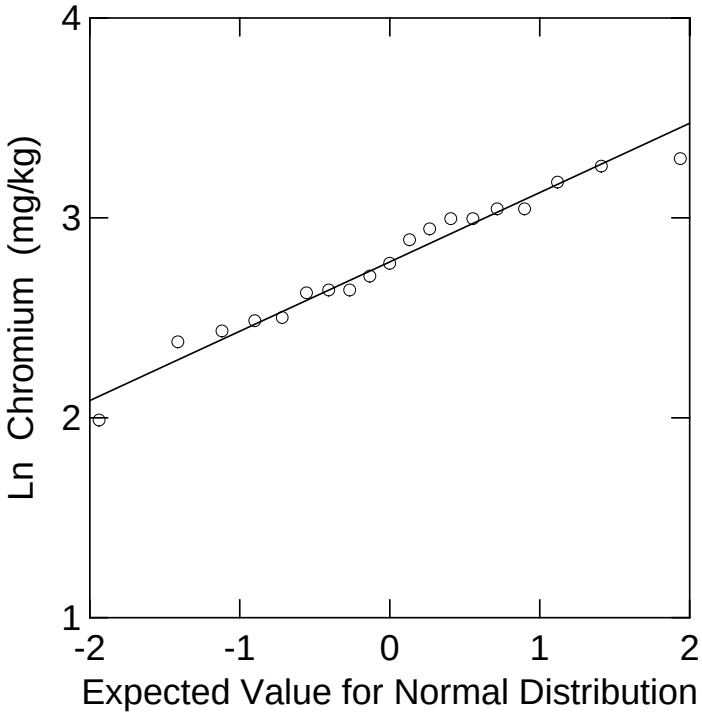


Figure A3.4.5. Probability Plot of Chromium Concentrations (Natural Logarithm) in SEEU Surface Soil

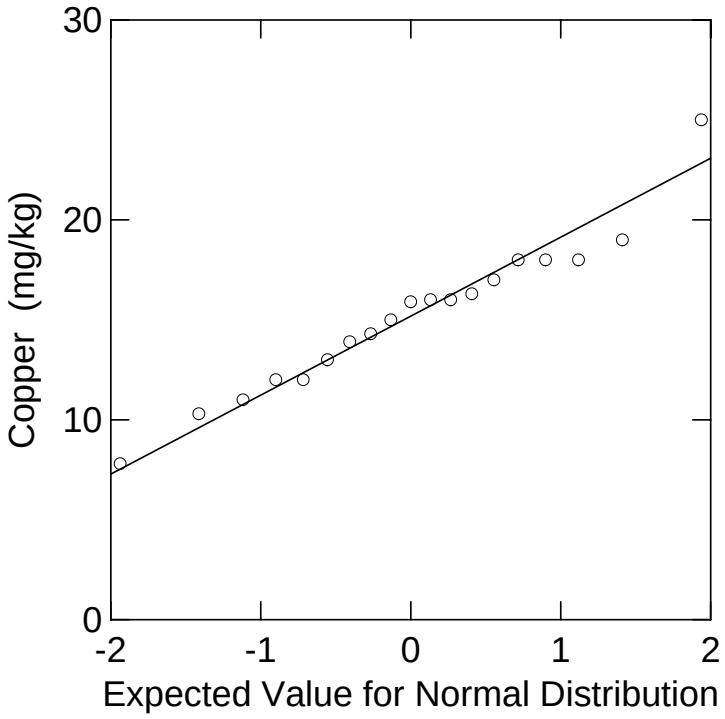


Figure A3.4.6. Probability Plot of Copper Concentrations (Natural Logarithm) in SEEU Surface Soil

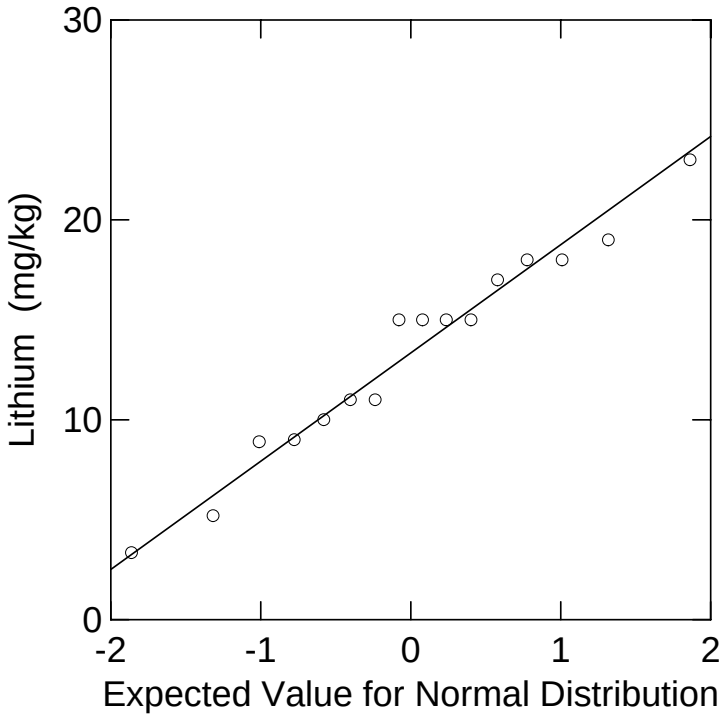


Figure A3.4.7. Probability Plot of Lithium Concentrations (Natural Logarithm) in SEEU Surface Soil

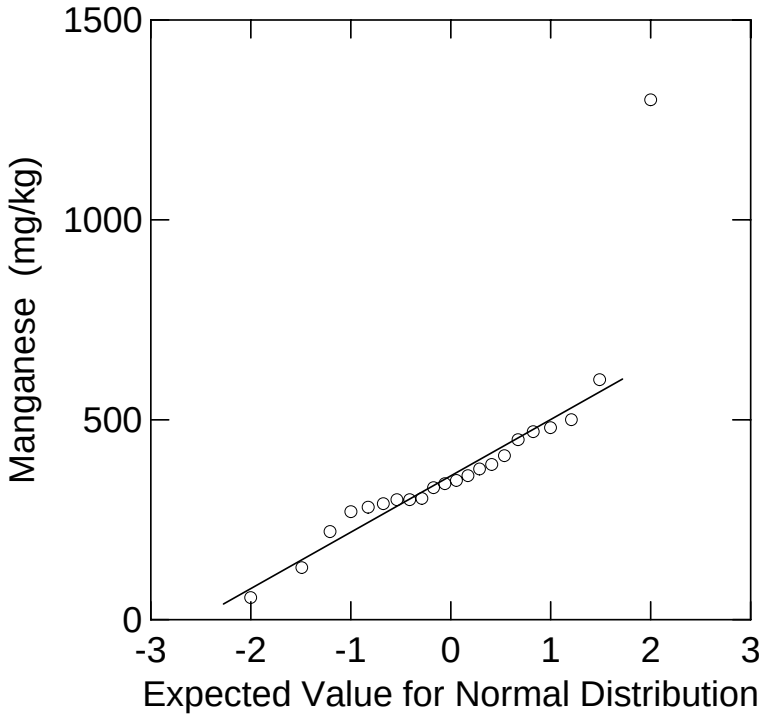


Figure A3.4.8. Probability Plot of Manganese Concentrations (Natural Logarithm) in SEEU Surface Soil/Surface Sediment

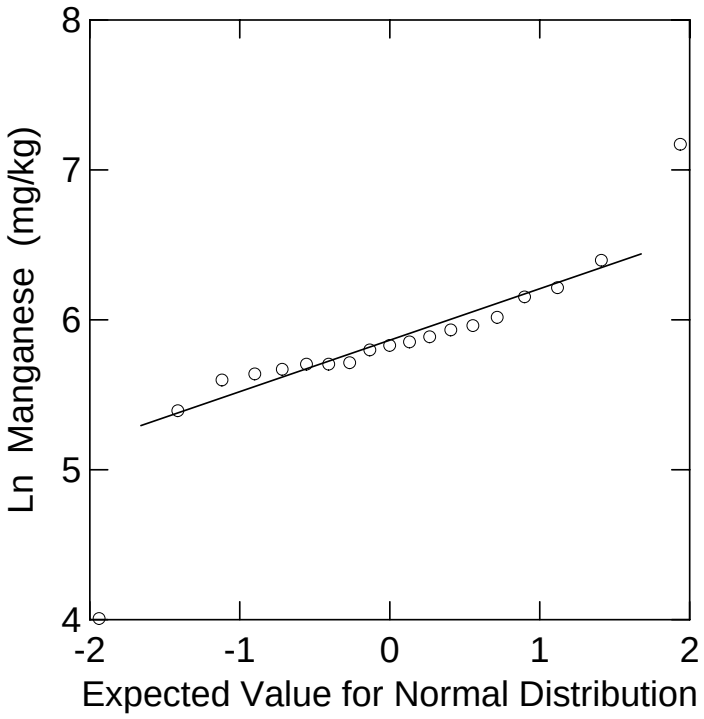


Figure A3.4.9. Probability Plot of Manganese Concentrations (Natural Logarithm) in SEEU Surface Soil

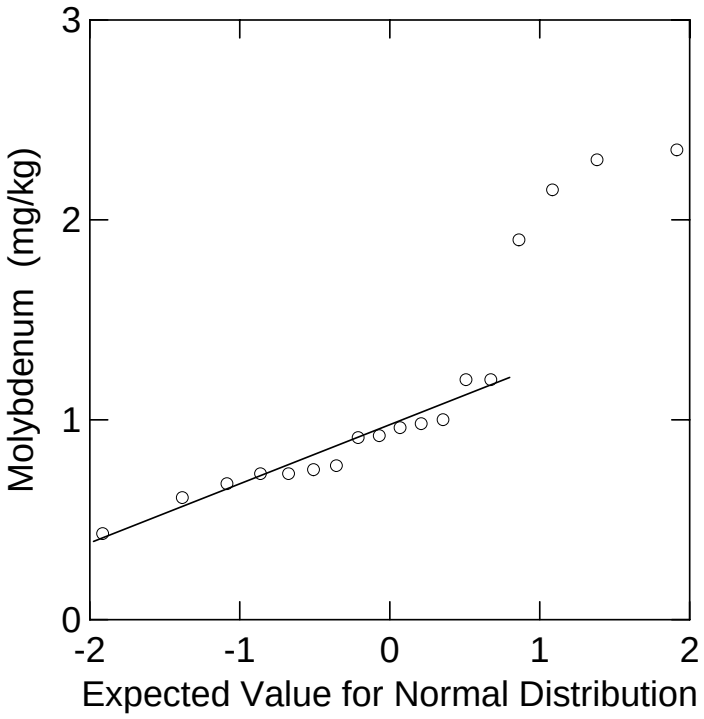


Figure A3.4.10. Probability Plot of Molybdenum Concentrations (Natural Logarithm) in SEEU Surface Soil

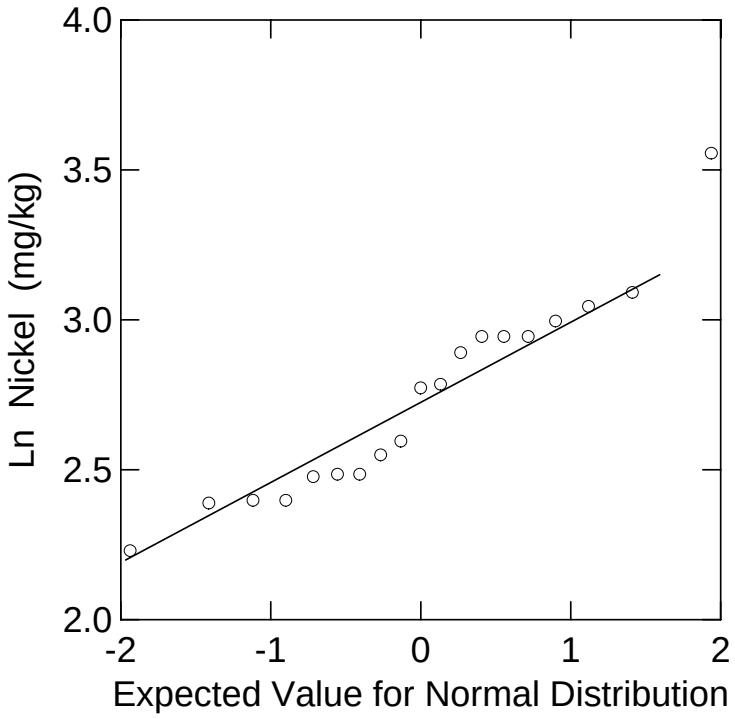
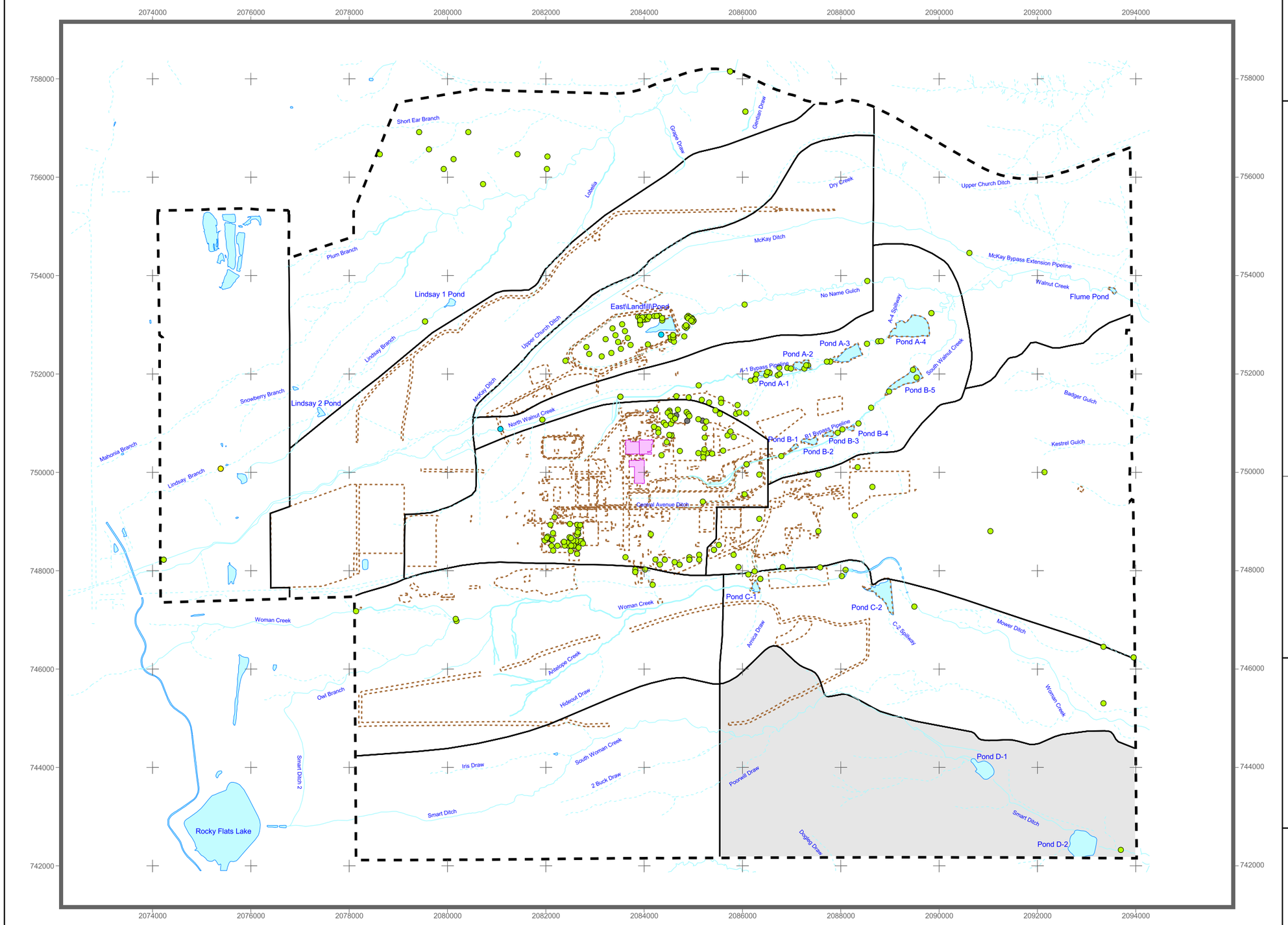


Figure A3.4.11. Probability Plot of Nickel Concentrations (Natural Logarithm) in SEEU Surface Soil

Figure A3.4.12

Radium-228 Activity in Sitewide Surface Soil/Surface Sediment



KEY

- Concentration > 3x Background MDC
- Concentration > Background MDC and <= 3x Background MDC
- Concentration > WRW PRG and <= Background MDC
- Concentration <= WRW PRG
- Nondetect (ND)

WRW PRG = 0.111 pCi/g
Background MDC = 4.10 pCi/g
3 x Background MDC = 12.3 pCi/g

Standard Map Features

- Southeast Buffer Zone Area EU
- Exposure Unit boundaries
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Ephemeral stream
- Intermittent stream
- Perennial stream
- Site boundary

N
W E
S

0 1000 2000 Feet

Scale 1:24,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

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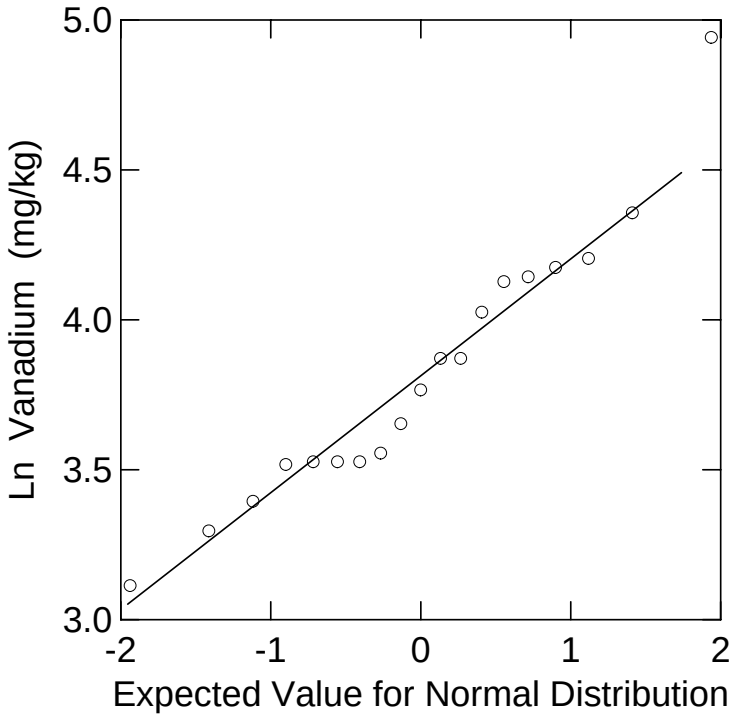

Figure A3.4.13. Probability Plot of Vanadium Concentrations (Natural Logarithm) in SEEU Surface Soil

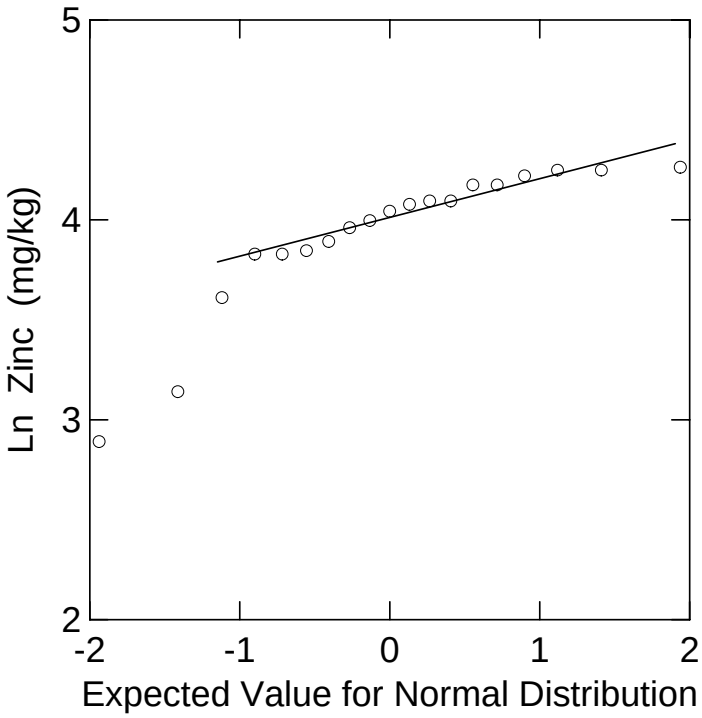

Figure A3.4.14. Probability Plot of Zinc Concentrations (Natural Logarithm) in SEEU Surface Soil

COMPREHENSIVE RISK ASSESSMENT

SOUTHEAST BUFFER ZONE AREA EXPOSURE UNIT

VOLUME 13: ATTACHMENT 4

CRA Analytical Data Set