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Department of Energy

Portsmouth/Paducah Project Office
1017 Majestic Drive, Suite 200
Lexington, Kentucky 40513
(859) 219-4000

MAR 28 2016

PPPO-02-3181534-16A

Mr. Brian Begley
Federal Facility Agreement Manager
Division of Waste Management
Kentucky Department for Environmental Protection
200 Fair Oaks Lane, 2nd Floor
Frankfort, Kentucky 40601

Ms. Julie Corkran
Federal Facility Agreement Manager
U.S. Environmental Protection Agency, Region 4
61 Forsyth Street
Atlanta, Georgia 30303

Dear Mr. Begley and Ms. Corkran:

SOILS OPERABLE UNIT REMEDIAL INVESTIGATION 2 REPORT AT THE PADUCAH GASEOUS DIFFUSION PLANT, PADUCAH, KENTUCKY (DOE/LX/07-2306&D2)

References:

1. Letter from J. Corkran to T. Duncan, "EPA Comments on: Soils Operable Unit Remedial Investigation 2 Report at the U.S. Department of Energy, Paducah Gaseous Diffusion Plant, DOE/LX/07-2306&D1," dated November 5, 2015
2. Letter from A. Webb to T. Duncan, "Submittal of comments to the Soils Operable Unit Remedial Investigation 2 Report, DOE/LX/07-2306&D1," dated September 30, 2015

Please find enclosed for your approval, the certified *Soils Operable Unit Remedial Investigation 2 Report at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-2306&D2 (Soils OU RI 2 Report). The subject document has been revised in response to comments received from the Kentucky Department for Environmental Protection and the U.S. Environmental Protection Agency on September 30, 2015, and November 5, 2015, respectively. This document also contains revisions based on feedback received during the comment resolution teleconferences held with the Federal Facility Agreement parties on December 17, 2015, December 18, 2015, and February 16, 2016. A redline version of the document and comment response summaries are also included.

If you have any questions or require additional information, please contact April Ladd at (270) 441-6843.

Sincerely,

Tracey Duncan
Federal Facility Agreement Manager
Portsmouth/Paducah Project Office

Enclosures:

1. Certification Page
2. Soils OU RI 2 Report (clean)
3. Soils OU RI 2 Report (redline)
4. Soils OU RI 2 Comment Response Summary—U.S. Environmental Protection Agency
5. Soils OU RI 2 Comment Response Summary—Kentucky Division of Waste Management

e-copy w/enclosures:
april.ladd@lex.doe.gov, PPPO/PAD
april.webb@ky.gov, KDEP/Frankfort
brian.begley@ky.gov, KDEP/Frankfort
corkran.julie@epa.gov, EPA/Atlanta
craig.jones@ffspaducah.com, FFS/Kevil
ffscorrespondence@ffspaducah.com, FFS/Kevil
gaye.brewer@ky.gov, KDEP/PAD
jennifer.watson@ffspaducah.com, FFS/Kevil
jennifer.woodard@lex.doe.gov, PPPO/PAD
leo.williamson@ky.gov, KDEP/Frankfort
mark.duff@ffspaducah.com, FFS/Kevil
mike.guffey@ky.gov, KDEP/Frankfort
myrna.redfield@ffspaducah.com, FFS/Kevil
nathan.garner@ky.gov, KYRHB/Frankfort
pad.rmc@swiftstaley.com, SSI/Kevil
reinhard.knerr@lex.doe.gov, PPPO/PAD
stephaniec.brock@ky.gov, KYRHB/Frankfort

CERTIFICATION

Document Identification: ***Soils Operable Unit Remedial Investigation 2 Report at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,*** **DOE/LX/07-2306&D2**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Fluor Federal Services, Inc.

3-28-16

Mark J. Duff, Director, Environmental Management

Date Signed

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

U.S. Department of Energy

Jennifer Woodard

3/28/16

Jennifer Woodard, Site Lead
Portsmouth/Paducah Project Office

Date Signed

DOE/LX/07-2306&D2
Primary Document

Soils Operable Unit Remedial Investigation 2 Report at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

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Soils Operable Unit Remedial Investigation 2 Report at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Date Issued—March 2016

U.S. DEPARTMENT OF ENERGY
Office of Environmental Management

Prepared by
FLUOR FEDERAL SERVICES, INC.,
Paducah Deactivation Project
managing the
Deactivation Project at the
Paducah Gaseous Diffusion Plant
under Task Order DE-DT0007774

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CONTENTS

TABLES

FIGURES

ACRONYMS

ACO	Administrative Consent Order
AL	action level
AOC	area of concern
ARAR	applicable or relevant and appropriate requirement
AT123D	Analytical Transient 1-,2-,3-Dimensional
BGOU	Burial Grounds Operable Unit
BHHRA	baseline human health risk assessment
BRA	baseline risk assessment
CAS	Chemical Abstract Service
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
COC	contaminant of concern
COE	U.S. Army Corps of Engineers
COPC	chemical of potential concern
COPEC	contaminant of potential ecological concern
CSM	conceptual site model
CSOU	Comprehensive Site Operable Unit
D&D	decontamination and decommissioning
DAF	dilution attenuation factor
DMSA	DOE Material Storage Area
DNAPL	dense nonaqueous-phase liquid
DOE	U.S. Department of Energy
DOECAP	DOE Consolidated Audit Program
DQO	data quality objective
DUF_6	depleted uranium hexafluoride
EDD	electronic data deliverable
EE/CA	engineering evaluation/cost analysis
ELCR	excess lifetime cancer risk
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ESV	ecological screening value
EU	exposure unit
FFA	Federal Facility Agreement
FOE	frequency of exposure
FS	feasibility study
FSP	field sampling plan
GC/MS	gas chromatograph/mass spectrometer
GDP	gaseous diffusion plant
GPS	global positioning system
GWOU	Groundwater Operable Unit
GWS	gamma walkover survey
HI	hazard index
HQ	hazard quotient
HU	hydrogeologic unit
KAR	*Kentucky Administrative Regulations*
KDEP	Kentucky Department for Environmental Protection
KPDES	Kentucky Pollutant Discharge Elimination System
LUC	land use control

MARSSIM	Multi-Agency Radiological Survey and Site Investigation Manual
MCL	maximum contaminant level
MDA	minimum detectable activity
MDC	minimum detectable concentration
NAL	no action level
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priorities List
NSDD	North-South Diversion Ditch
OREIS	Oak Ridge Environmental Information System
OS	outside
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PAL	project action limit
PCB	polychlorinated biphenyl
PEMS	Project Environmental Measurements System
PGDP	Paducah Gaseous Diffusion Plant
POE	point of exposure
QA	quality assurance
QC	quality control
RAGS	Risk Assessment Guidance for Superfund
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RGA	Regional Gravel Aquifer
RGO	remedial goal option
RI	remedial investigation
RME	reasonable maximum exposure
ROD	Record of Decision
RPD	relative percent difference
SAR	SWMU Assessment Report
SER	Site Evaluation Report
SERA	screening-level ecological risk assessment
SESOIL	Seasonal Soil Compartment Model
SI	site investigation
SMO	Sample Management Office
SMP	Site Management Plan
SOP	standard operating procedure
SSL	soil screening level
SVOC	semivolatile organic compound
SWMU	solid waste management unit
SWOU	Surface Water Operable Unit
TED	total effective dose
TVA	Tennessee Valley Authority
UCL	upper confidence limit
UCRS	Upper Continental Recharge System
USGS	U.S. Geological Survey
VOC	volatile organic compound
WAG	waste area group
WKWMA	West Kentucky Wildlife Management Area
XRF	X-ray fluorescence

EXECUTIVE SUMMARY

The Paducah Gaseous Diffusion Plant (PGDP) is an inactive uranium enrichment facility that is owned by the U.S. Department of Energy (DOE). DOE is conducting environmental restoration activities at PGDP in accordance with the requirements of the Paducah Federal Facility Agreement (FFA), which coordinates Resource Conservation and Recovery Act and the Comprehensive Environmental Response, Compensation, and Liability Act cleanup requirements. PGDP was placed on the National Priorities List in 1994. DOE, the U.S. Environmental Protection Agency (EPA), and the Commonwealth of Kentucky (Kentucky) entered into an FFA in 1998 (EPA 1998).

This Remedial Investigation (RI) Report was prepared following the outlines found in Appendix D of the FFA for PGDP (EPA 1998) and is consistent with the elements found in Appendix B of the Soils Operable Unit (OU) RI/Feasibility Study (FS) Work Plan (Work Plan) (DOE 2010a), but the outline format was modified to meet specific project requirements.

Sixteen solid waste management units (SWMUs)/areas of concern (AOCs), listed in Table ES.1, were determined to require additional characterization subsequent to the Soils OU RI performed in 2010 to delineate the nature and extent of contamination (Table ES.1 identifies 17 SWMUs/AOCs because SWMU 225 has been divided into SWMU 225-A and SWMU 225-B). On April 13, 2012, the FFA parties agreed that the Soils OU RI would be bifurcated into two investigations based on the results of the 2010 field investigation (DOE 2012). A work plan addendum was developed and approved to describe how additional sampling would be performed (DOE 2014a). This work plan addendum supplemented the approved Work Plan for the Soils OU (DOE 2010a), which was completed in June 2010, and the work performed in this phase of the project is referred to as the Soils OU RI 2 within this document. Data gaps that were addressed at each of the SWMUs/AOCs by this subsequent RI are listed in Table ES.1. The work plan addendum (DOE 2014a) documents March and April 2014 walkdowns and scoping meetings where the FFA parties identified SWMUs whose evaluations were recommended for deferral to another OU [e.g., the Soils and Slabs OU and/or Decontamination and Decommissioning (D&D) OU] or did not require additional sampling (i.e., SWMU 224). Units were deferred to another OU on the basis that they could not be characterized adequately based on current conditions or have the potential to be recontaminated during D&D activities (DOE 2014a).

> The Soils OU RI Work Plan (DOE 2010a) is referred to as the "Work Plan." The Soils OU RI Work Plan Addendum (DOE 2014a) is referred to as the "work plan addendum" or "addendum."

This RI Report, referred to as the Soils OU RI 2 Report, has been developed to present results of the field investigation that was conducted in fall of 2014 for the SWMUs/AOCs requiring additional characterization. Historical data, in addition to data collected during the Soils OU RI and Soils OU RI 2, were combined to form the entire data set used to evaluate the Soils OU RI 2. This Soils OU RI 2 Report documents the nature and extent of contamination, contaminant fate and transport, and risk characterization.[1] Further, this Soils OU RI 2 Report summarizes the information known about the SWMUs/AOCs and describes how the additional investigation fills the data gaps and supports remedial decision making.

[1] The baseline human health risk assessment (BHHRA) in this report considers residential land use consistent with EPA Region 4 Human Health Risk Assessment Supplemental Guidance. As discussed in the Paducah Site Management Plan (DOE 2015a) (SMP), the Paducah Human Health Risk Methods Document (DOE 2015b), and this Soils OU RI 2 Report, industrial and recreational use, and not residential use, are the reasonably anticipated land uses for the SWMU/AOCs assessed. The risk characterization for the residential scenario will be used in subsequent documents to identify unlimited use/unlimited exposure for no further action determinations and any land use controls appropriate for reasonably anticipated land uses.

SWMU 229 was deferred to this subsequent RI to further delineate the extent of radionuclide contamination to the south and east of the unit. A radiological walkover survey and a judgmental grab sample were planned for this unit. During the course of the Soils OU RI 2 field work, the unit consistently contained standing water. As stated in the survey plan of the work plan addendum (DOE 2014a), gamma radiological surveys would not be performed in areas of standing water; therefore, the planned activities for this unit could not be completed. After discussion among the FFA parties on December 2, 2014, it was concluded that the activities for SWMU 229 will need to be conducted at a later time when the unit is free of standing water (e.g., July, August). Activities shall occur at the earliest possible opportunity based upon the condition of the unit. SWMU 229 was not evaluated within this report; however, SWMU 229 will be reported in an addendum to this report once the field activities are completed.

Table ES.1. Soils OU RI 2 SWMUs/AOCs

SWMU/ AOC No.	Location	Description	Data Gap Addressed[1]
13	C-746-P&P1	Scrap Yards	Extent of surface soil undefined
15	C-746-C	Scrap Yard	Extent undefined to the east
16[2]	C-746-D	Scrap Yard	Nature and extent undefined
26	C-400 to C-404	4-inch Underground Transfer Line	Extent of surface soil undefined
47[2]	C-400	Technetium-99 (Tc-99) Storage Tank Area	Extent undefined to the south and west
56	C-540-A	Polychlorinated biphenyl (PCB) Staging Area	To be evaluated with SWMU 80
74[2]	C-340	Transformer Spill Site	Nature and extent undefined
77	C-634-B	Sulfuric Acid Storage Tank	Nature and extent undefined
80	C-540	PCB Spill Site	Vertical extent undefined, horizontal extent undefined south of road
204	Dyke Road	Historical Staging Area	Nature and extent undefined
211-A	C-720	Trichloroethene Spill Site Northwest	Extent undefined to the south and west
224	C-340	DOE Material Storage Area (DMSA) Outside (OS)-13, empty drum storage	Extent undefined to the south, east, and west
225-A[3]	C-533-1	DMSA OS-14, Rail Cars	Nature and extent undefined
225-B[3]	C-533-1	Contaminated Soil Area near C-533-1, DMSA OS-14	Nature and extent defined; to be included in this Soils OU RI 2 Report
226[2]	C-745-B	DMSA OS-15	Extent undefined to the east and west
229[4]	C-746-F	DMSA OS-18	Extent undefined to the south and east
565	North of C-611 Water Treatment Plant	Rubble Area K	Extent undefined to the north

[1] Nature and extent refer to nature and extent of contamination.
[2] After a site walkdown by the FFA parties, the parties agreed to defer this unit to the Soils and Slabs OU.
[3] Subsequent to the Soils OU RI/FS Work Plan (DOE 2010a), SWMU 225 was divided into SWMUs 225-A and 225-B (DOE 2014a).
[4] SWMU 229 was not evaluated within this report; however, SWMU 229 will be reported in an addendum to this report once field activities are completed.

PROJECT OBJECTIVES AND GOALS

The goals for the Soils OU RI 2 are consistent with those established in the Paducah FFA (EPA 1998) and the SMP (DOE 2015a) negotiated among DOE, EPA, and Kentucky. The primary objectives for the Soils OU presented in the SMP are to protect human health and the environment by taking actions necessary to prevent both on-site and off-site human exposure that presents an unacceptable risk and to implement actions that provide the greatest opportunities to achieve significant risk reduction before site closure.

The goals of this Soils OU RI 2 are as follows:

Goal 1: Characterize Nature and Extent of Source Zone(s);
Goal 2: Determine Surface and Subsurface Transport Mechanisms and Pathways;
Goal 3: Complete a Baseline Risk Assessment for the Soils OU; and
Goal 4: Support Evaluation of Remedial Alternatives.

The Work Plan (DOE 2010a) and addendum (DOE 2014a) utilized a compilation of sampling information collected on and around PGDP ranging from 1988 to 2014. During development of the Work Plan, data existing at that time were evaluated relative to the data quality objectives (DQOs) defined in the Work Plan (DOE 2010a). The result of the evaluation was the identification of data gaps for each SWMU/AOC. The data collected during the summer of 2010 and the fall of 2014 have addressed those data gaps. Sampling results collected during both RIs and historical data of sufficient quality to meet DQOs, per the evaluation in the Work Plan (DOE 2010a), have been used (1) to determine nature and extent of contamination, (2) to model the effect contamination may have on groundwater, and (3) to assess potential risks and hazards posed by each SWMU/AOC.

This RI Report summarizes the results of the characterization of the sources at each one of the SWMUs/AOCs, identifies SWMUs/AOCs with potential for migration from these impacted soils to groundwater or runoff to adjacent drainageways, and summarizes potential risks/hazards associated with the SWMUs/AOCs (Goals 1–3). These form the basis for supporting an evaluation of potential actions in an FS (Goal 4).

Soils OU RI 2 SWMUs/AOCs are evaluated based on the criteria in the FFA for a reasonable maximum exposure for both current and future land use for excess lifetime cancer risks (ELCRs) of 1E-06 or hazard index (HI) greater than 1, and for adverse environmental impacts (EPA 1998).

CHARACTERIZE NATURE AND EXTENT OF SOURCE ZONE (GOAL 1)

The conceptual site model for the Soils OU RI 2 SWMUs/AOCs represents no migration of contamination as the expected condition. The scenario that contaminants have impacted surface water and, through vertical infiltration in the soil, impacted the groundwater underlying these sources is unlikely.

The Soils OU RI 2 includes a range of sites of different sizes, locations, and impacts resulting from a range of historical activities, all of which can affect potential current and future distribution of contamination. As noted from the SWMU/AOC descriptions, historical activities include spills, scrap yards, soil or rubble piles, PCB release sites, and impacts from a range of other discrete activities.

Collectively, analysis of the Soils OU RI 2 SWMUs/AOCs indicates the presence of inorganic compounds, organic compounds, and radionuclides above screening levels. Soil sampling results were compared to the appropriate no action levels (NALs) and background concentrations to identify the list of potential contaminants to be evaluated for the purposes of determining nature and extent of contamination. Consistent with the Work Plan (DOE 2010a), which identifies industrial or recreational use as the current and reasonably anticipated future land uses, the horizontal and vertical extent was based on NALs for future industrial workers (inside the Limited Area), and teen recreator (outside the Limited Area). For naturally occurring constituents, delineation also is based on comparison with background concentrations. Chapter 5 summarizes the characterization of the Soils OU RI 2 SWMUs/AOCs.

The prevalent contaminants are metals (including uranium), polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs) [benzo(a)pyrene equivalents], and radionuclides (including uranium radioisotopes).

The lateral extent of the contamination has been defined within the constraints of the approved Work Plan (DOE 2010a) and addendum (DOE 2014a). Field data were used to assist in delineation. The approved Work Plan extent was considered defined for these SWMUs/AOCs at the boundary of another SWMU or anthropogenic feature (DOE 2010a).

DETERMINE SURFACE AND SUBSURFACE TRANSPORT MECHANISMS AND PATHWAYS (GOAL 2)

Chapter 5 and Appendix C document the fate and transport modeling used in the evaluation of soil sources impacts on groundwater at SWMUs/AOCs investigated in this RI.

Previous work has shown that the primary pathway for groundwater flow is vertical migration through the Upper Continental Recharge System (UCRS), followed by lateral migration in the Regional Gravel Aquifer (RGA). Contaminated groundwater could migrate to points of exposure (POEs). The POE evaluated was the RGA at the SWMU/AOC boundary.

Impacts on groundwater in the RGA were evaluated for those soil constituents that had the potential to cause an exceedance of a primary drinking water standard [maximum contaminant level (MCL)] or health based/risk based level (if no MCL was available) at the SWMU/AOC boundary.

Soil contaminant screening identified Tc-99 at SWMUs 13, 15, and 26 as potentially impacting RGA groundwater quality. These SWMU contaminant scenarios were subjected to groundwater modeling to bound the potential for impacts to RGA groundwater. SESOIL and AT123D simulation results are summarized in Table ES.2.

Table ES.2. SESOIL and AT123D Maximum Predicted Groundwater Concentrations

SWMU/ AOC	Soil Constituents	Maximum RGA Groundwater Concentration at SWMU/AOC Boundary (Time to Reach Boundary)
13	Tc-99	510 pCi/L (33 years)
15	Tc-99	680 pCi/L (33 years)
26	Tc-99	0*

*Leaching does not result in Tc-99 groundwater concentrations greater than the AT123D minimum reported concentration of 1E-2 µg/L (169 pCi/L) at SWMU 26 boundary.

Based on the modeling results, the incremental contributions of Tc-99 currently present in soil at SWMU 13 and SWMU 15 does not have the potential to impact the RGA groundwater at the SWMU boundary at concentrations (510 pCi/L and 680 pCi/L, respectively) that exceed the screening criterion of 900 pCi/L (DOE 2013). Consistent with the Soils OU RI Report (DOE 2013), 900 pCi/L was the criterion used in screening to determine which SWMUs were modeled for Tc-99 transport. Further, a review of the monitoring well and extraction well data does not show incremental impacts to the RGA Tc-99 plume from SWMU 13 or SWMU 15. The RGA Tc-99 plume is from the vicinity of C-400. Further, the RGA Tc-99 plume does not pass under SWMU 13 or SWMU 15.

Some Soils OU RI 2 SWMUs/AOCs are adjacent to drainageways that have been characterized previously. Based upon the modeling performed as part of the Surface Water Site Investigation report for the outfalls and the associated internal ditches, no contaminants are migrating in surface water (dissolved or through sediment) from ditches to surrounding creeks at concentrations that may adversely impact human health (DOE 2008a).

A removal action for the contaminated sediment associated with Surface Water Operable Unit (SWOU) (On-Site) (DOE 2011a) was conducted for Outfalls 001, 008, 010, 011, and 015 and associated internal ditches. A final response action for internal ditches, outfalls, and creeks will be addressed by the SWOU, as described in the SMP (DOE 2015a). Based upon the analysis that was performed on sources found within the Soils OU RI 2 SWMUs/AOCs, contaminant migration from sources is not expected to have a deleterious effect upon groundwater and surface water.

COMPLETE A BASELINE RISK ASSESSMENT FOR THE SOILS OU (GOAL 3)

PGDP is an industrial facility surrounded by a state-maintained wildlife refuge and residential property. The current and reasonably anticipated future use of locations within the current Limited Area is industrial, and the reasonably anticipated future use of locations outside the Limited Area is recreational. The risk characterization for these current and reasonably anticipated future uses will be used when making risk management decisions in subsequent documents.

Consistent with the Paducah Human Health Risk Methods Document (DOE 2015b), which incorporates both EPA and Kentucky risk assessment guidance, the BHHRA for the SWMUs/AOCs characterized risk for a range of reasonably anticipated and hypothetical current and future use scenarios. In developing these scenarios, the concept of reasonable maximum exposure (RME) was used. Additionally, consistent with the results available, the exposure assessment primarily considered exposure to soil (surface and/or subsurface).

For the Soils OU RI 2 sites, there were five priority contaminants of concern (COCs) [priority COCs are identified as those COCs with a chemical-specific ELCR > 1E-04 or a chemical-specific HQ > 1, to highlight to risk managers the COCs driving Total ELCR or Total HQ at the Soils OU RI 2 SWMUs/AOCs] for the future industrial worker scenario or the teen recreational user scenario, as appropriate, based on results at one or more SWMUs/AOCs. Two priority COCs, PCBs and uranium-238, are associated with the highest Total ELCRs at most SWMUs/AOCs exceeding ELCR > 1E-04. Another two priority COCs, thallium and uranium, contribute to chemical-specific HQ > 1. The fifth priority COC, arsenic, contributes to both ELCR and HI. Potential cancer risk and noncancer hazard for each of the Soils OU RI 2 SWMUs/AOCs are illustrated in Chapter 5, as appropriate. These illustrations show a summary of COCs contributing to risk for the appropriate current and reasonably anticipated future use scenario (i.e., future industrial worker or teen recreational user, as appropriate).

Dose Assessment

The dose assessment performed for the surface soil indicated dose for SWMUs/AOCs inside the Limited Area was as high as 52 mrem/yr for the future industrial worker (SWMUs 56/80). Two SWMU areas inside the Limited Area (SWMUs 26 and 56/80) were estimated higher than the 25 mrem/yr benchmark (DOE 2015b). The dose assessment performed for surface soil outside the Limited Area estimated a dose, as established in the RMD, as high as 50 mrem/yr (AOC 204) for the teen recreational user scenario.

SCREENING ECOLOGICAL RISK ASSESSMENT

Consistent with the Paducah Ecological Risk Methods Document (DOE 2015c), which incorporates both EPA and Kentucky risk assessment guidance, the screening ecological risk assessment (SERA) was limited to a comparison of maximum concentrations in surface soils at the SWMUs/AOCs against ecological screening levels in order to identify the chemicals of potential ecological concern (COPECs). The SERA does not consider the limited habitat, SWMU/AOC size, or other factors that also need to be considered to characterize ecological risk. The results of the SERA will be used in the future sitewide ecological Baseline Risk Assessment that will be conducted as part of the SWOU. The following observations are made for the SERA.

Primary Risk Drivers

- Total PCBs. The maximum PCB concentration was greater than 10 times the ecological screening values (ESVs) of 0.02 mg/kg at 8 SWMUs/AOCs (13, 15, 26, 56, 77, 80, 204, and 211-A), with a combined area of about 24 acres. The largest of these was AOC 204 (11.3 acres). Runoff from this SWMU discharges to Outfall 011. The maximum concentration for these 8 SWMUs/AOCs was 475 mg/kg at SWMUs 56 and 80. However, there may be some bias when using field data because PCBs were not detected in some areas. The ESV is 0.02 mg/kg and is well below the detection limit for field screening; therefore, the risk may be overstated, since one-half the detection limit is used for nondetected constituents.

- Uranium. The maximum uranium concentration was above 10 times the ESV of 5 mg/kg (background is 4.9 mg/kg) at 8 SWMUs/AOCs (13, 15, 26, 56, 77, 80, 204, and 229), representing a combined area of 24 acres. The highest concentration was 13,070 mg/kg at AOC 204 (11.3 acres).

Other Chemicals of Potential Ecological Concern/Uncertainties

- **Metals.** As indicated in the Data Quality Analysis, there may be uncertainties when using X-ray fluorescence data to estimate risks. Three metals (aluminum, antimony, and mercury) show significant exceedances of the ESVs at all of the SWMUs/AOCs with the exception of AOC 565.

SUPPORT EVALUATION OF REMEDIAL ALTERNATIVES (GOAL 4)

The representative data set used for the Soils OU RI 2 SWMUs/AOCs is sufficient to support the evaluation of remedial alternatives in the FS. Other information was gathered in support of the evaluation of remedial alternatives to include infrastructure issues, extent of contamination, and verification of site descriptions. Discussion of possible remedial technologies applicable for the Soils OU RI 2 SWMUs/AOCs is located in the SWMU/AOC-specific sections along with impacts on or by groundwater and surface water.

Remedial goal options (RGOs) were calculated for each COC as determined by the conclusions of the BHHRA. These RGOs should not be interpreted as being cleanup goals, but as risk-based values that may be used by risk managers to revise preliminary remediation goals to be consistent with the remedial action objectives in the FS and to develop cleanup goals from these revised preliminary remediation goals in the Record of Decision. The COCs and RGOs consistent with the current and reasonably anticipated future use scenarios (i.e., industrial use, including both the industrial and excavation worker and the teen recreator) are shown in Table ES.3.

Table ES.3. Consolidated RGOs for the Soils OU RI 2 SWMUs/AOCs for Current and Reasonably Anticipated Future Use Scenarios

COC	RGO at ELCR=1E-6	RGO at ELCR=1E-5	RGO at ELCR=1E-4	RGO at HI=0.1	RGO at HI=1	RGO at HI=3	Units
Future Industrial Worker (Exposed to Surface Soils)							
Arsenic	1.41E+00	1.41E+01	1.41E+02	2.26E+01	2.26E+02	6.78E+02	mg/kg
Cobalt	N/A	N/A	N/A	9.82E+00	9.82E+01	2.95E+02	mg/kg
Dioxins/Furans, Total	1.63E-05	1.63E-04	1.63E-03	N/A	N/A	N/A	mg/kg
PAH, Total	8.94E-02	8.94E-01	8.94E+00	N/A	N/A	N/A	mg/kg
PCB, Total	3.05E-01	3.05E+00	3.05E+01	N/A	N/A	N/A	mg/kg
Thallium	N/A	N/A	N/A	2.34E+00	2.34E+01	7.01E+01	mg/kg
Uranium	N/A	N/A	N/A	6.58E+02	6.58E+03	1.97E+04	mg/kg
Americium-241	5.45E+00	5.45E+01	5.45E+02	N/A	N/A	N/A	pCi/g
Cesium-137	1.14E-01	1.14E+00	1.14E+01	N/A	N/A	N/A	pCi/g
Neptunium-237	2.53E-01	2.53E+00	2.53E+01	N/A	N/A	N/A	pCi/g
Plutonium-239/240	1.30E+01	1.30E+02	1.30E+03	N/A	N/A	N/A	pCi/g
Protactinium-231	1.47E+00	1.47E+01	1.47E+02	N/A	N/A	N/A	pCi/g
Radium-228	1.67E-01	1.67E+00	1.67E+01	N/A	N/A	N/A	pCi/g
Technetium-99	3.78E+02	3.78E+03	3.78E+04	N/A	N/A	N/A	pCi/g
Thorium-230	1.71E+01	1.71E+02	1.71E+03	N/A	N/A	N/A	pCi/g
Uranium-234	2.01E+01	2.01E+02	2.01E+03	N/A	N/A	N/A	pCi/g
Uranium-235	3.73E-01	3.73E+00	3.73E+01	N/A	N/A	N/A	pCi/g
Teen Recreational User (Exposed to Surface Soils)							
Antimony	N/A	N/A	N/A	4.48E+01	4.48E+02	1.35E+03	mg/kg
Arsenic	6.14E-01	6.14E+00	6.14E+01	1.03E+01	1.03E+02	3.10E+02	mg/kg
Cobalt	N/A	N/A	N/A	3.35E+01	3.35E+02	1.00E+03	mg/kg
Dioxins/Furans, Total	7.09E-06	7.09E-05	7.09E-04	N/A	N/A	N/A	mg/kg
Iron	N/A	N/A	N/A	7.85E+04	7.85E+05	2.35E+06	mg/kg
Mercury	N/A	N/A	N/A	3.36E+01	3.36E+02	1.01E+03	mg/kg
PAH, Total	5.03E-02	5.03E-01	5.03E+00	N/A	N/A	N/A	mg/kg
PCB, Total	1.73E-01	1.73E+00	1.73E+01	N/A	N/A	N/A	mg/kg
Thallium	N/A	N/A	N/A	1.12E+00	1.12E+01	3.36E+01	mg/kg
Uranium	N/A	N/A	N/A	3.34E+02	3.34E+03	1.00E+04	mg/kg
Cesium-137	2.79E-01	2.79E+00	2.79E+01	N/A	N/A	N/A	pCi/g
Neptunium-237	6.03E-01	6.03E+00	6.03E+01	N/A	N/A	N/A	pCi/g
Plutonium-239/240	1.05E+01	1.05E+02	1.05E+03	N/A	N/A	N/A	pCi/g
Protactinium-231	2.76E+00	2.76E+01	2.76E+02	N/A	N/A	N/A	pCi/g
Radium-228	3.60E-01	3.60E+00	3.60E+01	N/A	N/A	N/A	pCi/g
Tc-99	3.18E+02	3.18E+03	3.18E+04	N/A	N/A	N/A	pCi/g
Thorium-230	1.42E+01	1.42E+02	1.42E+03	N/A	N/A	N/A	pCi/g
Uranium-234	1.61E+01	1.61E+02	1.61E+03	N/A	N/A	N/A	pCi/g
Uranium-235	8.75E-01	8.75E+00	8.75E+01	N/A	N/A	N/A	pCi/g
Uranium-238	3.29E+00	3.29E+01	3.29E+02	N/A	N/A	N/A	pCi/g
Excavation Worker (Exposed to Surface and Subsurface Soils)							
Antimony	N/A	N/A	N/A	1.32E+01	1.32E+02	3.95E+02	mg/kg
Arsenic	2.52E+00	2.52E+01	2.52E+02	8.09E+00	8.09E+01	2.43E+02	mg/kg
Cadmium	N/A	N/A	N/A	2.53E+01	2.53E+02	7.60E+02	mg/kg
Cobalt	N/A	N/A	N/A	9.82E+00	9.82E+01	2.95E+02	mg/kg
Copper	N/A	N/A	N/A	1.32E+03	1.32E+04	3.95E+04	mg/kg
Iron	N/A	N/A	N/A	2.30E+04	2.30E+05	6.91E+05	mg/kg
Manganese	N/A	N/A	N/A	7.57E+02	7.57E+03	2.27E+04	mg/kg
Mercury	N/A	N/A	N/A	9.86E+00	9.86E+01	2.96E+02	mg/kg
Nickel	N/A	N/A	N/A	1.64E+02	1.64E+03	4.91E+03	mg/kg

Table ES.3. Consolidated RGOs for the Soils OU SWMUs/AOCs for Current and Reasonably Anticipated Future Use Scenarios (Continued)

COC	RGO at ELCR=1E-6	RGO at ELCR=1E-5	RGO at ELCR=1E-4	RGO at HI=0.1	RGO at HI=1	RGO at HI=3	Units
Excavation Worker (Exposed to Surface and Subsurface Soils) (Continued)							
PAH, Total	3.25E-01	3.25E+00	3.25E+01	N/A	N/A	N/A	mg/kg
PCB, Total	1.14E+00	1.14E+01	1.14E+02	N/A	N/A	N/A	mg/kg
Thallium	N/A	N/A	N/A	3.29E-01	3.29E+00	9.86E+00	mg/kg
Uranium	N/A	N/A	N/A	9.80E+01	9.80E+02	2.94E+03	mg/kg
Vanadium	N/A	N/A	N/A	1.65E+02	1.65E+03	4.95E+03	mg/kg
Cesium-137	6.12E-01	6.12E+00	6.12E+01	N/A	N/A	N/A	pCi/g
Neptunium-237	1.56E+00	1.56E+01	1.56E+02	N/A	N/A	N/A	pCi/g
Plutonium-239/240	9.80E+00	9.80E+01	9.80E+02	N/A	N/A	N/A	pCi/g
Protactinium-231	4.57E+00	4.57E+01	4.57E+02	N/A	N/A	N/A	pCi/g
Radium-228	3.69E-01	3.69E+00	3.69E+01	N/A	N/A	N/A	pCi/g
Tc-99	3.05E+02	3.05E+03	3.05E+04	N/A	N/A	N/A	pCi/g
Thorium-230	1.34E+01	1.34E+02	1.34E+03	N/A	N/A	N/A	pCi/g
Uranium-234	1.51E+01	1.51E+02	1.51E+03	N/A	N/A	N/A	pCi/g
Uranium-235	2.18E+00	2.18E+01	2.18E+02	N/A	N/A	N/A	pCi/g
Uranium-238	5.95E+00	5.95E+01	5.95E+02	N/A	N/A	N/A	pCi/g

CONCLUSIONS

Following are the major contaminant distribution findings for the 12 SWMUs/AOCs (13, 15, 26, 56, 77, 80, 204, 211-A, 224, 225-A, 225-B, and 565) addressed in the Soils OU RI 2.

- The BHHRA completed as part of the Soils OU RI 2 indicates that the cumulative ELCR benchmark of 1E-06 and/or cumulative HI benchmark of 1.0 is exceeded at 11 of the 12 SWMUs/AOCs (for one or more exposure scenarios evaluated); therefore, as stated in the Work Plan, Decision Rule D1a, an FS is appropriate to address impacted media (i.e., surface and subsurface soil) at each of these 11 SWMUs/AOCs (DOE 2010a).

- AOC 565 is being recommended for no further action due to a cumulative ELCR < 1E-6 and cumulative HI < 1.0.

- Five priority COCs based on a chemical-specific ELCR > 1E-04 or chemical-specific hazard quotient (HQ) > 1 were identified based on results at one or more SWMUs/AOCs: Total PCBs, arsenic, thallium, uranium, and uranium-238.

- The SERA identified COPECs at 11 of the 12 SWMUs/AOCs (AOC 565 did not have COPECs).

The risk levels associated with contamination at 11 of the 12 identified SWMUs/AOCs meet the criteria to be evaluated further in an FS. The 11 SWMUs/AOCs include 13, 15, 26, 56, 77, 80, 204, 211-A, 224, 225-A, and 225-B. Consistent with the FFA, an FS will be developed to evaluate remedial action alternatives to mitigate the potential risks and hazards to human health and the environment and address the potential migration of contaminants from source areas to surface water and groundwater for 11 of the Soils OU RI 2 SWMUs/AOCs that were evaluated in this RI Report.

UNCERTAINTIES/ASSUMPTIONS

The Work Plan identified data gaps on a SWMU-by-SWMU basis that needed to be filled to proceed with the FS (DOE 2010a). The Work Plan (DOE 2010a) and addendum (DOE 2014a) were implemented to reduce any remaining uncertainties from previous investigations regarding the nature of the source zone, extent of the source zone and secondary sources, surface transport mechanisms, and to support evaluation of remedial technologies in the FS.

Nature of the Source Zone

For the SWMUs/AOCs in this Soils OU RI 2 Report, the available historical documentation and soil characterization data are sufficient relative to chemical and physical properties of soil to screen technology types and to conduct detailed alternative analysis for the Soils OU RI 2. However, the RI identified several uncertainties that may affect the FS. The potential impact of these source zone uncertainties on alternatives analysis will be documented, as necessary, and evaluated further in the FS (see Section 4.1 for examples). Additional uncertainty exists for the Soils OU RI 2 SWMUs/AOCs because of the higher detection limits for the field data used in the risk assessment, which is further discussed in Appendix B.

Many of the Soils OU RI 2 SWMUs/AOCs have been investigated previously. The Soils OU RI 2 uses a combination of historical and current analytical results of soil and groundwater from the area of each SWMU/AOC. The results of previous investigations and the 2010 RI sampling documented and confirmed the presence of metals, organic compounds, and radionuclides in the Soils OU RI 2 areas. The associated samples were collected and analyzed over several previous investigations, as well as for the Soils OU RI 2, using several methods. Quality control/quality assurance practices at PGDP, now and previously, limit the uncertainty associated with the sampling and analysis process. Nevertheless, changes have occurred to analytical methods that limit the strict comparison of data (e.g., laboratory reporting limits have varied over time). In some cases, analytical method detection limits are above screening criteria, such as the future industrial worker NAL.

Extent of the Source Zone and Secondary Sources

Up to two contingency step-outs were allowed by the Work Plan (DOE 2010a). The RI investigated extent of contamination from ground surface to 10 ft below ground surface (bgs) or up to 16 ft bgs at infrastructure (e.g., pipelines) (DOE 2015a). Uncertainties associated with horizontal and vertical extent will be managed in the FS. Sampling did not identify any secondary sources of groundwater contamination from the Soils OU RI 2 SWMUs/AOCs, such as potential dense nonaqueous-phase liquid (DNAPL) source zones.

Surface and Subsurface Transport Mechanisms

Whether contaminated soil and groundwater could migrate to the POE (i.e., SWMU/AOC boundary) via a groundwater pathway was evaluated (Figure ES.1). Previous work has shown that the primary pathway for groundwater flow and the site-related contaminants is vertical migration through the UCRS, followed by lateral migration in the RGA. Modeling results, which came from the analysis of this primary pathway for groundwater flow, show that contaminants in soil are not expected to migrate to groundwater and reach concentrations in groundwater above MCLs.

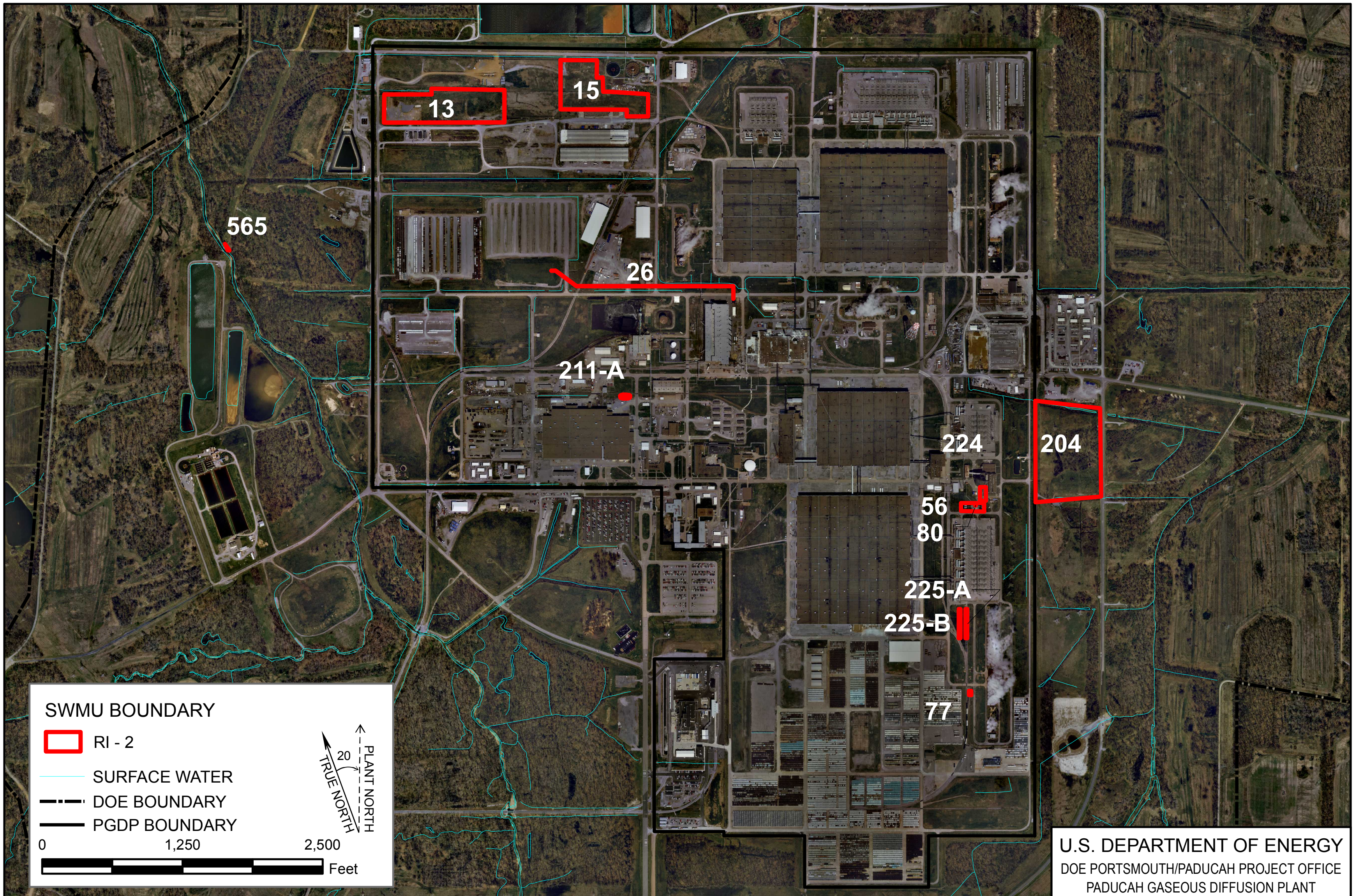

Figure ES.1. Location of the Soils OU RI 2 SWMUs/AOCs

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Internal plant ditches are grass-lined and the outfall ditches are grass-lined or otherwise stabilized; therefore, a qualitative analysis in this report and a quantitative analysis in DOE 2008b determined that the contaminants are not likely to be transported attached to suspended soil particles within the ditches and outfalls.

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1. INTRODUCTION

The Paducah Gaseous Diffusion Plant (PGDP), located within the Jackson Purchase region of western Kentucky, was an active uranium enrichment complex from 1952 until 2013. The U.S. Department of Energy (DOE) owns the area the enrichment complex operated and is responsible for environmental restoration activities associated with legacy operation of PGDP (CERCLIS #KY8-890-008-982). DOE is the lead agency for response actions, and the U.S. Environmental Protection Agency (EPA) and the Kentucky Department for Environmental Protection (KDEP) have regulatory oversight responsibilities.

In 1988, off-site groundwater contamination was detected in groundwater wells north of PGDP. Consequently, DOE and EPA Region 4 entered into an Administrative Consent Order (ACO) under Sections 104 and 106 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). In 1994, PGDP was placed on the National Priorities List (NPL), a list of sites designated by EPA as having the highest priority for site remediation. Additionally, Section 120 of CERCLA requires federally owned NPL sites to enter into a Federal Facility Agreement (FFA) (EPA 1998). An FFA was finalized among DOE, EPA, and the Commonwealth of Kentucky (Kentucky) in 1998.

Source units and areas of contamination at PGDP have been combined into operable units (OUs) for evaluation of remedial actions. These OUs include the Surface Water OU (SWOU), the Burial Grounds OU (BGOU), the Soils OU, the Groundwater OU (GWOU), and the Decontamination and Decommissioning (D&D) OU. Each OU is designed to remediate contaminated media and/or facilities associated with PGDP. After completion of these activities, the Comprehensive Site OU (CSOU) evaluation will be conducted, with implementation of additional actions, as needed, to ensure long-term protectiveness.

The Soils OU is being implemented in a phased approach [i.e., pre-gaseous diffusion plant (GDP) shutdown and post-GDP shutdown] consisting of remedial and removal actions to accomplish the following goals (DOE 2015b):

- Prevent human exposure to contamination presenting an unacceptable risk;
- Prevent or minimize further off-site migration; and
- Reduce, control, or minimize contaminated soil hot spots contributing to off-site contamination.

Additionally, the phased approach allows the site to use information gained in earlier phases of the cleanup to refine and implement subsequent cleanup objectives and actions in support of final cleanup status. Slabs, subsurface structures, and underlying soils left after completing D&D of the operating GDP, will be addressed in subsequent actions. Figure 1.1, adapted from the Site Management Plan (SMP) (DOE 2015a), illustrates the phases and accomplishments of the Soils OU.

The original scope of the Soils OU consisted of 86 SWMUs/AOCs. During the development of the Remedial Investigation/Feasibility Study (RI/FS) Work Plan (DOE 2010a) and Report (DOE 2013), it was determined that only 63 of the 86 SWMUs/AOCs included within the original scope would be addressed under this OU prior to GDP shutdown based upon accessibility. Sixteen SWMUs/AOCs were determined to require additional characterization subsequent to the Soils OU RI to delineate the extent of contamination. The work performed in this phase of the project is referred to as the Soils OU RI 2 within this document. During scoping of the project and a March 10, 2014, site walkdown, 4 of the 16 SWMUs/AOCs (16, 47, 74, and 226) were deferred to the Soils and Slabs OU. During the course of the Soils OU RI 2 field work, SWMU 229 consistently contained standing water. As stated in the survey plan of the work plan addendum (DOE 2014a), gamma radiological surveys would not be performed in areas

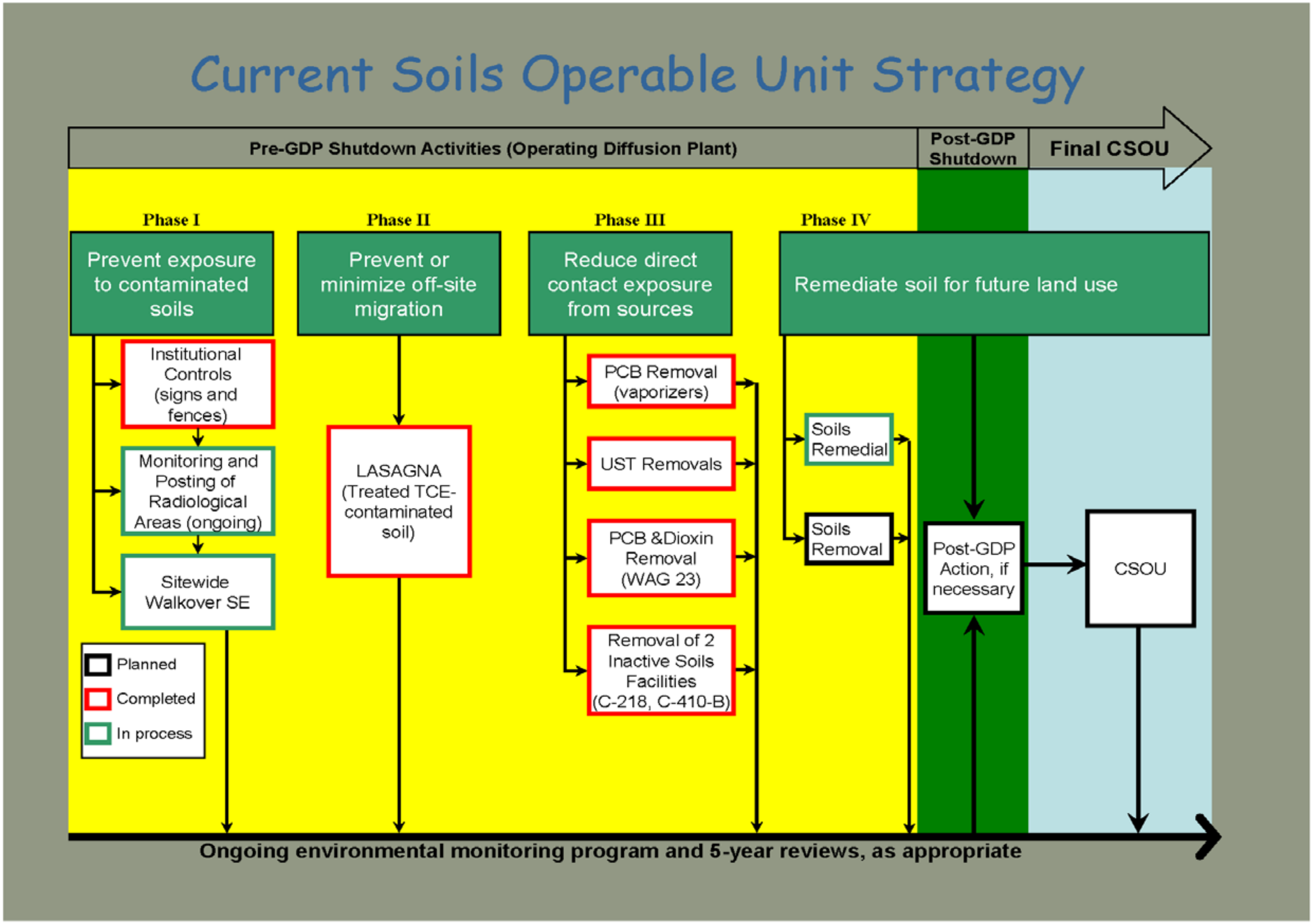

Figure 1.1. Soils OU Paducah Soils Strategy

of standing water; therefore, the planned activities (i.e., radiological walkover survey and a judgmental grab sample) for this unit could not be completed. After discussion among the FFA parties on December 2, 2014, it was concluded that activities for SWMU 229 will need to be conducted at a later time when the unit is free of standing water (e.g., July, August). Activities shall occur at the earliest possible opportunity based upon the condition of the unit. SWMU 229 has not been evaluated within this report; however, SWMU 229 will be reported in an addendum to this report once field activities are completed. The remaining 12 SWMUs/AOCs addressed by this RI Report are detailed in Table 1.1, and the location of each is shown on Figure 1.2.

Table 1.1. SWMUs/AOCs Addressed in this Soils OU RI 2 Report

SWMU/ AOC No.	Location	Description	Data Gap Addressed[1]
13	C-746-P&P1	Scrap Yards	Extent of surface soil undefined
15	C-746-C	Scrap Yard	Extent undefined to the east
26	C-400 to C-404	4-inch Underground Transfer Line	Extent of surface soil undefined
56	C-540-A	Polychlorinated biphenyl (PCB) Staging Area	To be evaluated with SWMU 80
77	C-634-B	Sulfuric Acid Storage Tank	Nature and extent undefined
80	C-540	PCB Spill Site	Vertical extent undefined, horizontal extent undefined south of road
204	Dyke Road	Historical Staging Area	Nature and extent undefined
211-A	C-720	Trichloroethene Spill Site Northwest	Extent undefined to the south and west
224	C-340	DOE Material Storage Area (DMSA) Outside (OS)-13, empty drum storage	Extent undefined to the south, east, and west
225-A[2]	C-533-1	DMSA OS-14, Rail Cars	Nature and extent undefined
225-B[2]	C-533-1	Contaminated Soil Area near C-533-1, DMSA OS-14	Nature and extent defined; to be included in this Soils OU RI 2 Report
565	North of C-611 Water Treatment Plant	Rubble Area K	Extent undefined to the north

[1] Nature and extent refer to nature and extent of contamination.
[2] Subsequent to the Work Plan (DOE 2010a), SWMU 225 was divided into SWMUs 225-A and 225-B.

1.1 PURPOSE OF REPORT

The Soils OU RI 2 followed the investigation outlined in the Work Plan (DOE 2010a) and addendum (DOE 2014a). This report documents the results of the RI, Baseline Human Health Risk Assessment (BHHRA), and Screening Ecological Risk Assessment (SERA) for 12 SWMUs/AOCs.

Historical data in addition to data collected during the Soils OU RI and Soils OU RI 2 were combined to form the entire data set used to evaluate the Soils OU RI 2. This data set will be used in the FS.

The work plan utilized the data quality objective (DQO) process as a planning tool to assist in the identification of environmental problems and to define the data collection process needed to support decisions (DOE 2010a).

The problem statement developed through the DQO process and documented in the Work Plan follows (DOE 2010a):

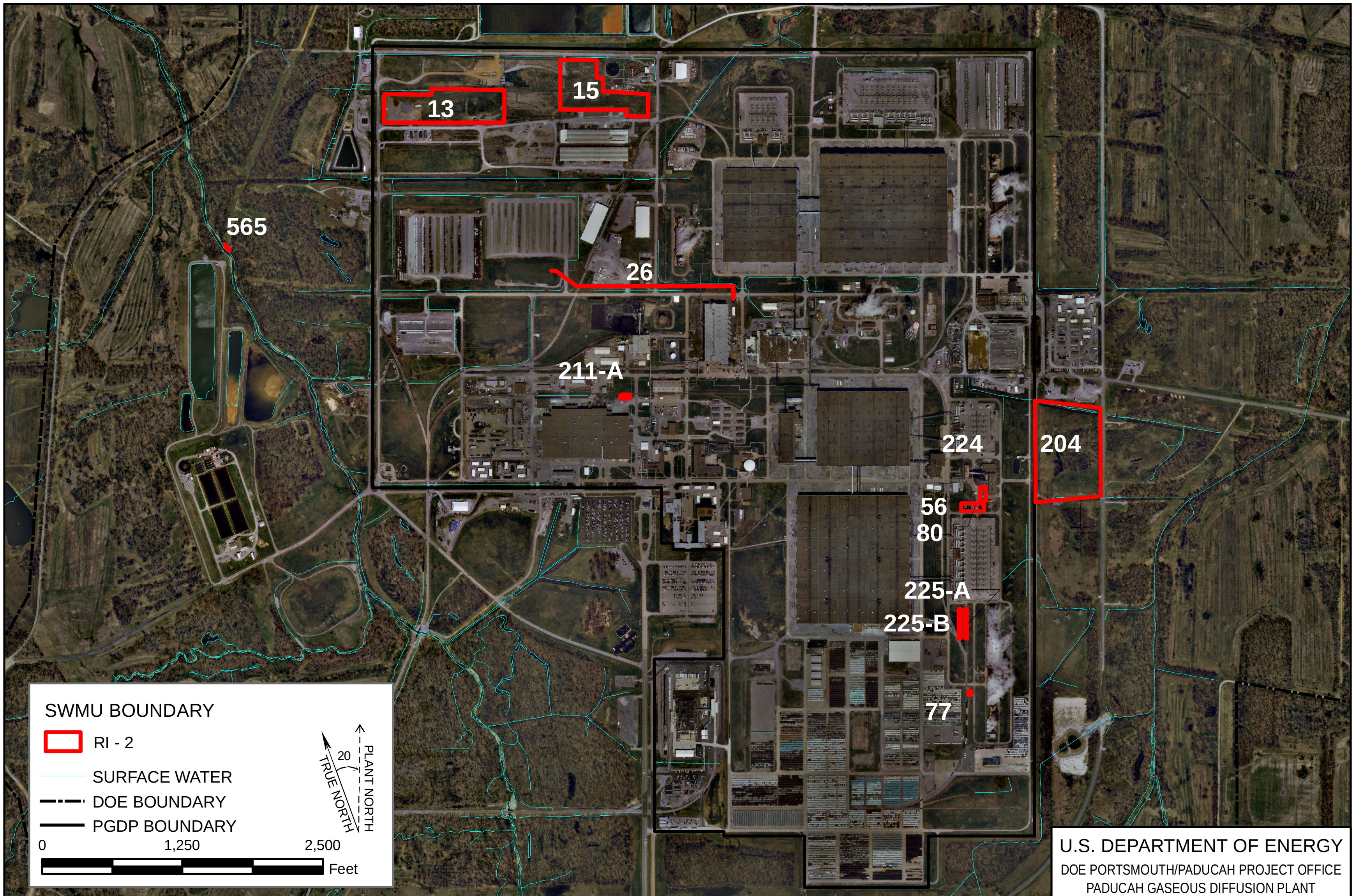

Figure 1.2. Location of the Soils OU RI 2 SWMUs/AOCs

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> Past releases from the PGDP may have resulted in the contamination of soil found at the SWMUs and AOCs. The nature and extent of contamination has not been adequately defined, nor is it known whether these potential contaminants pose unacceptable risks to current and reasonably anticipated future receptors under some exposure scenarios.

The goals of the RI are (1) characterize nature and extent of source zone; (2) determine surface and subsurface transport mechanisms and pathways; (3) complete a baseline risk assessment (BRA) for the Soils OU; and (4) support evaluation of remedial alternatives. These goals are listed in Table 1.2.

Recommended remedial action objectives (RAOs) will be presented in the forthcoming FS.

Table 1.2. Goals, Decisions, and Questions Identified for the Soils OU

GOAL 1: CHARACTERIZE NATURE AND EXTENT OF SOURCE ZONE
Decisions and questions
1-1: What are the suspected contaminants?
1-2: What are the plant processes that could have contributed to the contamination? When and over what duration did releases occur?
1-3: What are the concentrations and activities at the source?
1-4: What is the area and volume of the source zone? What is the vertical and lateral extent of contamination?
1-5: What are the chemical and physical properties of associated material at the source areas?
1-6: What are the past, current, and potential future migratory paths?
GOAL 2: DETERMINE SURFACE AND SUBSURFACE TRANSPORT MECHANISMS AND PATHWAYS
Decisions and questions
2-1: What are the contaminant migration trends?
2-2: What are the effects of underground pipelines and plant operations on migration pathways including ditches?
2-3: What are the physical and chemical properties of the formations and subsurface matrices?
GOAL 3: COMPLETE A BASELINE RISK ASSESSMENT FOR THE SOILS OU
Decisions and questions
3-1: Where do the contaminant concentrations exceed no action levels?
3-2: Are isolated areas of contamination present or is contamination general?
3-3: What are the contaminants of concern (COCs) that define the contamination?
3-4: What are the no action levels?
3-5: Are SWMUs/AOCs within the Soils OU similar enough to be addressed in the same manner?
GOAL 4: SUPPORT EVALUATION OF REMEDIAL ALTERNATIVES
Decisions and questions
4-1: What are the possible remedial technologies applicable for this unit?
4-2: What are the physical and chemical properties of media to be remediated?
4-3: Are cultural impediments present?
4-4: What is the extent of contamination (geologic limitations presented by the source zone)?
4-5: What would be the impact of action on and by other sources?
4-6: What would the impact of an action at the source be on the integrator units?
4-7: What are stakeholders' perceptions of contamination at or migrating from source zone?

Table is from Work Plan (DOE 2010a).

1.2 PROJECT SCOPE

This Soils OU RI 2 is focused on 12 SWMUs/AOCs listed in Table 1.1 and the areas immediately surrounding them to determine if the SWMUs/AOCs pose a risk to human health or the environment. As stated in the SMP, a primary objective for this project is to contribute to the protection of on-site workers and off-site residents by addressing sources of soil contamination (DOE 2015c).

The scope of the Soils OU includes potential contaminant migration pathways from the soil to surface water and groundwater, but does not include sampling either the surface water or groundwater. Also, the scope of the Soils OU does not include any drainage ditches bounding the Soils OU SWMUs/AOCs. These ditches are components of the SWOU. The GWOU will address dissolved-phase groundwater contamination in the Regional Gravel Aquifer (RGA) beneath the Soils OU SWMUs/AOCs. The secondary sources of groundwater contamination that are derived from the burial grounds or deep subsurface soil are within the scope of the BGOU or the CSOU. DOE integrates the Natural Resource Damage Assessment values into the CERCLA process. As such, it is the expectation that the sampling data generated by this RI, in addition to the historical data available, will be sufficient to support the Natural Resource Damage Assessment process.

The DQO process was used to focus the sampling strategy on SWMU/AOC-specific media, contamination, and migration pathways, and identify data needs. Data collected during both of the Soils OU RI field efforts, together with historical data presented in the Work Plan (DOE 2010a), met project DQOs and were used to determine nature and extent of contamination.

The following list summarizes the activities that were conducted as part of the Soils OU RI 2 (not all activities were performed at each SWMU/AOC because of specific circumstances at the different SWMUs/AOCs):

- Collection of surface soil and subsurface soil samples;
- Analysis of the samples by the field laboratory [X-ray fluorescence (XRF) and polychlorinated biphenyl (PCB) test kits] and analysis of 10% of the samples by a fixed-base laboratory;
- Gamma radiological walkover survey with judgmental grab sample for radiological constituents, if necessary;
- Evaluation of nature and extent of contamination based on collected RI samples and historical samples;
- Modeling of contaminant fate and transport and estimation of future contaminant concentrations at selected points of exposure; and
- Determination of potential ecological and human health risks associated with each site.
  - For the on-site future industrial worker, if the SWMU/AOC was inside the PGDP security fence;
  - For the teenage recreational land user, if the SWMU/AOC was outside the PGDP security fence; or
  - Residential scenarios were assessed consistent with the Risk Methods Document (DOE 2015b).

Consistent with the Work Plan (DOE 2010a), the nature and extent of surface soils (0–1 ft bgs) and shallow subsurface soils (1–4 ft bgs) and subsurface soils (4–10 ft bgs) within the Soils OU SWMUs/AOCs are included in this RI.

To address uncertainties identified in the Soils OU, the observational approach was used in the design of the sampling strategy for the Soils OU RI/FS Work Plan (DOE 2010a). The key concepts are as follows:

- The RI strategy is based on a specified "most probable site condition," which, for the Soils OU RI/FS, assumes that contamination is limited to surface and near surface soil (0–4 ft bgs) and potentially is impacting human health and welfare or the environment adversely.

- Reasonable deviations from the most probable site condition are identified. One reasonable deviation for the Soils OU RI/FS is that no contamination is impacting human health and welfare or the environment adversely. Other reasonable deviations would be that contamination has migrated to depths greater than 4 ft bgs, but still within the Soils OU bound of 10 ft bgs (16 ft bgs at pipelines) and to either the SWOU or GWOU. Site conditions should not differ significantly from the postulated conditions shown in the conceptual models, described in Chapter 3.

- Site assessment factors were identified for observation to detect contamination. These factors included sensory observation of contamination (site walkdowns), field screening, field analyses with portable instruments, geophysical surveys, historical data evaluation, and laboratory analysis of samples.

- The Field Sampling Plan (FSP) included a contingency plan to address deviations from the most probable site conditions.

This Soils OU RI 2 field effort provided information to fill data gaps identified for each SWMU/AOC. Data were screened against significant chemicals of potential concern (COPCs) listed in the *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky, Volume 1: Human Health, Volume 2: Ecological* (DOE 2015b; DOE 2015c). Significant COPCs for the PGDP are listed in Table 1.3.

1.3 SOILS OU SWMU/AOC EVALUATION

The scope of the Soils OU includes an RI, BHHRA, SERA, evaluation of remedial alternatives, remedy selection, and implementation of actions [e.g., excavation, land use controls (LUCs)], as necessary, for protection of human health and the environment.

Project uncertainties that could affect the scope and schedule include the amount and scope of RI characterization needed (e.g., field samples, borings) to achieve the RI goals and the remedial action necessary to achieve a final decision.

One objective of this investigation is to determine the nature and extent of contamination in the soils to a depth of 10 ft bgs or up to 16 ft bgs at infrastructure (e.g., pipelines). For all source units, the initial focus of the investigation was surface and subsurface soil contamination to a depth of 4 ft bgs. If contamination at 4 ft bgs was found, then the subsurface soil to a depth of 10 ft bgs was investigated. Any contamination that was found to extend past the depths specified in this investigation will be addressed by another OU. If a SWMU/AOC had a pipeline located within its boundary, then sampling occurred to a depth of 1 ft below the invert of the pipeline.

Remedial alternatives will be screened at the time the RAOs for the Soils OU are developed.

Table 1.3. Significant Chemicals of Potential Concern at the PGDP[1]

Inorganic Chemicals		Organic Compounds		Radionuclides	
Analyte	**CAS Number**	**Analyte**	**CAS Number**	**Analyte**	**CAS Number**
Aluminum	7429905	Acenaphthene	83329	Americium-241	14596102
Antimony	7440360	Acenaphthylene	208968	Cesium-137+D	10045973
Arsenic	7440382	Acrylonitrile	107131	Neptunium-237+D	13994202
Barium	7440393	Anthracene	120127	Plutonium-238	13981163
Beryllium	7440417	Benzene	71432	Plutonium-239	15117483
Boron	7440428	Bromodichloromethane	75274	Plutonium-240	14119336
Cadmium	7440439	Carbazole	86748	Technetium-99 (Tc-99)	14133767
Chromium III	16065831	Carbon tetrachloride	56235	Thorium-230	14269637
Chromium VI	18540299	Chloroform	67663	Uranium-234	13966295
Cobalt	7440484	1,1-Dichloroethene	75354	Uranium-235+D	15117961
Copper	7440508	1,2-Dichloroethane	107062	Uranium-238+D	7440611
Fluoride	16984488	1,2-Dichloroethene (mixed)	540590		
Iron	7439896	*trans*-1,2-Dichloroethene	156605		
Lead	7439921	*cis*-1,2-Dichloroethene	156592		
Manganese	7439965	Dieldrin	60571		
Mercury	7439976	Ethylbenzene	100414		
Molybdenum	7439987	Fluoranthene	206440		
Nickel	7440020	Fluorene	86737		
Selenium	7782492	Hexachlorobenzene	118741		
Silver	7440224	Naphthalene	91203		
Thallium	7440280	2-Nitroaniline	88744		
Uranium	N/A	N-Nitroso-di-n-propylamine	621647		
Vanadium	7440622	Pentachlorophenol	87865		
Zinc	7440666	Phenanthrene	85018		
		Pyrene	129000		
		Tetrachloroethene	127184		
		1,1,1-Trichloroethane	71556		
		1,1,2-Trichloroethane	79005		
		Trichloroethene	79016		
		Total Dioxins/Furans	1746016		
		2,3,7,8-HpCDD	37871004		
		2,3,7,8-HpCDF	38998753		
		2,3,7,8-HxCDD	34465468		
		2,3,7,8-HxCDF	55684941		
		OCDD	3268879		
		OCDF	39001020		
		2,3,7,8-PeCDD	36088229		
		1,2,3,7,8-PeCDF	57117416		
		2,3,4,7,8-PeCDF	57117314		
		2,3,7,8-TCDD	1746016		
		2,3,7,8-TCDF	5127319		
		Total PAHs	50328		
		Benz(a)anthracene	56553		
		Benzo(a)pyrene	50328		
		Benzo(b)fluoranthene	205992		
		Benzo(k)fluoranthene	207089		
		Chrysene	218019		
		Dibenz(a,h)anthracene	53703		
		Indeno(1,2,3-cd)pyrene	193395		
		Total PCBs	1336363		
		Aroclor 1016	12674112		
		Aroclor 1221	11104282		
		Aroclor 1232	11141165		
		Aroclor 1242	53469219		
		Aroclor 1248	12672296		
		Aroclor 1254	11097691		
		Aroclor 1260	11096825		
		Vinyl chloride	75014		
		Xylenes (Mixture)	1330207		
		p-Xylene	106423		
		m-Xylene	108383		
		o-Xylene	95476		

CAS = Chemical Abstract Service

[1] This list of chemicals, compounds, and radionuclides was compiled from COPCs retained as COCs in BRAs performed at PGDP between 1990 and 2013 (DOE 2015b). This table differs slightly from Table 1.1 of the Work Plan (DOE 2010a) to be consistent with the updated Risk Methods Document (DOE 2015b).

1.4 PROJECT SCHEDULE

Table 1.4 provides a planning schedule for the Soils OU. This schedule is an estimate for planning and is included here for informational purposes only and is not intended to establish enforceable schedules or milestones. Enforceable milestones are contained in Appendix C of the FFA or Appendix 5 of the SMP (DOE 2015a).

Table 1.4. Project Schedule for Soils OU RI and FS[1]

Activity	Milestone
Issue D1 RI 2 RI Report	August 31, 2015
Issue D1 FS	3rd quarter 2025
Issue D1 Proposed Plan	1st quarter 2026
Issue D1 Record of Decision (ROD)	3rd quarter 2026
Issue D1 Remedial Action Completion Report	September 30, 2030

[1] These are general planning dates for submittal of the CERCLA decision documents. Any extensions will impact the schedule. This schedule is included in this document for information purposes only and is not intended to establish enforceable schedules or milestones. Enforceable milestones, if any, will be established in the FFA or SMP and will be updated in accordance with Sections XXIX and/or XXXIX of the FFA.

1.5 REPORT ORGANIZATION

This RI 2 report was prepared following the guidance found in Appendix D of the FFA for PGDP (EPA 1998) and is consistent with the elements found in Appendix B of the Work Plan (DOE 2010a), but was modified to meet specific project requirements.

Chapter 1—Introduction
Chapter 2—Study Area Investigation
Chapter 3—Physical Characteristics of the Study Area
Chapter 4—Evaluation Approach
Chapter 5—Soils OU RI 2 SWMUs/AOCs

Following the outline of the preceding Soils OU RI Report (DOE 2013), Chapter 5 is divided into 10 subsections, one for each of the SWMUs/AOCs investigated in Soils OU RI 2 (SWMUs 56 and 80 were evaluated together, as were SWMUs 225-A and 225-B); the following information is found in each of the 10 subsections:

- Background
- Fieldwork Summary
- Nature and Extent of Contamination—Surface Soils
- Nature and Extent of Contamination—Subsurface Soils
- Fate and Transport
- Baseline Risk Assessment
- Summary
- Conclusions

Chapter 6—Conclusions for the Soils OU Remedial Investigation
Chapter 7—References

Additionally, the following appendices are included to support the information presented in the text.

Appendix A—Technical Memorandum for Field Activities
Appendix B—Data Quality Analysis
Appendix C—Fate and Transport Modeling
Appendix D—Baseline Human Health Risk Assessment
Appendix E—Screening Ecological Risk Assessment
Appendix F—Analytical Data (CD)

2. STUDY AREA INVESTIGATION

This section includes descriptions of field activities associated with site characterization of the Soils OU RI 2, which was conducted in accordance with the approved Work Plan (DOE 2010a) and Addendum (DOE 2014a). A technical memorandum documenting details of field activities is included in Appendix A.

2.1 SOIL INVESTIGATIONS

When the Work Plan was being developed, existing/historical sampling information collected at and around PGDP over the course of the last several years was compiled and a searchable database of soil analytical results was included in Appendix B of the Work Plan (DOE 2010a) on a compact disk. Historical data were compiled from the resources listed in Table 2.1.

A review of historical data for each of the Soils OU SWMUs/AOCs was used to determine the following:

- SWMU/AOC COPCs,
- Extent and quality of existing data, and
- Sufficiency of data to support an FS for remedial options.

Where data were absent or insufficient to characterize the nature and extent of contamination and to support remedy selection, specific data gaps were identified. These data gaps were the basis for additional sampling. Contamination has been defined as concentrations exceeding background or any detected concentration if instrument reporting limits are higher than background values (DOE 2010a). Sampling for each SWMU/AOC included a gamma radiological walkover and grid-based composite sampling unless otherwise noted.

At SWMUs/AOCs for which additional sampling was performed, one five-point composite over each 45-ft grid was collected for surface soils (0–1 ft bgs) and shallow subsurface soils (1–4 ft bgs). Unless otherwise noted, one grab sample was collected from the center of each grid with four additional grab samples collected 15 ft from the center point in each cardinal direction (north, south, east, and west) to make up the five-point composite. On alternating grids, grab samples were collected from the center of the grid and four additional grab samples collected 15 ft from the center point in each secondary direction (northeast, northwest, southeast, southwest) to make up the five-point composite.

Historical data, in addition to data collected during the Soils OU RI and Soils OU RI 2, were combined to form the entire data set used to evaluate the Soils OU RI 2. This data set will be used in the FS.

Soil samples were collected generally from 0–1 ft, 1–4 ft, and up to 16 ft bgs at pipelines in order to identify potential contaminant migration and exposure pathways, as directed by the Work Plan (DOE 2010a). Soil samples then were analyzed by the field laboratory to determine if contingency samples were needed by comparing the field laboratory results to the project action levels (PALs) listed in Table 2.2. The project action levels were developed as a benchmark for contingency sampling only. The PALs used for this Soils OU RI 2 deviated from the Work Plan (DOE 2010a). The deviation is discussed in Section 4.1. Additional depth (4–7 ft and 7–10 ft bgs) and/or horizontal extent (step-out grid) sampling was required if the field laboratory results exceeded these levels. Locations of these soil samples are shown in figures for each SWMU/AOC, along with summary tables of data in Chapter 5 of this RI Report. A list of SWMUs/AOCs sampled, acreage, and the associated number of collected samples is found in Table 2.3.

Table 2.1. Summary of Historical Information[1]

Year	Reference	Title	SWMUs/AOCs
1991	CH2M HILL 1991	Results of the Site Investigation, Phase I	15, 26, 27, 56, 77, 80
1992	CH2M HILL 1992	Results of the Site Investigation, Phase II	13, 15, 26, 56, 77, 80
1993	DOE 1993	Interim Corrective Measure Work Plan for Containment of Scrap Yard Sediment Runoff	15
1994	DOE 1994a	Interim Corrective Measures Report & Operation and Maintenance Plan for Containment of Scrap Yard Sediment Runoff at the PGDP	13, 15
1995	DOE 1995a	C-400 Process and Structure Review	26
1995	DOE 1995b	Final Site Evaluation Report for the Outfall 010, 011, and 012 Areas, Paducah Gaseous Diffusion Plant, Paducah, Kentucky	204
1995	DOE 1995c	Treatability Study Report for Waste Area Group (WAG) 23 PCB Sites at PGDP	56, 80
1995	DOE 1995d	Work Plan for Phase I of the Waste Area Group 6 Remedial Investigation Industrial Hydrogeologic Study at Paducah Gaseous Diffusion Plant	26
1996	DOE 1996	Feasibility Study for Waste Area Group 23 and Solid Waste Management Unit 1 of Waste Area Group 27 at the Paducah Gaseous Diffusion Plant	56, 80
1997	DOE 1997a	Action Memorandum for Waste Area Group 23 and Solid Waste Management Unit 1 of Waste Area Group 27, PCB Sites, Paducah Gaseous Diffusion Plant, Paducah, Kentucky	56, 80
1997	DOE 1997b	Integrated Remedial Investigation/Feasibility Study Work Plan for Waste Area Group 6	26
1997	DOE 1997c	Proposed Remedial Action Plan for Waste Area Group 23 and Solid Waste Management Unit 1 of Waste Area Group 27, PCB Sites	56, 80
1997	DOE 1997d	Treatability Study Program Plan for Waste Area Group 6 at the Paducah Gaseous Diffusion Plant	26
1998	DOE 1998a	Integrated Remedial Investigation/Feasibility Study Work Plan for Waste Area Group 27 at Paducah Gaseous Diffusion Plant	211
1998	DOE 1998b	Proposed Remedial Action Plan for Waste Area Group 23 and Solid Waste Management Unit 1 of Waste Area Group 27, PCB Sites	211
1999	DOE 1999a	Remedial Investigation Report for Waste Area Group 27 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky	211

Table 2.1. Summary of Historical Information (Continued)[1]

Year	Reference	Title	SWMUs/AOCs
1999	DOE 1999b	Remedial Investigation Report for Waste Area Group 6 (C-400) at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky	26
1999	DOE 1999c	Engineering Evaluation/Cost Analysis (EE/CA) for Scrap Metal Removal at PGDP	13, 15
1999	DOE 1999d	Proposed Remedial Action Plan for Waste Area Group 23 and Solid Waste Management Unit 1 of Waste Area Group 27, PCB Sites	211
1999	DOE 1999e	Residual Risk Evaluation Report for Waste Area Group 23 and Solid Waste Management Unit 1 of Waste Area Group 27, PCB Sites	211
1999	DOE 1999f	Surfactant Enhanced Subsurface Remediation Treatability Study Report for the WAG 6	26
2000	DOE 2000	Remedial Investigation Report for Waste Area Group 28 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky	204
2001	DOE 2001a	Action Memorandum for Scrap Metal Disposition at the Paducah Gaseous Diffusion Plant	13, 15
2001	DOE 2001b	Final Inventory/Characterization Report for the OS-14 Department of Energy Material Storage Area at the Paducah Gaseous Diffusion Plant	225
2002	DOE 2002a	Final Inventory/Characterization Report for the OS-02, Department of Energy Material Storage Area at the Paducah Gaseous Diffusion Plant	224, 225
2002	DOE 2002b	Final Inventory/Characterization Report for the OS-13 Department of Energy Material Storage Area at the Paducah Gaseous Diffusion Plant	224
2011	DOE 2011b	Site Evaluation Report for Solid Waste Management Unit 13 Burial Grounds Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky	13

[1] Table adapted from DOE 2010a.

Table 2.2. Field Analysis and Limits for Grid Sampling

Analyte	Project Quantitation Limit (mg/kg)	Industrial Worker ELCR = 1E-5 (mg/kg)[a]	Industrial Worker HI = 1 (mg/kg)[a]	PGDP Background (mg/kg)[b]	Project Action Limit (mg/kg)[c]
Arsenic	11	9.99	160	7.9	11
Chromium (total)	85	1,980	32,300	16	1,980
Copper	35	N/A	14,300	19	14,300
Iron	100	N/A	100,000[d]	28,000	100,000
Lead	13	N/A	800[e]	23	800
Manganese	85	N/A	515	820	820
Mercury (inorganic)	10	N/A	9	0.13	10
Molybdenum	15	N/A	1,790	N/A	1,790
Nickel	65	100,000[d]	430	21	430
Selenium	20	N/A	1,790	0.7	1,790
Silver	10	N/A	108	2.3	108
Uranium	20	224[f]	1,070	4.6	224
Vanadium	70	N/A	108	37	108
Zinc	25	N/A	100,000[d]	60	100,000
Total PCBs	5	28.6	N/A	N/A	28.6

N/A = not applicable.
[a] ELCR and HI values are derived from values presented in Table A.4 of the Risk Methods Document (DOE 2014b) and updated for use of the Kentucky-preferred dermal absorption values [Table B.5 (DOE 2014b)].
[b] PGDP background values are taken from Table A.12 of the Risk Methods Document (DOE 2014b), the lesser of surface and subsurface is presented.
[c] The PAL is the greater of background and the lesser of the ELCR-based and the HI-based value, unless unachievable by the quantitation limit. If unachievable, the project quantitation limit is used as the PAL.
[d] The screening value was reduced to an upper limit value (100,000 mg/kg) to remain consistent with the Risk Methods Document (DOE 2014b).
[e] The value for lead is the no action level (NAL) presented in Table A.4 of the Risk Methods Document (DOE 2014b), this value was not adjusted to ELCR=1E-5 or HI=1.
[f] The ELCR=1E-5 for uranium was calculated from the ELCR=1E-5 for U-238 (DOE 2014b) (i.e., 74.8 pCi/g × 3). The isotope of uranium with the greatest mass abundance in natural uranium metal is U-238 (99.3%). A common conversion to determine the mass of uranium metal present, when the uranium is at or near the isotopic abundance in natural uranium, is to multiply the U-238 activity concentration by 3. This conversion factor is based upon the specific activity of U-238 (3.3E5 pCi/g).

Table 2.3. SWMU/AOC Composite Samples Collected

SWMU/AOC	Composite Samples Collected*	Acres
13	158	6.83
15	234	5.29
26	35	0.04
77	2	0.50
56/80	28	0.34
204	370	3.00
211-A	27	0.06
224	1	0.15
225-A	1	0.09
225-B	1	0.09

*Total number of composite samples collected under both the Soils OU RI and Soils OU RI 2 field efforts. Radiological judgmental grab samples for SWMUs/AOCs 13, 15, 26, 56/80, 204, 211-A, 224, and 565 are not included in this table.

To address the uncertainties identified in the Soils OU, the observational approach was used in the design of the sampling strategy for the Soils OU RI/FS. Field laboratory results were used to determine locations of contingency samples used to determine the lateral and/or vertical (4–7 ft and 7–10 ft bgs) extent of contamination whenever results from the originally planned locations indicated that the "edge" of contamination had not been defined. A summary of these contingency samples is included in the summary of the investigation for each SWMU/AOC in Chapter 5. Figures display if contingency "step-out" grids were needed for horizontal extent. In addition, a judgmental radiological soil grab sample (0–6 inches) was collected based on the gamma radiological walkover results.

Split samples and replicates were obtained from the composite as necessary. Analyses for each composite sample consisted of field analysis of Resource Conservation and Recovery Act (RCRA) metals, plus uranium, by XRF and Total PCB by PCB test kits. Ten percent of the samples had fixed-base laboratory confirmation splits. The 10% included at least one surface and one shallow subsurface from each SWMU/AOC that was sampled. These fixed-base laboratory samples were randomly selected from all sample locations within the SWMUs/AOCs.

2.2 RECTIFICATION FROM ORIGINALLY PLANNED SAMPLE LOCATIONS

Site conditions necessitated elimination of some of the RI grids (i.e., asphalt, concrete, standing water, dense underground utilities, gravel, structures, ongoing plant operations). Necessary modifications of the sampling strategy are detailed in Appendix A and rectification maps are provided.

2.3 QUALITY ASSURANCE/QUALITY CONTROL

Quality control (QC) was monitored throughout the RI process. QC included field sampling, laboratory analysis, and data management. This section describes QC for the Soils OU RI 2. A review of data collected during the summer of 2010 as part of the Soils OU RI is included in Appendix B.

2.3.1 Field Sampling QC

Field QC samples were collected to assess data quality. Appendix F provides the data from the field QC samples in a searchable database on compact disk. The target frequency of collection for QC samples for the entire project was 1 in 20 for equipment rinseates, field blanks, and field duplicates. Overall, this target was met for the project. Trip blanks were collected at a frequency of 1 per sample cooler containing volatile organic compound (VOC) samples.

2.3.2 Laboratory QC

ALS Environmental—Fort Collins performed all of the laboratory analyses of soil samples for the Soils OU RI 2. The laboratory was contracted through the DOE Sample Management Office (SMO) and is DOE-approved and Nuclear Regulatory Commission licensed. The laboratory is audited annually for compliance with DOE Consolidated Audit Program (DOECAP) requirements. Approved SW-846 methods were used for all samples, except those parameters for which other methods are necessary. The analysis followed appropriate protocols, and Level D data packages were provided along with electronic data deliverables (EDDs).

The following data qualifiers were used for reporting fixed-base laboratory results:

Inorganic Analysis

U The analyte was analyzed for, but not detected.

J Indicates an estimated value.

Organic Analysis

B This flag is used when the analyte is found in the associated blank as well as in the sample.

U Indicates compound was analyzed for, but not detected.

J Indicates an estimated value. This flag is used under the following circumstances: (1) when estimating a concentration for tentatively identified compounds where a 1:1 response is assumed; (2) when the mass spectral and retention time data indicate the presence of a compound that meets the gas chromatograph/mass spectrometer (GC/MS) identification criteria, and the result is less than the contract-required quantitation limit or reporting limit, but greater than the MDL; (3) when the retention time data indicate the presence of a compound that meets the GC identification criteria, and the result is less than the RL, but greater than the MDL; and (4) the reported value is estimated.

Radionuclide Analysis

U Indicates compound was analyzed for, but result was less than the minimum detectable activity (MDA) [or minimum detectable concentration (MDC)].

Precision, accuracy, and completeness objectives were presented in Section 2 of the Soils OU RI 2 work plan addendum (DOE 2014a). An assessment of these objectives for laboratory analytical data was performed. The results of this assessment are provided in Table 2.4.

Table 2.4. QA Assessment for Laboratory Measurements of RI 2 Data

Parameter	Method	Matrix	Precision (%)	Completeness (%)	Accuracy (%)
Metals	SW-846-6020, 7471	Soil	100	93	100
PCBs	SW-846-8082	Soil	100	93	100
SVOCs	SW-846-8270	Soil	100	100	100
VOCs	SW-846-8260	Soil	100	99	99
Alpha/Beta Activity	900.0 MOD	Soil	100	100	100
Cs-137	901.1 MOD	Soil	100	100	100
Am-241, Np-237, Pu-238, Pu-239/240, Th-228, Th-230, Th-232, U-234, U-235, U-238	DOE A-01-R MOD	Soil	100	100	100
Tc-99	DOE TC-02-RC MOD	Soil	100	100	100

Precision refers to the level of agreement among repeated measurements of the same characteristic, usually under a given set of conditions. To determine the precision of the laboratory analysis, a routine program of replicate analyses is performed. The absolute difference between the two values calculated is referred to as the relative percent difference (RPD). Precision was determined for this RI by reviewing laboratory-applied qualifiers that pertain to laboratory duplicates (i.e., "M" and "*" for inorganic analyses, "Y" for organic analyses, and "D" for radionuclide analyses) over all analyses. Quality assurance (QA) objectives for precision given in the Work Plan are performance based, with RPDs that ranged from 20 to 50% (DOE 2010a). These objectives were met by the data collected during this RI.

Accuracy refers to the nearness of a measurement to an accepted reference or true value. To determine the accuracy of an analytical method and/or the laboratory analysis, a periodic program of sample spiking is conducted. Accuracy for this RI was determined by reviewing laboratory-applied qualifiers that pertain to laboratory spikes over all analyses (i.e., "N" and "W" for inorganic analyses; "Y" for organic analyses; and "B," "M," and "L" for radionuclide analyses). QA objectives for accuracy given in the Work Plan are performance based; no concentrations of target compounds greater than the quantitation limits in method/instrument blanks, field blanks, and equipment rinseates. This objective was achieved for the project data set.

Representativeness is the degree to which discrete samples accurately and precisely reflect a characteristic of a population, variations at a sampling location, or a changing environmental condition. Representativeness is a qualitative parameter and will be achieved through careful, informed selection of sampling sites, drilling sites, drilling depths, and analytical parameters and through the proper collection and handling of samples to avoid interference and minimize contamination and sample loss. This objective was achieved for the Soils OU RI 2 by evaluating field condition before and during the data acquisition process to ensure that the most representative sample set possible was collected. This is evidenced by the field changes described in Appendix A.

Completeness is a measure of the percentage of valid, viable data obtained from a measurement system compared with the amount expected under normal conditions. The goal of completeness is to generate a sufficient amount of valid data to satisfy project needs. Data validation met DQOs for this project though only one result for each acrolein, ethyl methacrylate, and vinyl acetate was rejected. Completeness also is a measure of samples collected during the field effort with respect to those targeted for collection in the work plan (DOE 2010a) and addendum (DOE 2014a). All soil samples targeted for collection during this RI were collected with the exceptions as noted in Appendix A.

Comparability is the extent to which comparisons among different measurements of the same quantity or quality will yield valid conclusions. Comparability was assessed in terms of field standard operating procedures (SOPs), analytical methods, QC, and data reporting. In addition, data validation assesses the processes employed by the laboratory that affect data comparability.

Historical data determined to be representative of current conditions were evaluated for precision and accuracy as described previously. This assessment was performed over all measurements for the projects associated with the Soils OU RI 2 SWMUs/AOCs. Multiple laboratories analyzed samples for these historical projects. The comparison for the precision and accuracy of historical results encompassed the entire historical data set and did not differentiate between projects or laboratories. All historical analyses were within the criteria established by the work plan addendum (DOE 2014a) for Soils OU RI 2 data, with the exception of accuracy of metals analyses in soil.

Sensitivity or lower limit of detection can be established from actual measured performance based on spike recoveries in the matrix of concern or from acceptable method performance on a certified referenced material of the appropriate matrix and within the appropriate calibration range for the application. The data collected met the sensitivity established in the DQOs for this project.

2.3.3 Data Management QC

The Soils OU Project Environmental Measurements System (PEMS) was used to manage field-generated data; import laboratory-generated data; add data qualifiers based on data verification, validation, and assessment; and to transfer data to the Paducah Oak Ridge Environmental Information System (Paducah OREIS). PEMS included a tracking system to identify, track, and monitor each sample and associated data from point of collection through final data reporting. The system includes field measurements, chain-of-custody information, a tracking system for tracking hard copy data packages, and EDDs. PEMS also includes information for field planning and data evaluation.

All data packages and EDDs received from the laboratory were tracked, reviewed, and maintained in a secure environment. When first received, data packages were assigned a document control number and then logged into a tracking system. The following information was tracked: sample delivery group numbers, date received, document control number, number of samples, sample analyses, receipt of EDDs, and comments.

The data verification processes for laboratory data were implemented for both hard copy data and EDDs. The data packages were reviewed to confirm that all samples had been analyzed for the requested parameters. Discrepancies were reported to the laboratory and the data validators. As part of a series of internal integrity checks within PEMS, a check was run to identify which of the requested samples and analyses were not received in an EDD. Hard copy data packages were checked to confirm agreement with the associated EDD. Integrity checks in PEMS also were used to check the list of compounds generated by the laboratory to confirm that data were provided for all requested analytes. Discrepancies were reported to the laboratories for responses and/or correction and to the data validators.

Data verification within PEMS included standardization of analytical methods, chemical names and units, as well as checks for holding time violations and detections above background values.

PEMS system requirements included backups, security, change control, and interfacing with other data management systems. PEMS was housed on the Paducah network. System backups were performed nightly following standard Paducah network protocol. Updates made to the files were copied to a computer backup tape each night, and an entire backup was performed each week.

Security of PEMS and data used for the data management effort was considered essential to the success of the project. The security protocol followed by the data management team was consistent with that of the Paducah network. Access to the network is password protected. Access to PEMS was limited, on an as-needed basis, to the data management personnel. Read-write, graded access to PEMS was limited to the data management team, which consisted of the PEMS coordinator and the supporting data entry staff. The data management staff assisted other project members with data needs from PEMS by running requested queries.

A large volume of data was generated during both of the Soils OU RI field investigations. To confirm that the data set could be used in the decision making process, the RI team performed various checks and reviews during and after the fieldwork to maintain data consistency and identify problem areas. These checks and reviews included electronic verification and manual assessments by the RI team, as well as independent Level IV validation of fixed-base laboratory data. Approximately 22,869 records were reviewed during the Soils OU RI 2 data assessment.

Data validation is a process performed for a data set by a qualified individual independent from sampling, laboratory, project management, and other decision making personnel for the project. Data validation is performed in accordance with EPA guidance. In the data validation process, the laboratory adherence to analytical method requirements is evaluated. Data collected for this RI was validated at a frequency of 10%.

As part of the data review process, findings were qualified as necessary to reflect data validation results. The following qualifiers were assigned by the data validators:

U Analyte compound or nuclide considered not detected above the reported detection limit.

J Analyte compound or nuclide identified; the associated numerical value is approximated.

UJ Analyte compound or nuclide not detected above the reported detection limit, and the reported detection limit is approximated due to quality deficiency.

R Result is not usable for its intended purpose, so data are of “information only” quality and should be supplemented with additional data for decision making.

= Data were validated; however, no qualifier was added.

The data rejected by validation were VOC analyses. Acrolein (1 rejected of 38 data points), ethyl methacrylate (1 rejected of 38 data points), and vinyl acetate (1 rejected of 38 data points) were rejected due to the matrix spike and/or matrix spike duplicate recovery being below the lower control limit.

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3. PHYSICAL CHARACTERISTICS OF THE STUDY AREA

This chapter presents the physical and ecological characteristics of PGDP and the region surrounding it. The discussion focuses on region- and PGDP-wide characteristics to support subsequent evaluations of the nature and extent and the fate and transport of contaminants exiting the SWMUs/AOCs.

This RI field effort focused on collection and analysis of soil samples to address deficiencies in the existing characterization of the nature and extent of contamination. These sampling and analytical activities yielded additional data for the soils in each SWMU/AOC. The results of those activities have been incorporated into the SWMU/AOC-specific discussions.

Numerous investigations detail physical characteristics of PGDP that are pertinent to the Soils OU RI 2; the primary references include those listed in Table 2.1.

3.1 SURFACE FEATURES

PGDP is located on a 3,556-acre DOE site approximately 10 miles west of Paducah, Kentucky, and 3.5 miles south of the Ohio River in the western part of McCracken County (Figure 3.1). The PGDP industrial area occupies approximately 650 acres of the DOE site, surrounded by an additional 689-acre buffer zone. DOE licenses most of the remaining acreage to the Commonwealth of Kentucky as part of the West Kentucky Wildlife Management Area (WKWMA). Tennessee Valley Authority (TVA) Shawnee Fossil Plant borders the DOE site to the northeast, between PGDP and the Ohio River.

Three small communities are situated within three miles of the DOE property boundary: Heath and Grahamville to the east and Kevil to the southwest. The next closest municipality is Metropolis, Illinois, five miles to the northeast of PGDP on the north side of the Ohio River.

The dominant topographic features in the area of PGDP are nearly level to gently sloping dissected plains and the flood plain of the Ohio River. Local elevations range from 290 ft above mean sea level (amsl) along the Ohio River to 450 ft amsl southwest of PGDP. Ground surface elevations vary from 360 ft to 390 ft amsl within the PGDP boundary, where most of the Soils OU RI 2 SWMUs/AOCs are located. Generally, the topography in the PGDP area slopes toward the Ohio River at an approximate gradient of 27 ft per mile (CH2M HILL 1992).

3.2 METEOROLOGY

The National Weather Service office at Barkley Regional Airport (located four miles to the southeast of PGDP) documents hourly meteorological measurements. Current and historical meteorological information regarding temperature, precipitation, and wind speed/direction are available from the National Oceanic and Atmospheric Administration’s (NOAA’s) National Climatic Data Center.

The climate of the PGDP region is humid-continental. Summers are warm (July averages 79°F) and winters are moderately cold (January averages 35°F). PGDP experiences a yearly surplus of precipitation versus evapotranspiration. The 30-year average monthly precipitation for the period 1961 through 1990 is 4.11 inches, varying from an average of 3.00 inches in October (the monthly average low) to an average of 5.01 inches in April (the monthly average high). Monthly estimates of evapotranspiration using the Thornthwaite method (Thornthwaite and Mather 1957) equal or exceed average rainfall for the period May through September (season of no net infiltration).

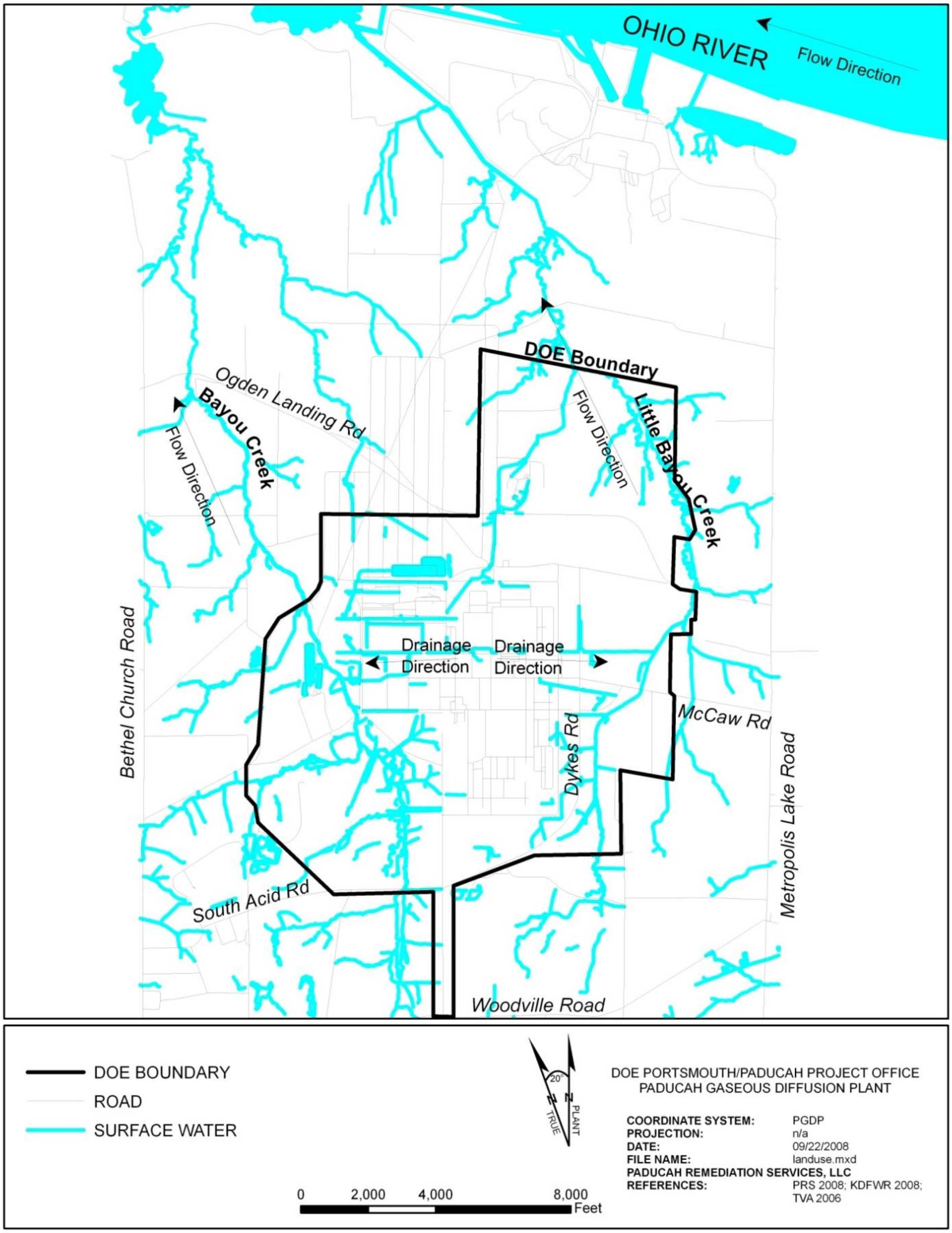


Figure 3.1. Surface Water Features in the Vicinity of the DOE Site

Heavy rainfall associated with thunderstorms or low-pressure systems occurs occasionally at PGDP. Table 3.1 presents the predicted storm recurrence intervals for PGDP (Dupont and Allen 2000).

Table 3.1. Rainfall Intensity as a Function of Recurrence Interval and Storm Duration for Western Kentucky

	Recurrence Interval (years)					
Storm Duration (minutes)	2	5	10	25	50	100
	Precipitation (inches per hour)					
5	11.80	16.69	19.98	24.19	27.33	30.46
10	7.02	9.44	11.05	13.09	14.61	16.11
15	5.20	6.82	7.90	9.25	10.26	11.26
20	4.20	5.43	6.25	7.27	8.04	8.79
30	3.12	3.96	4.52	5.22	5.74	6.25
60	1.89	2.34	2.64	3.02	3.31	3.59
80	1.54	1.89	2.13	2.43	2.65	2.87
100	1.30	1.61	1.81	2.05	2.24	2.43
120	1.15	1.41	1.58	1.80	1.96	2.12
1,440	0.20	0.26	0.30	0.34	0.38	0.41

The prevailing wind is from the south-southwest at approximately 10 miles per hour. Historically, stronger winds are recorded when the winds are from the southwest.

3.3 SURFACE WATER HYDROLOGY

PGDP is situated in the western portion of the Ohio River basin, 15 miles downstream of the confluence of the Ohio River with the Tennessee River and 35 miles upstream of the confluence of the Ohio River with the Mississippi River. The Ohio River is located approximately 3.5 miles north of PGDP. It is the most significant surface water feature in the region, carrying over 25 billion gal/day of water through its channel. A U.S. Geological Survey (USGS) gaging station at Metropolis, Illinois (USGS 03611500), monitors the Ohio River stage near PGDP. River stage typically varies between 290 ft and 328 ft amsl over the course of a year. Water levels on the lower Ohio River generally are highest in winter and early spring and lowest in late summer and early fall. The entire PGDP is above the historical high water floodplain of the Ohio River (CH2M HILL 1991) and above the local 100-year flood elevation of the Ohio River (333 ft). [The highest Ohio River stage recorded at Metropolis, Illinois (February 2, 1937) was 343 ft.]

The plant overlies the divide between Bayou and Little Bayou Creeks (Figure 3.1). Bayou Creek is a perennial stream on the western boundary of the plant that flows generally northward, from approximately 2.5 miles south of the plant site to the Ohio River along a 9-mile course. Little Bayou Creek is an intermittent stream located on the eastern boundary of the plant; its drainage originates within WKWMA and extends northward along a 6.5-mile course, which joins Bayou Creek near the Ohio River. Most of the flow within Bayou and Little Bayou Creeks is from process effluents or surface water runoff from PGDP. Networks of ditches discharge effluent and surface water runoff from PGDP to the creeks. Contributions from PGDP comprise approximately 85% of the base flow within Bayou Creek and 100% of the base flow within Little Bayou Creek.

Multiple groundwater aquifers underlie PGDP (see Section 3.6 for a discussion of PGDP hydrogeology). The shallowest aquifers occur in the Continental Deposits and the McNairy Formation, both of which discharge into the Ohio River north of PGDP. A large, downward, vertical hydraulic gradient within the Upper Continental Deposits, which represents an aquitard, typically limits the amount of groundwater discharge to the ditches of PGDP and adjacent creeks. Gaining reaches in the creeks are found on Bayou Creek south of PGDP and on Little Bayou Creek to the north of PGDP where it meets the Ohio River flood plain. Both creeks have gaining reaches adjacent to the Ohio River.

Other surface water bodies in the vicinity of PGDP include several small ponds, inactive clay and gravel pits, and settling basins scattered throughout the PGDP plant area; a marshy area just south of the confluence of Bayou Creek and Little Bayou Creek; ash settling ponds of the Shawnee Fossil Plant; and Metropolis Lake, located east of the Shawnee Fossil Plant.

3.4 GEOLOGY

PGDP lies within the Jackson Purchase region of western Kentucky, which represents the northern tip of the Mississippi Embayment portion of the Coastal Plain Province. The stratigraphic sequence in the region consists of Cretaceous, Tertiary, and Quaternary sediments unconformably overlying Paleozoic bedrock (Figure 3.2). The following sections describe the primary geologic units of the PGDP region.

3.4.1 Bedrock

Mississippian carbonates, composed of dark gray limestone with some interbedded chert and shale, underlie the entire PGDP area at an approximate depth of 300 ft to 340 ft.

3.4.2 Rubble Zone

Deep soil borings at PGDP commonly encounter a rubble zone of chert gravel at the top of the bedrock. The age and continuity of the rubble zone remain undetermined.

3.4.3 McNairy Formation

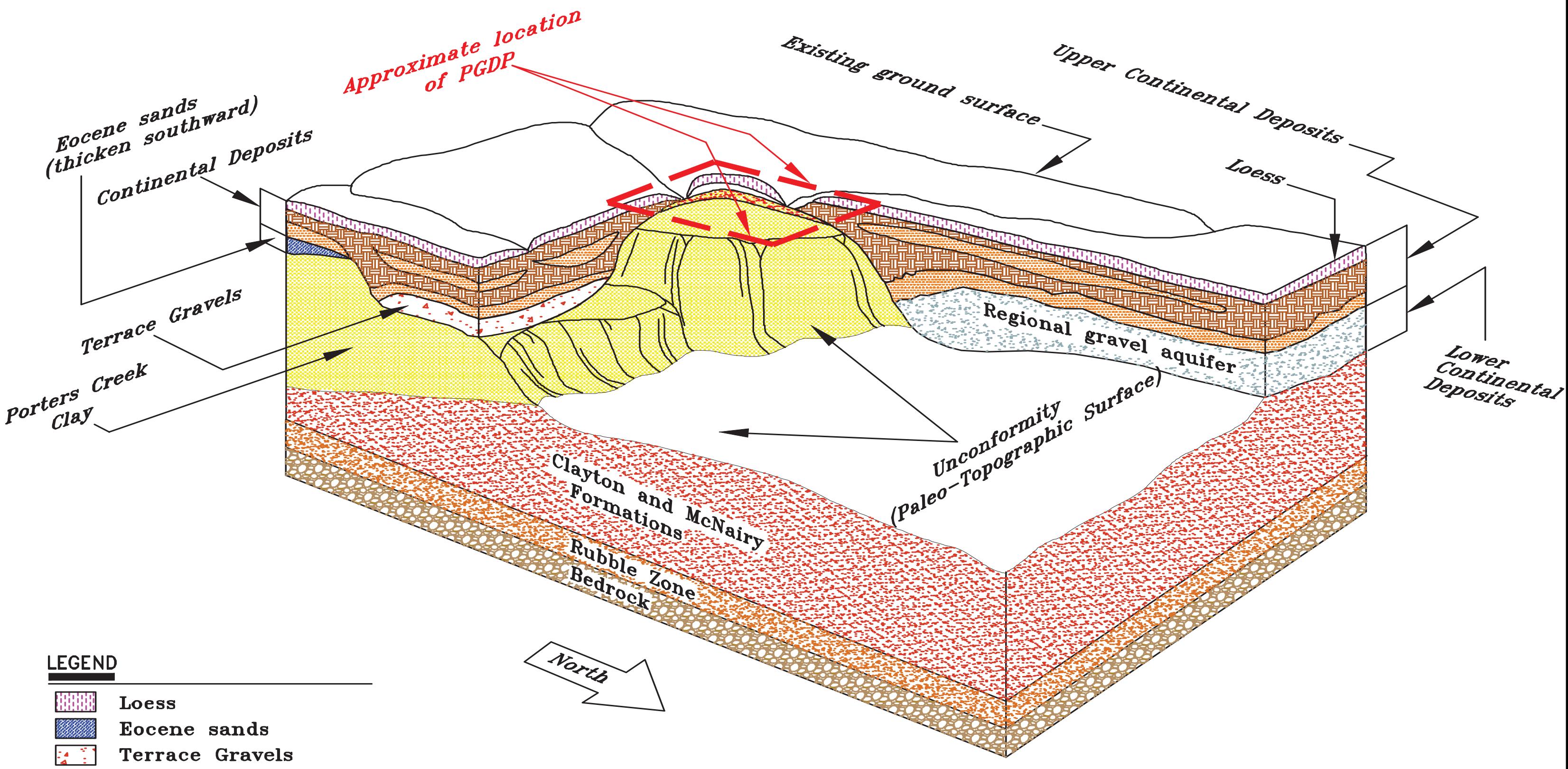
The McNairy Formation consists of Upper Cretaceous, fine clastic sediments. At PGDP, the upper and middle members of the McNairy Formation are typically grayish-white to dark-gray, micaceous silt and clay interbedded with gray to yellow, very fine- to fine-grained sand. The middle (Levings) member tends to contain fewer sand interbeds. The basal McNairy member at PGDP is primarily a light gray, very fine to fine sand.

3.4.4 Porters Creek Clay/Porters Creek Terrace Slope

Paleocene age Porters Creek Clay underlies the southern portions of the DOE site and consists of dark gray to black silt with varying amounts of clay and fine-grained, micaceous, commonly glauconitic, sand. The Porters Creek Clay subcrops along a buried terrace slope that extends east–west under the south end of the PGDP industrial area. This subcrop is the northern limit of Porters Creek Clay and the southern limit of the Pleistocene Lower Continental Deposits under PGDP.

3.4.5 Eocene Sands

Eocene sands occur south of PGDP above the Porters Creek Clay. This unit includes undifferentiated quartz sands and interbedded and interlensing silts and clays of the Claiborne Group and Wilcox Formation (Olive 1980). The Eocene sands thicken to the south of PGDP.



LEGEND

- Loess
- Eocene sands
- Terrace Gravels
- Clayton and McNairy Formations
- Porters Creek Clay
- Continental Deposits – Interbedded silts/clay and sand/gravel
- Regional Gravel Aquifer
- Sand
- Rubble Zone
- Bedrock

Not to Scale

Source: Clausen et al. 1992a

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Figure 3.2. PGDP Stratigraphic Sections

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3.4.6 Continental Deposits

Continental sediments [Pliocene(?)[2] to Pleistocene age] unconformably overlie the Cretaceous through Eocene strata throughout the area. These continental sediments were deposited on an irregular erosional surface consisting of several terraces. The thicker Continental Deposits sections represent Pleistocene valley fill sediments that comprise a fining-upward cycle. The continental sediments have been divided into the two distinct facies described below.

(1) <u>Lower Continental Deposits</u>. The Lower Continental Deposits is a gravel facies consisting of chert, ranging from pebbles to cobbles, in a matrix of poorly sorted sand and silt. Gravels of the Lower Continental Deposits overlie three distinct terraces in the PGDP area.

- The upper terrace Lower Continental Deposits consists of Pliocene(?) gravel units, ranging in thickness from near 0 ft to 30 ft, occurring in the southern portion of the DOE site at elevations greater than 350 ft amsl. This gravel unit overlies the Eocene sands and Porters Creek Clay (where the Eocene sands are missing).

- Pliocene(?) gravels of the Lower Continental Deposits also occur on an intermediate terrace eroded into the Porters Creek Clay at an elevation of approximately 320 ft to 345 ft amsl in the southeastern and eastern portions of the DOE site. The thickness of this unit typically ranges from 15 ft to 20 ft.

- The Lower Continental Deposits of the upper and intermediate terraces are collectively referred to as the Terrace Gravel.

- The third and most prominent of the three Lower Continental Deposits members consists of a Pleistocene gravel deposit resting on an erosional surface at an elevation of approximately 280 ft amsl. This gravel underlies most of the plant area and the region to the north, but pinches out under the south side of PGDP along the subcrop of the Porters Creek Clay. The Pleistocene member of the Lower Continental Deposits averages approximately 30 ft in thickness. Trends of greater thickness, as much as 50 ft, fill deeper scour channels that trend east–west beneath the site.

(2) Upper Continental Deposits. The Upper Continental Deposits are a Pleistocene age, fine-grained clastics facies that commonly overlies the Lower Continental Deposits. This unit ranges in thickness from 15 ft to 55 ft. The Upper Continental Deposits includes three general horizons beneath PGDP: (1) an upper silt and clay interval, (2) an intermediate interval of common sand and gravel lenses (sand and gravel content generally diminishes northward), and (3) a lower silt and clay interval. The upper silt and clay interval consists of the Peoria Loess and Roxana Silt (DOE 2003; WLA 2006). The Peoria Loess and Roxana Silt blanket the entire PGDP area.

3.5 SOILS

The surficial deposits found in the vicinity of PGDP are Pleistocene loess and Holocene alluvium. Both units commonly consist of clayey silt or silty clay and range in color from yellowish-brown to brownish-gray or tan, making field differentiation difficult. The general soil map for Ballard and McCracken Counties delineates three soil associations within the vicinity of PGDP: the Rosebloom-Wheeling-Dubbs association, the Grenada-Calloway association, and the Calloway-Henry association (USDA 1976).

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[2] A question mark indicates uncertain age.

In the immediate PGDP area, the predominant soil is the Henry soil series of the Calloway-Henry association, which consists of nearly level, somewhat poorly to poorly drained, medium-textured soils on upland positions. The Henry soil series contains poorly drained, acidic soils that have a fragipan. Henry soils typically have moderate permeability above the fragipan and low permeability within the fragipan. Permeability in the fragipan is less than 0.4 ft/day (DOE 1998c). It should be noted that soils within the industrial area of PGDP could be classified as "urban" since they have been impacted by human influence and many of the original characteristics have been lost.

Several other soil groups also occur in limited areas of the region, including the Grenada, Falaya-Collins, Waverly, Vicksburg, and Loring.

The soils in the vicinity of PGDP tend to have a low buffering capacity, with a pH ranging from 4.5 to 5.5. Measurements of the cation exchange capacity of site soils range from 8.92 to 69.8 milliequivalents per liter (mEq/L) (DOE 1999b). Under background conditions, the cation exchange capacity is sufficient to bind metals in the soils; however, acidic leachate will increase metal solubility and mobility significantly.

3.6 HYDROGEOLOGY

The significant geologic units relative to shallow groundwater flow at PGDP include the Terrace Gravel and Porters Creek Clay (south part of the DOE site) and the Pleistocene Continental Deposits and McNairy Formation (underlying PGDP and adjacent areas to the north). Groundwater flow in the Pleistocene Continental Deposits is a primary pathway for transport of dissolved contamination from PGDP. The following paragraphs provide the framework of the shallow groundwater flow system at PGDP.

(1) Terrace Gravel Flow System. The Porters Creek Clay is a confining unit to downward groundwater flow south of the PGDP industrial area. A shallow water table flow system is developed in the Terrace Gravel, where it overlies the Porters Creek Clay south of the PGDP industrial area. Discharge from this water table flow system provides baseflow to Bayou Creek and underflow to the Pleistocene Continental Deposits to the east of PGDP.

The elevation of the top of the Porters Creek Clay is an important control to the area's groundwater flow trends. A distinct groundwater divide is centered in hills located approximately 9,000 ft southwest of the PGDP industrial area, where the Terrace Gravel and Eocene sands overlie a "high" on the top of the Porters Creek Clay. In adjacent areas where the top of the Porters Creek Clay approaches land surface, as it does south of PGDP and near the subcrop of the Porters Creek Clay to the west of the industrial complex, the majority of groundwater flow is forced to discharge into surface streams (gaining reaches) and little underflow occurs into the Pleistocene Continental Deposits. To the east of PGDP, the Terrace Gravel overlies a lower terrace eroded into the top of the Porters Creek Clay. In this area, a thick sequence of Terrace Gravel occurs adjacent to the Pleistocene Continental Deposits, allowing significant underflow from the Terrace Gravel. Surface drainages in this area are typically loosing reaches. Figure 3.3 presents hydraulic potential trends for the Terrace Gravel flow system.

(2) Upper Continental Recharge System (UCRS). The upper strata, where infiltration of water from the surface occurs and where the uppermost zone of saturation exists, in the Upper Continental Deposits (beneath PGDP and the contiguous land to the north) is called the UCRS. Groundwater flow is primarily downward in the Upper Continental Deposits. A plot of elevation of water level versus midpoint of well screen for UCRS wells at PGDP (Figure 3.4) demonstrates that steep vertical

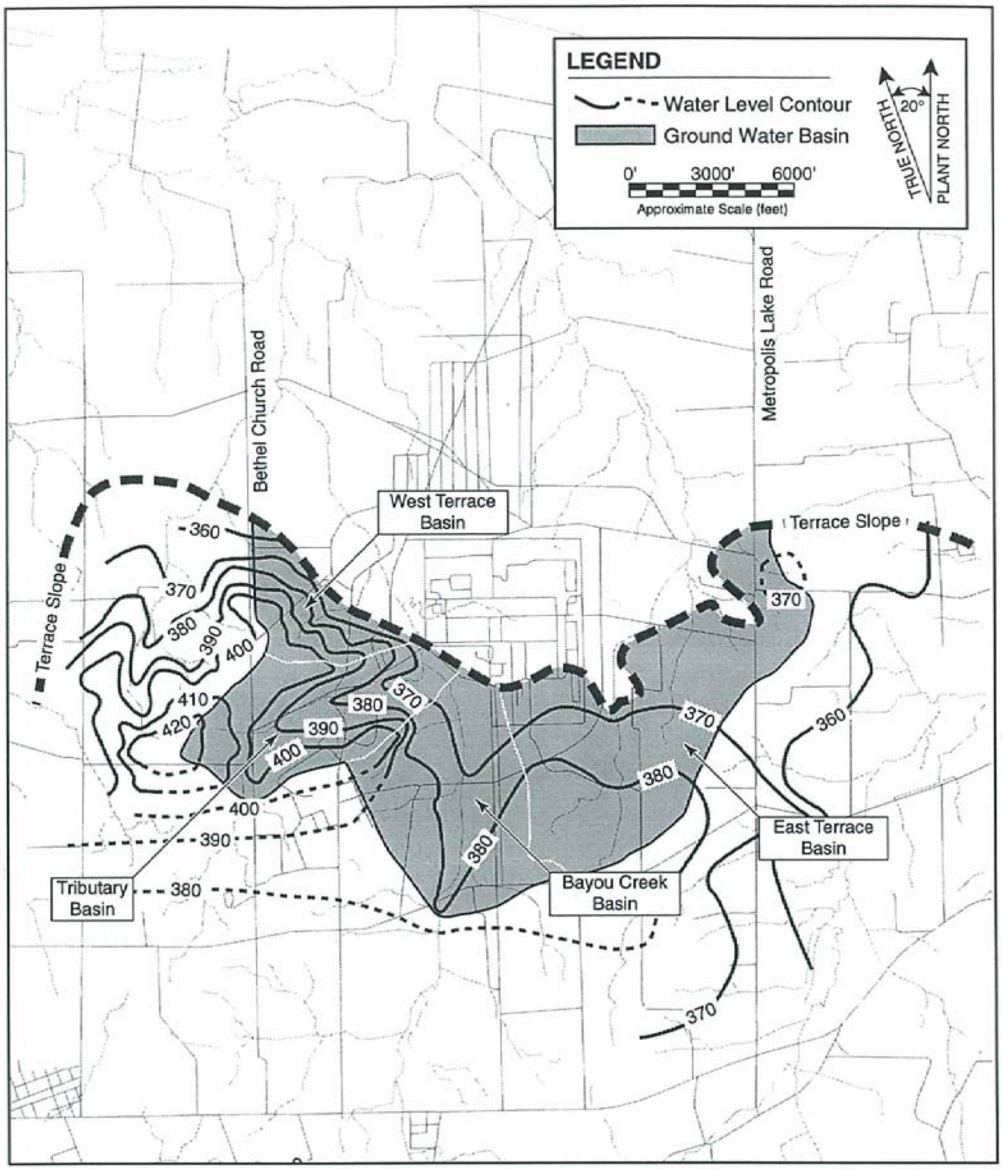

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Figure 3.3. Water Table Trends in the Terrace Deposits South of the PGDP

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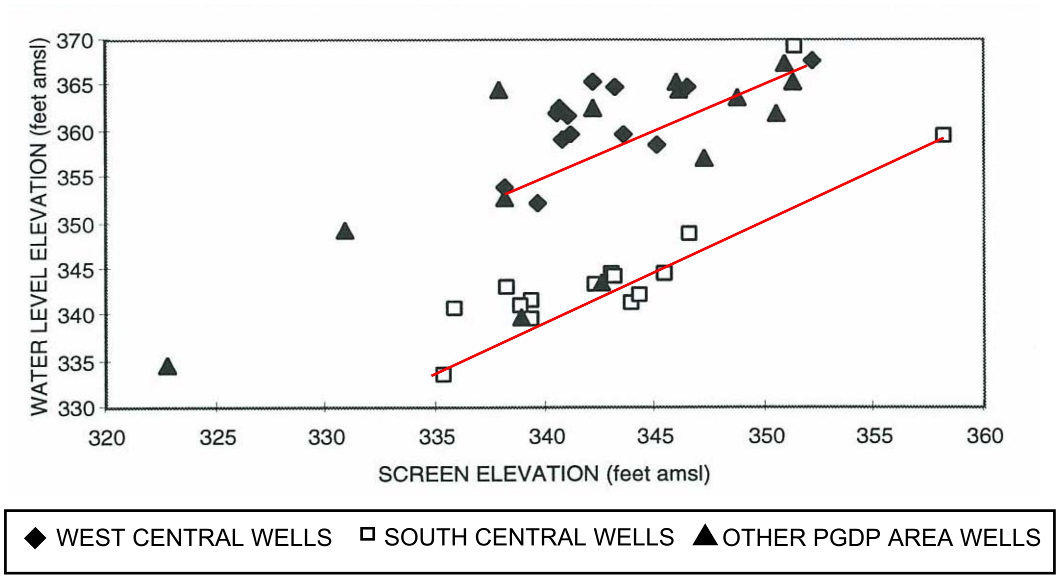

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Figure 3.4. Plot of Water Level ersus Well Screen for Upper Continental Recharge System Wells

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hydraulic gradients are characteristic of the UCRS. Vertical hydraulic gradients generally range from 0.5 to 1 ft/ft where measured by wells completed at different depths in the UCRS. Vertical gradients are 1 to 2 orders of magnitude greater than lateral hydraulic gradients. While groundwater flow is predominantly downward, there will be some lateral flow due to heterogeneities in the shallow soils.

The infiltration rate for the PGDP area is approximately 6.6 inches/yr based on site-specific groundwater modeling. This 6.6 inches/yr applied over the area of the industrial area of the plant yields approximately 0.4 mgd of recharge to the shallow groundwater system. Leakage from plant water utilities, ditches, lagoons, and cooling tower basins is suspected to be another important source of infiltration at PGDP. Water use for PGDP for calendar year 2006 averaged 13 mgd. Municipal water systems lose as much as 24% of the daily conveyance (Jowitt and Xu 1990). A similar loss of the PGDP system would equal 3.1 mgd. Since the UCRS groundwater flow is predominantly downward, areas with higher anthropogenic recharge create mounding of hydraulic head in the RGA that can affect contaminant transport. Because the hydraulic conductivity in the RGA on-site is relatively large, the mounding is only slight (often less than 1 ft) and difficult to measure.

(3) RGA. Vertically infiltrating water from the UCRS moves downward into a basal sand member of the Upper Continental Deposits and the Pleistocene gravel member of the Lower Continental Deposits and then laterally north toward the Ohio River. This lateral flow system is called the RGA. The RGA is the shallow aquifer beneath PGDP and contiguous lands to the north. Groundwater of the RGA meets requirements of a Class II groundwater as delineated in *Guidelines for Ground-Water Classification under the EPA Ground-Water Protection Strategy* (EPA 1988).

Hydraulic potential in the RGA declines toward the Ohio River, which is the control of base level of the region's surface water and groundwater systems. The RGA potentiometric surface gradient beneath PGDP is commonly 10-4 ft/ft, but increases by an order of magnitude near the Ohio River. (Vertical gradients are not well documented, but small.)

The hydraulic conductivity of the RGA varies spatially. Pumping tests have documented the hydraulic conductivity of the RGA ranges from 53 ft/day to 5,700 ft/day. East-to-west flow of the ancestral Tennessee River, which laid down the Pleistocene Continental Deposits gravel member, tended to orient permeable gravel and sand lenses east-west. Thus, with the hydraulic head in the RGA generally decreasing northward toward the Ohio River, groundwater flow trends to the northeast and northwest from PGDP in response to the anisotropy of the hydraulic conductivity as well as the anthropogenic recharge, which is greatest in the industrial portion of the plant. Anthropogenic recharge from waterline leaks, lagoons, cooling tower basins, and other sources provides the primary driving force in moving groundwater in northeastern and northwestern flow directions from the industrial plant area. Ambient groundwater flow rates in the more permeable pathways of the RGA commonly range from 1 to 3 ft/day.

Previous work has shown that the primary pathway for groundwater flow and the site-related contaminants is vertical migration through the UCRS, followed by lateral migration in the RGA. The two primary groundwater plume contaminants at PGDP are trichloroethene (TCE) and Tc-99. Interpretation of the location of these plumes is updated on a regular basis with the addition of groundwater analytical data from various projects at the site. Figures 3.5 and 3.6 illustrate the plume maps presented in the calendar year 2012 plume map update (LATA Kentucky 2013). Monitoring wells used to generate the plume maps are plotted on the figures.

(4) McNairy Flow System. Groundwater flow in the fine sands and silts of the McNairy Formation is called the McNairy Flow System. The overall McNairy groundwater flow direction in the area of

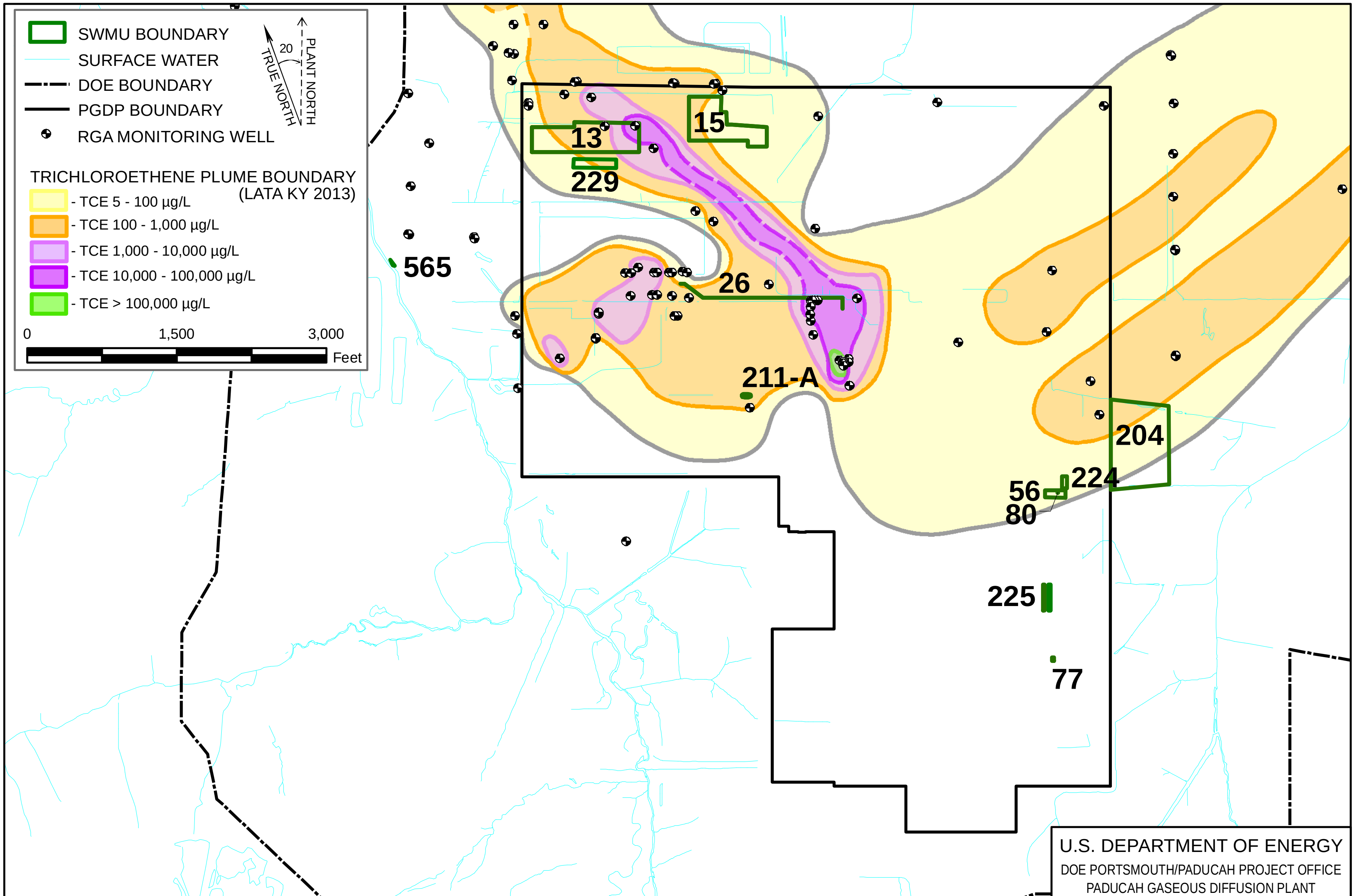

Figure 3.5. Location of Trichloroethene Plume in Relation to Soils OU RI 2 SWMUs

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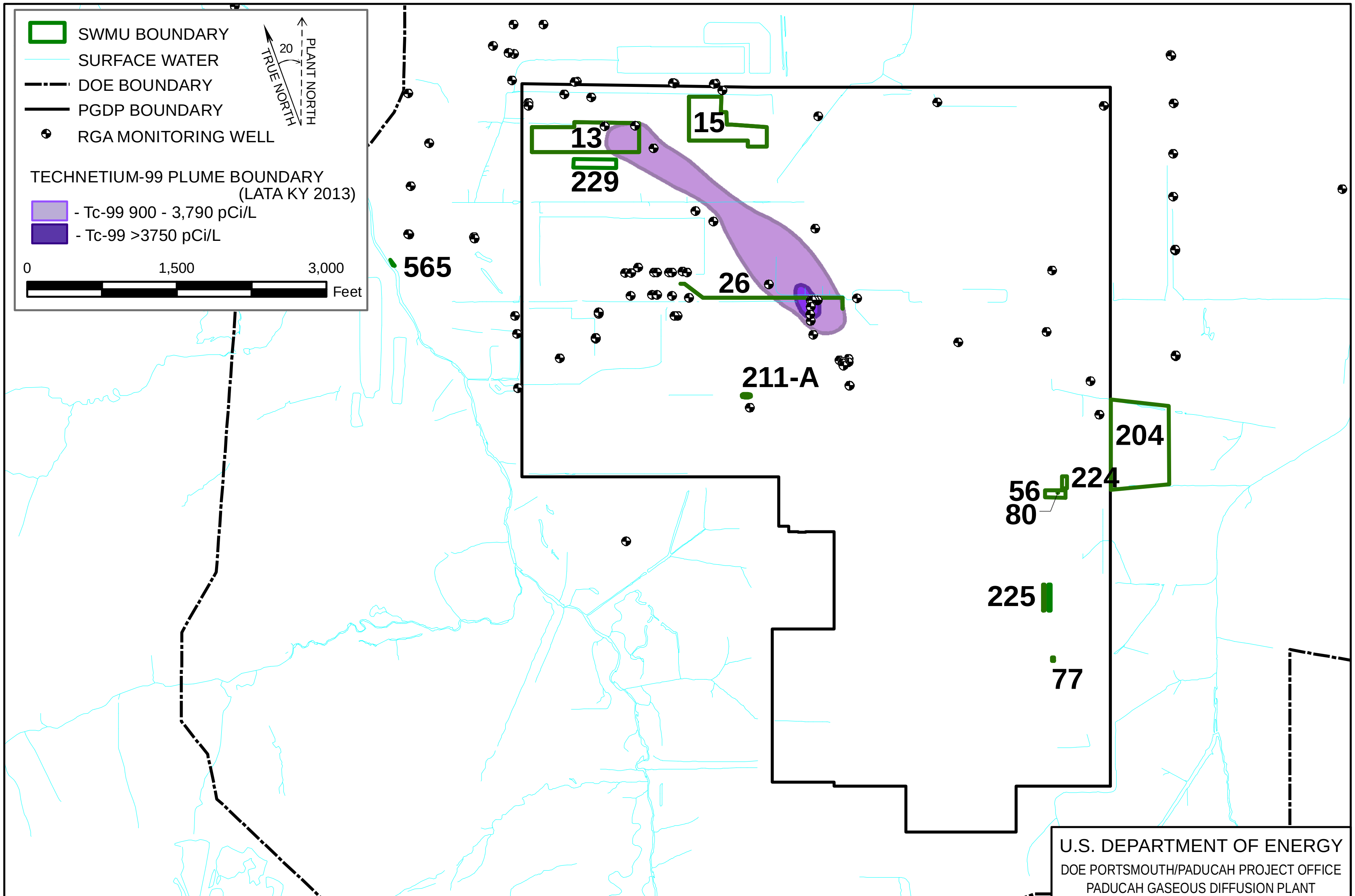

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Figure 3.6. Location of Technetium-99 Plume in Relation to Soils OU RI 2 SWMUs

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PGDP is northward to the Ohio River, similar to that of the RGA. Hydraulic potential is greater in the RGA than in the McNairy Flow System beneath PGDP. Area monitoring well clusters document an average downward vertical gradient of 0.03 ft/ft. Because the RGA has a steeper hydraulic potential slope toward the Ohio River than does the McNairy Flow System, the vertical gradient reverses nearer the Ohio River. [The "hinge line," which is where the vertical hydraulic gradient between the RGA and McNairy Flow System changes from a downward vertical gradient to an upward vertical gradient, parallels the Ohio River near the northern DOE property boundary (LMES 1996).]

The contact between the Lower Continental Deposits and the McNairy Formation is a marked hydraulic properties boundary. Representative lateral and vertical hydraulic conductivities of the upper McNairy Formation in the area of PGDP are approximately 0.02 ft/day and 0.0005 ft/day, respectively. Vertical infiltration of groundwater into the McNairy Formation beneath PGDP is on the order of 0.1 inch per year. (Lateral flow in the McNairy Formation beneath PGDP is on the order of 0.03 inch per year.) As a result, little interchange occurs between the RGA and McNairy Flow System.

Hydrogeologic Units

Five hydrogeologic units (HUs) commonly are used to discuss the shallow groundwater flow system beneath the DOE site and the contiguous lands to the north (Figure 3.7). In descending order, the HUs are described below:

- Upper Continental Deposits
  - HU 1 (UCRS): Loess that covers the entire site.
  - HU 2 (UCRS): Discontinuous sand and gravel lenses in a clayey silt matrix. In some areas of the plant, the HU2 interval consists of an upper sand and gravel member (HU2A) and a lower sand and gravel member (HU2B) separated by a thin silt unit.
  - HU 3 (UCRS): Relatively impermeable unit that acts as the upper semiconfining-to-confining layer for the RGA. The lithologic composition of HU3 varies from clay to fine sand, but is predominantly silt and clay.
  - HU 4 (RGA): Near-continuous sand unit with a clayey silt matrix that forms the top of the RGA.
- Lower Continental Deposits
  - HU 5 (RGA): Gravel, sand, and silt.

3.7 DEMOGRAPHY AND LAND USE

The WKWMA and some sparsely populated agricultural lands surround PGDP. Historically, the economy of western Kentucky has been based on agriculture, although there has been increased industrial development in recent years. The population of McCracken County, Kentucky is approximately 66,000 (DOC 2013). The major city in McCracken County is Paducah, Kentucky, whose population is approximately 25,000 (DOC 2013). Three small communities are located within 3 miles of the DOE property boundary at PGDP: Heath and Grahamville to the east and Kevil to the southwest.

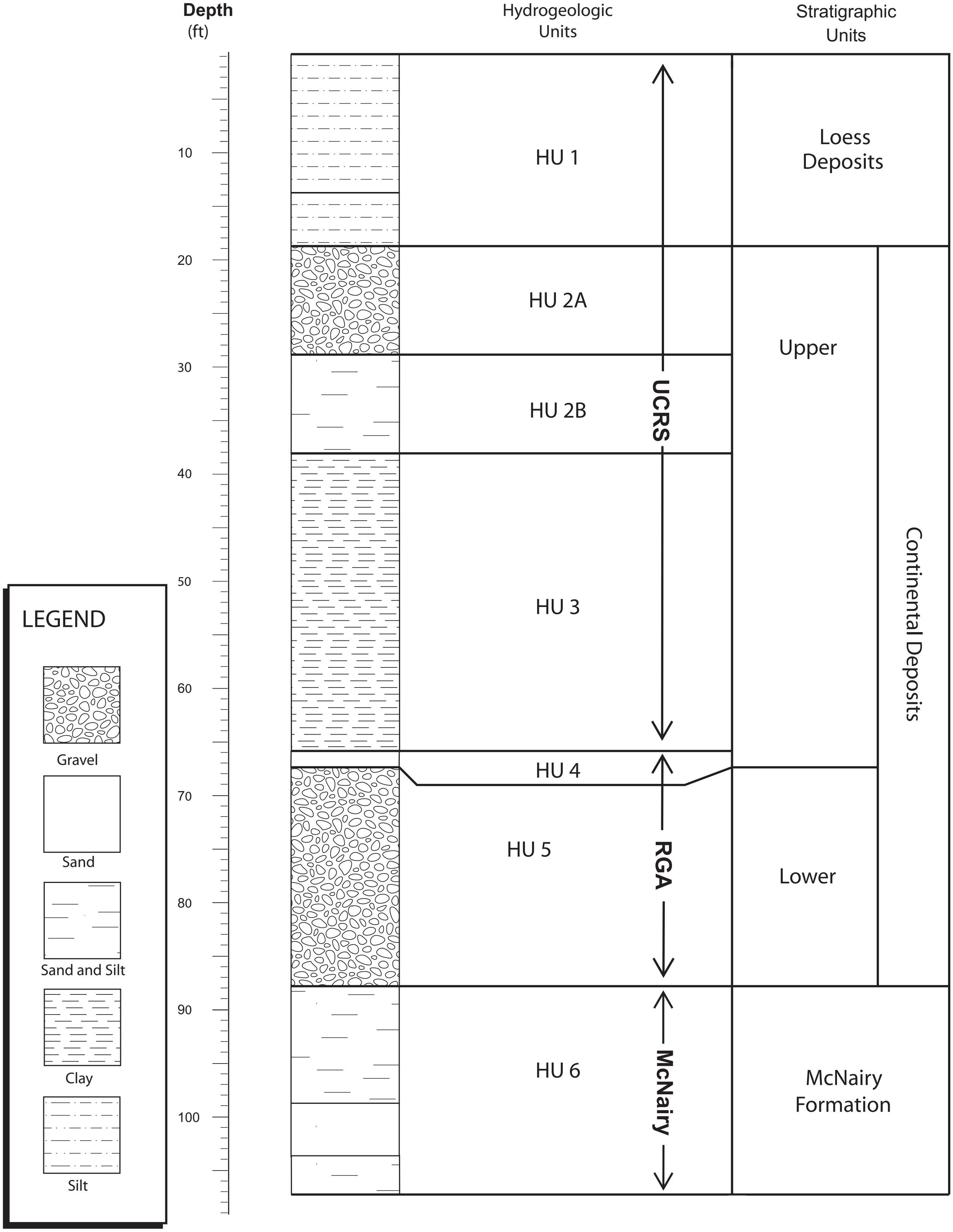

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Figure 3.7. Example Stratigraphic and Hydrogeologic Units

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The population within a 50-mile radius of PGDP is about 534,000 according to the 2010 census. Within a 10-mile radius of PGDP, the population is about 89,000 (ESRI 2012).

In addition to the residential population surrounding the plant, WKWMA draws thousands of visitors each year for recreational purposes. Visitors use the area primarily for hunting and fishing, but other activities include horseback riding, hiking, and bird watching. An estimated 7,500 fishermen visit the area each year (DOE 2015b).

For the PGDP area, current and reasonably anticipated future land use is depicted in the SMP, as shown in Figures 3.8 and 3.9 (DOE 2015a).

3.8 ECOLOGY

The following sections give a brief overview of the terrestrial and aquatic systems at PGDP. A more detailed description, including identification and discussion of sensitive habitats and threatened/endangered species, is contained in the *Investigation of Sensitive Ecological Resources Inside the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (CDM Federal 1994) and *Environmental Investigations at the Paducah Gaseous Diffusion Plant and Surrounding Area, McCracken County, Kentucky, Volume V: Floodplain Investigation, Part A: Results of Field Survey* (COE 1994).

3.8.1 Terrestrial Systems

The terrestrial component of the PGDP ecosystem includes the plants and animals that use the upland habitats for food, reproduction, and protection. Upland vegetative communities in the vicinity of PGDP consist primarily of grassland, forest, and thicket habitats with agricultural areas. The main crops grown in the PGDP area include soybeans, corn, tobacco, and sorghum.

Most of the area in the vicinity of PGDP has been cleared of vegetation at some time. PGDP mows much of the grassland habitat adjacent to the plant. The Kentucky Department of Fish and Wildlife Resources manages a large percentage of the adjacent WKWMA to promote native prairie vegetation by burning, mowing, and various other techniques.

Dominant overstory species of the forested areas include oaks, hickories, maples, elms, and sweetgum. Understory species include snowberry, poison ivy, trumpet creeper, Virginia creeper, and Solomon's seal. Thicket areas consist predominantly of maples, black locust, sumac, persimmon, and forest species in the sapling stage with herbaceous ground cover similar to that of the forest understory.

Wildlife commonly found in the PGDP area consists of species indigenous to open grassland, thicket, and forest habitats. Small mammal surveys conducted on WKWMA documented the presence of southern short-tailed shrew, prairie vole, house mouse, rice rat, and deer mouse (KSNPC 1991). Large mammals commonly present in the area include coyote, eastern cottontail, opossum, groundhog, whitetail deer, raccoon, and gray squirrel. Mist netting activities in the area have captured red bat, little brown bat, Indiana bat, northern long-eared bat, evening bat, and eastern pipistrelle (KSNPC 1991).

The typical birds of the area are European starling, cardinal, red-winged blackbird, mourning dove, bobwhite quail, turkey, killdeer, American robin, eastern meadowlark, eastern bluebird, bluejay, red-tail hawk, and great horned owl.

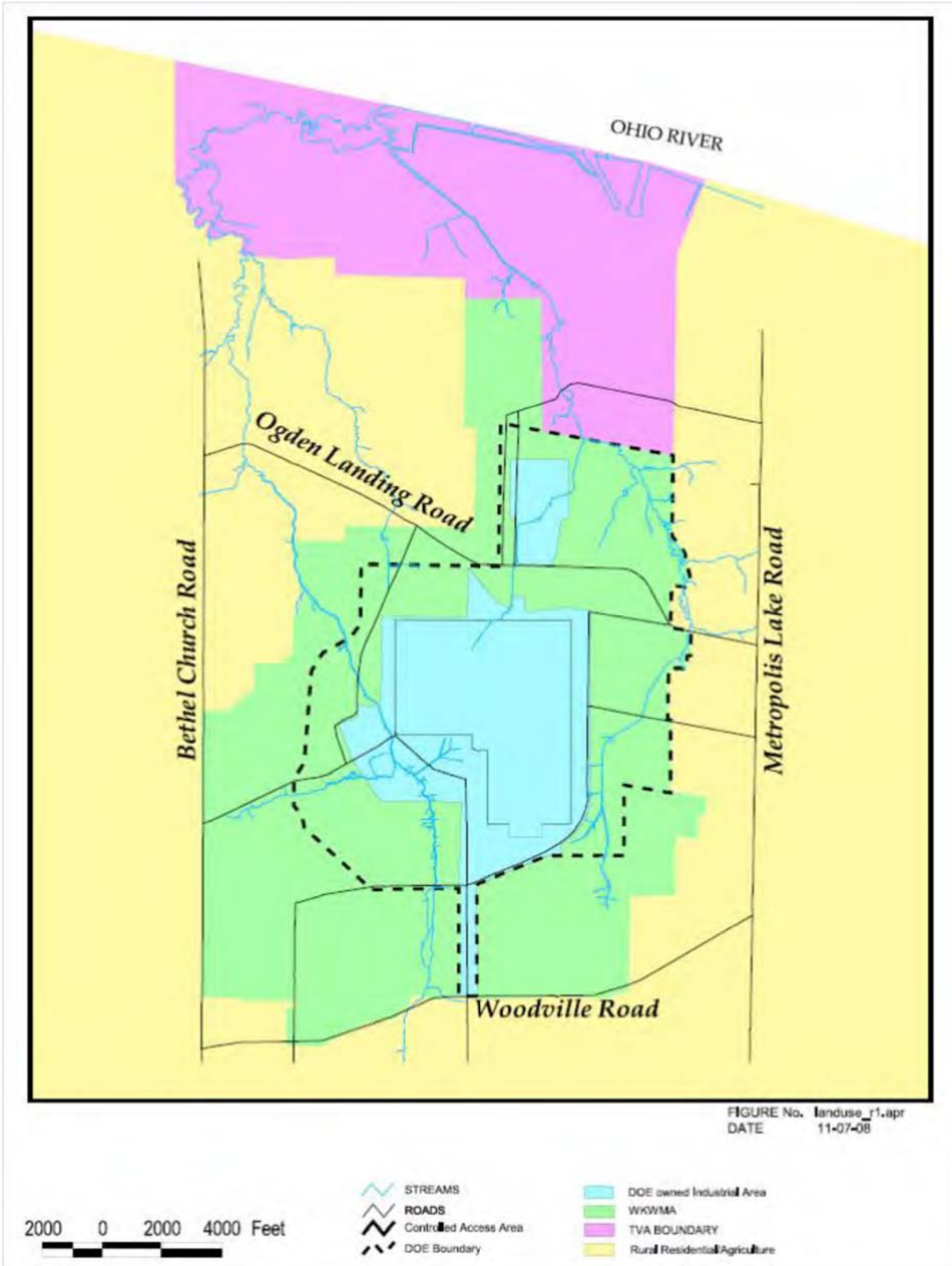

Figure 3.8. Current Land Use at PGDP

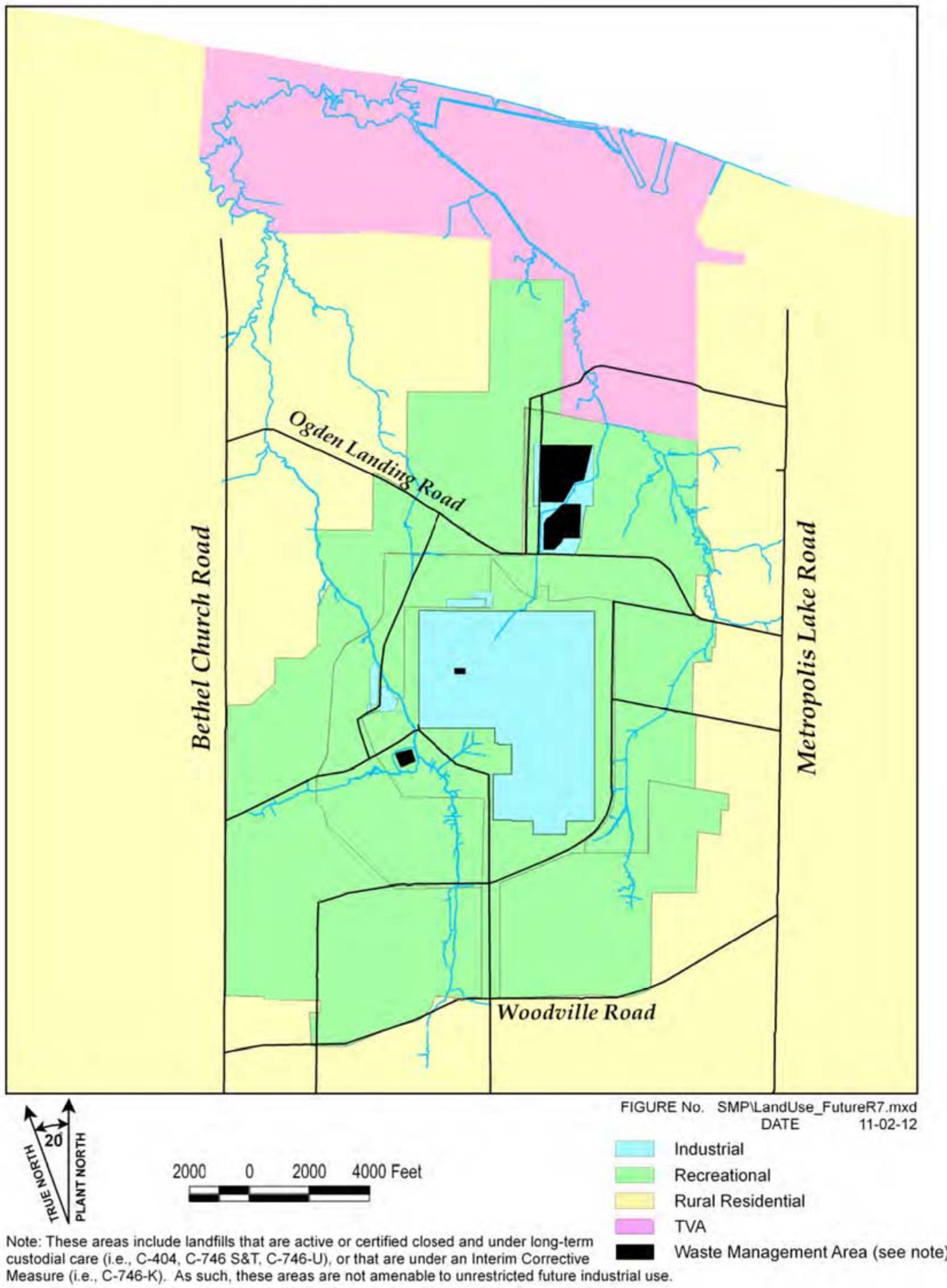

Figure 3.9. Reasonably Anticipated Future Land Use at PGDP

Amphibians and reptiles present in the PGDP area include cricket frog, Fowler's toad, common snapping turtle, green tree frog, chorus frog, southern leopard frog, eastern fence lizard, and red-eared slider (KSNPC 1991). Additionally, snakes, skinks, and salamanders have been observed in the PGDP area according to the Kentucky Department of Fish and Wildlife Resources (KDFWR 2015).

3.8.2 Aquatic Systems

The aquatic communities, which includes vertebrates and invertebrates, in and around the PGDP area that could be impacted by PGDP discharges are found in two perennial streams (Bayou Creek and Little Bayou Creek), the North-South Diversion Ditch (NSDD) (a former ditch for the discharge of plant effluents to Little Bayou Creek), a marsh located at the confluence of Bayou Creek and Little Bayou Creek, and other drainage areas. The dominant fish species found are several species of sunfish, especially bluegill and green sunfish, bass, and catfish. Shallow streams, characteristic of the two main area creeks, are commonly dominated by bluegill, green and longear sunfish, and stonerollers.

3.8.3 Wetlands and Floodplains

The wetlands of the PGDP vicinity include a swamp covering 165 acres immediately south of the confluence of Bayou and Little Bayou Creeks. A 1994 study of the PGDP area by the U.S. Corps of Engineers (COE) (1994) groups the area wetlands into 16 vegetative cover types encompassing forested, scrub/shrub, and emergent wetlands. Wetland vegetation consists of species such as sedges, rushes, spikerushes, and various other grasses and forbs in the emergent portions; red maple, sweet gum, oaks, and hickories in the forested portions; and black willow and various other saplings of forested species in the thicket portions. Wetlands inside the plant security fence are confined to portions of drainage ditches traversing the site (CDM Federal 1994).

At PGDP, three bodies of water cause most area flooding: the Ohio River, Bayou Creek, and Little Bayou Creek. The floodplain analysis performed by the COE found that much of the built-up portions of the plant lie outside the 100- and 500-year floodplains of these streams (COE 1994). In addition, this analysis determined that ditches within the plant area can contain the expected 100- and 500-year discharges. It should be noted that precipitation frequency estimates for the 100- and 500-year events were updated in 2004 in the NOAA Atlas 14 (NOAA 2004). In the updated report, the mean precipitation estimate for the 100-year, 24-hour event in Atlas 14 for the Paducah area is 10.1% to 15% greater than the mean estimate in previous publications. As stated in Atlas 14, in many cases, the mean precipitation estimate used previously still is within the confidence limits provided in Atlas 14; therefore, it is likely the plant ditches still will contain the 100- and 500-year discharges.

4. EVALUATION APPROACH

This project was scoped prior to GDP shutdown (see Section 1). As discussed in the SMP, prior to GDP shutdown, the Soils OU will focus on accessible plant surface soils (ground surface to 10 ft bgs and 16 ft bgs in the vicinity of pipelines) not associated with PGDP operations (DOE 2015a). This Soils OU RI 2 Report has been prepared to present findings from the investigation conducted to assess adequately the nature and extent of the release or threat of release of hazardous substances, pollutants, or contaminants or hazardous wastes and hazardous constituents and to gather necessary data to support the corresponding BRA and FS, and it is consistent with 40 *CFR* § 300.5 (EPA 1998), as planned by the Work Plan (DOE 2010a) and addendum (DOE 2014a). This report is a foundation to determine what actions, if any, are needed to address impacts in soils associated with the Soils OU RI 2 SWMUs/AOCs.

This report does the following:

- Provides a summary of the samples collected and analytical results by SWMU/AOC and COPC, including a summary of the sampling methodology;
- Screens the results against background and risk-based levels taken from the Risk Methods Document (DOE 2015b) and developed in the BHHRA (Appendix D) to identify COPCs and COCs that are present at the SWMU/AOC;
- Presents the results of a BHHRA, including selection of COCs and priority COCs for each SWMU/AOC, based upon consideration of uncertainties in risk characterization and observations on the risk evaluation;
- Presents the results of a SERA;
- Develops remedial goal options (RGOs) for scenarios evaluated in the BHHRA; and
- Compares the analytical results to the RGOs and presents a summary of those comparisons.

The information/data and analyses that form the basis of the decision process for the Soils OU RI 2 SWMUs/AOCs are documented in subsections of Chapter 5 of this RI 2. Given the large number of SWMUs/AOCs, this section highlights the information to be presented generally for each of these SWMU/AOC evaluations to address the goals of the RI. Of note is SWMU 56 that, due to its small size and location, has been evaluated as part of SWMU 80, and the evaluation has been summarized in the discussion on SWMU 80. Due to their proximity to one another, SWMU 225-A and SWMU 225-B were evaluated together.

4.1 PROJECT ACTION LIMITS

The XRF results for some of the metals from soil samples collected during the Soils OU RI 2 exceeded the PALs established in the Soils OU Work Plan (DOE 2010a) for determining step-outs/step-downs for the Soils OU RI 2 project. The PALs developed for the Soils OU RI were based on the NALs in the 2001 Risk Methods Document. Significant revisions to the methodology and values for calculating risk have occurred since that time, especially with respect to metals (e.g., dermal absorption factors and the withdrawal of cancer slope factors for beryllium and cadmium). Before implementing the step-outs/step-downs, the project team reevaluated the 2010 Work Plan PALs in order to ensure the PALs still were appropriate for this determination.

Three options for reevaluating the Soils OU RI 2 PALs were discussed among the FFA project teams on December 2, 8, and 9, 2014: (1) revise the existing PALs to be consistent with the documented rules set forth in the 2010 Work Plan;[3] (2) update PALs based on the 2014 Risk Methods Document (DOE 2014b); and (3) update PALs based on use of Kentucky Department for Environmental Protection (KDEP)-recommended dermal absorption values. The same guidelines used in the Soils OU RI Work Plan (e.g., greater of background and the lesser of the ELCR-based and the hazard index (HI)-based value) (DOE 2010a) were applied when determining the PALs from the 2014 Risk Methods Document and KDEP-recommended dermal absorption values.

To determine a path forward, the data obtained for Soils OU RI 2 were compared to the 2010 Work Plan PALs, 2014 Risk Methods Document, and 2014 KDEP-recommended dermal absorption values. The chemicals that exceeded the 2010 PALs are arsenic, copper, iron, lead, manganese, nickel, silver, uranium, vanadium, zinc, and PCBs. The chemicals that exceeded the 2014 Risk Methods Document PALs were arsenic, uranium, and PCBs. The chemicals that exceeded the 2014 PALs based on use of KDEP-recommended dermal absorption values were arsenic, chromium, manganese, vanadium, uranium, and PCBs.

The FFA project teams agreed that the same guidelines used in the Soils OU RI Work Plan (e.g., greater of background and the lesser of the ELCR-based and the HI-based value) would be applied when determining the PALs from the 2014 RMD and KDEP-recommended dermal absorption values. The FFA project teams further agreed that the use of the updated PALs based on use of KDEP-recommended dermal absorption values was appropriate for determining step-outs/step-downs for metals and PCBs. The FFA project teams further determined that vanadium and manganese should be excluded from the step-out/step-down determination for the following reasons:

- The maximum XRF results for these chemicals were below the PALs based on the 2014 Risk Methods Document (determined using EPA methodology);
- Some higher vanadium results were likely due to the interferences in XRF analysis;
- Vanadium results were within the range of background concentrations found in the U.S. (though above the PGDP background levels);
- Vanadium sources include historical and current oil and coal combustion—potentially related to general industrial activity and not PGDP releases;
- Vanadium is a component in many steels; thus, rusting steel may contribute to on-site vanadium levels;
- Both vanadium and manganese are used in steel corrosion control additives;
- Manganese results were within the range of U.S. background concentrations (though above the PGDP background levels);
- Manganese is a component of many steels; thus, rusting steel may contribute to on-site manganese levels;

[3] Table 9.2 of the 2010 Work Plan stated that the PAL would be the greater of background and the lesser of the ELCR-based and the HI-based value, unless unachievable by the quantitation limit (DOE 2010a). If unachievable, the project quantitation limit is used as the PAL.

- Manganese is a component of aluminum alloys, including beverage cans; thus, oxidized beverage cans can contribute to on-site manganese levels;

- Manganese sources include current and historical coal and gasoline combustion (a manganese compound is an octane booster); thus, general industrial activity may contribute to PGDP concentrations; and

- Higher manganese results may be due to nodules commonly present in soils.

4.2 DATA SETS

The data set for the Soils OU RI 2 consists of historical data collected at depths up to 16 ft bgs and data collected during the Soils OU RI and Soils OU RI 2. Use of historical and RI data is addressed in Appendix B. The historical data set includes the Soils OU analytical suite as defined in the work plan addendum (DOE 2014a); it was evaluated as described in the Work Plan (DOE 2010a). Any exceptions to the rules identified in the Work Plan have been noted in Appendix B (DOE 2010a).

Collectively, quality historical data and RI data are considered the representative data set and are sufficient for decision making associated with the Soils OU RI 2 SWMUs/AOCs evaluated in this report. In order to more comprehensively evaluate the data for the Soils OU RI 2 SWMUs/AOCs, plutonium-239 data were assessed as plutonium-239/240 and uranium-235/236 were assessed as uranium-235. Data summaries use Total PCBs, Total PAHs, and Total dioxins/furans; individual contributors are not included in the summaries (DOE 2015b).

During the RI, the data collected consisted of field laboratory (i.e., PCB test kits and metal analysis by XRF) and fixed-base laboratory data analyses. Data quality is described in Appendix B. Of note, the evaluation of the XRF data with fixed-base laboratory data indicates the use of XRF results for copper, iron, nickel, and zinc has good correlation and, therefore, is reliable for use in determining nature and extent and hot spots. Arsenic, chromium, molybdenum, mercury, selenium, silver, and uranium XRF results are generally below the reporting limits. While these results will not lead to incorrect decisions in the risk assessment, conversely, these results may not provide much useful information for nature and extent determination. For vanadium, comparison with the fixed-base laboratory data indicates risks derived from XRF data will be significantly overstated for detects. See Appendix B for additional information.

In general, because of differences in detection limits, XRF detections near or below the detection limits may incorrectly suggest the presence of the metal above background levels.

Uncertainty Analysis. Because of the scope of this RI, the conducted evaluations used the entire data set, default assumptions, and standard evaluations (e.g., screening using maximum values) that do not incorporate potentially-relevant differences among SWMUs/AOCs. This is appropriate for the RI; however, the use of this approach introduces an uncertainty because such an evaluation may overestimate the impacts associated with an individual SWMU/AOC. In developing alternatives in the FS, additional evaluation of data collected and compiled for this RI may be performed to address these uncertainties. Additional evaluation may include these steps or processes; some of these are discussed further in the Data Quality Analysis (Appendix B) and the BHHRA (Appendix D).

1. Incorporate future changes to site conditions.

2. Evaluate the data from a given SWMU/AOC against the full range of background (rather than the initial screening against site-specific background already conducted). This additional evaluation would seek to identify whether the presence of certain metals and radionuclides in the Soils OU SWMUs/AOCs is at levels consistent with or above background.

3. Reconsider the default assumptions used in the data treatment for a given SWMU/AOC to ensure that the FS considers the data and determines them to be representative of the SWMU/AOC conditions.

4. Evaluate individual constituent results to ensure that they should properly be considered as representative of the data set. These evaluations may include these steps or processes.

   - Review data associated with common laboratory contaminants [e.g., methylene chloride (EPA 1996)]. The concentrations in the Soils OU data set may be associated with laboratory contamination; therefore, before an action is taken to address the methylene chloride at a given SWMU/AOC, its presence in the SWMU/AOC may be reevaluated to determine whether these data are representative of the actual site conditions.

   - Reevaluate data to develop a set more representative of actual conditions. As noted, the RI typically conducted an initial screening using the maximum value. The FS may perform additional data evaluation to subdivide the SWMUs/AOCs to allow the remedial approach to treat sub-areas differently, should this evaluation warrant. For example, the FS could contemplate removal of hot spots that would then allow a reestimation of the data set to be representative of the residual conditions.

5. Adjust the default parameters to more accurately reflect the specific SWMU/AOC conditions. For example, the soil/water distribution coefficient (i.e., K_d) for Tc-99 is a very sensitive parameter used in groundwater modeling (DOE 2015b). The K_d (0.2 L/kg) for Tc-99 that was used in the modeling assumes the Tc-99 is in a form that will readily dissolve in water; however, the form of this constituent at a particular SWMU/AOC may not conform to this assumption. Should additional evaluation identify that the K_d for a given constituent for a SWMU/AOC is not appropriate, the value may be adjusted and the modeling reperformed, with agreement among the FFA parties during scoping that additional modeling is warranted to support the FS remedy evaluation.

4.3 GAMMA WALKOVER SURVEY

Gamma walkover surveys (GWSs) were completed as part of this RI to indicate levels of high activity to support the collection of judgmental radiological samples for fixed-base laboratory analysis to be used to better understand the nature of contamination (DOE 2010a). Results of GWS for many SWMUs and AOCs were found not to match up well with results from samples sent for fixed-base laboratory analyses. There are two primary contributing factors for this lack of correlation between the results of GWS and analyses of samples sent to the fixed-base laboratory:

- *A priori* calculations of detector response and scanning MDC were performed in accordance with Multi-Agency Radiological Survey and Site Investigation Manual (MARSSIM), as approved by Nuclear Regulatory Commission, DOE, and EPA. Guidance and examples contained within MARSSIM and supporting documents (such as NUREG 1507) provide the equations and parameters for determining scanning MDC and derivation of a net cpm value correlating to a specific soil concentration in pCi/g. These calculations are performed using default parameters that describe an area 56 cm in diameter uniformly contaminated down to 15 cm bgs. If the contaminated area is larger or smaller than the area used in the calculations or the contamination is not uniform, then different results in net cpm correlate to varying activity concentrations. For example, using the default parameters, a 10,800 net cpm is equivalent to an activity concentration of uranium-238 and short-lived decay products of 171 pCi/g of soil. If the contaminated area is really 100 cm in diameter, then the same reading of 10,800 cpm is equivalent to an activity concentration of uranium-238 and short-lived decay products of 25 pCi/g of soil.

- The GWS net cpm result and the fixed-base laboratory sampling result represent contamination present in different parts of the soil column. The GWS net cpm result is representative of contamination found on or near the soil surface. The sample collected for fixed-based laboratory analysis, however, is representative of contamination that extends from the soil surface to a depth of 6 inches after the vegetative layer is removed, if necessary.

Some other contributing factors that may lead to a lack of correlation between the results of GWS and analyses of samples sent to the fixed-base laboratory include inaccurate positional data, heterogeneous distribution of radionuclides in soil, and geometric variation in source/detector distance due to probe movement.

GWS were being performed concurrently with the Sitewide Evaluation walkovers and the same detectors were used for both projects. During the review of the initial gamma radiological walkover survey data for Sitewide Evaluation location, PS-26-02-V-1, unusually high count rates were observed in the data set for detector 262330. Multiple resurveys of the area with the unusually high count rate measurements were performed in the field to determine the validity of the measurements. These resurveys did not reproduce the original elevated measurements. A review of daily performance check and QC survey data did not reveal any issues with detector 262330. Upon further investigation, it was determined that the detector window of detector 262330 was punctured, which allowed light to impinge upon the detector resulting in elevated count rates measurements. The puncture was limited to a very small area of the detector window behind the protective screen. As a result of the puncture in the window, elevated count rate measurements were observed only when the detector was used in direct sun. The detector window was repaired and placed back into service.

A review of other data generated by detector 262330 was performed to determine if unusually high count rate measurements were observed at other survey areas. If elevated count rates were observed, resurveys were performed to verify the count rate measurements. If the count rate measurements could not be confirmed, the original data generated by detector 262330 were considered suspect, and the area was resurveyed. Based on resurveys, the unusually high count rate measurements were confirmed to be suspect; therefore, these were not used in the inflection point analysis to select a sample location.

4.4 NATURE AND EXTENT

The Soils OU RI 2 SWMU/AOC evaluations focus first on summarizing the representative analytical results for surface and subsurface soils. The process for highlighting chemicals of greatest potential interest was done consistent with the Work Plan (DOE 2010a) considering the following:

- Background concentrations

- Action levels (ALs) and NALs (future industrial worker inside the Limited Area, teen recreator outside the Limited Area)

- Groundwater protection site-specific soil screening levels (SSLs) for the UCRS and RGA [dilution attenuation factors (DAFs) of 1 and 58 for the UCRS and RGA, respectively, based on maximum contaminant levels (MCLs), where available] (see Appendix C)

The values used for highlighting the contaminants of greatest potential interest (denoted as COPCs in Nature and Extent sections) are consistent with the Risk Methods Document (DOE 2015b) and are included in Appendix D for the chemicals evaluated for this RI. The SSLs protective of groundwater for the RGA screening are discussed further in Section 4.4 and Appendix C.

4.5 FATE AND TRANSPORT

Potential migration of surface and subsurface contamination may occur via leaching to groundwater and subsequent transport or runoff of surface contamination to adjacent drainageways. SWMUs that are adjacent to drainageways are identified, and where COPCs are identified in surface soils, this pathway is considered complete, but only qualitatively evaluated. Internal plant ditches are grass-lined and the outfall ditches are grass-lined or otherwise stabilized; therefore, the contaminants are not likely to be transported attached to suspended soil particles within the ditches and outfalls (DOE 2008b).

The surface water pathway is not considered a likely off-site exposure route from Soils OU RI 2 source areas. Surface water at the site is controlled by a series of ditches and outfalls. Surface water flow in the ditches is intermittent and not consistently available for human contact; therefore, risk was not calculated for future contaminants in surface water. Additionally, the intermittent flow limits the ecological receptors that are present in the ditches.

The SI/BRA for the SWOU (DOE 2008b) presented the following for the outfalls and the associated internal ditches. Of the 54 contingency samples collected from internal ditches and areas associated with outfalls 001, 008, 010 and 015, seven showed uranium-238 and/or cesium-137 activity exceeding indicator levels. Six contingency samples and one duplicate sample showed elevated PCB concentrations in the outfalls. This was most notable in Outfall 010, EU 10, where all five of the contingency samples contained Total PCB concentrations in excess of 100 mg/kg each. This indicates that there is a potential source uncertainty to manage considering impacts to ditches bordering the Soils OU SWMUs.

Based upon the modeling performed as part of the SWOU EE/CA for the outfalls and the associated internal ditches, no contaminants are migrating in surface water (dissolved or through sediment) from ditches to surrounding creeks at concentrations that may adversely impact human health (DOE 2008a).

A removal action for the contaminated sediment associated with SWOU (On-Site) (DOE 2011a) was conducted for Outfalls 001, 008, 010, 011, and 015 and associated internal ditches. A final response action for internal ditches, outfalls, and creeks will be addressed by the SWOU, as described in the SMP (DOE 2015a).

Only the northwest corner of PGDP (e.g., SWMU 13 and SWMU 15) provides an exception. The Northwest Corner Scrap Yard area is controlled under an interim corrective measure. Drainage ditches around SWMU 13 and SWMU 15 are routed to the C-613 Sedimentation Basin before discharging into Outfall 001.

A primary migration pathway of concern for contaminants in soil is the potential for these to pose an ongoing source of contamination to RGA groundwater and subsequent migration to off-site areas. In Chapter 5 of this RI, the nature and extent evaluation highlights detected contaminants exceeding the SSL for one or more of the samples. The SSL for the RGA screening is derived using the project-specific DAF of 58 and the SSL for the UCRS screening was derived using the project-specific DAF of 1, as presented in Appendix C, Attachment C2 of the Soils OU RI Report (DOE 2013).

This process conservatively identifies chemicals that should be considered further for potential impacts to the RGA and downgradient receptors. The screening process is supplemented with a review of related information to ensure that concentrations that may be below background levels or of constituents that do not pose a threat to the RGA at PGDP and/or are infrequently detected/exceeded are not evaluated further. Therefore, a process to refine this list and identify chemicals for more detailed modeling was established in Appendix C, Attachment C1 of the Soils OU RI Report (DOE 2013) and is presented with updated information in Appendix C, Attachment C1 of this document.

4.5.1 Process for Developing Target Soil Constituents for Modeling

The overall modeling process as detailed in Appendix C includes the following:

- Screen historical and RI analytical results from the Soils OU against the SSLs protective of groundwater to identify soil constituents that might impact groundwater;

- Review of the site-related soil constituents that are not screened from further modeling to identify which SWMU/AOC soil constituent combinations to subject to more detailed modeling;

- Identify certain process-related soil constituents for detailed modeling even though they were not detected above SSLs for groundwater protection to ensure appropriate DAF was used;

- Identify hotspots by evaluating the distribution of soil contaminants across SWMUs/AOCs using three-dimensional modeling software;

- Evaluate transport to the RGA using Seasonal Soil Compartment Model (SESOIL) for soil constituents selected for detail modeling; and

- Estimate the concentrations of soil constituents in RGA groundwater at the SWMU/AOC boundary using Analytical Transient 1-,2-,3-Dimensional (AT123D).

It was clear when reviewing these screening results on an OU-wide basis, that many of these chemicals were not indicative of potential threats to groundwater based on the data patterns, background, and results of groundwater monitoring. Many of the SSLs are at concentrations consistent with background for many naturally occurring chemicals, a factor that was considered further in the modeling process. Because of these issues, the list of chemicals was refined to define more accurately those with potential concern for impacts to the RGA.

For example, VOC concentrations at levels below that which would pose a risk to the RGA groundwater (e.g., TCE at SWMU 211-A at 0.079 mg/kg) still may have the potential to impact a limited volume of UCRS water or soil vapors that hypothetically would pose a low risk under a future residential scenario where contact with UCRS water or soil vapors could occur (as in a basement for a residence built into SWMU 211-A). Soils OU RI 2 SWMUs/AOCs that have detectable levels of VOCs that are not considered to pose a threat to RGA groundwater include SWMUs/AOCs 15, 26, 204, and 211-A.

This RI developed information to support the FS evaluation of a range of remedial alternatives selected for a given SWMU/AOC that addresses potentially complete exposure pathways and manages the risks/uncertainties identified in this RI.

Initial screening of the maximum detected value of constituents from each SWMU/AOC included determining how many of the results from that SWMU/AOC had a detected value greater than the SSL or the greater of the surface and subsurface background value.

Additional evaluation was conducted to identify which groundwater SWMU/AOC soil constituent combinations were actually subjected to groundwater modeling. The additional evaluation included a comparison of the overall average value of the constituent (calculated using both detected values and nondetected values at one-half the detection limit) with the screening values described above. If the overall average value of the constituent for the SWMU/AOC was below the background value or the SSL, then the constituent was not further considered for modeling for fate and transport. If the average value was above both the background value and the SSL, then the constituent was reviewed further to identify whether modeling would be performed.

Further, to determine if hot spots existed within a SWMU/AOC, for those SWMUs/AOCs not already being modeled, the detected results of those constituents exceeding either the SSL or background value were visually examined and evaluated, [e.g., consideration of GWOU FS (DOE 2001c) and three-dimensional modeling software (see Appendix C)].

Based on the screening discussed in Appendix C, modeling was completed for the soil constituents as listed in Table 4.1.

Table 4.1. SWMUs/AOCs and Associated Soil Constituents Subjected to Modeling

SWMU/AOC	Soil Constituent
13	Tc-99
15	Tc-99
26	Tc-99

At SWMU 26, uranium-234 was detected at an activity concentration greater than both the background value and SSL. However, the mass concentration of uranium assumed to be present based upon the assumption that the uranium isotopes were present at natural abundance would be 79 mg/kg. At 79 mg/kg, the average concentration is less than the average uranium concentration at SWMU 81 (2,502 mg/kg) that modeling in the Soils OU RI Report (DOE 2013) found not to migrate to the RGA within 1,000 years. Based on this, uranium was not modeled at SWMUs 15, 26, 56/80, or 211-A.

Nickel exceeded both the background value and the SSL at SWMU 26 and exhibited clustering when the results were viewed in 3-dimensions; however, the average concentration of nickel (156 mg/kg) was less than the average concentration for SWMU 14 (401 mg/kg in the 0-5 ft soils), which was modeled in the Soils OU RI Report (DOE 2013) where the results of the modeling showed that nickel did not reach the RGA groundwater in the 1,000-year SESOIL modeling period. Based on this, nickel was not modeled at SWMU 26.

4.5.2 Data Interpretation and Results for Target Groundwater Modeling Soil Constituents

Chemicals subjected to detailed modeling underwent SESOIL and AT123D modeling evaluation to further refine the estimates of RGA groundwater concentrations at the SWMU/AOC boundary (Appendix C).

4.6 RISK ASSESSMENT

Grid sampling for the Soils OU RI 2 was set up primarily on 45-ft centers with compositing of five grab samples within each grid for two horizons: surface and subsurface. Coordinates for these samples were recorded as the center of the grid, as the composite sampling was designed to be representative of the grid. The grid sampling yielded approximately 10 samples per horizon per half acre, on average. [One-half acre is significant because it typically is used as the size of an exposure unit (EU) for risk assessment purposes (DOE 2015b).]

Step-out contingency locations were included in the EU to which the contingency grid is adjacent. As described in the Work Plan (DOE 2010a), step-out contingency grids were sampled if contamination was found in a grid at the boundary of a SWMU/AOC when field data results exceeded the PAL (see Table 2.2). Up to two contingency grids were sampled past the SWMU/AOC boundary unless an anthropogenic feature (e.g., ditch, road, building, or another SWMU/AOC) was reached. All of these samples obtained field analytical data for metals and PCBs. Additionally, fixed-base analytical data were obtained for each horizon for each unit for metals and PCBs, as well as radionuclides and semivolatile organic compounds (SVOCs). Samples from which fixed-base analytical data were obtained were selected randomly among the samples on each horizon (i.e., the surface grid sample and the subsurface grid sample submitted for fixed-base laboratory analysis may not be from the same grid location).

Acceptable historical data, as determined by the data quality analysis, were assigned to an appropriate grid before beginning the data analysis described here. Historical data located outside the SWMU/AOC boundary and outside the boundary of a step-out contingency grid were not considered representative of the SWMU/AOC.

The representative sampling design for the Soils OU RI 2 SWMUs/AOCs was gridding. In some instances (such as SWMUs/AOCs not grid sampled), when a grid was applied to the SWMUs/AOCs, empty cells resulted. In order to fill an empty cell, the average value of similar cells was considered the most appropriate value. For this RI, similar cells were defined as those within the same EU.

For each grid, a detect or nondetect flag was assigned for each analyte using field laboratory data, fixed-base laboratory data, and/or historical data. For purposes of assigning flags, historical data were included with fixed-base laboratory results or field laboratory results, whichever is applicable. A nondetect flag was set only if both field laboratory results and fixed-base results are nondetect or not available. Flags were assigned according to the following rules as specified in the work plan (DOE 2010a):

(1) If field laboratory result is a nondetect and a fixed-base laboratory sample was not collected and an acceptable historical result is not available for the grid, then the grid is assigned a nondetect flag.

(2) If the field laboratory result is a nondetect and a fixed-base laboratory sample was collected or an acceptable historical result is available, then the fixed-base laboratory or historical result is used in assigning flag.

    (a) If the fixed-base laboratory result is a nondetect, then the grid is assigned a nondetect flag.
    (b) If the fixed-base laboratory result is a detect, then the grid is assigned a detect flag.

(3) If the field laboratory result is a detect and a fixed-base laboratory sample was not collected and no acceptable historical result is available for the grid, then the grid is assigned a detect flag.

(4) If the field laboratory result is a detect and a fixed-base laboratory sample was collected or an acceptable historical result is available, then

(a) If the fixed-base laboratory result is a nondetect, then the grid is assigned a detect flag.
(b) If the fixed-base laboratory result is a detect, then the grid is assigned a detect flag.

For each grid, a concentration for each analyte was assigned.

(1) If the analyte has a nondetect flag for the grid, then the concentration was set as the lower of field laboratory and fixed-base laboratory detection limit.

(2) If the analyte has a detect flag, then the concentration was set as the maximum detected value across field laboratory and fixed-base laboratory results.

These rules are in the flowchart depicted in Figure 4.1.

Background values (see Appendix D) were compared on an EU basis by examining the results across all the grids within the EU. Nondetect results were not considered present above background even if the detection limit for the chemical was greater than the background value; a discussion of the uncertainty associated with this approach is presented in Appendix D, Attachment D7. The magnitude of this uncertainty was determined to be small. If an analyte was detected in one or more grids within the EU, then the maximum detected value across all grids within the EU was used for background comparison. (If the maximum detected value was greater than background, then the analyte is considered to be present above background. If the maximum detected value was less than background, then the analyte is not considered to be present above background.) The maximum radiological value across all the grids within the EU was used for background comparison.

COPCs were selected for each EU for those analytes that were detected above background and where the maximum detected value is greater than the no action level [as defined in the Risk Methods Document (DOE 2015b) for the hypothetical child residential scenario[4], see Appendix D]. As described in the Work Plan (DOE 2010a), for those analytes that were never detected within an EU, even if the detection limit is greater than the NAL, the analyte was not considered a COPC (DOE 2010a). With the large number of samples required for the gridded sampling approach, the majority of the samples were analyzed using field analytical instruments. Though the quantitation limits are higher for these instruments, the increased coverage of each unit decreases the uncertainty of the analytical precision. Trace analytes may not be determined throughout the unit, but major constituents are thus, less likely to be missed. Fixed-base laboratory detection limits that are higher than no action levels were addressed as an uncertainty in the baseline human health risk assessment.

Exposure point calculations were performed for each EU for those analytes that were retained as COPCs. For each COPC, data were summarized within each sampling location (i.e., within each grid) before calculating the exposure point concentration (EPC) for the EU. This was necessary to ensure that each location was equally represented in the EU EPC calculation. The scenarios shown in Figure 4.2 illustrate

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[4] In the Risk Methods Document, the child resident scenario NAL is the lesser of the hazard-based value for a child age 1 to 6 and the lifetime excess cancer risk-based value for the resident. The hazard target used in the calculation is 0.1, and the excess cancer risk target used in the calculation is 1×10^{-6}. Consistent with the Work Plan (DOE 2010a), the project action limits in the Quality Assurance Project Plan were set to the child resident scenario NAL from the Risk Methods Document (DOE 2001).

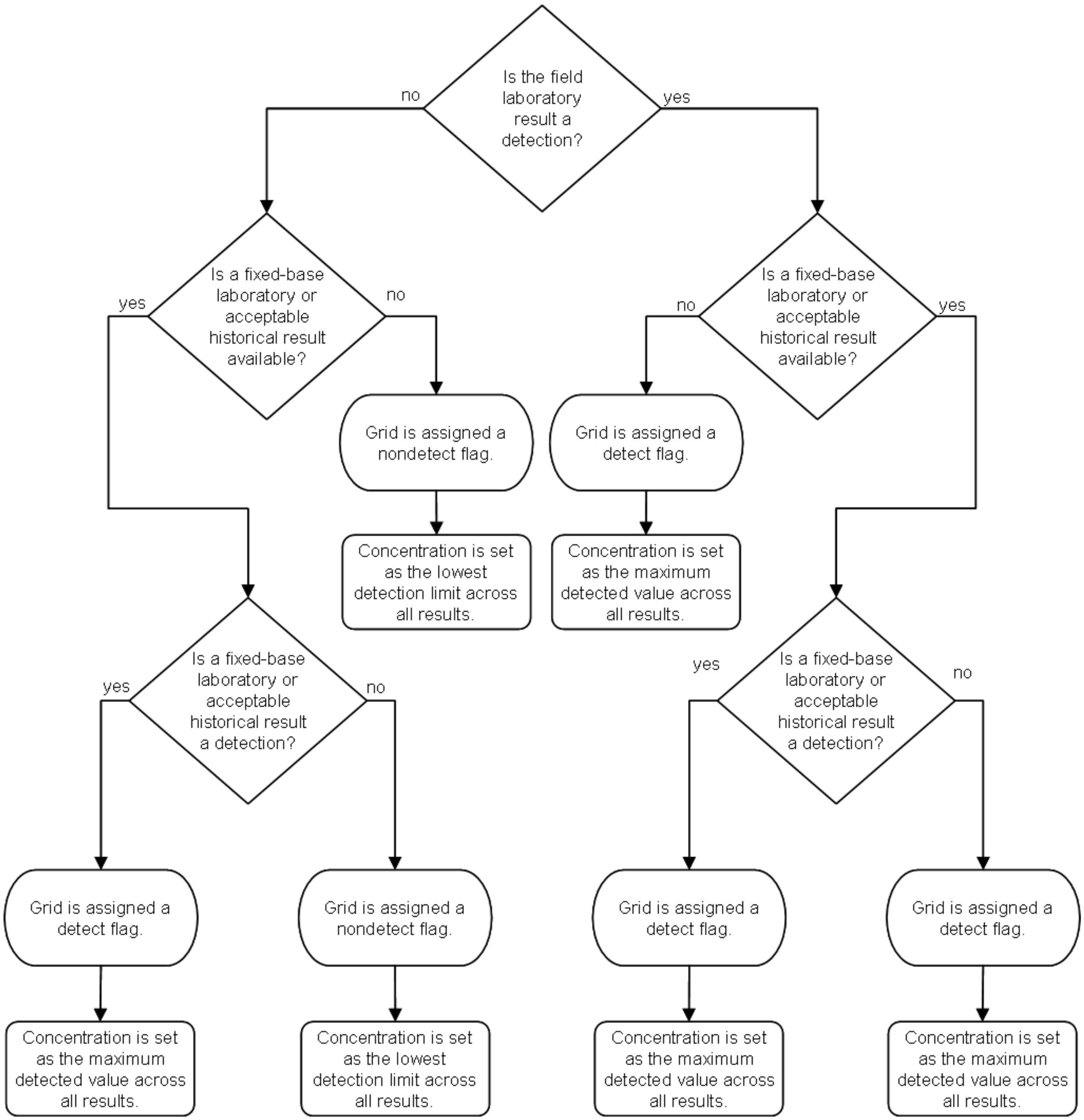

Figure taken from DOE 2010a.

Figure 4.1. Flowchart Depicting Application of Detect and Nondetect Flags

each possible case that may have resulted from implementation of the field sampling strategy for this RI and its response.

Further, in Case 1, shown in Figure 4.2, the COPC consists of all detected results, so the EPC was calculated using, as the grid result, the maximum detected value within the grid.

	RESULTS	**TO REPRESENT GRID ANALYTE CONCENTRATION**
Case 1: *Field laboratory results, Fixed-base laboratory results, No historical results*	Field laboratory: detect Fixed-base laboratory: nondetect	Use the field laboratory result
	Field laboratory: nondetect Fixed-base laboratory: detect	Use the fixed-base laboratory result
	Field laboratory: detect Fixed-base laboratory: detect	Use the maximum detected result
	Field laboratory: nondetect Fixed-base laboratory: nondetect	Use the smaller detection limit
Case 2: *Field laboratory results, No fixed-base laboratory results, No historical results*	Field laboratory: detect	Use the field laboratory result
	Field laboratory: nondetect	Use the field laboratory detection limit
Case 3: *Field laboratory results, No fixed-base laboratory results, Historical results*	Field laboratory: detect Historical: nondetect	Use the field laboratory result
	Field laboratory: nondetect Historical: detect	Use the historical result
	Field laboratory: detect Historical: detect	Use the maximum detected result
	Field laboratory: nondetect Historical: nondetect	Use the smaller detection limit
Case 4: *Field laboratory results, Fixed-base laboratory results, Historical results*	Field laboratory: detect Fixed-base laboratory: nondetect Historical: nondetect	Use the field laboratory result
	Field laboratory: nondetect Fixed-base laboratory: detect Historical: nondetect	Use the fixed-base laboratory result
	Field laboratory: nondetect Fixed-base laboratory: nondetect Historical: detect	Use the historical result and consider any uncertainties regarding historical data during project nature and extent scoping
	Field laboratory: detect Fixed-base laboratory: detect Historical: nondetect	Use the maximum detected result
	Field laboratory: detect Fixed-base laboratory: nondetect Historical: detect	Use the maximum detected result
	Field laboratory: nondetect Fixed-base laboratory: detect Historical: detect	Use the maximum detected result
	Field laboratory: detect Fixed-base laboratory: detect Historical: detect	Use the maximum detected result
	Field laboratory: nondetect Fixed-base laboratory: nondetect Historical: nondetect	Use the smallest detection limit

Figure taken from DOE 2010a.

Figure 4.2. Exposure Point Concentration Calculation Scenarios

In Case 2, only detect and nondetect field results are available for grids. In this case, the EPC for the EU is calculated using the maximum detected field result for grids with detected results and the field detection limit for grids without a detected result.

In Case 3, data are a combination of historical and field results. In this case, maximum field detect result is used for the grid value if all historical results are nondetects; the maximum historical detect result is used for the grid value if all field results are nondetects; the largest detected value is used as the grid result if all field and historical results are detects, and, the smallest detection limit is used for the grid result if all field and historical results are nondetects. [It should be noted, discarding nondetect results that are greater than the maximum detected result in this manner, if they do not significantly influence the outcome, is consistent with EPA Risk Assessment Guidance for Superfund (RAGS) (EPA 1989).]

In Case 4, data are a combination of historical, fixed-base laboratory, and field results. In this case, maximum field detect result is used for the grid value if all historical results and fixed-base results are nondetects; the maximum fixed-base detect result is used for the grid value if all field results and historical results are nondetects; the maximum historical detect result is used for the grid value if all field results and fixed-base results are nondetects; the largest detected value is used as the grid result if a combination of field, fixed-base, and historical results are detects; and the smallest detection limit is used for the grid result if all field, fixed-base, and historical results are nondetects. [This methodology is consistent with RAGS (EPA 1989).] A calculation was completed to determine the importance of the anomalous situation where the nondetect result exceeds the maximum detected value within a data set being analyzed. If the nondetect value that exceeds the maximum detected result would cause the EPC to exceed the maximum detected result, then it would be discarded from the data set.

Analytical results from radiological judgmental sampling and pipeline sampling were included with other fixed-base laboratory results when assigning grid values with the grid sampling previously described.

After the data set was built for each analyte within the EU, the rules for EPC calculation were as follows:

(1) If results from fewer than ten grids are available, then the EU EPC was the maximum detected concentration across all grids within the EU.

(2) If results from ten or more grids are available, then a distribution check will be performed, and the EU EPC will be the value recommended by EPA's ProUCL software noted as the "Potential UCL to Use." ProUCL incorporates a number of different distributional tests that may be used to perform the distributional tests and calculate the most appropriate UCL (EPA 2013). Consistent with the Risk Methods Document, the most recent version of ProUCL (Version 5.0) was used for calculating the EPCs for the Soils OU RI 2 (DOE 2015b). An exception to this is if not all the grids contained a value for an analyte. In this instance, the average of the grid values present was assigned to the grids with no value before the EU EPC was calculated.

The BHHRA characterized cancer risks and noncancer hazards by EU for each Soils OU RI 2 SWMU/AOC for all COPCs for the following scenarios:

- Current Industrial Worker[5]
- Future Industrial Worker (see footnote 5)

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[5] The "future industrial worker" reflects default assumptions (i.e., 250 days/year for 25 years). A "current industrial worker" scenario has been added to the default scenario to be more reflective of current site conditions and practices with a lower exposure frequency (i.e., 14 days/years for 25 years).

- Outdoor Worker
- Excavation Worker
- Recreational User
- Future Hypothetical Rural Resident

Likely scenarios for the Soils OU RI 2 SWMUs/AOCs are discussed in Chapter 5 and include that of the future industrial worker for SWMUs/AOCs inside the Limited Area and teen recreator for SWMUs/AOCs outside the Limited Area. Additionally, a hypothetical residential scenario, and an excavation worker scenario were assessed for all SWMUs/AOCs.

Analytical results from judgmental radiological sampling, pipeline sampling, and historical sampling were included with other fixed-base laboratory results when assigning grid values as previously described.

4.6.1 Human Health

A detailed approach to the risk assessment and the supporting information and tables is provided in Appendix D. For each of the SWMU/AOC summaries, tables are provided with the risk estimates for the various receptors, the COCs, and the primary routes of exposure that are driving these results.

The receptors evaluated and the exposure parameters used to develop risk estimates are in Table 4.2. The following highlighted components of the risk assessment are included in the SWMU/AOC summaries as appropriate.

Direct Contact Exposures. This includes incidental ingestion, inhalation, dermal absorption, and external exposure to ionizing radiation routes of exposure. This may include contact with contamination currently at the surface or to contaminants in the entire soil column in the future during earthwork.

- **Surface soil (0–1 ft) impacts are evaluated with a range of exposure scenarios.** Because of the sizes of the EUs and limited activities in these areas, current worker exposures are estimated based on a more representative frequency (14 days/year); however, the future worker scenario includes default assumptions (250 days/year). A future hypothetical resident, a recreational user, and outdoor worker scenarios also were evaluated.

- **Surface/subsurface soils.** Bounding the potential contact issues with contaminants that may be present in soils from 0–16 ft requires scenarios either for temporary exposures during excavation or longer term exposures if the soil column were mixed during future activities and, subsequently, a receptor may be in contact with this average concentration for a longer duration. The surface/subsurface soils were evaluated using the outdoor worker assumptions [185 days/year for 25 years as per the Risk Methods Document (DOE 2015b)]. The intake parameters for the excavation worker are the same as the outdoor worker with the exception of exposure duration. Exposure duration was shortened to 5 years for the excavation worker.

Surface Water. Although some Soils OU RI 2 SWMUs/AOCs are located near drainageways, significant surface water contamination is not expected as a result of these SWMUs/AOCs (UK 2007). Internal plant ditches are grass-lined and the outfalls are grass-lined or otherwise stabilized; therefore, the contaminants are not likely to be transported attached to suspended soil particles within the ditches and outfalls (DOE 2008b). Further, due to the physical cover at the SWMUs limiting the potential for particulate transport through sheet flow and based upon the modeling performed as part of the SI report for the outfalls and the associated internal ditches, no contaminants are migrating in surface water (dissolved or

Table 4.2. Exposure Factors Used for Intake Calculations in BHHRA[a]

Pathway Variable	Units	Current Industrial Worker[b]	Future Industrial Worker	Outdoor Worker	Excavation Worker	Adult Resident	Child Resident	Adult Recreational User	Teen Recreational User	Child Recreational User
Exposure frequency	days/year	14	250	185	185	350	350	104	140	140
Exposure duration	years	25	25	25	5	20	6	10	10	6
Body weight	kg	80	80	80	80	80	15	80	43	15
Averaging time—cancer	days	70 × 365	70 × 365	70 × 365	70 × 365	70 × 365	70 × 365	70 × 365	70 × 365	70 × 365
Averaging time—noncancer	days	365 × 25	365 × 25	365 × 25	365 × 5	365 × 20	365 × 6	365 × 10	365 × 10	365 × 6
Incidental Ingestion of Soil/Sediment										
Incidental ingestion rate	mg/day	50	50	480	480	100	200	100	100	200
Fraction ingested		1	1	1	1	1	1	1	1	1
Dermal Contact with Soil/Sediment										
Body surface area exposed	m^2/day	0.347	0.347	0.347	0.347	0.6032	0.269	0.6032	0.75	0.269
Soil-to-skin adherence factor	mg/cm^2–day	1	1	1	1	1	1	1	1	1
Inhalation of Vapors and Particulates Emitted from Soil/Sediment										
Total inhalation rate	m^3/hour	2.5	2.5	2.5	2.5	0.833	0.833	2.5	2.5	2.5
Exposure time	hours/day	8	8	8	8	24	24	5	5	5
Particulate emission factor	m^3/kg	6.20E+08	6.20E+08	6.20E+08	6.20E+08	9.30E+08	9.30E+08	9.30E+08	9.30E+08	9.30E+08
External Exposure to Ionizing Radiation from Soil/Sediment										
Exposure frequency	day/day	14/365	250/365	185/365	185/365	350/365	350/365	104/365	140/365	140/365
Gamma shielding factor	unitless	0.2	0.2	0.2	0.2	0.2	0.2	0	0	0
Gamma exposure time factor	hr/hr	8/24	8/24	8/24	8/24	18/24	18/24	5/24	5/24	5/24
Ingestion of Groundwater										
Drinking water ingestion rate	L/day	N/A	N/A	N/A	N/A	2.5	0.78	N/A	N/A	N/A
Dermal Contact with RGA Groundwater (showering)										
Body surface area exposed	m^2	N/A	N/A	N/A	N/A	2.09	0.6378	N/A	N/A	N/A
Event time	hour/event	N/A	N/A	N/A	N/A	0.71	0.71	N/A	N/A	N/A
Event frequency	events/day	N/A	N/A	N/A	N/A	1	1	N/A	N/A	N/A

Table 4.2. Exposure Factors Used for Intake Calculations in BHHRA[a] (Continued)

Pathway Variable	Units	Current Industrial Worker	Future Industrial Worker	Outdoor Worker	Excavation Worker	Adult Resident	Child Resident	Adult Recreational User	Teen Recreational User	Child Recreational User
Inhalation RGA Groundwater										
Indoor inhalation rate	m^3/hour	N/A	N/A	N/A	N/A	0.833	0.833	N/A	N/A	N/A
Exposure time in the shower	hours/day	N/A	N/A	N/A	N/A	0.71	0.71	N/A	N/A	N/A
Time of shower	hour	N/A	N/A	N/A	N/A	0.1	0.1	N/A	N/A	N/A
Time after shower	hour	N/A	N/A	N/A	N/A	0.1	0.1	N/A	N/A	N/A
Fraction volatilized while showering	unitless	N/A	N/A	N/A	N/A	0.75	0.75	N/A	N/A	N/A
Water flow rate	L/h	N/A	N/A	N/A	N/A	890	890	N/A	N/A	N/A
Bathroom volume	m^3	N/A	N/A	N/A	N/A	11	11	N/A	N/A	N/A
Averaging time—cancer	hours	N/A	N/A	N/A	N/A	24 × 70 × 365	24 × 70 × 365	N/A	N/A	N/A
Averaging time—noncancer	hours	N/A	N/A	N/A	N/A	24 × 365 × 20	24 × 365 × 6	N/A	N/A	N/A
Exposure time household use	hours/day	N/A	N/A	N/A	N/A	24	24	N/A	N/A	N/A
Exchange rate	changes/day	N/A	N/A	N/A	N/A	10	10	N/A	N/A	N/A
Mixing coefficient	unitless	N/A	N/A	N/A	N/A	0.5	0.5	N/A	N/A	N/A
Fraction volatilized household use	unitless	N/A	N/A	N/A	N/A	0.5	0.5	N/A	N/A	N/A
Water flow rate	L/day	N/A	N/A	N/A	N/A	890	890	N/A	N/A	N/A
House volume	m^3	N/A	N/A	N/A	N/A	450	450	N/A	N/A	N/A

Notes:
[a] Information compiled September 2014, See DOE 2015b, *Methods for Conducting Risk Assessment and Risk Evaluation at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky, Volume 1. Human Health*, DOE/LX/07-0107&D2/R6/V1, July.
[b] Best professional judgment; similar to value used for DOE 2008b.

through sediment) from ditches to surrounding creeks at concentrations that may adversely impact human health (DOE 2008a). The uncertainty in surface water transport of contaminants will be managed in the FS**.** As a result, human health risks associated with exposure to surface water will not be assessed in the BHHRA (Appendix D).

Groundwater. Ingestion of groundwater is evaluated only for hypothetical future residential scenarios at the one SWMU identified in the fate and transport section and modeled (SWMU 13) to show transport potentially reaching the RGA. The RGA groundwater concentration at the SWMU boundary was used for risk estimates. The UCRS groundwater is not evaluated specifically; however, the tables shown in the nature and extent section highlight those constituents that exceeded SSL values for the UCRS. Though not quantified in this evaluation, UCRS groundwater could pose as a medium of concern under certain exposure scenarios; however, these risks were not quantified due to the high improbability of the UCRS at these Soils OU RI 2 SWMUs/AOCs being used as a drinking water aquifer [see Section 3.3.4.3 of the Risk Methods Document (DOE 2015b)].

Dose Assessment. This RI does not integrate potential dose across multiple routes of exposure, particularly since radionuclides were not identified during the evaluation of impacts to groundwater and dose from ingestion of game was not evaluated for the current on-site areas. Dose assessments are conducted to provide information for risk managers and are separate from the risk assessment conducted for decision making. The Risk Methods Document (Table A.8) provides dose-based SSLs. These were used to derive an estimate of the total dose (mrem/yr) for each of the primary scenarios evaluated (DOE 2015b). In presenting these results, the following comparisons are considered:

- Per the Risk Methods Document (DOE 2015b), a dose less than 1 mrem/yr is *de minimis*, and the benchmark for dose-based action is 25 mrem/year [DOE Order 458.1 states that if the estimated total effective dose (TED) for members of the public exceeds 25 mrem in a year, then additional evaluation is conducted] (DOE 2015b).

- DOE Order 458.1, *Radiation Protection of the Public and Environment*, requires that all exposure pathways not result in radiation exposures to members of the general public greater than a TED of 100 mrem/year (not applicable for current on-site areas, but consideration for future use).

- These do not reflect exposures to the public, which would be estimated at the site boundary. Significant releases to air are not expected from individual SWMUs/AOCs.

Pathways Not Quantitatively Evaluated. The following discusses pathways not quantitatively evaluated.

- In the SWMU/AOC summaries, it is noted where a SWMU/AOC is near a drainageway. Surface water pathways were not quantitatively evaluated in this OU because the potential for surface water migration of contaminants was addressed during the SWOU (On-Site) SI. The EE/CA for that project stated the following: "Based upon the modeling performed as part of the SI report for the outfalls and the associated internal ditches, no contaminants are migrating in surface water (dissolved or through sediment) from ditches to surrounding creeks at concentrations that may adversely impact human health" (DOE 2008a).

  A removal action for the contaminated sediment associated with SWOU (On-Site) (DOE 2011a) was conducted for Outfalls 001, 008, 010, 011, and 015 and associated internal ditches. A final response action for internal ditches, outfalls, and creeks will be addressed by the SWOU, as described in the SMP (DOE 2015a).

Only the northwest corner of PGDP (e.g., SWMU 13 and SWMU 15) provides an exception. The Northwest Corner Scrap Yard area is controlled under an interim corrective measure. Drainage ditches around SWMU 13 and SWMU 15 are routed to the C-613 Sedimentation Basin before discharging into Outfall 001.

- A rural resident with a garden or raising beef was not evaluated. Residential use on-site is not reasonably anticipated. Criteria more protective than the typical residential scenarios may be derived during the FS. (All except one SWMU would exceed 1E-06 risk cumulative risk for the hypothetical resident without including the garden/beef scenarios.)

- Ingestion of game. Recreational use of the off-site areas is reasonably anticipated; however, this was not evaluated on a SWMU/AOC-specific basis. Considering the range of the game, the range of the hunter, and the small size of the SWMUs/AOCs, the analysis of this has great uncertainty for any SWMU/AOC-specific risk management decision.

Lead. Lead is evaluated separately from the cancer risks and noncancer hazards assessment methodology, as proposed by EPA. Exposures to lead were evaluated based on the approach recommended in the *Memorandum: Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities* (EPA 1994). The site media lead levels are compared directly against the health protective lead concentrations for the risk-based site management decisions. Lead was identified as a COPC if the maximum concentration is greater than 400 mg/kg (residential screening value) consistent with the Risk Methods Document (DOE 2015b). The average concentration subsequently was compared with this value (this is consistent with EPA guidance for estimating soil lead concentrations for use in lead uptake models, which emphasized the importance that the frequency of exposure and the duration of exposure be over a sufficient duration for the blood lead concentration to become nearly constant over time). No subsequent modeling of lead exposures was completed since the average soil concentration was below 400 mg/kg (residential scenario) at each of the Soils OU RI 2 SWMUs/AOCs.

Contaminants of Concern. For each Soils OU RI 2 SWMU/AOC, the total ELCR and total HI for all pathways within a use scenario of concern are compared to the benchmarks of ELCR > 1E-06 or an HI > 0.1, respectively. COPCs within a use scenario of concern exceeding either of these benchmarks are deemed COCs for the use scenario of concern. The COCs are identified in the tables in Chapter 5. Priority COCs are identified as those COCs with either ELCR > 1E-04 or HI > 1 or both to highlight to risk managers the COCs driving total ELCR or total HI at the Soils OU RI 2 SWMUs/AOCs (DOE 2015b).

Uncertainty Analysis. The uncertainty discussion for the BHHRA (Appendix D) documents a range of issues that may be considered by risk managers in making decisions for these sites.

4.6.2 Ecological Risk Screening

The surface soil concentrations were screened against the ecological screening values (ESVs) for soil as included in Appendix E. This approach does not include consideration of background or other factors; however, given the industrial nature of many of the Soils OU RI 2 SWMUs/AOCs, the background screening values are included. Consistent with the Soils OU RI Report, for each SWMU/AOC summary, the primary chemicals that exceeded the respective screening values are shown (HQ $\geq$ 10) as well as the overall HI for the constituents detected, allowing comparison of the HIs, SWMU/AOC sizes, and other factors like proximity to a drainageway (DOE 2013). These primary chemicals that exceed screening values with an HQ $\geq$ 10 are termed priority chemicals of potential ecological concern (COPECs) within this report.

4.7 REMEDIAL GOAL OPTIONS

RGOs were developed individually for each Soils OU RI 2 SWMU/AOC for scenarios analyzed in the BHHRA. RGOs were calculated for each COC as determined in the conclusions of the BHHRA. COCs and RGOs are presented to evaluate direct contact exposure for the future industrial worker, excavation worker, and future hypothetical resident for the SWMUs/AOCs inside the Limited Area and for the teen recreational user, excavation worker, outdoor worker exposed to surface soil, and future hypothetical resident for the Soils OU RI 2 SWMUs/AOCs outside the Limited Area in Chapter 5.

4.8 SWMU/AOC AREA DETERMINATIONS

The human health and ecological risk assessments used acreage for a SWMU/AOC based on global positioning system (GPS) coordinates and mapping tools. This acreage is reflected in the figures within this document. Of note, the acreage presented in the Background sections of this document may be inconsistent with acreage used in the risk assessments due to its being based on historical SWMU Assessment Report (SAR) administrative boundaries, which typically were estimated using a map/figure.

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5. SOILS OU RI 2 SWMUs/AOCs

This chapter includes a discussion of the Soils OU RI 2 SWMUs/AOCs, which includes the following SWMUs/AOCs:

- SWMU 13, C-746-P&P1, Scrap Yards
- SWMU 15, C-746-C, Scrap Yard
- SWMU 26, C-400 to C-404, 4-inch Underground Transfer Line
- SWMUs 56 and 80, C-540-A PCB Staging Area and C-540 PCB Spill Site
- SWMU 77, C-634-B, Sulfuric Acid Storage Tank
- AOC 204, Historical Staging Area
- SWMU 211-A, C-720, TCE Spill Site Northwest
- SWMU 224, C-340, DMSA OS-13, empty drum storage
- SWMU 225-A, C-533-1, DMSA OS-14, rail cars
- SWMU 225-B, Contaminated Soil Area near C-533-1 DMSA OS-14
- AOC 565, North of C-611 Water Treatment Plant, Rubble Area K

The SWMU/AOC-specific discussions highlight the current understanding of the impact of each Soils OU RI 2 SWMU/AOC. Chapter 4 describes the overall evaluation approach that was used for each Soils OU RI 2 SWMU/AOC. Figures display the 45 ft grids that were used for the composite sampling and historical sample assignments. There are approximately 10 grids for each EU for SWMUs/AOCs that are larger than 0.5 acres. If a SWMU/AOC is smaller than 0.5 acres, it is considered one EU. If contingency "step-out" grids were deemed necessary by field laboratory results to define extent, the step-out grids are displayed on the figures.

All of the Soils OU RI 2 SWMUs/AOCs, except AOCs 204 and 565, are located within the industrial area of PGDP, as shown on Figure 1.2. At all of the Soils OU RI 2 SWMUs/AOCs fieldwork was conducted in accordance with the Work Plan (DOE 2010a) and addendum (DOE 2014a).

Nature and extent is divided into surface and subsurface sections that summarize the representative data set and describe the future industrial worker scenario for SWMUs located inside the Limited Area and teen recreator scenario for SWMUs/AOCs located outside the Limited Area. The evaluation of the XRF data with fixed-base laboratory data indicates the use of XRF results for copper, iron, nickel, and zinc has good correlation and, therefore, is reliable for use in determining nature and extent and hot spots. Arsenic, chromium, molybdenum, mercury, selenium, silver, and uranium XRF results are generally below the reporting limits and will not lead to incorrect decisions in the risk assessment; however, these results may not provide much useful information for nature and extent determination. For vanadium, comparison with the fixed-base laboratory data indicates XRF data are much higher; therefore, risks may be overestimated when using the XRF data. See Appendix B for additional information.

For the fate and transport section, the process for evaluating surface water runoff and groundwater modeling is described in Chapter 4 and Appendix C, and only the conclusions are provided in the SWMU/AOC-specific sections.

The human health risk assessment narrative discusses the future industrial worker (for AOCs 204 and 565, which are outside the Limited Area, the teen recreational user is discussed instead of the future industrial worker); the excavation worker; and the hypothetical future resident. Each Soils OU RI 2 SWMU/AOC was evaluated for the scenarios listed below. Additional discussion of these scenarios is presented in Appendix D.

- Current industrial on-site worker (This assumes exposure to surface soils only.)

- Future industrial on-site worker (This assumes exposure to surface soils only.)

- Outdoor worker (Surface and Subsurface Soils: 0–16 ft bgs) [This assumes exposure to surface (0–1 ft bgs) and a mixture of the surface (0–1 ft bgs) and subsurface soils (1–16 ft bgs), as appropriate, following a future construction activity. As a subset of the outdoor worker exposed to surface and subsurface soils, the potential risks and hazards for shorter-term exposure for workers during excavation also are provided.]

- Hypothetical future adult and child residents (This assumes exposure to surface soils only.)

- Future adult, teen, and child recreational users (This assumes exposure to surface soils only.)

The following are the uncertainties in the human health risk assessment that may affect the Soils OU RI 2 SWMUs/AOCs in Chapter 5.

- Arithmetic average lead concentration is compared to the NAL to determine additional risk analysis potentially leading to missed lead exposure (specifically SWMU 15).

- Concentration of total cancerous polycyclic aromatic hydrocarbons (PAHs) were used to estimate risk, and the minimum detection limit of the PAHs with toxicity equivalence factors were used when PAHs were not detected.

- Some detection limits for XRF data are above background concentrations and NALs; the COPCs identified using these data are expected to overstate the presence of these metals.

- For those constituents that never were detected within an EU, even if the detection limit is greater than the NAL, the constituent was not considered a COPC.

- For determining COPCs, maximum detected values were screened against background values presented in the Risk Methods Document regardless of analytical method used (DOE 2015b). For uranium-238, this presents an uncertainty with respect to those samples analyzed using nitric extraction. The adjusted background value for uranium-238 is lower than the value used to screen.

- UCL (95% on the mean) concentrations were used as EPCs if there were a sufficient number of samples and distinct results to calculate a UCL. This likely will lead to an overestimation of actual exposure because receptors are assumed to be exposed to the UCL concentration for the entire exposure duration.

- Conservative (i.e., health protective) exposure factors are used when information available is limited in the form of using reasonable maximum exposure assumptions, as per the Risk Methods Document (DOE 2015b). This may result in an overestimation of potential risk.

- Many of the Soils OU RI 2 SWMUs/AOCs (especially AOC 565) evaluated in this assessment are very small, and the assumptions used for the levels of exposures (duration, frequency) overstate potential chronic exposures in these units.

- The risk assessment does not consider that concentrations of some COCs may be lower or higher in the future because of processes such as degradation and attenuation.

- Additivity of multiple chemicals is assumed. Whether assuming additivity can lead to an underestimation or overestimation of risk is unknown.

- Most of the assumptions about exposure and toxicity used in the BHHRA are representative of statistical upper-bounds or even maximums for each parameter. The result of combining several such upper-bound assumptions is that the final estimate of potential exposure or potential risk is overestimated.

Additional information can be found in Appendix D.

For the ecological screening, the priority COPECs that exceeded the respective screening values are shown in tables within each subsection (HQ ≥ 10) as well as the overall HI for the constituents detected. This allows for comparison of the HIs, SWMU/AOC sizes, and other factors such as proximity to a surface water body. Additional information is contained in Appendix E.

5.1 SWMU 13, C-746-P&P1 SCRAP YARDS

5.1.1 Background

The C-746-P and C-746-P1 Scrap Yards (SWMU 13) are located in the northwest corner of the plant site. SWMU 13 includes both scrap yards, C-746-P and C-746-P1, and is approximately 314,000 ft^2 (290 ft × 1,076 ft).

SWMU 13, C-746-P Scrap Yard, was an aboveground scrap yard used for storage from the 1950s to 2005 for clean scrap metal prior to sale to metal reclaimers. During the summer of 1989, some scrap at the yard was found to be contaminated by uranium. Based on this discovery, the site was divided into a contaminated scrap yard, comprising approximately the eastern two-thirds of the original waste management unit and designated as C-746-P, and a clean scrap yard, comprising approximately the western one-third of the original unit and designated C-746-P1. Suspected contaminants of the scrap metal include uranium and asbestos. The scrap yard also contained drums of "heels" of remnant fluids potentially contaminated by petroleum hydrocarbons and TCE.

These storage yards were emptied, as specified by the Action Memorandum for Scrap Metal (DOE 2001a) and documented in the Removal Action Report for Scrap Metal (DOE 2008c).

The Phase II SI (CH2M HILL 1992) sampled shallow soils in the area. Suspected COCs for the SWMU soils include SVOCs, metals, and radionuclides.

Geophysic evaluations were performed at SWMU 13 in areas inside the C-746-P and C-746-P1 Scrap Yards as part of the BGOU RI to determine if scrap metal was buried in them. The results of the geophysical survey indicated there is metal in three areas. At two locations the metal is 2 ft bgs, and in the third metal is 2 ft bgs, with a center trough of 4 ft to 6 ft bgs (DOE 2010a).

The SWMU 13 Site Evaluation conducted in 2010 sampled subsurface soil and groundwater. The evaluation concluded that chemicals detected in soils encountered between 10 and 20 ft bgs were below background and/or relevant screening criteria for potential impacts to groundwater. Because of depth, they do not pose potential future direct contact risks to human health or risk for ecological receptors. Disturbed soil was noted in one borehole (#6) to a depth of 15 ft; the highest concentrations for Total PCBs (0.57 mg/kg), uranium-238 (1.49 pCi/g), and neptunium-237 (0.057 pCi/g) reported in the SER were found in the 10-14 ft increment of this borehole (DOE 2011b).

Prior to 2011, SWMU 13 was included in both the Soils OU and the BGOU; in 2011 a SWMU 13 SER, DOE/LX/07-1259&D1 (DOE 2011b), concluded that no BGOU response action was required and a SAR was submitted and approved to remove SWMU 13 from BGOU, but retained it as part of Soils OU.

5.1.2 Fieldwork Summary

During the first RI for the Soils OU, it had been determined that historical data were representative of the nature and adequately delineate the extent of contamination; therefore, no samples were collected from SWMU 13 during the 2010 field effort (DOE 2010a).

The unit underwent a gamma radiological walkover survey (Figure 5.1.1) using a FIDLER; the 22,376 measurements ranged from 4,142 to 519,703 cpm. This SWMU consists entirely of gravel with a soil and grass mix. This is a posted contamination area. A judgmental grab sample was collected for radiological constituents.

During RI 2, 158 surface soil grid samples were planned and collected for the unit. Contingency samples were not required. These grid samples were collected at first contact of soil beneath overlying rock. These samples, despite the depth collected, are considered surface samples for purposes of this RI.

The unit underwent a gamma radiological walkover survey (Figure 5.1.1) during RI 2 using a FIDLER; the 130,575 measurements ranged from 3,100 to 31,278 cpm. A judgmental grab sample was collected for radiological constituents.

5.1.3 Nature and Extent of Contamination—Surface Soils

The representative data set presented in Table 5.1.1 provides the nature of the contamination in SWMU 13 surface soils, and Figures 5.1.2–5.1.4 illustrate the horizontal extent. A complete list of sampling results is provided in Appendix F (samples with ending depths of 1 ft bgs or less or null are considered surface soils). Grid numbers shown below are truncated from the figures. Figures contain the SWMU#–grid#, with zeros filling the appropriate spaces to make three digits.

The lateral extent of SWMU 13 surface soil contamination is considered defined adequately for supporting the BRA and FS. SWMU 13 consists of 14 EUs.

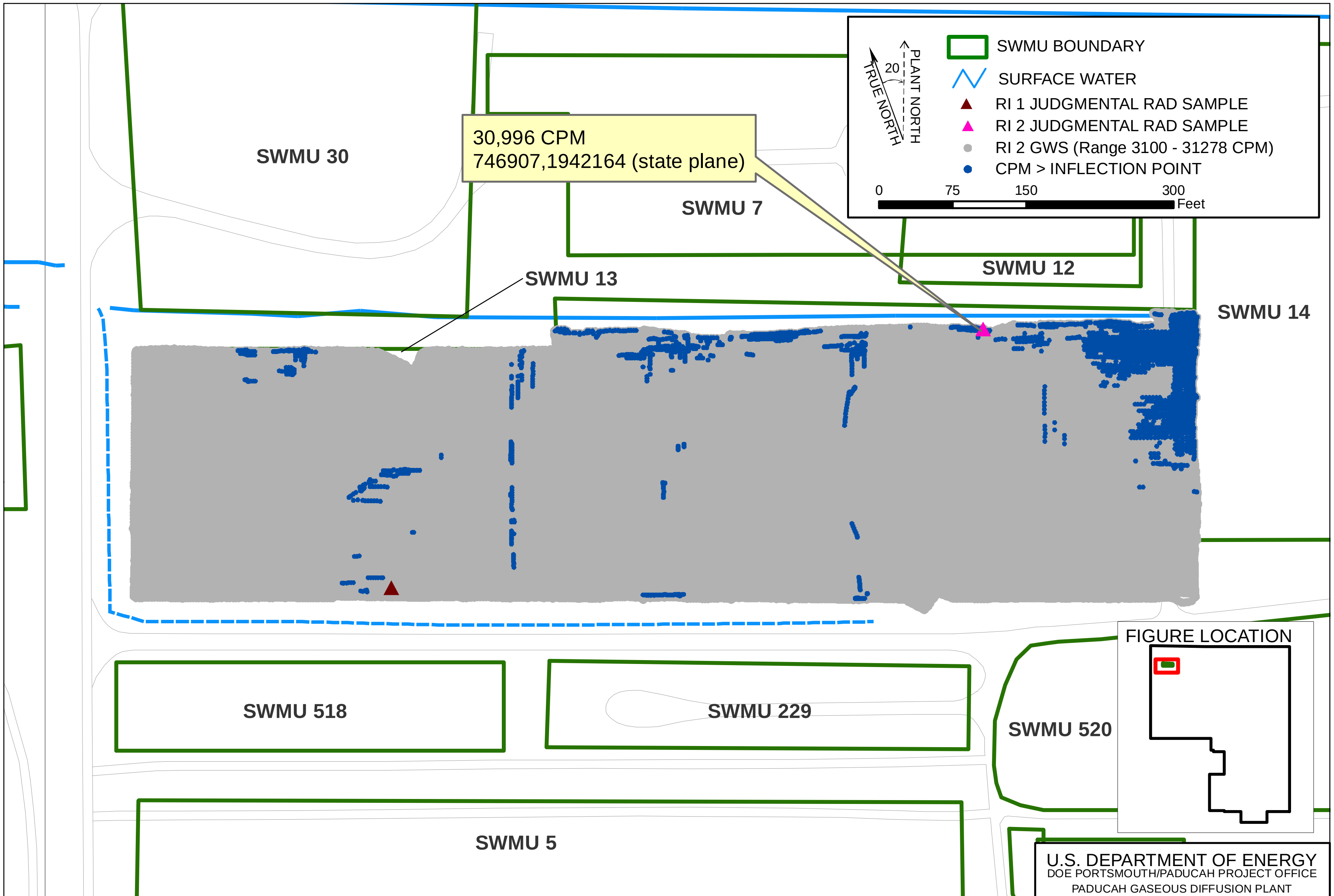

Figure 5.1.1. SWMU 13 Gamma Walkover Survey

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3/17/2015

Table 5.1.1. Surface Soil Data Summary: SWMU 13

Type	Analysis	Unit	Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
			Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
METAL	Aluminum	mg/kg	4.00E+03	1.40E+04	6.21E+03	0/24	24/24	1/24	1.30E+04	0/24	1.00E+05	0/24	1.00E+05	0/24	24/24	4.2–20
METAL	Antimony	mg/kg	9.20E-02	8.20E-01	2.21E-01	0/24	16/24	5/24	2.10E-01	0/24	9.34E+01	0/24	2.80E+03	0/24	3/24	0.025–20
METAL	Arsenic	mg/kg	3.40E+00	9.30E+00	5.88E+00	0/176	16/176	0/176	1.20E+01	16/176	1.41E+00	0/176	1.41E+02	0/176	16/176	0.17–10
METAL	Barium	mg/kg	5.80E+01	1.80E+02	9.77E+01	0/24	24/24	0/24	2.00E+02	0/24	4.04E+04	0/24	1.00E+05	0/24	18/24	0.084–2.5
METAL	Beryllium	mg/kg	3.60E-01	6.20E-01	4.72E-01	0/24	16/24	0/24	6.70E-01	0/24	4.50E+02	0/24	1.35E+04	0/24	0/24	0.042–0.5
METAL	Cadmium	mg/kg	2.50E-02	1.20E+00	2.40E-01	1/24	16/24	4/24	2.10E-01	0/24	6.12E+01	0/24	1.84E+03	0/24	3/24	0.025–2
METAL	Calcium	mg/kg	7.00E+02	1.40E+05	1.39E+04	0/24	24/24	0/24	2.00E+05	0/24	N/A	0/24	N/A	N/A	N/A	84–200
METAL	Chromium	mg/kg	6.70E+00	2.20E+01	1.04E+01	0/176	24/176	2/176	1.60E+01	0/176	1.98E+02	0/176	1.98E+04	0/176	0/176	0.84–12
METAL	Cobalt	mg/kg	3.10E+00	1.20E+01	6.16E+00	0/24	24/24	0/24	1.40E+01	0/24	6.87E+01	0/24	2.06E+03	24/24	24/24	0.084–2.5
METAL	Copper	mg/kg	7.10E+00	1.86E+02	3.99E+01	0/176	160/176	149/176	1.90E+01	0/176	9.34E+03	0/176	1.00E+05	0/176	30/176	0.84–4
METAL	Iron	mg/kg	6.54E+03	4.78E+04	2.14E+04	0/176	176/176	17/176	2.80E+04	0/176	1.00E+05	0/176	1.00E+05	176/176	176/176	8.4–20
METAL	Lead	mg/kg	9.90E+00	6.57E+02	8.91E+01	0/176	36/176	22/176	3.60E+01	0/176	8.00E+02	0/176	8.00E+02	0/176	26/176	0.042–20
METAL	Lithium	mg/kg	5.13E+00	8.59E+00	6.49E+00	0/8	6/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	5–5
METAL	Magnesium	mg/kg	4.70E+02	8.40E+03	1.32E+03	0/24	24/24	1/24	7.70E+03	0/24	N/A	0/24	N/A	N/A	N/A	2.5–11
METAL	Manganese	mg/kg	1.19E+02	3.11E+03	6.50E+02	0/176	176/176	9/176	1.50E+03	0/176	4.72E+03	0/176	1.00E+05	174/176	176/176	0.17–24
METAL	Mercury	mg/kg	3.40E-02	8.40E-02	5.28E-02	1/176	13/176	0/176	2.00E-01	0/176	7.01E+01	0/176	2.10E+03	0/176	13/176	0.027–40
METAL	Molybdenum	mg/kg	2.80E-01	4.30E+01	1.03E+01	0/168	28/168	0/168	N/A	0/168	1.17E+03	0/168	3.51E+04	13/168	28/168	0.084–3
METAL	Nickel	mg/kg	5.33E+00	1.40E+02	1.95E+01	0/176	142/176	33/176	2.10E+01	0/176	4.30E+03	0/176	1.00E+05	0/176	142/176	0.42–5
METAL	Potassium	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	1.30E+03	0/1	N/A	0/1	N/A	N/A	N/A	-
METAL	Selenium	mg/kg	6.00E-01	5.00E+00	1.03E+00	0/176	16/176	13/176	8.00E-01	0/176	1.17E+03	0/176	3.51E+04	0/176	16/176	0.084–3
METAL	Silver	mg/kg	2.70E-02	1.46E+02	2.08E+01	0/176	19/176	6/176	2.30E+00	0/176	1.17E+03	0/176	3.51E+04	6/176	8/176	0.0084–50
METAL	Sodium	mg/kg	4.50E+01	8.50E+01	6.20E+01	15/16	15/16	0/16	3.20E+02	0/16	N/A	0/16	N/A	N/A	N/A	84–110
METAL	Thallium	mg/kg	8.60E-02	1.40E-01	1.10E-01	0/24	15/24	0/24	2.10E-01	0/24	2.34E+00	0/24	7.02E+01	0/24	0/24	0.017–20
METAL	Tin	mg/kg	N/A	N/A	N/A	0/9	0/9	0/9	N/A	0/9	N/A	0/9	N/A	N/A	N/A	100–100
METAL	Uranium	mg/kg	8.80E-01	1.30E+02	9.48E+00	0/177	18/177	5/177	4.90E+00	0/177	6.81E+02	0/177	2.04E+04	0/177	3/177	0.0084–100
METAL	Vanadium	mg/kg	1.70E+01	1.58E+02	9.50E+01	0/176	176/176	166/176	3.80E+01	0/176	1.15E+03	0/176	3.45E+04	0/176	176/176	0.084–5
METAL	Zinc	mg/kg	1.71E+01	1.04E+03	8.15E+01	0/176	176/176	35/176	6.50E+01	0/176	7.01E+04	0/176	1.00E+05	0/176	81/176	1–10
PPCB	4,4'-DDD	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
PPCB	4,4'-DDE	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
PPCB	4,4'-DDT	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
PPCB	Aldrin	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
PPCB	alpha-BHC	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
PPCB	beta-BHC	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
PPCB	delta-BHC	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
PPCB	Dieldrin	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	5.15E-02	0/1	5.15E+00	0/1	0/1	-
PPCB	Heptachlor	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
PPCB	Lindane	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
PPCB	Methoxychlor	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
PPCB	PCB, Total	mg/kg	1.00E-01	1.25E+00	4.46E-01	0/176	7/176	0/176	N/A	4/176	3.05E-01	0/176	3.05E+01	0/176	7/176	0.05–0.1
SVOA	1,2,4,5-Tetrachlorobenzene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
SVOA	1,2,4-Trichlorobenzene	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.37–0.5
SVOA	1,2-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.37–0.5
SVOA	1,2-Diphenylhydrazine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
SVOA	1,3-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.37–0.5
SVOA	1,4-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.37–0.5
SVOA	1-Chloronaphtalene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
SVOA	1-Naphthalenamine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
SVOA	2,3,4,6-Tetrachlorophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
SVOA	2,4,5-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.37–0.5
SVOA	2,4,6-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.37–0.5
SVOA	2,4-Dichlorophenol	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.37–0.5
SVOA	2,4-Dimethylphenol	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.37–0.5
SVOA	2,4-Dinitrophenol	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.46–0.83

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.1.1. Surface Soil Data Summary: SWMU 13 (Continued)

			Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
Type	Analysis	Unit	Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
SVOA	2,4-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.22–0.5
SVOA	2,6-Dichlorophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
SVOA	2,6-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.22–0.5
SVOA	2-Chloronaphthalene	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.37–0.5
SVOA	2-Chlorophenol	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.37–0.5
SVOA	2-Methyl-4,6-dinitrophenol	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.46–0.83
SVOA	2-Methylnaphthalene	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.37–0.5
SVOA	2-Methylphenol	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.37–0.5
SVOA	2-Naphthalenamine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
SVOA	2-Nitrobenzenamine	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	2.91E+02	0/24	8.73E+03	0/24	0/24	0.46–0.83
SVOA	2-Nitrophenol	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.37–0.5
SVOA	3,3'-Dichlorobenzidine	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.22–0.5
SVOA	3-Methylcholanthrene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
SVOA	3-Nitrobenzenamine	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.46–0.83
SVOA	4-Aminobiphenyl	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
SVOA	4-Bromophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.37–0.5
SVOA	4-Chloro-3-methylphenol	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.37–0.5
SVOA	4-Chlorobenzenamine	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.37–0.5
SVOA	4-Chlorophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.37–0.5
SVOA	4-Methylphenol	mg/kg	N/A	N/A	N/A	0/9	0/9	0/9	N/A	0/9	N/A	0/9	N/A	N/A	N/A	0.46–0.5
SVOA	4-Nitrophenol	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.46–0.83
SVOA	7,12-Dimethylbenz(a)anthracene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
SVOA	a,a-Dimethylphenethylamine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
SVOA	Acenaphthene	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	1.40E+03	0/24	4.20E+04	0/24	0/24	0.37–0.5
SVOA	Acenaphthylene	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	1.40E+03	0/24	4.20E+04	N/A	N/A	0.37–0.5
SVOA	Acetophenone	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
SVOA	Aniline	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
SVOA	Anthracene	mg/kg	1.50E-02	1.50E-02	1.50E-02	1/24	1/24	0/24	N/A	0/24	6.99E+03	0/24	2.10E+05	0/24	0/24	0.37–0.5
SVOA	Benzenemethanol	mg/kg	N/A	N/A	N/A	0/16	0/16	0/16	N/A	0/16	N/A	0/16	N/A	N/A	N/A	0.37–0.42
SVOA	Benzidine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
SVOA	Benzo(ghi)perylene	mg/kg	1.60E-01	1.60E-01	1.60E-01	1/24	1/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.37–0.5
SVOA	Benzoic acid	mg/kg	N/A	N/A	N/A	0/16	0/16	0/16	N/A	0/16	N/A	0/16	N/A	N/A	N/A	1.8–2.1
SVOA	Bis(2-chloroethoxy)methane	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.37–0.5
SVOA	Bis(2-chloroethyl) ether	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.37–0.5
SVOA	Bis(2-chloroisopropyl) ether	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.37–0.5
SVOA	Bis(2-ethylhexyl)phthalate	mg/kg	2.30E-01	2.30E-01	2.30E-01	1/24	1/24	0/24	N/A	0/24	5.88E+01	0/24	5.88E+03	0/24	0/24	0.37–0.5
SVOA	Butyl benzyl phthalate	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.37–0.5
SVOA	Carbazole	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	4.12E+01	0/8	4.12E+03	0/8	0/8	0.46–0.5
SVOA	Dibenzofuran	mg/kg	N/A	N/A	N/A	0/16	0/16	0/16	N/A	0/16	N/A	0/16	N/A	N/A	N/A	0.37–0.42
SVOA	Diethyl phthalate	mg/kg	N/A	N/A	N/A	0/16	0/16	0/16	N/A	0/16	N/A	0/16	N/A	N/A	N/A	0.37–0.42
SVOA	Dimethyl phthalate	mg/kg	N/A	N/A	N/A	0/16	0/16	0/16	N/A	0/16	N/A	0/16	N/A	N/A	N/A	0.37–0.42
SVOA	Di-n-butyl phthalate	mg/kg	N/A	N/A	N/A	0/16	0/16	0/16	N/A	0/16	N/A	0/16	N/A	N/A	N/A	0.37–0.42
SVOA	Di-n-octylphthalate	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.37–0.5
SVOA	Ethyl methanesulfonate	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
SVOA	Fluoranthene	mg/kg	1.40E-01	7.10E-01	3.14E-01	4/16	5/16	0/16	N/A	0/16	9.32E+02	0/16	2.80E+04	0/16	0/16	0.37–0.42
SVOA	Fluorene	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	9.32E+02	0/24	2.80E+04	0/24	0/24	0.37–0.5
SVOA	Hexachlorobenzene	mg/kg	N/A	N/A	N/A	0/16	0/16	0/16	N/A	0/16	5.15E-01	0/16	5.15E+01	0/16	0/16	0.0037–0.0041
SVOA	Hexachlorobutadiene	mg/kg	N/A	N/A	N/A	0/16	0/16	0/16	N/A	0/16	N/A	0/16	N/A	N/A	N/A	0.22–0.25
SVOA	Hexachlorocyclopentadiene	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.37–0.5
SVOA	Hexachloroethane	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.37–0.5
SVOA	Isophorone	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.37–0.5
SVOA	m,p-cresol	mg/kg	N/A	N/A	N/A	0/15	0/15	0/15	N/A	0/15	N/A	0/15	N/A	N/A	N/A	0.37–0.42
SVOA	Methyl methanesulfonate	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.1.1. Surface Soil Data Summary: SWMU 13 (Continued)

Type	Analysis	Unit	Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
			Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
SVOA	Naphthalene	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	1.67E+01	0/24	1.61E+03	0/24	0/24	0.37–0.5
SVOA	Nitrobenzene	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.37–0.5
SVOA	N-Nitrosodimethylamine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
SVOA	N-Nitroso-di-n-propylamine	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	1.18E-01	0/24	1.18E+01	0/24	0/24	0.37–0.5
SVOA	N-Nitrosodiphenylamine	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.37–0.5
SVOA	N-Nitrosopiperidine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
SVOA	PAH, Total	mg/kg	1.30E-04	8.33E-01	1.11E-01	0/22	14/22	0/22	N/A	3/22	8.94E-02	0/22	8.94E+00	0/22	2/22	-
SVOA	p-Dimethylaminoazobenzene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
SVOA	Pentachlorobenzene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
SVOA	Pentachloronitrobenzene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
SVOA	Pentachlorophenol	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	8.91E-01	0/24	8.91E+01	N/A	N/A	0.46–0.75
SVOA	Phenacetin	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
SVOA	Phenanthrene	mg/kg	8.40E-02	3.50E-01	1.89E-01	4/24	4/24	0/24	N/A	0/24	1.40E+03	0/24	4.20E+04	0/24	4/24	0.37–0.5
SVOA	Phenol	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.37–0.5
SVOA	p-Nitroaniline	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.46–0.83
SVOA	Pronamide	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
SVOA	Pyrene	mg/kg	1.10E-01	6.40E-01	3.02E-01	4/24	5/24	0/24	N/A	0/24	6.99E+02	0/24	2.10E+04	0/24	0/24	0.37–0.5
SVOA	Pyridine	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.37–0.5
VOA	1,1,1-Trichloroethane	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	3.58E+03	0/8	1.07E+05	0/8	0/8	0.01–0.01
VOA	1,1,2,2-Tetrachloroethane	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.01–0.01
VOA	1,1,2-Trichloroethane	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	6.32E-01	0/8	1.90E+01	0/8	0/8	0.01–0.01
VOA	1,1-Dichloroethane	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	1.58E+01	0/8	1.58E+03	0/8	0/8	0.01–0.01
VOA	1,1-Dichloroethene	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	1.00E+02	0/8	3.00E+03	0/8	0/8	0.01–0.01
VOA	1,2-Dichloroethane	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	2.09E+00	0/8	2.09E+02	0/8	0/8	0.01–0.01
VOA	1,2-Dichloropropane	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.01–0.01
VOA	1,2-Dimethylbenzene	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	2.81E+02	0/8	8.43E+03	0/8	0/8	0.01–0.01
VOA	2-Butanone	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.25–0.25
VOA	2-Hexanone	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.05–0.05
VOA	2-Methylpyridine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	-
VOA	4-Methyl-2-pentanone	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.25–0.25
VOA	Acetone	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.25–0.25
VOA	Benzene	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	5.31E+00	0/8	5.31E+02	0/8	0/8	0.01–0.01
VOA	Bromodichloromethane	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	1.30E+00	0/8	1.30E+02	0/8	0/8	0.01–0.01
VOA	Bromoform	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.01–0.01
VOA	Bromomethane	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.02–0.02
VOA	Carbon disulfide	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.01–0.01
VOA	Carbon tetrachloride	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	2.96E+00	0/8	2.96E+02	0/8	0/8	0.01–0.01
VOA	Chlorobenzene	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.01–0.01
VOA	Ethylbenzene	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	2.66E+01	0/8	2.66E+03	0/8	0/8	0.01–0.01
VOA	m,p-Xylene	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	2.54E+02	0/8	7.62E+03	0/8	0/8	0.01–0.01
VOA	Methylene chloride	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.01–0.01
VOA	Styrene	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.01–0.01
VOA	Tetrachloroethene	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	4.00E+01	0/8	1.20E+03	N/A	N/A	0.01–0.01
VOA	Toluene	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	6.25E+03	0/8	1.88E+05	0/8	0/8	0.01–0.01
VOA	*trans*-1,2-Dichloroethene	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	6.51E+01	0/8	1.95E+03	0/8	0/8	0.01–0.01
VOA	*trans*-1,3-Dichloropropene	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.01–0.01
VOA	Trichloroethene	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	1.90E+00	0/8	5.70E+01	0/8	0/8	0.01–0.01
RADS	Americium-241	pCi/g	2.50E-02	2.50E-02	2.50E-02	0/25	1/25	0/25	N/A	0/25	5.99E+00	0/25	5.99E+02	0/25	0/25	0.024–0.142
RADS	Cesium-134	pCi/g	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.00869–0.02
RADS	Cesium-137	pCi/g	3.45E-02	3.93E-01	1.84E-01	0/25	7/25	0/25	4.90E-01	5/25	1.02E-01	0/25	1.02E+01	0/25	0/25	0.0105–0.066
RADS	Cobalt-60	pCi/g	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.0105–0.0294
RADS	Neptunium-237	pCi/g	1.74E-02	1.08E+00	3.86E-01	0/26	7/26	3/26	1.00E-01	3/26	2.29E-01	0/26	2.29E+01	0/26	5/26	0.0149–0.0489
RADS	Plutonium-238	pCi/g	1.29E-02	3.31E-02	2.10E-02	0/25	7/25	0/25	7.30E-02	0/25	2.87E+01	0/25	2.87E+03	0/25	0/25	0.0053–0.212

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.1.1. Surface Soil Data Summary: SWMU 13 (Continued)

Type	Analysis	Unit	Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		DL Range
			Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	
RADS	Plutonium-239/240	pCi/g	5.86E-03	1.73E-01	5.51E-02	0/26	9/26	6/26	2.50E-02	0/26	2.47E+01	0/26	2.47E+03	0/26	0/26	0.00529 - 0.0406
RADS	Technetium-99	pCi/g	7.48E-01	1.50E+02	3.89E+01	0/26	9/26	8/26	2.50E+00	0/26	1.20E+03	0/26	1.20E+05	9/26	9/26	0.46–3.38
RADS	Thorium-228	pCi/g	3.23E-01	1.20E+00	7.94E-01	0/25	25/25	0/25	1.60E+00	0/25	N/A	0/25	N/A	N/A	N/A	0.0289–0.2
RADS	Thorium-230	pCi/g	3.46E-01	1.51E+00	9.32E-01	0/26	26/26	1/26	1.50E+00	0/26	3.39E+01	0/26	3.39E+03	0/26	0/26	0.01–0.198
RADS	Thorium-232	pCi/g	3.03E-01	1.20E+00	7.77E-01	0/25	25/25	0/25	1.50E+00	0/25	N/A	0/25	N/A	N/A	N/A	0.0106–0.0785
RADS	Uranium-234	pCi/g	7.96E-01	3.57E+01	5.03E+00	0/25	18/25	9/25	1.20E+00	0/25	5.53E+01	0/25	5.53E+03	3/25	18/25	0.01–0.505
RADS	Uranium-235	pCi/g	3.17E-02	4.12E+00	3.51E-01	0/26	23/26	14/26	6.00E-02	2/26	3.40E-01	0/26	3.40E+01	1/26	15/26	0.008–0.0532
RADS	Uranium-238	pCi/g	9.13E-01	6.41E+01	6.78E+00	4/25	25/25	15/25	1.20E+00	8/25	1.60E+00	0/25	1.60E+02	6/25	25/25	0.007–0.531

One or more samples exceed AL value
One or more samples exceed NAL value
One or more samples exceed background value
One or more samples exceed SSLs of RGA and UCRS groundwater protection

Counts of analyses are based on the maximum detected result from a sample (i.e., if a sample has analytical results from two different labs, only the maximum value is counted).
Field replicates, or separate samples are counted independently.

The uranium (metal)/uranium (isotopic) may not be from the same sample thus a correlation between uranium (metal)/uranium (isotopic) data may not be possible.
Uranium-238 that was analyzed using method RL-7128NITRIC is compared to a background value of 0.4 pCi/g for surface and subsurface.

Screening values are shown in Appendices C and D.

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

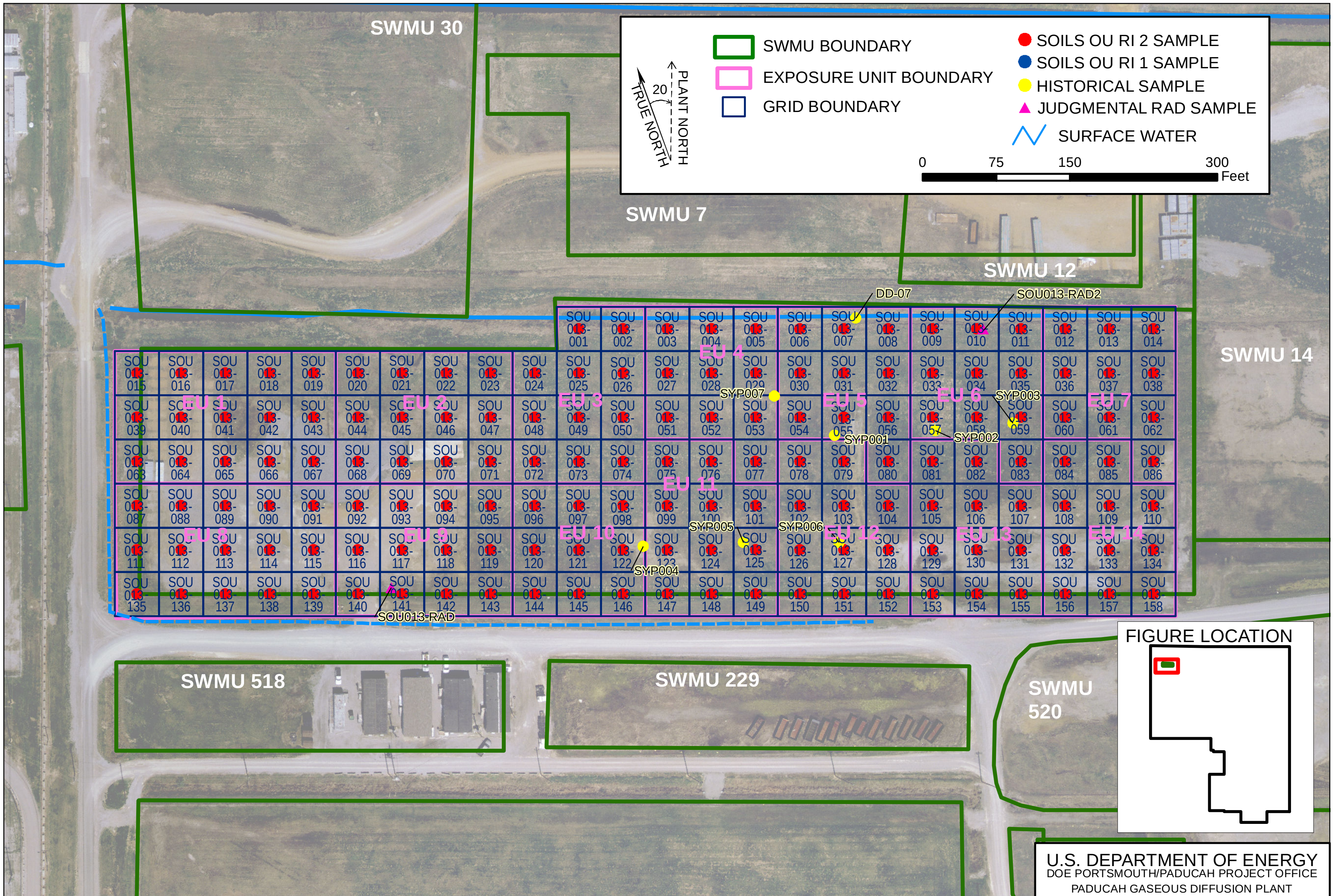

Figure 5.1.2. SWMU 13 Sample Locations—Surface Soil

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2/19/2015

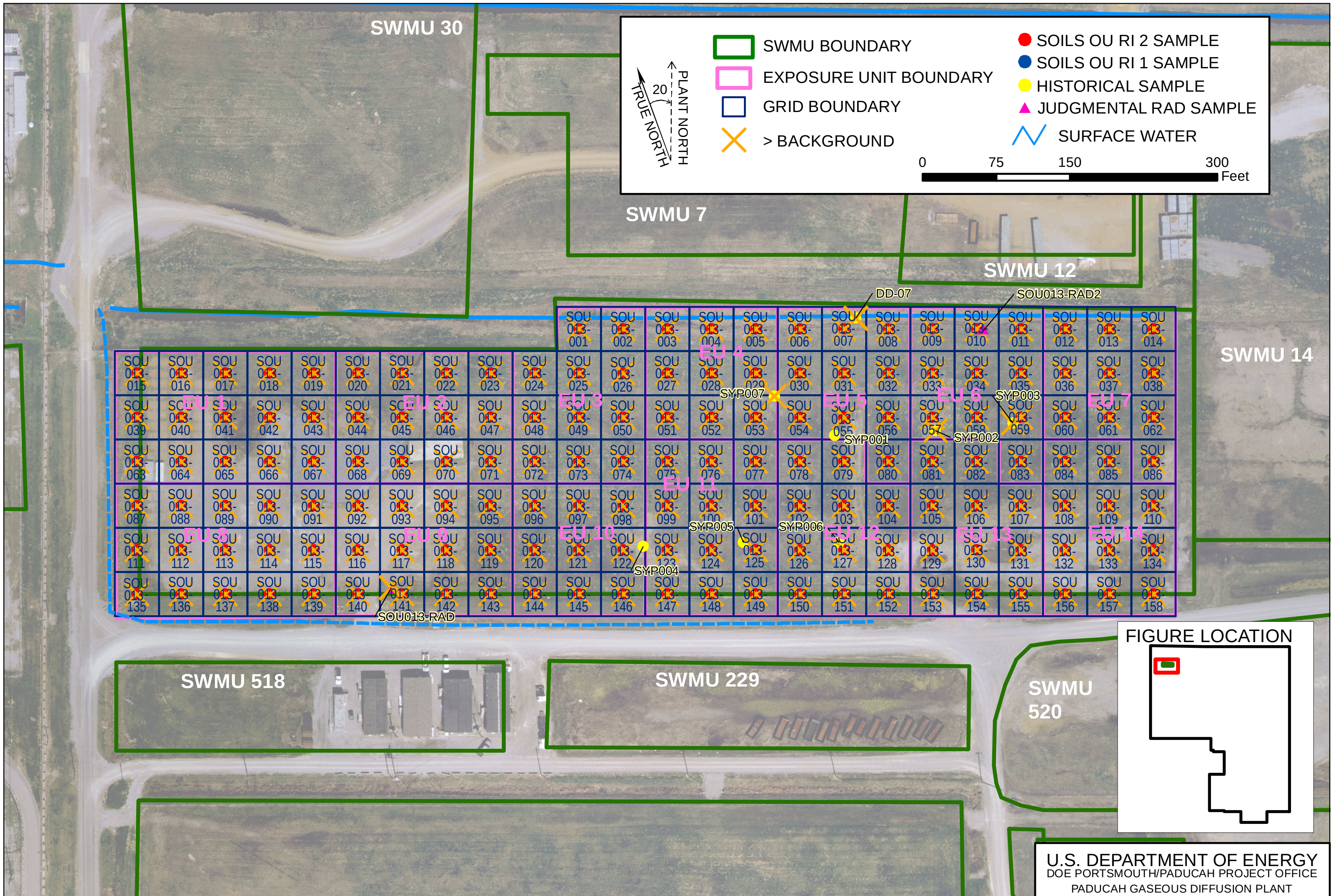

Figure 5.1.3. SWMU 13 Background Exceedances—Surface Soil

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Location	Exceedances
DD-07	Aluminum (14000 mg/kg) Antimony (0.82 mg/kg) Cadmium (1.2 mg/kg) Chromium (19 mg/kg) Copper (46 mg/kg) Nickel (140 mg/kg) Uranium (130 mg/kg) Zinc (240 mg/kg) Neptunium-237 (0.53 pCi/g) Plutonium-239/240 (0.03 pCi/g) Technetium-99 (150 pCi/g) Uranium-234 (35.7 pCi/g) Uranium-235 (4.12 pCi/g) Uranium-238 (64.1 pCi/g)
SOU013-001	Copper (44 mg/kg) Vanadium (107 mg/kg)
SOU013-002	Copper (47 mg/kg) Manganese (2248 mg/kg) Nickel (80 mg/kg) Vanadium (116 mg/kg) Zinc (136 mg/kg)
SOU013-003	Copper (107 mg/kg) Lead (273 mg/kg) Nickel (58 mg/kg) Vanadium (105 mg/kg) Zinc (342 mg/kg)
SOU013-004	Copper (39 mg/kg) Vanadium (78 mg/kg)
SOU013-005	Copper (39 mg/kg) Vanadium (78 mg/kg)
SOU013-006	Copper (36 mg/kg) Vanadium (97 mg/kg)
SOU013-007	Copper (120 mg/kg) Lead (657 mg/kg) Nickel (44 mg/kg) Vanadium (105 mg/kg) Zinc (918 mg/kg)
SOU013-008	Copper (40 mg/kg) Lead (55 mg/kg) Vanadium (92 mg/kg)
SOU013-009	Copper (42 mg/kg) Vanadium (110 mg/kg) Zinc (82 mg/kg)
SOU013-010	Copper (34 mg/kg) Uranium (60 mg/kg) Vanadium (95 mg/kg)
SOU013-011	Copper (27 mg/kg) Vanadium (95 mg/kg)
SOU013-012	Copper (34 mg/kg) Iron (28088 mg/kg) Nickel (23 mg/kg) Vanadium (110 mg/kg)
SOU013-013	Copper (35 mg/kg) Vanadium (94 mg/kg)
SOU013-014	Vanadium (86 mg/kg)
SOU013-015	Copper (45 mg/kg) Vanadium (103 mg/kg)
SOU013-016	Copper (32 mg/kg) Lead (57 mg/kg) Vanadium (73 mg/kg)
SOU013-017	Copper (35 mg/kg) Vanadium (93 mg/kg)
SOU013-018	Copper (39 mg/kg) Vanadium (99 mg/kg)
SOU013-019	Copper (31 mg/kg) Vanadium (83 mg/kg)
SOU013-020	Copper (34 mg/kg) Selenium (1 mg/kg) Vanadium (80 mg/kg) Uranium-234 (1.34 pCi/g) Uranium-235 (0.072 pCi/g) Uranium-238 (1.4 pCi/g)
SOU013-021	Copper (33 mg/kg) Vanadium (76 mg/kg)
SOU013-022	Copper (32 mg/kg) Vanadium (108 mg/kg)
SOU013-023	Vanadium (83 mg/kg)
SOU013-024	Selenium (0.97 mg/kg) Vanadium (106 mg/kg) Uranium-235 (0.0702 pCi/g)
SOU013-025	Copper (33 mg/kg) Vanadium (94 mg/kg)
SOU013-026	Copper (186 mg/kg) Iron (41021 mg/kg) Lead (484 mg/kg) Nickel (60 mg/kg) Vanadium (94 mg/kg) Zinc (1043 mg/kg)
SOU013-027	Copper (101 mg/kg) Iron (36780 mg/kg) Lead (165 mg/kg) Nickel (41 mg/kg) Vanadium (87 mg/kg) Zinc (431 mg/kg)
SOU013-028	Copper (43 mg/kg) Selenium (0.89 mg/kg) Vanadium (110 mg/kg) Technetium-99 (8.75 pCi/g) Uranium-234 (1.45 pCi/g) Uranium-235 (0.0875 pCi/g) Uranium-238 (2.04 pCi/g)
SOU013-029	Copper (34 mg/kg) Nickel (22 mg/kg) Vanadium (88 mg/kg)
SOU013-030	Copper (52 mg/kg) Lead (58 mg/kg) Nickel (22 mg/kg) Vanadium (73 mg/kg) Zinc (82 mg/kg)
SOU013-031	Copper (42 mg/kg) Vanadium (92 mg/kg) Zinc (105 mg/kg)
SOU013-032	Copper (73 mg/kg) Lead (198 mg/kg) Nickel (26 mg/kg) Vanadium (93 mg/kg) Zinc (182 mg/kg)
SOU013-033	Copper (57 mg/kg) Iron (43337 mg/kg) Lead (209 mg/kg) Nickel (56 mg/kg) Vanadium (103 mg/kg) Zinc (420 mg/kg)
SOU013-034	Copper (60 mg/kg) Lead (66 mg/kg) Nickel (28 mg/kg) Vanadium (101 mg/kg) Zinc (123 mg/kg)
SOU013-035	Antimony (0.36 mg/kg) Cadmium (0.85 mg/kg) Copper (61 mg/kg) Magnesium (8400 mg/kg) Nickel (39 mg/kg) Selenium (0.92 mg/kg) Uranium (13 mg/kg) Vanadium (158 mg/kg) Zinc (185 mg/kg) Plutonium-239/240 (0.0453 pCi/g) Technetium-99 (20.8 pCi/g) Uranium-234 (2.59 pCi/g) Uranium-235 (0.164 pCi/g) Uranium-238 (5.18 pCi/g)

Figure 5.1.3. SWMU 13 Background Exceedances—Surface Soil (Continued)

SOU013-036	Copper (40 mg/kg) Vanadium (140 mg/kg)
SOU013-037	Copper (46 mg/kg) Silver (146 mg/kg) Vanadium (145 mg/kg)
SOU013-038	Copper (40 mg/kg) Lead (94 mg/kg) Selenium (0.97 mg/kg) Vanadium (118 mg/kg) Uranium-235 (0.0764 pCi/g) Uranium-238 (1.3 pCi/g)
SOU013-039	Copper (51 mg/kg) Lead (87 mg/kg) Nickel (29 mg/kg) Vanadium (97 mg/kg) Zinc (407 mg/kg)
SOU013-040	Copper (29 mg/kg) Selenium (1.2 mg/kg) Vanadium (103 mg/kg) Uranium-235 (0.107 pCi/g)
SOU013-041	Copper (38 mg/kg) Vanadium (81 mg/kg)
SOU013-042	Copper (38 mg/kg) Vanadium (80 mg/kg)
SOU013-043	Copper (34 mg/kg) Vanadium (86 mg/kg)
SOU013-044	Copper (38 mg/kg) Vanadium (76 mg/kg)
SOU013-045	Vanadium (96 mg/kg)
SOU013-046	Copper (36 mg/kg) Lead (152 mg/kg) Nickel (39 mg/kg) Vanadium (71 mg/kg) Zinc (124 mg/kg)
SOU013-047	Copper (45 mg/kg) Iron (30625 mg/kg) Manganese (2072 mg/kg) Vanadium (98 mg/kg)
SOU013-048	Copper (33 mg/kg) Vanadium (79 mg/kg)
SOU013-049	Copper (29 mg/kg) Vanadium (85 mg/kg)
SOU013-050	Copper (39 mg/kg) Vanadium (92 mg/kg)
SOU013-051	Copper (47 mg/kg) Iron (29193 mg/kg) Vanadium (94 mg/kg)
SOU013-052	Copper (89 mg/kg) Iron (29689 mg/kg) Lead (189 mg/kg) Nickel (43 mg/kg) Vanadium (108 mg/kg) Zinc (1038 mg/kg)
SOU013-053	Copper (78 mg/kg) Nickel (23 mg/kg) Vanadium (79 mg/kg)
SOU013-054	Cadmium (0.25 mg/kg) Copper (36 mg/kg) Selenium (0.91 mg/kg) Vanadium (77 mg/kg) Plutonium-239/240 (0.0299 pCi/g) Technetium-99 (2.63 pCi/g) Uranium-234 (1.79 pCi/g) Uranium-235 (0.13 pCi/g) Uranium-238 (2.51 pCi/g)
SOU013-055	Copper (52 mg/kg) Nickel (32 mg/kg) Vanadium (138 mg/kg) Zinc (86 mg/kg)
SOU013-056	Nickel (23 mg/kg) Vanadium (100 mg/kg) Zinc (195 mg/kg)
SOU013-057	Copper (37 mg/kg) Lead (113 mg/kg) Vanadium (126 mg/kg)
SOU013-058	Copper (37 mg/kg) Vanadium (84 mg/kg)
SOU013-059	Copper (43 mg/kg) Lead (72 mg/kg) Vanadium (101 mg/kg)
SOU013-060	Copper (37 mg/kg) Lead (77 mg/kg) Vanadium (91 mg/kg)
SOU013-061	Copper (34 mg/kg) Vanadium (91 mg/kg)
SOU013-062	Copper (43 mg/kg) Iron (39372 mg/kg) Silver (108 mg/kg) Vanadium (123 mg/kg)
SOU013-063	Copper (47 mg/kg) Vanadium (72 mg/kg) Zinc (866 mg/kg)
SOU013-064	Copper (38 mg/kg) Vanadium (99 mg/kg)
SOU013-065	Copper (29 mg/kg) Vanadium (80 mg/kg)
SOU013-066	Copper (29 mg/kg) Vanadium (85 mg/kg)
SOU013-067	Copper (35 mg/kg) Vanadium (78 mg/kg)
SOU013-068	Vanadium (80 mg/kg)
SOU013-069	Copper (32 mg/kg) Iron (30751 mg/kg) Manganese (2156 mg/kg) Vanadium (94 mg/kg)
SOU013-070	Copper (35 mg/kg) Vanadium (99 mg/kg)
SOU013-071	Copper (33 mg/kg) Vanadium (93 mg/kg)
SOU013-072	Copper (38 mg/kg) Vanadium (79 mg/kg)
SOU013-073	Vanadium (72 mg/kg)
SOU013-074	Copper (38 mg/kg) Vanadium (78 mg/kg)
SOU013-075	Copper (32 mg/kg) Vanadium (91 mg/kg)
SOU013-076	Copper (32 mg/kg) Selenium (0.94 mg/kg) Vanadium (86 mg/kg)
SOU013-077	Copper (30 mg/kg) Vanadium (80 mg/kg)
SOU013-078	Copper (37 mg/kg) Vanadium (71 mg/kg)
SOU013-079	Copper (48 mg/kg) Vanadium (109 mg/kg) Zinc (72 mg/kg)
SOU013-080	Copper (39 mg/kg) Iron (31295 mg/kg) Manganese (1843 mg/kg) Vanadium (83 mg/kg)
SOU013-081	Copper (34 mg/kg) Vanadium (70 mg/kg)
SOU013-082	Copper (44 mg/kg) Vanadium (99 mg/kg)
SOU013-083	Copper (33 mg/kg) Iron (40685 mg/kg) Vanadium (106 mg/kg)
SOU013-084	Copper (45 mg/kg) Vanadium (101 mg/kg)

Figure 5.1.3. SWMU 13 Background Exceedances—Surface Soil (Continued)

SOU013-085	Copper (37 mg/kg) Vanadium (105 mg/kg) Zinc (84 mg/kg)
SOU013-086	Copper (42 mg/kg) Vanadium (92 mg/kg)
SOU013-087	Manganese (1752 mg/kg) Vanadium (84 mg/kg) Zinc (69 mg/kg)
SOU013-088	Copper (38 mg/kg) Vanadium (83 mg/kg)
SOU013-089	Copper (31 mg/kg) Vanadium (96 mg/kg)
SOU013-090	Copper (36 mg/kg) Manganese (1927 mg/kg) Vanadium (102 mg/kg)
SOU013-091	Copper (33 mg/kg) Vanadium (80 mg/kg)
SOU013-092	Vanadium (88 mg/kg)
SOU013-093	Copper (35 mg/kg) Vanadium (91 mg/kg)
SOU013-094	Copper (34 mg/kg) Vanadium (85 mg/kg)
SOU013-095	Copper (25 mg/kg) Vanadium (112 mg/kg)
SOU013-096	Copper (32 mg/kg) Vanadium (92 mg/kg)
SOU013-097	Copper (41 mg/kg) Vanadium (111 mg/kg)
SOU013-098	Copper (33 mg/kg) Vanadium (106 mg/kg)
SOU013-099	Copper (39 mg/kg) Vanadium (101 mg/kg)
SOU013-100	Copper (35 mg/kg) Silver (42 mg/kg) Vanadium (85 mg/kg)
SOU013-101	Copper (41 mg/kg) Vanadium (100 mg/kg)
SOU013-102	Copper (39 mg/kg) Vanadium (84 mg/kg)
SOU013-103	Copper (41 mg/kg) Vanadium (104 mg/kg)
SOU013-104	Copper (37 mg/kg) Vanadium (71 mg/kg)
SOU013-105	Copper (47 mg/kg) Iron (47830 mg/kg) Vanadium (115 mg/kg)
SOU013-106	Vanadium (79 mg/kg)
SOU013-107	Copper (35 mg/kg) Vanadium (84 mg/kg)
SOU013-108	Copper (30 mg/kg) Vanadium (99 mg/kg)
SOU013-109	Copper (33 mg/kg) Vanadium (112 mg/kg)
SOU013-110	Copper (37 mg/kg) Nickel (23 mg/kg) Vanadium (139 mg/kg)
SOU013-111	Copper (35 mg/kg) Vanadium (113 mg/kg) Zinc (229 mg/kg)
SOU013-112	Vanadium (78 mg/kg)
SOU013-113	Copper (34 mg/kg) Vanadium (99 mg/kg)
SOU013-114	Copper (33 mg/kg) Vanadium (92 mg/kg)
SOU013-115	Copper (30 mg/kg) Vanadium (89 mg/kg)
SOU013-116	Copper (34 mg/kg) Nickel (24 mg/kg) Vanadium (88 mg/kg)
SOU013-117	Copper (33 mg/kg) Vanadium (83 mg/kg)
SOU013-118	Copper (35 mg/kg) Vanadium (80 mg/kg)
SOU013-119	Copper (31 mg/kg) Vanadium (88 mg/kg)
SOU013-120	Copper (36 mg/kg) Nickel (22 mg/kg) Selenium (0.91 mg/kg) Silver (54 mg/kg) Vanadium (105 mg/kg) Uranium-235 (0.0777 pCi/g)
SOU013-121	Copper (28 mg/kg) Vanadium (82 mg/kg)
SOU013-122	Copper (34 mg/kg) Vanadium (130 mg/kg)
SOU013-123	Copper (36 mg/kg) Vanadium (125 mg/kg)
SOU013-124	Vanadium (116 mg/kg)
SOU013-125	Copper (34 mg/kg) Vanadium (108 mg/kg)
SOU013-126	Iron (30409 mg/kg) Manganese (3114 mg/kg) Vanadium (106 mg/kg)
SOU013-127	Copper (37 mg/kg) Nickel (23 mg/kg) Vanadium (85 mg/kg)
SOU013-128	Copper (41 mg/kg) Vanadium (151 mg/kg)
SOU013-129	Copper (34 mg/kg) Vanadium (139 mg/kg)
SOU013-130	Iron (33717 mg/kg) Manganese (1951 mg/kg) Vanadium (117 mg/kg)
SOU013-131	Copper (32 mg/kg) Vanadium (108 mg/kg)
SOU013-132	Copper (40 mg/kg) Vanadium (119 mg/kg)
SOU013-133	Copper (47 mg/kg) Vanadium (120 mg/kg)
SOU013-134	Copper (35 mg/kg) Vanadium (158 mg/kg)
SOU013-135	Copper (107 mg/kg) Nickel (60 mg/kg) Vanadium (101 mg/kg) Zinc (390 mg/kg)
SOU013-136	Copper (41 mg/kg) Iron (31310 mg/kg) Vanadium (118 mg/kg) Zinc (102 mg/kg)
SOU013-137	Copper (35 mg/kg) Vanadium (99 mg/kg) Zinc (147 mg/kg)
SOU013-138	Antimony (0.22 mg/kg) Lead (293 mg/kg) Vanadium (96 mg/kg) Uranium-235 (0.0838 pCi/g) Uranium-238 (1.24 pCi/g)
SOU013-139	Copper (36 mg/kg) Lead (60 mg/kg) Vanadium (87 mg/kg)
SOU013-140	Copper (47 mg/kg) Nickel (39 mg/kg) Vanadium (149 mg/kg) Zinc (70 mg/kg)

Figure 5.1.3. SWMU 13 Background Exceedances—Surface Soil (Continued)

SOU013-141	Copper (55 mg/kg) Nickel (27 mg/kg) Vanadium (145 mg/kg) Zinc (666 mg/kg)
SOU013-142	Copper (47 mg/kg) Lead (121 mg/kg) Vanadium (123 mg/kg) Zinc (84 mg/kg)
SOU013-143	Antimony (0.23 mg/kg) Chromium (22 mg/kg) Copper (35 mg/kg) Nickel (32 mg/kg) Vanadium (115 mg/kg)
SOU013-144	Copper (41 mg/kg) Iron (37986 mg/kg) Manganese (3088 mg/kg) Selenium (5 mg/kg) Vanadium (108 mg/kg)
SOU013-145	Copper (38 mg/kg) Vanadium (105 mg/kg)
SOU013-146	Copper (39 mg/kg) Vanadium (122 mg/kg)
SOU013-147	Copper (41 mg/kg) Vanadium (101 mg/kg)
SOU013-148	Copper (44 mg/kg) Vanadium (99 mg/kg)
SOU013-149	Copper (64 mg/kg) Nickel (25 mg/kg) Vanadium (138 mg/kg) Zinc (81 mg/kg)
SOU013-150	Copper (159 mg/kg) Lead (90 mg/kg) Nickel (61 mg/kg) Vanadium (116 mg/kg) Zinc (183 mg/kg)
SOU013-151	Copper (48 mg/kg) Nickel (26 mg/kg) Vanadium (120 mg/kg) Zinc (100 mg/kg)
SOU013-152	Copper (37 mg/kg) Nickel (24 mg/kg) Selenium (0.86 mg/kg) Silver (124 mg/kg) Vanadium (117 mg/kg)
SOU013-153	Copper (46 mg/kg) Iron (33608 mg/kg) Vanadium (145 mg/kg) Zinc (97 mg/kg)
SOU013-154	Copper (29 mg/kg) Vanadium (94 mg/kg)
SOU013-155	Copper (36 mg/kg) Vanadium (112 mg/kg)
SOU013-156	Copper (31 mg/kg) Selenium (0.91 mg/kg) Vanadium (92 mg/kg) Technetium-99 (2.56 pCi/g) Uranium-234 (1.84 pCi/g) Uranium-235 (0.117 pCi/g) Uranium-238 (2.07 pCi/g)
SOU013-157	Copper (39 mg/kg) Vanadium (75 mg/kg)
SOU013-158	Copper (40 mg/kg) Silver (34 mg/kg) Vanadium (76 mg/kg)
SOU013-RAD	Uranium (18.2 mg/kg) Neptunium-237 (0.89 pCi/g) Plutonium-239/240 (0.128 pCi/g) Technetium-99 (6.81 pCi/g) Uranium-234 (4.35 pCi/g) Uranium-235 (0.311 pCi/g) Uranium-238 (6.08 pCi/g)
SOU013-RAD2	Neptunium-237 (1.08 pCi/g) Plutonium-239/240 (0.173 pCi/g) Technetium-99 (142 pCi/g) Thorium-230 (1.51 pCi/g) Uranium-234 (30.7 pCi/g) Uranium-235 (2.11 pCi/g) Uranium-238 (62.9 pCi/g)
SYP002	Uranium-238 (1.31 pCi/g)
SYP003	Uranium-238 (1.32 pCi/g)
SYP007	Uranium-238 (1.32 pCi/g)

Figure 5.1.3. SWMU 13 Background Exceedances—Surface Soil (Continued)

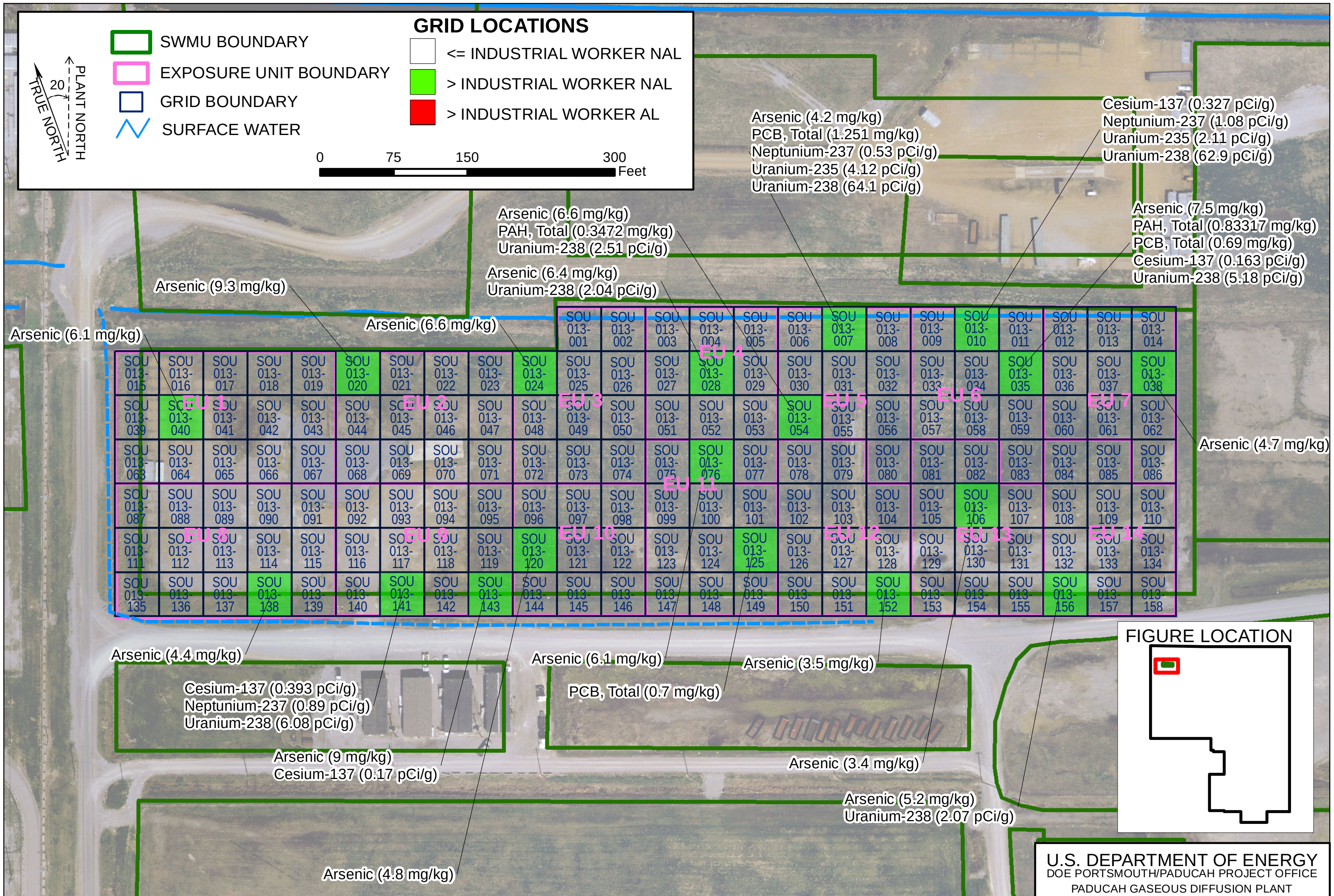

Figure 5.1.4. SWMU 13 NAL Exceedances—Surface Soil

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3/12/2015

Metals

Metals were not detected in the surface soil above both background screening levels and the industrial worker NALs. No metals exceed ALs in SWMU 13 surface soils.

The following metals were detected in the SWMU 13 surface soil above both the SSLs for the protection of UCRS groundwater and background screening levels.

Metal	Grid	EU
Aluminum	7	5
Antimony	7, 35	5, 6
Cadmium	7, 35	5, 6
Copper	2, 3, 7, 26, 27, 30, 32, 33, 34, 35, 37, 39, 51, 52, 53, 55, 63, 79, 105, 133, 135, 140, 141, 142, 149, 150, 151, 153	1, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 14
Iron	12, 26, 27, 33, 47, 51, 52, 62, 69, 80, 83, 105, 126, 130, 136, 144, 153	2, 3, 4, 5, 6, 7, 8, 10, 12, 13
Lead	3, 7, 8, 16, 26, 27, 30, 32, 33, 34, 38, 39, 46, 52, 57, 59, 60, 138, 139, 142, 150	1, 2, 3, 4, 5, 6, 7, 8, 9, 12
Manganese	2, 47, 69, 80, 87, 90, 126, 130, 144	2, 3, 5, 8, 10, 12, 13
Molybdenum[1]	2, 11, 20, 24, 28, 30, 33, 35, 38, 39, 40, 54, 76, 92, 97, 106, 120, 121, 123, 127, 138, 143, 148, 152, 153, 155, 156	All EUs
Nickel	2, 3, 7, 12, 26, 27, 29, 30, 32, 33, 34, 35, 37, 39, 46, 50, 52, 53, 55, 56, 61, 110, 116, 120, 127, 135, 136, 140, 141, 143, 149, 150, 151, 152	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14
Selenium	20, 24, 28, 35, 38, 40, 54, 76, 120, 144, 152, 156	1, 2, 3, 4, 5, 6, 7, 10, 11, 12, 14
Silver	37, 62, 100, 120, 152, 158	7, 11, 10, 12, 14
Uranium	7, 10, 141	5, 6, 9
Vanadium	All grids	All EUs
Zinc	2, 3, 7, 9, 26, 27, 30, 31, 32, 33, 34, 35, 39, 46, 52, 55, 56, 63, 79, 85, 87, 111, 135, 136, 137, 140, 141, 142, 149, 150, 151, 153	1, 2, 3, 4, 5, 6, 8, 9, 11, 12, 13, 14

[1] No soil background value is available.

The following were detected above the SSLs for the protection of RGA groundwater and the background screening levels.

Metal	Grid	EU
Iron	12, 26, 27, 33, 47, 51, 52, 62, 69, 80, 83, 105, 126, 130, 136, 144, 153	2, 3, 4, 5, 6, 7, 8, 10, 12, 13
Manganese	2, 47, 69, 80, 87, 90, 126, 130, 144	2, 3, 5, 8, 10, 12, 13
Molybdenum[1]	2, 11, 30, 33, 39, 92, 97, 121, 123, 127, 148, 153, 155	1, 3, 5, 6, 9, 10, 11, 12, 13
Silver	37, 62, 100, 120, 152, 158	7, 10, 11, 12, 14

[1] No soil background value is available.

PCBs

Total PCBs were detected above the industrial worker NALs in the surface soil in grids 7 (EU 5), 35 (EU 6), and 125 (EU 11). No PCBs were detected above the industrial worker ALs.

Total PCBs were detected in the SWMU 13 surface soil above the SSLs for the protection of UCRS groundwater in grid 7 (EU 5), grid 28 (EU 4), grid 35 (EU 6), grid 54 (EU 5), grid 125 (EU 11), grid 156 (EU 14). None were detected above SSLs for the protection of RGA groundwater.

SVOCs

Total PAHs were detected above industrial worker NALs in the surface soil in two grids: 35 (EU 6) and 54 (EU 5). No SVOCs were detected in the SWMU 13 surface soil above industrial worker ALs.

Of the SVOCs, phenanthrene (grid 7, EU 5; grid 35, EU 6; and grid 54, EU 5) and Total PAHs (grid 35, EU 6 and grid 54, EU 5) were detected above the SSLs for the protection of UCRS groundwater. None were detected above the SSLs for the protection of RGA groundwater.

VOCs

No VOCs were sampled for this unit.

Radionuclides

The following are the radioisotopes that were above both the background screening levels and the industrial worker NALs and the grids and EUs in which they were found.

Radioisotope	Grid	EU
Neptunium-237[1]	7, 10, 141	5, 6, 9
Uranium-235	7, 10	5, 6
Uranium-238	7, 10, 28, 35, 54, 141, 156	4, 5, 6, 9, 14

[1] No soil background value is available.

No radionuclides were detected above industrial worker ALs in the SWMU 13 surface soil.

The following were detected above both the background screening levels and SSLs for the protection of UCRS.

Radioisotope	Grid	EU
Neptunium-237	7, 10, 141	5, 6, 9
Tc-99	7, 10, 28, 35, 54, 141, 156	4, 5, 6, 9, 14
Uranium-234	7, 10, 20, 28, 35, 54, 141, 156	2, 4, 5, 6, 9, 14
Uranium-235	7, 10, 20, 24, 28, 35, 38, 40, 54, 120, 138, 141, 156	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 14
Uranium-238	7, 10, 20, 28, 35, 38, 53, 54, 57, 59, 138, 141, 156	2, 4, 5, 6, 7, 8, 9, 14

Tc-99 in grid 7 (EU 5), grid 10 (EU 6), grid 28 (EU 4), grid 35 (EU 6), grid 54 (EU 5), grid 141 (EU 9), grid 156 (EU 14); uranium-234 in grid 7, grid 10, and grid 141; uranium-235 in grid 10; and uranium-238 in grid 7, grid 10, grid 35, grid 54, and grid 141 were detected above both the background screening levels and the SSLs for the protection of RGA groundwater.

5.1.4 Nature and Extent of Contamination—Subsurface Soils

The representative data set presented in Table 5.1.2 provides the nature of contamination in SWMU 13 subsurface soils, and Figures 5.1.5–5.1.7 illustrate the horizontal extent. A complete list of detailed sampling results, including sampling depths, is provided in Appendix F (samples with ending depths

Table 5.1.2. Subsurface Soil Data Summary: SWMU 13

			Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
Type	**Analysis**	**Unit**	**Min**	**Max**	**Avg**	**FOD**	**FOD**	**FOE**	**Bkgd**	**FOE**	**NAL**	**FOE**	**AL**	**RGA**	**UCRS**	**DL Range**
METAL	Aluminum	mg/kg	2.82E+03	1.02E+04	6.22E+03	0/66	66/66	0/66	1.20E+04	0/66	1.00E+05	0/66	1.00E+05	0/66	64/66	17.2–39.8
METAL	Antimony	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	2.10E-01	0/66	9.34E+01	0/66	2.80E+03	0/66	0/66	5.27–9.97
METAL	Arsenic	mg/kg	8.88E-01	3.65E+00	1.91E+00	0/66	20/66	0/66	7.90E+00	11/66	1.41E+00	0/66	1.41E+02	0/66	20/66	0.855–19.8
METAL	Barium	mg/kg	4.94E+01	1.78E+02	9.41E+01	0/30	30/30	1/30	1.70E+02	0/30	4.04E+04	0/30	1.00E+05	0/30	19/30	2.15–2.47
METAL	Beryllium	mg/kg	4.58E-01	9.40E-01	6.07E-01	0/66	14/66	4/66	6.90E-01	0/66	4.50E+02	0/66	1.35E+04	0/66	0/66	0.428–0.497
METAL	Cadmium	mg/kg	1.80E+00	6.78E+00	3.08E+00	0/66	8/66	8/66	2.10E-01	0/66	6.12E+01	0/66	1.84E+03	0/66	8/66	1.71–1.99
METAL	Calcium	mg/kg	4.28E+02	9.14E+04	7.72E+03	0/66	65/66	17/66	6.10E+03	0/66	N/A	0/66	N/A	N/A	N/A	85.5–1000
METAL	Chromium	mg/kg	2.94E+00	1.64E+02	1.23E+01	0/66	66/66	1/66	4.30E+01	0/66	1.98E+02	0/66	1.98E+04	0/66	0/66	2.14–2.48
METAL	Copper	mg/kg	2.43E+00	4.31E+01	8.65E+00	0/66	53/66	3/66	2.50E+01	0/66	9.34E+03	0/66	1.00E+05	0/66	0/66	2.14–2.48
METAL	Iron	mg/kg	2.17E+03	1.38E+04	6.08E+03	0/36	36/36	0/36	2.80E+04	0/36	1.00E+05	0/36	1.00E+05	36/36	36/36	17.1–19.9
METAL	Lead	mg/kg	2.04E+01	4.99E+01	3.71E+01	0/30	3/30	2/30	2.30E+01	0/30	8.00E+02	0/30	8.00E+02	0/30	3/30	17.2–19.8
METAL	Manganese	mg/kg	1.53E+01	3.47E+02	7.71E+01	0/36	36/36	0/36	8.20E+02	0/36	4.72E+03	0/36	1.00E+05	3/36	36/36	2.14–2.48
METAL	Mercury	mg/kg	1.20E-02	4.80E-02	1.88E-02	0/66	9/66	0/66	1.30E-01	0/66	7.01E+01	0/66	2.10E+03	0/66	1/66	0.01–0.2
METAL	Molybdenum	mg/kg	N/A	N/A	N/A	0/36	0/36	0/36	N/A	0/36	1.17E+03	0/36	3.51E+04	0/36	0/36	1.32–2.49
METAL	Nickel	mg/kg	4.47E+00	2.04E+01	7.90E+00	0/66	42/66	0/66	2.20E+01	0/66	4.30E+03	0/66	1.00E+05	0/66	42/66	4.28–4.97
METAL	Selenium	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	7.00E-01	0/66	1.17E+03	0/66	3.51E+04	0/66	0/66	0.855–19.8
METAL	Silver	mg/kg	2.81E+00	2.81E+00	2.81E+00	0/66	1/66	1/66	2.70E+00	0/66	1.17E+03	0/66	3.51E+04	0/66	1/66	1.32–2.49
METAL	Thallium	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	3.40E-01	0/66	2.34E+00	0/66	7.02E+01	0/66	0/66	1.71–19.8
METAL	Uranium	mg/kg	9.29E-01	9.29E-01	9.29E-01	0/36	1/36	0/36	4.60E+00	0/36	6.81E+02	0/36	2.04E+04	0/36	0/36	0.855–0.994
METAL	Vanadium	mg/kg	3.59E+00	3.93E+01	1.50E+01	0/66	66/66	2/66	3.70E+01	0/66	1.15E+03	0/66	3.45E+04	0/66	52/66	2.14–2.48
METAL	Zinc	mg/kg	1.95E+01	1.37E+02	4.14E+01	0/66	26/66	5/66	6.00E+01	0/66	7.01E+04	0/66	1.00E+05	0/66	7/66	17.1–19.9
PPCB	PCB, Total	mg/kg	1.20E-01	9.90E-01	4.15E-01	0/66	10/66	0/66	N/A	6/66	3.05E-01	0/66	3.05E+01	0/66	10/66	0.09–0.13
SVOA	1,2,4-Trichlorobenzene	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	1,2-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	1,3-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	1,4-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	2,4,5-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	2,4,6-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	2,4-Dichlorophenol	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	2,4-Dimethylphenol	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	2,4-Dinitrophenol	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	2,4-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	2,6-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	2-Chloronaphthalene	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	2-Chlorophenol	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	2-Methyl-4,6-dinitrophenol	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	2-Methylnaphthalene	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	2-Methylphenol	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	2-Nitrophenol	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	4-Bromophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	4-Chloro-3-methylphenol	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	4-Chlorophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	4-Nitrophenol	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	Acenaphthene	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	1.40E+03	0/66	4.20E+04	0/66	0/66	0.47–0.5
SVOA	Acenaphthylene	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	1.40E+03	0/66	4.20E+04	N/A	N/A	0.47–0.5
SVOA	Anthracene	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	6.99E+03	0/66	2.10E+05	0/66	0/66	0.47–0.5
SVOA	Benzo(ghi)perylene	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	N/A	0/66	N/A	N/A	N/A	0.47–0.5
SVOA	Bis(2-chloroethoxy)methane	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	Bis(2-chloroethyl) ether	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	Bis(2-chloroisopropyl) ether	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	Bis(2-ethylhexyl)phthalate	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	5.88E+01	0/30	5.88E+03	0/30	0/30	0.47–0.5
SVOA	Butyl benzyl phthalate	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	Diethyl phthalate	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.1.2. Subsurface Soil Data Summary: SWMU 13 (Continued)

Type	Analysis	Unit	Detected Results Min	Detected Results Max	Detected Results Avg	J-qualified FOD	FOD	Provisional Background FOE	Provisional Background Bkgd	Industrial Worker FOE	Industrial Worker NAL	Industrial Worker FOE	Industrial Worker AL	GW Protection Screen RGA	GW Protection Screen UCRS	DL Range
SVOA	Dimethyl phthalate	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	Di-n-butyl phthalate	mg/kg	4.90E-01	6.80E+00	1.53E+00	2/66	17/66	0/66	N/A	0/66	N/A	0/66	N/A	N/A	N/A	0.47–0.5
SVOA	Di-n-octylphthalate	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	Fluoranthene	mg/kg	7.10E-01	1.40E+00	9.52E-01	0/66	5/66	0/66	N/A	0/66	9.32E+02	0/66	2.80E+04	0/66	0/66	0.47–0.5
SVOA	Fluorene	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	9.32E+02	0/66	2.80E+04	0/66	0/66	0.47–0.5
SVOA	Hexachlorobenzene	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	5.15E-01	0/30	5.15E+01	0/30	0/30	0.47–0.5
SVOA	Hexachlorobutadiene	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	Hexachlorocyclopentadiene	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	Hexachloroethane	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	Isophorone	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	m,p-Cresol	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	Naphthalene	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	1.67E+01	0/66	1.61E+03	0/66	0/66	0.47–0.5
SVOA	Nitrobenzene	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	N-Nitroso-di-n-propylamine	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	1.18E-01	0/30	1.18E+01	0/30	0/30	0.47–0.5
SVOA	N-Nitrosodiphenylamine	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	PAH, Total	mg/kg	5.16E-02	1.23E+00	6.41E-01	0/66	2/66	0/66	N/A	1/66	8.94E-02	0/66	8.94E+00	0/66	1/66	–
SVOA	Pentachlorophenol	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	8.91E-01	0/30	8.91E+01	N/A	N/A	0.47–0.5
SVOA	Phenanthrene	mg/kg	5.40E-01	5.50E-01	5.45E-01	0/66	2/66	0/66	N/A	0/66	1.40E+03	0/66	4.20E+04	0/66	2/66	0.47–0.5
SVOA	Phenol	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	Pyrene	mg/kg	5.80E-01	1.70E+00	9.04E-01	0/66	5/66	0/66	N/A	0/66	6.99E+02	0/66	2.10E+04	0/66	1/66	0.47–0.5
SVOA	Pyridine	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.47–0.5
SVOA	Total Cresols	mg/kg	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.94–1
VOA	1,1,1,2-Tetrachloroethane	mg/kg	N/A	N/A	N/A	0/36	0/36	0/36	N/A	0/36	N/A	0/36	N/A	N/A	N/A	0.00497–0.00504
VOA	1,1,1-Trichloroethane	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	3.58E+03	0/66	1.07E+05	0/66	0/66	0.00497–0.00504
VOA	1,1,2,2-Tetrachloroethane	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	N/A	0/66	N/A	N/A	N/A	0.00497–0.01
VOA	1,1,2-Trichloroethane	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	6.32E-01	0/66	1.90E+01	0/66	0/66	0.00497–0.00504
VOA	1,1-Dichloroethane	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	1.58E+01	0/66	1.58E+03	0/66	0/66	0.00497–0.00504
VOA	1,1-Dichloroethene	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	1.00E+02	0/66	3.00E+03	0/66	0/66	0.00497–0.00504
VOA	1,2,3-Trichloropropane	mg/kg	N/A	N/A	N/A	0/36	0/36	0/36	N/A	0/36	N/A	0/36	N/A	N/A	N/A	0.00497–0.00504
VOA	1,2-Dichloroethane	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	2.09E+00	0/66	2.09E+02	0/66	0/66	0.00497–0.00504
VOA	1,2-Dichloropropane	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	N/A	0/66	N/A	N/A	N/A	0.00497–0.00504
VOA	1,2-Dimethylbenzene	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	2.81E+02	0/66	8.43E+03	0/66	0/66	0.00497–0.00504
VOA	2-Butanone	mg/kg	6.20E-03	4.20E-02	1.57E-02	8/66	22/66	0/66	N/A	0/66	N/A	0/66	N/A	N/A	N/A	0.00497–0.00504
VOA	2-Chloroethyl vinyl ether	mg/kg	N/A	N/A	N/A	0/36	0/36	0/36	N/A	0/36	N/A	0/36	N/A	N/A	N/A	0.00497–0.0101
VOA	2-Hexanone	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	N/A	0/66	N/A	N/A	N/A	0.00497–0.00504
VOA	4-Methyl-2-pentanone	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	N/A	0/66	N/A	N/A	N/A	0.00497–0.00504
VOA	Acetone	mg/kg	5.45E-03	9.80E-02	3.78E-02	22/66	25/66	0/66	N/A	0/66	N/A	0/66	N/A	N/A	N/A	0.00497–0.00504
VOA	Acrolein	mg/kg	N/A	N/A	N/A	0/36	0/36	0/36	N/A	0/36	N/A	0/36	N/A	N/A	N/A	0.00497–0.00504
VOA	Acrylonitrile	mg/kg	N/A	N/A	N/A	0/36	0/36	0/36	N/A	0/36	1.24E+00	0/36	1.24E+02	0/36	0/36	0.00497–0.00504
VOA	Benzene	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	5.31E+00	0/66	5.31E+02	0/66	0/66	0.00497–0.00504

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.1.2. Subsurface Soil Data Summary: SWMU 13 (Continued)

Type	Analysis	Unit	Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		DL Range
			Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	
VOA	Bromodichloromethane	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	1.30E+00	0/66	1.30E+02	0/66	0/66	0.00497–0.00504
VOA	Bromoform	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	N/A	0/66	N/A	N/A	N/A	0.00497–0.00504
VOA	Bromomethane	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	N/A	0/66	N/A	N/A	N/A	0.00497–0.00504
VOA	Carbon disulfide	mg/kg	6.80E-03	7.60E-03	6.99E-03	9/66	29/66	0/66	N/A	0/66	N/A	0/66	N/A	N/A	N/A	0.00497–0.00504
VOA	Carbon tetrachloride	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	2.96E+00	0/66	2.96E+02	0/66	0/66	0.00497–0.00504
VOA	Chlorobenzene	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	N/A	0/66	N/A	N/A	N/A	0.00497–0.00504
VOA	Chloroethane	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	N/A	0/66	N/A	N/A	N/A	0.00497–0.00504
VOA	Chloroform	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	1.39E+00	0/66	1.39E+02	0/66	0/66	0.00497–0.00504
VOA	Chloromethane	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	N/A	0/66	N/A	N/A	N/A	0.00497–0.00504
VOA	*cis*-1,2-Dichloroethene	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	4.67E+02	0/66	1.40E+04	0/66	0/66	0.00497–0.00504
VOA	*cis*-1,3-Dichloropropene	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	N/A	0/66	N/A	N/A	N/A	0.00497–0.00504
VOA	Dibromochloromethane	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	N/A	0/66	N/A	N/A	N/A	0.00497–0.00504
VOA	Dibromomethane	mg/kg	N/A	N/A	N/A	0/36	0/36	0/36	N/A	0/36	N/A	0/36	N/A	N/A	N/A	0.00497–0.00504
VOA	Dichlorodifluoromethane	mg/kg	5.86E-03	5.86E-03	5.86E-03	1/36	1/36	0/36	N/A	0/36	3.68E+01	0/36	1.10E+03	0/36	0/36	0.00497–0.00504
VOA	Ethyl methacrylate	mg/kg	N/A	N/A	N/A	0/36	0/36	0/36	N/A	0/36	N/A	0/36	N/A	N/A	N/A	0.00497–0.00504
VOA	Ethylbenzene	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	2.66E+01	0/66	2.66E+03	0/66	0/66	0.00497–0.00504
VOA	Iodomethane	mg/kg	N/A	N/A	N/A	0/36	0/36	0/36	N/A	0/36	N/A	0/36	N/A	N/A	N/A	0.00497–0.00504
VOA	m,p-Xylene	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	2.54E+02	0/66	7.62E+03	0/66	0/66	0.005–0.0101
VOA	Methylene chloride	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	N/A	0/66	N/A	N/A	N/A	0.00497–0.00504
VOA	Styrene	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	N/A	0/66	N/A	N/A	N/A	0.00497–0.00504
VOA	Tetrachloroethene	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	4.00E+01	0/66	1.20E+03	N/A	N/A	0.00497–0.00504
VOA	Toluene	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	6.25E+03	0/66	1.88E+05	0/66	0/66	0.00497–0.00504
VOA	*trans*-1,2-Dichloroethene	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	6.51E+01	0/66	1.95E+03	0/66	0/66	0.00497–0.00504
VOA	*trans*-1,3-Dichloropropene	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	N/A	0/66	N/A	N/A	N/A	0.00497–0.00504
VOA	*trans*-1,4-Dichloro-2-butene	mg/kg	N/A	N/A	N/A	0/36	0/36	0/36	N/A	0/36	N/A	0/36	N/A	N/A	N/A	0.00497–0.00504
VOA	Trichloroethene	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	1.90E+00	0/66	5.70E+01	0/66	0/66	0.00497–0.00504
VOA	Trichlorofluoromethane	mg/kg	N/A	N/A	N/A	0/36	0/36	0/36	N/A	0/36	N/A	0/36	N/A	N/A	N/A	0.00497–0.00504
VOA	Vinyl acetate	mg/kg	N/A	N/A	N/A	0/36	0/36	0/36	N/A	0/36	N/A	0/36	N/A	N/A	N/A	0.00497–0.00504
VOA	Vinyl chloride	mg/kg	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	2.06E+00	0/66	2.06E+02	0/66	0/66	0.00497–0.00504
RADS	Americium-241	pCi/g	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	5.99E+00	0/66	5.99E+02	0/66	0/66	0.0481–0.0947
RADS	Cesium-137	pCi/g	3.24E-02	5.62E-01	1.58E-01	0/66	10/66	2/66	2.80E-01	4/66	1.02E-01	0/66	1.02E+01	0/66	1/66	0.022–0.0386
RADS	Cobalt-60	pCi/g	9.70E-02	9.70E-02	9.70E-02	0/30	1/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	0.029–0.041

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.1.2. Subsurface Soil Data Summary: SWMU 13 (Continued)

Type	Analysis	Unit	Detected Results Min	Detected Results Max	Detected Results Avg	J-qualified FOD	FOD	Provisional Background FOE	Provisional Background Bkgd	Industrial Worker FOE	Industrial Worker NAL	Industrial Worker FOE	Industrial Worker AL	GW Protection Screen RGA	GW Protection Screen UCRS	DL Range
RADS	Neptunium-237	pCi/g	5.70E-02	1.51E-01	1.02E-01	0/66	4/66	0/66	N/A	0/66	2.29E-01	0/66	2.29E+01	0/66	4/66	0.0306–0.0588
RADS	Plutonium-238	pCi/g	N/A	N/A	N/A	0/66	0/66	0/66	N/A	0/66	2.87E+01	0/66	2.87E+03	0/66	0/66	0.0122–0.0559
RADS	Plutonium-239/240	pCi/g	8.33E-02	1.31E-01	1.07E-01	0/66	3/66	0/66	N/A	0/66	2.47E+01	0/66	2.47E+03	0/66	0/66	0.0117–0.0926
RADS	Potassium-40	pCi/g	6.05E+00	1.16E+01	9.89E+00	0/30	30/30	0/30	1.60E+01	0/30	N/A	0/30	N/A	N/A	N/A	0.23–0.362
RADS	Radium-226	pCi/g	3.79E-01	4.89E-01	4.34E-01	0/30	2/30	0/30	1.50E+00	0/30	N/A	0/30	N/A	N/A	N/A	0.0937–0.197
RADS	Strontium-90	pCi/g	N/A	N/A	N/A	0/30	0/30	0/30	N/A	0/30	N/A	0/30	N/A	N/A	N/A	1.17–1.54
RADS	Technetium-99	pCi/g	1.84E+00	1.81E+01	5.58E+00	0/66	10/66	7/66	2.80E+00	0/66	1.20E+03	0/66	1.20E+05	10/66	10/66	0.681–1.78
RADS	Thorium-228	pCi/g	6.55E-01	1.36E+00	1.01E+00	0/66	36/66	0/66	1.60E+00	0/66	N/A	0/66	N/A	N/A	N/A	0.187–0.989
RADS	Thorium-230	pCi/g	4.87E-01	1.30E+00	8.09E-01	0/66	47/66	0/66	1.40E+00	0/66	3.39E+01	0/66	3.39E+03	0/66	0/66	0.175–0.509
RADS	Thorium-232	pCi/g	2.26E-01	1.35E+00	7.07E-01	0/66	66/66	0/66	1.50E+00	0/66	N/A	0/66	N/A	N/A	N/A	0.098–0.331
RADS	Uranium-234	pCi/g	2.48E-01	3.48E+00	6.58E-01	0/66	51/66	6/66	1.20E+00	0/66	5.53E+01	0/66	5.53E+03	1/66	51/66	0.0345–2.48
RADS	Uranium-235	pCi/g	2.35E-02	2.03E-01	6.91E-02	0/66	12/66	4/66	6.00E-02	0/66	3.40E-01	0/66	3.40E+01	0/66	5/66	0.0189–0.464
RADS	Uranium-238	pCi/g	2.45E-01	6.42E+00	1.07E+00	0/66	51/66	15/66	1.20E+00	7/66	1.60E+00	0/66	1.60E+02	6/66	51/66	0.0102–0.552

One or more samples exceed AL value
One or more samples exceed NAL value
One or more samples exceed background value
One or more samples exceed SSLs of RGA and UCRS groundwater protection

Counts of analyses are based on the maximum detected result from a sample (i.e., if a sample has analytical results from two different labs, only the maximum value is counted).
Field replicates, or separate samples are counted independently.

The uranium (metal)/uranium (isotopic) may not be from the same sample thus a correlation between uranium (metal)/uranium (isotopic) data may not be possible.
Uranium-238 that was analyzed using method RL-7128NITRIC is compared to a background value of 0.4 pCi/g for surface and subsurface.

Screening values are shown in Appendices C and D.

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

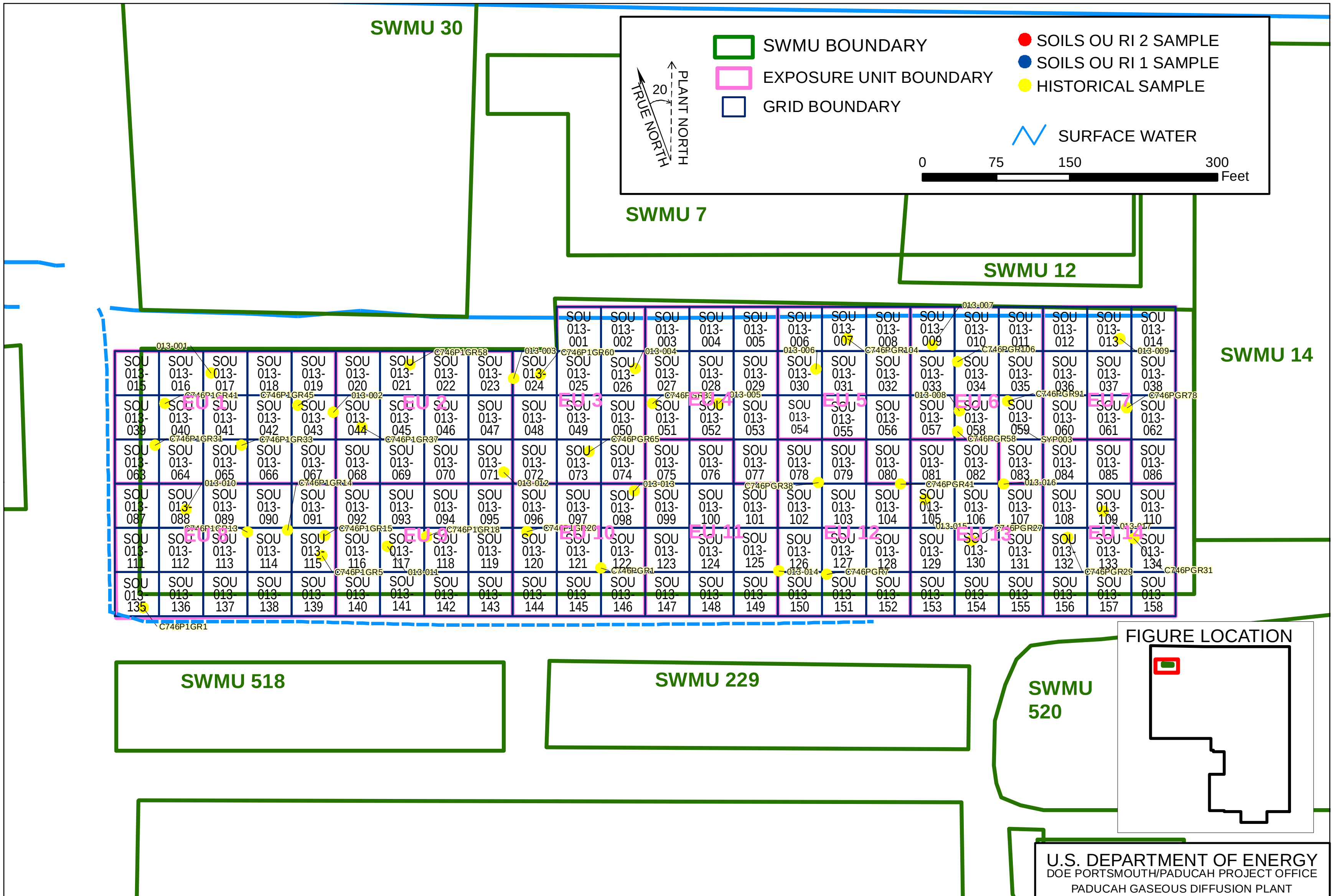

Figure 5.1.5. SWMU 13 Sample Locations—Subsurface Soil

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1/15/2015

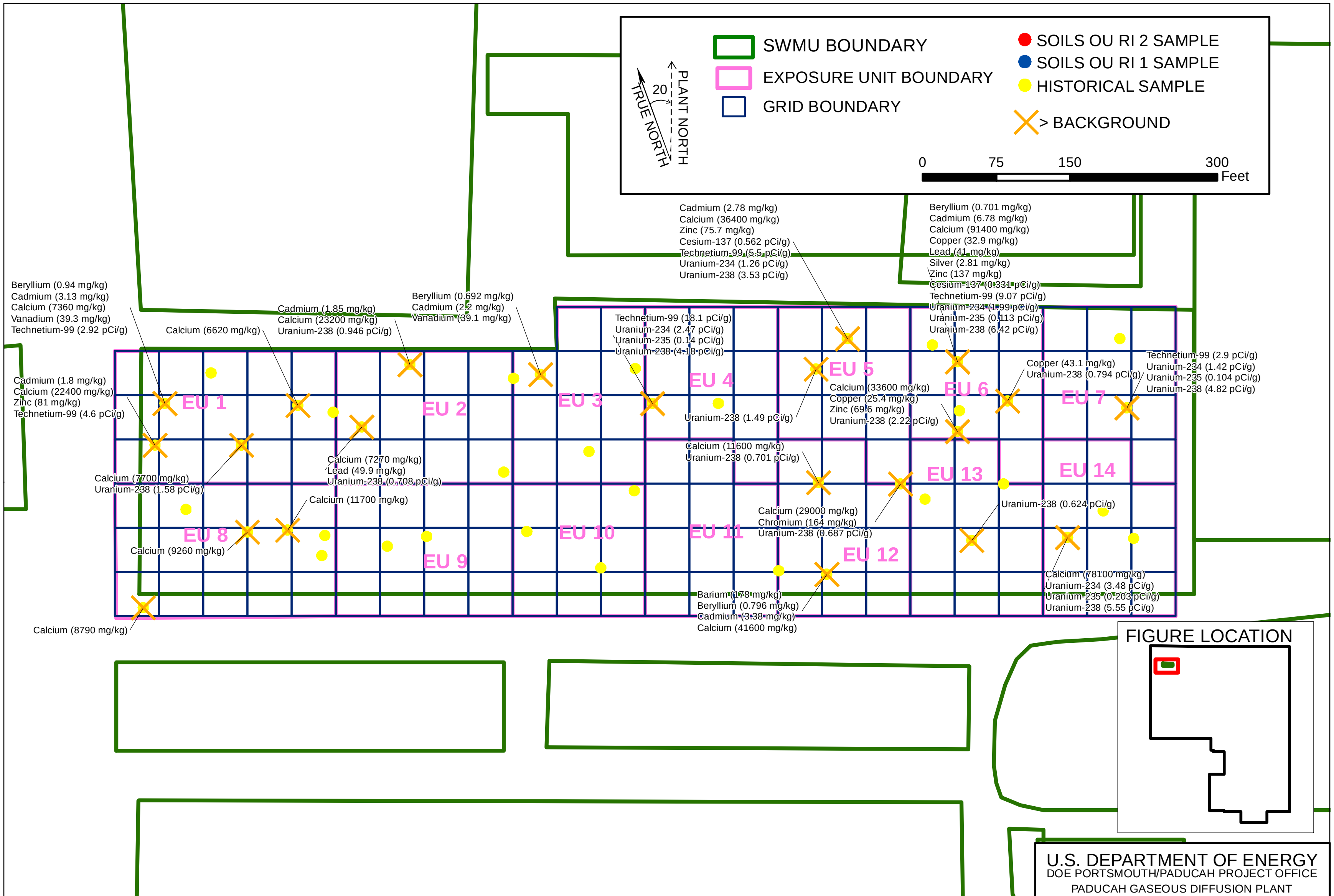

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Figure 5.1.6. SWMU 13 Background Exceedances—Subsurface Soil

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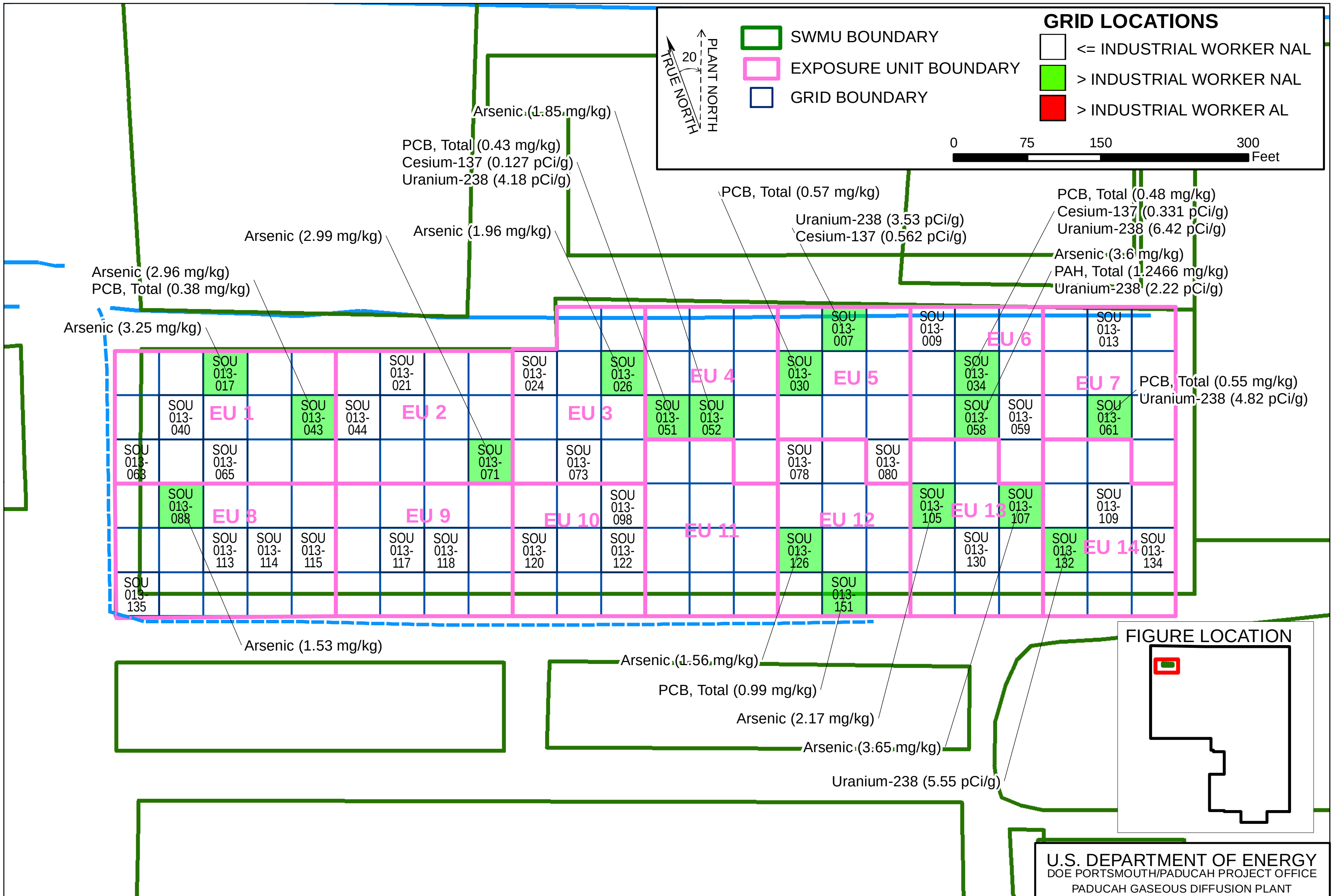

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Figure 5.1.7. SWMU 13 NAL Exceedances—Subsurface Soil

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greater than 1 ft bgs are considered subsurface soils in this nature and extent section). Grid numbers shown below are truncated from the figures. Figures contain the SWMU#–grid#, with zeros filling the appropriate spaces to make three digits.

The horizontal and vertical extent of SWMU 13 subsurface soil contamination is considered defined adequately for supporting the BRA and FS. There is some uncertainty with vertical extent; however, this will be addressed in the FS.

Metals

No metals were detected above both the industrial worker NALs and background screening levels in the SWMU 13 subsurface soil. No metals were detected above the industrial worker ALs in the SWMU 13 subsurface soil.

The following metals were detected in the SWMU 13 subsurface soil above both the background screening levels (if available) and the SSLs for the protection of UCRS groundwater.

Metal	Grid	EU
Barium	151	12
Cadmium	7, 21, 24, 34, 40, 63, 151	1, 2, 3, 5, 6, 12
Lead	34, 44	2, 6
Silver	34	6
Vanadium	24, 40	1, 3
Zinc	7, 34, 58, 63	1, 5, 6

No metals were detected above both the background screening levels and the SSLs for the protection of RGA groundwater.

PCBs

Total PCBs were detected above industrial worker NALs in the subsurface soil of grids 30 (EU 5), 34 (EU 6), 43 (EU 1), 51 (EU 4), 61 (EU 7), and 151 (EU 12). Only grid 151 is on the border of SWMU 13. The grid is on the southern boundary of SWMU 13 bounded by a road.

The PCBs were detected above industrial worker NALs to a maximum depth of 15 ft bgs. The end depth of the borehole from which the 15 ft bgs sample was taken was 18 ft bgs. The dataset for this RI Report includes only results for samples taken at or above 16 ft bgs, per the Work Plan (DOE 2010a). The Soils OU is defined in the SMP as soils to 10 ft bgs (or 16 ft bgs at pipelines). No PCBs were detected above industrial worker ALs in SWMU 13 subsurface soil.

Total PCBs were detected above the SSLs for the protection of the UCRS [grids 7 and 30 (EU 5), 34 (EU 6), 43 (EU 1), 51 (EU 4), 58 (EU 6), 61 (EU 7), and 78 and 151 (EU 12)], but not above the SSLs for the protection of the RGA.

SVOCs

PAHs were detected above industrial worker NALs in the SWMU 13 subsurface soil. No SVOCs were detected above industrial worker ALs in the SWMU 13 subsurface soil.

Phenanthrene (grid 7, EU 5 and grid 63, EU 1), pyrene (grid 58, EU 6), and total PAHs (grid 58, EU 6) were detected above the SSLs for the protection of UCRS groundwater. No SVOCs were detected above the SSLs for the protection of RGA groundwater.

<u>VOCs</u>

No VOCs were detected above the industrial worker NALs or ALs in the SWMU 13 subsurface soil. Further, no VOCs were detected above the SSLs for the protection of UCRS or RGA groundwater.

<u>Radionuclides</u>

Cesium-137 and uranium-238 were detected above the industrial worker NALs in the SWMU 13 subsurface soil. Cesium-137 was detected at or above both background screening levels and the industrial worker NALs in grids 7 and 34 in EUs 5 and 6, respectively. Uranium-238 was detected above both background screening levels and the industrial worker NALs in grids 7, 34, 51, 58, 61, and 132 in EUs 5, 6, 4, 6, 7, and 14, respectively. The maximum depth of the radionuclide above both background screening levels and the industrial worker NALs was 3.5 ft bgs. Only grid 7 is on the border of SWMU 13. The grid is on the northern boundary of SWMU 13 bounded by a ditch. No radionuclides were detected above the industrial worker ALs in the SWMU 13 subsurface soil.

The following radionuclides were detected in the SWMU 13 subsurface soil above both the background screening levels (if available) and the SSLs for the protection of UCRS groundwater.

Radionuclide	Grid	EU
Cesium-137	7	5
Neptunium-237[1]	7, 30, 34, 51	4, 5, 6
Tc-99	7, 34, 40, 51, 61, 63	1, 4, 5, 6, 7
Uranium-234	7, 34, 51, 61, 132	4, 5, 6, 7, 14
Uranium-235	34, 51, 61, 132	4, 6, 7, 14
Uranium-238	7, 30, 34, 51, 58, 61, 65, 132	1, 4, 5, 6, 7, 14

[1] No soil background value is available.

Tc-99, uranium-234, and uranium-238 were detected above both the background screening levels and the SSLs for the protection of RGA groundwater as follows.

Radionuclide	Grid	EU
Tc-99	7, 34, 40, 51, 61, 63	1, 4, 5, 6, 7
Uranium-234	132	14
Uranium-238	7, 34, 51, 61, 132	4, 5, 6, 7, 14

5.1.5 Fate and Transport

Tc-99 at SWMU 13 was selected for further evaluation using modeling to estimate the potential for transport at a rate that could cause an MCL (or risk-based level if an MCL is unavailable) exceedance in the RGA at the SWMU boundary. SESOIL and AT123D simulation modeling results are summarized in Appendix C.

Tc-99 was selected for modeling because the average concentration at the SWMU exceeded both the RG SSL and background concentrations (see Appendix C). Modeling predicts Tc-99 to be 510 pCi/L at the SWMU boundary when it reaches the RGA, which is less than the 900 pCi/L screening criterion (DOE 2013).

There is potential for runoff because this SWMU is surrounded by ditches that discharge to Outfall 001. This runoff is captured in the C-613 Sedimentation Basin prior to discharge into Outfall 001. A removal action for the contaminated sediment associated with SWOU (On-Site) (DOE 2011a) was conducted for Outfalls 001, 008, 010, 011, 015, and associated internal ditches. A final response action for internal ditches, outfalls, and creeks will be addressed by the SWOU, as described in the SMP (DOE 2015a).

5.1.6 Baseline Risk Assessment

Human Health. Potential risks and hazards for current/future human health for SWMU 13 were evaluated for each of 14 EUs (~ 0.5 acres each) for direct contact. These results are summarized in Appendix D and in the subsections that follow, including the COCs and relative contributions to the overall ELCR/HI. Lead was identified as a COPC; however, the average concentration did not exceed 400 mg/kg, the NAL for lead for the residential scenario (DOE 2015b); therefore, modeling was not performed, and lead was not considered a COC for SWMU 13.

The cumulative ELCR and the cumulative HI for one or more EUs at SWMU 13 exceed the benchmarks of cumulative ELCR of 1E-06 and cumulative HI greater than 1, respectively for one or more scenarios; therefore, as stated in the Work Plan, Decision Rule D1a, (DOE 2010a), this SWMU will be evaluated in the FS. As described in the BHHRA (Appendix D), COCs were identified after considering the results of the risk characterization and the uncertainties affecting the results.

COCs were identified as those COPCs considered to contribute at least 1E-06 ELCR or 0.1 HI to a scenario of concern. The basis for COC identification is presented in Appendix D. The identified COCs considered to contribute to the ELCR/HI, the EPC, and the RGOs calculated for a range of ELCR/HI benchmarks are presented in Table 5.1.3 for the future industrial worker, excavation worker, and the hypothetical resident. Table 5.1.3 also compares the EPC to the RGO for each COC under each exposure scenario. Table 5.1.3 summarizes the ELCR/HI posed by the COCs for this SWMU under each exposure scenario by depicting the maximum ELCR/HI contribution per COC.

Additionally, SWMU 13 was evaluated for risk to the hypothetical resident exposed to RGA groundwater at the SWMU boundary. Tc-99 was the only COC determined potentially to migrate to the RGA groundwater. The ELCR to the hypothetical resident is 2.7E-05 from exposure to RGA groundwater contributed by SWMU 13 contaminants.

Ecological Screening. COPECs for SWMU 13 include metals, SVOCs, and PCBs. Potential hazards for ecological receptors and the associated priority COPECs (maximum HQ $\geq$ 10) are summarized in Table 5.1.4.

5.1.7 SWMU 13 Summary

The text below summarizes the results for SWMU 13 using the goals for the project identified during the DQO process for RI scoping.

Goal 1. Characterize Nature and Extent of Source Zone

The plant processes that could have contributed to contamination here is the storage of scrap metal for approximately 50 years in outside elements.

Table 5.1.3. RGOs for SWMU 13

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3]			HI[4]	RGOs for HI[3]		
					1E-06	1E-05	1E-04		0.1	1	3
Future Industrial Worker											
1	**Cumulative**			**< 1.0E-06**				**< 1**			
2	**Cumulative**			**< 1.0E-06**				**< 1**			
3	**Cumulative**			**< 1.0E-06**				**< 1**			
4	PAH, Total	4.13E-01	mg/kg	4.6E-06	8.94E-02	8.94E-01	8.94E+00	< 0.1	N/A	N/A	N/A
4	PCB, Total	1.05E+01	mg/kg	3.4E-05	3.05E-01	3.05E+00	3.05E+01	< 0.1	N/A	N/A	N/A
4	Uranium-238	1.78E+00	pCi/g	1.1E-06	1.65E+00	1.65E+01	1.65E+02	N/A	N/A	N/A	N/A
4	**Cumulative**			**4.0E-05**				**< 1**			
5	PAH, Total	4.41E-01	mg/kg	4.9E-06	8.94E-02	8.94E-01	8.94E+00	< 0.1	N/A	N/A	N/A
5	PCB, Total	6.66E+00	mg/kg	2.2E-05	3.05E-01	3.05E+00	3.05E+01	< 0.1	N/A	N/A	N/A
5	Neptunium-237	3.88E-01	pCi/g	1.5E-06	2.53E-01	2.53E+00	2.53E+01	N/A	N/A	N/A	N/A
5	Uranium-234	2.57E+01	pCi/g	1.3E-06	2.01E+01	2.01E+02	2.01E+03	N/A	N/A	N/A	N/A
5	Uranium-235	2.95E+00	pCi/g	7.9E-06	3.73E-01	3.73E+00	3.73E+01	N/A	N/A	N/A	N/A
5	Uranium-238	4.60E+01	pCi/g	2.8E-05	1.65E+00	1.65E+01	1.65E+02	N/A	N/A	N/A	N/A
5	**Cumulative**			**6.6E-05**				**< 1**			
6	PAH, Total	6.51E-01	mg/kg	7.3E-06	8.94E-02	8.94E-01	8.94E+00	< 0.1	N/A	N/A	N/A
6	PCB, Total	1.08E+01	mg/kg	3.5E-05	3.05E-01	3.05E+00	3.05E+01	< 0.1	N/A	N/A	N/A
6	Neptunium-237	1.25E+00	pCi/g	4.9E-06	2.53E-01	2.53E+00	2.53E+01	N/A	N/A	N/A	N/A
6	Uranium-234	2.04E+01	pCi/g	1.0E-06	2.01E+01	2.01E+02	2.01E+03	N/A	N/A	N/A	N/A
6	Uranium-235	1.40E+00	pCi/g	3.7E-06	3.73E-01	3.73E+00	3.73E+01	N/A	N/A	N/A	N/A
6	Uranium-238	4.17E+01	pCi/g	2.5E-05	1.65E+00	1.65E+01	1.65E+02	N/A	N/A	N/A	N/A
6	**Cumulative**			**7.8E-05**				**< 1**			
7	**Cumulative**			**< 1.0E-06**				**< 1**			
8	**Cumulative**			**< 1.0E-06**				**< 1**			
9	Neptunium-237	6.88E-01	pCi/g	2.7E-06	2.53E-01	2.53E+00	2.53E+01	N/A	N/A	N/A	N/A
9	Uranium-238	4.07E+00	pCi/g	2.5E-06	1.65E+00	1.65E+01	1.65E+02	N/A	N/A	N/A	N/A
9	**Cumulative**			**5.5E-06**				**< 1**			
10	**Cumulative**			**< 1.0E-06**				**< 1**			
11	PCB, Total	1.03E+01	mg/kg	**3.4E-05**	3.05E-01	3.05E+00	3.05E+01	< 0.1	N/A	N/A	N/A
11	**Cumulative**			**3.4E-05**				**< 1**			
12	**Cumulative**			**< 1.0E-06**				**< 1**			
13	**Cumulative**			**< 1.0E-06**				**< 1**			

Table 5.1.3. RGOs for SWMU 13 (Continued)

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3] 1E-06	1E-05	1E-04	HI[4]	RGOs for HI[3] 0.1	1	3
Future Industrial Worker (Continued)											
14	PCB, Total	6.46E+00	mg/kg	2.1E-05	3.05E-01	3.05E+00	3.05E+01	< 0.1	N/A	N/A	N/A
14	Uranium-238	2.07E+00	pCi/g	1.3E-06	1.65E+00	1.65E+01	1.65E+02	N/A	N/A	N/A	N/A
14	**Cumulative**			**2.3E-05**				**< 1**			
Excavation Worker											
1	**Cumulative**			**8.4E-06**				**< 1**			
2	Arsenic	1.04E+01	mg/kg	4.1E-06	2.52E+00	2.52E+01	2.52E+02	0.1	8.09E+00	8.09E+01	2.43E+02
2	**Cumulative**			**4.3E-06**				**< 1**			
3	PAH, Total	4.93E-01	mg/kg	1.5E-06	3.25E-01	3.25E+00	3.25E+01	< 0.1	N/A	N/A	N/A
3	**Cumulative**			**1.5E-06**				**< 1**			
4	PAH, Total	5.59E-01	mg/kg	1.7E-06	3.25E-01	3.25E+00	3.25E+01	< 0.1	N/A	N/A	N/A
4	PCB, Total	1.09E+01	mg/kg	9.5E-06	1.14E+00	1.14E+01	1.14E+02	< 0.1	N/A	N/A	N/A
4	**Cumulative**			**1.2E-05**				**< 1**			
5	PAH, Total	5.43E-01	mg/kg	1.7E-06	3.25E-01	3.25E+00	3.25E+01	< 0.1	N/A	N/A	N/A
5	PCB, Total	1.03E+01	mg/kg	9.0E-06	1.14E+00	1.14E+01	1.14E+02	< 0.1	N/A	N/A	N/A
5	Uranium-234	2.02E+01	pCi/g	1.3E-06	1.51E+01	1.51E+02	1.51E+03	N/A	N/A	N/A	N/A
5	Uranium-235	2.73E+00	pCi/g	1.3E-06	2.18E+00	2.18E+01	2.18E+02	N/A	N/A	N/A	N/A
5	Uranium-238	3.77E+01	pCi/g	6.3E-06	5.95E+00	5.95E+01	5.95E+02	N/A	N/A	N/A	N/A
5	**Cumulative**			**2.1E-05**				**< 1**			
6	PAH, Total	8.43E-01	mg/kg	2.6E-06	3.25E-01	3.25E+00	3.25E+01	< 0.1	N/A	N/A	N/A
6	PCB, Total	7.04E+00	mg/kg	6.1E-06	1.14E+00	1.14E+01	1.14E+02	< 0.1	N/A	N/A	N/A
6	Uranium-234	1.55E+01	pCi/g	1.0E-06	1.51E+01	1.51E+02	1.51E+03	N/A	N/A	N/A	N/A
6	Uranium-238	3.25E+01	pCi/g	5.5E-06	5.95E+00	5.95E+01	5.95E+02	N/A	N/A	N/A	N/A
6	**Cumulative**			**1.7E-05**				**< 1**			
7	PCB, Total	1.08E+01	mg/kg	9.5E-06	1.14E+00	1.14E+01	1.14E+02	< 0.1	N/A	N/A	N/A
7	**Cumulative**			**1.0E-05**				**< 1**			
8	PAH, Total	5.39E-01	mg/kg	1.7E-06	3.25E-01	3.25E+00	3.25E+01	< 0.1	N/A	N/A	N/A
8	**Cumulative**			**1.7E-06**				**< 1**			
9	Arsenic	1.25E+01	mg/kg	4.9E-06	2.52E+00	2.52E+01	2.52E+02	0.2	8.09E+00	8.09E+01	2.43E+02
9	PAH, Total	4.60E-01	mg/kg	1.4E-06	3.25E-01	3.25E+00	3.25E+01	< 0.1	N/A	N/A	N/A
9	**Cumulative**			**7.7E-06**				**< 1**			
10	**Cumulative**			**< 1.0E-06**				**< 1**			

Table 5.1.3. RGOs for SWMU 13 (Continued)

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3]			HI[4]	RGOs for HI[3]		
					1E-06	1E-05	1E-04		0.1	1	3
Excavation Worker (Continued)											
11	PCB, Total	1.03E+01	mg/kg	9.0E-06	1.14E+00	1.14E+01	1.14E+02	< 0.1	N/A	N/A	N/A
11	**Cumulative**			9.0E-06				**< 1**			
12	PCB, Total	1.03E+01	mg/kg	9.0E-06	1.14E+00	1.14E+01	1.14E+02	< 0.1	N/A	N/A	N/A
12	**Cumulative**			**9.0E-06**				**< 1**			
13	**Cumulative**			**< 1.0E-06**				**< 1**			
14	PAH, Total	5.41E-01	mg/kg	1.7E-06	3.25E-01	3.25E+00	3.25E+01	< 0.1	N/A	N/A	N/A
14	PCB, Total	1.06E+01	mg/kg	9.2E-06	1.14E+00	1.14E+01	1.14E+02	< 0.1	N/A	N/A	N/A
14	**Cumulative**			**1.2E-05**				**< 1**			
Hypothetical Resident[5]											
1	**Cumulative**			**< 1.0E-06**				**< 1**			
2	Iron	2.47E+04	mg/kg	N/A	N/A	N/A	N/A	0.5	5.47E+03	5.48E+04	1.64E+05
2	Manganese	1.22E+03	mg/kg	N/A	N/A	N/A	N/A	0.7	1.82E+02	1.82E+03	5.47E+03
2	Vanadium	9.38E+01	mg/kg	N/A	N/A	N/A	N/A	0.2	3.93E+01	3.93E+02	1.18E+03
2	Uranium-238	1.40E+00	pCi/g	2.8E-06	4.99E-01	4.99E+00	4.99E+01		N/A	N/A	N/A
2	**Cumulative**			**2.8E-06**				**1.4**			
3	Iron	2.63E+04	mg/kg	N/A	N/A	N/A	N/A	0.5	5.47E+03	5.48E+04	1.64E+05
3	Manganese	1.09E+03	mg/kg	N/A	N/A	N/A	N/A	0.6	1.82E+02	1.82E+03	5.47E+03
3	Vanadium	9.88E+01	mg/kg	N/A	N/A	N/A	N/A	0.3	3.93E+01	3.93E+02	1.18E+03
3	**Cumulative**			**< 1.0E-06**				**1.4**			
4	PAH, Total	4.13E-01	mg/kg	1.8E-05	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
4	PCB, Total	1.05E+01	mg/kg	1.3E-04	7.82E-02	7.82E-01	7.82E+00	N/A	N/A	N/A	N/A
4	Uranium-238	1.78E+00	pCi/g	3.6E-06	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
4	**Cumulative**			**1.6E-04**				**< 1**			

Table 5.1.3. RGOs for SWMU 13 (Continued)

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3]			HI[4]	RGOs for HI[3]		
					1E-06	1E-05	1E-04		0.1	1	3
Hypothetical Resident[5] (Continued)											
5	Aluminum	9.83E+03	mg/kg	N/A	N/A	N/A	N/A	0.1	7.73E+03	7.73E+04	2.32E+05
5	Iron	2.42E+04	mg/kg	N/A	N/A	N/A	N/A	0.4	5.47E+03	5.48E+04	1.64E+05
5	Manganese	9.08E+02	mg/kg	N/A	N/A	N/A	N/A	0.5	1.82E+02	1.82E+03	5.47E+03
5	PAH, Total	4.41E-01	mg/kg	1.9E-05	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
5	PCB, Total	6.66E+00	mg/kg	8.5E-05	7.82E-02	7.82E-01	7.82E+00	N/A	N/A	N/A	N/A
5	Uranium	7.41E+01	mg/kg	N/A	N/A	N/A	N/A	0.3	2.34E+01	2.34E+02	7.01E+02
5	Vanadium	1.06E+02	mg/kg	N/A	N/A	N/A	N/A	0.3	3.93E+01	3.93E+02	1.18E+03
5	Neptunium-237	3.88E-01	pCi/g	5.0E-06	7.72E-02	7.72E-01	7.72E+00	N/A	N/A	N/A	N/A
5	Uranium-234	2.57E+01	pCi/g	4.5E-06	5.73E+00	5.73E+01	5.73E+02	N/A	N/A	N/A	N/A
5	Uranium-235	2.95E+00	pCi/g	2.6E-05	1.14E-01	1.14E+00	1.14E+01	N/A	N/A	N/A	N/A
5	Uranium-238	4.60E+01	pCi/g	9.2E-05	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
5	**Cumulative**			**2.3E-04**				**1.7**			
6	Iron	3.09E+04	mg/kg	N/A	N/A	N/A	N/A	0.6	5.48E+03	5.48E+04	1.64E+05
6	PAH, Total	6.51E-01	mg/kg	2.9E-05	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
6	PCB, Total	1.08E+01	mg/kg	1.4E-04	7.82E-02	7.82E-01	7.82E+00	N/A	N/A	N/A	N/A
6	Uranium	3.70E+01	mg/kg	N/A	N/A	N/A	N/A	0.2	2.34E+01	2.34E+02	7.01E+02
6	Vanadium	1.20E+02	mg/kg	N/A	N/A	N/A	N/A	0.3	3.93E+01	3.93E+02	1.18E+03
6	Neptunium-237	1.25E+00	pCi/g	1.6E-05	7.72E-02	7.72E-01	7.72E+00	N/A	N/A	N/A	N/A
6	Uranium-234	2.04E+01	pCi/g	3.6E-06	5.73E+00	5.73E+01	5.73E+02	N/A	N/A	N/A	N/A
6	Uranium-235	1.40E+00	pCi/g	1.2E-05	1.14E-01	1.14E+00	1.14E+01	N/A	N/A	N/A	N/A
6	Uranium-238	4.17E+01	pCi/g	8.4E-05	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
6	**Cumulative**			**2.8E-04**				**1.0**			
7	Iron	2.78E+04	mg/kg	N/A	N/A	N/A	N/A	0.5	5.48E+03	5.48E+04	1.64E+05
7	Silver	1.85E+02	mg/kg	N/A	N/A	N/A	N/A	0.5	3.91E+01	3.91E+02	1.17E+03
7	Vanadium	1.22E+02	mg/kg	N/A	N/A	N/A	N/A	0.3	3.93E+01	3.93E+02	1.18E+03
7	Uranium-238	1.30E+00	pCi/g	2.6E-06	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
7	**Cumulative**			**2.6E-06**				**1.3**			
8	Iron	2.41E+04	mg/kg	N/A	N/A	N/A	N/A	0.4	5.48E+03	5.48E+04	1.64E+05
8	Manganese	1.12E+03	mg/kg	N/A	N/A	N/A	N/A	0.6	1.82E+02	1.82E+03	5.47E+03
8	Vanadium	9.97E+01	mg/kg	N/A	N/A	N/A	N/A	0.3	3.93E+01	3.93E+02	1.18E+03
8	**Cumulative**			**< 1.0E-06**				**1.3**			

Table 5.1.3. RGOs for SWMU 13 (Continued)

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3]			HI[4]	RGOs for HI[3]		
					1E-06	1E-05	1E-04		0.1	1	3
Hypothetical Resident[5] (Continued)											
9	PAH, Total	2.65E-02	mg/kg	1.2E-06	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
9	Neptunium-237	6.88E-01	pCi/g	8.9E-06	7.72E-02	7.72E-01	7.72E+00	N/A	N/A	N/A	N/A
9	Uranium-238	4.07E+00	pCi/g	8.2E-06	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
9	**Cumulative**			**1.8E-05**				**< 1**			
10	Iron	3.80E+04	mg/kg	N/A	N/A	N/A	N/A	0.7	5.48E+03	5.48E+04	1.64E+05
10	Manganese	3.09E+03	mg/kg	N/A	N/A	N/A	N/A	1.7	1.82E+02	1.82E+03	5.47E+03
10	Silver	5.40E+01	mg/kg	N/A	N/A	N/A	N/A	0.1	3.91E+01	3.91E+02	1.17E+03
10	Vanadium	1.30E+02	mg/kg	N/A	N/A	N/A	N/A	0.3	3.93E+01	3.93E+02	1.18E+03
10	**Cumulative**			**< 1.0E-06**				**2.9**			
11	PCB, Total	1.03E+01	mg/kg	1.3E-04	7.82E-02	7.82E-01	7.82E+00	N/A	N/A	N/A	N/A
11	**Cumulative**			**1.3E-04**				**< 1**			
12	Iron	2.30E+04	mg/kg	N/A	N/A	N/A	N/A	0.4	5.48E+03	5.48E+04	1.64E+05
12	Manganese	1.35E+03	mg/kg	N/A	N/A	N/A	N/A	0.7	1.82E+02	1.82E+03	5.47E+03
12	Silver	8.88E+01	mg/kg	N/A	N/A	N/A	N/A	0.2	3.91E+01	3.91E+02	1.17E+03
12	Vanadium	1.16E+02	mg/kg	N/A	N/A	N/A	N/A	0.3	3.93E+01	3.93E+02	1.18E+03
12	**Cumulative**			**< 1.0E-06**				**1.7**			
13	Iron	2.89E+04	mg/kg	N/A	N/A	N/A	N/A	0.5	5.48E+03	5.48E+04	1.64E+05
13	Manganese	1.13E+03	mg/kg	N/A	N/A	N/A	N/A	0.6	1.82E+02	1.82E+03	5.47E+03
13	Vanadium	1.19E+02	mg/kg	N/A	N/A	N/A	N/A	0.3	3.93E+01	3.93E+02	1.18E+03
13	**Cumulative**			**< 1.0E-06**				**1.5**			
14	PAH, Total	3.27E-02	mg/kg	1.4E-06	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
14	PCB, Total	6.46E+00	mg/kg	8.3E-05	7.82E-02	7.82E-01	7.82E+00	N/A	N/A	N/A	N/A
14	Uranium-238	2.07E+00	pCi/g	4.2E-06	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
14	**Cumulative**			**8.8E-05**				**< 1**			

Grayed cells indicate EPC value is lower than RGO value or an RGO value is not applicable.
N/A = Not applicable because the COC was not applicable (i.e., the COC was of concern for HI, but not ELCR or it was of concern for ELCR by not HI).
[1] See Tables D.6 and D.7 (Appendix D) for EPC values.
[2] See Appendix D, Exhibit D.6, for ELCR.
[3] See Table D.47 for RGOs.
[4] See Appendix D, Exhibit D.6, for HI.
[5] RGOs for residential land use are based on exposure to a resident age 1-27. For carcinogens, the dose method incorporates age-adjusted values for the 26-year exposure duration. Because child soil ingestion rates are higher and body weights are lower, noncancer RGOs are based on the child resident exposure assumptions.

Table 5.1.4. Ecological Screening for SWMU 13

Ground Cover	Near a Surface Water Body?	Total HI[a]	Priority COPECs[b]	Background (mg/kg)[c]	Soil ESV (mg/kg)[d]	Maximum (mg/kg)	HQ (max conc)[a]	EPC (mg/kg)	HQ (EPC)[a]
Gravel with a soil/grass mix	No	674	Aluminum	13,000	50	14,000	280.0	7,078	141.6
			Antimony	0.21	0.27	10	37.04	7.666	28.4
			Iron	28,000	200	47,830	239.15	22,491	112.5
			Mercury	0.2	0.1	20	200	20.49	204.9
			PCB, Total	N/A	0.02	2.5	125	2.557	127.9
			Vanadium	38	7.8	158	20.26	98.61	12.6

Table is from Appendix E, Table E.1.
[a] Total HI includes concentrations from all of the COPECs (listed in Table E4.1); only priority COPECs (i.e., the COPECs with HQs greater than 10, using the EPCs) are shown in this table.
[b] Only priority COPECs are listed. See Appendix E for additional COPECs.
[c] Background value is from DOE 2015b.
[d] ESVs from DOE 2015c and Appendix E of this report.

COPCs for surface and subsurface soils from SWMU 13 are shown on Tables 5.1.1 and 5.1.2 as those analytes with green boxes under the "Industrial Worker/FOE" columns for surface and shallow subsurface soil, and those with blue boxes under the "GW Protection Screen/RGA/UCRS" columns for groundwater. For metals and radioisotopes, an orange box under the "Provisional Background" must accompany the green and blue boxes. Contaminants were detected greater than background and greater than industrial worker NALs to a maximum depth of 15 ft bgs. The end depth of the borehole from which the 15 ft bgs sample was taken was 18 ft bgs. The dataset for this RI Report includes only results for samples taken at or above 16 ft bgs, per the Work Plan (DOE 2010a). The Soils OU is defined in the SMP as soils to 10 ft bgs (or 16 ft bgs at pipelines).The following are the COPCs identified for each EU at SWMU 13.

- EU 1
  - Surface—metals
  - Subsurface—metals, radioisotopes, PCBs, SVOCs
- EU 2
  - Surface—metals, radioisotopes
  - Subsurface—metals
- EU 3
  - Surface—metals, radioisotopes
  - Subsurface—metals
- EU 4
  - Surface—metals, radioisotopes, PCBs
  - Subsurface—PCBs, radioisotopes
- EU 5
  - Surface—metals, radioisotopes, PCBs, PAHs, SVOCs
  - Subsurface—metals, radioisotopes, PCBs, PAHs, SVOCs

- EU 6

  — Surface—metals, radioisotopes, PCBs, PAHs, SVOCs
  — Subsurface—metals, radioisotopes, PCBs, SVOCs

- EU 7

  — Surface—metals, radioisotopes
  — Subsurface—PCBs, radioisotopes

- EU 8

  — Surface—metals, radioisotopes
  — Subsurface—none

- EU 9

  — Surface—metals, radioisotopes
  — Subsurface—none

- EU 10

  — Surface—metals, radioisotopes
  — Subsurface—none

- EU 11

  — Surface—metals, PCBs
  — Subsurface—metals, PCBs

- EU 12

  — Surface—metals
  — Subsurface—metals, PCBs

- EU 13

  — Surface—metals
  — Subsurface—none

- EU 14

  — Surface— metals, radioisotopes, PCBs
  — Subsurface—uranium isotopes

Goal 2. Determine Surface and Subsurface Transport Mechanisms and Pathways

The contaminants at SWMU 13 are readily adsorbed to soil particles, so they do not migrate without a direct connection to surface water. There is potential for runoff because this SWMU is surrounded by ditches that discharge to Outfall 001; however, the runoff is captured in the C-613 Sedimentation Basin prior to discharge into Outfall 001. There are no underground pipelines at SWMU 13. The conceptual site model (CSM) can be found in Appendix D.

Goal 3. Complete a Baseline Risk Assessment for the Soils OU

Cumulative ELCRs or HIs exceeded benchmarks of 1E-06 and 1, respectively, for the future industrial worker, excavation worker, and hypothetical residential scenarios. COCs for these scenarios for SWMU 13 are as follows:

- Future Industrial worker
  - Total PAHs
  - Total PCBs
  - Neptunium-237
  - Uranium-234
  - Uranium-235
  - Uranium-238
- Excavation worker
  - Arsenic
  - Total PAHs
  - Total PCBs
  - Uranium-234
  - Uranium-235
  - Uranium-238
- Hypothetical Resident (hazards evaluated against the child resident)
  - Aluminum
  - Iron
  - Manganese
  - Silver
  - Uranium
  - Vanadium
  - Total PAHs
  - Total PCBs
  - Neptunium-237
  - Uranium-234
  - Uranium-235
  - Uranium-238

Figure 5.1.8 shows the COCs exceeding RGOs for the future industrial worker.

Priority COCs (i.e., HQ > 1 or chemical-specific ELCR > 1E-04) for SWMU 13 are located in 4 of 14 EUs. The priority COCs are Total PCBs and manganese for the hypothetical resident. No other scenarios have priority COCs.

No priority COCs were identified for groundwater modeled from soil.

For SWMU 13, COPECs exceed ESVs. Priority COPECs (i.e., maximum HQ ≥ 10) are the following:

- Aluminum
- Antimony
- Mercury

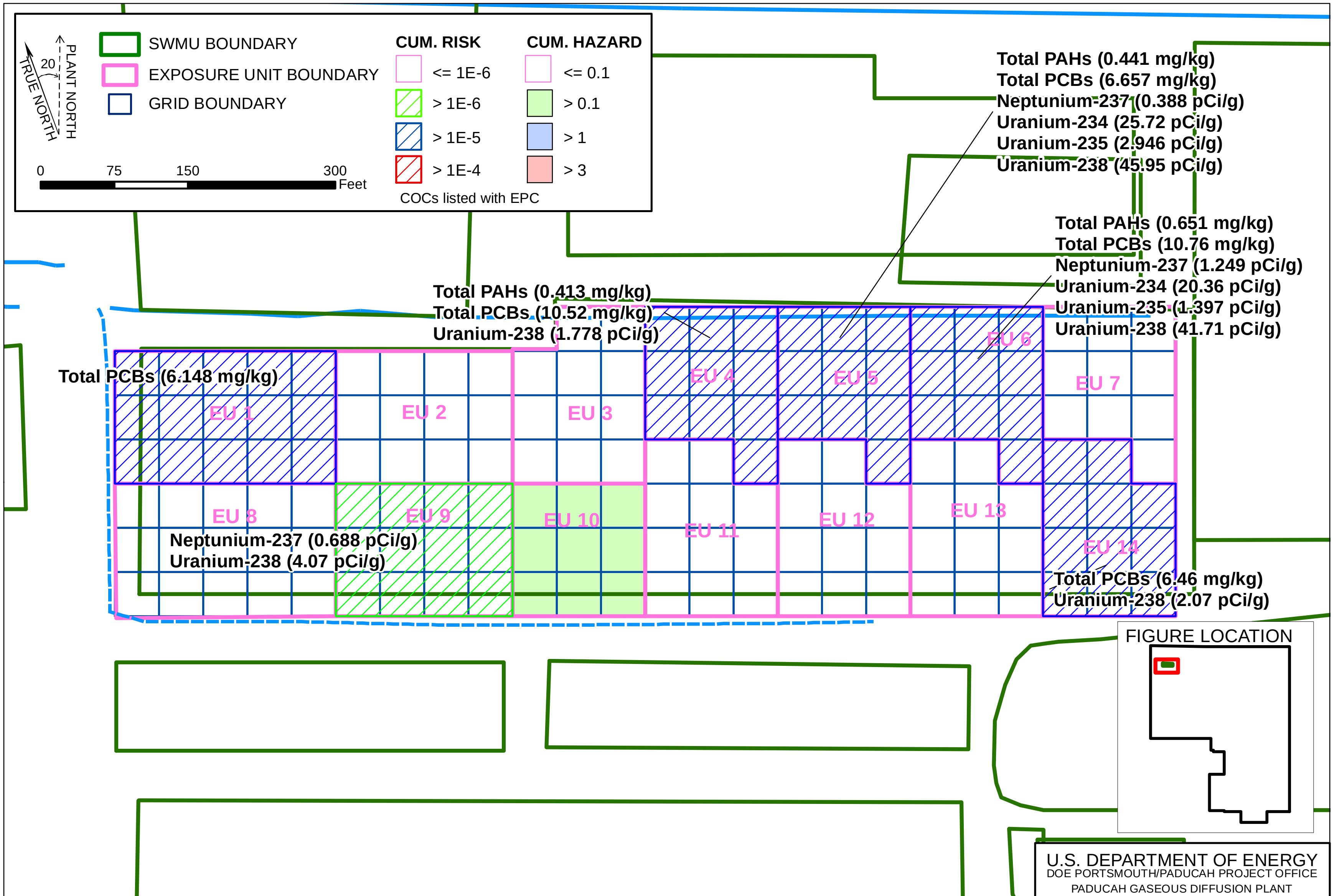

Figure 5.1.8. Summary of COCs Contributing to Risk to the Future Industrial Worker at SWMU 13

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- Total PCBs
- Vanadium

Goal 4. Support Evaluation of Remedial Alternatives

The representative data set used for SWMU 13 is sufficient to support decision making and indicates that SWMU 13 should proceed to the FS. An uncertainty concerning depth of contamination should be considered in the FS. Possible remedial technologies applicable for this unit, as discussed in the Work Plan (DOE 2010a), are posting, fencing (or other means of limiting access), excavation, and/or other remedial technologies that will be described in the FS.

SWMU 13 is adjacent to SWMU 14 (C-746-E Contaminated Scrap Yard), north of SWMU 518 (Field South of C-746-P1 Clean Scrap Yard), which were part of the Soils OU RI, and north of SWMU 229, which was planned for this RI, but was unable to be investigated (see Section 1). SWMU 13 also is south of SWMUs 7 and 30, both which are part of BGOU. A response action at SWMU 13 would not have an impact on groundwater or surface water.

5.1.8 SWMU 13 Conclusion

RI 2 has defined adequately the nature and extent of contamination in soils at SWMU 13; an FS is appropriate for the SWMU due to cancer risks and/or noncancer hazards exceeding the decision rule benchmarks (DOE 2010a) for scenarios including future industrial worker, excavation worker, and hypothetical resident. The reasonably anticipated future land use for this SWMU is industrial land use as shown in the SMP (DOE 2015a).

5.2 SWMU 15, C-746-C Scrap Yard

5.2.1 Background

The C-746-C Scrap Yard (SWMU 15) is located in the northwest corner of the plant site. SWMU 15 is approximately 250,000 ft^2.

The C-746-C Scrap Yard originally was used to store uncontaminated scrap metal prior to being shipped off-site; however, it was converted to long-term storage of scrap metal after off-site shipments were discontinued. It is divided into north and south areas to segregate the space into two different storage yards. A large portion of the south section was used for storage of ingots produced in the C-746 smelting operations and turnings from the machine shop. Most of the north section was used in the construction of the C-616 Chromate Treatment Facility and clarifiers.

The storage yard was emptied as specified by the Action Memorandum for Scrap Metal (DOE 2001a) and documented in the Removal Action Report for Scrap Metal (DOE 2008c).

SWMU 15 is suspected to be a source of radiological and possibly metals contamination, though no documented release has occurred from the area.

5.2.2 Fieldwork Summary

During the first RI for the Soils OU, 232 grid samples were collected out of the 234 planned for the unit. The presence of utilities prevented collection of the samples. Field laboratory results indicated that contingency samples were required to determine the nature and extent of contamination because of elevated concentrations of cadmium, copper, iron, lead, manganese, nickel, uranium, zinc, and PCBs. Twenty-four contingency samples were planned and collected. Appendix A contains the sampling rectification map.

The unit underwent a gamma radiological walkover survey (Figure 5.2.1) using a FIDLER; the 26,375 measurements ranged from 4,462 to 84,768 cpm. It appears as though an equipment malfunction occurred while performing the gamma walkover survey on the western third of SWMU 15. Judging from the path taken by the technician, the instrument measures in the < 10,300 negative counts per minute (ncpm), then rises to values as high as 550,000 ncpm. If there truly was activity at that level, then this would be expected; however, another instrument operating side by side, did not register the same count rates. Presently, SWMU 15 is fenced and is a posted Contamination Area. The area consists mostly of gravel with some soil and grass. Some roadways still exist. A judgmental grab sample was collected for radiological constituents.

During RI 2, one grid sample was planned and collected for the unit to delineate further the extent of lead contamination to the east of the unit related to grid 015-037. Field laboratory results indicated that contingency samples were needed to determine the nature and extent of contamination because of elevated concentrations of PCBs. Six contingency samples were planned and collected.

No additional gamma radiological walkover survey was required for this unit; however, a new judgmental grab sample was collected for radiological constituents (Figure 5.2.1). The location of the judgmental grab sample was selected using existing survey data following the protocol established in Section 1.3.2 of the Work Plan Addendum (DOE 2014a).

5.2.3 Nature and Extent of Contamination—Surface Soils

The representative data set presented in Table 5.2.1 provides the nature of the contamination in SWMU 15 surface soils, and Figures 5.2.2–5.2.4 illustrate the horizontal extent. A complete list of sampling results is provided in Appendix F (samples with ending depths of 1 ft bgs or less or null are considered surface soils). Grid numbers shown below are truncated from the figures. Figures contain the SWMU#–grid#, with zeros filling the appropriate spaces to make three digits.

The lateral extent of SWMU 15 surface soil contamination is considered defined adequately for supporting the BRA and FS. SWMU 15 consists of 10 EUs.

<u>Metals</u>

Metals were detected above the industrial worker NALs in the SWMU 15 surface soil. The following metals were detected at or above both background screening levels and the industrial worker NALs.

Metal	Grid	EU
Antimony	1, 15, 21, 28, 30, 35, 36, 45, 46, 52, 55, 64, 65, 70, 73, 77, 78, 79, 80, 84, 85, 86, 87, 96, 97, 99, 101, 102, 106, 113, 116, 117	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
Arsenic	5, 8, 11, 12, 23, 24, 26, 28, 29, 30, 31, 33, 34, 35, 36, 40, 41, 42, 45, 63, 64, 68, 69, 87, 89, 90, 93	1, 2, 3, 4, 5, 6, 7, 8, 9
Iron	33, 35	3, 4
Lead	33, 36	3, 4

ALs are the same values as the NALs for iron and lead; therefore NAL exceedances of these two metals also are AL exceedances.

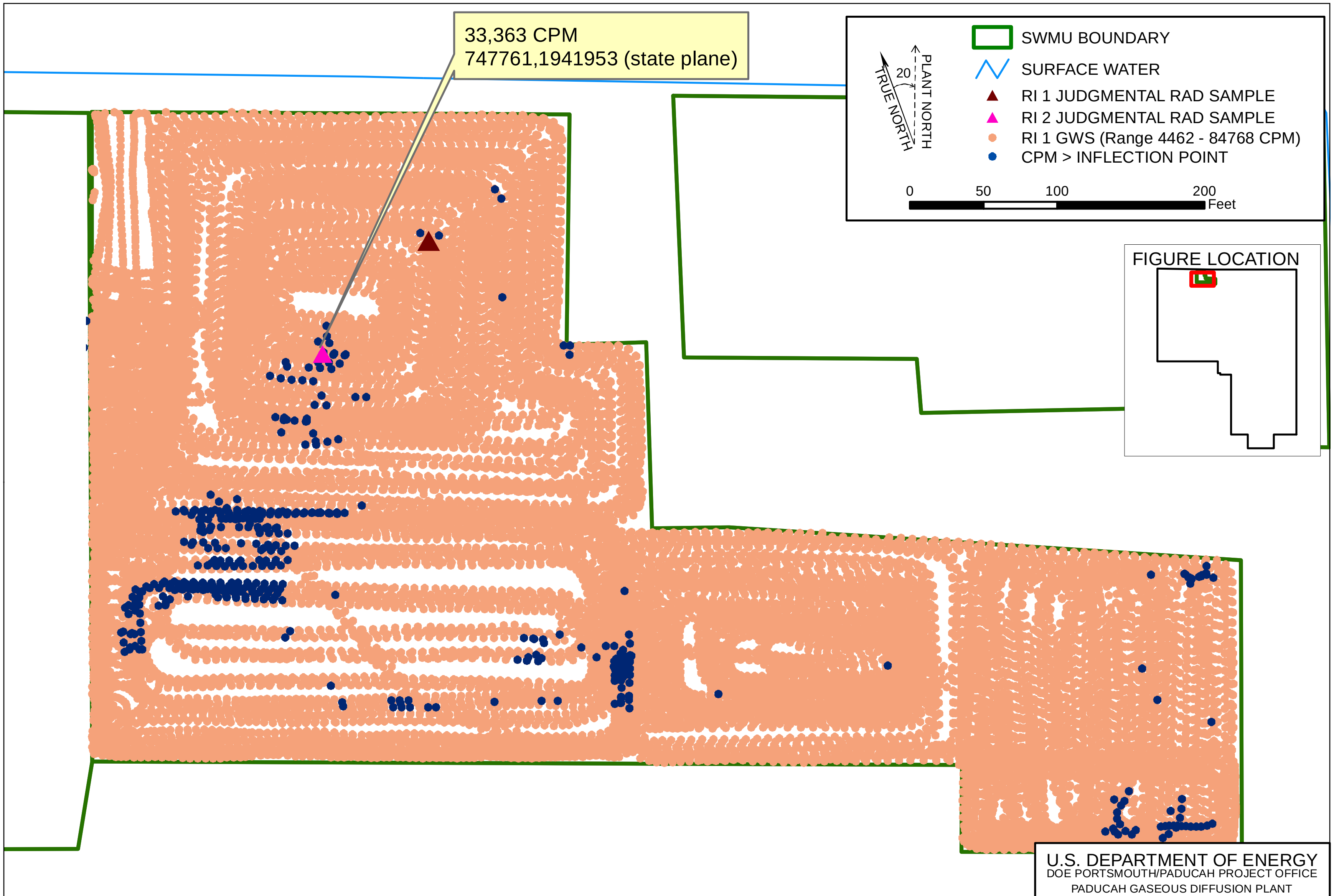

Figure 5.2.1. SWMU 15 Gamma Walkover Survey

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Table 5.2.1. Surface Soil Data Summary: SWMU 15

			Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
Type	Analysis	Unit	Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
METAL	Aluminum	mg/kg	4.16E+03	9.25E+03	7.69E+03	0/11	11/11	0/11	1.30E+04	0/11	1.00E+05	0/11	1.00E+05	0/11	11/11	5–5.7
METAL	Antimony	mg/kg	2.40E-01	2.83E+02	7.87E+01	0/122	98/122	98/122	2.10E-01	33/122	9.34E+01	0/122	2.80E+03	94/122	97/122	0.03–30
METAL	Arsenic	mg/kg	5.75E+00	6.26E+01	1.40E+01	0/125	77/125	28/125	1.20E+01	77/125	1.41E+00	0/125	1.41E+02	18/125	77/125	0.2–11
METAL	Barium	mg/kg	3.57E+01	6.30E+02	3.01E+02	0/122	120/122	100/122	2.00E+02	0/122	4.04E+04	0/122	1.00E+05	0/122	117/122	0.1–100
METAL	Beryllium	mg/kg	3.80E-01	7.60E-01	5.23E-01	0/11	11/11	1/11	6.70E-01	0/11	4.50E+02	0/11	1.35E+04	0/11	0/11	0.05–0.11
METAL	Cadmium	mg/kg	7.00E-02	2.42E+01	1.06E+01	0/122	30/122	26/122	2.10E-01	0/122	6.12E+01	0/122	1.84E+03	1/122	26/122	0.03–12
METAL	Calcium	mg/kg	2.80E+03	1.56E+05	4.94E+04	0/11	11/11	0/11	2.00E+05	0/11	N/A	0/11	N/A	N/A	N/A	52.3–287
METAL	Chromium	mg/kg	2.20E+01	1.51E+02	5.72E+01	0/125	53/125	53/125	1.60E+01	0/125	1.98E+02	0/125	1.98E+04	0/125	0/125	1–85
METAL	Cobalt	mg/kg	7.10E+00	3.41E+01	1.17E+01	0/11	11/11	2/11	1.40E+01	0/11	6.87E+01	0/11	2.06E+03	11/11	11/11	0.1–0.23
METAL	Copper	mg/kg	1.19E+01	6.12E+03	3.55E+02	0/125	103/125	102/125	1.90E+01	0/125	9.34E+03	0/125	1.00E+05	2/125	85/125	1–35
METAL	Iron	mg/kg	9.63E+03	1.71E+05	3.00E+04	0/125	125/125	44/125	2.80E+04	2/125	1.00E+05	2/125	1.00E+05	125/125	125/125	5.2–100
METAL	Lead	mg/kg	6.95E+00	1.04E+03	1.12E+02	0/125	117/125	67/125	3.60E+01	2/125	8.00E+02	2/125	8.00E+02	2/125	103/125	0.05–13
METAL	Magnesium	mg/kg	4.31E+02	6.73E+03	2.94E+03	0/11	11/11	0/11	7.70E+03	0/11	N/A	0/11	N/A	N/A	N/A	10–57.5
METAL	Manganese	mg/kg	1.19E+02	2.90E+03	5.89E+02	0/125	125/125	4/125	1.50E+03	0/125	4.72E+03	0/125	1.00E+05	121/125	125/125	0.2–85
METAL	Mercury	mg/kg	3.28E-02	1.53E+01	3.86E+00	0/125	15/125	11/125	2.00E-01	0/125	7.01E+01	0/125	2.10E+03	8/125	15/125	0.0349–40
METAL	Molybdenum	mg/kg	9.90E-01	2.36E+01	5.50E+00	0/125	16/125	0/125	N/A	0/125	1.17E+03	0/125	3.51E+04	3/125	16/125	0.1–15
METAL	Nickel	mg/kg	1.20E+01	3.79E+03	2.84E+02	0/125	101/125	98/125	2.10E+01	0/125	4.30E+03	0/125	1.00E+05	58/125	101/125	0.5–65
METAL	Selenium	mg/kg	6.10E-01	2.67E+01	2.23E+00	0/125	13/125	10/125	8.00E-01	0/125	1.17E+03	0/125	3.51E+04	1/125	13/125	0.1–20
METAL	Silver	mg/kg	1.90E-02	1.80E+01	5.40E+00	0/125	26/125	16/125	2.30E+00	0/125	1.17E+03	0/125	3.51E+04	15/125	22/125	0.01–50
METAL	Sodium	mg/kg	3.86E+01	2.66E+02	8.98E+01	1/11	11/11	0/11	3.20E+02	0/11	N/A	0/11	N/A	N/A	N/A	20.9–100
METAL	Thallium	mg/kg	6.50E-02	3.00E-01	1.76E-01	0/11	10/11	3/11	2.10E-01	0/11	2.34E+00	0/11	7.02E+01	0/11	6/11	0.02–0.23
METAL	Uranium	mg/kg	2.74E+00	4.59E+02	7.56E+01	0/126	100/126	99/126	4.90E+00	0/126	6.81E+02	0/126	2.04E+04	0/126	87/126	0.01–20
METAL	Vanadium	mg/kg	2.01E+01	1.22E+02	5.12E+01	0/125	18/125	8/125	3.80E+01	0/125	1.15E+03	0/125	3.45E+04	0/125	18/125	0.1–70
METAL	Zinc	mg/kg	2.19E+01	3.17E+03	3.01E+02	0/125	125/125	91/125	6.50E+01	0/125	7.01E+04	0/125	1.00E+05	2/125	117/125	1–25
PPCB	PCB, Total	mg/kg	2.40E-02	5.50E+01	1.05E+01	1/126	35/126	0/126	N/A	33/126	3.05E-01	4/126	3.05E+01	30/126	33/126	0.035–5
SVOA	1,2,4-Trichlorobenzene	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.35–0.4
SVOA	1,2-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.35–0.4
SVOA	1,3-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.35–0.4
SVOA	1,4-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.35–0.4
SVOA	2,4,5-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.35–0.4
SVOA	2,4,6-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.35–0.4
SVOA	2,4-Dichlorophenol	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.35–0.4
SVOA	2,4-Dimethylphenol	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.35–0.4
SVOA	2,4-Dinitrophenol	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.79–1.8
SVOA	2,4-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.24–0.38
SVOA	2,6-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.24–0.38
SVOA	2-Chloronaphthalene	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.35–0.4
SVOA	2-Chlorophenol	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.35–0.4
SVOA	2-Methyl-4,6-dinitrophenol	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.79–1.8
SVOA	2-Methylnaphthalene	mg/kg	5.20E-02	5.20E-02	5.20E-02	1/11	1/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.35–0.4
SVOA	2-Methylphenol	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.35–0.4
SVOA	2-Nitrobenzenamine	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	2.91E+02	0/11	8.73E+03	0/11	0/11	0.79–1.8
SVOA	2-Nitrophenol	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.35–0.4
SVOA	3,3'-Dichlorobenzidine	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.24–1.8
SVOA	3-Nitrobenzenamine	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.79–1.8
SVOA	4-Bromophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.35–0.4
SVOA	4-Chloro-3-methylphenol	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.35–0.4
SVOA	4-Chlorobenzenamine	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.35–0.4
SVOA	4-Chlorophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.35–0.4
SVOA	4-Nitrophenol	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.79–1.8
SVOA	Acenaphthene	mg/kg	3.60E-02	4.60E-01	1.88E-01	5/11	6/11	0/11	N/A	0/11	1.40E+03	0/11	4.20E+04	0/11	0/11	0.35–0.4
SVOA	Acenaphthylene	mg/kg	4.20E-02	1.30E-01	8.60E-02	2/11	2/11	0/11	N/A	0/11	1.40E+03	0/11	4.20E+04	N/A	N/A	0.35–0.4
SVOA	Anthracene	mg/kg	6.40E-02	7.70E-01	3.21E-01	4/11	7/11	0/11	N/A	0/11	6.99E+03	0/11	2.10E+05	0/11	0/11	0.35–0.4

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.2.1. Surface Soil Data Summary: SWMU 15 (Continued)

			Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
Type	Analysis	Unit	Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
SVOA	Benzenemethanol	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.35–0.4
SVOA	Benzo(ghi)perylene	mg/kg	5.40E-02	8.90E-01	3.19E-01	5/11	10/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.35–0.4
SVOA	Benzoic acid	mg/kg	3.70E-01	3.90E-01	3.80E-01	2/11	2/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	1.7–2
SVOA	Bis(2-chloroethoxy)methane	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.35–0.4
SVOA	Bis(2-chloroethyl) ether	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.0069–0.4
SVOA	Bis(2-chloroisopropyl) ether	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.35–0.4
SVOA	Bis(2-ethylhexyl)phthalate	mg/kg	4.80E-02	3.90E-01	2.26E-01	2/11	4/11	0/11	N/A	0/11	5.88E+01	0/11	5.88E+03	0/11	0/11	0.35–0.4
SVOA	Butyl benzyl phthalate	mg/kg	3.90E-02	3.90E-02	3.90E-02	1/11	1/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.35–0.4
SVOA	Dibenzofuran	mg/kg	4.40E-02	2.00E-01	9.46E-02	5/11	5/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.35–0.4
SVOA	Diethyl phthalate	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.35–0.4
SVOA	Dimethyl phthalate	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.35–0.4
SVOA	Di-n-butyl phthalate	mg/kg	6.30E-02	6.30E-02	6.30E-02	1/11	1/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.35–0.4
SVOA	Di-n-octylphthalate	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.35–0.4
SVOA	Fluoranthene	mg/kg	8.00E-02	3.60E+00	1.41E+00	3/11	10/11	0/11	N/A	0/11	9.32E+02	0/11	2.80E+04	0/11	0/11	0.35–0.4
SVOA	Fluorene	mg/kg	8.60E-02	3.90E-01	1.87E-01	4/11	5/11	0/11	N/A	0/11	9.32E+02	0/11	2.80E+04	0/11	0/11	0.35–0.4
SVOA	Hexachlorobenzene	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	5.15E-01	0/11	5.15E+01	0/11	0/11	0.0041–0.38
SVOA	Hexachlorobutadiene	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.24–0.38
SVOA	Hexachlorocyclopentadiene	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.4–1.8
SVOA	Hexachloroethane	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.35–0.4
SVOA	Isophorone	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.35–0.4
SVOA	m,p-Cresol	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.4–0.76
SVOA	Naphthalene	mg/kg	1.20E-01	1.20E-01	1.20E-01	1/11	1/11	0/11	N/A	0/11	1.67E+01	0/11	1.61E+03	1/11	1/11	0.35–0.4
SVOA	Nitrobenzene	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.4–1.8
SVOA	N-Nitroso-di-n-propylamine	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	1.18E-01	0/11	1.18E+01	0/11	0/11	0.0069–0.4
SVOA	N-Nitrosodiphenylamine	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.35–0.4
SVOA	PAH, Total	mg/kg	2.33E-02	2.44E+00	9.78E-01	0/11	11/11	0/11	N/A	10/11	8.94E-02	0/11	8.94E+00	0/11	8/11	-
SVOA	Pentachlorophenol	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	8.91E-01	0/11	8.91E+01	N/A	N/A	0.71–1.8
SVOA	Phenanthrene	mg/kg	1.10E-01	2.90E+00	1.02E+00	4/11	9/11	0/11	N/A	0/11	1.40E+03	0/11	4.20E+04	5/11	9/11	0.35–0.4
SVOA	Phenol	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.35–0.4
SVOA	p-Nitroaniline	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.79–1.8
SVOA	Pyrene	mg/kg	8.90E-02	3.00E+00	1.11E+00	3/11	10/11	0/11	N/A	0/11	6.99E+02	0/11	2.10E+04	0/11	5/11	0.35–0.4
SVOA	Pyridine	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.4–0.76
RADS	Americium-241	pCi/g	2.00E-02	4.37E-01	1.17E-01	0/13	5/13	0/13	N/A	0/13	5.99E+00	0/13	5.99E+02	0/13	0/13	0.011–0.072
RADS	Cesium-137	pCi/g	4.02E-02	2.00E-01	1.07E-01	1/13	5/13	0/13	4.90E-01	2/13	1.02E-01	0/13	1.02E+01	0/13	0/13	0.0242–0.13
RADS	Neptunium-237	pCi/g	1.80E-02	4.10E+00	7.21E-01	0/13	11/13	10/13	1.00E-01	7/13	2.29E-01	0/13	2.29E+01	1/13	10/13	0.008–0.0368
RADS	Plutonium-238	pCi/g	1.80E-02	1.20E-01	4.32E-02	0/13	6/13	1/13	7.30E-02	0/13	2.87E+01	0/13	2.87E+03	0/13	0/13	0.014–0.11
RADS	Plutonium-239/240	pCi/g	8.50E-03	2.78E+00	3.55E-01	1/13	12/13	10/13	2.50E-02	0/13	2.47E+01	0/13	2.47E+03	0/13	3/13	0.00565–0.068
RADS	Technetium-99	pCi/g	6.50E-01	3.67E+02	5.72E+01	1/13	11/13	9/13	2.50E+00	0/13	1.20E+03	0/13	1.20E+05	11/13	11/13	0.4–0.7
RADS	Thorium-228	pCi/g	4.29E-01	9.40E-01	6.23E-01	0/13	13/13	0/13	1.60E+00	0/13	N/A	0/13	N/A	N/A	N/A	0.014–0.15
RADS	Thorium-230	pCi/g	5.39E-01	7.23E+00	1.69E+00	0/13	13/13	5/13	1.50E+00	0/13	3.39E+01	0/13	3.39E+03	0/13	4/13	0.01–0.123
RADS	Thorium-232	pCi/g	4.26E-01	8.60E-01	6.06E-01	0/13	13/13	0/13	1.50E+00	0/13	N/A	0/13	N/A	N/A	N/A	0.006–0.0546
RADS	Uranium-234	pCi/g	7.00E-01	1.85E+02	2.38E+01	0/13	13/13	12/13	1.20E+00	2/13	5.53E+01	0/13	5.53E+03	10/13	13/13	0.008–0.704
RADS	Uranium-235	pCi/g	4.80E-02	2.17E+01	2.25E+00	0/13	13/13	12/13	6.00E-02	7/13	3.40E-01	0/13	3.40E+01	2/13	12/13	0.01–0.584
RADS	Uranium-238	pCi/g	9.10E-01	1.10E+03	9.89E+01	0/13	13/13	12/13	1.20E+00	12/13	1.60E+00	1/13	1.60E+02	10/13	13/13	0.007–0.497

One or more samples exceed AL value
One or more samples exceed NAL value
One or more samples exceed background value
One or more samples exceed SSLs of RGA and UCRS groundwater protection

Counts of analyses are based on the maximum detected result from a sample (i.e., if a sample has analytical results from two different labs, only the maximum value is counted).
Field replicates, or separate samples are counted independently.

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

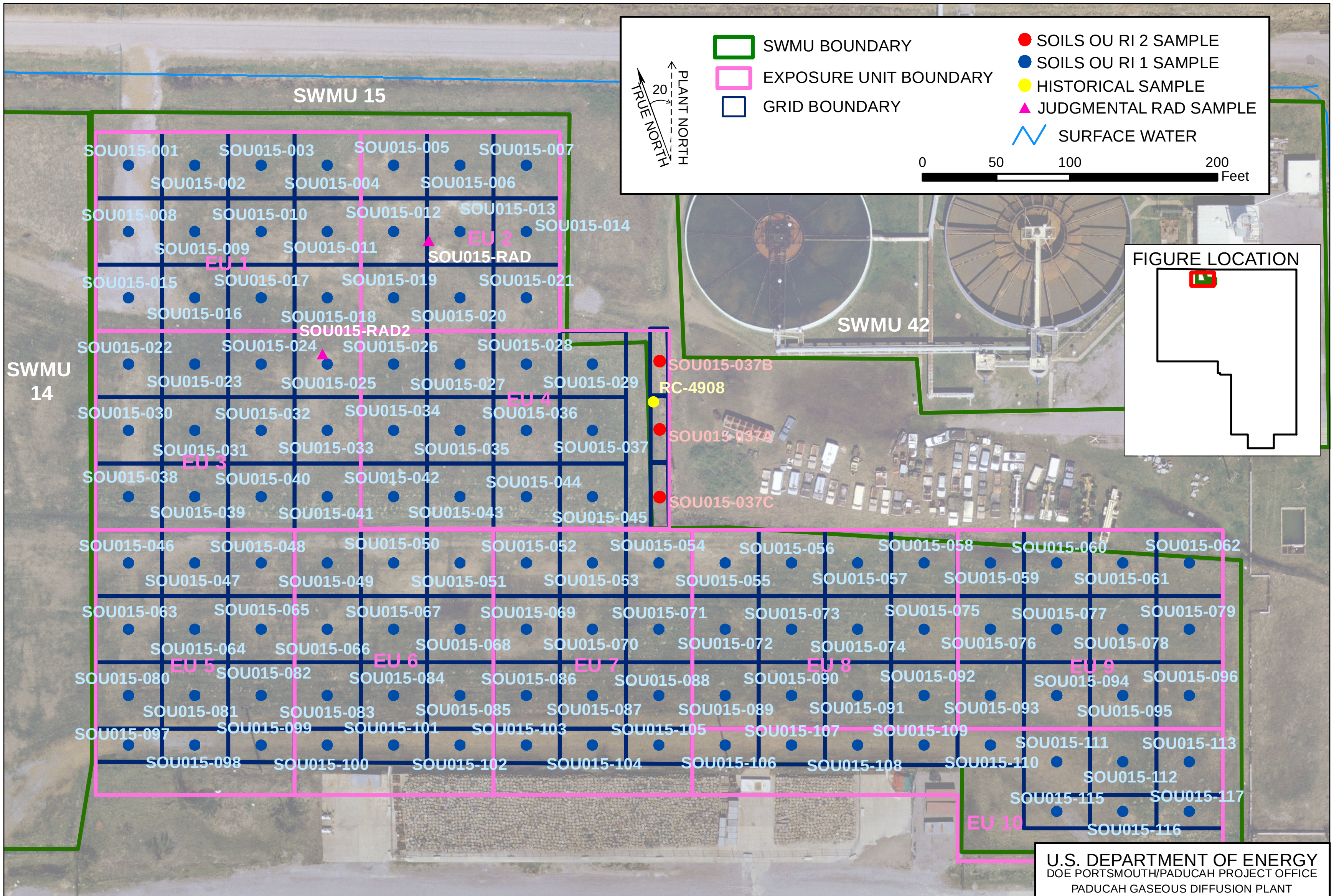
Table 5.2.1. Surface Soil Data Summary: SWMU 15 (Continued)

			Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
Type	Analysis	Unit	Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range

The uranium (metal)/uranium (isotopic) may not be from the same sample thus a correlation between uranium (metal)/uranium (isotopic) data may not be possible.
Uranium-238 that was analyzed using method RL-7128NITRIC is compared to a background value of 0.4 pCi/g for surface and subsurface.

Screening values are shown in Appendices C and D.

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable



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PADUCAH GASEOUS DIFFUSION PLANT

FLUOR

Figure 5.2.2. SWMU 15 Sample Locations—Surface Soil

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2/19/2015

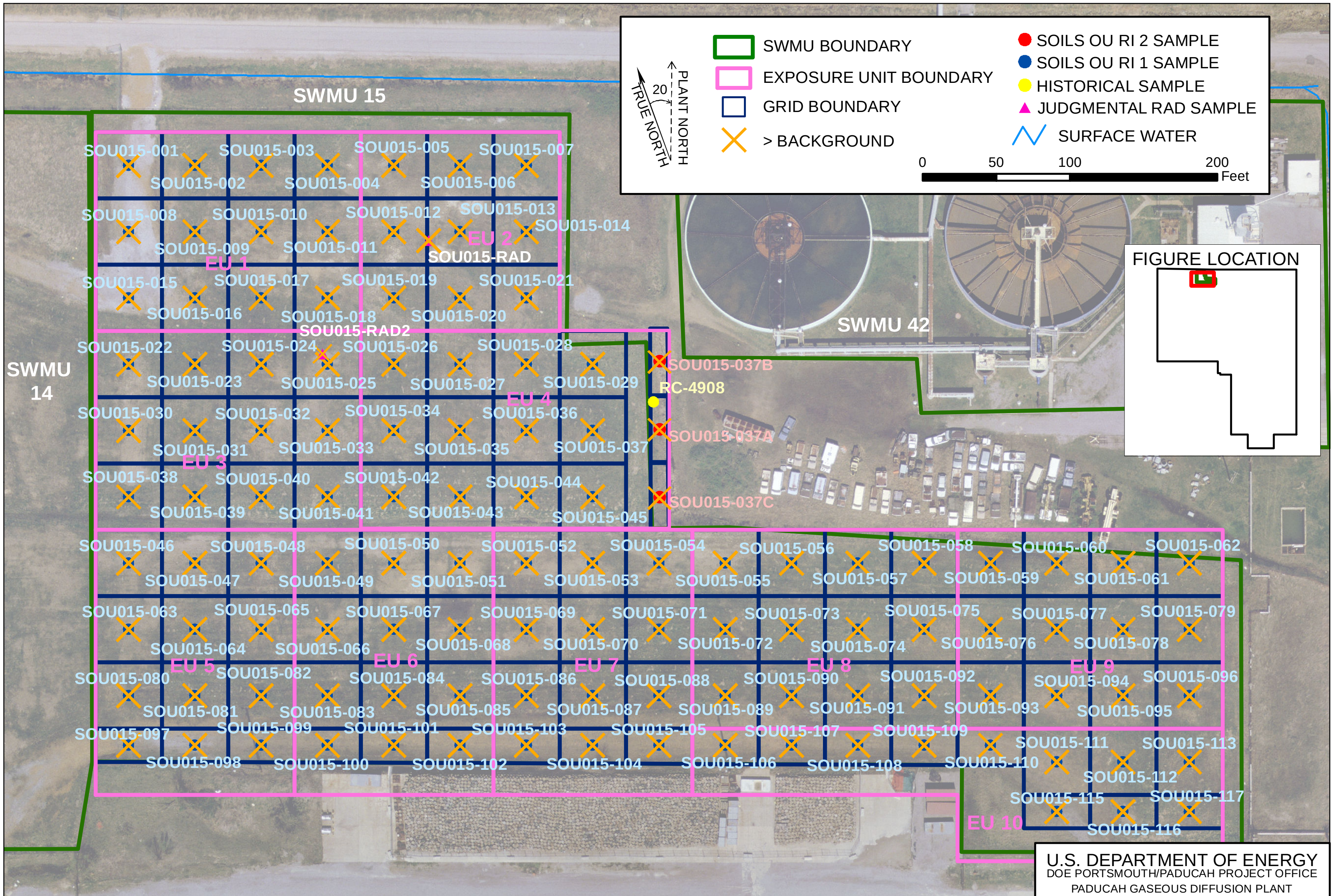

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Figure 5.2.3. SWMU 15 Background Exceedances—Surface Soil

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3/12/2015

Location	Background Exceedances
SOU015-001	Antimony (102.24 mg/kg) Barium (308.19 mg/kg) Chromium (36.75 mg/kg) Nickel (61.44 mg/kg) Silver (12.29 mg/kg)
SOU015-002	Antimony (43.21 mg/kg) Barium (221.02 mg/kg) Chromium (56.1 mg/kg) Copper (68.24 mg/kg) Iron (37400 mg/kg) Nickel (82.32 mg/kg) Thallium (0.24 mg/kg) Uranium (6.9 mg/kg) Uranium-234 (1.52 pCi/g) Uranium-235/236 (0.08 pCi/g) Uranium-238 (1.85 pCi/g)
SOU015-003	Chromium (45.73 mg/kg) Copper (116.06 mg/kg) Iron (29839.87 mg/kg) Uranium (7.82 mg/kg) Zinc (102.98 mg/kg)
SOU015-004	Antimony (75.35 mg/kg) Barium (302.44 mg/kg) Copper (303.4 mg/kg) Nickel (119.14 mg/kg) Uranium (15.05 mg/kg) Zinc (104.72 mg/kg)
SOU015-005	Antimony (77.97 mg/kg) Arsenic (16.26 mg/kg) Barium (339.55 mg/kg) Chromium (40.79 mg/kg) Copper (68.78 mg/kg) Iron (38889.2 mg/kg) Lead (40.94 mg/kg) Nickel (73.79 mg/kg) Uranium (32.23 mg/kg) Zinc (150.59 mg/kg)
SOU015-006	Barium (228.36 mg/kg) Nickel (89.18 mg/kg) Zinc (68.3 mg/kg)
SOU015-007	Antimony (0.66 mg/kg) Chromium (41.41 mg/kg) Selenium (1 mg/kg) Uranium (7.59 mg/kg) Uranium-234 (1.28 pCi/g) Uranium-235/236 (0.097 pCi/g) Uranium-238 (1.96 pCi/g)
SOU015-008	Arsenic (12.15 mg/kg) Barium (269.66 mg/kg)
SOU015-009	Copper (34.63 mg/kg) Zinc (67.54 mg/kg)
SOU015-010	Antimony (41.2 mg/kg) Barium (200.8 mg/kg) Copper (72.09 mg/kg) Nickel (85.21 mg/kg) Uranium (18.61 mg/kg) Zinc (108.9 mg/kg)
SOU015-011	Antimony (50.92 mg/kg) Arsenic (20.04 mg/kg) Barium (274.43 mg/kg) Copper (205.59 mg/kg) Iron (28293.95 mg/kg) Lead (55.35 mg/kg) Nickel (260.5 mg/kg) Uranium (45.33 mg/kg) Zinc (191.44 mg/kg)
SOU015-012	Antimony (92.37 mg/kg) Arsenic (16.18 mg/kg) Barium (380.87 mg/kg) Copper (54.71 mg/kg) Iron (34298.88 mg/kg) Lead (45.82 mg/kg) Mercury (8.62 mg/kg) Nickel (113.81 mg/kg) Uranium (96.02 mg/kg) Zinc (170.51 mg/kg)
SOU015-013	Antimony (68.89 mg/kg) Barium (274.13 mg/kg) Copper (81.57 mg/kg) Lead (51.11 mg/kg) Nickel (197.26 mg/kg) Uranium (131.7 mg/kg) Zinc (202.16 mg/kg)
SOU015-014	Barium (209.86 mg/kg) Copper (79.73 mg/kg) Iron (28387.3 mg/kg) Lead (74.34 mg/kg) Nickel (187.68 mg/kg) Uranium (87.36 mg/kg) Zinc (220.24 mg/kg)
SOU015-015	Antimony (105.97 mg/kg) Barium (348.97 mg/kg) Cadmium (14.01 mg/kg)
SOU015-016	Antimony (89.23 mg/kg) Barium (267.19 mg/kg) Copper (44.07 mg/kg) Nickel (89.47 mg/kg) Silver (10.31 mg/kg) Uranium (12.61 mg/kg) Zinc (89.78 mg/kg)
SOU015-017	Copper (68.26 mg/kg) Nickel (114.83 mg/kg) Uranium (39.48 mg/kg) Zinc (145.52 mg/kg)
SOU015-018	Antimony (84.1 mg/kg) Barium (300.71 mg/kg) Chromium (39.04 mg/kg) Copper (68.16 mg/kg) Iron (36984.53 mg/kg) Nickel (152.72 mg/kg) Uranium (42.19 mg/kg) Zinc (197.59 mg/kg)
SOU015-019	Antimony (65.15 mg/kg) Barium (342.08 mg/kg) Copper (107.65 mg/kg) Iron (30695.01 mg/kg) Lead (98.67 mg/kg) Nickel (173.84 mg/kg) Uranium (44.5 mg/kg) Zinc (255.82 mg/kg)
SOU015-020	Antimony (44.71 mg/kg) Barium (301.84 mg/kg) Chromium (59 mg/kg) Copper (142.35 mg/kg) Iron (30458.96 mg/kg) Lead (91.11 mg/kg) Mercury (9.33 mg/kg) Nickel (185.32 mg/kg) Uranium (87.1 mg/kg) Zinc (219.53 mg/kg)
SOU015-021	Antimony (98.31 mg/kg) Barium (358.76 mg/kg) Chromium (46.94 mg/kg) Copper (134.94 mg/kg) Iron (30367.71 mg/kg) Lead (65.97 mg/kg) Nickel (147.34 mg/kg) Uranium (87.85 mg/kg) Zinc (224.78 mg/kg)
SOU015-022	Antimony (76.04 mg/kg) Barium (364.22 mg/kg) Chromium (63.02 mg/kg) Copper (22.56 mg/kg) Nickel (63.2 mg/kg) Uranium (9.9 mg/kg) Vanadium (70.92 mg/kg) Zinc (75.9 mg/kg)

Figure 5.2.3. SWMU 15 Background Exceedances—Surface Soil (Continued)

SOU015-023	Arsenic (13.68 mg/kg)
	Copper (101.93 mg/kg)
	Lead (57.8 mg/kg)
	Nickel (155.19 mg/kg)
	Uranium (49.32 mg/kg)
	Zinc (243.58 mg/kg)
SOU015-024	Antimony (45.76 mg/kg)
	Arsenic (18.63 mg/kg)
	Barium (343.29 mg/kg)
	Chromium (44.22 mg/kg)
	Copper (281.4 mg/kg)
	Lead (173.6 mg/kg)
	Nickel (213.12 mg/kg)
	Uranium (256.63 mg/kg)
	Zinc (440.42 mg/kg)
SOU015-025	Chromium (38.98 mg/kg)
	Copper (118.34 mg/kg)
	Lead (67.51 mg/kg)
	Nickel (238.39 mg/kg)
	Uranium (224.77 mg/kg)
	Zinc (223.92 mg/kg)
SOU015-026	Arsenic (49.64 mg/kg)
	Chromium (77.11 mg/kg)
	Copper (542.68 mg/kg)
	Iron (76614.02 mg/kg)
	Lead (412.75 mg/kg)
	Nickel (571.09 mg/kg)
	Uranium (238.77 mg/kg)
	Zinc (680.56 mg/kg)
SOU015-027	Chromium (81.34 mg/kg)
	Copper (398.95 mg/kg)
	Iron (59817.57 mg/kg)
	Lead (284.5 mg/kg)
	Nickel (426.07 mg/kg)
	Uranium (110.12 mg/kg)
	Zinc (632.85 mg/kg)
SOU015-028	Antimony (98.71 mg/kg)
	Arsenic (20.11 mg/kg)
	Barium (459.91 mg/kg)
	Cadmium (19.73 mg/kg)
	Chromium (53.38 mg/kg)
	Copper (219.94 mg/kg)
	Iron (38012.42 mg/kg)
	Lead (136.21 mg/kg)
	Nickel (275.57 mg/kg)
	Uranium (49.7 mg/kg)
	Zinc (569 mg/kg)

SOU015-029	Antimony (52.77 mg/kg)
	Arsenic (27.53 mg/kg)
	Barium (321.77 mg/kg)
	Chromium (69.93 mg/kg)
	Copper (372.86 mg/kg)
	Iron (30093.56 mg/kg)
	Lead (188.68 mg/kg)
	Nickel (182.78 mg/kg)
	Uranium (29.46 mg/kg)
	Zinc (368.42 mg/kg)
SOU015-030	Antimony (112.15 mg/kg)
	Arsenic (15.21 mg/kg)
	Barium (323.79 mg/kg)
	Cadmium (14.2 mg/kg)
	Copper (27.22 mg/kg)
	Lead (107.62 mg/kg)
SOU015-031	Arsenic (18.59 mg/kg)
	Chromium (35.36 mg/kg)
	Copper (294.99 mg/kg)
	Lead (258.2 mg/kg)
	Nickel (177.38 mg/kg)
	Selenium (26.71 mg/kg)
	Uranium (105.03 mg/kg)
	Vanadium (74.72 mg/kg)
	Zinc (356.34 mg/kg)
SOU015-032	Antimony (73.6 mg/kg)
	Barium (299.91 mg/kg)
	Chromium (61.31 mg/kg)
	Copper (507.41 mg/kg)
	Iron (46489.86 mg/kg)
	Lead (303.7 mg/kg)
	Nickel (451.46 mg/kg)
	Uranium (169.53 mg/kg)
	Zinc (759.33 mg/kg)
SOU015-033	Antimony (93.35 mg/kg)
	Arsenic (21.8 mg/kg)
	Barium (298.68 mg/kg)
	Beryllium (0.76 mg/kg)
	Cadmium (11.9 mg/kg)
	Chromium (112 mg/kg)
	Cobalt (34.1 mg/kg)
	Copper (4360 mg/kg)
	Iron (171000 mg/kg)
	Lead (827 mg/kg)
	Manganese (2850 mg/kg)
	Mercury (2.74 mg/kg)
	Nickel (2410 mg/kg)
	Selenium (1.2 mg/kg)
	Silver (3.2 mg/kg)
	Thallium (0.26 mg/kg)
	Uranium (459 mg/kg)
	Zinc (1830 mg/kg)

SOU015-033	Neptunium-237 (4.1 pCi/g)
	Plutonium-238 (0.12 pCi/g)
	Plutonium-239/240 (2.78 pCi/g)
	Technetium-99 (367 pCi/g)
	Thorium-230 (7.23 pCi/g)
	Uranium-234 (69.6 pCi/g)
	Uranium-235/236 (4.21 pCi/g)
	Uranium-238 (96.7 pCi/g)
SOU015-034	Arsenic (51.31 mg/kg)
	Barium (321.95 mg/kg)
	Chromium (94.3 mg/kg)
	Copper (669.03 mg/kg)
	Iron (90853.28 mg/kg)
	Lead (437.53 mg/kg)
	Nickel (850.73 mg/kg)
	Uranium (126.28 mg/kg)
	Zinc (809.89 mg/kg)
SOU015-035	Antimony (97.24 mg/kg)
	Arsenic (38.65 mg/kg)
	Barium (378.04 mg/kg)
	Chromium (150.66 mg/kg)
	Copper (1273.93 mg/kg)
	Iron (142401.3 mg/kg)
	Lead (699.99 mg/kg)
	Manganese (2487.8 mg/kg)
	Mercury (15.28 mg/kg)
	Nickel (1512.05 mg/kg)
	Uranium (259.26 mg/kg)
	Zinc (2178.29 mg/kg)
SOU015-036	Antimony (97.15 mg/kg)
	Arsenic (40.86 mg/kg)
	Barium (381.14 mg/kg)
	Chromium (135.97 mg/kg)
	Copper (1134.05 mg/kg)
	Iron (94782.79 mg/kg)
	Lead (1040.18 mg/kg)
	Manganese (2252.18 mg/kg)
	Nickel (3787.15 mg/kg)
	Uranium (146.71 mg/kg)
	Zinc (1787.54 mg/kg)
SOU015-037	Antimony (50.27 mg/kg)
	Chromium (97.53 mg/kg)
	Copper (593.89 mg/kg)
	Iron (56004.48 mg/kg)
	Lead (442.98 mg/kg)
	Mercury (13.44 mg/kg)
	Nickel (469.48 mg/kg)
	Uranium (62.87 mg/kg)
	Zinc (884.18 mg/kg)

Figure 5.2.3. SWMU 15 Background Exceedances—Surface Soil (Continued)

SOU015-037A	Antimony (0.8 mg/kg)
	Cadmium (0.42 mg/kg)
	Chromium (22 mg/kg)
	Copper (191 mg/kg)
	Iron (35477 mg/kg)
	Lead (443 mg/kg)
	Nickel (94 mg/kg)
	Selenium (0.86 mg/kg)
	Uranium (109 mg/kg)
	Vanadium (122 mg/kg)
	Zinc (218 mg/kg)
	Neptunium-237 (0.461 pCi/g)
	Plutonium-239/240 (0.0375 pCi/g)
	Technetium-99 (11.2 pCi/g)
	Uranium-234 (4 pCi/g)
	Uranium-235 (0.271 pCi/g)
	Uranium-238 (6.19 pCi/g)
SOU015-037B	Copper (45 mg/kg)
	Vanadium (96 mg/kg)
SOU015-037C	Copper (38 mg/kg)
	Vanadium (106 mg/kg)
SOU015-038	Uranium (23.36 mg/kg)
SOU015-039	Antimony (73.89 mg/kg)
	Barium (374.56 mg/kg)
	Chromium (36.39 mg/kg)
	Copper (383.77 mg/kg)
	Lead (105.1 mg/kg)
	Nickel (274.85 mg/kg)
	Uranium (150.62 mg/kg)
	Zinc (557.73 mg/kg)
SOU015-040	Antimony (47.67 mg/kg)
	Arsenic (21.57 mg/kg)
	Barium (403.94 mg/kg)
	Chromium (53.52 mg/kg)
	Copper (540.53 mg/kg)
	Iron (43598.51 mg/kg)
	Lead (200.32 mg/kg)
	Nickel (326.08 mg/kg)
	Uranium (221.2 mg/kg)
	Zinc (792.64 mg/kg)
SOU015-041	Arsenic (62.55 mg/kg)
	Barium (314.91 mg/kg)
	Chromium (53.87 mg/kg)
	Copper (533.24 mg/kg)
	Lead (372.16 mg/kg)
	Nickel (378.07 mg/kg)
	Uranium (94.23 mg/kg)
	Zinc (520.51 mg/kg)
SOU015-042	Antimony (78.54 mg/kg)
	Arsenic (15.33 mg/kg)
	Barium (347.43 mg/kg)
	Copper (104.16 mg/kg)
	Lead (102.5 mg/kg)
	Nickel (98.75 mg/kg)
	Uranium (58.98 mg/kg)
	Zinc (221.53 mg/kg)
SOU015-043	Copper (240.71 mg/kg)
	Lead (85.34 mg/kg)
	Nickel (156.45 mg/kg)
	Uranium (57.17 mg/kg)
	Zinc (401.73 mg/kg)
SOU015-044	Antimony (80.25 mg/kg)
	Barium (260.37 mg/kg)
	Cadmium (24.15 mg/kg)
	Chromium (46 mg/kg)
	Copper (209.81 mg/kg)
	Iron (30000 mg/kg)
	Lead (199 mg/kg)
	Mercury (1.24 mg/kg)
	Nickel (160.04 mg/kg)
	Selenium (1.4 mg/kg)
	Uranium (56 mg/kg)
	Zinc (362.39 mg/kg)
	Neptunium-237 (0.8 pCi/g)
	Plutonium-239/240 (0.39 pCi/g)
	Technetium-99 (46.3 pCi/g)
	Thorium-230 (2.39 pCi/g)
	Uranium-234 (10.7 pCi/g)
	Uranium-235/236 (0.43 pCi/g)
	Uranium-238 (18.7 pCi/g)
SOU015-045	Antimony (118.48 mg/kg)
	Arsenic (33.11 mg/kg)
	Barium (343.64 mg/kg)
	Cadmium (16.3 mg/kg)
	Chromium (55.41 mg/kg)
	Copper (438.01 mg/kg)
	Iron (51787.97 mg/kg)
	Lead (386.11 mg/kg)
	Nickel (298 mg/kg)
	Silver (17.99 mg/kg)
	Uranium (102.67 mg/kg)
	Zinc (924.13 mg/kg)
SOU015-046	Antimony (125.42 mg/kg)
	Barium (378.37 mg/kg)
	Copper (62.18 mg/kg)
	Silver (14.99 mg/kg)
	Uranium (12.65 mg/kg)
	Zinc (102.71 mg/kg)
SOU015-047	Antimony (46.02 mg/kg)
	Barium (345.97 mg/kg)
	Chromium (42.79 mg/kg)
	Copper (215.78 mg/kg)
	Lead (47.77 mg/kg)
	Nickel (471.45 mg/kg)
	Uranium (364.2 mg/kg)
	Zinc (192.9 mg/kg)
SOU015-048	Antimony (58.14 mg/kg)
	Barium (305.52 mg/kg)
	Copper (566.14 mg/kg)
	Lead (96.05 mg/kg)
	Nickel (676 mg/kg)
	Silver (11.76 mg/kg)
	Uranium (284.04 mg/kg)
	Zinc (348.88 mg/kg)
SOU015-049	Antimony (80.3 mg/kg)
	Barium (378.61 mg/kg)
	Copper (212.66 mg/kg)
	Lead (42.39 mg/kg)
	Nickel (381.27 mg/kg)
	Uranium (43.78 mg/kg)
	Zinc (161.61 mg/kg)
SOU015-050	Antimony (54.48 mg/kg)
	Barium (310.33 mg/kg)
	Chromium (36.58 mg/kg)
	Copper (45.81 mg/kg)
SOU015-051	Antimony (45.43 mg/kg)
	Barium (255.5 mg/kg)
	Copper (311.41 mg/kg)
	Lead (55.9 mg/kg)
	Nickel (161.17 mg/kg)
	Uranium (73.94 mg/kg)
	Zinc (292.66 mg/kg)
SOU015-052	Antimony (137.58 mg/kg)
	Barium (442.93 mg/kg)
	Cadmium (17.97 mg/kg)
	Copper (122.75 mg/kg)
	Nickel (94.38 mg/kg)
	Selenium (4.99 mg/kg)
	Uranium (40.93 mg/kg)
	Zinc (119.8 mg/kg)
SOU015-053	Antimony (83.92 mg/kg)
	Barium (291.49 mg/kg)
	Cadmium (1 mg/kg)
	Chromium (33 mg/kg)
	Copper (155 mg/kg)
	Iron (35200 mg/kg)
	Lead (61.5 mg/kg)
	Nickel (108.55 mg/kg)
	Selenium (0.97 mg/kg)

Figure 5.2.3. SWMU 15 Background Exceedances—Surface Soil (Continued)

SOU015-053	Thallium (0.3 mg/kg) Uranium (50.9 mg/kg) Zinc (248 mg/kg) Neptunium-237 (0.223 pCi/g) Plutonium-239/240 (0.116 pCi/g) Technetium-99 (12.8 pCi/g) Uranium-234 (6.49 pCi/g) Uranium-235/236 (0.45 pCi/g) Uranium-238 (8.05 pCi/g)
SOU015-054	Antimony (62.19 mg/kg) Barium (348.28 mg/kg) Chromium (32.45 mg/kg) Copper (73.07 mg/kg) Uranium (13.69 mg/kg) Zinc (121.56 mg/kg)
SOU015-055	Antimony (104.94 mg/kg) Barium (453.71 mg/kg) Chromium (49.77 mg/kg) Iron (33899.68 mg/kg) Uranium (7.69 mg/kg)
SOU015-056	Barium (264.34 mg/kg) Chromium (37.97 mg/kg) Copper (24.71 mg/kg) Uranium (12.89 mg/kg) Zinc (82.46 mg/kg)
SOU015-057	Antimony (39.35 mg/kg) Barium (285.74 mg/kg) Copper (77.54 mg/kg) Nickel (120.23 mg/kg) Uranium (33.49 mg/kg) Zinc (165.91 mg/kg)
SOU015-058	Chromium (97.61 mg/kg) Copper (142.57 mg/kg) Iron (28634.22 mg/kg) Lead (67.75 mg/kg) Nickel (238.93 mg/kg) Uranium (59.79 mg/kg) Zinc (345.34 mg/kg)
SOU015-059	Antimony (47.79 mg/kg) Barium (221.71 mg/kg) Copper (56.51 mg/kg) Nickel (157.46 mg/kg) Uranium (22.72 mg/kg) Zinc (130.46 mg/kg)
SOU015-060	Copper (50.86 mg/kg) Nickel (107.29 mg/kg) Uranium (20.33 mg/kg) Vanadium (68.62 mg/kg) Zinc (115.85 mg/kg)
SOU015-061	Antimony (89.22 mg/kg) Barium (526.22 mg/kg) Chromium (59.41 mg/kg) Nickel (66.85 mg/kg)
SOU015-062	Antimony (91.9 mg/kg) Barium (344.44 mg/kg) Copper (116.61 mg/kg) Lead (61.12 mg/kg) Nickel (208.34 mg/kg) Uranium (38.85 mg/kg) Zinc (206.76 mg/kg)
SOU015-063	Antimony (75.8 mg/kg) Arsenic (12.59 mg/kg) Barium (384.31 mg/kg) Copper (309.46 mg/kg) Lead (52.34 mg/kg) Nickel (202.86 mg/kg) Uranium (112.39 mg/kg) Zinc (242.38 mg/kg)
SOU015-064	Antimony (98.23 mg/kg) Arsenic (19.15 mg/kg) Barium (483.8 mg/kg) Chromium (32.22 mg/kg) Copper (6122.47 mg/kg) Lead (100.83 mg/kg) Nickel (453.06 mg/kg) Silver (11.77 mg/kg) Uranium (261.91 mg/kg) Zinc (3168.62 mg/kg)
SOU015-065	Antimony (100.36 mg/kg) Barium (509.77 mg/kg) Cadmium (20.65 mg/kg) Copper (435.31 mg/kg) Lead (108.85 mg/kg) Nickel (440.58 mg/kg) Uranium (93.86 mg/kg) Zinc (272.26 mg/kg)
SOU015-066	Antimony (72.3 mg/kg) Barium (341.8 mg/kg) Copper (426.62 mg/kg) Iron (38664.12 mg/kg) Lead (60.33 mg/kg) Nickel (334.16 mg/kg) Uranium (32.98 mg/kg) Zinc (199.43 mg/kg)
SOU015-067	Antimony (42.46 mg/kg) Barium (268.48 mg/kg) Cadmium (1.5 mg/kg) Chromium (43.2 mg/kg) Cobalt (16.2 mg/kg) Copper (292 mg/kg) Iron (54500 mg/kg)
SOU015-067	Lead (96.4 mg/kg) Mercury (0.41 mg/kg) Nickel (175.64 mg/kg) Selenium (1.4 mg/kg) Uranium (112 mg/kg) Zinc (286 mg/kg) Neptunium-237 (0.64 pCi/g) Plutonium-239/240 (0.17 pCi/g) Technetium-99 (32.5 pCi/g) Thorium-230 (1.94 pCi/g) Uranium-234 (8.74 pCi/g) Uranium-235/236 (0.57 pCi/g) Uranium-238 (15.4 pCi/g)
SOU015-068	Antimony (63.18 mg/kg) Arsenic (18.04 mg/kg) Barium (340.15 mg/kg) Chromium (57.97 mg/kg) Copper (793.22 mg/kg) Iron (39568.21 mg/kg) Lead (169.9 mg/kg) Nickel (616.54 mg/kg) Uranium (74.77 mg/kg) Zinc (719.23 mg/kg)
SOU015-069	Antimony (60.38 mg/kg) Arsenic (20.68 mg/kg) Barium (354.63 mg/kg) Chromium (78.71 mg/kg) Copper (1803.24 mg/kg) Iron (60521.86 mg/kg) Lead (278.59 mg/kg) Manganese (2903.39 mg/kg) Nickel (834.44 mg/kg) Uranium (73.85 mg/kg) Zinc (1392.97 mg/kg)
SOU015-070	Antimony (136.13 mg/kg) Barium (519.96 mg/kg) Cadmium (16.92 mg/kg) Chromium (39.71 mg/kg) Copper (468.54 mg/kg) Lead (139.56 mg/kg) Nickel (297.56 mg/kg) Uranium (63.99 mg/kg) Zinc (409.88 mg/kg)
SOU015-071	Antimony (44.57 mg/kg) Barium (287.09 mg/kg) Copper (27.45 mg/kg)
SOU015-072	Antimony (87.03 mg/kg) Barium (343.37 mg/kg) Cadmium (16.9 mg/kg) Chromium (41.84 mg/kg) Copper (271.75 mg/kg)

Figure 5.2.3. SWMU 15 Background Exceedances—Surface Soil (Continued)

SOU015-072	Lead (59.44 mg/kg)
	Nickel (87.55 mg/kg)
	Uranium (42.17 mg/kg)
	Zinc (136.7 mg/kg)
SOU015-073	Antimony (123.84 mg/kg)
	Barium (465.9 mg/kg)
	Cadmium (16.59 mg/kg)
	Copper (91.48 mg/kg)
	Nickel (135.44 mg/kg)
	Silver (14.24 mg/kg)
	Uranium (43.23 mg/kg)
	Zinc (148.09 mg/kg)
SOU015-074	Copper (200.91 mg/kg)
	Lead (45.04 mg/kg)
	Nickel (170.72 mg/kg)
	Uranium (40.18 mg/kg)
	Zinc (202.52 mg/kg)
SOU015-075	Antimony (50.7 mg/kg)
	Barium (273.52 mg/kg)
	Chromium (49.75 mg/kg)
	Copper (235.84 mg/kg)
	Iron (39124.51 mg/kg)
	Lead (78.61 mg/kg)
	Mercury (10.04 mg/kg)
	Nickel (318.08 mg/kg)
	Uranium (23.27 mg/kg)
	Zinc (628.99 mg/kg)
SOU015-076	Antimony (84.32 mg/kg)
	Barium (344.36 mg/kg)
	Copper (126.49 mg/kg)
	Iron (31498.46 mg/kg)
	Lead (87.31 mg/kg)
	Nickel (202.7 mg/kg)
	Uranium (32.69 mg/kg)
	Zinc (487.87 mg/kg)
SOU015-077	Antimony (161.37 mg/kg)
	Barium (553.78 mg/kg)
	Copper (50.51 mg/kg)
	Silver (10.75 mg/kg)
	Uranium (28.76 mg/kg)
SOU015-078	Antimony (135.79 mg/kg)
	Barium (423.47 mg/kg)
	Cadmium (21.56 mg/kg)
	Copper (55.69 mg/kg)
	Nickel (116.05 mg/kg)
	Uranium (27.22 mg/kg)

SOU015-079	Antimony (140.77 mg/kg)
	Barium (410.86 mg/kg)
	Cadmium (15.86 mg/kg)
	Copper (100.82 mg/kg)
	Iron (31910.3 mg/kg)
	Silver (15.42 mg/kg)
	Uranium (21.21 mg/kg)
SOU015-080	Antimony (121.71 mg/kg)
	Barium (498.76 mg/kg)
	Copper (275.98 mg/kg)
	Lead (90.07 mg/kg)
	Nickel (125.22 mg/kg)
	Uranium (30 mg/kg)
	Zinc (271.36 mg/kg)
SOU015-081	Antimony (69.45 mg/kg)
	Barium (320.64 mg/kg)
	Cadmium (14.56 mg/kg)
	Chromium (33.4 mg/kg)
	Copper (357.41 mg/kg)
	Lead (139.05 mg/kg)
	Mercury (0.338 mg/kg)
	Nickel (216.92 mg/kg)
	Selenium (1.1 mg/kg)
	Uranium (96.76 mg/kg)
	Zinc (285.36 mg/kg)
	Neptunium-237 (0.69 pCi/g)
	Plutonium-239/240 (0.104 pCi/g)
	Technetium-99 (107 pCi/g)
	Uranium-234 (5.83 pCi/g)
	Uranium-235/236 (0.46 pCi/g)
	Uranium-238 (10.3 pCi/g)
SOU015-082	Antimony (91.91 mg/kg)
	Barium (294.09 mg/kg)
	Copper (125.32 mg/kg)
	Lead (58.29 mg/kg)
	Silver (13.25 mg/kg)
	Uranium (28.11 mg/kg)
	Zinc (153.24 mg/kg)
SOU015-083	Antimony (81.1 mg/kg)
	Barium (371.37 mg/kg)
	Copper (726.36 mg/kg)
	Lead (119.53 mg/kg)
	Nickel (232.27 mg/kg)
	Uranium (28.64 mg/kg)
	Zinc (529.97 mg/kg)

SOU015-084	Antimony (111.19 mg/kg)
	Barium (473.67 mg/kg)
	Cadmium (14.62 mg/kg)
	Copper (281.7 mg/kg)
	Lead (95.5 mg/kg)
	Nickel (144.26 mg/kg)
	Uranium (32.46 mg/kg)
	Zinc (242.7 mg/kg)
SOU015-085	Antimony (97.46 mg/kg)
	Barium (358.06 mg/kg)
	Chromium (54.74 mg/kg)
	Copper (289.84 mg/kg)
	Lead (90.53 mg/kg)
	Nickel (245.52 mg/kg)
	Uranium (83.04 mg/kg)
	Zinc (301.78 mg/kg)
SOU015-086	Antimony (126.64 mg/kg)
	Barium (438.89 mg/kg)
	Cadmium (17.79 mg/kg)
	Chromium (39.54 mg/kg)
	Copper (563.19 mg/kg)
	Iron (35188.88 mg/kg)
	Lead (138.95 mg/kg)
	Nickel (355.01 mg/kg)
	Uranium (48.82 mg/kg)
	Zinc (483.85 mg/kg)
SOU015-087	Antimony (283.01 mg/kg)
	Arsenic (33.09 mg/kg)
	Barium (331.83 mg/kg)
	Chromium (77.06 mg/kg)
	Copper (363.44 mg/kg)
	Iron (32276.05 mg/kg)
	Lead (193.13 mg/kg)
	Nickel (268.44 mg/kg)
	Uranium (82.92 mg/kg)
	Zinc (437.11 mg/kg)
SOU015-088	Antimony (65.05 mg/kg)
	Barium (325.46 mg/kg)
	Copper (458.45 mg/kg)
	Iron (40923.79 mg/kg)
	Lead (159 mg/kg)
	Nickel (610.38 mg/kg)
	Uranium (49.55 mg/kg)
	Zinc (366.94 mg/kg)
SOU015-089	Antimony (54.15 mg/kg)
	Arsenic (12.06 mg/kg)
	Cadmium (0.74 mg/kg)
	Chromium (33.8 mg/kg)
	Copper (133 mg/kg)
	Iron (29600 mg/kg)

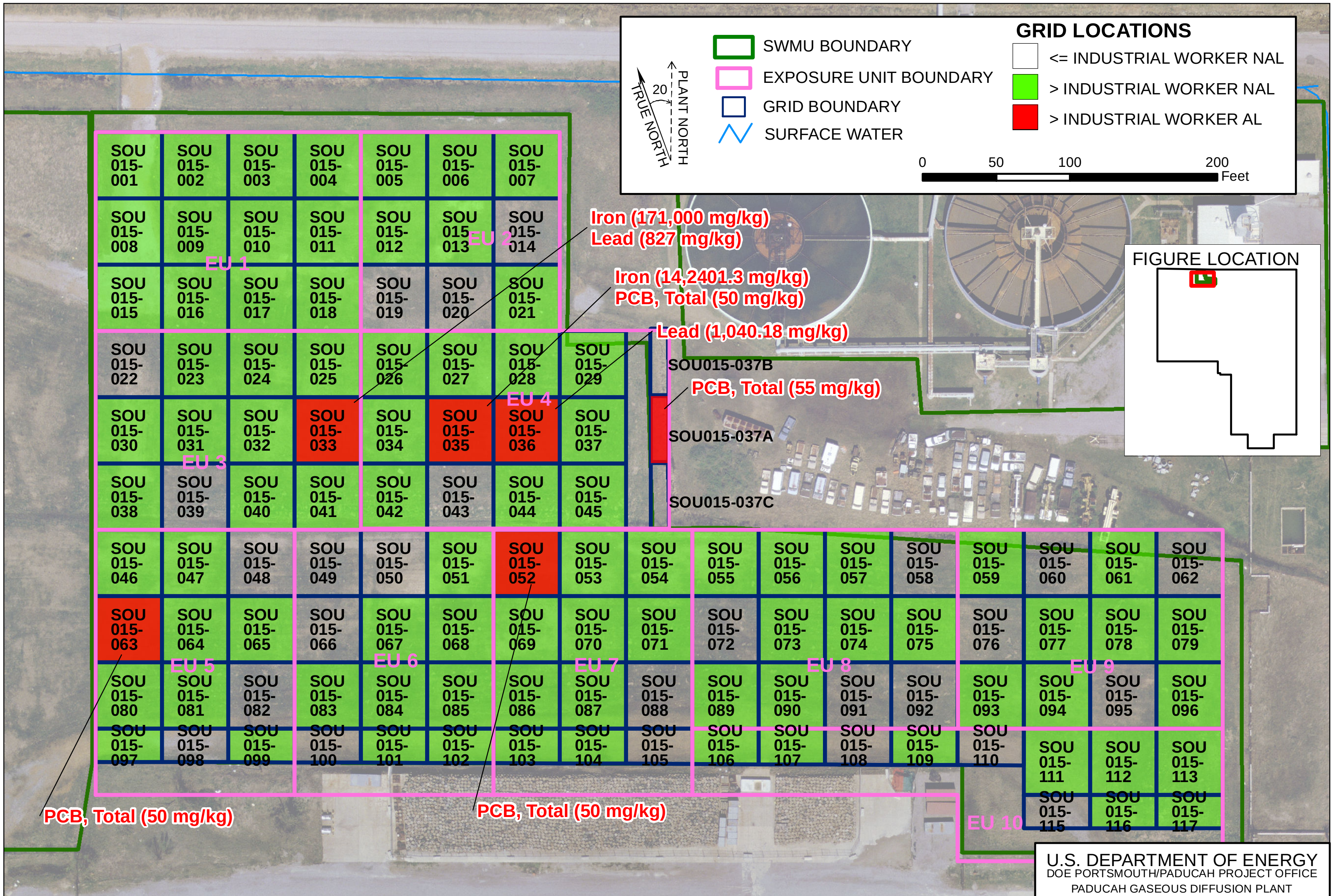
Figure 5.2.3. SWMU 15 Background Exceedances—Surface Soil (Continued)

SOU015-089	Lead (40.3 mg/kg) Mercury (9.03 mg/kg) Nickel (87.48 mg/kg) Selenium (0.95 mg/kg) Uranium (24.2 mg/kg) Zinc (114 mg/kg) Neptunium-237 (0.365 pCi/g) Plutonium-239/240 (0.123 pCi/g) Thorium-230 (1.61 pCi/g) Uranium-234 (4.5 pCi/g) Uranium-235/236 (0.304 pCi/g) Uranium-238 (6.64 pCi/g)
SOU015-090	Arsenic (13.83 mg/kg) Chromium (46.2 mg/kg) Copper (111.87 mg/kg) Lead (38.13 mg/kg) Nickel (139.37 mg/kg) Uranium (19.5 mg/kg) Zinc (127.06 mg/kg)
SOU015-091	Antimony (74.9 mg/kg) Barium (397.88 mg/kg) Copper (41.28 mg/kg) Nickel (82.73 mg/kg) Uranium (11.13 mg/kg) Zinc (76.82 mg/kg)
SOU015-092	Barium (325.16 mg/kg) Copper (76.5 mg/kg) Nickel (190.46 mg/kg) Uranium (81.68 mg/kg) Zinc (165.25 mg/kg)
SOU015-093	Antimony (0.28 mg/kg) Arsenic (12.41 mg/kg) Chromium (140.57 mg/kg) Copper (137.78 mg/kg) Iron (32445.8 mg/kg) Lead (56.15 mg/kg) Nickel (175.85 mg/kg) Uranium (43.96 mg/kg) Zinc (364.08 mg/kg) Neptunium-237 (0.128 pCi/g) Plutonium-239/240 (0.042 pCi/g) Uranium-234 (4.33 pCi/g) Uranium-235/236 (0.242 pCi/g) Uranium-238 (7.12 pCi/g)
SOU015-094	Antimony (66.35 mg/kg) Barium (211.98 mg/kg) Chromium (51.88 mg/kg) Copper (293.87 mg/kg) Iron (34774.83 mg/kg)
SOU015-094	Nickel (128.22 mg/kg) Uranium (18.65 mg/kg) Zinc (109.82 mg/kg)
SOU015-095	Antimony (80.11 mg/kg) Barium (277.14 mg/kg) Uranium (25.33 mg/kg) Vanadium (77.92 mg/kg)
SOU015-096	Antimony (119.06 mg/kg) Barium (458.13 mg/kg) Copper (27.4 mg/kg) Nickel (93.54 mg/kg) Silver (11.93 mg/kg) Uranium (12.6 mg/kg)
SOU015-097	Antimony (96.2 mg/kg) Barium (316.32 mg/kg) Cadmium (13.12 mg/kg) Copper (25.45 mg/kg)
SOU015-098	Antimony (63.74 mg/kg) Barium (249.52 mg/kg) Copper (25.37 mg/kg)
SOU015-099	Antimony (109.31 mg/kg) Barium (478.08 mg/kg) Cadmium (14.83 mg/kg) Copper (21.89 mg/kg)
SOU015-100	Antimony (51.09 mg/kg) Barium (330.18 mg/kg) Cadmium (15.17 mg/kg)
SOU015-101	Antimony (95.94 mg/kg) Barium (347.08 mg/kg) Nickel (91.44 mg/kg)
SOU015-102	Antimony (112.24 mg/kg) Barium (317.92 mg/kg) Cadmium (15.36 mg/kg) Copper (22.41 mg/kg) Nickel (74.25 mg/kg) Silver (10.91 mg/kg)
SOU015-103	Antimony (64.99 mg/kg) Barium (329.86 mg/kg) Copper (25.24 mg/kg) Nickel (80.37 mg/kg) Silver (12.86 mg/kg)
SOU015-104	Antimony (93.32 mg/kg) Barium (322.45 mg/kg) Nickel (73.64 mg/kg) Uranium (7.36 mg/kg)
SOU015-105	Antimony (87.28 mg/kg) Barium (224.6 mg/kg) Nickel (70.23 mg/kg) Zinc (65.59 mg/kg)
SOU015-106	Antimony (105.9 mg/kg) Barium (404.9 mg/kg) Cadmium (16.7 mg/kg) Nickel (197.91 mg/kg) Zinc (81.54 mg/kg)
SOU015-107	Antimony (83.08 mg/kg) Barium (307.01 mg/kg) Nickel (137.06 mg/kg) Silver (10.81 mg/kg)
SOU015-108	Antimony (65.67 mg/kg) Barium (326.73 mg/kg) Mercury (7.84 mg/kg) Nickel (226.39 mg/kg) Zinc (65.77 mg/kg)
SOU015-109	Antimony (68.07 mg/kg) Barium (257.49 mg/kg) Nickel (83.18 mg/kg) Silver (10.63 mg/kg)
SOU015-110	Nickel (65.83 mg/kg)
SOU015-111	Antimony (0.24 mg/kg) Chromium (35.5 mg/kg) Copper (25.06 mg/kg) Nickel (68.44 mg/kg) Zinc (239.58 mg/kg) Technetium-99 (4.13 pCi/g)
SOU015-112	Antimony (76.58 mg/kg) Barium (266.41 mg/kg)
SOU015-113	Antimony (98.54 mg/kg) Barium (314.63 mg/kg) Cadmium (15.01 mg/kg)
SOU015-115	Antimony (70.74 mg/kg) Barium (311.2 mg/kg) Nickel (123.95 mg/kg) Uranium (12.89 mg/kg)
SOU015-116	Antimony (117.15 mg/kg) Barium (383.99 mg/kg) Nickel (108.87 mg/kg) Uranium (90.15 mg/kg) Zinc (96.34 mg/kg)
SOU015-117	Antimony (124.94 mg/kg) Barium (629.9 mg/kg) Uranium (74.65 mg/kg)
SOU015-RAD	Uranium (36.1 mg/kg) Neptunium-237 (0.135 pCi/g) Plutonium-239/240 (0.071 pCi/g) Technetium-99 (11.3 pCi/g) Uranium-234 (6.51 pCi/g) Uranium-235/236 (0.38 pCi/g) Uranium-238 (12.1 pCi/g)

Figure 5.2.3. SWMU 15 Background Exceedances—Surface Soil (Continued)

SOU015-RAD2	Neptunium-237 (0.368 pCi/g) Plutonium-239/240 (0.401 pCi/g) Technetium-99 (34.6 pCi/g) Thorium-230 (1.86 pCi/g) Uranium-234 (185 pCi/g) Uranium-235 (21.7 pCi/g) Uranium-238 (1100 pCi/g)

Figure 5.2.3. SWMU 15 Background Exceedances—Surface Soil (Continued)



U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

Figure 5.2.4. SWMU 15 NAL Exceedances—Surface Soil

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SOU015-001	Antimony (102.24 mg/kg)
SOU015-002	Arsenic (9.8 mg/kg)
	PAH, Total (1.71437 mg/kg)
	Uranium-238 (1.85 pCi/g)
SOU015-003	Arsenic (8.6 mg/kg)
SOU015-004	Arsenic (10.1 mg/kg)
SOU015-005	Arsenic (16.26 mg/kg)
SOU015-006	Arsenic (9.48 mg/kg)
SOU015-007	Arsenic (7.7 mg/kg)
	PAH, Total (2.1078 mg/kg)
	PCB, Total (0.33 mg/kg)
	Uranium-238 (1.96 pCi/g)
SOU015-008	Arsenic (12.15 mg/kg)
SOU015-009	Arsenic (7.35 mg/kg)
SOU015-010	Arsenic (10.76 mg/kg)
SOU015-011	Arsenic (20.04 mg/kg)
SOU015-012	Arsenic (16.18 mg/kg)
SOU015-013	Arsenic (9.99 mg/kg)
	Uranium-235 (0.38 pCi/g)
	Uranium-238 (12.1 pCi/g)
SOU015-015	Antimony (105.97 mg/kg)
SOU015-016	Arsenic (7.55 mg/kg)
SOU015-017	Arsenic (8.95 mg/kg)
SOU015-018	Arsenic (10.64 mg/kg)
SOU015-021	Antimony (98.31 mg/kg)
	Arsenic (11.84 mg/kg)
SOU015-023	Arsenic (13.68 mg/kg)
SOU015-024	Arsenic (18.63 mg/kg)
SOU015-025	Arsenic (9.98 mg/kg)
	Neptunium-237 (0.368 pCi/g)
	Uranium-234 (185 pCi/g)
	Uranium-235 (21.7 pCi/g)
	Uranium-238 (1100 pCi/g)
SOU015-026	Arsenic (49.64 mg/kg)
SOU015-027	PCB, Total (10 mg/kg)
SOU015-028	Antimony (98.71 mg/kg)
	Arsenic (20.11 mg/kg)
	PCB, Total (5 mg/kg)
SOU015-029	Arsenic (27.53 mg/kg)
	PCB, Total (10 mg/kg)
SOU015-030	Antimony (112.15 mg/kg)
	Arsenic (15.21 mg/kg)
SOU015-031	Arsenic (18.59 mg/kg)
SOU015-032	PCB, Total (5 mg/kg)

SOU015-033	Arsenic (21.8 mg/kg)
	Iron (171000 mg/kg)
	Lead (827 mg/kg)
	PAH, Total (1.4541 mg/kg)
	PCB, Total (9.9 mg/kg)
SOU015-033	Cesium-137 (0.2 pCi/g)
	Neptunium-237 (4.1 pCi/g)
	Uranium-234 (69.6 pCi/g)
	Uranium-235 (4.21 pCi/g)
	Uranium-238 (96.7 pCi/g)
SOU015-034	Arsenic (51.31 mg/kg)
	PCB, Total (5 mg/kg)
SOU015-035	Antimony (97.24 mg/kg)
	Arsenic (38.65 mg/kg)
	Iron (142401.3 mg/kg)
	PCB, Total (50 mg/kg)
SOU015-036	Antimony (97.15 mg/kg)
	Arsenic (40.86 mg/kg)
	Lead (1040.18 mg/kg)
	PCB, Total (10 mg/kg)
SOU015-037	PCB, Total (10 mg/kg)
SOU015-037A	Arsenic (7.9 mg/kg)
	PCB, Total (55 mg/kg)
	Neptunium-237 (0.461 pCi/g)
	Uranium-238 (6.19 pCi/g)
SOU015-038	Arsenic (8.47 mg/kg)
SOU015-040	Arsenic (21.57 mg/kg)
	PCB, Total (10 mg/kg)
SOU015-041	Arsenic (62.55 mg/kg)
SOU015-042	Arsenic (15.33 mg/kg)
SOU015-044	Arsenic (6 mg/kg)
	PAH, Total (2.4449 mg/kg)
	PCB, Total (6.4 mg/kg)
	Cesium-137 (0.14 pCi/g)
	Neptunium-237 (0.8 pCi/g)
	Uranium-235 (0.43 pCi/g)
	Uranium-238 (18.7 pCi/g)
SOU015-045	Antimony (118.48 mg/kg)
	Arsenic (33.11 mg/kg)
	PCB, Total (10 mg/kg)
SOU015-046	Antimony (125.42 mg/kg)
SOU015-047	Arsenic (11.52 mg/kg)
SOU015-049	PCB, Total (5 mg/kg)
SOU015-051	Arsenic (11 mg/kg)

SOU015-052	Antimony (137.58 mg/kg)
	Arsenic (8.9 mg/kg)
	PCB, Total (50 mg/kg)
SOU015-053	Arsenic (10.48 mg/kg)
	PAH, Total (0.15884 mg/kg)
	PCB, Total (0.34 mg/kg)
SOU015-053	Uranium-235 (0.45 pCi/g)
	Uranium-238 (8.05 pCi/g)
SOU015-054	Arsenic (7.92 mg/kg)
SOU015-055	Antimony (104.94 mg/kg)
	Arsenic (7.37 mg/kg)
SOU015-056	Arsenic (7.73 mg/kg)
SOU015-057	Arsenic (9.88 mg/kg)
SOU015-059	Arsenic (8.16 mg/kg)
SOU015-061	Arsenic (10.23 mg/kg)
SOU015-063	Arsenic (12.59 mg/kg)
	PCB, Total (50 mg/kg)
SOU015-064	Antimony (98.23 mg/kg)
	Arsenic (19.15 mg/kg)
	PCB, Total (5 mg/kg)
SOU015-065	Antimony (100.36 mg/kg)
	PCB, Total (5 mg/kg)
SOU015-067	Arsenic (10.2 mg/kg)
	PAH, Total (1.6235 mg/kg)
	PCB, Total (5 mg/kg)
	Neptunium-237 (0.64 pCi/g)
	Uranium-235 (0.57 pCi/g)
	Uranium-238 (15.4 pCi/g)
SOU015-068	Arsenic (18.04 mg/kg)
	PCB, Total (10 mg/kg)
SOU015-069	Arsenic (20.68 mg/kg)
	PCB, Total (10 mg/kg)
SOU015-070	Antimony (136.13 mg/kg)
	PCB, Total (10 mg/kg)
SOU015-071	Arsenic (8.39 mg/kg)
SOU015-073	Antimony (123.84 mg/kg)
	Arsenic (11.92 mg/kg)
SOU015-074	Arsenic (9.82 mg/kg)
SOU015-075	Arsenic (11.87 mg/kg)
SOU015-077	Antimony (161.37 mg/kg)
SOU015-078	Antimony (135.79 mg/kg)
	Arsenic (7.72 mg/kg)
SOU015-079	Antimony (140.77 mg/kg)
SOU015-080	Antimony (121.71 mg/kg)

Figure 5.2.4. SWMU 15 NAL Exceedances—Surface Soil (Continued)

SOU015-081	Arsenic (8.3 mg/kg) PAH, Total (0.5106 mg/kg) PCB, Total (5.6 mg/kg) Neptunium-237 (0.69 pCi/g) Uranium-235 (0.46 pCi/g) Uranium-238 (10.3 pCi/g)
SOU015-083	PCB, Total (5 mg/kg)
SOU015-084	Antimony (111.19 mg/kg)
SOU015-085	Antimony (97.46 mg/kg) Arsenic (10.64 mg/kg)
SOU015-086	Antimony (126.64 mg/kg)
SOU015-087	Antimony (283.01 mg/kg) Arsenic (33.09 mg/kg) PCB, Total (5 mg/kg)

SOU015-089	Arsenic (12.06 mg/kg) PAH, Total (0.35879 mg/kg) PCB, Total (4.9 mg/kg) Neptunium-237 (0.365 pCi/g) Uranium-238 (6.64 pCi/g)
SOU015-090	Arsenic (13.83 mg/kg)
SOU015-093	Arsenic (12.41 mg/kg) PAH, Total (0.23832 mg/kg) PCB, Total (0.33 mg/kg) Uranium-238 (7.12 pCi/g)
SOU015-094	Arsenic (10.77 mg/kg)
SOU015-096	Antimony (119.06 mg/kg) Arsenic (7.89 mg/kg)
SOU015-097	Antimony (96.2 mg/kg)
SOU015-099	Antimony (109.31 mg/kg) Arsenic (6.52 mg/kg)
SOU015-101	Antimony (95.94 mg/kg) Arsenic (6.61 mg/kg)
SOU015-102	Antimony (112.24 mg/kg)

SOU015-103	Arsenic (6.17 mg/kg)
SOU015-104	Arsenic (6.04 mg/kg)
SOU015-106	Antimony (105.9 mg/kg) Arsenic (6.48 mg/kg)
SOU015-107	Arsenic (9.42 mg/kg)
SOU015-109	Arsenic (5.75 mg/kg)
SOU015-111	Arsenic (7.2 mg/kg) PAH, Total (0.128447 mg/kg)
SOU015-112	Arsenic (8.68 mg/kg)
SOU015-113	Antimony (98.54 mg/kg) Arsenic (6.43 mg/kg)
SOU015-116	Antimony (117.15 mg/kg) Arsenic (8.5 mg/kg)
SOU015-117	Antimony (124.94 mg/kg) Arsenic (9.37 mg/kg)

Figure 5.2.4. SWMU 15 NAL Exceedances—Surface Soil (Continued)

The following metals were detected in the SWMU 15 surface soil above both the background screening levels (if available) and the SSLs for the protection of UCRS groundwater.

Metal	Grid	EU
Antimony	1, 2, 4, 5, 7, 10, 11, 12, 13, 15, 16, 18, 19, 20, 21, 22, 24, 28, 29, 30, 32, 33, 35, 36, 37, 39, 40, 42, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 57, 59, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 91, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 112, 113, 115, 116, 117	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
Arsenic	5, 8, 11, 12, 23, 24, 26, 28, 29, 30, 31, 33, 34, 35, 36, 40, 41, 42, 45, 63, 64, 68, 69, 87, 89, 90, 93	1, 2, 3, 4, 5, 6, 7, 8, 9
Barium	1, 5, 12, 15, 19, 21, 22, 24, 28, 29, 30, 34, 35, 36, 39, 40, 41, 42, 45, 46, 47, 49, 50, 52, 54, 55, 61, 62, 63, 64, 65, 66, 68, 69, 70, 72, 73, 76, 77, 78, 79, 80, 81, 83, 84, 85, 86, 87, 88, 91, 92, 96, 97, 99, 100, 101, 102, 103, 104, 106, 108, 113, 115, 116, 117	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
Cadmium	15, 28, 30, 33, 37A, 44, 45, 52, 53, 65, 67, 70, 72, 73, 78, 79, 81, 84, 86, 89, 97, 99, 100, 102, 106, 113	1, 4, 3, 7, 5, 6, 8, 9, 10
Cobalt	33, 67	3, 6
Copper	2, 3, 4, 5, 10, 11, 12, 13, 14, 17, 18, 19, 20, 21, 23, 24, 25, 26, 27, 28, 29, 31, 32, 33, 34, 35, 36, 37, 37A, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 57, 58, 59, 60, 62, 63, 64, 65, 66, 67, 68, 69, 70, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 92, 93, 94	1, 2, 3, 4, 5, 6, 7, 8, 9
Iron	2, 3, 5, 11, 12, 14, 18, 19, 20, 21, 26, 27, 28, 29, 32, 33, 34, 35, 36, 37, 37A, 40, 44, 45, 53, 55, 58, 66, 67, 68, 69, 75, 76, 79, 86, 87, 88, 89, 93, 94	1, 2, 3, 4, 6, 7, 8, 9
Lead	5, 11, 12, 13, 14, 17, 19, 20, 21, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 37A, 39, 40, 41, 42, 43, 44, 45, 47, 48, 49, 51, 53, 58, 62, 63, 64, 65, 66, 67, 68, 69, 70, 72, 74, 75, 76, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 93	1, 2, 3, 4, 5, 6, 7, 8, 9
Manganese	33, 35, 36, 69	3, 4, 7
Mercury	12, 20, 33, 35, 37, 44, 67, 75, 81, 89, 108	2, 3, 4, 5, 6, 8, 10
Molybdenum[1]	2, 7, 26, 33, 35, 36, 37A, 44, 45, 53, 67, 81, 89, 93, 111	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
Nickel	1, 2, 4, 5, 6, 10, 11, 12, 13, 14, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 31, 32, 33, 34, 35, 36, 37, 37A, 037B, 037C, 39, 40, 41, 42, 43, 44, 45, 47, 48, 49, 51, 52, 53, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 72, 73, 74, 75, 76, 78, 80, 81, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 96, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 115, 116	1, 2, 4, 5, 6, 7, 8, 9, 10
Selenium	7, 31, 33, 37A, 44, 52, 53, 67, 81, 89	2, 3, 4, 5, 6, 7, 8
Silver	1, 16, 33, 45, 46, 48, 64, 73, 77, 79, 82, 96, 102, 103, 107, 109	1, 3, 4, 5, 6, 7, 8, 9, 10
Thallium	2, 33, 44, 53	1, 3, 4, 7
Uranium	4, 5, 10, 11, 12, 13, 14, 17, 18, 19, 20, 21, 23, 24, 25, 26, 27, 28, 29, 31, 32, 33, 34, 35, 36, 37, 37A, 38, 39, 40, 41, 42, 43, 44, 45, 47, 48, 49, 51, 52, 53, 54, 57, 58, 59, 60, 62, 63, 64, 65, 66, 67, 68, 69, 70, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 92, 93, 94, 95, 116, 117	1, 2, 3, 4, 5, 6, 7, 8, 9, 10

Metal	Grid	EU
Vanadium	22, 31, 37A, 037B, 037C, 60, 95	3, 4, 9
Zinc	3, 4, 5, 6, 9, 10, 11, 12, 13, 14, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 31, 32, 33, 34, 35, 36, 37, 37A, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 51, 52, 53, 54, 56, 57, 58, 59, 60, 62, 63, 64, 65, 66, 67, 68, 69, 70, 72, 73, 74, 75, 76, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 105, 106, 108, 111, 116	1, 2, 3, 4, 5, 6, 7, 8, 9, 10

[1] No soil background value is available.

For the protection of RGA groundwater, the following metals were detected in the SWMU 15 surface soil above both the SSLs and background screening levels (if available).

Metal	Grid	EU
Antimony	1, 2, 4, 5, 10, 11, 12, 13, 15, 16, 18, 19, 20, 21, 22, 24, 28, 29, 30, 32, 33, 35, 36, 37, 39, 40, 42, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 57, 59, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 91, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 112, 113, 115, 116, 117	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
Arsenic	11, 24, 26, 28, 29, 31, 33, 34, 35, 36, 40, 41, 45, 64, 68, 69, 87	1, 3, 4, 5, 6, 7
Cadmium	44	4
Cobalt	33, 67	3, 6
Copper	33, 64	3, 5
Iron	2, 3, 5, 11, 12, 14, 18, 19, 20, 21, 26, 27, 28, 29, 32, 33, 34, 35, 36, 37, 37A, 40, 44, 45, 53, 55, 58, 66, 67, 68, 69, 75, 76, 79, 86, 87, 88, 89, 93, 94	1, 2, 3, 4, 6, 7, 8, 9
Lead	33, 36	3, 4
Manganese	33, 35, 36, 69	3, 4, 7
Mercury	12, 20, 33, 35, 37, 75, 89, 108	2, 3, 4, 8, 10
Molybdenum[1]	33, 35, 45	3, 4
Nickel	11, 13, 14, 18, 19, 20, 21, 23, 24, 25, 26, 27, 28, 29, 31, 32, 33, 34, 35, 36, 37, 39, 40, 41, 43, 44, 45, 47, 48, 49, 51, 58, 59, 62, 63, 64, 65, 66, 67, 68, 69, 70, 74, 75, 76, 81, 83, 85, 86, 87, 88, 92, 93, 106, 108	1, 2, 4, 5, 6, 7, 8, 9, 10
Selenium	31	3
Silver	1, 16, 45, 46, 48, 64, 73, 77, 79, 82, 96, 102, 103, 107, 109	1, 4, 5, 6, 7, 8, 9, 10
Zinc	35, 64	4, 5

[1] No soil background value is available.

PCBs

Total PCBs were detected above the industrial worker NALs in the SWMU 15 surface soil in grid 7 from EU2; grid 32, 33, and 40 from EU 3; grids 27, 28, 29, 34, 35, 36, 37, 37, 37A, 44, and 45 from EU 4; grids 63, 64, 65, and 81 from EU 5; grids 49, 67, 68, and 83 from EU 6; grids 52, 53, 69, 70, and 87 from EU 7; grid 89 from EU 8; and grid 93 from EU 9. Grids 35 (EU 4), 37A (EU 4), 52 (EU 7), and 63 (EU 5) detected PCBs above the industrial worker ALs.

Total PCBs were detected in the SWMU 15 surface soil above the SSLs for the protection of UCRS groundwater in the following:

Grid	EU
7, 27, 28, 29, 32, 33, 34, 35, 36, 37, 37A, 40, 44, 45, 49, 52, 53, 63, 64, 65, 67, 68, 69, 70, 81, 83, 87, 89, 93	2, 3, 4, 5, 6, 7, 8, 9

All of the above, except grids 7 (EU 2), 53 (EU 7), and 93 (EU 9) also were detected above SSLs for the protection of RGA groundwater.

SVOCs

Total PAHs were detected above industrial worker NALs in the surface soil in the following grids: 2, 7, 33, 44, 53, 67, 81, 89, 93, 111, which include grids from each of the 10 EUs. No SVOCs were detected in the SWMU 15 surface soil above industrial worker ALs.

Of the SVOCs, naphthalene [grid 7 (EU 2)]; phenanthrene [grids 7 (EU 2), 33 (EU 3), 44 (EU 4), 53 (EU 7), 67 (EU 6), 81 (EU 5), 89 (EU 8), and 93 (EU 9)]; pyrene [grids 2 (EU 1), 7 (EU 2), 33 (EU 3), 44 (EU 4), and 67 (EU 6)]; and Total PAHs [grids 2 (EU 1), 7 (EU 2), 33 (EU 3), 44 (EU 4), 67 (EU 6), 81 (EU 5), 89 (EU 8), and 93 (EU 9)] were detected above the SSLs for the protection of UCRS groundwater. Naphthalene [grid 7 (EU 2)] and phenanthrene [grids 2 (EU 1), 7 (EU 2), 33 (EU 3), 44 (EU 4), and 67 (EU 6)] also were detected above the SSLs for the protection of RGA groundwater.

VOCs

No VOCs were sampled for this unit.

Radionuclides

The following are the radioisotopes that were above both the background screening levels and the industrial worker NALs and the grids and EUs in which they were found.

Radionuclide	Grid	EU
Neptunium-237	25, 33, 37A, 44, 67, 81, 89	3, 4, 5, 6, 8
Uranium-234	25, 33	3
Uranium-235	13, 25, 33, 44, 53, 67, 81	2, 3, 4, 5, 6, 7
Uranium-238	2, 7, 13, 25, 33, 37A, 44, 53, 67, 81, 89, 93	1, 2, 4, 8

Uranium-238 was detected above industrial worker ALs in the SWMU 15 surface soil.

The following radionuclides were detected in the SWMU 15 surface soil above both the background screening levels (if available) and the SSLs for the protection of UCRS groundwater.

Radionuclide	Grid	EU
Neptunium-237	13, 25, 33, 37A, 44, 53, 67, 81, 89, 93	2–9
Plutonium-239/240	25, 33, 44	3, 4
Tc-99	13, 25, 33, 37A, 44, 53, 67, 81, 111	2–7, 10
Thorium-230	25, 33, 44, 67	3, 4, 6
Uranium-234	2, 7, 13, 25, 33, 37A, 44, 53, 67, 81, 89, 93	1–9
Uranium-235	2, 7, 13, 25, 33, 37A, 44, 53, 67, 81, 89, 93	1–9
Uranium-238	2, 7, 13, 25, 33, 37A, 44, 53, 67, 81, 89, 93	1–9

Neptunium-237, Tc-99, uranium-234, and uranium-238 were detected above both the background screening levels and the SSLs for the protection of RGA groundwater as follows.

Radionuclide	Grid	EU
Neptunium-237	33	3
Tc-99	13, 25, 33, 37A, 44, 53, 67, 81, 111	2–7, 10
Uranium-234	13, 25, 33, 37A, 44, 53, 67, 81, 89, 93	2–9
Uranium-235	25, 33	3
Uranium-238	13, 25, 33, 37A, 44, 53, 67, 81, 89, 93	2–9

5.2.4 Nature and Extent of Contamination—Subsurface Soils

The representative data set presented in Table 5.2.2 provides the nature of contamination in SWMU 15 subsurface soils, and Figures 5.2.5–5.2.7 illustrate the horizontal extent. A complete list of detailed sampling results, including sampling depths, is provided in Appendix F (samples with ending depths greater than 1 ft bgs are considered subsurface soils in this nature and extent section). Grid numbers shown below are truncated from the figures. Figures contain the SWMU#–grid#, with zeros filling the appropriate spaces to make three digits.

The horizontal and vertical extent of SWMU 15 subsurface soil contamination is considered defined adequately for supporting the BRA and FS. There is some uncertainty with vertical extent; however, this will be addressed in the FS.

Metals

Antimony, arsenic, and lead were detected above both the industrial worker NAL and background screening levels in the SWMU 15 subsurface soil, as shown below. The maximum depth of metals above both background screening levels and the industrial worker NALs was 10 ft bgs.

Metal	Grid	EU
Antimony	1, 3, 8, 11, 15, 16, 17, 19, 25, 32, 35, 36, 41, 45, 52, 54, 55, 57, 58, 59, 63, 64, 67, 78, 80, 81, 85, 91, 93, 94, 98, 99, 100, 109, 116	All EUs
Arsenic	2, 3, 4, 5, 6, 11, 13, 17, 24, 25, 26, 27, 31, 32, 33, 34, 35, 36, 41, 47, 55, 56, 57, 63, 64, 78, 89, 94, 97, 98, 99, 104, 109, 111, 113	1, 2, 3, 4, 5, 7, 8, 9, 10
Lead	41	3

As with surface soils, since ALs are the same values as the NALs for lead, the NAL exceedance of this metal also is an AL exceedance.

Table 5.2.2. Subsurface Soil Data Summary: SWMU 15

			Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
Type	Analysis	Unit	Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
METAL	Aluminum	mg/kg	4.18E+03	1.68E+04	7.45E+03	0/29	29/29	3/29	1.20E+04	0/29	1.00E+05	0/29	1.00E+05	0/29	29/29	5.5–17.5
METAL	Antimony	mg/kg	3.40E-01	1.77E+02	7.60E+01	0/187	158/187	158/187	2.10E-01	40/187	9.34E+01	0/187	2.80E+03	155/187	158/187	0.55–30
METAL	Arsenic	mg/kg	3.80E+00	1.11E+02	9.86E+00	0/193	88/193	44/193	7.90E+00	88/193	1.41E+00	0/193	1.41E+02	4/193	88/193	1.1–17.5
METAL	Barium	mg/kg	6.54E+01	6.78E+02	3.87E+02	0/187	187/187	172/187	1.70E+02	0/187	4.04E+04	0/187	1.00E+05	0/187	178/187	1.61–100
METAL	Beryllium	mg/kg	3.73E-01	7.30E-01	4.98E-01	0/29	24/29	1/29	6.90E-01	0/29	4.50E+02	0/29	1.35E+04	0/29	0/29	0.11–0.437
METAL	Cadmium	mg/kg	2.60E-02	2.40E+01	7.43E+00	0/187	35/187	26/187	2.10E-01	0/187	6.12E+01	0/187	1.84E+03	3/187	24/187	0.055–12
METAL	Calcium	mg/kg	8.52E+02	9.65E+04	6.29E+03	0/29	29/29	2/29	6.10E+03	0/29	N/A	0/29	N/A	N/A	N/A	54.5–286
METAL	Chromium	mg/kg	6.06E+00	1.19E+02	3.56E+01	0/193	79/193	22/193	4.30E+01	0/193	1.98E+02	0/193	1.98E+04	0/193	0/193	1.1–85
METAL	Cobalt	mg/kg	3.60E+00	1.14E+01	7.03E+00	0/15	15/15	0/15	1.30E+01	0/15	6.87E+01	0/15	2.06E+03	15/15	15/15	0.22–0.24
METAL	Copper	mg/kg	4.70E+00	8.07E+02	5.84E+01	0/193	82/193	43/193	2.50E+01	0/193	9.34E+03	0/193	1.00E+05	0/193	27/193	1.1–35
METAL	Iron	mg/kg	4.44E+03	6.78E+04	1.39E+04	0/179	179/179	9/179	2.80E+04	0/179	1.00E+05	0/179	1.00E+05	179/179	179/179	5.5–100
METAL	Lead	mg/kg	6.53E+00	1.80E+03	3.05E+01	0/193	169/193	23/193	2.30E+01	1/193	8.00E+02	1/193	8.00E+02	1/193	83/193	0.33–17.5
METAL	Magnesium	mg/kg	7.75E+02	3.25E+03	1.41E+03	0/15	15/15	3/15	2.10E+03	0/15	N/A	0/15	N/A	N/A	N/A	54.5–60.9
METAL	Manganese	mg/kg	5.48E+01	2.72E+03	3.25E+02	0/179	173/179	5/179	8.20E+02	0/179	4.72E+03	0/179	1.00E+05	145/179	173/179	0.22–85
METAL	Mercury	mg/kg	8.10E-03	1.22E+01	1.85E+00	0/193	25/193	11/193	1.30E-01	0/193	7.01E+01	0/193	2.10E+03	9/193	14/193	0.0364–40
METAL	Molybdenum	mg/kg	2.20E-01	2.30E+00	7.67E-01	0/179	15/179	0/179	N/A	0/179	1.17E+03	0/179	3.51E+04	0/179	15/179	0.55–15
METAL	Nickel	mg/kg	3.87E+00	4.11E+02	6.61E+01	0/193	77/193	50/193	2.20E+01	0/193	4.30E+03	0/193	1.00E+05	10/193	77/193	0.55–65
METAL	Selenium	mg/kg	9.10E-01	4.19E+00	1.76E+00	0/193	18/193	18/193	7.00E-01	0/193	1.17E+03	0/193	3.51E+04	0/193	18/193	0.55–20
METAL	Silver	mg/kg	3.30E-02	1.53E+01	5.53E+00	0/193	36/193	23/193	2.70E+00	0/193	1.17E+03	0/193	3.51E+04	23/193	24/193	0.22–50
METAL	Sodium	mg/kg	3.40E+01	2.21E+02	1.03E+02	0/15	15/15	0/15	3.40E+02	0/15	N/A	0/15	N/A	N/A	N/A	21.8–24.3
METAL	Thallium	mg/kg	9.80E-02	6.10E-01	2.83E-01	0/29	15/29	5/29	3.40E-01	0/29	2.34E+00	0/29	7.02E+01	0/29	12/29	0.22–17.5
METAL	Uranium	mg/kg	1.30E+00	8.73E+01	1.63E+01	0/179	55/179	43/179	4.60E+00	0/179	6.81E+02	0/179	2.04E+04	0/179	24/179	0.02–20
METAL	Vanadium	mg/kg	1.13E+01	1.32E+02	3.75E+01	0/193	39/193	11/193	3.70E+01	0/193	1.15E+03	0/193	3.45E+04	0/193	39/193	1.1–70
METAL	Zinc	mg/kg	1.15E+01	6.36E+02	4.92E+01	0/193	192/193	27/193	6.00E+01	0/193	7.01E+04	0/193	1.00E+05	0/193	68/193	1–25
PPCB	PCB, Total	mg/kg	1.10E-02	5.00E+01	5.99E+00	0/193	12/193	0/193	N/A	8/193	3.05E-01	2/193	3.05E+01	3/193	8/193	0.036–5
SVOA	1,2,4-Trichlorobenzene	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.36–0.5
SVOA	1,2-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.36–0.5
SVOA	1,3-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.36–0.5
SVOA	1,4-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.36–0.5
SVOA	2,4,5-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.36–0.5
SVOA	2,4,6-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.36–0.5
SVOA	2,4-Dichlorophenol	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.36–0.5
SVOA	2,4-Dimethylphenol	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.36–0.5
SVOA	2,4-Dinitrophenol	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.48–1.9
SVOA	2,4-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.36–0.5
SVOA	2,6-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.36–0.5
SVOA	2-Chloronaphthalene	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.36–0.5
SVOA	2-Chlorophenol	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.36–0.5
SVOA	2-Methyl-4,6-dinitrophenol	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.48–1.9
SVOA	2-Methylnaphthalene	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.36–0.5
SVOA	2-Methylphenol	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.36–0.5
SVOA	2-Nitrobenzenamine	mg/kg	N/A	N/A	N/A	0/12	0/12	0/12	N/A	0/12	2.91E+02	0/12	8.73E+03	0/12	0/12	1.7–1.9
SVOA	2-Nitrophenol	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.36–0.5
SVOA	3,3'-Dichlorobenzidine	mg/kg	N/A	N/A	N/A	0/12	0/12	0/12	N/A	0/12	N/A	0/12	N/A	N/A	N/A	1.7–1.9
SVOA	3-Nitrobenzenamine	mg/kg	N/A	N/A	N/A	0/12	0/12	0/12	N/A	0/12	N/A	0/12	N/A	N/A	N/A	1.7–1.9
SVOA	4-Bromophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.36–0.5
SVOA	4-Chloro-3-methylphenol	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.36–0.5
SVOA	4-Chlorobenzenamine	mg/kg	N/A	N/A	N/A	0/12	0/12	0/12	N/A	0/12	N/A	0/12	N/A	N/A	N/A	0.36–0.4
SVOA	4-Chlorophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.36–0.5
SVOA	4-Nitrophenol	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.48–1.9
SVOA	Acenaphthene	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	1.40E+03	0/26	4.20E+04	0/26	0/26	0.36–0.5
SVOA	Acenaphthylene	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	1.40E+03	0/26	4.20E+04	N/A	N/A	0.36–0.5
SVOA	Anthracene	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	6.99E+03	0/26	2.10E+05	0/26	0/26	0.36–0.5

FOD = frequency of detection
FOE = frequency of exceedance
n/a = not applicable
* For RADS, all results are reported.

Table 5.2.2. Subsurface Soil Data Summary: SWMU 15 (Continued)

Type	Analysis	Unit	Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		DL Range
			Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	
SVOA	Benzenemethanol	mg/kg	N/A	N/A	N/A	0/12	0/12	0/12	N/A	0/12	N/A	0/12	N/A	N/A	N/A	0.36–0.4
SVOA	Benzo(ghi)perylene	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.36–0.5
SVOA	Benzoic acid	mg/kg	3.90E-01	4.00E-01	3.97E-01	3/12	3/12	0/12	N/A	0/12	N/A	0/12	N/A	N/A	N/A	1.7–1.9
SVOA	Bis(2-chloroethoxy)methane	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.36–0.5
SVOA	Bis(2-chloroethyl) ether	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.0072–0.5
SVOA	Bis(2-chloroisopropyl) ether	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.36–0.5
SVOA	Bis(2-ethylhexyl)phthalate	mg/kg	5.20E-02	1.30E-01	8.98E-02	4/26	4/26	0/26	N/A	0/26	5.88E+01	0/26	5.88E+03	0/26	0/26	0.36–0.5
SVOA	Butyl benzyl phthalate	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.36–0.5
SVOA	Dibenzofuran	mg/kg	N/A	N/A	N/A	0/12	0/12	0/12	N/A	0/12	N/A	0/12	N/A	N/A	N/A	0.36–0.4
SVOA	Diethyl phthalate	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.36–0.5
SVOA	Dimethyl phthalate	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.36–0.5
SVOA	Di-n-butyl phthalate	mg/kg	4.80E-01	4.10E+00	1.27E+00	0/26	9/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.36–0.5
SVOA	Di-n-octylphthalate	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.36–0.5
SVOA	Fluoranthene	mg/kg	4.50E-02	6.70E-02	5.47E-02	3/26	3/26	0/26	N/A	0/26	9.32E+02	0/26	2.80E+04	0/26	0/26	0.36–0.5
SVOA	Fluorene	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	9.32E+02	0/26	2.80E+04	0/26	0/26	0.36–0.5
SVOA	Hexachlorobenzene	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	5.15E-01	0/26	5.15E+01	0/26	0/26	0.36–0.5
SVOA	Hexachlorobutadiene	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.36–0.5
SVOA	Hexachlorocyclopentadiene	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.48–1.9
SVOA	Hexachloroethane	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.36–0.5
SVOA	Isophorone	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.36–0.5
SVOA	m,p-Cresol	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.48–0.8
SVOA	Naphthalene	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	1.67E+01	0/26	1.61E+03	0/26	0/26	0.36–0.5
SVOA	Nitrobenzene	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.48–1.9
SVOA	N-Nitroso-di-n-propylamine	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	1.18E-01	0/26	1.18E+01	0/26	0/26	0.0072–0.5
SVOA	N-Nitrosodiphenylamine	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.36–0.5
SVOA	PAH, Total	mg/kg	1.80E-02	5.57E-02	3.52E-02	0/27	4/27	0/27	N/A	4/27	8.94E-02	0/27	8.94E+00	0/27	0/27	–
SVOA	Pentachlorophenol	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	8.91E-01	0/26	8.91E+01	N/A	N/A	0.48–1.9
SVOA	Phenanthrene	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	1.40E+03	0/26	4.20E+04	0/26	0/26	0.36–0.5
SVOA	Phenol	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.36–0.5
SVOA	p-Nitroaniline	mg/kg	N/A	N/A	N/A	0/12	0/12	0/12	N/A	0/12	N/A	0/12	N/A	N/A	N/A	1.7–1.9
SVOA	Pyrene	mg/kg	4.70E-02	7.00E-02	5.85E-02	2/26	2/26	0/26	N/A	0/26	6.99E+02	0/26	2.10E+04	0/26	0/26	0.36–0.5
SVOA	Pyridine	mg/kg	N/A	N/A	N/A	0/26	0/26	0/26	N/A	0/26	N/A	0/26	N/A	N/A	N/A	0.48–0.8
SVOA	Total Cresols	mg/kg	N/A	N/A	N/A	0/14	0/14	0/14	N/A	0/14	N/A	0/14	N/A	N/A	N/A	0.96–1
VOA	1,1,1-Trichloroethane	mg/kg	N/A	N/A	N/A	0/14	0/14	0/14	N/A	0/14	3.58E+03	0/14	1.07E+05	0/14	0/14	0.005–0.005
VOA	1,1,2,2-Tetrachloroethane	mg/kg	N/A	N/A	N/A	0/14	0/14	0/14	N/A	0/14	N/A	0/14	N/A	N/A	N/A	0.005–0.005
VOA	1,1,2-Trichloroethane	mg/kg	N/A	N/A	N/A	0/14	0/14	0/14	N/A	0/14	6.32E-01	0/14	1.90E+01	0/14	0/14	0.005–0.005
VOA	1,1-Dichloroethane	mg/kg	6.10E-03	6.10E-03	6.10E-03	0/14	1/14	0/14	N/A	0/14	1.58E+01	0/14	1.58E+03	0/14	1/14	0.005–0.005
VOA	1,1-Dichloroethene	mg/kg	N/A	N/A	N/A	0/14	0/14	0/14	N/A	0/14	1.00E+02	0/14	3.00E+03	0/14	0/14	0.005–0.005
VOA	1,2-Dichloroethane	mg/kg	N/A	N/A	N/A	0/14	0/14	0/14	N/A	0/14	2.09E+00	0/14	2.09E+02	0/14	0/14	0.005–0.005
VOA	1,2-Dichloropropane	mg/kg	N/A	N/A	N/A	0/14	0/14	0/14	N/A	0/14	N/A	0/14	N/A	N/A	N/A	0.005–0.005
VOA	1,2-Dimethylbenzene	mg/kg	N/A	N/A	N/A	0/14	0/14	0/14	N/A	0/14	2.81E+02	0/14	8.43E+03	0/14	0/14	0.005–0.005
VOA	2-Butanone	mg/kg	5.90E-03	3.60E-02	1.34E-02	5/14	5/14	0/14	N/A	0/14	N/A	0/14	N/A	N/A	N/A	0.005–0.005
VOA	2-Hexanone	mg/kg	6.40E-03	6.40E-03	6.40E-03	0/14	1/14	0/14	N/A	0/14	N/A	0/14	N/A	N/A	N/A	0.005–0.005
VOA	4-Methyl-2-pentanone	mg/kg	N/A	N/A	N/A	0/14	0/14	0/14	N/A	0/14	N/A	0/14	N/A	N/A	N/A	0.005–0.005
VOA	Acetone	mg/kg	7.10E-03	3.60E-02	1.37E-02	8/14	8/14	0/14	N/A	0/14	N/A	0/14	N/A	N/A	N/A	0.005–0.005
VOA	Benzene	mg/kg	N/A	N/A	N/A	0/14	0/14	0/14	N/A	0/14	5.31E+00	0/14	5.31E+02	0/14	0/14	0.005–0.005
VOA	Bromodichloromethane	mg/kg	N/A	N/A	N/A	0/14	0/14	0/14	N/A	0/14	1.30E+00	0/14	1.30E+02	0/14	0/14	0.005–0.005
VOA	Bromoform	mg/kg	N/A	N/A	N/A	0/14	0/14	0/14	N/A	0/14	N/A	0/14	N/A	N/A	N/A	0.005–0.005
VOA	Bromomethane	mg/kg	N/A	N/A	N/A	0/14	0/14	0/14	N/A	0/14	N/A	0/14	N/A	N/A	N/A	0.005–0.005
VOA	Carbon disulfide	mg/kg	6.60E-03	6.90E-03	6.75E-03	14/14	14/14	0/14	N/A	0/14	N/A	0/14	N/A	N/A	N/A	0.005–0.005
VOA	Carbon tetrachloride	mg/kg	N/A	N/A	N/A	0/14	0/14	0/14	N/A	0/14	2.96E+00	0/14	2.96E+02	0/14	0/14	0.005–0.005
VOA	Chlorobenzene	mg/kg	N/A	N/A	N/A	0/14	0/14	0/14	N/A	0/14	N/A	0/14	N/A	N/A	N/A	0.005–0.005
VOA	Chloroethane	mg/kg	N/A	N/A	N/A	0/14	0/14	0/14	N/A	0/14	N/A	0/14	N/A	N/A	N/A	0.005–0.005

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.2.2. Subsurface Soil Data Summary: SWMU 15 (Continued)

			Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
Type	**Analysis**	**Unit**	**Min**	**Max**	**Avg**	**FOD**	**FOD**	**FOE**	**Bkgd**	**FOE**	**NAL**	**FOE**	**AL**	**RGA**	**UCRS**	**DL Range**
VOA	Chloroform	mg/kg	N/A	N/A	N/A	0/14	0/14	0/14	N/A	0/14	1.39E+00	0/14	1.39E+02	0/14	0/14	0.005–0.005
VOA	Chloromethane	mg/kg	N/A	N/A	N/A	0/14	0/14	0/14	N/A	0/14	N/A	0/14	N/A	N/A	N/A	0.005–0.005
VOA	*cis*-1,2-Dichloroethene	mg/kg	N/A	N/A	N/A	0/14	0/14	0/14	N/A	0/14	4.67E+02	0/14	1.40E+04	0/14	0/14	0.005–0.005
VOA	*cis*-1,3-Dichloropropene	mg/kg	N/A	N/A	N/A	0/14	0/14	0/14	N/A	0/14	N/A	0/14	N/A	N/A	N/A	0.005–0.005
VOA	Dibromochloromethane	mg/kg	8.30E-03	8.30E-03	8.30E-03	0/14	1/14	0/14	N/A	0/14	N/A	0/14	N/A	N/A	N/A	0.005–0.005
VOA	Ethylbenzene	mg/kg	N/A	N/A	N/A	0/14	0/14	0/14	N/A	0/14	2.66E+01	0/14	2.66E+03	0/14	0/14	0.005–0.005
VOA	m,p-Xylene	mg/kg	N/A	N/A	N/A	0/14	0/14	0/14	N/A	0/14	2.54E+02	0/14	7.62E+03	0/14	0/14	0.0099–0.01
VOA	Methylene chloride	mg/kg	N/A	N/A	N/A	0/14	0/14	0/14	N/A	0/14	N/A	0/14	N/A	N/A	N/A	0.005–0.005
VOA	Styrene	mg/kg	N/A	N/A	N/A	0/14	0/14	0/14	N/A	0/14	N/A	0/14	N/A	N/A	N/A	0.005–0.005
VOA	Tetrachloroethene	mg/kg	N/A	N/A	N/A	0/14	0/14	0/14	N/A	0/14	4.00E+01	0/14	1.20E+03	N/A	N/A	0.005–0.005
VOA	Toluene	mg/kg	N/A	N/A	N/A	0/14	0/14	0/14	N/A	0/14	6.25E+03	0/14	1.88E+05	0/14	0/14	0.005–0.005
VOA	*trans*-1,2-Dichloroethene	mg/kg	N/A	N/A	N/A	0/14	0/14	0/14	N/A	0/14	6.51E+01	0/14	1.95E+03	0/14	0/14	0.005–0.005
VOA	*trans*-1,3-Dichloropropene	mg/kg	N/A	N/A	N/A	0/14	0/14	0/14	N/A	0/14	N/A	0/14	N/A	N/A	N/A	0.005–0.005
VOA	Trichloroethene	mg/kg	N/A	N/A	N/A	0/14	0/14	0/14	N/A	0/14	1.90E+00	0/14	5.70E+01	0/14	0/14	0.005–0.005
VOA	Vinyl chloride	mg/kg	N/A	N/A	N/A	0/14	0/14	0/14	N/A	0/14	2.06E+00	0/14	2.06E+02	0/14	0/14	0.005–0.005
RADS	Americium-241	pCi/g	9.30E-02	9.30E-02	9.30E-02	0/24	1/24	0/24	N/A	0/24	5.99E+00	0/24	5.99E+02	0/24	0/24	0.011–0.107
RADS	Cesium-137	pCi/g	N/A	N/A	N/A	0/24	0/24	0/24	2.80E-01	0/24	1.02E-01	0/24	1.02E+01	0/24	0/24	0.026–0.1
RADS	Cobalt-60	pCi/g	N/A	N/A	N/A	0/14	0/14	0/14	N/A	0/14	N/A	0/14	N/A	N/A	N/A	0.0238–0.0315
RADS	Neptunium-237	pCi/g	1.30E-02	8.20E-01	3.74E-01	0/24	4/24	0/24	N/A	2/24	2.29E-01	0/24	2.29E+01	0/24	3/24	0.0093–0.101
RADS	Plutonium-238	pCi/g	2.60E-02	4.80E-02	3.67E-02	0/24	3/24	0/24	N/A	0/24	2.87E+01	0/24	2.87E+03	0/24	0/24	0.013–0.156
RADS	Plutonium-239/240	pCi/g	5.10E-02	7.90E-01	2.53E-01	0/24	4/24	0/24	N/A	0/24	2.47E+01	0/24	2.47E+03	0/24	1/24	0.0064–0.0898
RADS	Potassium-40	pCi/g	8.70E+00	1.13E+01	9.96E+00	0/14	14/14	0/14	1.60E+01	0/14	N/A	0/14	N/A	N/A	N/A	0.177–0.233
RADS	Radium-226	pCi/g	6.93E-01	7.49E-01	7.19E-01	0/14	4/14	0/14	1.50E+00	0/14	N/A	0/14	N/A	N/A	N/A	0.106–0.193
RADS	Strontium-90	pCi/g	N/A	N/A	N/A	0/14	0/14	0/14	N/A	0/14	N/A	0/14	N/A	N/A	N/A	1.36–1.79
RADS	Technetium-99	pCi/g	7.60E-01	1.83E+02	2.13E+01	0/24	17/24	12/24	2.80E+00	0/24	1.20E+03	0/24	1.20E+05	17/24	17/24	0.4–1.66
RADS	Thorium-228	pCi/g	7.50E-01	1.13E+00	9.67E-01	0/24	10/24	0/24	1.60E+00	0/24	N/A	0/24	N/A	N/A	N/A	0.01–0.984
RADS	Thorium-230	pCi/g	5.60E-01	3.08E+00	1.11E+00	0/24	13/24	1/24	1.40E+00	0/24	3.39E+01	0/24	3.39E+03	0/24	1/24	0.008–0.524
RADS	Thorium-232	pCi/g	3.05E-01	1.10E+00	6.64E-01	0/24	24/24	0/24	1.50E+00	0/24	N/A	0/24	N/A	N/A	N/A	0.006–0.135
RADS	Uranium-234	pCi/g	3.00E-01	1.49E+01	1.50E+00	0/24	24/24	4/24	1.20E+00	0/24	5.53E+01	0/24	5.53E+03	2/24	24/24	0.00865–0.1
RADS	Uranium-235	pCi/g	3.37E-02	1.13E+00	1.18E-01	3/24	19/24	7/24	6.00E-02	1/24	3.40E-01	0/24	3.40E+01	0/24	10/24	0.007–0.11
RADS	Uranium-238	pCi/g	3.57E-01	1.90E+01	1.91E+00	0/24	24/24	15/24	1.20E+00	4/24	1.60E+00	0/24	1.60E+02	2/24	24/24	0.007–0.09

One or more samples exceed AL value

One or more samples exceed NAL value

One or more samples exceed background value

One or more samples exceed SSLs of RGA and UCRS groundwater protection

Counts of analyses are based on the maximum detected result from a sample (i.e., if a sample has analytical results from two different labs, only the maximum value is counted).
Field replicates, or separate samples are counted independently.

The uranium (metal)/uranium (isotopic) may not be from the same sample thus a correlation between uranium (metal)/uranium (isotopic) data may not be possible.
Uranium-238 that was analyzed using method RL-7128NITRIC is compared to a background value of 0.4 pCi/g for surface and subsurface.

Screening values are shown in Appendices C and D.

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

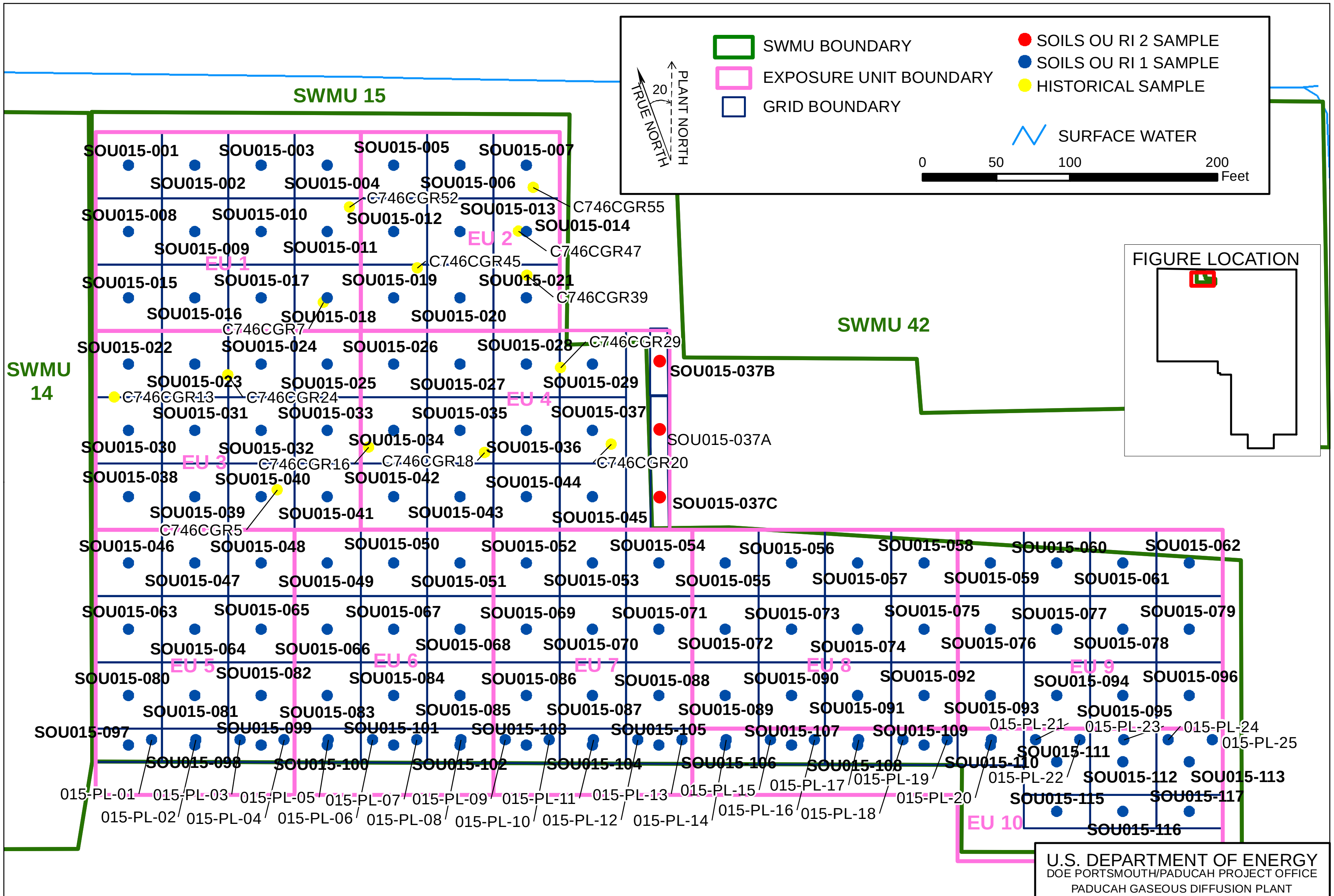

Figure 5.2.5. SWMU 15 Sample Locations—Subsurface Soil

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1/7/2015

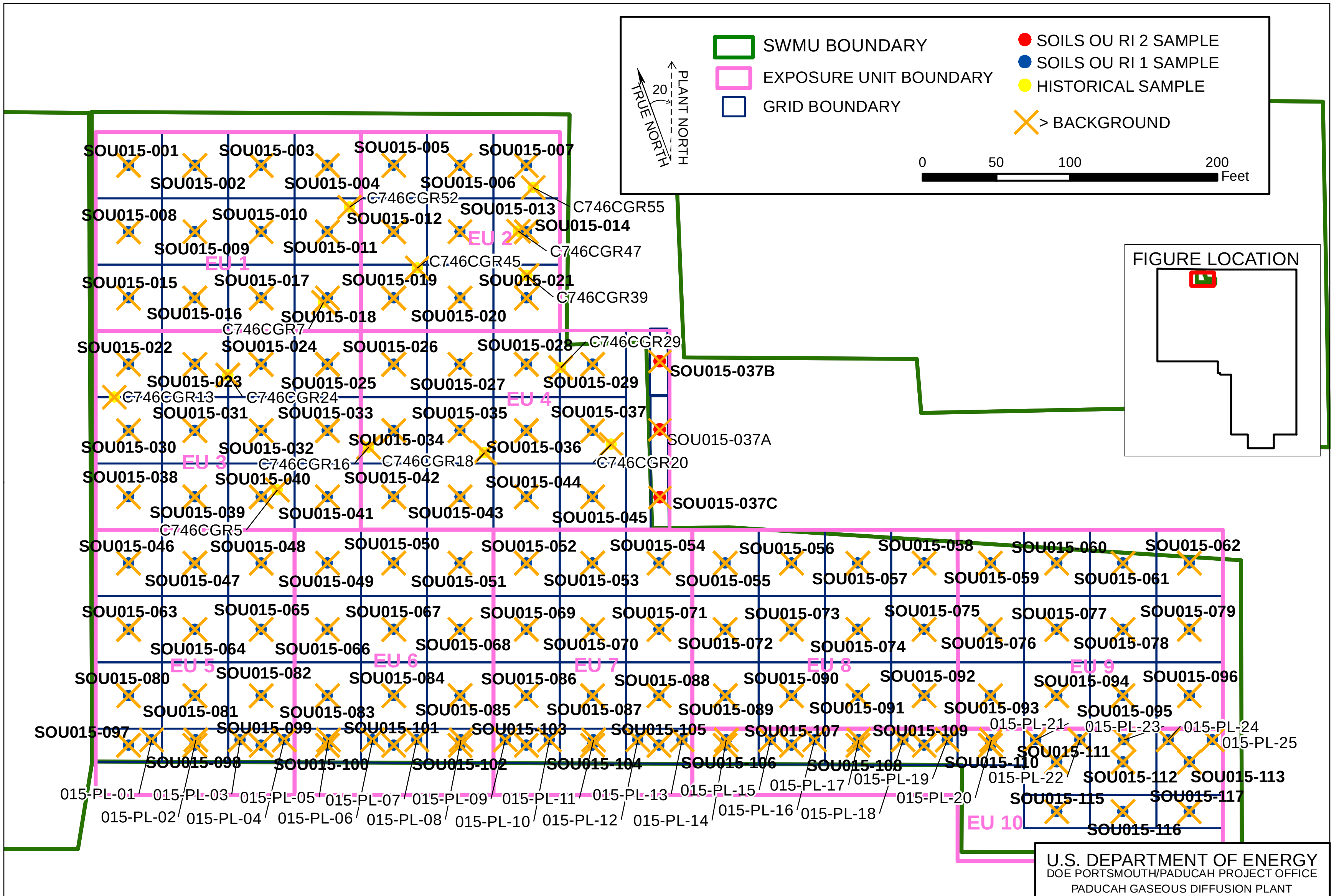

Figure 5.2.6. SWMU 15 Background Exceedances—Subsurface Soil

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2/13/2015

015-PL-01	Antimony (39.97 mg/kg)
	Barium (338.76 mg/kg)
015-PL-02	Antimony (66.05 mg/kg)
	Arsenic (8.62 mg/kg)
	Barium (409.7 mg/kg)
	Chromium (43.3 mg/kg)
015-PL-03	Antimony (79.54 mg/kg)
	Barium (380.85 mg/kg)
	Silver (11.09 mg/kg)
015-PL-04	Aluminum (13800 mg/kg)
	Antimony (71.36 mg/kg)
	Arsenic (11.8 mg/kg)
	Barium (458.77 mg/kg)
	Chromium (63.89 mg/kg)
	Magnesium (2500 mg/kg)
	Selenium (1.1 mg/kg)
015-PL-05	Antimony (86.78 mg/kg)
	Barium (387.48 mg/kg)
	Uranium (9.11 mg/kg)
015-PL-06	Antimony (75.1 mg/kg)
	Barium (451.34 mg/kg)
015-PL-07	Antimony (80.65 mg/kg)
	Barium (509.61 mg/kg)
015-PL-08	Antimony (58.51 mg/kg)
	Barium (380.59 mg/kg)
	Nickel (57.08 mg/kg)
015-PL-09	Antimony (41.34 mg/kg)
	Barium (260.96 mg/kg)
015-PL-10	Antimony (39.06 mg/kg)
	Barium (327.18 mg/kg)
015-PL-11	Antimony (88.59 mg/kg)
	Barium (415.67 mg/kg)
015-PL-12	Antimony (49.29 mg/kg)
	Barium (338.56 mg/kg)
015-PL-13	Antimony (57.74 mg/kg)
	Barium (351.18 mg/kg)
015-PL-14	Antimony (44.08 mg/kg)
	Barium (397.7 mg/kg)
	Calcium (35200 mg/kg)
	Selenium (0.91 mg/kg)
015-PL-15	Antimony (50.14 mg/kg)
	Barium (395.72 mg/kg)
015-PL-16	Barium (347.57 mg/kg)
015-PL-17	Antimony (60.32 mg/kg)
	Barium (381.3 mg/kg)
	Nickel (54.15 mg/kg)
015-PL-18	Antimony (59.29 mg/kg)
	Barium (403.38 mg/kg)
	Chromium (62.91 mg/kg)
015-PL-19	Antimony (67.01 mg/kg)
	Barium (432.87 mg/kg)
	Nickel (70.12 mg/kg)
015-PL-20	Antimony (71.18 mg/kg)
	Barium (407.94 mg/kg)
	Nickel (70.18 mg/kg)
015-PL-21	Antimony (71.02 mg/kg)
	Arsenic (7.95 mg/kg)
	Barium (353.16 mg/kg)
015-PL-22	Antimony (63.2 mg/kg)
	Arsenic (7.92 mg/kg)
	Barium (378.04 mg/kg)
015-PL-23	Antimony (79.42 mg/kg)
	Barium (456.22 mg/kg)
015-PL-24	Antimony (47.47 mg/kg)
	Arsenic (9.16 mg/kg)
	Barium (418.93 mg/kg)
015-PL-25	Antimony (69.02 mg/kg)
	Barium (418.07 mg/kg)
C746CGR13	Cadmium (1.67 mg/kg)
C746CGR16	Cadmium (1.57 mg/kg)
	Technetium-99 (3.18 pCi/g)
	Uranium-235 (0.071 pCi/g)
	Uranium-238 (1.33 pCi/g)
C746CGR18	Cadmium (1.4 mg/kg)
	Technetium-99 (13.1 pCi/g)
	Uranium-238 (1.09 pCi/g)
C746CGR20	Uranium-238 (0.765 pCi/g)
C746CGR24	Cadmium (1.81 mg/kg)
	Technetium-99 (20.1 pCi/g)
	Uranium-235 (0.0801 pCi/g)
	Uranium-238 (2.07 pCi/g)
C746CGR29	Technetium-99 (30.6 pCi/g)
	Uranium-234 (3.28 pCi/g)
	Uranium-235 (0.191 pCi/g)
	Uranium-238 (4.66 pCi/g)
C746CGR39	Mercury (1.2 mg/kg)
	Nickel (28.3 mg/kg)
	Technetium-99 (4.43 pCi/g)
	Uranium-234 (1.96 pCi/g)
	Uranium-235 (0.109 pCi/g)
	Uranium-238 (2.02 pCi/g)
C746CGR45	Cadmium (1.58 mg/kg)
	Technetium-99 (3.8 pCi/g)
	Uranium-238 (0.59 pCi/g)
C746CGR47	Uranium-238 (0.892 pCi/g)
C746CGR5	Technetium-99 (19.1 pCi/g)
	Uranium-238 (1.02 pCi/g)
C746CGR52	Uranium-238 (0.711 pCi/g)
C746CGR55	Uranium-238 (0.463 pCi/g)
C746CGR7	Technetium-99 (183 pCi/g)
	Uranium-235 (0.0665 pCi/g)
	Uranium-238 (1.31 pCi/g)
SOU015-001	Antimony (134.96 mg/kg)
	Barium (427.78 mg/kg)
	Chromium (48.86 mg/kg)
	Nickel (78.57 mg/kg)
	Vanadium (83.44 mg/kg)
SOU015-002	Antimony (88.3 mg/kg)
	Arsenic (9.45 mg/kg)
	Barium (466.52 mg/kg)
	Silver (9.5 mg/kg)
SOU015-003	Antimony (105.71 mg/kg)
	Arsenic (13.49 mg/kg)
	Barium (532.02 mg/kg)
	Cadmium (0.25 mg/kg)
	Copper (31.84 mg/kg)
	Iron (28716.07 mg/kg)
	Nickel (60.51 mg/kg)
	Selenium (2.1 mg/kg)
	Thallium (0.61 mg/kg)

Figure 5.2.6. SWMU 15 Background Exceedances—Subsurface Soil (Continued)

SOU015-004	Antimony (79.26 mg/kg)
	Arsenic (11.38 mg/kg)
	Barium (456.02 mg/kg)
	Cadmium (14.54 mg/kg)
SOU015-005	Antimony (50.84 mg/kg)
	Arsenic (14.89 mg/kg)
	Barium (407.01 mg/kg)
SOU015-006	Aluminum (16800 mg/kg)
	Antimony (0.61 mg/kg)
	Arsenic (8.7 mg/kg)
	Barium (177.82 mg/kg)
	Magnesium (2440 mg/kg)
	Selenium (1.7 mg/kg)
	Thallium (0.35 mg/kg)
	Vanadium (37.2 mg/kg)
SOU015-007	Antimony (81.15 mg/kg)
	Barium (578.95 mg/kg)
SOU015-008	Antimony (102.67 mg/kg)
	Barium (415.32 mg/kg)
	Cadmium (16.74 mg/kg)
	Uranium (7.66 mg/kg)
SOU015-009	Barium (316.22 mg/kg)
SOU015-010	Barium (225.88 mg/kg)
SOU015-011	Antimony (124.95 mg/kg)
	Arsenic (8.14 mg/kg)
	Barium (633.06 mg/kg)
	Uranium (34.93 mg/kg)
	Zinc (83.52 mg/kg)
SOU015-012	Antimony (64.16 mg/kg)
	Barium (384.39 mg/kg)
	Silver (10.62 mg/kg)
SOU015-013	Arsenic (8.08 mg/kg)
	Barium (276.91 mg/kg)
SOU015-014	Antimony (46.42 mg/kg)
	Barium (337.13 mg/kg)
	Uranium (11.82 mg/kg)
	Vanadium (78.35 mg/kg)
SOU015-015	Antimony (95.4 mg/kg)
	Barium (547.42 mg/kg)

SOU015-016	Antimony (112.18 mg/kg)
	Barium (532.11 mg/kg)
	Copper (25.84 mg/kg)
	Nickel (67.68 mg/kg)
	Zinc (88.36 mg/kg)
SOU015-017	Antimony (96.65 mg/kg)
	Arsenic (12.55 mg/kg)
	Barium (529.31 mg/kg)
	Copper (27.8 mg/kg)
	Lead (36.95 mg/kg)
	Selenium (1.5 mg/kg)
	Silver (10 mg/kg)
	Thallium (0.51 mg/kg)
	Uranium (13.81 mg/kg)
SOU015-018	Antimony (43.62 mg/kg)
	Barium (299.83 mg/kg)
SOU015-019	Antimony (107.93 mg/kg)
	Barium (398.84 mg/kg)
	Cadmium (15.14 mg/kg)
	Copper (147.32 mg/kg)
	Iron (34674.5 mg/kg)
	Lead (46.9 mg/kg)
	Nickel (374.75 mg/kg)
	Uranium (31.97 mg/kg)
	Zinc (176.36 mg/kg)
SOU015-020	Antimony (62.94 mg/kg)
	Barium (246.67 mg/kg)
SOU015-021	Antimony (76.23 mg/kg)
	Barium (389.81 mg/kg)
	Vanadium (93.8 mg/kg)
SOU015-022	Antimony (71.67 mg/kg)
	Barium (336.81 mg/kg)
SOU015-023	Antimony (80.39 mg/kg)
	Barium (428.06 mg/kg)
SOU015-024	Antimony (64.36 mg/kg)
	Arsenic (8.08 mg/kg)
	Barium (409.13 mg/kg)
	Silver (10.81 mg/kg)
	Uranium (24.07 mg/kg)

SOU015-025	Antimony (119.9 mg/kg)
	Arsenic (9.46 mg/kg)
	Barium (536.34 mg/kg)
	Cadmium (17.84 mg/kg)
	Chromium (65.16 mg/kg)
	Copper (161 mg/kg)
	Lead (83 mg/kg)
	Nickel (102.49 mg/kg)
	Selenium (1.6 mg/kg)
	Thallium (0.36 mg/kg)
	Uranium (87.3 mg/kg)
	Zinc (145 mg/kg)
	Technetium-99 (44.7 pCi/g)
	Thorium-230 (3.08 pCi/g)
	Uranium-234 (14.9 pCi/g)
	Uranium-235/236 (1.13 pCi/g)
	Uranium-238 (19 pCi/g)
SOU015-026	Antimony (89.76 mg/kg)
	Arsenic (30.75 mg/kg)
	Barium (436.71 mg/kg)
	Copper (200.37 mg/kg)
	Iron (38790.42 mg/kg)
	Lead (162.89 mg/kg)
	Nickel (410.66 mg/kg)
	Uranium (59.46 mg/kg)
	Zinc (329.29 mg/kg)
SOU015-027	Antimony (85.6 mg/kg)
	Arsenic (10.53 mg/kg)
	Barium (491.52 mg/kg)
	Zinc (159.57 mg/kg)
SOU015-028	Antimony (73.98 mg/kg)
	Barium (332.12 mg/kg)
	Selenium (1.5 mg/kg)
	Thallium (0.37 mg/kg)
	Technetium-99 (12.1 pCi/g)
	Uranium-234 (1.3 pCi/g)
	Uranium-235/236 (0.069 pCi/g)
	Uranium-238 (1.5 pCi/g)

Figure 5.2.6. SWMU 15 Background Exceedances—Subsurface Soil (Continued)

SOU015-029	Antimony (92.92 mg/kg) Barium (456.61 mg/kg) Copper (36.73 mg/kg) Uranium (11.33 mg/kg)
SOU015-030	Antimony (52.7 mg/kg) Barium (308.09 mg/kg)
SOU015-031	Antimony (74.56 mg/kg) Arsenic (10.9 mg/kg) Barium (417.31 mg/kg) Chromium (43.34 mg/kg) Copper (47.98 mg/kg) Nickel (90.21 mg/kg) Uranium (12.08 mg/kg) Zinc (68.9 mg/kg)
SOU015-032	Antimony (159.13 mg/kg) Arsenic (8.06 mg/kg) Barium (538.61 mg/kg) Cadmium (22.12 mg/kg) Chromium (119.13 mg/kg) Iron (67761.05 mg/kg) Vanadium (131.86 mg/kg)
SOU015-033	Antimony (60.03 mg/kg) Arsenic (15.57 mg/kg) Barium (345.55 mg/kg) Chromium (52.23 mg/kg) Copper (306.08 mg/kg) Lead (119.52 mg/kg) Nickel (170.99 mg/kg) Uranium (24.63 mg/kg) Zinc (306.38 mg/kg)
SOU015-034	Arsenic (13.3 mg/kg) Barium (339.88 mg/kg) Copper (147.89 mg/kg) Iron (29664.63 mg/kg) Lead (52.14 mg/kg) Nickel (204.99 mg/kg) Uranium (65.95 mg/kg) Zinc (176.14 mg/kg)

SOU015-035	Antimony (116.9 mg/kg) Arsenic (8.43 mg/kg) Barium (606.66 mg/kg) Copper (63.4 mg/kg) Manganese (825.78 mg/kg) Nickel (69.56 mg/kg) Uranium (10.4 mg/kg) Zinc (87.27 mg/kg)
SOU015-036	Antimony (120.44 mg/kg) Arsenic (27.24 mg/kg) Barium (472.08 mg/kg) Cadmium (15.63 mg/kg) Chromium (106.26 mg/kg) Copper (806.71 mg/kg) Lead (254.26 mg/kg) Nickel (361.74 mg/kg) Uranium (38.02 mg/kg) Zinc (511.35 mg/kg)
SOU015-037	Antimony (50.88 mg/kg) Barium (229.71 mg/kg) Lead (27.57 mg/kg)
SOU015-037A	Copper (79 mg/kg) Iron (31171 mg/kg) Lead (64 mg/kg) Nickel (28 mg/kg) Vanadium (121 mg/kg) Zinc (77 mg/kg)
SOU015-037B	Copper (49 mg/kg) Iron (41867 mg/kg) Vanadium (117 mg/kg)
SOU015-037C	Copper (32 mg/kg) Vanadium (89 mg/kg)
SOU015-038	Antimony (63.94 mg/kg) Barium (419.93 mg/kg)
SOU015-039	Antimony (64.27 mg/kg) Barium (462.76 mg/kg) Chromium (47.68 mg/kg) Uranium (23.77 mg/kg) Zinc (63.64 mg/kg)

SOU015-040	Antimony (66.16 mg/kg) Barium (400.88 mg/kg) Copper (47.52 mg/kg) Uranium (11.96 mg/kg)
SOU015-041	Antimony (168.73 mg/kg) Arsenic (111.35 mg/kg) Barium (643.67 mg/kg) Chromium (48.7 mg/kg) Copper (436.82 mg/kg) Lead (1798.75 mg/kg) Mercury (12.23 mg/kg) Nickel (246.26 mg/kg) Silver (11.6 mg/kg) Uranium (61.41 mg/kg) Zinc (636.47 mg/kg)
SOU015-042	Antimony (80.06 mg/kg) Barium (365.17 mg/kg) Chromium (50.37 mg/kg) Copper (113.85 mg/kg) Lead (57.92 mg/kg) Nickel (73.48 mg/kg) Uranium (10.68 mg/kg) Zinc (105.1 mg/kg)
SOU015-043	Copper (61.15 mg/kg) Lead (34.38 mg/kg) Uranium (18.69 mg/kg) Zinc (82.21 mg/kg)
SOU015-044	Antimony (93.37 mg/kg) Barium (394.37 mg/kg) Cadmium (17.1 mg/kg) Copper (34.28 mg/kg) Silver (11.41 mg/kg) Uranium (34.37 mg/kg)
SOU015-045	Antimony (108.72 mg/kg) Barium (411.78 mg/kg) Cadmium (17.02 mg/kg) Chromium (61.63 mg/kg) Nickel (97.17 mg/kg) Silver (9.82 mg/kg) Uranium (30.19 mg/kg) Zinc (84.94 mg/kg)

Figure 5.2.6. SWMU 15 Background Exceedances—Subsurface Soil (Continued)

SOU015-046	Antimony (63.68 mg/kg)
	Barium (404.45 mg/kg)
	Cadmium (13.65 mg/kg)
	Selenium (1.5 mg/kg)
	Silver (10.19 mg/kg)
SOU015-047	Antimony (77.31 mg/kg)
	Arsenic (15.45 mg/kg)
	Barium (467.42 mg/kg)
	Mercury (10.63 mg/kg)
	Uranium (14.35 mg/kg)
SOU015-048	Antimony (71.81 mg/kg)
	Barium (387.47 mg/kg)
	Cadmium (15.92 mg/kg)
	Silver (13.67 mg/kg)
	Uranium (15.17 mg/kg)
SOU015-049	Antimony (46.18 mg/kg)
	Barium (343.96 mg/kg)
SOU015-050	Antimony (64.99 mg/kg)
	Barium (385.82 mg/kg)
SOU015-051	Antimony (84.84 mg/kg)
	Barium (469.67 mg/kg)
SOU015-052	Aluminum (12900 mg/kg)
	Antimony (115.05 mg/kg)
	Barium (435.7 mg/kg)
	Cadmium (14.74 mg/kg)
	Chromium (63.93 mg/kg)
	Nickel (58.64 mg/kg)
	Selenium (2.1 mg/kg)
SOU015-053	Antimony (79.17 mg/kg)
	Barium (432.53 mg/kg)
	Nickel (56.05 mg/kg)
SOU015-054	Antimony (104.6 mg/kg)
	Barium (488.48 mg/kg)
SOU015-055	Antimony (93.7 mg/kg)
	Arsenic (8.89 mg/kg)
	Barium (489.71 mg/kg)
	Copper (69.9 mg/kg)
	Lead (29.78 mg/kg)
	Selenium (3.99 mg/kg)

SOU015-056	Antimony (58.52 mg/kg)
	Arsenic (9.3 mg/kg)
	Barium (381.78 mg/kg)
SOU015-057	Antimony (116.05 mg/kg)
	Arsenic (10.47 mg/kg)
	Barium (508.92 mg/kg)
SOU015-058	Antimony (100.79 mg/kg)
	Barium (456.59 mg/kg)
SOU015-059	Antimony (111.99 mg/kg)
	Barium (432.77 mg/kg)
	Silver (12.15 mg/kg)
SOU015-060	Antimony (50.14 mg/kg)
	Barium (316.34 mg/kg)
	Selenium (1.3 mg/kg)
SOU015-061	Barium (260.76 mg/kg)
SOU015-062	Barium (342.97 mg/kg)
	Nickel (63.02 mg/kg)
	Uranium (17.79 mg/kg)
SOU015-063	Antimony (100.51 mg/kg)
	Arsenic (14.47 mg/kg)
	Barium (558.4 mg/kg)
	Cadmium (0.31 mg/kg)
	Calcium (96500 mg/kg)
	Copper (86.8 mg/kg)
	Magnesium (3250 mg/kg)
	Mercury (7.16 mg/kg)
	Nickel (77.67 mg/kg)
	Selenium (1.3 mg/kg)
	Uranium (24.1 mg/kg)
	Zinc (67 mg/kg)
SOU015-064	Antimony (99.45 mg/kg)
	Arsenic (8.43 mg/kg)
	Barium (672.14 mg/kg)
	Cadmium (19.41 mg/kg)
	Copper (49.64 mg/kg)
	Manganese (1285.51 mg/kg)
	Nickel (90.81 mg/kg)
	Uranium (11.68 mg/kg)

SOU015-065	Barium (373.37 mg/kg)
	Copper (35.72 mg/kg)
	Lead (42.01 mg/kg)
	Selenium (3.39 mg/kg)
SOU015-066	Antimony (90.73 mg/kg)
	Barium (477.06 mg/kg)
SOU015-067	Antimony (107.28 mg/kg)
	Barium (474.71 mg/kg)
	Copper (51.92 mg/kg)
	Silver (9.88 mg/kg)
	Uranium (11.29 mg/kg)
SOU015-068	Antimony (0.34 mg/kg)
	Barium (224.9 mg/kg)
	Selenium (1.8 mg/kg)
	Technetium-99 (10.2 pCi/g)
SOU015-069	Antimony (72.58 mg/kg)
	Barium (370.95 mg/kg)
	Chromium (59.04 mg/kg)
	Uranium (10.05 mg/kg)
SOU015-070	Antimony (79.38 mg/kg)
	Barium (477.24 mg/kg)
SOU015-071	Barium (302.23 mg/kg)
	Uranium (21.68 mg/kg)
SOU015-072	Antimony (63.57 mg/kg)
	Barium (355.21 mg/kg)
	Cadmium (16.62 mg/kg)
	Selenium (1.5 mg/kg)
SOU015-073	Antimony (36.27 mg/kg)
	Barium (348.9 mg/kg)
SOU015-074	Antimony (55.87 mg/kg)
	Barium (373.52 mg/kg)
SOU015-075	Antimony (77.59 mg/kg)
	Barium (402.92 mg/kg)
	Nickel (57.05 mg/kg)
SOU015-076	Antimony (57.22 mg/kg)
	Barium (328.29 mg/kg)
SOU015-077	Antimony (78.63 mg/kg)
	Barium (396.61 mg/kg)
	Nickel (73.65 mg/kg)

Figure 5.2.6. SWMU 15 Background Exceedances—Subsurface Soil (Continued)

Sample	Background Exceedance
SOU015-078	Antimony (101.17 mg/kg)
	Arsenic (23.59 mg/kg)
	Barium (552.15 mg/kg)
	Chromium (53.77 mg/kg)
	Iron (42171.73 mg/kg)
	Lead (47.94 mg/kg)
	Manganese (2716.85 mg/kg)
SOU015-079	Antimony (40.17 mg/kg)
	Barium (307.08 mg/kg)
	Chromium (45.93 mg/kg)
SOU015-080	Antimony (94.81 mg/kg)
	Barium (381.73 mg/kg)
	Cadmium (17.03 mg/kg)
	Selenium (4.19 mg/kg)
	Silver (10.21 mg/kg)
SOU015-081	Antimony (125.39 mg/kg)
	Barium (469.48 mg/kg)
	Copper (25.62 mg/kg)
	Nickel (131.8 mg/kg)
	Silver (14.26 mg/kg)
	Uranium (12.65 mg/kg)
SOU015-082	Barium (191.84 mg/kg)
	Chromium (49.83 mg/kg)
	Copper (51.69 mg/kg)
SOU015-083	Antimony (69.35 mg/kg)
	Barium (335.56 mg/kg)
SOU015-084	Antimony (55.95 mg/kg)
	Barium (377.71 mg/kg)
	Copper (28.86 mg/kg)
	Mercury (6.66 mg/kg)
SOU015-085	Antimony (93.7 mg/kg)
	Barium (412.12 mg/kg)
	Copper (347.25 mg/kg)
	Lead (118.02 mg/kg)
	Nickel (206.53 mg/kg)
	Uranium (37.78 mg/kg)
	Zinc (360.54 mg/kg)
SOU015-086	Antimony (73.01 mg/kg)
	Barium (360.77 mg/kg)
	Cadmium (12.76 mg/kg)
SOU015-087	Antimony (41.72 mg/kg)
	Barium (269.84 mg/kg)
	Copper (210.66 mg/kg)
	Lead (109.2 mg/kg)
	Nickel (172.5 mg/kg)
	Uranium (30.5 mg/kg)
	Zinc (210.92 mg/kg)
SOU015-088	Antimony (73.06 mg/kg)
	Barium (370.86 mg/kg)
	Copper (43.23 mg/kg)
	Lead (23.96 mg/kg)
	Nickel (61.35 mg/kg)
	Uranium (7.31 mg/kg)
SOU015-089	Antimony (75.88 mg/kg)
	Arsenic (11.25 mg/kg)
	Barium (405.39 mg/kg)
	Chromium (63.73 mg/kg)
	Copper (160.9 mg/kg)
	Lead (48.53 mg/kg)
	Manganese (889.9 mg/kg)
	Mercury (7.54 mg/kg)
	Nickel (97.5 mg/kg)
	Uranium (13.45 mg/kg)
	Zinc (95 mg/kg)
SOU015-090	Antimony (83.33 mg/kg)
	Barium (426.54 mg/kg)
	Copper (47.54 mg/kg)
	Lead (43.6 mg/kg)
	Zinc (67.74 mg/kg)
SOU015-091	Antimony (105.03 mg/kg)
	Barium (437.53 mg/kg)
SOU015-092	Antimony (61.94 mg/kg)
	Barium (402.22 mg/kg)
	Nickel (79.72 mg/kg)
	Uranium (7.67 mg/kg)
SOU015-093	Antimony (104.64 mg/kg)
	Barium (494.46 mg/kg)
	Mercury (6.54 mg/kg)
SOU015-094	Antimony (110.78 mg/kg)
	Arsenic (8.46 mg/kg)
	Barium (469.79 mg/kg)
	Silver (14.98 mg/kg)
SOU015-095	Barium (258.73 mg/kg)
	Manganese (858.29 mg/kg)
SOU015-096	Antimony (63.61 mg/kg)
	Barium (425.29 mg/kg)
SOU015-097	Antimony (73.12 mg/kg)
	Arsenic (9.42 mg/kg)
	Barium (474.4 mg/kg)
	Mercury (6.6 mg/kg)
	Silver (10.48 mg/kg)
	Uranium (7.36 mg/kg)
SOU015-098	Antimony (105.37 mg/kg)
	Arsenic (14.16 mg/kg)
	Barium (635.5 mg/kg)
	Cadmium (24.04 mg/kg)
	Chromium (66.14 mg/kg)
	Copper (26.38 mg/kg)
	Iron (34998.73 mg/kg)
	Nickel (57.49 mg/kg)
	Silver (10.09 mg/kg)
	Uranium (7.68 mg/kg)
	Zinc (60.16 mg/kg)
SOU015-099	Antimony (176.98 mg/kg)
	Barium (678.25 mg/kg)
	Cadmium (17.1 mg/kg)
	Silver (15.31 mg/kg)
SOU015-100	Antimony (100.9 mg/kg)
	Barium (474.37 mg/kg)
	Silver (9.69 mg/kg)
SOU015-101	Antimony (85.86 mg/kg)
	Barium (449.17 mg/kg)
	Mercury (7.83 mg/kg)
SOU015-102	Antimony (47.17 mg/kg)
	Barium (315.26 mg/kg)
	Nickel (57.39 mg/kg)

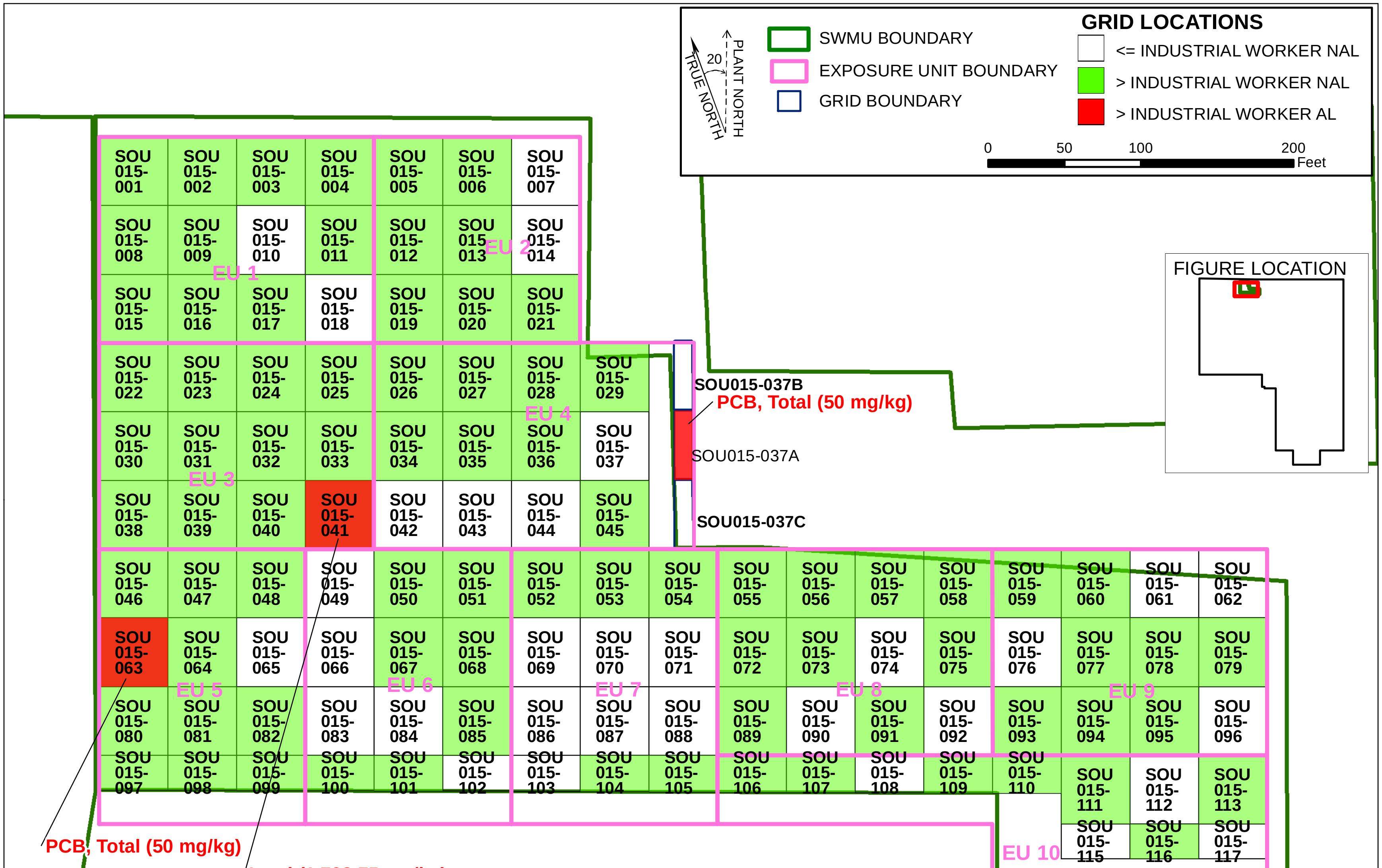
Figure 5.2.6. SWMU 15 Background Exceedances—Subsurface Soil (Continued)

SOU015-103	Antimony (70.29 mg/kg)
	Barium (412.25 mg/kg)
	Copper (31.78 mg/kg)
	Nickel (64 mg/kg)
SOU015-104	Antimony (75.36 mg/kg)
	Arsenic (10.84 mg/kg)
	Barium (487.64 mg/kg)
	Copper (26.91 mg/kg)
SOU015-105	Antimony (85.3 mg/kg)
	Barium (552.62 mg/kg)
	Beryllium (0.73 mg/kg)
	Nickel (76.32 mg/kg)
	Selenium (1.7 mg/kg)
	Silver (9.74 mg/kg)
	Zinc (89.97 mg/kg)
SOU015-106	Antimony (70.14 mg/kg)
	Barium (436.99 mg/kg)
	Nickel (65.77 mg/kg)

SOU015-107	Antimony (78.26 mg/kg)
	Barium (417.28 mg/kg)
	Mercury (6.41 mg/kg)
SOU015-108	Antimony (81.74 mg/kg)
	Barium (416.28 mg/kg)
SOU015-109	Antimony (125.93 mg/kg)
	Arsenic (9.75 mg/kg)
	Barium (500.98 mg/kg)
SOU015-110	Antimony (50.77 mg/kg)
	Barium (287.75 mg/kg)
	Copper (75.07 mg/kg)
	Lead (25.53 mg/kg)
	Nickel (222.05 mg/kg)
	Selenium (1.6 mg/kg)
	Uranium (11.21 mg/kg)
	Technetium-99 (9.22 pCi/g)

SOU015-111	Antimony (79.63 mg/kg)
	Barium (513.21 mg/kg)
	Nickel (95.18 mg/kg)
SOU015-112	Antimony (67.12 mg/kg)
	Barium (465.05 mg/kg)
SOU015-113	Antimony (46.62 mg/kg)
	Arsenic (7.98 mg/kg)
	Barium (457.39 mg/kg)
SOU015-115	Antimony (89.26 mg/kg)
	Barium (468.14 mg/kg)
	Uranium (10.31 mg/kg)
SOU015-116	Antimony (106.12 mg/kg)
	Barium (534.43 mg/kg)
	Nickel (58.29 mg/kg)
	Uranium (45.13 mg/kg)
SOU015-117	Antimony (59.6 mg/kg)
	Barium (370.98 mg/kg)

Figure 5.2.6. SWMU 15 Background Exceedances—Subsurface Soil (Continued)



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PADUCAH GASEOUS DIFFUSION PLANT

Figure 5.2.7. SWMU 15 NAL Exceedances—Subsurface Soil

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SOU015-001	Antimony (134.96 mg/kg)
SOU015-002	Arsenic (9.45 mg/kg)
SOU015-003	Antimony (105.71 mg/kg) Arsenic (13.49 mg/kg)
SOU015-004	Arsenic (11.38 mg/kg)
SOU015-005	Arsenic (14.89 mg/kg)
SOU015-006	Arsenic (8.7 mg/kg)
SOU015-008	Antimony (102.67 mg/kg) Arsenic (7.77 mg/kg)
SOU015-009	Arsenic (6.16 mg/kg)
SOU015-011	Antimony (124.95 mg/kg) Arsenic (8.14 mg/kg)
SOU015-012	Arsenic (6.49 mg/kg)
SOU015-013	Arsenic (8.08 mg/kg)
SOU015-015	Antimony (95.4 mg/kg)
SOU015-016	Antimony (112.18 mg/kg)
SOU015-017	Antimony (96.65 mg/kg) Arsenic (12.55 mg/kg)
SOU015-019	Antimony (107.93 mg/kg)
SOU015-020	Arsenic (7.1 mg/kg)
SOU015-021	Neptunium-237 (0.556 pCi/g) Uranium-238 (2.02 pCi/g)
SOU015-022	Arsenic (6.69 mg/kg)
SOU015-023	Uranium-238 (2.07 pCi/g)
SOU015-024	Arsenic (8.08 mg/kg)
SOU015-025	Antimony (119.9 mg/kg) Arsenic (9.46 mg/kg) PCB, Total (0.41 mg/kg) Neptunium-237 (0.82 pCi/g) Uranium-235 (1.13 pCi/g) Uranium-238 (19 pCi/g)
SOU015-026	Arsenic (30.75 mg/kg)
SOU015-027	Arsenic (10.53 mg/kg)
SOU015-028	Arsenic (7.67 mg/kg)
SOU015-029	PCB, Total (0.47 mg/kg) Uranium-238 (4.66 pCi/g)
SOU015-030	Arsenic (6.76 mg/kg)
SOU015-031	Arsenic (10.9 mg/kg)
SOU015-032	Antimony (159.13 mg/kg) Arsenic (8.06 mg/kg)
SOU015-033	Arsenic (15.57 mg/kg)
SOU015-034	Arsenic (13.3 mg/kg)
SOU015-035	Antimony (116.9 mg/kg) Arsenic (8.43 mg/kg) PCB, Total (0.37 mg/kg)
SOU015-036	Antimony (120.44 mg/kg) Arsenic (27.24 mg/kg)
SOU015-037A	PCB, Total (50 mg/kg)
SOU015-038	Arsenic (6.08 mg/kg)
SOU015-039	Arsenic (5.98 mg/kg)
SOU015-040	PCB, Total (0.35 mg/kg)
SOU015-041	Antimony (168.73 mg/kg) Arsenic (111.35 mg/kg) Lead (1798.75 mg/kg)
SOU015-045	Antimony (108.72 mg/kg) Arsenic (7.76 mg/kg)
SOU015-046	Arsenic (6.2 mg/kg)
SOU015-047	Arsenic (15.45 mg/kg)
SOU015-048	Arsenic (6.31 mg/kg)
SOU015-050	Arsenic (7.66 mg/kg)
SOU015-051	Arsenic (6.31 mg/kg)
SOU015-052	Antimony (115.05 mg/kg) Arsenic (6.52 mg/kg) PCB, Total (5 mg/kg)
SOU015-053	Arsenic (5.72 mg/kg)
SOU015-054	Antimony (104.6 mg/kg) Arsenic (7.28 mg/kg)
SOU015-055	Antimony (93.7 mg/kg) Arsenic (8.89 mg/kg)
SOU015-056	Arsenic (9.3 mg/kg)
SOU015-057	Antimony (116.05 mg/kg) Arsenic (10.47 mg/kg)
SOU015-058	Antimony (100.79 mg/kg) Arsenic (6.23 mg/kg)
SOU015-059	Antimony (111.99 mg/kg)
SOU015-060	Arsenic (6.25 mg/kg)
SOU015-063	Antimony (100.51 mg/kg) Arsenic (14.47 mg/kg) PCB, Total (50 mg/kg)
SOU015-064	Antimony (99.45 mg/kg) Arsenic (8.43 mg/kg)
SOU015-067	Antimony (107.28 mg/kg)
SOU015-068	Arsenic (3.8 mg/kg)
SOU015-072	Arsenic (4.7 mg/kg)
SOU015-073	Arsenic (7.14 mg/kg)
SOU015-075	Arsenic (7.03 mg/kg)
SOU015-077	Arsenic (7.6 mg/kg)
SOU015-078	Antimony (101.17 mg/kg) Arsenic (23.59 mg/kg)
SOU015-079	Arsenic (5.89 mg/kg)
SOU015-080	Antimony (94.81 mg/kg)
SOU015-081	Antimony (125.39 mg/kg) Arsenic (6.5 mg/kg)
SOU015-082	Arsenic (7.29 mg/kg)
SOU015-085	Antimony (93.7 mg/kg)
SOU015-089	Arsenic (11.25 mg/kg)
SOU015-091	Antimony (105.03 mg/kg)
SOU015-093	Antimony (104.64 mg/kg) Arsenic (5.66 mg/kg)
SOU015-094	Antimony (110.78 mg/kg) Arsenic (8.46 mg/kg)
SOU015-095	Arsenic (6.78 mg/kg)
SOU015-097	Arsenic (9.42 mg/kg)
SOU015-098	Antimony (105.37 mg/kg) Arsenic (14.16 mg/kg)
SOU015-099	Antimony (176.98 mg/kg) Arsenic (11.8 mg/kg)
SOU015-100	Antimony (100.9 mg/kg) Arsenic (6.91 mg/kg)
SOU015-101	Arsenic (7.04 mg/kg)
SOU015-104	Arsenic (10.84 mg/kg)
SOU015-105	Arsenic (7.4 mg/kg)
SOU015-106	Arsenic (6.89 mg/kg)
SOU015-107	Arsenic (5.2 mg/kg)
SOU015-109	Antimony (125.93 mg/kg) Arsenic (9.75 mg/kg)
SOU015-110	Arsenic (5.1 mg/kg)
SOU015-111	Arsenic (7.95 mg/kg)
SOU015-113	Arsenic (9.16 mg/kg)
SOU015-116	Antimony (106.12 mg/kg) Arsenic (6 mg/kg)

Figure 5.2.4. SWMU 15 NAL Exceedances—Surface Soil (Continued)

The following metals were detected in the SWMU 15 subsurface soils above both the background screening levels (if available) and the SSLs for the protection of UCRS groundwater.

Metal	Grid	EU
Aluminum	6, 52, 99	2, 5, 7
Antimony	1, 2, 3, 4, 5, 6, 7, 8, 11, 12, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 35, 36, 37, 38, 39, 40, 41, 42, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 63, 64, 66, 67, 68, 69, 70, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 115, 116, 117	All EUs
Metal	**Grid**	**EU**
Arsenic	2, 3, 4, 5, 6, 11, 13, 17, 24, 25, 26, 27, 31, 32, 33, 34, 35, 36, 41, 47, 55, 56, 57, 63, 64, 78, 89, 94, 97, 98, 99, 104, 109, 111, 113	1, 2, 3, 4, 5, 7, 8, 9, 10
Barium	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 115, 116, 117	All EUs
Metal	**Grid**	**EU**
Cadmium	4, 8, 19, 22, 23, 25, 32, 34, 35, 36, 44, 45, 46, 48, 52, 64, 72, 80, 86, 98, 99	1, 2, 3, 4, 5, 7, 8
Copper	19, 25, 26, 31, 33, 34, 35, 36, 37A, 37B, 40, 41, 42, 43, 55, 63, 64, 67, 82, 85, 87, 89, 90, 110	2, 3, 4, 5, 6, 7, 8, 10
Iron	3, 19, 26, 32, 34, 37A, 37B, 78, 98	1, 2, 3, 4, 5, 9
Lead	17, 19, 25, 26, 33, 34, 36, 37, 37A, 41, 42, 43, 55, 65, 78, 85, 87, 88, 89, 90, 110	All EUs
Manganese	35, 64, 78, 89, 95	4, 5, 8, 9
Mercury	21, 41, 47, 63, 84, 89, 93, 97, 101, 107	2, 3, 5, 6, 8, 9, 10
Molybdenum[1]	3, 6, 17, 25, 28, 46, 52, 60, 63, 68, 72, 99, 105, 106, 110	All EUs
Nickel	1, 3, 16, 19, 21, 25, 26, 31, 33, 34, 35, 36, 37A, 41, 42, 45, 52, 53, 62, 63, 64, 75, 77, 81, 85, 87, 88, 89, 92, 98, 102, 103, 105, 106, 108, 109, 110, 111, 116	All EUs
Selenium	3, 6, 17, 25, 28, 46, 52, 55, 60, 63, 65, 68, 72, 80, 99, 105, 106, 110	All EUs
Silver	2, 12, 17, 24, 41, 44, 45, 46, 48, 59, 67, 80, 81, 94, 97, 98, 99, 100, 105	1, 2, 3, 4, 5, 6, 7, 9
Thallium	3, 6, 17, 25, 28	1, 2, 3, 4
Uranium	11, 17, 19, 24, 25, 26, 33, 34, 36, 39, 41, 43, 44, 45, 47, 48, 62, 63, 71, 85, 87, 116	1, 2, 3, 4, 5, 6, 7, 9, 10
Vanadium	1, 6, 14, 21, 32, 37A, 37B, 37C	1, 2, 3, 4
Zinc	11, 16, 19, 25, 26, 27, 31, 33, 34, 35, 36, 37A, 39, 41, 42, 43, 45, 63, 85, 87, 89, 90, 98, 105	1, 2, 3, 4, 5, 6, 7, 8

[1] No soil background value is available.

For the protection of RGA groundwater, the following metals were detected in the SWMU 15 subsurface soil above both the SSLs and background screening levels (if available).

Metal	Grid	EU
Antimony	1, 2, 3, 4, 5, 7, 8, 11, 12, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 35, 36, 37, 38, 39, 40, 41, 42, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 63, 64, 66, 67, 69, 70, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 115, 116, 117	All EUs
Arsenic	26, 36, 41, 78	3, 4, 9
Cadmium	32, 98	3, 5
Iron	3, 19, 26, 32, 34, 37A, 37B, 78, 98	1, 2, 3, 4, 5, 9
Lead	41	3
Metal	**Grid**	**EU**
Manganese	35, 64, 78, 89, 95	4, 5, 8, 9
Mercury	41, 47, 63, 84, 89, 93, 97, 101, 107	3, 5, 6, 8, 9, 10
Nickel	19, 26, 33, 34, 36, 41, 85, 87, 110	2, 4, 3, 6, 7, 10
Silver	2, 12, 17, 24, 41, 44, 45, 46, 48, 59, 67, 80, 81, 94, 97, 98, 99, 100, 105	1, 2, 3, 4, 5, 6, 7, 9

PCBs

Total PCBs were detected above industrial worker NALs and SSLs for the protection of UCRS groundwater in grids 25 (EU 3), 29 (EU 4), 35 (EU 4), 37A (EU 4), 40 (EU 3), 52 (EU 7), and 63 (EU 5) in subsurface soils at SWMU 15. Additionally, grids 37A and 63 contain Total PCBs above industrial worker ALs; grids 37A, 52, and 63 contain Total PCBs above SSL for the protection of RGA groundwater.

The PCBs were detected above industrial worker NALs to a maximum depth of 7 ft bgs. Only grid 63 is on the border of SWMU 15. The grid is on the western boundary of SWMU 15 bordered by SWMU 14. Additionally, outside of the SWMU 15 boundary is step-out grid 037A. The grid is located east of the SWMU and is bordered to the south and west by SWMU 15 and to the north and east by a ditch.

SVOCs

SVOCs were not detected above screening levels in subsurface soils at SWMU 15.

VOCs

No VOCs were detected above industrial worker NALs or ALs in SWMU 15 subsurface soils. 1,1-dichloroethane in grid 23 (EU 3) was detected above the SSL for the protection of UCRS groundwater. None were detected above the SSLs for protection of RGA groundwater.

Radionuclides

Neptunium-237 [grids 21 (EU 2) and 25 (EU 3)], uranium-235 [grid 25 (EU 3)], and uranium-238 [grids-21 (EU 2), 23 (EU 3), 25 (EU 3), 29 (EU 4)] were above both the background screening levels (if available) and the industrial worker NALs in the SWMU 15 subsurface soils. The maximum depth of the radionuclide above both background screening levels and the industrial worker NALs was 4 ft bgs. No radionuclides were detected above the industrial worker ALs.

The following radionuclides were detected in the SWMU 15 subsurface soils above both the background screening levels (if available) and the SSLs for the protection of UCRS groundwater.

Radionuclide	**Grid**	**EU**
Neptunium-237[1]	21, 25, 29	2, 3, 4
Plutonium-239/240[1]	25	3
Tc-99	14, 18, 19, 21, 23, 25, 28, 29, 34, 35, 40, 68, 110	1, 2, 3, 4, 6, 10
Thorium-230	25	3
Uranium-234	21, 25, 28, 29	2, 3, 4
Uranium-235	18, 21, 23, 25, 28, 29, 34	1, 2, 3, 4
Uranium-238	18, 21, 23, 25, 28, 29, 34, 72	1, 2, 3, 4, 8

[1] No soil background value is available.

For the protection of RGA groundwater, the following were detected in the SWMU 15 subsurface soil above both the SSLs and background screening levels.

Radionuclide	**Grid**	**EU**
Tc-99	18, 19, 21, 23, 25, 28, 29, 34, 35, 40, 68, 110	1, 2, 3, 4, 6, 10
Uranium-234	25, 29	3, 4
Uranium-238	25, 29	3, 4

5.2.5 Fate and Transport

Tc-99 and uranium-234 at SWMU 15 were identified for further evaluation under fate and transport (Chapter 4). SESOIL and AT123D simulation modeling results are summarized in Appendix C.

Tc-99 was selected for modeling because the average concentration at the SWMU exceeded both the RG SSL and background concentrations (see Appendix C). Modeling predicts Tc-99 to be 680 pCi/L at the SWMU boundary when it reaches the RGA, which is less than 900 pCi/L screening criterion (DOE 2013).

Uranium-234 was detected at an activity concentration greater than both the background value and SSL; however, the mass concentration of uranium assumed to be present based upon the assumption that the uranium isotopes were present at natural abundance would be 27 mg/kg. At 27 mg/kg, the average concentration is less than the average uranium concentration at SWMU 81 (2,502 mg/kg) that modeling in the Soils OU RI Report (DOE 2013) found not to migrate to the RGA within 1,000 years. Based on this, uranium-234 was not modeled at SWMU 15.

A potential exists for runoff because this SWMU is surrounded by ditches that discharge to Outfall 001. This runoff is captured in the C-613 Sedimentation Basin prior to discharge into Outfall 001. A removal action for the contaminated sediment associated with SWOU (On-Site) (DOE 2011a) was conducted for Outfalls 001, 008, 010, 011, and 015 and associated internal ditches. A final response action for internal ditches, outfalls, and creeks will be addressed by the SWOU, as described in the SMP (DOE 2015a).

5.2.6 Baseline Risk Assessment

Human Health. Potential risks and hazards for current/future human health for SWMU 15 were evaluated for each of ten EUs (~ 0.5 acres each) for direct contact. These results are summarized in Appendix D and in the subsections that follow, including the COCs and relative contributions to the overall ELCR/HI. Lead was identified as a COPC; however, the average concentration did not exceed 400 mg/kg, the NAL for lead for the residential scenario (DOE 2015b); therefore, modeling was not performed and lead was not considered a COC for SWMU 15.

The cumulative ELCR and the cumulative HI for one or more EUs at SWMU 15 exceed the benchmarks of cumulative ELCR of 1E-06 and cumulative HI greater than 1, respectively for one or more scenarios; therefore, as stated in the Work Plan, Decision Rule D1a, (DOE 2010a), this SWMU will be evaluated in the FS. As described in the BHHRA (Appendix D), COCs were identified after considering the results of the risk characterization and the uncertainties affecting the results.

COCs were identified as those COPCs considered to contribute at least 1E-06 ELCR or 0.1 HI to a scenario of concern. The basis for COC identification is presented in Appendix D.

The identified COCs considered to contribute to the ELCR/HI, the EPC, and the RGOs calculated for a range of ELCR/HI benchmarks are presented in Table 5.2.3 for the future industrial worker, excavation worker, and the hypothetical resident. Table 5.2.3 also compares the EPC to the RGO for each COC under each exposure scenario. Table 5.2.3 summarizes the ELCR/HI posed by the COCs for this SWMU under each exposure scenario by depicting the maximum ELCR/HI contribution per COC.

Table 5.2.3. RGOs for SWMU 15

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3]			HI[4]	RGOs for HI[3]		
					1E-06	1E-05	1E-04		0.1	1	3
Future Industrial Worker											
1	Arsenic	1.27E+01	mg/kg	8.9E-06	1.41E+00	1.41E+01	1.41E+02	< 0.1	N/A	N/A	N/A
1	PAH, Total	1.71E+00	mg/kg	1.9E-05	8.94E-02	8.94E-01	8.94E+00	< 0.1	N/A	N/A	N/A
1	Uranium-238	1.85E+00	pCi/g	1.1E-06	1.65E+00	1.65E+01	1.65E+02	N/A	N/A	N/A	N/A
1	**Cumulative**			**2.9E-05**				**< 1**			
2	Arsenic	1.63E+01	mg/kg	1.1E-05	1.41E+00	1.41E+01	1.41E+02	< 0.1	N/A	N/A	N/A
2	PAH, Total	2.11E+00	mg/kg	2.4E-05	8.94E-02	8.94E-01	8.94E+00	< 0.1	N/A	N/A	N/A
2	PCB, Total	3.30E-01	mg/kg	1.1E-06	3.05E-01	3.05E+00	3.05E+01	< 0.1	N/A	N/A	N/A
2	Uranium-235	3.80E-01	pCi/g	1.0E-06	3.73E-01	3.73E+00	3.73E+01	N/A	N/A	N/A	N/A
2	Uranium-238	1.21E+01	pCi/g	7.3E-06	1.65E+00	1.65E+01	1.65E+02	N/A	N/A	N/A	N/A
2	**Cumulative**			**4.5E-05**				**< 1**			
3	Arsenic	2.74E+01	mg/kg	1.9E-05	1.41E+00	1.41E+01	1.41E+02	0.1	2.26E+01	2.26E+02	6.78E+02
3	PAH, Total	1.45E+00	mg/kg	1.6E-05	8.94E-02	8.94E-01	8.94E+00	< 0.1	N/A	N/A	N/A
3	PCB, Total	6.82E+00	mg/kg	2.2E-05	3.05E-01	3.05E+00	3.05E+01	< 0.1	N/A	N/A	N/A
3	Neptunium-237	3.24E+00	pCi/g	1.3E-05	2.53E-01	2.53E+00	2.53E+01	N/A	N/A	N/A	N/A
3	Uranium-234	1.40E+02	pCi/g	7.0E-06	2.01E+01	2.01E+02	2.01E+03	N/A	N/A	N/A	N/A
3	Uranium-235	1.49E+01	pCi/g	4.0E-05	3.73E-01	3.73E+00	3.73E+01	N/A	N/A	N/A	N/A
3	Uranium-238	8.68E+02	pCi/g	5.3E-04	1.65E+00	1.65E+01	1.65E+02	N/A	N/A	N/A	N/A
3	**Cumulative**			**6.5E-04**				**< 1**			
4	Arsenic	3.37E+01	mg/kg	2.4E-05	1.41E+00	1.41E+01	1.41E+02	0.1	2.26E+01	2.26E+02	6.78E+02
4	PAH, Total	1.75E+00	mg/kg	2.0E-05	8.94E-02	8.94E-01	8.94E+00	< 0.1	N/A	N/A	N/A
4	PCB, Total	3.13E+01	mg/kg	1.0E-04	3.05E-01	3.05E+00	3.05E+01	< 0.1	N/A	N/A	N/A
4	Neptunium-237	6.60E-01	pCi/g	2.6E-06	2.53E-01	2.53E+00	2.53E+01	N/A	N/A	N/A	N/A
4	Uranium-238	1.35E+01	pCi/g	8.2E-06	1.65E+00	1.65E+01	1.65E+02	N/A	N/A	N/A	N/A
4	**Cumulative**			**1.6E-04**				**< 1**			
5	Arsenic	1.28E+01	mg/kg	9.0E-06	1.41E+00	1.41E+01	1.41E+02	< 0.1	N/A	N/A	N/A
5	PAH, Total	5.11E-01	mg/kg	5.7E-06	8.94E-02	8.94E-01	8.94E+00	< 0.1	N/A	N/A	N/A
5	PCB, Total	2.51E+01	mg/kg	8.2E-05	3.05E-01	3.05E+00	3.05E+01	< 0.1	N/A	N/A	N/A
5	Neptunium-237	6.90E-01	pCi/g	2.7E-06	2.53E-01	2.53E+00	2.53E+01	N/A	N/A	N/A	N/A
5	Uranium-235	4.60E-01	pCi/g	1.2E-06	3.73E-01	3.73E+00	3.73E+01	N/A	N/A	N/A	N/A
5	Uranium-238	1.03E+01	pCi/g	6.3E-06	1.65E+00	1.65E+01	1.65E+02	N/A	N/A	N/A	N/A
5	**Cumulative**			**1.1E-04**				**< 1**			

Table 5.2.3. RGOs for SWMU 15 (Continued)

					RGOs for ELCR[3]				RGOs for HI[3]		
EU	COC	EPC[1]	Units	ELCR[2]	1E-06	1E-05	1E-04	HI[4]	0.1	1	3
Future Industrial Worker (Continued)											
6	Arsenic	1.24E+01	mg/kg	8.8E-06	1.41E+00	1.41E+01	1.41E+02	< 0.1	N/A	N/A	N/A
6	PAH, Total	1.62E+00	mg/kg	1.8E-05	8.94E-02	8.94E-01	8.94E+00	< 0.1	N/A	N/A	N/A
6	PCB, Total	6.17E+00	mg/kg	2.0E-05	3.05E-01	3.05E+00	3.05E+01	< 0.1	N/A	N/A	N/A
6	Neptunium-237	6.40E-01	pCi/g	2.5E-06	2.53E-01	2.53E+00	2.53E+01	N/A	N/A	N/A	N/A
6	Uranium-235	5.70E-01	pCi/g	1.5E-06	3.73E-01	3.73E+00	3.73E+01	N/A	N/A	N/A	N/A
6	Uranium-238	1.54E+01	pCi/g	9.3E-06	1.65E+00	1.65E+01	1.65E+02	N/A	N/A	N/A	N/A
6	**Cumulative**			**6.1E-05**				**< 1**			
7	Arsenic	1.61E+01	mg/kg	1.1E-05	1.41E+00	1.41E+01	1.41E+02	< 0.1	N/A	N/A	N/A
7	PAH, Total	1.59E-01	mg/kg	1.8E-06	8.94E-02	8.94E-01	8.94E+00	< 0.1	N/A	N/A	N/A
7	PCB, Total	2.57E+01	mg/kg	8.4E-05	3.05E-01	3.05E+00	3.05E+01	< 0.1	N/A	N/A	N/A
7	Uranium-235	4.50E-01	pCi/g	1.2E-06	3.73E-01	3.73E+00	3.73E+01	N/A	N/A	N/A	N/A
7	Uranium-238	8.05E+00	pCi/g	4.9E-06	1.65E+00	1.65E+01	1.65E+02	N/A	N/A	N/A	N/A
7	**Cumulative**			**1.0E-04**				**< 1**			
8	Arsenic	1.17E+01	mg/kg	8.2E-06	1.41E+00	1.41E+01	1.41E+02	< 0.1	N/A	N/A	N/A
8	PAH, Total	3.59E-01	mg/kg	4.0E-06	8.94E-02	8.94E-01	8.94E+00	< 0.1	N/A	N/A	N/A
8	PCB, Total	5.01E+00	mg/kg	1.6E-05	3.05E-01	3.05E+00	3.05E+01	< 0.1	N/A	N/A	N/A
8	Neptunium-237	3.65E-01	pCi/g	1.4E-06	2.53E-01	2.53E+00	2.53E+01	N/A	N/A	N/A	N/A
8	Uranium-238	6.64E+00	pCi/g	4.0E-06	1.65E+00	1.65E+01	1.65E+02	N/A	N/A	N/A	N/A
8	**Cumulative**			**3.4E-05**				**< 1**			
9	Arsenic	1.10E+01	mg/kg	7.8E-06	1.41E+00	1.41E+01	1.41E+02	< 0.1	N/A	N/A	N/A
9	PAH, Total	2.38E-01	mg/kg	2.7E-06	8.94E-02	8.94E-01	8.94E+00	< 0.1	N/A	N/A	N/A
9	PCB, Total	6.31E+00	mg/kg	2.1E-05	3.05E-01	3.05E+00	3.05E+01	< 0.1	N/A	N/A	N/A
9	Uranium-238	7.12E+00	pCi/g	4.3E-06	1.65E+00	1.65E+01	1.65E+02	N/A	N/A	N/A	N/A
9	**Cumulative**			**3.6E-05**				**< 1**			
10	PAH, Total	1.28E-01	mg/kg	1.4E-06	8.94E-02	8.94E-01	8.94E+00	< 0.1	N/A	N/A	N/A
10	**Cumulative**			**1.4E-06**				**< 1**			

Table 5.2.3. RGOs for SWMU 15 (Continued)

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3]			HI[4]	RGOs for HI[3]		
					1E-06	1E-05	1E-04		0.1	1	3
Excavation Worker											
1	Antimony	1.08E+02	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.8	1.32E+01	1.32E+02	3.95E+02
1	Arsenic	1.32E+01	mg/kg	5.2E-06	2.52E+00	2.52E+01	2.52E+02	0.2	8.09E+00	8.09E+01	2.43E+02
1	Cadmium	2.72E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	2.53E+01	2.53E+02	7.60E+02
1	Iron	2.97E+04	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	2.30E+04	2.30E+05	6.91E+05
1	PAH, Total	1.16E+00	mg/kg	3.6E-06	3.25E-01	3.25E+00	3.25E+01	< 0.1	N/A	N/A	N/A
1	Thallium	1.31E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	4	3.29E-01	3.29E+00	9.86E+00
1	**Cumulative**			**9.4E-06**				**5.4**			
2	Antimony	1.08E+02	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.8	1.32E+01	1.32E+02	3.95E+02
2	Arsenic	1.63E+01	mg/kg	6.4E-06	2.52E+00	2.52E+01	2.52E+02	0.2	8.09E+00	8.09E+01	2.43E+02
2	Iron	3.89E+04	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.2	2.30E+04	2.30E+05	6.91E+05
2	Manganese	1.37E+03	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.2	7.57E+02	7.57E+03	2.27E+04
2	PAH, Total	2.11E+00	mg/kg	6.5E-06	3.25E-01	3.25E+00	3.25E+01	< 0.1	N/A	N/A	N/A
2	Thallium	3.50E-01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	3.29E-01	3.29E+00	9.86E+00
2	Uranium	1.32E+02	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	9.80E+01	9.80E+02	2.94E+03
2	Uranium-238	1.21E+01	pCi/g	2.0E-06	5.95E+00	5.95E+01	5.95E+02	N/A	N/A	N/A	N/A
2	**Cumulative**			**1.6E-05**				**2.1**			
3	Antimony	1.15E+02	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.9	1.32E+01	1.32E+02	3.95E+02
3	Arsenic	3.65E+01	mg/kg	1.4E-05	2.52E+00	2.52E+01	2.52E+02	0.5	8.09E+00	8.09E+01	2.43E+02
3	Cobalt	2.37E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.2	9.82E+00	9.82E+01	2.95E+02
3	Copper	1.60E+03	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	1.32E+03	1.32E+04	3.95E+04
3	Iron	9.52E+04	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.4	2.30E+04	2.30E+05	6.91E+05
3	Manganese	1.62E+03	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.2	7.57E+02	7.57E+03	2.27E+04
3	Mercury	2.08E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.2	9.86E+00	9.86E+01	2.96E+02
3	Nickel	8.38E+02	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.5	1.64E+02	1.64E+03	4.91E+03
3	PAH, Total	9.85E-01	mg/kg	3.0E-06	3.25E-01	3.25E+00	3.25E+01	< 0.1	N/A	N/A	N/A
3	PCB, Total	1.40E+01	mg/kg	1.2E-05	1.14E+00	1.14E+01	1.14E+02	< 0.1	N/A	N/A	N/A
3	Thallium	1.64E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	5	3.29E-01	3.29E+00	9.86E+00
3	Uranium	2.16E+02	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.2	9.80E+01	9.80E+02	2.94E+03

Table 5.2.3. RGOs for SWMU 15 (Continued)

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3]			HI[4]	RGOs for HI[3]		
					1E-06	1E-05	1E-04		0.1	1	3
Excavation Worker (Continued)											
3	Neptunium-237	4.06E+00	pCi/g	2.6E-06	1.56E+00	1.56E+01	1.56E+02	N/A	N/A	N/A	N/A
3	Uranium-234	1.91E+02	pCi/g	1.3E-05	1.51E+01	1.51E+02	1.51E+03	N/A	N/A	N/A	N/A
3	Uranium-235	2.15E+01	pCi/g	9.8E-06	2.18E+00	2.18E+01	2.18E+02	N/A	N/A	N/A	N/A
3	Uranium-238	1.08E+03	pCi/g	1.8E-04	5.95E+00	5.95E+01	5.95E+02	N/A	N/A	N/A	N/A
3	**Cumulative**			**2.4E-04**				**8.3**			
4	Antimony	9.30E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.7	1.32E+01	1.32E+02	3.95E+02
4	Arsenic	3.37E+01	mg/kg	1.3E-05	2.52E+00	2.52E+01	2.52E+02	0.4	8.09E+00	8.09E+01	2.43E+02
4	Iron	6.97E+04	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.3	2.30E+04	2.30E+05	6.91E+05
4	Manganese	1.29E+03	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.2	7.57E+02	7.57E+03	2.27E+04
4	Mercury	5.08E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.5	9.86E+00	9.86E+01	2.96E+02
4	Nickel	1.24E+03	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.8	1.64E+02	1.64E+03	4.91E+03
4	PAH, Total	1.25E+00	mg/kg	3.8E-06	3.25E-01	3.25E+00	3.25E+01	< 0.1	N/A	N/A	N/A
4	PCB, Total	3.13E+01	mg/kg	2.7E-05	1.14E+00	1.14E+01	1.14E+02	< 0.1	N/A	N/A	N/A
4	Thallium	2.06E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	6.3	3.29E-01	3.29E+00	9.86E+00
4	Uranium	1.29E+02	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	9.80E+01	9.80E+02	2.94E+03
4	Uranium-238	9.63E+00	pCi/g	1.6E-06	5.95E+00	5.95E+01	5.95E+02	N/A	N/A	N/A	N/A
4	**Cumulative**			**4.7E-05**				**9.4**			
5	Antimony	1.22E+02	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.9	1.32E+01	1.32E+02	3.95E+02
5	Arsenic	1.33E+01	mg/kg	5.3E-06	2.52E+00	2.52E+01	2.52E+02	0.2	8.09E+00	8.09E+01	2.43E+02
5	Copper	5.63E+03	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.4	1.32E+03	1.32E+04	3.95E+04
5	Iron	2.31E+04	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	2.30E+04	2.30E+05	6.91E+05
5	Manganese	7.28E+02	mg/kg	< 1.0E-06	N/A	N/A	N/A	< 0.1	N/A	N/A	N/A
5	Mercury	1.96E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.2	9.86E+00	9.86E+01	2.96E+02
5	PCB, Total	4.64E+01	mg/kg	4.1E-05	1.14E+00	1.14E+01	1.14E+02	< 0.1	N/A	N/A	N/A
5	Uranium	1.74E+02	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.2	9.80E+01	9.80E+02	2.94E+03
5	Uranium-238	8.14E+00	pCi/g	1.4E-06	5.95E+00	5.95E+01	5.95E+02	N/A	N/A	N/A	N/A
5	**Cumulative**			**4.9E-05**				**2.4**			

Table 5.2.3. RGOs for SWMU 15 (Continued)

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3]			HI[4]	RGOs for HI[3]		
					1E-06	1E-05	1E-04		0.1	1	3
Excavation Worker (Continued)											
6	Antimony	9.94E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.8	1.32E+01	1.32E+02	3.95E+02
6	Arsenic	1.20E+01	mg/kg	4.8E-06	2.52E+00	2.52E+01	2.52E+02	0.1	8.09E+00	8.09E+01	2.43E+02
6	Cadmium	2.50E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	< 0.1	N/A	N/A	N/A
6	Cobalt	1.13E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	9.82E+00	9.82E+01	2.95E+02
6	Iron	3.29E+04	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	2.30E+04	2.30E+05	6.91E+05
6	Mercury	1.87E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.2	9.86E+00	9.86E+01	2.96E+02
6	PAH, Total	1.25E+00	mg/kg	3.8E-06	3.25E-01	3.25E+00	3.25E+01	< 0.1	N/A	N/A	N/A
6	PCB, Total	6.17E+00	mg/kg	5.4E-06	1.14E+00	1.14E+01	1.14E+02	< 0.1	N/A	N/A	N/A
6	Uranium-238	1.21E+01	pCi/g	2.0E-06	5.95E+00	5.95E+01	5.95E+02	N/A	N/A	N/A	N/A
6	**Cumulative**			**1.7E-05**				**1.8**			
7	Antimony	1.41E+02	mg/kg	< 1.0E-06	N/A	N/A	N/A	1.1	1.32E+01	1.32E+02	3.95E+02
7	Arsenic	1.61E+01	mg/kg	6.4E-06	2.52E+00	2.52E+01	2.52E+02	0.2	8.09E+00	8.09E+01	2.43E+02
7	Cadmium	2.78E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	2.53E+01	2.53E+02	7.60E+02
7	Iron	3.45E+04	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	2.30E+04	2.30E+05	6.91E+05
7	Manganese	1.17E+03	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.2	7.57E+02	7.57E+03	2.27E+04
7	PCB, Total	2.55E+01	mg/kg	2.2E-05	1.14E+00	1.14E+01	1.14E+02	< 0.1	N/A	N/A	N/A
7	Uranium-238	6.39E+00	pCi/g	1.1E-06	5.95E+00	5.95E+01	5.95E+02	N/A	N/A	N/A	N/A
7	**Cumulative**			**3.1E-05**				**2.2**			
8	Antimony	9.93E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.8	1.32E+01	1.32E+02	3.95E+02
8	Arsenic	1.14E+01	mg/kg	4.5E-06	2.52E+00	2.52E+01	2.52E+02	0.1	8.09E+00	8.09E+01	2.43E+02
8	Iron	2.83E+04	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	2.30E+04	2.30E+05	6.91E+05
8	Mercury	1.73E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.2	9.86E+00	9.86E+01	2.96E+02
8	PCB, Total	6.29E+00	mg/kg	5.5E-06	1.14E+00	1.14E+01	1.14E+02	< 0.1	N/A	N/A	N/A
8	**Cumulative**			**1.2E-05**				**1.5**			

Table 5.2.3. RGOs for SWMU 15 (Continued)

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3]			HI[4]	RGOs for HI[3]		
					1E-06	1E-05	1E-04		0.1	1	3
Excavation Worker (Continued)											
9	Antimony	1.22E+02	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.9	1.32E+01	1.32E+02	3.95E+02
9	Arsenic	1.31E+01	mg/kg	5.2E-06	2.52E+00	2.52E+01	2.52E+02	0.2	8.09E+00	8.09E+01	2.43E+02
9	Cadmium	2.81E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	2.53E+01	2.53E+02	7.60E+02
9	Iron	3.02E+04	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	2.30E+04	2.30E+05	6.91E+05
9	Manganese	1.57E+03	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.2	7.57E+02	7.57E+03	2.27E+04
9	Mercury	1.74E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.2	9.86E+00	9.86E+01	2.96E+02
9	PCB, Total	6.51E+00	mg/kg	5.7E-06	1.14E+00	1.14E+01	1.14E+02	< 0.1	N/A	N/A	N/A
9	**Cumulative**			**1.2E-05**				**1.9**			
10	Antimony	1.26E+02	mg/kg	< 1.0E-06	N/A	N/A	N/A	1	1.32E+01	1.32E+02	3.95E+02
10	Arsenic	9.75E+00	mg/kg	3.9E-06	2.52E+00	2.52E+01	2.52E+02	0.1	8.09E+00	8.09E+01	2.43E+02
10	Nickel	2.26E+02	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	1.64E+02	1.64E+03	4.91E+03
10	**Cumulative**			**4.3E-06**				**1.5**			
Hypothetical Resident[5]											
1	Antimony	7.49E+01	mg/kg	N/A	N/A	N/A	N/A	2.4	3.13E+00	3.13E+01	9.39E+01
1	Arsenic	1.27E+01	mg/kg	4.7E-05	2.67E-01	2.67E+00	2.67E+01	0.8	1.67E+00	1.67E+01	5.01E+01
1	Cadmium	1.56E+01	mg/kg	N/A	N/A	N/A	N/A	0.3	5.07E+00	5.07E+01	1.52E+02
1	Iron	2.95E+04	mg/kg	N/A	N/A	N/A	N/A	0.5	5.47E+03	5.48E+04	1.64E+05
1	PAH, Total	1.71E+00	mg/kg	7.6E-05	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
1	Thallium	2.40E-01	mg/kg	N/A	N/A	N/A	N/A	0.3	7.82E-02	7.82E-01	2.35E+00
1	Uranium	3.26E+01	mg/kg	N/A	N/A	N/A	N/A	0.1	2.34E+01	2.34E+02	7.01E+02
1	Uranium-238	1.85E+00	pCi/g	3.7E-06	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
1	**Cumulative**			**1.3E-04**				**4.8**			
2	Antimony	9.83E+01	mg/kg	N/A	N/A	N/A	N/A	3.1	3.13E+00	3.13E+01	9.39E+01
2	Arsenic	1.63E+01	mg/kg	6.1E-05	2.67E-01	2.67E+00	2.67E+01	1	1.67E+00	1.67E+01	5.01E+01
2	Iron	3.89E+04	mg/kg	N/A	N/A	N/A	N/A	0.7	5.48E+03	5.48E+04	1.64E+05
2	Mercury	9.33E+00	mg/kg	N/A	N/A	N/A	N/A	0.4	2.35E+00	2.35E+01	7.04E+01
2	Nickel	1.97E+02	mg/kg	N/A	N/A	N/A	N/A	0.5	3.90E+01	3.90E+02	1.17E+03
2	PAH, Total	2.11E+00	mg/kg	9.3E-05	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
2	PCB, Total	3.30E-01	mg/kg	4.2E-06	7.82E-02	7.82E-01	7.82E+00	N/A	N/A	N/A	N/A
2	Uranium	1.32E+02	mg/kg	N/A	N/A	N/A	N/A	0.6	2.34E+01	2.34E+02	7.01E+02

Table 5.2.3. RGOs for SWMU 15 (Continued)

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3]			HI[4]	RGOs for HI[3]		
					1E-06	1E-05	1E-04		0.1	1	3
Hypothetical Resident[5] (Continued)											
2	Uranium-234	6.51E+00	pCi/g	1.1E-06	5.73E+00	5.73E+01	5.73E+02	N/A	N/A	N/A	N/A
2	Uranium-235	3.80E-01	pCi/g	3.3E-06	1.14E-01	1.14E+00	1.14E+01	N/A	N/A	N/A	N/A
2	Uranium-238	1.21E+01	pCi/g	2.4E-05	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
2	**Cumulative**			**1.9E-04**				**6.3**			
3	Antimony	7.10E+01	mg/kg	N/A	N/A	N/A	N/A	2.3	3.13E+00	3.13E+01	9.39E+01
3	Arsenic	2.74E+01	mg/kg	1.0E-04	2.67E-01	2.67E+00	2.67E+01	1.6	1.67E+00	1.67E+01	5.01E+01
3	Cadmium	1.25E+01	mg/kg	N/A	N/A	N/A	N/A	0.2	5.07E+00	5.07E+01	1.52E+02
3	Cobalt	3.41E+01	mg/kg	N/A	N/A	N/A	N/A	1.5	2.34E+00	2.34E+01	7.02E+01
3	Copper	1.60E+03	mg/kg	N/A	N/A	N/A	N/A	0.5	3.13E+02	3.13E+03	9.39E+03
3	Iron	9.20E+04	mg/kg	N/A	N/A	N/A	N/A	1.7	5.48E+03	5.48E+04	1.64E+05
3	Manganese	1.60E+03	mg/kg	N/A	N/A	N/A	N/A	0.9	1.82E+02	1.82E+03	5.47E+03
3	Mercury	1.05E+01	mg/kg	N/A	N/A	N/A	N/A	0.4	2.35E+00	2.35E+01	7.04E+01
3	Nickel	8.38E+02	mg/kg	N/A	N/A	N/A	N/A	2.1	3.90E+01	3.90E+02	1.17E+03
3	PAH, Total	1.45E+00	mg/kg	6.4E-05	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
3	PCB, Total	6.82E+00	mg/kg	8.7E-05	7.82E-02	7.82E-01	7.82E+00	N/A	N/A	N/A	N/A
3	Thallium	2.60E-01	mg/kg	N/A	N/A	N/A	N/A	0.3	7.82E-02	7.82E-01	2.35E+00
3	Uranium	2.16E+02	mg/kg	N/A	N/A	N/A	N/A	0.9	2.34E+01	2.34E+02	7.01E+02
3	Vanadium	7.31E+01	mg/kg	N/A	N/A	N/A	N/A	0.2	3.93E+01	3.93E+02	1.18E+03
3	Neptunium-237	3.24E+00	pCi/g	4.2E-05	7.72E-02	7.72E-01	7.72E+00	N/A	N/A	N/A	N/A
3	Tc-99	2.90E+02	pCi/g	2.7E-06	1.07E+02	1.07E+03	1.07E+04	N/A	N/A	N/A	N/A
3	Thorium-230	5.14E+00	pCi/g	1.1E-06	4.89E+00	4.89E+01	4.89E+02	N/A	N/A	N/A	N/A
3	Uranium-234	1.40E+02	pCi/g	2.4E-05	5.73E+00	5.73E+01	5.73E+02	N/A	N/A	N/A	N/A
3	Uranium-235	1.49E+01	pCi/g	1.3E-04	1.14E-01	1.14E+00	1.14E+01	N/A	N/A	N/A	N/A
3	Uranium-238	8.68E+02	pCi/g	1.7E-03	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
3	**Cumulative**			**2.2E-03**				**12.7**			
4	Antimony	7.63E+01	mg/kg	N/A	N/A	N/A	N/A	2.4	3.13E+00	3.13E+01	9.39E+01
4	Arsenic	3.37E+01	mg/kg	1.3E-04	2.67E-01	2.67E+00	2.67E+01	2	1.67E+00	1.67E+01	5.01E+01
4	Cadmium	1.86E+01	mg/kg	N/A	N/A	N/A	N/A	0.4	5.07E+00	5.07E+01	1.52E+02
4	Copper	5.99E+02	mg/kg	N/A	N/A	N/A	N/A	0.2	3.13E+02	3.13E+03	9.39E+03
4	Iron	6.90E+04	mg/kg	N/A	N/A	N/A	N/A	1.3	5.48E+03	5.48E+04	1.64E+05
4	Manganese	1.29E+03	mg/kg	N/A	N/A	N/A	N/A	0.7	1.82E+02	1.82E+03	5.47E+03
4	Mercury	3.04E+01	mg/kg	N/A	N/A	N/A	N/A	1.3	2.35E+00	2.35E+01	7.04E+01
4	Nickel	1.24E+03	mg/kg	N/A	N/A	N/A	N/A	3.2	3.90E+01	3.90E+02	1.17E+03

Table 5.2.3. RGOs for SWMU 15 (Continued)

					RGOs for ELCR[3]				RGOs for HI[3]		
EU	**COC**	**EPC[1]**	**Units**	**ELCR[2]**	**1E-06**	**1E-05**	**1E-04**	**HI[4]**	**0.1**	**1**	**3**
Hypothetical Resident[5] (Continued)											
4	PAH, Total	1.75E+00	mg/kg	7.7E-05	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
4	PCB, Total	3.13E+01	mg/kg	4.0E-04	7.82E-02	7.82E-01	7.82E+00	N/A	N/A	N/A	N/A
4	Thallium	1.85E-01	mg/kg	N/A	N/A	N/A	N/A	0.2	7.82E-02	7.82E-01	2.35E+00
4	Uranium	1.29E+02	mg/kg	N/A	N/A	N/A	N/A	0.6	2.34E+01	2.34E+02	7.01E+02
4	Vanadium	8.43E+01	mg/kg	N/A	N/A	N/A	N/A	0.2	3.93E+01	3.93E+02	1.18E+03
4	Neptunium-237	6.60E-01	pCi/g	8.5E-06	7.72E-02	7.72E-01	7.72E+00	N/A	N/A	N/A	N/A
4	Uranium-234	7.93E+00	pCi/g	1.4E-06	5.73E+00	5.73E+01	5.73E+02	N/A	N/A	N/A	N/A
4	Uranium-235	3.64E-01	pCi/g	3.2E-06	1.14E-01	1.14E+00	1.14E+01	N/A	N/A	N/A	N/A
4	Uranium-238	1.35E+01	pCi/g	2.7E-05	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
4	**Cumulative**			**6.4E-04**				**12.5**			
5	Antimony	1.01E+02	mg/kg	N/A	N/A	N/A	N/A	3.2	3.13E+00	3.13E+01	9.39E+01
5	Arsenic	1.28E+01	mg/kg	4.8E-05	2.67E-01	2.67E+00	2.67E+01	0.8	1.67E+00	1.67E+01	5.01E+01
5	Cadmium	1.46E+01	mg/kg	N/A	N/A	N/A	N/A	0.3	5.07E+00	5.07E+01	1.52E+02
5	Copper	5.63E+03	mg/kg	N/A	N/A	N/A	N/A	1.8	3.13E+02	3.13E+03	9.39E+03
5	Nickel	3.53E+02	mg/kg	N/A	N/A	N/A	N/A	0.9	3.90E+01	3.90E+02	1.17E+03
5	PAH, Total	5.11E-01	mg/kg	2.3E-05	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
5	PCB, Total	2.51E+01	mg/kg	3.2E-04	7.82E-02	7.82E-01	7.82E+00	N/A	N/A	N/A	N/A
5	Uranium	1.76E+02	mg/kg	N/A	N/A	N/A	N/A	0.8	2.34E+01	2.34E+02	7.01E+02
5	Neptunium-237	6.90E-01	pCi/g	8.9E-06	7.72E-02	7.72E-01	7.72E+00	N/A	N/A	N/A	N/A
5	Uranium-235	4.60E-01	pCi/g	4.0E-06	1.14E-01	1.14E+00	1.14E+01	N/A	N/A	N/A	N/A
5	Uranium-238	1.03E+01	pCi/g	2.1E-05	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
5	**Cumulative**			**4.3E-04**				**7.8**			
6	Antimony	8.85E+01	mg/kg	N/A	N/A	N/A	N/A	2.8	3.13E+00	3.13E+01	9.39E+01
6	Arsenic	1.24E+01	mg/kg	4.7E-05	2.67E-01	2.67E+00	2.67E+01	0.7	1.67E+00	1.67E+01	5.01E+01
6	Cadmium	1.64E+01	mg/kg	N/A	N/A	N/A	N/A	0.3	5.07E+00	5.07E+01	1.52E+02
6	Cobalt	1.62E+01	mg/kg	N/A	N/A	N/A	N/A	0.7	2.34E+00	2.34E+01	7.02E+01
6	Copper	4.23E+02	mg/kg	N/A	N/A	N/A	N/A	0.1	3.13E+02	3.13E+03	9.39E+03
6	Iron	3.29E+04	mg/kg	N/A	N/A	N/A	N/A	0.6	5.48E+03	5.48E+04	1.64E+05
6	Nickel	3.00E+02	mg/kg	N/A	N/A	N/A	N/A	0.8	3.90E+01	3.90E+02	1.17E+03
6	PAH, Total	1.62E+00	mg/kg	7.2E-05	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
6	PCB, Total	6.17E+00	mg/kg	7.9E-05	7.82E-02	7.82E-01	7.82E+00	N/A	N/A	N/A	N/A
6	Uranium	6.30E+01	mg/kg	N/A	N/A	N/A	N/A	0.3	2.34E+01	2.34E+02	7.01E+02

Table 5.2.3. RGOs for SWMU 15 (Continued)

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3]			HI[4]	RGOs for HI[3]		
					1E-06	1E-05	1E-04		0.1	1	3
Hypothetical Resident[5] (Continued)											
6	Neptunium-237	6.40E-01	pCi/g	8.3E-06	7.72E-02	7.72E-01	7.72E+00	N/A	N/A	N/A	N/A
6	Uranium-234	8.74E+00	pCi/g	1.5E-06	5.73E+00	5.73E+01	5.73E+02	N/A	N/A	N/A	N/A
6	Uranium-235	5.70E-01	pCi/g	5.0E-06	1.14E-01	1.14E+00	1.14E+01	N/A	N/A	N/A	N/A
6	Uranium-238	1.54E+01	pCi/g	3.1E-05	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
6	**Cumulative**			**2.4E-04**				**6.4**			
7	Antimony	1.37E+02	mg/kg	N/A	N/A	N/A	N/A	4.4	3.13E+00	3.13E+01	9.39E+01
7	Arsenic	1.61E+01	mg/kg	6.0E-05	2.67E-01	2.67E+00	2.67E+01	1	1.67E+00	1.67E+01	5.01E+01
7	Cadmium	1.80E+01	mg/kg	N/A	N/A	N/A	N/A	0.4	5.07E+00	5.07E+01	1.52E+02
7	Copper	8.29E+02	mg/kg	N/A	N/A	N/A	N/A	0.3	3.13E+02	3.13E+03	9.39E+03
7	Iron	3.42E+04	mg/kg	N/A	N/A	N/A	N/A	0.6	5.47E+03	5.48E+04	1.64E+05
7	Manganese	1.18E+03	mg/kg	N/A	N/A	N/A	N/A	0.6	1.82E+02	1.82E+03	5.47E+03
7	Nickel	5.59E+02	mg/kg	N/A	N/A	N/A	N/A	1.4	3.90E+01	3.90E+02	1.17E+03
7	PAH, Total	1.59E-01	mg/kg	7.0E-06	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
7	PCB, Total	2.57E+01	mg/kg	3.3E-04	7.82E-02	7.82E-01	7.82E+00	N/A	N/A	N/A	N/A
7	Thallium	3.00E-01	mg/kg	N/A	N/A	N/A	N/A	0.4	7.82E-02	7.82E-01	2.35E+00
7	Uranium	5.39E+01	mg/kg	N/A	N/A	N/A	N/A	0.2	2.34E+01	2.34E+02	7.01E+02
7	Uranium-234	6.49E+00	pCi/g	1.1E-06	5.73E+00	5.73E+01	5.73E+02	N/A	N/A	N/A	N/A
7	Uranium-235	4.50E-01	pCi/g	4.0E-06	1.14E-01	1.14E+00	1.14E+01	N/A	N/A	N/A	N/A
7	Uranium-238	8.05E+00	pCi/g	1.6E-05	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
7	**Cumulative**			**4.2E-04**				**9.3**			
8	Antimony	7.42E+01	mg/kg	N/A	N/A	N/A	N/A	2.4	3.13E+00	3.13E+01	9.39E+01
8	Arsenic	1.17E+01	mg/kg	4.4E-05	2.67E-01	2.67E+00	2.67E+01	0.7	1.67E+00	1.67E+01	5.01E+01
8	Cadmium	1.68E+01	mg/kg	N/A	N/A	N/A	N/A	0.3	5.07E+00	5.07E+01	1.52E+02
8	Iron	2.83E+04	mg/kg	N/A	N/A	N/A	N/A	0.5	5.47E+03	5.48E+04	1.64E+05
8	Mercury	1.01E+01	mg/kg	N/A	N/A	N/A	N/A	0.4	2.35E+00	2.35E+01	7.04E+01
8	Nickel	1.82E+02	mg/kg	N/A	N/A	N/A	N/A	0.5	3.90E+01	3.90E+02	1.17E+03
8	PAH, Total	3.59E-01	mg/kg	1.6E-05	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
8	PCB, Total	5.01E+00	mg/kg	6.4E-05	7.82E-02	7.82E-01	7.82E+00	N/A	N/A	N/A	N/A
8	Uranium	4.46E+01	mg/kg	N/A	N/A	N/A	N/A	0.2	2.34E+01	2.34E+02	7.01E+02
8	Neptunium-237	3.65E-01	pCi/g	4.7E-06	7.72E-02	7.72E-01	7.72E+00	N/A	N/A	N/A	N/A
8	Uranium-238	6.64E+00	pCi/g	1.3E-05	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
8	**Cumulative**			**1.4E-04**				**5.0**			

Table 5.2.3. RGOs for SWMU 15 (Continued)

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3]			HI[4]	RGOs for HI[3]		
					1E-06	1E-05	1E-04		0.1	1	3
Hypothetical Resident[5] (Continued)											
9	Antimony	1.12E+02	mg/kg	N/A	N/A	N/A	N/A	3.6	3.13E+00	3.13E+01	9.39E+01
9	Arsenic	1.10E+01	mg/kg	4.1E-05	2.67E-01	2.67E+00	2.67E+01	0.7	1.67E+00	1.67E+01	5.01E+01
9	Cadmium	1.81E+01	mg/kg	N/A	N/A	N/A	N/A	0.4	5.07E+00	5.07E+01	1.52E+02
9	Iron	2.76E+04	mg/kg	N/A	N/A	N/A	N/A	0.5	5.47E+03	5.48E+04	1.64E+05
9	PAH, Total	2.38E-01	mg/kg	1.1E-05	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
9	PCB, Total	6.31E+00	mg/kg	8.1E-05	7.82E-02	7.82E-01	7.82E+00	N/A	N/A	N/A	N/A
9	Uranium	3.07E+01	mg/kg	N/A	N/A	N/A	N/A	0.1	2.34E+01	2.34E+02	7.01E+02
9	Vanadium	7.33E+01	mg/kg	N/A	N/A	N/A	N/A	0.2	3.93E+01	3.93E+02	1.18E+03
9	Uranium-238	7.12E+00	pCi/g	1.4E-05	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
9	**Cumulative**			**1.5E-04**				**5.8**			
10	Antimony	1.25E+02	mg/kg	N/A	N/A	N/A	N/A	4	3.13E+00	3.13E+01	9.39E+01
10	Cadmium	1.67E+01	mg/kg	N/A	N/A	N/A	N/A	0.3	5.07E+00	5.07E+01	1.52E+02
10	Mercury	7.84E+00	mg/kg	N/A	N/A	N/A	N/A	0.3	2.35E+00	2.35E+01	7.04E+01
10	Nickel	2.26E+02	mg/kg	N/A	N/A	N/A	N/A	0.6	3.90E+01	3.90E+02	1.17E+03
10	PAH, Total	1.28E-01	mg/kg	5.7E-06	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
10	Uranium	9.02E+01	mg/kg	N/A	N/A	N/A	N/A	0.4	2.34E+01	2.34E+02	7.01E+02
10	**Cumulative**			**5.7E-06**				**5.6**			

Grayed cells indicate EPC value is lower than RGO value or an RGO value is not applicable.
N/A = Not applicable because the COC was not applicable (i.e., the COC was of concern for HI, but not ELCR or it was of concern for ELCR by not HI).
[1] See Tables D.6 and D.7 (Appendix D) for EPC values.
[2] See Appendix D, Exhibit D.6, for ELCR.
[3] See Table D.47 for RGOs.
[4] See Appendix D, Exhibit D.6, for HI.
[5] RGOs for residential land use are based on exposure to a resident age 1-27. For carcinogens, the dose method incorporates age-adjusted values for the 26-year exposure duration. Because child soil ingestion rates are higher and body weights are lower, noncancer RGOs are based on the child resident exposure assumptions.

Ecological Screening. COPECs for SWMU 15 include metals, SVOCs, and PCBs. Potential hazards for ecological receptors and the associated priority COPECs (maximum HQ ≥ 10) are summarized in Table 5.2.4.

Table 5.2.4. Ecological Screening for SWMU 15

Ground Cover	Near a Surface Water Body?	Total HI[a]	Priority COPECs[b]	Background (mg/kg)[c]	Soil ESV (mg/kg)[d]	Maximum (mg/kg)	HQ (max conc)[a]	EPC (mg/kg)	HQ (EPC)[a]
Gravel with a soil/grass mix	Yes	1,326	Aluminum	13,000	50	9,250	185.0	8,455	169.1
			Antimony	0.21	0.27	283.01	1048.19	87.04	322.4
			Cadmium	0.21	0.36	24.15	67.08	8.604	23.9
			Copper	19	28	6122.47	218.66	571.9	20.4
			High molecular weight PAHs	N/A	1.1	15.99	14.54	12.35	11.2
			Iron	28,000	200	171,000	855	37,414	187.1
			Lead	36	11	1040.18	94.56	134.7	12.2
			Mercury	0.2	0.1	20	200	6.116	61.2
			Nickel	21	38	3787.15	99.66	411.8	10.8
			PCB, Total	N/A	0.02	55	2750	8.604	430.2
			Selenium	0.8	0.52	26.71	51.37	10.2	19.6
			Uranium	4.9	5	459	91.8	91.33	18.3
			Zinc	65	46	3168.62	68.88	474.4	10.3

Table is from Appendix E, Table E.1.
[a] .Total HI includes concentrations from all of the COPECs (listed in Table E4.1), only priority COPECs (i.e., the COPECs with HQs greater than 10, using the EPCs) are shown in this table.
[b] Only priority COPECs are listed. See Appendix E for additional COPECs.
[c] Background value is from DOE 2015a.
[d] ESVs taken from DOE 2015c and Appendix E of this report.

5.2.7 SWMU 15 Summary

Goal 1. Characterize Nature and Extent of Source Zone

Plant processes that could have contributed to contamination here is placement of scrap metal in the elements.

COPCs for surface and subsurface soils from SWMU 15 are shown on Tables 5.2.1 and 5.2.2 as those analytes with green boxes under the “Industrial Worker/Frequency of Exposure (FOE)” columns for surface and shallow subsurface soil, and those with blue boxes under the “GW Protection Screen/RGA/UCRS” columns for groundwater. For metals and radioisotopes, an orange box under the “Provisional Background” also must accompany the green and blue boxes. Contaminants were detected greater than background and greater than industrial worker NALs to a maximum depth of 10 ft bgs. The COPCs identified for each EU in SWMU 15 are as follows:

- EU 1
  - — Surface—metals, PAHs, SVOCs, radionuclides
  - — Subsurface—metals, radionuclides

- EU 2
  - Surface—metals, PCBs, PAHs, SVOCs, radionuclides
  - Subsurface—metals, radionuclides
- EU 3
  - Surface—metals, PCBs, PAHs, SVOCs, VOCs, radionuclides
  - Subsurface—metals, PCBs, radionuclides
- EU 4
  - Surface—metals, PCBs, PAHs, SVOCs, radionuclides
  - Subsurface—metals, PCBs, radionuclides
- EU 5
  - Surface—metals, PCBs, PAHs, SVOCs, radionuclides
  - Subsurface—metals, PCBs
- EU 6
  - Surface—metals, PCBs, PAHs, SVOCs, radionuclides
  - Subsurface—metals, radionuclides
- EU 7
  - Surface—metals, PCBs, PAHs, SVOCs, radionuclides
  - Subsurface—metals, PCBs
- EU 8
  - Surface—metals, PCBs, PAHs, SVOCs, radionuclides
  - Subsurface—metals, radionuclides
- EU 9
  - Surface—metals, PCBs, PAHs, SVOCs, radionuclides
  - Subsurface—metals
- EU 10
  - Surface—metals, PAHs, radionuclides
  - Subsurface—metals, radionuclides

Goal 2. Determine Surface and Subsurface Transport Mechanisms and Pathways

The contaminants at SWMU 15 are readily adsorbed to soil particles, so they do not migrate without a direct connection to surface water. There is potential for runoff because this SWMU is surrounded by ditches that discharge to Outfall 001; however, the runoff is captured in the C-613 Sedimentation Basin prior to discharge into Outfall 001. Pipelines were sampled at SWMU 15 and results were evaluated within this RI, which do not indicate subsurface transport. The CSM can be found in Appendix D.

Goal 3. Complete a Baseline Risk Assessment for the Soils OU

Cumulative ELCRs or HIs exceeded benchmarks of 1E-06 and 1, respectively, for the future industrial worker, excavation worker, and hypothetical residential scenarios. COCs for these scenarios for SWMU 15 are as follows:

- Future Industrial worker
    - Arsenic
    - Total PAHs
    - Total PCBs
    - Neptunium-237
    - Uranium-234
    - Uranium-235
    - Uranium-238
- Excavation worker
    - Antimony
    - Arsenic
    - Cadmium
    - Cobalt
    - Copper
    - Iron
    - Manganese
    - Mercury
    - Nickel
    - Thallium
    - Uranium
    - Total PAHs
    - Total PCBs
    - Neptunium-237
    - Uranium-234
    - Uranium-235
    - Uranium-238
- Hypothetical Resident (hazards evaluated against the child resident)
    - Antimony
    - Arsenic
    - Cadmium
    - Cobalt
    - Copper
    - Iron
    - Manganese
    - Mercury
    - Nickel
    - Thallium
    - Uranium
    - Vanadium

- Total PAHs
- Total PCBs
- Neptunium-237
- Tc-99
- Thorium-230
- Uranium-234
- Uranium-235
- Uranium-238

Figure 5.2.8 shows the COCs exceeding RGOs for the future industrial worker.

Priority COCs (i.e., HQ > 1 or chemical-specific ELCR > 1E-04) for SWMU 15 are located in all EUs. The priority COCs are Total PCBs and uranium-238 for the industrial worker; antimony, thallium, and uranium-238 for the excavation worker; and Total PCBs, arsenic, antimony, cobalt, copper, iron, mercury, nickel, uranium-235, and uranium-238 for the hypothetical resident. Priority COCs for other scenarios are described in Appendix D.

No priority COCs were identified for groundwater modeled from soil.

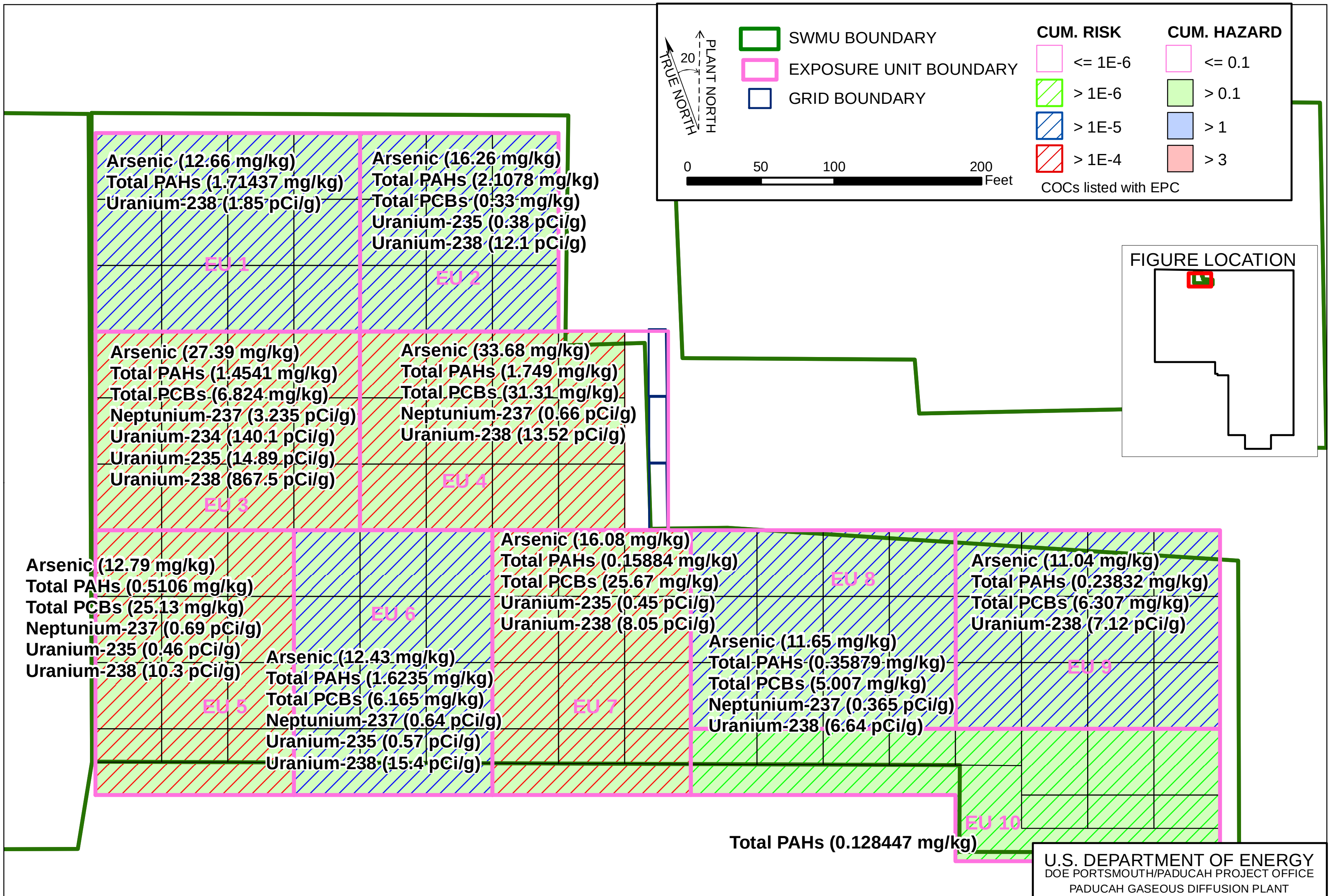
For SWMU 15, COPECs exceed ESVs. Priority COPECs (i.e., maximum HQ ≥ 10) are the following:

- Aluminum
- Antimony
- Cadmium
- Copper
- High Molecular Weight PAHs
- Lead
- Mercury
- Nickel
- Selenium
- Total PCBs
- Uranium
- Zinc

Goal 4. Support Evaluation of Remedial Alternatives

The representative data set used for SWMU 15 is sufficient to support decision making and indicates that an FS is appropriate. An uncertainty concerning depth of contamination should be considered in the FS. Possible remedial technologies applicable for this unit, as discussed in the Work Plan (DOE 2010a), are posting, fencing (or other means of limiting access), excavation, and/or other remedial technologies that will be described in the FS.

SWMU 15 is adjacent to SWMU 14 (C-746-E Contaminated Scrap Yard), which was part of the Soils OU RI, and SWMU 42 (C-616 Chromate Reduction Facility), which is part of the GDP D&D OU. A response action at SWMU 15 would not have an impact on groundwater or surface water.



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PADUCAH GASEOUS DIFFUSION PLANT

Figure 5.2.8. Summary of COCs Contributing to Risk to the Future Industrial Worker at SWMU 15

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5.2.8 SWMU 15 Conclusion

The RI defined adequately the nature and extent of contamination in soils at SWMU 15; an FS is appropriate for the SWMU due to cancer risks and/or noncancer hazards exceeding the decision rule benchmarks for scenarios including the future industrial worker, excavation worker, and hypothetical resident (DOE 2010a). The reasonably anticipated future land use of this SWMU is industrial, as shown in the SMP (DOE 2015a).

5.3 SWMU 26, C-400 to C-404, 4-inch Underground Transfer Line

5.3.1 Background

The C-400 to C-404 Underground Transfer Line (SWMU 26) is located in the central portion of the plant site. SWMU 26 is a 4-inch steel line, approximately 1,500 ft long. This SWMU runs along Kentucky Discharge Pollutant Elimination System (KPDES) Outfall 015.

From 1951 to 1956, SWMU 26 was used to transfer uranium-contaminated solutions from the C-400 Cleaning Building to the C-404 Lagoon for settling prior to discharge. The transfer line was abandoned in 1957.

The area surrounding the line was sampled during the Phase II SI (CH2M HILL 1992) and the WAG 6 RI (DOE 1999b), which placed SWMU 26 in Sector 8 and described as the area to the far north and far northeast of the C-400 Building and contains the C-401 Transfer Line (SWMU 26). Results of the investigation indicate metals, PAHs, and radionuclide contamination occurred from leaks in the pipeline.

Metals and radiological contaminants were found in high concentrations in soil samples collected directly beneath the pipeline, and nickel and copper were detected in a soil sample collected adjacent to the excavated pipeline area. At the western-most boring, VOCs and radionuclides were detected. The surface soil did not contain elevated radionuclide activity, which implies that the impact may be the result of a subsurface release.

The summary from the BHHRA for WAG 6, Table 7.1, shows which human health potential risks and hazards exceed *de minimis*.

5.3.2 Fieldwork Summary

During the first RI for the Soils OU, 64 subsurface grab sample locations were planned for the unit; 51 were collected. Some locations were not sampled due to being located in a road, having dense underground utilities, or overlapping SWMU 3, which is due west of SWMU 26. Appendix A contains the sampling rectification map.

The unit underwent a gamma radiological walkover survey (Figure 5.3.1) using a FIDLER; the 23,549 measurements ranged from 4,101 to 174,822 cpm. A judgmental grab sample was collected for radiological constituents. The ground cover for the area is soil on the east and west ends and a mix of soil and gravel in the center. The eastern portion of the area is posted as a contamination area. The lowest readings occur in the soil/gravel area adjacent to the C-759 scrap metal staging area. The highest readings occur in the southeast perimeter of the unit. Additional survey was not performed beyond the unit boundary because the area consisted of a ditch that was previously remediated by the SWOU (On-Site) (DOE 2011a).

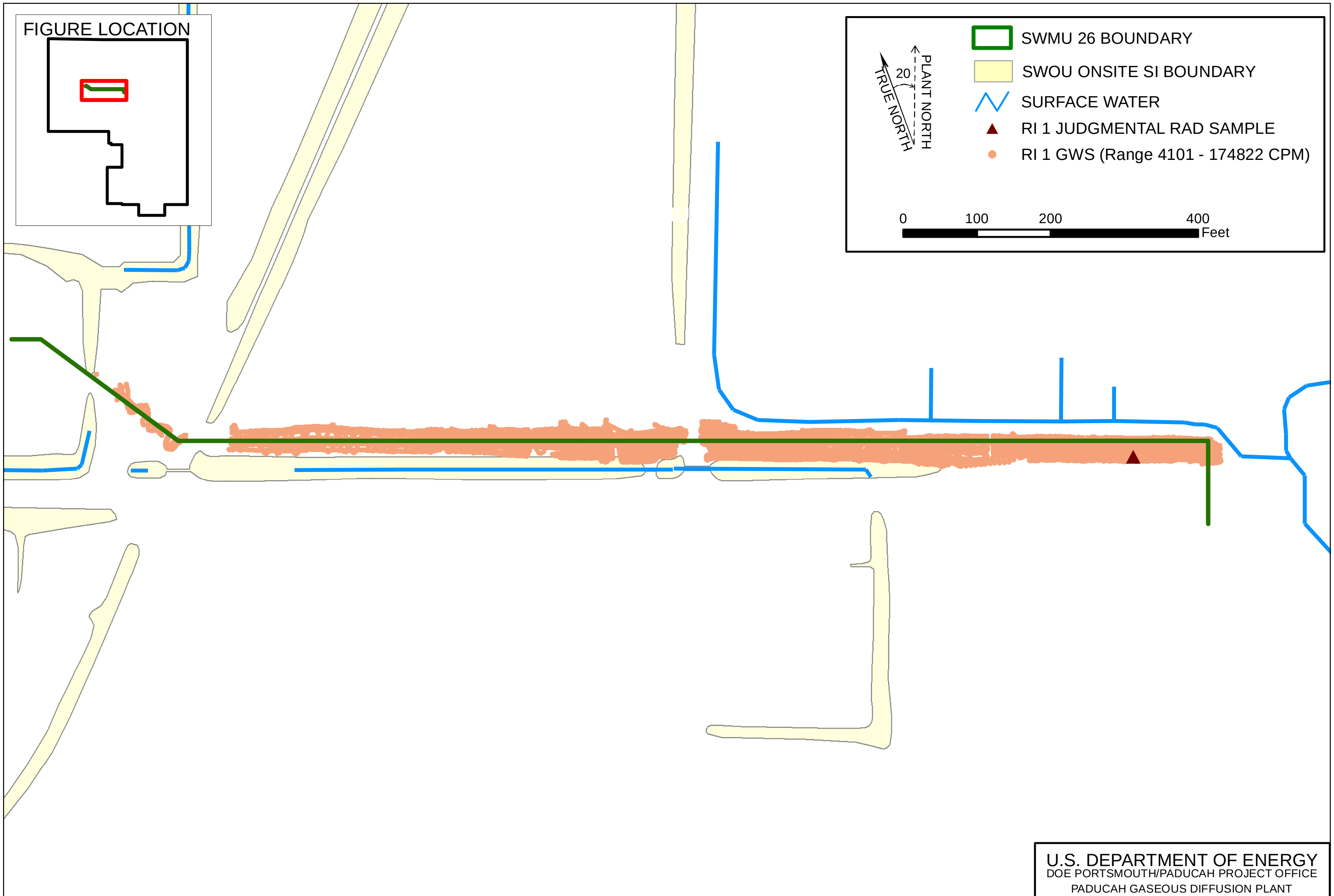

Figure 5.3.1. SWMU 26 Gamma Walkover Survey

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During RI 2, surface soil sampling was planned for the entire unit except for the grids within the gravel lot of the C-752 waste facility, the grids within the footprint of the C-404 Hazardous Waste Landfill, grids within the ditch previously sampled by the Surface Water OU, and the grids along the southern side of the NSDD. As a result, 35 grid samples were planned and collected for the unit. Field laboratory results indicated that contingency samples were needed to determine the nature and extent of contamination because of elevated concentrations of arsenic and uranium. Six contingency samples were planned and collected.

No additional gamma radiological walkover survey was required for this unit.

5.3.3 Nature and Extent of Contamination—Surface Soils

The representative data set presented in Table 5.3.1 provides the nature of the contamination in SWMU 26 surface soils, and Figures 5.3.2–5.3.4 illustrate the horizontal extent. A complete list of sampling results is provided in Appendix F (samples with ending depths of 1 ft bgs or less or null are considered surface soils). Grid numbers shown below are truncated from the figures. Figures contain the SWMU#–grid#, with zeros filling the appropriate spaces to make three digits.

The lateral extent of SWMU 26 surface soil contamination is considered defined adequately for supporting the BRA and FS. SWMU 26 consists of 4 EUs.

Metals

The following metals were detected in the surface soil above both background screening levels and the industrial worker NALs: arsenic in grids 6f (EU 2), 13 and 14 (EU 3), and 33 (EU 4); chromium in grid 35 (EU 4); cobalt and thallium in grid 6f (EU 2); and uranium in grids 6f (EU 2), and 25, 28, 30, 31, 33, 35 (EU 4). Arsenic in grid 33 (EU 4) exceeds ALs in SWMU 26 surface soils.

The following metals were detected in the SWMU 26 surface soil above both the SSLs for the protection of UCRS groundwater and the background screening levels.

Metal	Grid	EU
Aluminum	6f, 27	2, 4
Antimony	13, 19, 20	3, 4
Arsenic	6f, 13, 14, 33	2, 3, 4
Barium	6f, 13	2, 3
Beryllium	6f	2
Cadmium	2, 6d, 6f, 13	1, 2, 3
Cobalt	6f	2
Copper	1A, 2, 6, 6f, 10, 11, 12, 13, 14, 15, 16, 17, 19, 22, 23, 24, 25, 27, 28, 29, 30, 31, 32, 33, 34, 35	1, 2, 3, 4
Iron	1D, 1E, 4, 6f, 9, 10, 11, 12, 13, 22, 29, 31, 32, 33	1, 2, 3, 4
Lead	1C, 6f, 11, 13, 28, 29, 30, 31, 33, 34	1, 2, 3, 4
Mercury	13, 14, 24, 32, 35	3, 4
Molybdenum[1]	1A, 2, 6f, 7, 13, 16, 19, 24, 31, 33	1, 2, 3, 4
Nickel	1A, 1B, 1G, 2, 4, 6, 6d, 6f, 10, 11, 12, 13, 14, 15, 16, 17, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 33, 34, 35	1, 2, 3, 4
Selenium	6f, 7, 13, 14, 24	2, 3, 4
Silver	13, 14	3
Thallium	6f, 13, 19	2, 3

Table 5.3.1. Surface Soil Data Summary: SWMU 26

			Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
Type	Analysis	Unit	Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
METAL	Aluminum	mg/kg	2.99E+03	3.46E+04	8.95E+03	0/12	12/12	2/12	1.30E+04	0/12	1.00E+05	0/12	1.00E+05	0/12	11/12	4.1–357
METAL	Antimony	mg/kg	1.20E-01	1.40E+00	4.60E-01	0/12	8/12	4/12	2.10E-01	0/12	9.34E+01	0/12	2.80E+03	0/12	3/12	0.025–17.9
METAL	Arsenic	mg/kg	4.20E+00	1.60E+02	3.60E+01	0/58	16/58	7/58	1.20E+01	16/58	1.41E+00	1/58	1.41E+02	7/58	16/58	0.06–20
METAL	Barium	mg/kg	3.13E+01	8.15E+02	1.99E+02	0/19	19/19	4/19	2.00E+02	0/19	4.04E+04	0/19	1.00E+05	0/19	9/19	0.02–357
METAL	Beryllium	mg/kg	3.70E-01	1.57E+01	1.85E+00	0/15	12/15	5/15	6.70E-01	0/15	4.50E+02	0/15	1.35E+04	0/15	1/15	0.01–8.9
METAL	Boron	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	4.65E+04	0/1	1.00E+05	0/1	0/1	357–357
METAL	Cadmium	mg/kg	3.90E-02	2.50E+00	8.89E-01	0/19	10/19	5/19	2.10E-01	0/19	6.12E+01	0/19	1.84E+03	0/19	4/19	0.02–8.9
METAL	Calcium	mg/kg	4.50E+03	9.50E+04	2.18E+04	0/11	11/11	0/11	2.00E+05	0/11	N/A	0/11	N/A	N/A	N/A	0.1–8920
METAL	Chromium	mg/kg	4.85E+00	2.31E+02	4.57E+01	0/61	27/61	18/61	1.60E+01	1/61	1.98E+02	0/61	1.98E+04	0/61	0/61	0.07–17.9
METAL	Cobalt	mg/kg	5.40E+00	9.05E+01	1.51E+01	0/11	11/11	2/11	1.40E+01	1/11	6.87E+01	0/11	2.06E+03	11/11	11/11	0.082–89.2
METAL	Copper	mg/kg	8.80E+00	2.20E+02	6.12E+01	0/51	50/51	46/51	1.90E+01	0/51	9.34E+03	0/51	1.00E+05	0/51	29/51	0.1–44.6
METAL	Iron	mg/kg	6.84E+03	8.51E+04	2.67E+04	0/51	51/51	15/51	2.80E+04	0/51	1.00E+05	0/51	1.00E+05	51/51	51/51	8.2–179
METAL	Lead	mg/kg	6.80E+00	2.97E+02	8.17E+01	0/58	22/58	13/58	3.60E+01	0/58	8.00E+02	0/58	8.00E+02	0/58	17/58	0.041–20
METAL	Magnesium	mg/kg	6.60E+02	5.70E+03	1.95E+03	0/11	11/11	0/11	7.70E+03	0/11	N/A	0/11	N/A	N/A	N/A	0.1–8920
METAL	Manganese	mg/kg	8.20E+01	1.22E+03	4.53E+02	0/51	51/51	0/51	1.50E+03	0/51	4.72E+03	0/51	1.00E+05	46/51	51/51	0.02–26.8
METAL	Mercury	mg/kg	2.00E-02	1.24E+01	9.35E-01	2/61	17/61	8/61	2.00E-01	0/61	7.01E+01	0/61	2.10E+03	2/61	14/61	0.0083–40
METAL	Molybdenum	mg/kg	4.30E-01	7.80E+01	1.45E+01	0/48	12/48	0/48	N/A	0/48	1.17E+03	0/48	3.51E+04	4/48	12/48	0.082–71.4
METAL	Nickel	mg/kg	9.00E+00	2.03E+02	4.03E+01	0/55	54/55	38/55	2.10E+01	0/55	4.30E+03	0/55	1.00E+05	2/55	54/55	0.1–71.4
METAL	Potassium	mg/kg	2.84E+02	4.77E+02	3.85E+02	0/5	4/5	0/5	1.30E+03	0/5	N/A	0/5	N/A	N/A	N/A	2–8920
METAL	Selenium	mg/kg	3.00E-01	1.36E+01	4.85E+00	0/58	12/58	8/58	8.00E-01	0/58	1.17E+03	0/58	3.51E+04	0/58	12/58	0.082–26.8
METAL	Silicon	mg/kg	2.42E+03	2.42E+03	2.42E+03	0/1	1/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	892–892
METAL	Silver	mg/kg	1.60E-02	1.05E+01	4.03E+00	0/58	10/58	2/58	2.30E+00	0/58	1.17E+03	0/58	3.51E+04	2/58	7/58	0.0082–50
METAL	Sodium	mg/kg	2.90E+01	3.54E+02	1.57E+02	7/11	11/11	1/11	3.20E+02	0/11	N/A	0/11	N/A	N/A	N/A	1–8920
METAL	Thallium	mg/kg	9.50E-02	1.39E+01	1.92E+00	0/14	8/14	3/14	2.10E-01	1/14	2.34E+00	0/14	7.02E+01	1/14	3/14	0.016–19.2
METAL	Uranium	mg/kg	1.90E+00	3.10E+03	3.98E+02	0/55	33/55	32/55	4.90E+00	8/55	6.81E+02	0/55	2.04E+04	8/55	31/55	0.0082–892
METAL	Vanadium	mg/kg	1.42E+01	1.95E+02	1.15E+02	0/51	50/51	45/51	3.80E+01	0/51	1.15E+03	0/51	3.45E+04	0/51	50/51	0.082–35.7
METAL	Zinc	mg/kg	3.42E+01	8.00E+02	1.30E+02	0/50	50/50	42/50	6.50E+01	0/50	7.01E+04	0/50	1.00E+05	0/50	49/50	0.09–35.7
PPCB	PCB, Total	mg/kg	3.10E-02	1.90E+00	4.18E-01	3/86	20/86	0/86	N/A	11/86	3.05E-01	0/86	3.05E+01	0/86	18/86	0.018–1
SVOA	1,2,4-Trichlorobenzene	mg/kg	3.90E-03	3.90E-03	3.90E-03	1/10	1/10	0/10	N/A	0/10	N/A	0/10	N/A	N/A	N/A	0.0067–0.73
SVOA	1,2-Dichlorobenzene	mg/kg	2.60E-03	2.60E-03	2.60E-03	1/10	1/10	0/10	N/A	0/10	N/A	0/10	N/A	N/A	N/A	0.0067–0.73
SVOA	1,3-Dichlorobenzene	mg/kg	2.80E-03	2.80E-03	2.80E-03	1/10	1/10	0/10	N/A	0/10	N/A	0/10	N/A	N/A	N/A	0.0067–0.73
SVOA	1,4-Dichlorobenzene	mg/kg	3.70E-03	3.70E-03	3.70E-03	1/10	1/10	0/10	N/A	0/10	N/A	0/10	N/A	N/A	N/A	0.0067–0.73
SVOA	2,4,5-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.36–0.73
SVOA	2,4,6-Tribromophenol	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.709–0.715
SVOA	2,4,6-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.36–0.73
SVOA	2,4-Dichlorophenol	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.36–0.73
SVOA	2,4-Dimethylphenol	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.36–0.73
SVOA	2,4-Dinitrophenol	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.709–3.6
SVOA	2,4-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.22–0.73
SVOA	2,6-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.22–0.73
SVOA	2-Chloronaphthalene	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.36–0.73
SVOA	2-Chlorophenol	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.36–0.73
SVOA	2-Fluoro-1,1'-biphenyl	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.709–0.715
SVOA	2-Fluorophenol	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.709–0.715
SVOA	2-Methyl-4,6-dinitrophenol	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.709–3.6
SVOA	2-Methylnaphthalene	mg/kg	1.10E+00	1.10E+00	1.10E+00	0/8	1/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.36–0.73
SVOA	2-Methylphenol	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.36–0.73
SVOA	2-Nitrobenzenamine	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	2.91E+02	0/8	8.73E+03	0/8	0/8	0.709–3.6
SVOA	2-Nitrophenol	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.36–0.73
SVOA	3,3'-Dichlorobenzidine	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.22–1.4
SVOA	3-Nitrobenzenamine	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.709–3.6
SVOA	4-Bromophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.36–0.73
SVOA	4-Chloro-3-methylphenol	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.36–1.4

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.3.1. Surface Soil Data Summary: SWMU 26 (Continued)

			Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
Type	Analysis	Unit	Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
SVOA	4-Chlorobenzenamine	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.36–1.4
SVOA	4-Chlorophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.36–0.73
SVOA	4-Methylphenol	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.709–0.73
SVOA	4-Nitrophenol	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.709–3.6
SVOA	Acenaphthene	mg/kg	5.00E-02	5.00E-02	5.00E-02	1/12	1/12	0/12	N/A	0/12	1.40E+03	0/12	4.20E+04	0/12	0/12	0.04–0.73
SVOA	Acenaphthylene	mg/kg	N/A	N/A	N/A	0/12	0/12	0/12	N/A	0/12	1.40E+03	0/12	4.20E+04	N/A	N/A	0.04–0.73
SVOA	Aniline	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.709–0.715
SVOA	Anthracene	mg/kg	1.60E-01	1.60E-01	1.60E-01	1/12	1/12	0/12	N/A	0/12	6.99E+03	0/12	2.10E+05	0/12	0/12	0.04–0.73
SVOA	Benzenemethanol	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.36–1.4
SVOA	Benzidine	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.709–0.715
SVOA	Benzo(ghi)perylene	mg/kg	1.30E-01	1.80E-01	1.55E-01	3/12	3/12	0/12	N/A	0/12	N/A	0/12	N/A	N/A	N/A	0.04–0.73
SVOA	Benzoic acid	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.709–3.6
SVOA	Bis(2-chloroethoxy)methane	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.36–0.73
SVOA	Bis(2-chloroethyl) ether	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.36–0.73
SVOA	Bis(2-chloroisopropyl) ether	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.36–0.73
SVOA	Bis(2-ethylhexyl)phthalate	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	5.88E+01	0/8	5.88E+03	0/8	0/8	0.36–0.73
SVOA	Butyl benzyl phthalate	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.36–0.73
SVOA	Carbazole	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	4.12E+01	0/2	4.12E+03	0/2	0/2	0.709–0.715
SVOA	Dibenzofuran	mg/kg	3.00E-01	3.00E-01	3.00E-01	1/8	1/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.36–0.73
SVOA	Diethyl phthalate	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.36–0.73
SVOA	Dimethyl phthalate	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.36–0.73
SVOA	Di-n-butyl phthalate	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.36–0.73
SVOA	Di-n-octylphthalate	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.36–0.73
SVOA	Diphenyldiazene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.709–0.715
SVOA	Fluoranthene	mg/kg	4.00E-02	8.40E-01	4.36E-01	3/12	6/12	0/12	N/A	0/12	9.32E+02	0/12	2.80E+04	0/12	0/12	0.04–0.73
SVOA	Fluorene	mg/kg	5.00E-02	5.00E-02	5.00E-02	1/12	1/12	0/12	N/A	0/12	9.32E+02	0/12	2.80E+04	0/12	0/12	0.04–0.73
SVOA	Hexachlorobenzene	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	5.15E-01	0/8	5.15E+01	0/8	0/8	0.0036–0.73
SVOA	Hexachlorobutadiene	mg/kg	N/A	N/A	N/A	0/10	0/10	0/10	N/A	0/10	N/A	0/10	N/A	N/A	N/A	0.0067–0.73
SVOA	Hexachlorocyclopentadiene	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.36–0.73
SVOA	Hexachloroethane	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.36–0.73
SVOA	Isophorone	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.36–0.73
SVOA	m,p-cresol	mg/kg	N/A	N/A	N/A	0/6	0/6	0/6	N/A	0/6	N/A	0/6	N/A	N/A	N/A	0.36–0.42
SVOA	Naphthalene	mg/kg	4.80E-03	7.20E-01	3.62E-01	1/13	2/13	0/13	N/A	0/13	1.67E+01	0/13	1.61E+03	1/13	2/13	0.0067–0.73
SVOA	Nitrobenzene	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.36–0.73
SVOA	Nitrobenzene-d5	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.709–0.715
SVOA	N-Nitrosodimethylamine	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.709–0.715
SVOA	N-Nitroso-di-n-propylamine	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	1.18E-01	0/8	1.18E+01	0/8	0/8	0.36–0.73
SVOA	N-Nitrosodiphenylamine	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.36–0.73
SVOA	PAH, Total	mg/kg	1.09E-01	9.62E+00	1.59E+00	0/11	6/11	0/11	N/A	6/11	8.94E-02	1/11	8.94E+00	0/11	4/11	–
SVOA	Pentachlorophenol	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	8.91E-01	0/8	8.91E+01	N/A	N/A	0.65–3.6
SVOA	Phenanthrene	mg/kg	1.70E-01	7.90E-01	5.04E-01	6/12	6/12	0/12	N/A	0/12	1.40E+03	0/12	4.20E+04	2/12	6/12	0.04–0.73
SVOA	Phenol	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.36–0.73
SVOA	Phenol-d5	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.709–0.715
SVOA	p-Nitroaniline	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.709–3.6
SVOA	p-Terphenyl-d14	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.709–0.715
SVOA	Pyrene	mg/kg	2.30E-01	7.10E-01	5.17E-01	2/12	5/12	0/12	N/A	0/12	6.99E+02	0/12	2.10E+04	0/12	0/12	0.04–0.73
SVOA	Pyridine	mg/kg	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.36–0.715
VOA	(1,1-Dimethylethyl)benzene	mg/kg	1.00E-03	1.00E-03	1.00E-03	1/2	1/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	(1-Methylpropyl)benzene	mg/kg	1.40E-03	1.40E-03	1.40E-03	1/2	1/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	1,1,1,2-Tetrachloroethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	1,1,1-Trichloroethane	mg/kg	1.20E-03	1.20E-03	1.20E-03	1/6	1/6	0/6	N/A	0/6	3.58E+03	0/6	1.07E+05	0/6	0/6	0.005–0.0089
VOA	1,1,2,2-Tetrachloroethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	1,1,2-Trichloro-1,2,2-trifluoroethane	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	1.69E+04	0/1	5.07E+05	0/1	0/1	0.0067–0.0067

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.3.1. Surface Soil Data Summary: SWMU 26 (Continued)

			Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
Type	Analysis	Unit	Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
VOA	1,1,2-Trichloroethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	6.32E-01	0/2	1.90E+01	0/2	0/2	0.0067–0.0089
VOA	1,1-Dichloroethane	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	1.58E+01	0/4	1.58E+03	0/4	0/4	0.0067–0.0089
VOA	1,1-Dichloroethene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	1.00E+02	0/4	3.00E+03	0/4	0/4	0.0067–0.0089
VOA	1,1-Dichloropropene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	1,2,3-Trichlorobenzene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	1,2,3-Trichloropropane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	1,2,4-Trimethylbenzene	mg/kg	2.30E-03	2.30E-03	2.30E-03	1/2	1/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	1,2-Dibromo-3-chloropropane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.013–0.018
VOA	1,2-Dibromoethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	1,2-Dichloroethane	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	2.09E+00	0/4	2.09E+02	0/4	0/4	0.0067–0.0089
VOA	1,2-Dichloroethene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	2.10E+03	0/1	6.30E+04	0/1	0/1	0.013–0.013
VOA	1,2-Dichloropropane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	1,2-Dimethylbenzene	mg/kg	8.60E-04	8.60E-04	8.60E-04	1/2	1/2	0/2	N/A	0/2	2.81E+02	0/2	8.43E+03	0/2	0/2	0.0067–0.0089
VOA	1,3,5-Trimethylbenzene	mg/kg	1.80E-03	1.80E-03	1.80E-03	1/2	1/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	1,3-Dichloropropane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	1-Chloro-4-methylbenzene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	1-Methyl-4-(1-methylethyl)benzene	mg/kg	1.90E-03	1.90E-03	1.90E-03	1/2	1/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	2,2-Dichloropropane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	2-Butanone	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.027–0.036
VOA	2-Chloro-1,3-butadiene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	2-Hexanone	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.027–0.036
VOA	2-Methoxy-2-methylpropane	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.0067–0.0067
VOA	2-Nitropropane	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.013–0.013
VOA	4-Methyl-2-pentanone	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.027–0.027
VOA	Acetone	mg/kg	5.50E-03	5.50E-03	5.50E-03	1/4	1/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.027–0.036
VOA	Acetonitrile	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.067–0.089
VOA	Acrolein	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.067–0.089
VOA	Acrylonitrile	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	1.24E+00	0/2	1.24E+02	0/2	0/2	0.067–0.089
VOA	Allyl chloride	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.013–0.018
VOA	Benzene	mg/kg	6.30E-04	6.30E-04	6.30E-04	1/4	1/4	0/4	N/A	0/4	5.31E+00	0/4	5.31E+02	0/4	0/4	0.0067–0.0089
VOA	Bromobenzene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	Bromochloromethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	Bromodichloromethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	1.30E+00	0/2	1.30E+02	0/2	0/2	0.0067–0.0089
VOA	Bromoform	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	Bromomethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.013–0.018
VOA	Butylbenzene	mg/kg	2.10E-03	2.10E-03	2.10E-03	1/2	1/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	Carbon disulfide	mg/kg	9.80E-04	9.80E-04	9.80E-04	1/2	1/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	Carbon tetrachloride	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	2.96E+00	0/4	2.96E+02	0/4	0/4	0.0067–0.0089
VOA	Chlorobenzene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.0067–0.0089
VOA	Chloroethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.013–0.018
VOA	Chloroform	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	1.39E+00	0/4	1.39E+02	0/4	0/4	0.0067–0.0089
VOA	Chloromethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.013–0.018
VOA	*cis-1,2-Dichloroethene*	mg/kg	3.10E-04	3.10E-04	3.10E-04	1/2	1/2	0/2	N/A	0/2	4.67E+02	0/2	1.40E+04	0/2	0/2	0.0067–0.0089
VOA	*cis*-1,3-Dichloropropene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	Cumene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	Cyclohexanone	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.13–0.13
VOA	Dibromochloromethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	Dibromomethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	Dichlorodifluoromethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	3.68E+01	0/2	1.10E+03	0/2	0/2	0.013–0.018
VOA	Diethyl ether	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.013–0.013
VOA	Ethyl cyanide	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.033–0.045
VOA	Ethyl methacrylate	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	Ethylbenzene	mg/kg	1.00E-03	1.00E-03	1.00E-03	1/4	1/4	0/4	N/A	0/4	2.66E+01	0/4	2.66E+03	0/4	0/4	0.0067–0.0089

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.3.1. Surface Soil Data Summary: SWMU 26 (Continued)

Type	Analysis	Unit	Detected Results Min	Detected Results Max	Detected Results Avg	J-qualified FOD	FOD	Provisional Background FOE	Provisional Background Bkgd	Industrial Worker FOE	Industrial Worker NAL	Industrial Worker FOE	Industrial Worker AL	GW Protection Screen RGA	GW Protection Screen UCRS	DL Range
VOA	Hexane	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.013–0.013
VOA	Iodomethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	Isobutanol	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.27–0.36
VOA	m,p-Xylene	mg/kg	1.90E-03	1.90E-03	1.90E-03	1/2	1/2	0/2	N/A	0/2	2.54E+02	0/2	7.62E+03	0/2	0/2	0.0067–0.0089
VOA	Methacrylonitrile	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.033–0.045
VOA	Methyl methacrylate	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	Methylene chloride	mg/kg	6.20E-02	6.20E-02	6.20E-02	0/4	1/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.0067–0.0089
VOA	o-Chlorotoluene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	Pentachloroethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	Propylbenzene	mg/kg	2.00E-03	2.00E-03	2.00E-03	1/2	1/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	Styrene	mg/kg	9.90E-04	9.90E-04	9.90E-04	1/2	1/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	Tetrachloroethene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	4.00E+01	0/4	1.20E+03	N/A	N/A	0.0067–0.0089
VOA	Tetrahydrofuran	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.033–0.033
VOA	Toluene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	6.25E+03	0/4	1.88E+05	0/4	0/4	0.0067–0.0089
VOA	Total Xylene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	2.54E+02	0/2	7.62E+03	0/2	0/2	–
VOA	*trans*-1,2-Dichloroethene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	6.51E+01	0/2	1.95E+03	0/2	0/2	0.0067–0.0089
VOA	*trans*-1,3-Dichloropropene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	*trans*-1,4-Dichloro-2-butene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.013–0.018
VOA	Trichloroethene	mg/kg	3.40E-03	3.40E-03	3.40E-03	1/6	1/6	0/6	N/A	0/6	1.90E+00	0/6	5.70E+01	0/6	1/6	0.005–0.0089
VOA	Trichlorofluoromethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	Vinyl acetate	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0067–0.0089
VOA	Vinyl chloride	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	2.06E+00	0/2	2.06E+02	0/2	0/2	0.0067–0.0089
RADS	Actinium-228	pCi/g	2.62E-01	1.69E+00	7.44E-01	0/4	4/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.09168–0.66
RADS	Americium-241	pCi/g	1.10E-01	2.93E+00	1.12E+00	0/19	7/19	0/19	N/A	0/19	5.99E+00	0/19	5.99E+02	0/19	4/19	0.03–0.38
RADS	Antimony-124	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.02961–0.04193
RADS	Antimony-125	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.08931–0.1162
RADS	Barium-133	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.0413–0.05005
RADS	Barium-140	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.1179–0.203
RADS	Bismuth-211	pCi/g	2.18E+00	2.58E+00	2.41E+00	0/3	3/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.3328–0.4597
RADS	Bismuth-212	pCi/g	1.00E+00	1.00E+00	1.00E+00	0/3	1/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.2616–0.3454
RADS	Bismuth-214	pCi/g	6.87E-01	9.51E-01	7.78E-01	0/3	3/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.06092–0.0856
RADS	Cerium-139	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.04095–0.05126
RADS	Cerium-141	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.08169–0.1151
RADS	Cerium-144	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.3021–0.404
RADS	Cesium-134	pCi/g	N/A	N/A	N/A	0/6	0/6	0/6	N/A	0/6	N/A	0/6	N/A	N/A	N/A	0.01–0.04
RADS	Cesium-136	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.02793–0.063
RADS	Cesium-137	pCi/g	2.94E-02	1.12E+01	1.96E+00	0/19	17/19	6/19	4.90E-01	14/19	1.02E-01	1/19	1.02E+01	0/19	6/19	0.01–0.22
RADS	Chromium-51	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.2659–0.3394
RADS	Cobalt-56	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.02778–0.03782
RADS	Cobalt-57	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.03865–0.05348
RADS	Cobalt-58	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.02568–0.0429
RADS	Cobalt-60	pCi/g	N/A	N/A	N/A	0/8	0/8	0/8	N/A	0/8	N/A	0/8	N/A	N/A	N/A	0.01–0.03643
RADS	Europium-152	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.09796–0.1118
RADS	Europium-154	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.07981–0.1123
RADS	Europium-155	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.1919–0.2574

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.3.1. Surface Soil Data Summary: SWMU 26 (Continued)

			Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
Type	Analysis	Unit	Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
RADS	Iridium-192	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.03178–0.03724
RADS	Iron-59	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.03904–0.07771
RADS	Lead-210	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	4.067–6.47
RADS	Lead-211	pCi/g	4.25E-01	2.58E+00	1.73E+00	0/3	3/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.2099–0.4597
RADS	Lead-212	pCi/g	1.85E-01	1.88E+00	7.54E-01	0/4	4/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.06459–0.44
RADS	Lead-214	pCi/g	7.31E-01	2.60E+00	1.28E+00	0/4	4/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.06593–0.28
RADS	Manganese-54	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.02718–0.04443
RADS	Mercury-203	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.03791–0.04318
RADS	Neodymium-147	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.2782–0.6208
RADS	Neptunium-237	pCi/g	5.20E-02	4.10E+00	1.43E+00	1/19	12/19	10/19	1.00E-01	7/19	2.29E-01	0/19	2.29E+01	2/19	11/19	0.01–0.13
RADS	Neptunium-239	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.3288–0.9697
RADS	Niobium-94	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.02464–0.03852
RADS	Niobium-95	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.08486–0.1072
RADS	Plutonium-238	pCi/g	3.85E-02	3.90E-01	3.04E-01	0/16	4/16	3/16	7.30E-02	0/16	2.87E+01	0/16	2.87E+03	0/16	3/16	0.0061–0.31
RADS	Plutonium-239/240	pCi/g	1.01E-01	1.59E+01	3.79E+00	1/19	12/19	12/19	2.50E-02	0/19	2.47E+01	0/19	2.47E+03	1/19	9/19	0.00518–0.2
RADS	Potassium-40	pCi/g	2.11E+00	1.37E+01	6.68E+00	0/4	4/4	0/4	1.60E+01	0/4	N/A	0/4	N/A	N/A	N/A	0.176–1.9
RADS	Promethium-146	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.04395–0.05754
RADS	Protactinium-231	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.7811–1.265
RADS	Protactinium-233	pCi/g	4.76E-01	1.06E+00	7.00E-01	0/3	3/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.07367–0.09136
RADS	Protactinium-234m	pCi/g	7.90E+01	1.82E+02	1.33E+02	0/4	4/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	1.38–25
RADS	Radium-223	pCi/g	3.17E-01	6.29E-01	4.98E-01	0/3	3/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.212–0.2465
RADS	Radium-226	pCi/g	8.44E-01	8.98E-01	8.69E-01	0/3	3/3	0/3	1.50E+00	0/3	N/A	0/3	N/A	N/A	N/A	0.116–0.1593
RADS	Radium-228	pCi/g	1.48E-01	1.69E+00	7.68E-01	0/4	4/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.08142–0.66
RADS	Radon-219	pCi/g	3.37E-01	7.54E-01	5.60E-01	0/3	3/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.2734–0.3385
RADS	Ruthenium-106	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.2797–0.3824
RADS	Silver-110m	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.02968–0.04186
RADS	Sodium-22	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.01849–0.0397
RADS	Strontium-90	pCi/g	3.60E+00	7.00E+00	5.30E+00	0/3	2/3	1/3	4.70E+00	0/3	N/A	0/3	N/A	N/A	N/A	0.82–1.1
RADS	Technetium-99	pCi/g	1.00E+00	1.87E+03	2.64E+02	0/19	14/19	13/19	2.50E+00	2/19	1.20E+03	0/19	1.20E+05	14/19	14/19	0.5–4.25
RADS	Thallium-208	pCi/g	7.64E-02	8.20E-01	3.35E-01	0/4	4/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.04382–0.16
RADS	Thorium-227	pCi/g	2.89E-01	4.51E-01	3.70E-01	0/3	2/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.2605–0.2951
RADS	Thorium-228	pCi/g	2.78E-01	1.81E+00	6.74E-01	0/16	12/16	1/16	1.60E+00	0/16	N/A	0/16	N/A	N/A	N/A	0.053–1.6
RADS	Thorium-229	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.1601–0.2097
RADS	Thorium-230	pCi/g	5.81E-01	1.11E+02	1.22E+01	0/19	17/19	11/19	1.50E+00	1/19	3.39E+01	0/19	3.39E+03	1/19	8/19	0.05–1
RADS	Thorium-232	pCi/g	1.96E-01	2.03E+00	7.29E-01	0/16	14/16	1/16	1.50E+00	0/16	N/A	0/16	N/A	N/A	N/A	0.0163–0.82
RADS	Thorium-234	pCi/g	7.48E+00	3.14E+02	1.19E+02	0/7	7/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.65–5
RADS	Tin-113	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.04015–0.05153
RADS	Uranium-234	pCi/g	2.00E-01	4.37E+02	4.67E+01	0/19	19/19	14/19	1.20E+00	4/19	5.53E+01	0/19	5.53E+03	11/19	19/19	0.01–1.14
RADS	Uranium-235	pCi/g	2.70E-02	3.19E+01	2.92E+00	0/19	18/19	16/19	6.00E-02	9/19	3.40E-01	0/19	3.40E+01	4/19	16/19	0.00407–2
RADS	Uranium-238	pCi/g	7.90E-01	1.04E+03	1.15E+02	0/19	19/19	17/19	1.20E+00	17/19	1.60E+00	3/19	1.60E+02	14/19	19/19	0.00328–5
RADS	Yttrium-88	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.01626–0.03816
RADS	Zinc-65	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.03804–0.08077
RADS	Zirconium-95	pCi/g	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.08371–0.1015

One or more samples exceed AL value
One or more samples exceed NAL value
One or more samples exceed background value
One or more samples exceed SSLs of RGA and UCRS groundwater protection

Counts of analyses are based on the maximum detected result from a sample (i.e., if a sample has analytical results from two different labs, only the maximum value is counted).

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.3.1. Surface Soil Data Summary: SWMU 26 (Continued)

Type	Analysis	Unit	Detected Results			J-qualified	FOD	Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		DL Range
			Min	Max	Avg	FOD		FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	

Field replicates, or separate samples are counted independently.

The uranium (metal)/uranium (isotopic) may not be from the same sample thus a correlation between uranium (metal)/uranium (isotopic) data may not be possible.
Uranium-238 that was analyzed using method RL-7128NITRIC is compared to a background value of 0.4 pCi/g for surface and subsurface.

Screening values are shown in Appendices C and D.

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

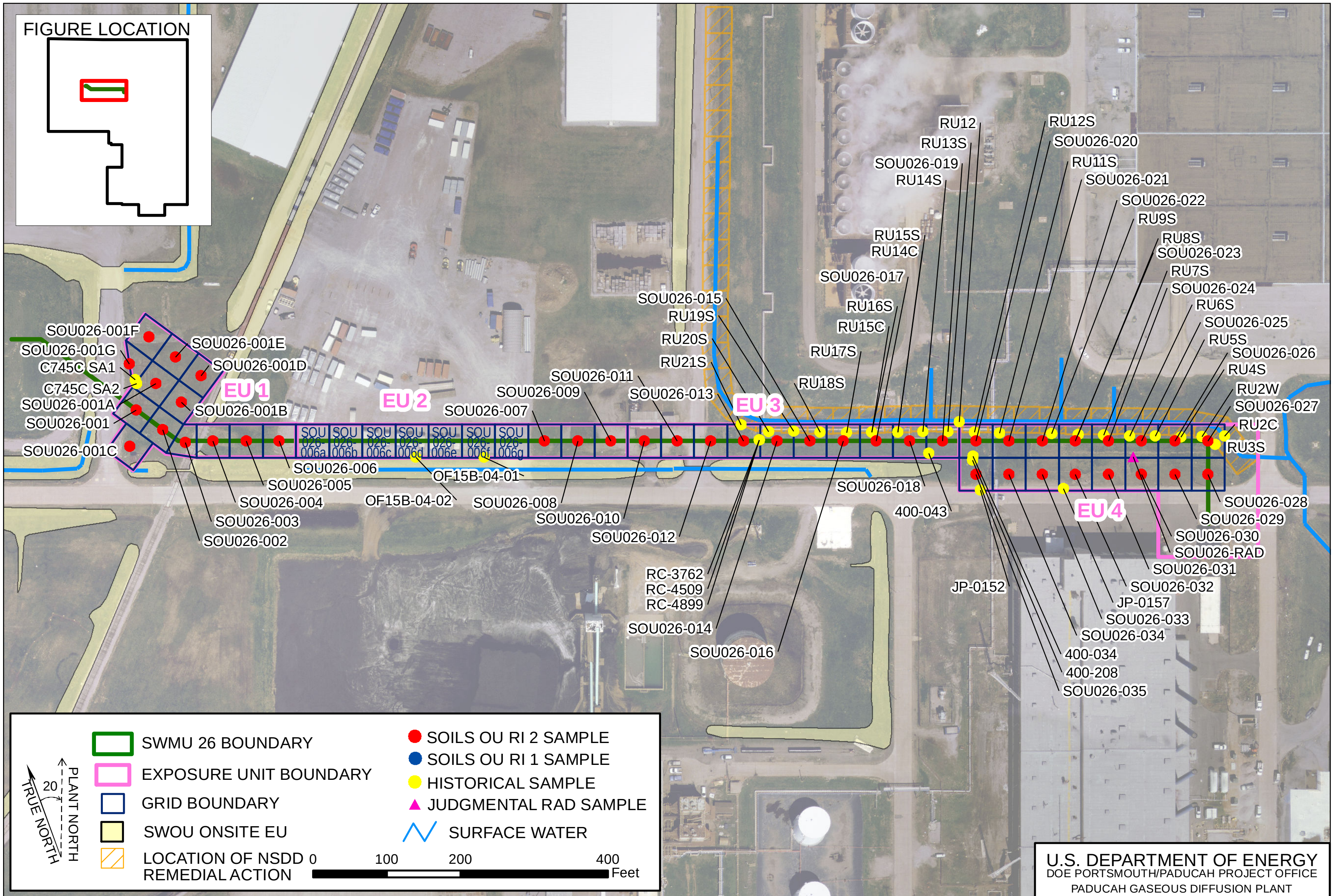

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Figure 5.3.2. SWMU 26 Sample Locations—Surface Soil

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3/12/2015

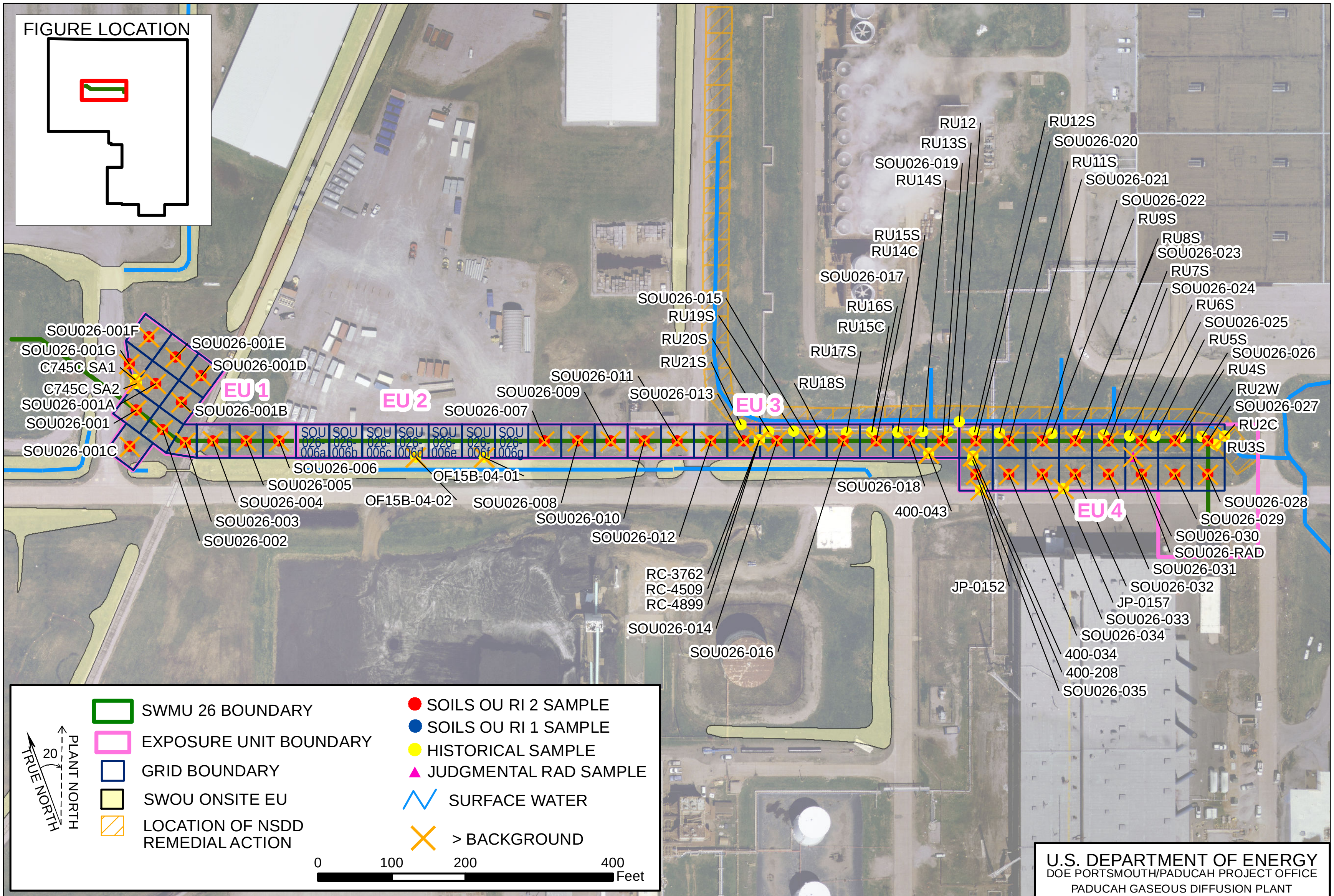

Figure 5.3.3. SWMU 26 Background Exceedances—Surface Soil

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400-034	Antimony (0.6 mg/kg) Beryllium (0.69 mg/kg) Cadmium (0.3 mg/kg) Chromium (27.2 mg/kg) Neptunium-237 (0.6 pCi/g) Plutonium-239/240 (0.4 pCi/g) Technetium-99 (17 pCi/g) Thorium-230 (1.6 pCi/g) Uranium-234 (3.1 pCi/g) Uranium-235 (0.2 pCi/g) Uranium-238 (4.6 pCi/g)
400-043	Antimony (1.4 mg/kg) Thallium (0.6 mg/kg) Plutonium-239/240 (0.2 pCi/g) Technetium-99 (3.1 pCi/g) Thorium-230 (1.6 pCi/g) Uranium-234 (1.7 pCi/g) Uranium-238 (2.7 pCi/g)
C745C SA1	Uranium-238 (1.68 pCi/g)
C745C SA2	Uranium-234 (12.2 pCi/g) Uranium-235 (1.96 pCi/g) Uranium-238 (108 pCi/g)
JP-0152	Chromium (231 mg/kg) Mercury (12.4 mg/kg) Uranium (1173 mg/kg) Neptunium-237 (3.31 pCi/g) Plutonium-238 (0.386 pCi/g) Plutonium-239/240 (7.2 pCi/g) Strontium-90 (7 pCi/g) Technetium-99 (1870 pCi/g) Thorium-230 (29.2 pCi/g) Uranium-234 (139 pCi/g) Uranium-235 (8.8 pCi/g) Uranium-238 (393 pCi/g)
JP-0157	Beryllium (0.79 mg/kg) Chromium (37 mg/kg) Mercury (0.63 mg/kg) Uranium (224 mg/kg) Cesium-137 (1.108 pCi/g) Neptunium-237 (2.058 pCi/g) Plutonium-239/240 (3.77 pCi/g) Technetium-99 (113 pCi/g) Thorium-230 (24 pCi/g) Uranium-234 (63.6 pCi/g) Uranium-235 (2.1 pCi/g) Uranium-238 (108 pCi/g)
OF15B-04-01	Aluminum (34600 mg/kg) Arsenic (81.4 mg/kg) Barium (213 mg/kg) Beryllium (15.7 mg/kg) Cadmium (2.24 mg/kg) Chromium (59.9 mg/kg) Cobalt (90.5 mg/kg) Copper (220 mg/kg) Iron (85100 mg/kg) Lead (39.2 mg/kg) Nickel (188 mg/kg) Selenium (13.6 mg/kg) Sodium (354 mg/kg) Thallium (13.9 mg/kg) Uranium (1050 mg/kg) Vanadium (40.8 mg/kg) Zinc (800 mg/kg) Cesium-137 (11.2 pCi/g) Neptunium-237 (0.26 pCi/g) Plutonium-239/240 (2.1 pCi/g) Technetium-99 (21.9 pCi/g) Thorium-228 (1.81 pCi/g) Thorium-230 (5.42 pCi/g) Thorium-232 (2.03 pCi/g) Uranium-234 (27.5 pCi/g) Uranium-235 (3.3 pCi/g) Uranium-238 (70 pCi/g) Uranium-238 (3.02 pCi/g)
OF15B-04-02	Cadmium (2.5 mg/kg) Copper (26.3 mg/kg) Nickel (25 mg/kg) Uranium (28.6 mg/kg) Zinc (70.4 mg/kg) Cesium-137 (6.41 pCi/g) Neptunium-237 (0.131 pCi/g) Plutonium-239/240 (2.42 pCi/g) Technetium-99 (8.93 pCi/g) Thorium-230 (2.42 pCi/g) Uranium-235 (0.0615 pCi/g) Uranium-238 (2.17 pCi/g)
RC-3762	Arsenic (130.36 mg/kg) Barium (815.02 mg/kg) Chromium (66.62 mg/kg) Lead (51.53 mg/kg) Mercury (0.9 mg/kg) Nickel (37.58 mg/kg) Selenium (12.5 mg/kg) Uranium (24 mg/kg)
RC-4509	Arsenic (25.84 mg/kg) Chromium (39.06 mg/kg) Mercury (0.36 mg/kg) Nickel (31.58 mg/kg) Selenium (5.63 mg/kg) Silver (10.45 mg/kg)
RU2C	Aluminum (13100 mg/kg) Chromium (24.3 mg/kg) Uranium (110 mg/kg) Technetium-99 (38.4 pCi/g) Uranium-234 (3.34 pCi/g) Uranium-235 (0.233 pCi/g) Uranium-238 (3.93 pCi/g)
SOU026-001	Copper (36 mg/kg) Uranium (381 mg/kg) Vanadium (87 mg/kg) Zinc (82 mg/kg)
SOU026-001A	Beryllium (0.94 mg/kg) Chromium (34 mg/kg) Copper (47 mg/kg) Nickel (25 mg/kg) Uranium (409 mg/kg) Vanadium (118 mg/kg) Zinc (78 mg/kg) Uranium-234 (1.7 pCi/g) Uranium-235 (0.154 pCi/g) Uranium-238 (9.19 pCi/g)
SOU026-001B	Copper (43 mg/kg) Uranium (473 mg/kg) Vanadium (125 mg/kg) Zinc (77 mg/kg)
SOU026-001C	Copper (45 mg/kg) Lead (84 mg/kg) Vanadium (120 mg/kg)
SOU026-001D	Copper (31 mg/kg) Iron (37876 mg/kg) Nickel (23 mg/kg) Vanadium (184 mg/kg) Zinc (66 mg/kg)
SOU026-001E	Copper (35 mg/kg) Iron (35316 mg/kg) Vanadium (128 mg/kg)
SOU026-001F	Copper (27 mg/kg) Zinc (79 mg/kg)
SOU026-001G	Copper (32 mg/kg) Nickel (23 mg/kg) Uranium (249 mg/kg) Vanadium (113 mg/kg) Zinc (76 mg/kg)

Figure 5.3.3. SWMU 26 Background Exceedances—Surface Soil (Continued)

SOU026-002	Antimony (0.25 mg/kg) Cadmium (0.91 mg/kg) Copper (49 mg/kg) Nickel (23 mg/kg) Uranium (9.4 mg/kg) Vanadium (117 mg/kg) Zinc (128 mg/kg) Uranium-235 (0.0665 pCi/g) Uranium-238 (2.24 pCi/g)
SOU026-003	Copper (36 mg/kg) Vanadium (119 mg/kg) Zinc (98 mg/kg)
SOU026-004	Copper (43 mg/kg) Iron (29397 mg/kg) Nickel (30 mg/kg) Uranium (121 mg/kg) Vanadium (136 mg/kg) Zinc (83 mg/kg)
SOU026-005	Copper (44 mg/kg) Vanadium (121 mg/kg)
SOU026-006	Copper (48 mg/kg) Nickel (23 mg/kg) Vanadium (100 mg/kg) Zinc (84 mg/kg)
SOU026-007	Copper (43 mg/kg) Selenium (0.82 mg/kg) Vanadium (143 mg/kg) Uranium-235 (0.0896 pCi/g)
SOU026-008	Copper (34 mg/kg) Vanadium (121 mg/kg)
SOU026-009	Copper (40 mg/kg) Iron (41656 mg/kg) Vanadium (141 mg/kg)
SOU026-010	Copper (55 mg/kg) Iron (39058 mg/kg) Nickel (24 mg/kg) Uranium (97 mg/kg) Vanadium (96 mg/kg) Zinc (121 mg/kg)
SOU026-011	Copper (114 mg/kg) Iron (34845 mg/kg) Lead (119 mg/kg) Nickel (59 mg/kg) Vanadium (60 mg/kg) Zinc (209 mg/kg)
SOU026-012	Copper (201 mg/kg) Iron (44804 mg/kg) Nickel (82 mg/kg) Vanadium (133 mg/kg) Zinc (170 mg/kg)
SOU026-013	Antimony (0.81 mg/kg) Arsenic (23 mg/kg) Barium (210 mg/kg) Beryllium (2.1 mg/kg) Cadmium (0.87 mg/kg) Chromium (55 mg/kg) Copper (95 mg/kg) Iron (35120 mg/kg) Lead (186 mg/kg) Nickel (104 mg/kg) Selenium (5 mg/kg) Thallium (0.34 mg/kg) Uranium (208 mg/kg) Vanadium (195 mg/kg) Zinc (179 mg/kg) Cesium-137 (5.43 pCi/g) Neptunium-237 (0.524 pCi/g) Plutonium-239/240 (1.34 pCi/g) Technetium-99 (24.8 pCi/g) Thorium-230 (4 pCi/g) Uranium-234 (6.91 pCi/g) Uranium-235 (0.438 pCi/g) Uranium-238 (9.45 pCi/g)
SOU026-014	Copper (59 mg/kg) Nickel (43 mg/kg) Vanadium (153 mg/kg) Zinc (145 mg/kg)
SOU026-015	Copper (73 mg/kg) Nickel (52 mg/kg) Uranium (194 mg/kg) Vanadium (110 mg/kg) Zinc (107 mg/kg)
SOU026-016	Copper (61 mg/kg) Nickel (37 mg/kg) Uranium (214 mg/kg) Vanadium (113 mg/kg) Zinc (96 mg/kg)
SOU026-017	Copper (51 mg/kg) Nickel (46 mg/kg) Vanadium (115 mg/kg) Zinc (96 mg/kg)
SOU026-018	Copper (56 mg/kg) Nickel (36 mg/kg) Vanadium (101 mg/kg) Zinc (79 mg/kg)
SOU026-019	Copper (50 mg/kg) Vanadium (148 mg/kg) Zinc (105 mg/kg)
SOU026-020	Copper (45 mg/kg) Nickel (30 mg/kg) Vanadium (138 mg/kg) Zinc (87 mg/kg)
SOU026-021	Nickel (27 mg/kg) Vanadium (146 mg/kg) Zinc (105 mg/kg)
SOU026-022	Copper (56 mg/kg) Iron (28683 mg/kg) Nickel (32 mg/kg) Uranium (126 mg/kg) Vanadium (153 mg/kg) Zinc (103 mg/kg)
SOU026-023	Copper (48 mg/kg) Nickel (24 mg/kg) Uranium (108 mg/kg) Vanadium (142 mg/kg) Zinc (95 mg/kg)
SOU026-024	Chromium (20 mg/kg) Copper (51 mg/kg) Mercury (0.28 mg/kg) Nickel (26 mg/kg) Selenium (0.85 mg/kg) Uranium (293 mg/kg) Vanadium (138 mg/kg) Zinc (105 mg/kg) Neptunium-237 (0.154 pCi/g) Plutonium-239/240 (0.102 pCi/g) Technetium-99 (7.52 pCi/g) Thorium-230 (1.56 pCi/g) Uranium-234 (7.66 pCi/g) Uranium-235 (0.491 pCi/g) Uranium-238 (11.8 pCi/g)
SOU026-025	Copper (46 mg/kg) Nickel (30 mg/kg) Vanadium (143 mg/kg) Zinc (90 mg/kg)
SOU026-026	Copper (44 mg/kg) Nickel (22 mg/kg) Vanadium (128 mg/kg) Zinc (80 mg/kg)

Figure 5.3.3. SWMU 26 Background Exceedances—Surface Soil (Continued)

SOU026-027	Chromium (80 mg/kg) Copper (80 mg/kg) Nickel (81 mg/kg) Vanadium (131 mg/kg) Zinc (74 mg/kg)
SOU026-028	Chromium (88 mg/kg) Copper (187 mg/kg) Lead (244 mg/kg) Nickel (203 mg/kg) Uranium (1102 mg/kg) Vanadium (98 mg/kg) Zinc (178 mg/kg)
SOU026-029	Copper (87 mg/kg) Iron (28508 mg/kg) Lead (209 mg/kg) Nickel (54 mg/kg) Uranium (618 mg/kg) Vanadium (133 mg/kg) Zinc (198 mg/kg)
SOU026-030	Copper (88 mg/kg) Lead (234 mg/kg) Nickel (89 mg/kg) Uranium (997 mg/kg) Vanadium (107 mg/kg) Zinc (284 mg/kg)
SOU026-031	Chromium (113 mg/kg) Copper (119 mg/kg) Iron (33738 mg/kg) Lead (297 mg/kg) Nickel (113 mg/kg) Uranium (1551 mg/kg) Vanadium (139 mg/kg) Zinc (463 mg/kg)
SOU026-032	Copper (47 mg/kg) Iron (28742 mg/kg) Vanadium (150 mg/kg) Zinc (93 mg/kg)
SOU026-033	Arsenic (160 mg/kg) Chromium (91 mg/kg) Copper (76 mg/kg) Iron (32684 mg/kg) Lead (255 mg/kg) Nickel (43 mg/kg) Uranium (1315 mg/kg) Vanadium (161 mg/kg) Zinc (179 mg/kg)
SOU026-034	Copper (129 mg/kg) Lead (132 mg/kg) Nickel (61 mg/kg) Uranium (140 mg/kg) Vanadium (131 mg/kg) Zinc (216 mg/kg)
SOU026-035	Copper (94 mg/kg) Nickel (40 mg/kg) Vanadium (116 mg/kg) Zinc (324 mg/kg)
SOU026-RAD	Uranium (3100 mg/kg) Cesium-137 (1.69 pCi/g) Neptunium-237 (4.1 pCi/g) Plutonium-238 (0.39 pCi/g) Plutonium-239/240 (15.9 pCi/g) Technetium-99 (186 pCi/g) Thorium-230 (111 pCi/g) Uranium-234 (437 pCi/g) Uranium-235 (31.9 pCi/g) Uranium-238 (1040 pCi/g)

Figure 5.3.3. SWMU 26 Background Exceedances—Surface Soil (Continued)

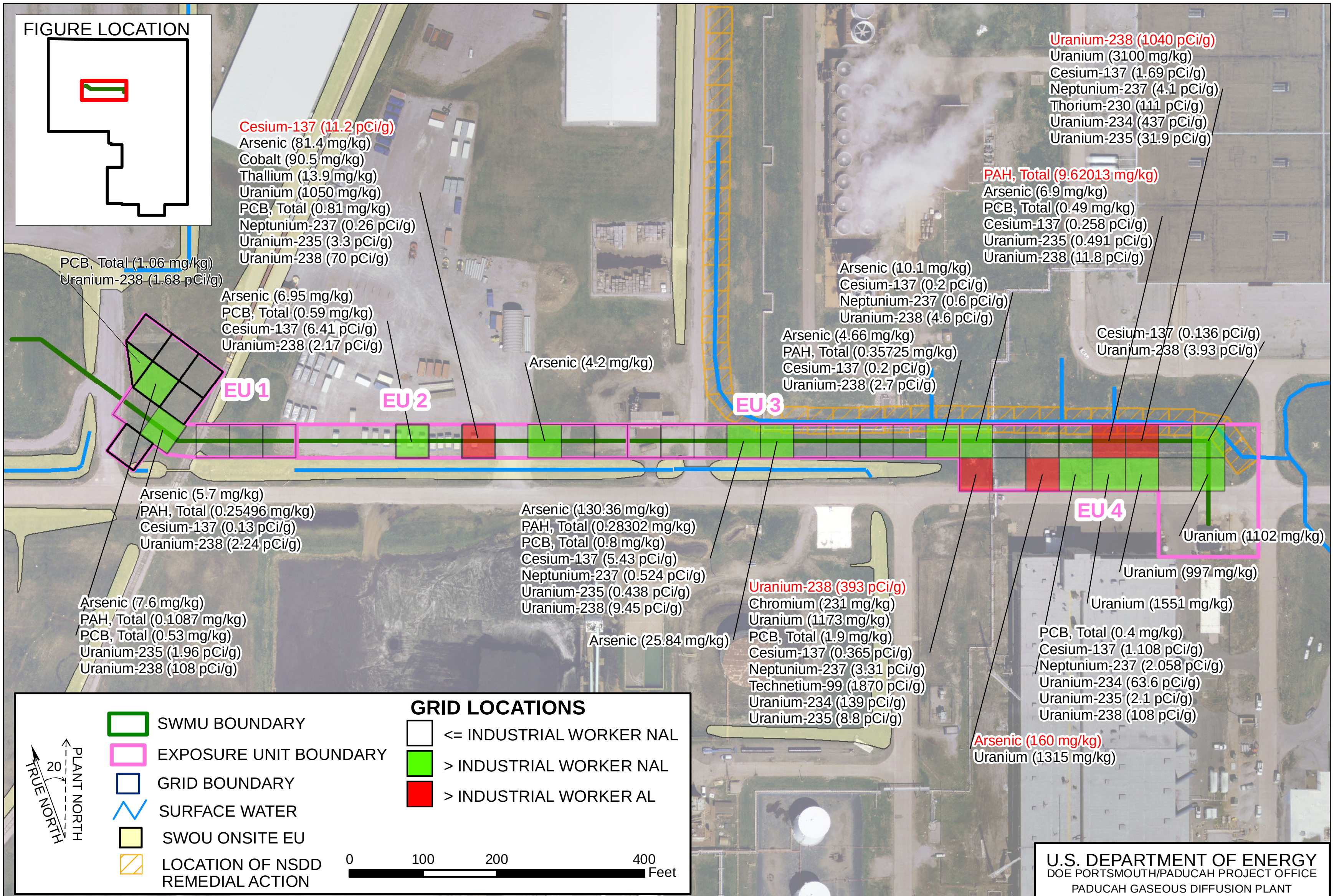

Figure 5.3.4. SWMU 26 NAL Exceedances—Surface Soil

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Metal (continued)	Grid	EU
Uranium	1, 1A, 1B, 1G, 4, 6d, 6f, 10, 13, 15, 16, 22, 23, 24, 25, 27, 28, 29, 30, 31, 32, 33, 34, 35	1, 2, 3, 4
Vanadium	1, 1A, 1B, 1C, 1D, 1E, 1G, 2, 3, 4, 5, 6, 6f, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35	1, 2, 3, 4
Zinc	1, 1A, 1B, 1D, 1F, 1G, 2, 3, 4, 6, 6d, 6f, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35	1, 2, 3, 4

[1] No soil background value is available.

The following were detected above the SSLs for the protection of RGA groundwater and the background screening levels.

Metal	Grid	EU
Arsenic	6f, 13, 14, 33	2, 3, 4
Cobalt	6f	2
Iron	1D, 1E, 4, 6f, 9, 10, 11, 12, 13, 22, 29, 31, 32, 33	1, 2, 3, 4
Mercury	35	4
Molybdenum[1]	16, 19, 31, 33	3, 4
Nickel	6f, 28	2, 4
Silver	13, 14	3
Thallium	6f	2
Uranium	6f, 25, 28, 30, 31, 33, 35	2, 4

[1] No soil background value is available.

PCBs

Total PCBs were detected above the industrial worker NALs in the surface soil in grids 1A and 1G (EU 1), 6d and 6f (EU 2); 13 (EU 3); and 24, 32, and 35 (EU 4). No PCBs were detected above the industrial worker ALs.

Total PCBs were detected in the SWMU 26 surface soil above the SSLs for the protection of UCRS groundwater in grids 1A and 1G (EU 1); 6d and 6f (EU 2); 13 and 14 (EU 3); and 24, 25, 32, and 35 (EU 4). None were detected above SSLs for the protection of RGA groundwater.

SVOCs

Total PAHs were detected above industrial worker NALs in the surface soil in the following grids: 1A and 2 (EU 1), 13 and 19 (EU 3), and 24 (EU 4). Total PAHs are present in grid 24 (EU 4) above the industrial worker AL.

Of the SVOCs, naphthalene [grids 6f (EU 2) and 13 (EU 3)]; phenanthrene [grids 2 (EU 1), 6d (EU 2), 13 and 19 (EU 3), and 24 (EU 4)]; and Total PAHs [grids 2 (EU 1), 13 and 19 (EU 3), and 24 (EU 4)] were detected above the SSLs for the protection of UCRS groundwater. Naphthalene in grid 13 and phenanthrene in grids 13 and 19 were detected above the SSLs for the protection of RGA groundwater.

VOCs

VOCs were not detected above NAL and AL screening levels in SWMU 26 surface soil. TCE was detected above SSLs for the protection of UCRS groundwater in grid 6f (EU 2). No VOCs were detected above the SSLs for the protection of RGA groundwater.

Radionuclides

The following are the radionuclides that were above both the background screening levels and the industrial worker NALs and the grids and EUs in which they were found.

Radionuclide	Grid	EU
Cesium-137	6d, 6f, 13, 25, 32	2–4
Neptunium-237	6f, 13, 20, 25, 32, 35	2–4
Tc-99	35	4
Thorium-230	25	4
Uranium-234	25, 32, 35	4
Uranium-235	1A, 6f, 13, 24, 25, 32, 35	1–4
Uranium-238	1A, 1G, 2, 6d, 6f, 13, 19, 20, 24, 25, 27, 32, 35	1–4

Cesium-137 in grid 6f (EU 2) and uranium-238 in grids 25 and 35 (EU 4) were detected above industrial worker ALs in the SWMU 26 surface soil.

The following were detected above both the background screening levels (if available) and SSLs for the protection of UCRS.

Radioisotope	Grid	EU
Americium-241[1]	25, 32, 35	4
Cesium-137	6d, 6f, 13, 25, 32	2–4
Neptunium-237	6d, 6f, 13, 20, 24, 25, 32, 35	2–4
Plutonium-238	25, 35	4
Plutonium-239/240	6d, 6f, 13, 20, 25, 32, 35	2–4
Tc-99	6d, 6f, 13, 19, 20, 24, 25, 27, 32, 35	2–
Thorium-230	6d, 6f, 13, 25, 32, 35	2–4
Uranium-234	1A, 6f, 13, 19, 20, 24, 25, 27, 32, 35	1–4
Uranium-235	1A, 2, 6d, 6f, 7, 13, 20, 24, 25, 27, 32, 35	1–4
Uranium-238	1A, 1G, 2, 6d, 6f, 13, 19, 20, 24, 25, 27, 32, 35	1–4

[1] No soil background value is available.

Neptunium-237 in grids 25 and 35 (EU 4); plutonium-239/240 in grid 25 (EU 4); Tc-99 in grids 6d and 6f (EU 2); 13 and 19 (EU 3); 20, 24, 25, 27, 32, 35 (EU 4); thorium-230 in grid 25 (EU 4); uranium-234 in grids 6f (EU 2); 13 (EU 3); and 20, 24, 25, 27, 32, 35 (EU 4); uranium-235 in grids 6f (EU 2) and 25 and 35 (EU 4); and uranium-238 in grids 1A (EU 1), 6f (EU 2), 13 and 19 (EU 3), and 20, 24, 25, 27, 32, and 35 (EU 4) were detected above both the background screening levels and the SSLs for the protection of RGA groundwater.

5.3.4 Nature and Extent of Contamination—Subsurface Soils

The representative data set presented in Table 5.3.2 provides the nature of contamination in SWMU 26 subsurface soils, and Figures 5.3.5–5.3.7 illustrate the horizontal extent. A complete list of detailed sampling results, including sampling depths, is provided in Appendix F (samples with ending depths greater than 1 ft bgs are considered subsurface soils in this nature and extent section). Grid numbers shown below are truncated from the figures. Figures contain the SWMU#–grid#, with zeros filling the appropriate spaces to make three digits.

The horizontal and vertical extent of SWMU 26 subsurface soil contamination is considered defined adequately for supporting the BRA and FS. There is some uncertainty with vertical extent; however, this will be addressed in the FS.

Table 5.3.2. Subsurface Soil Data Summary: SWMU 26

			Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
Type	Analysis	Unit	Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
METAL	Aluminum	mg/kg	2.94E+03	1.61E+04	9.53E+03	0/24	24/24	10/24	1.20E+04	0/24	1.00E+05	0/24	1.00E+05	0/24	23/24	5.3–100
METAL	Antimony	mg/kg	3.30E-01	1.57E+02	6.98E+01	0/69	41/69	41/69	2.10E-01	13/69	9.34E+01	0/69	2.80E+03	35/69	41/69	0.39–30
METAL	Arsenic	mg/kg	4.90E-01	1.26E+01	6.31E+00	0/69	35/69	10/69	7.90E+00	34/69	1.41E+00	0/69	1.41E+02	0/69	35/69	0.07–20
METAL	Barium	mg/kg	3.78E+01	6.45E+02	2.81E+02	0/69	67/69	44/69	1.70E+02	0/69	4.04E+04	0/69	1.00E+05	0/69	59/69	0.02–100
METAL	Beryllium	mg/kg	2.00E-01	2.49E+01	1.94E+00	0/24	23/24	6/24	6.90E-01	0/24	4.50E+02	0/24	1.35E+04	0/24	2/24	0.01–0.5
METAL	Cadmium	mg/kg	2.80E-02	2.83E+01	7.87E+00	0/69	20/69	13/69	2.10E-01	0/69	6.12E+01	0/69	1.84E+03	1/69	12/69	0.02–12
METAL	Calcium	mg/kg	7.51E+02	2.30E+05	5.29E+04	0/19	19/19	10/19	6.10E+03	0/19	N/A	0/19	N/A	N/A	N/A	0.1–539
METAL	Chromium	mg/kg	2.00E+00	1.41E+02	3.33E+01	0/69	30/69	3/69	4.30E+01	0/69	1.98E+02	0/69	1.98E+04	0/69	0/69	0.08–85
METAL	Cobalt	mg/kg	3.00E+00	2.36E+01	7.56E+00	0/19	19/19	3/19	1.30E+01	0/19	6.87E+01	0/19	2.06E+03	19/19	19/19	0.09–0.24
METAL	Copper	mg/kg	2.20E+00	9.52E+03	2.50E+02	0/69	29/69	6/69	2.50E+01	1/69	9.34E+03	0/69	1.00E+05	1/69	3/69	0.1–35
METAL	Iron	mg/kg	5.09E+03	5.17E+04	1.33E+04	0/69	69/69	3/69	2.80E+04	0/69	1.00E+05	0/69	1.00E+05	69/69	69/69	5.3–100
METAL	Lead	mg/kg	5.30E+00	8.75E+01	1.31E+01	0/69	60/69	4/69	2.30E+01	0/69	8.00E+02	0/69	8.00E+02	0/69	21/69	0.2–20
METAL	Magnesium	mg/kg	6.19E+02	8.05E+03	2.90E+03	0/19	19/19	5/19	2.10E+03	0/19	N/A	0/19	N/A	N/A	N/A	0.1–59.4
METAL	Manganese	mg/kg	8.09E+01	1.80E+03	3.88E+02	0/69	68/69	6/69	8.20E+02	0/69	4.72E+03	0/69	1.00E+05	57/69	68/69	0.02–85
METAL	Mercury	mg/kg	1.68E-02	1.40E+01	1.22E+00	0/69	14/69	4/69	1.30E-01	0/69	7.01E+01	0/69	2.10E+03	3/69	11/69	0.0089–10
METAL	Molybdenum	mg/kg	5.30E-01	2.01E+01	1.11E+01	0/50	5/50	0/50	N/A	0/50	1.17E+03	0/50	3.51E+04	1/50	5/50	0.53–15
METAL	Nickel	mg/kg	2.70E+00	1.76E+04	4.69E+02	0/69	28/69	11/69	2.20E+01	1/69	4.30E+03	0/69	1.00E+05	3/69	28/69	0.1–100
METAL	Potassium	mg/kg	1.82E+02	1.19E+03	4.70E+02	0/14	14/14	2/14	9.50E+02	0/14	N/A	0/14	N/A	N/A	N/A	2–3
METAL	Selenium	mg/kg	4.20E-01	4.49E+00	1.05E+00	0/69	10/69	7/69	7.00E-01	0/69	1.17E+03	0/69	3.51E+04	0/69	10/69	0.2–20
METAL	Silver	mg/kg	3.70E-02	1.06E+01	1.40E+00	0/69	12/69	3/69	2.70E+00	0/69	1.17E+03	0/69	3.51E+04	2/69	7/69	0.08–10
METAL	Sodium	mg/kg	2.45E+01	1.17E+03	2.69E+02	0/19	19/19	4/19	3.40E+02	0/19	N/A	0/19	N/A	N/A	N/A	1–23.8
METAL	Sulfur	mg/kg	4.00E-01	4.00E-01	4.00E-01	1/1	1/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	–
METAL	Thallium	mg/kg	1.20E-01	4.10E-01	2.06E-01	0/24	7/24	1/24	3.40E-01	0/24	2.34E+00	0/24	7.02E+01	0/24	5/24	0.21–3
METAL	Uranium	mg/kg	2.43E+00	4.81E+02	3.06E+01	0/55	23/55	20/55	4.60E+00	0/55	6.81E+02	0/55	2.04E+04	0/55	8/55	0.03–100
METAL	Vanadium	mg/kg	8.60E+00	7.26E+01	2.31E+01	0/69	24/69	1/69	3.70E+01	0/69	1.15E+03	0/69	3.45E+04	0/69	24/69	0.1–70
METAL	Zinc	mg/kg	4.70E+00	1.81E+02	4.26E+01	0/64	64/64	7/64	6.00E+01	0/64	7.01E+04	0/64	1.00E+05	0/64	30/64	0.09–25
PPCB	4,4'-DDD	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.018–0.021
PPCB	4,4'-DDE	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.018–0.021
PPCB	4,4'-DDT	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.018–0.021
PPCB	Aldrin	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.0091–0.011
PPCB	alpha-BHC	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.0091–0.011
PPCB	alpha-Chlordane	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.091–0.11
PPCB	beta-BHC	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.0091–0.011
PPCB	delta-BHC	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.0091–0.011
PPCB	Dieldrin	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	5.15E-02	0/7	5.15E+00	0/7	0/7	0.018–0.021
PPCB	Endosulfan I	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.0091–0.011
PPCB	Endosulfan II	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.018–0.021
PPCB	Endosulfan sulfate	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.018–0.021
PPCB	Endrin	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.018–0.021
PPCB	Endrin ketone	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.018–0.021
PPCB	gamma-Chlordane	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.091–0.11
PPCB	Heptachlor	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.0091–0.011
PPCB	Heptachlor epoxide	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.0091–0.011
PPCB	Lindane	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.0091–0.011
PPCB	Methoxychlor	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.091–0.11
PPCB	PCB, Total	mg/kg	1.50E-02	1.70E-01	5.89E-02	0/67	5/67	0/67	N/A	0/67	3.05E-01	0/67	3.05E+01	0/67	1/67	0.019–5
PPCB	Toxaphene	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.18–0.21
SVOA	1,2,4-Trichlorobenzene	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.35–0.916
SVOA	1,2-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.35–0.916
SVOA	1,3-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.35–0.916
SVOA	1,4-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.35–0.916
SVOA	2,4,5-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.35–2.200707376 69485
SVOA	2,4,6-Tribromophenol	mg/kg	N/A	N/A	N/A	0/6	0/6	0/6	N/A	0/6	N/A	0/6	N/A	N/A	N/A	0.739–0.916

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.3.2. Subsurface Soil Data Summary: SWMU 26 (Continued)

			Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
Type	Analysis	Unit	Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
SVOA	2,4,6-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.35–0.916
SVOA	2,4-Dichlorophenol	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.35–0.916
SVOA	2,4-Dimethylphenol	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.35–0.916
SVOA	2,4-Dinitrophenol	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.739–4.4
SVOA	2,4-Dinitrotoluene	mg/kg	4.57E-01	4.57E-01	4.57E-01	1/24	1/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.35–0.916
SVOA	2,6-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.35–0.916
SVOA	2-Chloronaphthalene	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.35–0.916
SVOA	2-Chlorophenol	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.35–0.916
SVOA	2-Fluoro-1,1'-biphenyl	mg/kg	N/A	N/A	N/A	0/6	0/6	0/6	N/A	0/6	N/A	0/6	N/A	N/A	N/A	0.739–0.916
SVOA	2-Fluorophenol	mg/kg	N/A	N/A	N/A	0/6	0/6	0/6	N/A	0/6	N/A	0/6	N/A	N/A	N/A	0.739–0.916
SVOA	2-Methyl-4,6-dinitrophenol	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.739–4.4
SVOA	2-Methylnaphthalene	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.35–0.916
SVOA	2-Methylphenol	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.35–0.916
SVOA	2-Nitrobenzenamine	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	2.91E+02	0/24	8.73E+03	0/24	0/24	0.739–4.4
SVOA	2-Nitrophenol	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.35–0.916
SVOA	3,3'-Dichlorobenzidine	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.739–1.9
SVOA	3-Nitrobenzenamine	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.739–4.4
SVOA	4-Bromophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.35–0.916
SVOA	4-Chloro-3-methylphenol	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.35–1.7
SVOA	4-Chlorobenzenamine	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.35–1.7
SVOA	4-Chlorophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.35–0.916
SVOA	4-Methylphenol	mg/kg	N/A	N/A	N/A	0/19	0/19	0/19	N/A	0/19	N/A	0/19	N/A	N/A	N/A	0.38–0.916
SVOA	4-Nitrophenol	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.739–4.4
SVOA	Acenaphthene	mg/kg	4.10E-02	4.10E-02	4.10E-02	1/28	1/28	0/28	N/A	0/28	1.40E+03	0/28	4.20E+04	0/28	0/28	0.35–0.916
SVOA	Acenaphthylene	mg/kg	N/A	N/A	N/A	0/29	0/29	0/29	N/A	0/29	1.40E+03	0/29	4.20E+04	N/A	N/A	0.35–0.916
SVOA	Aniline	mg/kg	N/A	N/A	N/A	0/6	0/6	0/6	N/A	0/6	N/A	0/6	N/A	N/A	N/A	0.739–0.916
SVOA	Anthracene	mg/kg	1.40E-01	1.40E-01	1.40E-01	1/29	1/29	0/29	N/A	0/29	6.99E+03	0/29	2.10E+05	0/29	0/29	0.35–0.916
SVOA	Benzenemethanol	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.35–1.7
SVOA	Benzidine	mg/kg	N/A	N/A	N/A	0/6	0/6	0/6	N/A	0/6	N/A	0/6	N/A	N/A	N/A	0.739–0.916
SVOA	Benzo(ghi)perylene	mg/kg	4.70E-02	1.30E-01	7.58E-02	4/28	4/28	0/28	N/A	0/28	N/A	0/28	N/A	N/A	N/A	0.35–0.916
SVOA	Benzoic acid	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.739–4.4
SVOA	Bis(2-chloroethoxy)methane	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.35–0.916
SVOA	Bis(2-chloroethyl) ether	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.007–0.916
SVOA	Bis(2-chloroisopropyl) ether	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.35–0.916
SVOA	Bis(2-ethylhexyl)phthalate	mg/kg	4.30E-02	5.70E+00	1.40E+00	2/24	6/24	0/24	N/A	0/24	5.88E+01	0/24	5.88E+03	0/24	1/24	0.35–0.916
SVOA	Butyl benzyl phthalate	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.35–0.916
SVOA	Carbazole	mg/kg	N/A	N/A	N/A	0/6	0/6	0/6	N/A	0/6	4.12E+01	0/6	4.12E+03	0/6	0/6	0.739–0.916
SVOA	Cineole	mg/kg	2.40E-02	2.40E-02	2.40E-02	1/1	1/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	–
SVOA	Dibenzofuran	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.35–0.916
SVOA	Diethyl phthalate	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.35–0.916
SVOA	Dimethyl phthalate	mg/kg	4.30E-01	4.30E-01	4.30E-01	0/24	1/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.35–0.916
SVOA	Di-n-butyl phthalate	mg/kg	1.10E-01	1.10E-01	1.10E-01	1/24	1/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.35–0.916
SVOA	Di-n-octylphthalate	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.35–0.916
SVOA	Diphenyldiazene	mg/kg	N/A	N/A	N/A	0/6	0/6	0/6	N/A	0/6	N/A	0/6	N/A	N/A	N/A	0.739–0.916
SVOA	Fluoranthene	mg/kg	4.40E-02	7.20E-01	2.87E-01	4/29	5/29	0/29	N/A	0/29	9.32E+02	0/29	2.80E+04	0/29	0/29	0.35–0.916
SVOA	Fluorene	mg/kg	4.90E-02	4.90E-02	4.90E-02	1/29	1/29	0/29	N/A	0/29	9.32E+02	0/29	2.80E+04	0/29	0/29	0.35–0.916
SVOA	Hexachlorobenzene	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	5.15E-01	0/24	5.15E+01	0/24	0/24	0.35–0.916
SVOA	Hexachlorobutadiene	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.35–0.916
SVOA	Hexachlorocyclopentadiene	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.38–1.9
SVOA	Hexachloroethane	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.35–0.916
SVOA	Isophorone	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.35–0.916
SVOA	m,p-Cresol	mg/kg	N/A	N/A	N/A	0/5	0/5	0/5	N/A	0/5	N/A	0/5	N/A	N/A	N/A	0.7–0.78
SVOA	Naphthalene	mg/kg	N/A	N/A	N/A	0/29	0/29	0/29	N/A	0/29	1.67E+01	0/29	1.61E+03	0/29	0/29	0.35–0.916

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.3.2. Subsurface Soil Data Summary: SWMU 26 (Continued)

Type	Analysis	Unit	Detected Results Min	Detected Results Max	Detected Results Avg	J-qualified FOD	FOD	Provisional Background FOE	Provisional Background Bkgd	Industrial Worker FOE	Industrial Worker NAL	Industrial Worker FOE	Industrial Worker AL	GW Protection Screen RGA	GW Protection Screen UCRS	DL Range
SVOA	Nitrobenzene	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.38–1.9
SVOA	Nitrobenzene-d5	mg/kg	N/A	N/A	N/A	0/6	0/6	0/6	N/A	0/6	N/A	0/6	N/A	N/A	N/A	0.739–0.916
SVOA	N-Nitrosodimethylamine	mg/kg	N/A	N/A	N/A	0/6	0/6	0/6	N/A	0/6	N/A	0/6	N/A	N/A	N/A	0.739–0.916
SVOA	N-Nitroso-di-n-propylamine	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	1.18E-01	0/24	1.18E+01	0/24	0/24	0.007–0.916
SVOA	N-Nitrosodiphenylamine	mg/kg	8.23E-01	8.23E-01	8.23E-01	0/24	1/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.35–0.916
SVOA	PAH, Total	mg/kg	7.60E-03	4.15E-01	1.16E-01	0/29	7/29	0/29	N/A	4/29	8.94E-02	0/29	8.94E+00	0/29	1/29	–
SVOA	Pentachlorophenol	mg/kg	2.10E+00	2.10E+00	2.10E+00	0/24	1/24	0/24	N/A	1/24	8.91E-01	0/24	8.91E+01	N/A	N/A	0.41–4.4
SVOA	Phenanthrene	mg/kg	6.40E-02	6.00E-01	2.09E-01	3/29	4/29	0/29	N/A	0/29	1.40E+03	0/29	4.20E+04	1/29	4/29	0.35–0.916
SVOA	Phenol	mg/kg	N/A	N/A	N/A	0/24	0/24	0/24	N/A	0/24	N/A	0/24	N/A	N/A	N/A	0.35–0.916
SVOA	Phenol-d5	mg/kg	N/A	N/A	N/A	0/6	0/6	0/6	N/A	0/6	N/A	0/6	N/A	N/A	N/A	0.739–0.916
SVOA	p-Nitroaniline	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.739–4.4
SVOA	p-Terphenyl-d14	mg/kg	N/A	N/A	N/A	0/6	0/6	0/6	N/A	0/6	N/A	0/6	N/A	N/A	N/A	0.739–0.916
SVOA	Pyrene	mg/kg	6.90E-02	5.60E-01	2.37E-01	4/29	5/29	0/29	N/A	0/29	6.99E+02	0/29	2.10E+04	0/29	0/29	0.35–0.916
SVOA	Pyridine	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	N/A	0/11	N/A	N/A	N/A	0.7–0.916
VOA	1,1,1,2-Tetrachloroethane	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.006–0.04
VOA	1,1,1-Trichloroethane	mg/kg	N/A	N/A	N/A	0/18	0/18	0/18	N/A	0/18	3.58E+03	0/18	1.07E+05	0/18	0/18	0.006–0.04
VOA	1,1,2,2-Tetrachloroethane	mg/kg	N/A	N/A	N/A	0/18	0/18	0/18	N/A	0/18	N/A	0/18	N/A	N/A	N/A	0.006–0.04
VOA	1,1,2-Trichloroethane	mg/kg	N/A	N/A	N/A	0/18	0/18	0/18	N/A	0/18	6.32E-01	0/18	1.90E+01	0/18	0/18	0.006–0.04
VOA	1,1-Dichloroethane	mg/kg	N/A	N/A	N/A	0/18	0/18	0/18	N/A	0/18	1.58E+01	0/18	1.58E+03	0/18	0/18	0.006–0.04
VOA	1,1-Dichloroethene	mg/kg	N/A	N/A	N/A	0/20	0/20	0/20	N/A	0/20	1.00E+02	0/20	3.00E+03	0/20	0/20	0.006–1
VOA	1,2,3-Trichloropropane	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.006–0.04
VOA	1,2-Dibromoethane	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.006–0.04
VOA	1,2-Dichloroethane	mg/kg	N/A	N/A	N/A	0/18	0/18	0/18	N/A	0/18	2.09E+00	0/18	2.09E+02	0/18	0/18	0.006–0.04
VOA	1,2-Dichloroethene	mg/kg	N/A	N/A	N/A	0/11	0/11	0/11	N/A	0/11	2.10E+03	0/11	6.30E+04	0/11	0/11	0.006–0.007
VOA	1,2-Dichloropropane	mg/kg	N/A	N/A	N/A	0/18	0/18	0/18	N/A	0/18	N/A	0/18	N/A	N/A	N/A	0.006–0.04
VOA	1,4-Cineole	mg/kg	3.30E-02	3.30E-02	3.30E-02	1/1	1/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	–
VOA	2-Butanone	mg/kg	N/A	N/A	N/A	0/17	0/17	0/17	N/A	0/17	N/A	0/17	N/A	N/A	N/A	0.012–0.9
VOA	2-Chloro-1,3-butadiene	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.006–0.04
VOA	2-Chloroethyl vinyl ether	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.01–0.09
VOA	2-Hexanone	mg/kg	N/A	N/A	N/A	0/18	0/18	0/18	N/A	0/18	N/A	0/18	N/A	N/A	N/A	0.011–0.4
VOA	2-Propanol	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.06–0.4
VOA	4-Methyl-2-pentanone	mg/kg	N/A	N/A	N/A	0/18	0/18	0/18	N/A	0/18	N/A	0/18	N/A	N/A	N/A	0.011–0.4
VOA	Acetone	mg/kg	2.10E-02	1.40E-01	6.23E-02	0/18	6/18	0/18	N/A	0/18	N/A	0/18	N/A	N/A	N/A	0.012–0.9
VOA	Acrolein	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.1–0.9
VOA	Acrylonitrile	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	1.24E+00	0/7	1.24E+02	0/7	0/7	0.1–0.9
VOA	Benzene	mg/kg	N/A	N/A	N/A	0/18	0/18	0/18	N/A	0/18	5.31E+00	0/18	5.31E+02	0/18	0/18	0.006–0.04
VOA	Bromodichloromethane	mg/kg	N/A	N/A	N/A	0/18	0/18	0/18	N/A	0/18	1.30E+00	0/18	1.30E+02	0/18	0/18	0.006–0.04
VOA	Bromoform	mg/kg	N/A	N/A	N/A	0/18	0/18	0/18	N/A	0/18	N/A	0/18	N/A	N/A	N/A	0.006–0.04
VOA	Bromomethane	mg/kg	N/A	N/A	N/A	0/18	0/18	0/18	N/A	0/18	N/A	0/18	N/A	N/A	N/A	0.01–0.09
VOA	Carbon disulfide	mg/kg	1.00E-03	1.00E-03	1.00E-03	2/18	2/18	0/18	N/A	0/18	N/A	0/18	N/A	N/A	N/A	0.006–0.04
VOA	Carbon tetrachloride	mg/kg	N/A	N/A	N/A	0/18	0/18	0/18	N/A	0/18	2.96E+00	0/18	2.96E+02	0/18	0/18	0.006–0.04
VOA	Chlorobenzene	mg/kg	N/A	N/A	N/A	0/18	0/18	0/18	N/A	0/18	N/A	0/18	N/A	N/A	N/A	0.006–0.04
VOA	Chloroethane	mg/kg	N/A	N/A	N/A	0/18	0/18	0/18	N/A	0/18	N/A	0/18	N/A	N/A	N/A	0.01–0.09
VOA	Chloroform	mg/kg	1.10E-02	1.10E-02	1.10E-02	0/18	1/18	0/18	N/A	0/18	1.39E+00	0/18	1.39E+02	0/18	0/18	0.006–0.04
VOA	Chloromethane	mg/kg	N/A	N/A	N/A	0/18	0/18	0/18	N/A	0/18	N/A	0/18	N/A	N/A	N/A	0.01–0.09
VOA	*cis*-1,2-Dichloroethene	mg/kg	4.40E-03	4.40E-03	4.40E-03	1/9	1/9	0/9	N/A	0/9	4.67E+02	0/9	1.40E+04	0/9	0/9	0.006–1
VOA	*cis*-1,3-Dichloropropene	mg/kg	N/A	N/A	N/A	0/18	0/18	0/18	N/A	0/18	N/A	0/18	N/A	N/A	N/A	0.006–0.04
VOA	Dibromochloromethane	mg/kg	N/A	N/A	N/A	0/18	0/18	0/18	N/A	0/18	N/A	0/18	N/A	N/A	N/A	0.006–0.04
VOA	Dibromomethane	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.006–0.04
VOA	Dichlorodifluoromethane	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	3.68E+01	0/7	1.10E+03	0/7	0/7	0.006–0.04
VOA	Diethyl ether	mg/kg	1.00E-02	2.00E-02	1.50E-02	2/2	2/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	–
VOA	Ethyl cyanide	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.1–0.9
VOA	Ethyl methacrylate	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.006–0.04

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.3.2. Subsurface Soil Data Summary: SWMU 26 (Continued)

			Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
Type	Analysis	Unit	Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
VOA	Ethylbenzene	mg/kg	N/A	N/A	N/A	0/18	0/18	0/18	N/A	0/18	2.66E+01	0/18	2.66E+03	0/18	0/18	0.006–0.04
VOA	Fenchone	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.021–0.021
VOA	Iodomethane	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.006–0.04
VOA	Methacrylonitrile	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.028–0.21
VOA	Methyl methacrylate	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.006–0.04
VOA	Methylene chloride	mg/kg	3.90E-02	7.90E-02	5.35E-02	0/18	4/18	0/18	N/A	0/18	N/A	0/18	N/A	N/A	N/A	0.006–0.062
VOA	Pentachloroethane	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.006–0.04
VOA	Styrene	mg/kg	N/A	N/A	N/A	0/18	0/18	0/18	N/A	0/18	N/A	0/18	N/A	N/A	N/A	0.006–0.04
VOA	Tetrachloroethene	mg/kg	N/A	N/A	N/A	0/18	0/18	0/18	N/A	0/18	4.00E+01	0/18	1.20E+03	N/A	N/A	0.006–0.04
VOA	Toluene	mg/kg	3.10E-01	3.20E-01	3.18E-01	0/18	2/18	0/18	N/A	0/18	6.25E+03	0/18	1.88E+05	0/18	0/18	0.006–0.04
VOA	Total Xylene	mg/kg	N/A	N/A	N/A	0/18	0/18	0/18	N/A	0/18	2.54E+02	0/18	7.62E+03	0/18	0/18	0.006–0.04
VOA	*trans*-1,2-Dichloroethene	mg/kg	N/A	N/A	N/A	0/9	0/9	0/9	N/A	0/9	6.51E+01	0/9	1.95E+03	0/9	0/9	0.006–1
VOA	*trans*-1,3-Dichloropropene	mg/kg	N/A	N/A	N/A	0/18	0/18	0/18	N/A	0/18	N/A	0/18	N/A	N/A	N/A	0.006–0.04
VOA	*trans*-1,4-Dichloro-2-butene	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.006–0.04
VOA	Trichloroethene	mg/kg	5.00E-04	1.00E-02	3.07E-03	3/25	6/25	0/25	N/A	0/25	1.90E+00	0/25	5.70E+01	0/25	3/25	0.001–5
VOA	Trichlorofluoromethane	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.006–0.04
VOA	Vinyl acetate	mg/kg	N/A	N/A	N/A	0/18	0/18	0/18	N/A	0/18	N/A	0/18	N/A	N/A	N/A	0.011–0.4
VOA	Vinyl chloride	mg/kg	N/A	N/A	N/A	0/20	0/20	0/20	N/A	0/20	2.06E+00	0/20	2.06E+02	0/20	0/20	0.001–1
RADS	Americium-241	pCi/g	2.00E-01	6.00E-01	4.00E-01	0/15	2/15	0/15	N/A	0/15	5.99E+00	0/15	5.99E+02	0/15	0/15	0.011–0.337
RADS	Cesium-137	pCi/g	9.90E-02	1.11E+01	1.50E+00	1/15	8/15	4/15	2.80E-01	7/15	1.02E-01	1/15	1.02E+01	0/15	2/15	0.0289–0.1
RADS	Neptunium-237	pCi/g	1.94E-01	5.26E+01	9.38E+00	0/10	6/10	0/10	N/A	4/10	2.29E-01	1/10	2.29E+01	1/10	6/10	0.0585–0.0725
RADS	Plutonium-238	pCi/g	4.30E-02	4.30E-02	4.30E-02	1/5	1/5	0/5	N/A	0/5	2.87E+01	0/5	2.87E+03	0/5	0/5	0.016–0.026
RADS	Plutonium-239/240	pCi/g	4.10E-02	1.12E+01	1.25E+00	6/15	7/15	0/15	N/A	0/15	2.47E+01	0/15	2.47E+03	0/15	2/15	0.012–0.0505
RADS	Technetium-99	pCi/g	3.00E-01	4.84E+03	3.46E+02	1/15	12/15	8/15	2.80E+00	1/15	1.20E+03	0/15	1.20E+05	11/15	12/15	0.37–2.43
RADS	Thorium-228	pCi/g	2.30E-01	1.36E+00	5.89E-01	0/5	5/5	0/5	1.60E+00	0/5	N/A	0/5	N/A	N/A	N/A	0.03–0.11
RADS	Thorium-230	pCi/g	3.89E-01	1.88E+01	2.03E+00	0/15	15/15	6/15	1.40E+00	0/15	3.39E+01	0/15	3.39E+03	0/15	4/15	0.02–0.187
RADS	Thorium-232	pCi/g	1.42E-01	1.38E+00	5.39E-01	0/5	5/5	0/5	1.50E+00	0/5	N/A	0/5	N/A	N/A	N/A	0.02–0.03
RADS	Uranium-234	pCi/g	5.10E-01	1.02E+02	7.87E+00	2/16	13/16	6/16	1.20E+00	1/16	5.53E+01	0/16	5.53E+03	3/16	13/16	0.02–0.772
RADS	Uranium-235	pCi/g	2.00E-02	4.90E+00	4.60E-01	2/16	13/16	9/16	6.00E-02	2/16	3.40E-01	0/16	3.40E+01	1/16	9/16	0.01–0.041
RADS	Uranium-238	pCi/g	7.00E-01	1.42E+02	9.98E+00	5/16	16/16	9/16	1.20E+00	9/16	1.60E+00	0/16	1.60E+02	6/16	16/16	0.01–0.918

One or more samples exceed AL value
One or more samples exceed NAL value
One or more samples exceed background value
One or more samples exceed SSLs of RGA and UCRS groundwater protection

Counts of analyses are based on the maximum detected result from a sample (i.e., if a sample has analytical results from two different labs, only the maximum value is counted).
Field replicates, or separate samples are counted independently.

The uranium (metal)/uranium (isotopic) may not be from the same sample thus a correlation between uranium (metal)/uranium (isotopic) data may not be possible.
Uranium-238 that was analyzed using method RL-7128NITRIC is compared to a background value of 0.4 pCi/g for surface and subsurface.

Screening values are shown in Appendices C and D.

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

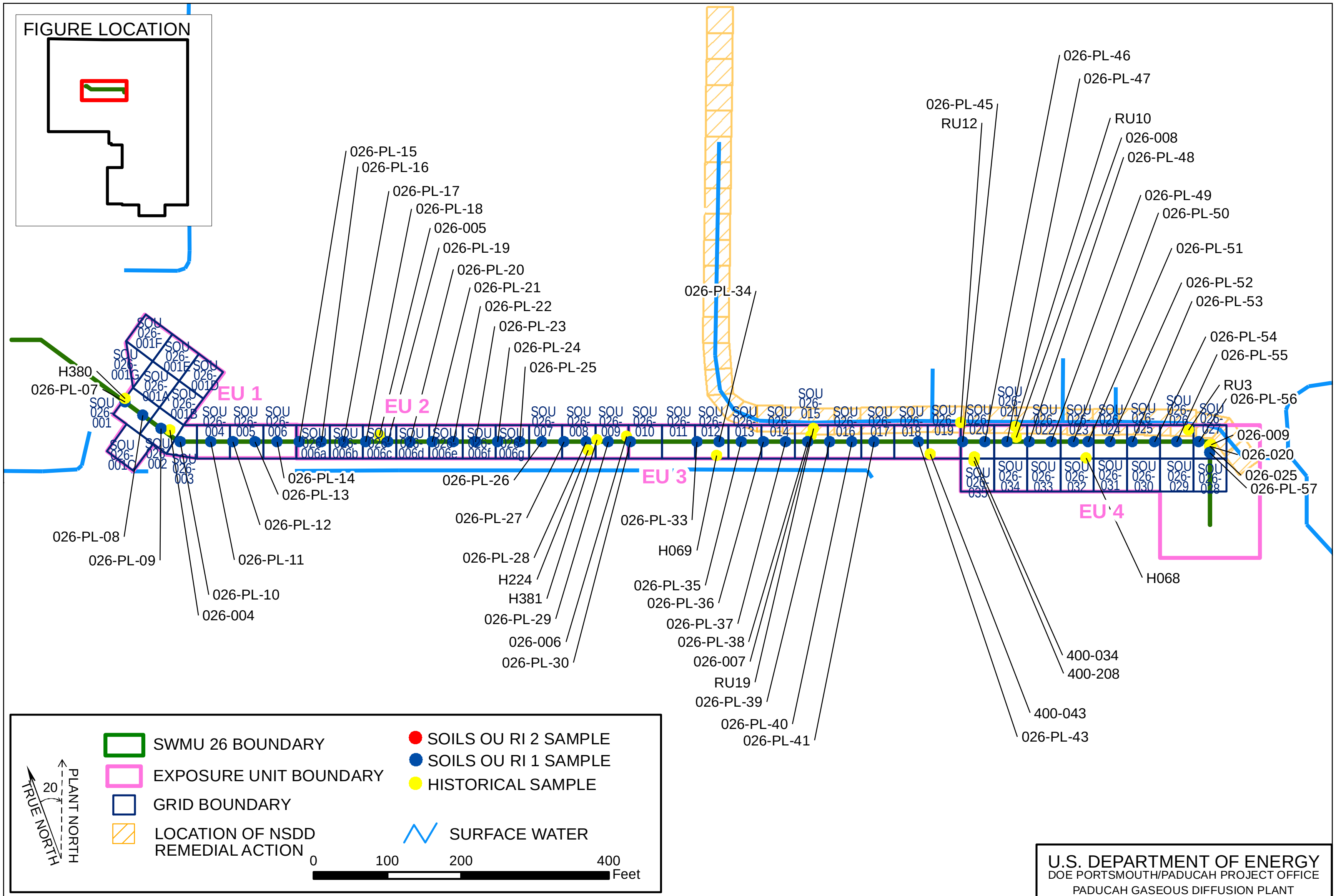

Figure 5.3.5. SWMU 26 Sample Locations—Subsurface Soil

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1/15/2015

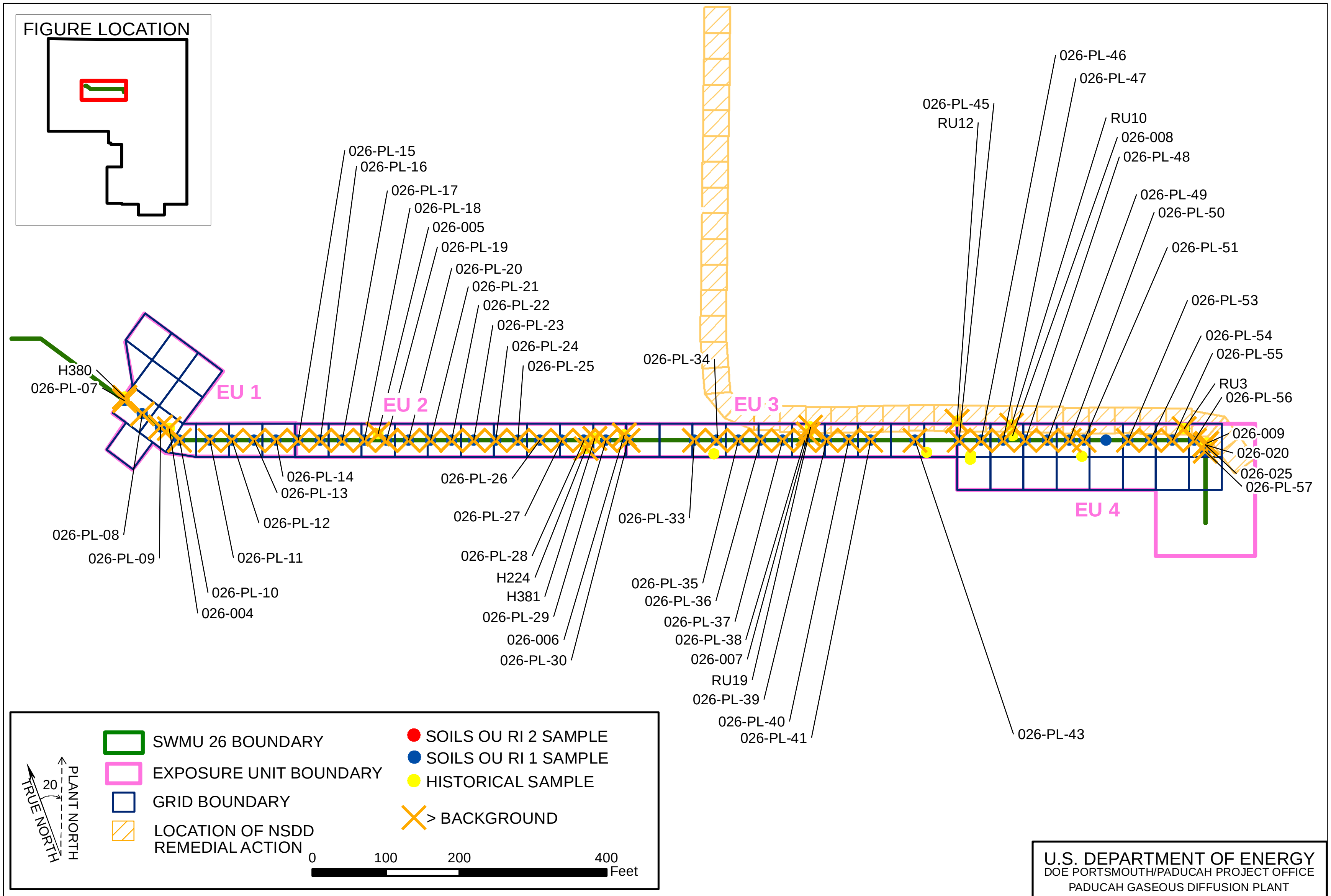

Figure 5.3.6. SWMU 26 Background Exceedances—Subsurface Soil

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Location	Exceedance
H380	Aluminum (12400 mg/kg)
	Arsenic (9.9 mg/kg)
	Beryllium (24.9 mg/kg)
	Cadmium (2.6 mg/kg)
	Calcium (113000 mg/kg)
	Cobalt (16.2 mg/kg)
	Magnesium (4090 mg/kg)
	Manganese (1790 mg/kg)
	Nickel (264 mg/kg)
	Potassium (1190 mg/kg)
	Thallium (0.41 mg/kg)
	Zinc (64.8 mg/kg)
026-PL-07	Antimony (66.03 mg/kg)
	Barium (242.34 mg/kg)
	Nickel (72.19 mg/kg)
	Uranium (7.58 mg/kg)
	Zinc (64.25 mg/kg)
026-PL-08	Antimony (39.37 mg/kg)
	Barium (272.63 mg/kg)
	Nickel (71.99 mg/kg)
	Uranium (481.46 mg/kg)
026-PL-09	Antimony (40.7 mg/kg)
	Arsenic (10.3 mg/kg)
	Barium (296.78 mg/kg)
	Beryllium (0.73 mg/kg)
	Calcium (44500 mg/kg)
	Magnesium (2700 mg/kg)
	Selenium (0.78 mg/kg)
	Uranium (45.2 mg/kg)
	Thorium-230 (1.98 pCi/g)
	Uranium-234 (2.14 pCi/g)
	Uranium-235 (0.243 pCi/g)
	Uranium-238 (11.8 pCi/g)
026-004	Aluminum (16100 mg/kg)
	Arsenic (9.2 mg/kg)
026-PL-10	Antimony (78.36 mg/kg)
	Arsenic (9.55 mg/kg)
	Barium (324.08 mg/kg)
	Uranium (11.54 mg/kg)
026-PL-11	Barium (354.1 mg/kg)
026-PL-12	Antimony (78.99 mg/kg)
	Barium (439.09 mg/kg)
026-PL-13	Barium (364.3 mg/kg)
026-PL-14	Antimony (121.38 mg/kg)
	Barium (509.57 mg/kg)
	Cadmium (19.6 mg/kg)
	Mercury (6.78 mg/kg)
	Uranium (6.7 mg/kg)
026-PL-15	Antimony (133.01 mg/kg)
	Barium (559.43 mg/kg)
026-PL-16	Antimony (123.78 mg/kg)
	Barium (560.1 mg/kg)
	Cadmium (28.31 mg/kg)
026-PL-17	Antimony (139.05 mg/kg)
	Barium (506.84 mg/kg)
	Cadmium (16.63 mg/kg)
026-PL-18	Antimony (122.53 mg/kg)
	Barium (499.19 mg/kg)
026-005	Aluminum (14200 mg/kg)
	Antimony (1 mg/kg)
	Calcium (13500 mg/kg)
026-PL-19	Antimony (60.25 mg/kg)
	Barium (249.54 mg/kg)
	Cadmium (15.39 mg/kg)
	Calcium (203000 mg/kg)
	Chromium (58.9 mg/kg)
	Magnesium (8050 mg/kg)
	Uranium-235 (0.061 pCi/g)
026-PL-20	Antimony (109.7 mg/kg)
	Barium (413.51 mg/kg)
	Zinc (91.13 mg/kg)
026-PL-21	Antimony (141.97 mg/kg)
	Barium (645.01 mg/kg)
026-PL-22	Antimony (156.65 mg/kg)
	Barium (604.25 mg/kg)
	Cadmium (14.95 mg/kg)
	Silver (10.64 mg/kg)
026-PL-23	Antimony (113.32 mg/kg)
	Barium (412.14 mg/kg)
	Mercury (14.04 mg/kg)
	Selenium (4.49 mg/kg)
026-PL-24	Antimony (121.16 mg/kg)
	Barium (490.57 mg/kg)
	Cadmium (19.72 mg/kg)
	Selenium (4.49 mg/kg)
026-PL-25	Antimony (53.5 mg/kg)
	Barium (320.03 mg/kg)
	Cadmium (12.92 mg/kg)
026-PL-26	Barium (259.05 mg/kg)
026-PL-27	Barium (332.29 mg/kg)
	Manganese (1505.82 mg/kg)
026-PL-28	Barium (271.1 mg/kg)
	Lead (23.29 mg/kg)
	Nickel (73.77 mg/kg)
H224	Calcium (16600 mg/kg)
H381	Aluminum (14700 mg/kg)
	Arsenic (8.3 mg/kg)
	Beryllium (16.8 mg/kg)
	Cadmium (1.4 mg/kg)
	Calcium (7200 mg/kg)
	Nickel (25.6 mg/kg)
	Potassium (953 mg/kg)
	Zinc (61 mg/kg)
026-PL-29	Antimony (120.85 mg/kg)
	Barium (489.07 mg/kg)
026-006	Aluminum (14600 mg/kg)
	Antimony (0.7 mg/kg)
	Arsenic (10.8 mg/kg)
	Beryllium (0.98 mg/kg)
	Calcium (7710 mg/kg)
	Manganese (852 mg/kg)
	Selenium (0.9 mg/kg)
	Sodium (352 mg/kg)
026-PL-30	Antimony (87.16 mg/kg)
	Barium (413.12 mg/kg)
	Cadmium (0.32 mg/kg)
	Calcium (230000 mg/kg)
	Magnesium (5040 mg/kg)
026-PL-33	Antimony (86.94 mg/kg)
	Barium (396 mg/kg)
	Copper (38.06 mg/kg)
	Silver (10.02 mg/kg)
026-PL-34	Barium (174.18 mg/kg)
	Uranium (12.35 mg/kg)
026-PL-35	Antimony (53.73 mg/kg)
	Barium (291.11 mg/kg)
026-PL-36	Uranium (7.19 mg/kg)
026-PL-37	Antimony (71.58 mg/kg)
	Barium (406.89 mg/kg)
026-PL-38	Antimony (48.09 mg/kg)
	Barium (310.37 mg/kg)
026-007	Aluminum (13500 mg/kg)
	Antimony (0.8 mg/kg)
	Sodium (417 mg/kg)
	Zinc (61.6 mg/kg)
	Cesium-137 (0.4 pCi/g)
	Thorium-230 (1.8 pCi/g)
RU19	Technetium-99 (40.7 pCi/g)
	Thorium-230 (2.45 pCi/g)
	Uranium-238 (1.72 pCi/g)
026-PL-39	Antimony (42.65 mg/kg)
	Arsenic (8.24 mg/kg)
	Barium (279.29 mg/kg)
026-PL-40	Antimony (55.89 mg/kg)
	Barium (349.48 mg/kg)
	Manganese (935 mg/kg)
	Selenium (0.78 mg/kg)
026-PL-41	Barium (221.18 mg/kg)
	Uranium (8.02 mg/kg)
026-PL-43	Antimony (41.31 mg/kg)
	Barium (277.68 mg/kg)
	Mercury (7.29 mg/kg)

Figure 5.3.6. SWMU 26 Background Exceedances—Subsurface Soil (Continued)

RU12	Beryllium (1.01 mg/kg)
	Cadmium (2.73 mg/kg)
	Iron (32500 mg/kg)
	Lead (30.1 mg/kg)
	Manganese (916 mg/kg)
	Uranium (200 mg/kg)
	Technetium-99 (10.7 pCi/g)
	Uranium-235 (0.122 pCi/g)
	Uranium-238 (2.37 pCi/g)
026-PL-45	Antimony (68.97 mg/kg)
	Barium (390.34 mg/kg)
	Uranium (11.02 mg/kg)
026-PL-46	Antimony (58.58 mg/kg)
	Arsenic (8.12 mg/kg)
	Barium (438.49 mg/kg)
	Nickel (81.89 mg/kg)
026-PL-47	Uranium (11.37 mg/kg)
RU10	Technetium-99 (4.05 pCi/g)
	Uranium-235 (0.116 pCi/g)
	Uranium-238 (1.95 pCi/g)
026-PL-48	Uranium (14.21 mg/kg)
026-PL-49	Uranium (11.18 mg/kg)
026-PL-50	Barium (207.86 mg/kg)
	Uranium (19.4 mg/kg)
026-PL-51	Antimony (60.31 mg/kg)
	Barium (337.78 mg/kg)
026-PL-53	Barium (212.92 mg/kg)
	Uranium (7.35 mg/kg)
026-PL-54	Antimony (64.12 mg/kg)
	Barium (302.82 mg/kg)
026-PL-55	Antimony (38.3 mg/kg)
	Barium (224.76 mg/kg)
RU3	Aluminum (12500 mg/kg)
	Uranium (106 mg/kg)
	Cesium-137 (0.369 pCi/g)
	Technetium-99 (10.9 pCi/g)
	Uranium-234 (3.44 pCi/g)
	Uranium-235 (0.217 pCi/g)
	Uranium-238 (5.01 pCi/g)
026-PL-56	Antimony (66.45 mg/kg)
	Arsenic (12.62 mg/kg)
	Barium (301.09 mg/kg)
	Beryllium (1 mg/kg)
	Calcium (6490 mg/kg)
	Cobalt (23.6 mg/kg)
	Lead (32.4 mg/kg)
	Magnesium (3290 mg/kg)
	Manganese (1800 mg/kg)
	Nickel (43.3 mg/kg)
	Selenium (1.1 mg/kg)
	Uranium (12.4 mg/kg)
	Vanadium (72.6 mg/kg)
	Zinc (83.8 mg/kg)
	Technetium-99 (7.67 pCi/g)
	Thorium-230 (1.5 pCi/g)
	Uranium-234 (1.82 pCi/g)
	Uranium-235 (0.119 pCi/g)
	Uranium-238 (2.07 pCi/g)
026-020	Aluminum (14400 mg/kg)
	Antimony (1.1 mg/kg)
	Arsenic (9.44 mg/kg)
	Cadmium (0.9 mg/kg)
	Calcium (10600 mg/kg)
	Chromium (141 mg/kg)
	Cobalt (16 mg/kg)
	Copper (9520 mg/kg)
	Iron (51700 mg/kg)
	Lead (87.5 mg/kg)
	Mercury (0.457 mg/kg)
	Nickel (17600 mg/kg)
	Selenium (1 mg/kg)
	Silver (4.12 mg/kg)
	Sodium (1170 mg/kg)
	Zinc (181 mg/kg)
	Cesium-137 (3.8 pCi/g)
	Technetium-99 (4840 pCi/g)
	Thorium-230 (18.8 pCi/g)
	Uranium-234 (102 pCi/g)
	Uranium-235 (4.9 pCi/g)
	Uranium-238 (142 pCi/g)
026-025	Aluminum (15700 mg/kg)
	Antimony (1 mg/kg)
	Chromium (140 mg/kg)
	Copper (390 mg/kg)
	Nickel (467 mg/kg)
	Sodium (661 mg/kg)
	Cesium-137 (11.1 pCi/g)
	Technetium-99 (265 pCi/g)
	Thorium-230 (3 pCi/g)
	Uranium-234 (28.2 pCi/g)
	Uranium-235 (1.1 pCi/g)
	Uranium-238 (36.5 pCi/g)
026-PL-57	Antimony (106.76 mg/kg)
	Barium (370.97 mg/kg)
	Cadmium (14.77 mg/kg)
	Copper (32.74 mg/kg)
	Iron (31962.63 mg/kg)
	Nickel (109.78 mg/kg)
	Uranium (57 mg/kg)
026-009	Aluminum (13900 mg/kg)
	Copper (146 mg/kg)
	Nickel (113 mg/kg)

Figure 5.3.6. SWMU 26 Background Exceedances—Subsurface Soil (Continued)

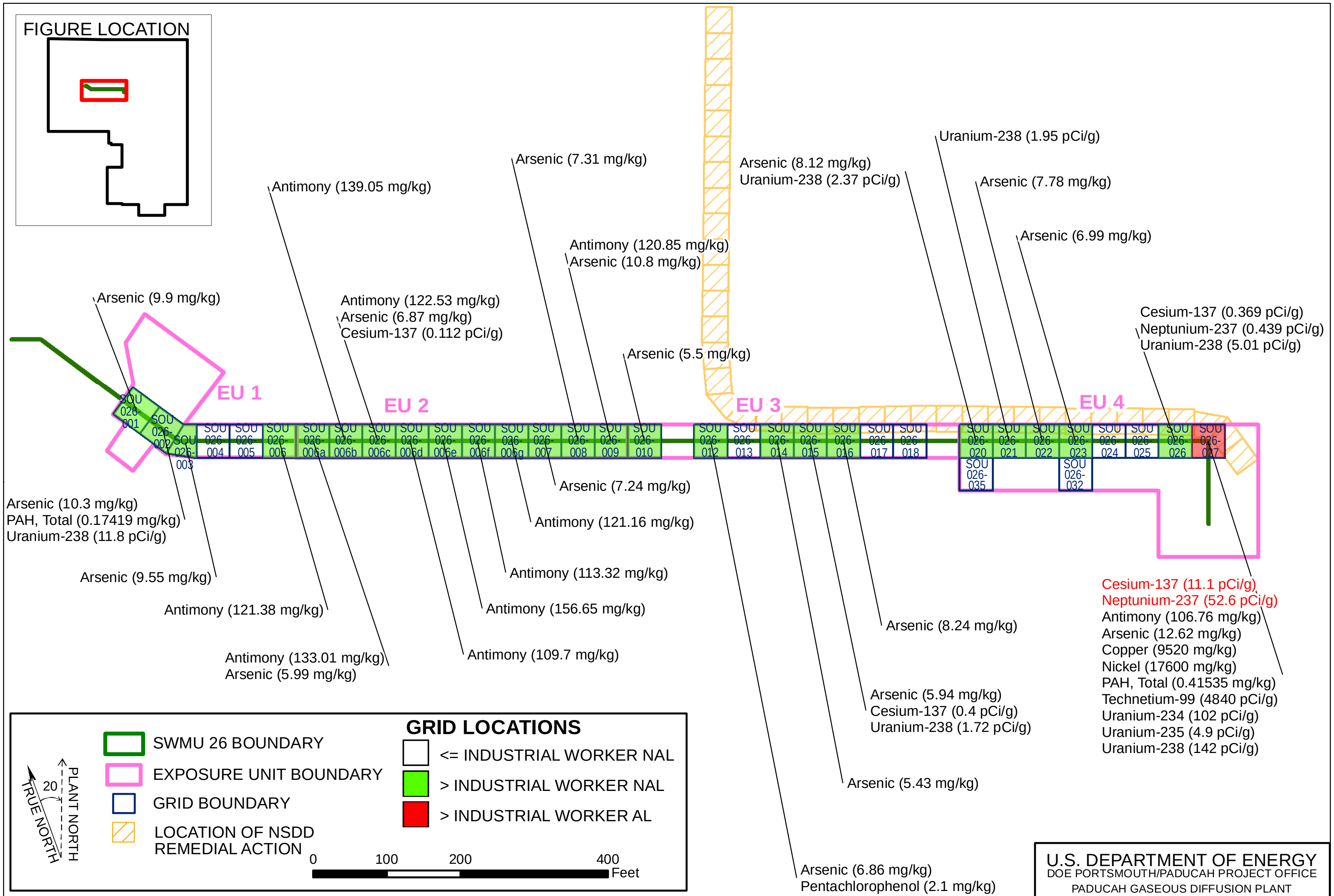

Figure 5.3.7. SWMU 26 NAL Exceedances—Subsurface Soil

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Metals

Metals were detected above the industrial worker NALs in the SWMU 26 subsurface soil. The following metals were detected at or above both background screening levels and the industrial worker NALs.

Metal	Grid	EU
Antimony	6, 6a, 6b, 6c, 6d, 6e, 6f, 6g, 9, 27	1, 2, 4
Arsenic	1, 2, 3, 9, 16, 20, 27	1–4
Copper	27	4
Nickel	27	4

The maximum depth of metals above both background screening levels and the industrial worker NALs was 9 ft bgs. No metals were detected above the industrial worker ALs in the SWMU 26 subsurface soil.

The following metals were detected in the SWMU 26 subsurface soil above both the background screening levels (if available) and the SSLs for the protection of UCRS groundwater.

Metal	Grid	EU
Aluminum	1, 2, 6c, 9, 15, 26, 27	1–4
Antimony	1, 2, 3, 5, 6, 6a, 6b, 6c, 6d, 6e, 6f, 6g, 9, 10, 12, 13, 14, 15, 16, 18, 20, 23, 25, 26, 27	1–4
Arsenic	1, 2, 3, 9, 16, 20, 27	1–4
Barium	1, 2, 3, 4, 5, 6, 6a, 6b, 6c, 6d, 6e, 6f, 6g, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 20, 23, 25, 26, 27	1–4
Beryllium	1, 9	1, 2
Cadmium	1, 6, 6a, 6b, 6c, 6e, 6g, 9, 20, 27	1, 2, 4
Cobalt	1, 27	1, 4
Copper	27	4
Iron	20, 27	4
Lead	8, 20, 27	2, 4
Manganese	1, 8, 9, 16, 20, 27	1–4
Mercury	6, 6f, 18, 27	1–4
Molybenum[1]	2, 6c, 10, 16, 27	1–4
Nickel	1, 8, 9, 20, 27	1, 2, 4
Selenium	2, 6f, 6g, 9, 16, 27	1–4
Silver	1, 6e, 12, 27	1–4
Thallium	1, 27	1, 4
Uranium	1, 2, 20, 22, 23, 26, 27	1, 4
Vanadium	27	4
Zinc	1, 6d, 9, 15, 27	1–4

[1] No soil background value is available.

Metals were detected above both the background screening levels and the SSLs for the protection of RGA groundwater as follows:

Metal	Grid	EU
Antimony	1, 2, 3, 5, 6, 6a, 6b, 6c, 6d, 6e, 6f, 6g, 9, 10, 12, 13, 14, 15, 16, 18, 20, 23, 25, 26, 27	1–4
Cadmium	6a	2
Cobalt	1, 27	1, 4
Copper	27	4
Iron	20, 27	4
Manganese	1, 8, 9, 16, 20, 27	1–4

Metal (continued)	Grid	EU
Mercury	6, 6f, 18	1–3
Molybenum[1]	6c	2
Nickel	1, 27	1, 4
Silver	6e, 12	2, 3

[1] No soil background value is available.

PCBs

Total PCBs were not detected above industrial worker NALs or ALs in the subsurface soil. Total PCBs were detected above the SSLs for the protection of the UCRS [grid 26 (EU 4)], but not above the SSLs for the protection of the RGA.

SVOCs

The SVOC pentachlorophenol was detected above industrial worker NALs in the SWMU 26 subsurface soil at grid 12 (EU 3). Total PAHs were detected above the industrial worker NAL in grids 2 and 27 (EUs 1 and 4, respectively). The maximum depth of SVOCs above both background screening levels and the industrial worker NALs was 7.5 ft bgs. No SVOCs were detected above industrial worker ALs.

Phenanthrene (grid 2, EU 1 and grid 27, EU 4), bis(2-ethylhexyl)phthalate (grid 32, EU 4), and total PAHs (grid 27, EU 4) were detected above the SSLs for the protection of UCRS groundwater. Phenanthrene (grid 27, EU 4) was detected above the SSLs for the protection of RGA groundwater.

VOCs

No VOCs were detected above the industrial worker NALs or ALs in the SWMU 26 subsurface soil. TCE in grids 8, 9, and 32 (EUs 2 and 4) was detected above the SSLs for the protection of UCRS groundwater, but was not detected above SSL for the protection of RGA groundwater.

Radionuclides

Cesium-137 (grid 15, EU 3 and grids 26 and 27, EU 4), neptunium-237, Tc-99 (grid 27, EU 4), uranium-234 (grid 27, EU 4), uranium-235 (grid 27, EU 4), and uranium-238 (grid 2, EU 1; grid 15, EU 3; and grids 20, 21, 26, and 27, EU 4) were detected above the industrial worker NALs and background screening levels (if available) in the SWMU 26 subsurface soil. The maximum depth of the radionuclide above both background screening levels and the industrial worker NALs was 9 ft bgs. Cesium-137 and neptunium-237 were detected above the industrial worker ALs and background screening levels (if available) in the SWMU 26 subsurface soil in grid 27.

The following radionuclides were detected in the SWMU 26 subsurface soil above both the background screening levels (if available) and the SSLs for the protection of UCRS groundwater.

Radionuclide	Grid	EU
Cesium-137	27	4
Neptunium-237[1]	15, 26, 27	3, 4
Plutonium-239/240	27	4
Tc-99	15, 20, 21, 26, 27	3, 4
Thorium-230	2, 15, 27	1, 3, 4
Uranium-234	2, 26, 27	1, 4
Uranium-235	2, 6c, 20, 21, 26, 27	1, 2, 4
Uranium-238	2, 15, 20, 21, 26, 27	1, 3, 4

[1] No soil background value is available.

Radionuclides detected above both the background screening levels (if available) and the SSLs for the protection of RGA groundwater as follows.

Radionuclide	Grid	EU
Neptunium-237[1]	27	4
Tc-99	15, 20, 21, 26, 27	3, 4
Uranium-234	26, 27	4
Uranium-235	27	4
Uranium-238	2, 20, 26, 27	1, 4

[1] No soil background value is available.

5.3.5 Fate and Transport

Tc-99, nickel, and uranuim-234 at SWMU 26 were identified for further evaluation under fate and transport (Chapter 4). SESOIL and AT123D simulation modeling results are summarized in Appendix C.

Tc-99 was selected for modeling because the average concentration at the SWMU exceeded both the RG SSL and background concentrations (see Appendix C). Modeling was performed for Tc-99, but was not predicted to reach the RGA at the SWMU boundary in measurable concentrations.

Uranium-234 was detected at an activity concentration greater than both the background value and SSL; however, the mass concentration of uranium assumed to be present based upon the assumption that the uranium isotopes were present at natural abundance would be 79 mg/kg. At 79 mg/kg, the average concentration is less than the average uranium concentration at SWMU 81 (2,502 mg/kg) that modeling in the Soils OU RI Report (DOE 2013) found not to migrate to the RGA within 1,000 years. Based on this, uranium-234 was not modeled at SWMU 26.

Nickel exceeded both the RG SSL and background concentrations at SWMU 26 and exhibited clustering when the results were viewed in 3-dimensions; however, the average concentration of nickel (156 mg/kg) was less than the average concentration for SWMU 14 (401 mg/kg in the 0-5 ft soils), which was modeled in the previous Soils OU RI Report (DOE 2013) where the results of the modeling showed that nickel did not reach the RGA groundwater in the 1,000-year SESOIL modeling period. Based on this, nickel was not modeled at SWMU 26.

There is potential for runoff to the west into Outfall 015, but is not considered significant (DOE 2008a). SWMU 26 is grass-covered or otherwise stabilized and the contaminants are not likely to be transported attached to suspended soil particles. A removal action for the contaminated sediment associated with SWOU (On-Site) (DOE 2011a) was conducted for Outfalls 001, 008, 010, 011, and 015 and associated internal ditches. A final response action for internal ditches, outfalls, and creeks will be addressed by the SWOU, as described in the SMP (DOE 2015a).

5.3.6 Baseline Risk Assessment

Human Health. Potential risks and hazards for current/future human health for SWMU 26 were evaluated for each of four EUs (~ 0.5 acres each) for direct contact. These results are summarized in Appendix D and in the subsections that follow, including the COCs and relative contributions to the overall ELCR/HI.

The cumulative ELCR and the cumulative HI for one or more EUs at SWMU 26 exceed the benchmarks of cumulative ELCR of 1E-06 and cumulative HI greater than 1, respectively, for one or more scenarios; therefore, as stated in the Work Plan, Decision Rule D1a, (DOE 2010a), this SWMU will be evaluated in the FS. As described in the BHHRA (Appendix D), COCs were identified after considering the results of the risk characterization and the uncertainties affecting the results.

COCs were identified as those COPCs considered to contribute at least 1E-06 ELCR or 0.1 HI to a scenario of concern. The basis for COC identification is presented in Appendix D.

The identified COCs considered to contribute to the ELCR/HI, the EPC, and the RGOs calculated for a range of ELCR/HI benchmarks are presented in Table 5.3.3 for the future industrial worker, excavation worker, and the hypothetical resident. Table 5.3.3 also compares the EPC to the RGO for each COC under each exposure scenario. Table 5.3.3 summarizes the ELCR/HI posed by the COCs for this SWMU under each exposure scenario by depicting the maximum ELCR/HI contribution per COC.

Ecological Screening. COPECs for SWMU 26 include metals, SVOCs, VOCs, and PCBs. Potential hazards for ecological receptors and the associated priority COPECs (maximum HQ $\geq$ 10) are summarized in Table 5.3.4.

5.3.7 SWMU 26 Summary

Goal 1. Characterize Nature and Extent of Source Zone

Plant processes that could have contributed to contamination at this SWMU are subsurface leaks from the transfer line.

The COPCs for SWMU 26 are shown on Tables 5.3.1 and 5.3.2 as those analytes with green boxes in the "Industrial Worker/FOE" columns for surface and shallow subsurface soil, and those with blue boxes under the "GW Protection Screen/RGA/UCRS" headings for groundwater. For metals and radioisotopes, an orange box under the "Provisional Background" must accompany the green and blue boxes. Contaminants were detected greater than background and greater than industrial worker NALs to a maximum depth of 9 ft bgs. The COPCs for each EU are as shown below:

- EU 1
  - Surface—metals, PCBs, PAHs, SVOCs, radionuclides
  - Subsurface—metals, radionuclides, PAHs, SVOCs, radionuclides
- EU 2
  - Surface—metals, PCBs, SVOCs, radionuclides
  - Subsurface—metals, radionuclides, VOCs
- EU 3
  - Surface—metals, PCBs, PAHs, SVOCs, radionuclides
  - Subsurface—metals, radionuclides, SVOCs
- EU 4
  - Surface—metals, PCBs, PAHs, SVOCs, radionuclides
  - Subsurface—metals, radionuclides, PCBs, PAHs, SVOCs, VOCs

Table 5.3.3. RGOs for SWMU 26

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3]			HI[4]	RGOs for HI[3]		
					1E-06	1E-05	1E-04		0.1	1	3
Future Industrial Worker											
1	PAH, Total	1.97E-01	mg/kg	2.2E-06	8.94E-02	8.94E-01	8.94E+00	< 0.1	N/A	N/A	N/A
1	PCB, Total	9.40E+00	mg/kg	3.1E-05	3.05E-01	3.05E+00	3.05E+01	< 0.1	N/A	N/A	N/A
1	Uranium-235	1.23E+00	pCi/g	3.3E-06	3.73E-01	3.73E+00	3.73E+01	N/A	N/A	N/A	N/A
1	Uranium-238	6.75E+01	pCi/g	4.1E-05	1.65E+00	1.65E+01	1.65E+02	N/A	N/A	N/A	N/A
1	**Cumulative**			**7.8E-05**				**< 1**			
2	Arsenic	4.23E+01	mg/kg	3.0E-05	1.41E+00	1.41E+01	1.41E+02	0.2	2.26E+01	2.26E+02	6.78E+02
2	Cobalt	6.59E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	< 0.1	N/A	N/A	N/A
2	PCB, Total	3.25E+00	mg/kg	1.1E-05	3.05E-01	3.05E+00	3.05E+01	< 0.1	N/A	N/A	N/A
2	Thallium	2.38E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	1	2.34E+00	2.34E+01	7.01E+01
2	Uranium	7.18E+02	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	6.58E+02	6.58E+03	1.97E+04
2	Cesium-137	9.52E+00	pCi/g	8.4E-05	1.14E-01	1.14E+00	1.14E+01	N/A	N/A	N/A	N/A
2	Radium-228	1.69E+00	pCi/g	1.0E-05	1.67E-01	1.67E+00	1.67E+01	N/A	N/A	N/A	N/A
2	Uranium-235	2.36E+00	pCi/g	6.3E-06	3.73E-01	3.73E+00	3.73E+01	N/A	N/A	N/A	N/A
2	Uranium-238	5.01E+01	pCi/g	3.0E-05	1.65E+00	1.65E+01	1.65E+02	N/A	N/A	N/A	N/A
2	**Cumulative**			**1.7E-04**				**1.5**			
3	Arsenic	7.56E+01	mg/kg	5.3E-05	1.41E+00	1.41E+01	1.41E+02	0.3	2.26E+01	2.26E+02	6.78E+02
3	PAH, Total	3.30E-01	mg/kg	3.7E-06	8.94E-02	8.94E-01	8.94E+00	< 0.1	N/A	N/A	N/A
3	PCB, Total	8.91E+00	mg/kg	2.9E-05	3.05E-01	3.05E+00	3.05E+01	< 0.1	N/A	N/A	N/A
3	Cesium-137	4.51E+00	pCi/g	4.0E-05	1.14E-01	1.14E+00	1.14E+01	N/A	N/A	N/A	N/A
3	Neptunium-237	3.70E-01	pCi/g	1.5E-06	2.53E-01	2.53E+00	2.53E+01	N/A	N/A	N/A	N/A
3	Uranium-238	7.00E+00	pCi/g	4.2E-06	1.65E+00	1.65E+01	1.65E+02	N/A	N/A	N/A	N/A
3	**Cumulative**			**1.3E-04**				**< 1**			
4	Arsenic	6.01E+01	mg/kg	4.2E-05	1.41E+00	1.41E+01	1.41E+02	0.3	2.26E+01	2.26E+02	6.78E+02
4	PAH, Total	5.53E+00	mg/kg	6.2E-05	8.94E-02	8.94E-01	8.94E+00	< 0.1	N/A	N/A	N/A
4	PCB, Total	7.95E+00	mg/kg	2.6E-05	3.05E-01	3.05E+00	3.05E+01	< 0.1	N/A	N/A	N/A
4	Cesium-137	1.02E+00	pCi/g	9.0E-06	1.14E-01	1.14E+00	1.14E+01	N/A	N/A	N/A	N/A
4	Neptunium-237	2.80E+00	pCi/g	1.1E-05	2.53E-01	2.53E+00	2.53E+01	N/A	N/A	N/A	N/A
4	Plutonium-239/240	1.35E+01	pCi/g	1.0E-06	1.30E+01	1.30E+02	1.30E+03	N/A	N/A	N/A	N/A
4	Tc-99	8.36E+02	pCi/g	2.2E-06	3.78E+02	3.78E+03	3.78E+04	N/A	N/A	N/A	N/A
4	Thorium-230	5.48E+01	pCi/g	3.2E-06	1.71E+01	1.71E+02	1.71E+03	N/A	N/A	N/A	N/A

Table 5.3.3. RGOs for SWMU 26 (Continued)

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3]			HI[4]	RGOs for HI[3]		
					1E-06	1E-05	1E-04		0.1	1	3
Future Industrial Worker (Continued)											
4	Uranium-234	2.15E+02	pCi/g	1.1E-05	2.01E+01	2.01E+02	2.01E+03	N/A	N/A	N/A	N/A
4	Uranium-235	1.52E+01	pCi/g	4.1E-05	3.73E-01	3.73E+00	3.73E+01	N/A	N/A	N/A	N/A
4	Uranium-238	8.49E+02	pCi/g	5.2E-04	1.65E+00	1.65E+01	1.65E+02	N/A	N/A	N/A	N/A
4	**Cumulative**			**7.2E-04**				**< 1**			
Excavation Worker											
1	Antimony	7.32E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.6	1.32E+01	1.32E+02	3.95E+02
1	Arsenic	1.01E+01	mg/kg	4.0E-06	2.52E+00	2.52E+01	2.52E+02	0.1	8.09E+00	8.09E+01	2.43E+02
1	Cobalt	1.17E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	9.82E+00	9.82E+01	2.95E+02
1	Iron	2.93E+04	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	2.30E+04	2.30E+05	6.91E+05
1	Manganese	8.52E+02	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	7.57E+02	7.57E+03	2.27E+04
1	Mercury	5.65E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.6	9.86E+00	9.86E+01	2.96E+02
1	PCB, Total	6.35E+00	mg/kg	5.5E-06	1.14E+00	1.14E+01	1.14E+02	< 0.1	N/A	N/A	N/A
1	Uranium	6.70E+02	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.7	9.80E+01	9.80E+02	2.94E+03
1	Vanadium	1.61E+02	mg/kg	< 1.0E-06	N/A	N/A	N/A	< 0.1	N/A	N/A	N/A
1	Uranium-238	6.95E+01	pCi/g	1.2E-05	5.95E+00	5.95E+01	5.95E+02	N/A	N/A	N/A	N/A
1	**Cumulative**			**2.3E-05**				**2.7**			
2	Antimony	2.73E+02	mg/kg	< 1.0E-06	N/A	N/A	N/A	2.1	1.32E+01	1.32E+02	3.95E+02
2	Arsenic	4.78E+01	mg/kg	1.9E-05	2.52E+00	2.52E+01	2.52E+02	0.6	8.09E+00	8.09E+01	2.43E+02
2	Cobalt	4.72E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.5	9.82E+00	9.82E+01	2.95E+02
2	Iron	4.46E+04	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.2	2.30E+04	2.30E+05	6.91E+05
2	Manganese	9.14E+02	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	7.57E+02	7.57E+03	2.27E+04
2	Mercury	2.36E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.2	9.86E+00	9.86E+01	2.96E+02
2	PAH, Total	3.85E-01	mg/kg	1.2E-06	3.25E-01	3.25E+00	3.25E+01	< 0.1	N/A	N/A	N/A
2	PCB, Total	8.33E+00	mg/kg	7.3E-06	1.14E+00	1.14E+01	1.14E+02	< 0.1	N/A	N/A	N/A
2	Thallium	1.68E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	5.1	3.29E-01	3.29E+00	9.86E+00
2	Uranium	1.15E+03	mg/kg	< 1.0E-06	N/A	N/A	N/A	1.2	9.80E+01	9.80E+02	2.94E+03
2	Cesium-137	8.23E+00	pCi/g	1.3E-05	6.12E-01	6.12E+00	6.12E+01	N/A	N/A	N/A	N/A
2	Radium-228	1.69E+00	pCi/g	4.6E-06	3.69E-01	3.69E+00	3.69E+01	N/A	N/A	N/A	N/A
2	Uranium-238	3.92E+01	pCi/g	6.6E-06	5.95E+00	5.95E+01	5.95E+02	N/A	N/A	N/A	N/A
2	**Cumulative**			**5.4E-05**				**10.3**			

Table 5.3.3. RGOs for SWMU 26 (Continued)

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3] 1E-06	1E-05	1E-04	HI[4]	RGOs for HI[3] 0.1	1	3
Excavation Worker (Continued)											
3	Antimony	6.79E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.5	1.32E+01	1.32E+02	3.95E+02
3	Arsenic	7.52E+01	mg/kg	3.0E-05	2.52E+00	2.52E+01	2.52E+02	0.9	8.09E+00	8.09E+01	2.43E+02
3	Iron	3.45E+04	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	2.30E+04	2.30E+05	6.91E+05
3	Mercury	1.79E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.2	9.86E+00	9.86E+01	2.96E+02
3	PAH, Total	3.47E-01	mg/kg	1.1E-06	3.25E-01	3.25E+00	3.25E+01	< 0.1	N/A	N/A	N/A
3	PCB, Total	5.51E+00	mg/kg	4.8E-06	1.14E+00	1.14E+01	1.14E+02	< 0.1	N/A	N/A	N/A
3	Thallium	2.51E+00	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.8	3.29E-01	3.29E+00	9.86E+00
3	Uranium	2.05E+02	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.2	9.80E+01	9.80E+02	2.94E+03
3	Cesium-137	3.38E+00	pCi/g	5.5E-06	6.12E-01	6.12E+00	6.12E+01	N/A	N/A	N/A	N/A
3	**Cumulative**			**4.3E-05**				**3.1**			
4	Antimony	7.32E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.6	1.32E+01	1.32E+02	3.95E+02
4	Arsenic	6.05E+01	mg/kg	2.4E-05	2.52E+00	2.52E+01	2.52E+02	0.7	8.09E+00	8.09E+01	2.43E+02
4	Cobalt	1.47E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	9.82E+00	9.82E+01	2.95E+02
4	Copper	3.24E+03	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.2	1.32E+03	1.32E+04	3.95E+04
4	Iron	3.21E+04	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	2.30E+04	2.30E+05	6.91E+05
4	Manganese	7.87E+02	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	7.57E+02	7.57E+03	2.27E+04
4	Mercury	1.90E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.2	9.86E+00	9.86E+01	2.96E+02
4	Nickel	1.21E+04	mg/kg	< 1.0E-06	N/A	N/A	N/A	1.9	6.45E+02	6.45E+03	1.93E+04
4	PAH, Total	4.28E+00	mg/kg	1.3E-05	3.25E-01	3.25E+00	3.25E+01	< 0.1	N/A	N/A	N/A
4	PCB, Total	7.96E+00	mg/kg	7.0E-06	1.14E+00	1.14E+01	1.14E+02	< 0.1	N/A	N/A	N/A
4	Thallium	1.53E+00	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.5	3.29E-01	3.29E+00	9.86E+00
4	Uranium	1.34E+03	mg/kg	< 1.0E-06	N/A	N/A	N/A	1.4	9.80E+01	9.80E+02	2.94E+03
4	Cesium-137	4.69E+00	pCi/g	7.7E-06	6.12E-01	6.12E+00	6.12E+01	N/A	N/A	N/A	N/A
4	Neptunium-237	3.87E+01	pCi/g	2.5E-05	1.56E+00	1.56E+01	1.56E+02	N/A	N/A	N/A	N/A
4	Plutonium-239/240	1.51E+01	pCi/g	1.5E-06	9.80E+00	9.80E+01	9.80E+02	N/A	N/A	N/A	N/A
4	Tc-99	3.81E+03	pCi/g	1.2E-05	3.05E+02	3.05E+03	3.05E+04	N/A	N/A	N/A	N/A
4	Thorium-230	8.68E+01	pCi/g	6.5E-06	1.34E+01	1.34E+02	1.34E+03	N/A	N/A	N/A	N/A
4	Uranium-234	3.46E+02	pCi/g	2.3E-05	1.51E+01	1.51E+02	1.51E+03	N/A	N/A	N/A	N/A
4	Uranium-235	2.46E+01	pCi/g	1.1E-05	2.18E+00	2.18E+01	2.18E+02	N/A	N/A	N/A	N/A
4	Uranium-238	8.24E+02	pCi/g	1.4E-04	5.95E+00	5.95E+01	5.95E+02	N/A	N/A	N/A	N/A
4	**Cumulative**			**2.7E-04**				**6.0**			

Table 5.3.3. RGOs for SWMU 26 (Continued)

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3]			HI[4]	RGOs for HI[3]		
					1E-06	1E-05	1E-04		0.1	1	3
Hypothetical Resident[5]											
1	Iron	2.88E+04	mg/kg	N/A	N/A	N/A	N/A	0.5	5.48E+03	5.48E+04	1.64E+05
1	PAH, Total	1.97E-01	mg/kg	8.7E-06	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
1	PCB, Total	9.40E+00	mg/kg	1.2E-04	7.82E-02	7.82E-01	7.82E+00	N/A	N/A	N/A	N/A
1	Uranium	6.28E+02	mg/kg	N/A	N/A	N/A	N/A	2.7	2.34E+01	2.34E+02	7.01E+02
1	Vanadium	1.61E+02	mg/kg	N/A	N/A	N/A	N/A	0.4	3.93E+01	3.93E+02	1.18E+03
1	Uranium-234	7.78E+00	pCi/g	1.4E-06	5.73E+00	5.73E+01	5.73E+02	N/A	N/A	N/A	N/A
1	Uranium-235	1.23E+00	pCi/g	1.1E-05	1.14E-01	1.14E+00	1.14E+01	N/A	N/A	N/A	N/A
1	Uranium-238	6.75E+01	pCi/g	1.4E-04	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
1	**Cumulative**			**2.8E-04**				**3.6**			
2	Aluminum	2.61E+04	mg/kg	N/A	N/A	N/A	N/A	0.3	7.73E+03	7.73E+04	2.32E+05
2	Arsenic	4.23E+01	mg/kg	1.6E-04	2.67E-01	2.67E+00	2.67E+01	2.5	1.67E+00	1.67E+01	5.01E+01
2	Cobalt	6.59E+01	mg/kg	N/A	N/A	N/A	N/A	2.8	2.34E+00	2.34E+01	7.02E+01
2	Iron	5.20E+04	mg/kg	N/A	N/A	N/A	N/A	0.9	5.47E+03	5.48E+04	1.64E+05
2	PCB, Total	3.25E+00	mg/kg	4.2E-05	7.82E-02	7.82E-01	7.82E+00	N/A	N/A	N/A	N/A
2	Thallium	2.38E+01	mg/kg	N/A	N/A	N/A	N/A	30.4	7.82E-02	7.82E-01	2.35E+00
2	Uranium	7.18E+02	mg/kg	N/A	N/A	N/A	N/A	3.1	2.34E+01	2.34E+02	7.01E+02
2	Vanadium	1.16E+02	mg/kg	N/A	N/A	N/A	N/A	0.3	3.93E+01	3.93E+02	1.18E+03
2	Cesium-137	9.52E+00	pCi/g	2.7E-04	3.51E-02	3.51E-01	3.51E+00	N/A	N/A	N/A	N/A
2	Neptunium-237	2.15E-01	pCi/g	2.8E-06	7.72E-02	7.72E-01	7.72E+00	N/A	N/A	N/A	N/A
2	Radium-228	1.69E+00	pCi/g	3.2E-05	5.25E-02	5.25E-01	5.25E+00	N/A	N/A	N/A	N/A
2	Uranium-234	1.98E+01	pCi/g	3.4E-06	5.73E+00	5.73E+01	5.73E+02	N/A	N/A	N/A	N/A
2	Uranium-235	2.36E+00	pCi/g	2.1E-05	1.14E-01	1.14E+00	1.14E+01	N/A	N/A	N/A	N/A
2	Uranium-238	5.01E+01	pCi/g	1.0E-04	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
2	**Cumulative**			**6.3E-04**				**40.7**			
3	Arsenic	7.56E+01	mg/kg	2.80E-04	2.67E-01	2.67E+00	2.67E+01	4.5	1.67E+00	1.67E+01	5.01E+01
3	Iron	3.46E+04	mg/kg	N/A	N/A	N/A	N/A	0.6	5.47E+03	5.48E+04	1.64E+05
3	Molybdenum	4.07E+01	mg/kg	N/A	N/A	N/A	N/A	0.1	3.91E+01	3.91E+02	1.17E+03
3	PAH, Total	3.30E-01	mg/kg	1.5E-05	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
3	PCB, Total	8.91E+00	mg/kg	1.1E-04	7.82E-02	7.82E-01	7.82E+00	N/A	N/A	N/A	N/A
3	Thallium	3.68E+00	mg/kg	N/A	N/A	N/A	N/A	4.7	7.82E-02	7.82E-01	2.35E+00
3	Uranium	2.05E+02	mg/kg	N/A	N/A	N/A	N/A	0.9	2.34E+01	2.34E+02	7.01E+02
3	Vanadium	1.44E+02	mg/kg	N/A	N/A	N/A	N/A	0.4	3.93E+01	3.93E+02	1.18E+03

Table 5.3.3. RGOs for SWMU 26 (Continued)

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3] 1E-06	RGOs for ELCR[3] 1E-05	RGOs for ELCR[3] 1E-04	HI[4]	RGOs for HI[3] 0.1	RGOs for HI[3] 1	RGOs for HI[3] 3
Hypothetical Resident[5] (Continued)											
3	Cesium-137	4.51E+00	pCi/g	1.3E-04	3.51E-02	3.51E-01	3.51E+00	N/A	N/A	N/A	N/A
3	Neptunium-237	3.70E-01	pCi/g	4.8E-06	7.72E-02	7.72E-01	7.72E+00	N/A	N/A	N/A	N/A
3	Uranium-235	3.15E-01	pCi/g	2.8E-06	1.14E-01	1.14E+00	1.14E+01	N/A	N/A	N/A	N/A
3	Uranium-238	7.00E+00	pCi/g	1.4E-05	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
3	**Cumulative**			**5.6E-04**				**11.2**			
4	Aluminum	1.11E+04	mg/kg	N/A	N/A	N/A	N/A	0.1	7.73E+03	7.73E+04	2.32E+05
4	Arsenic	6.01E+01	mg/kg	2.3E-04	2.67E-01	2.67E+00	2.67E+01	3.6	1.67E+00	1.67E+01	5.01E+01
4	Iron	2.81E+04	mg/kg	N/A	N/A	N/A	N/A	0.5	5.48E+03	5.48E+04	1.64E+05
4	Mercury	7.33E+01	mg/kg	N/A	N/A	N/A	N/A	3.1	2.35E+00	2.35E+01	7.04E+01
4	PAH, Total	5.53E+00	mg/kg	2.4E-04	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
4	PCB, Total	7.95E+00	mg/kg	1.0E-04	7.82E-02	7.82E-01	7.82E+00	N/A	N/A	N/A	N/A
4	Uranium	1.47E+03	mg/kg	N/A	N/A	N/A	N/A	6.3	2.34E+01	2.34E+02	7.01E+02
4	Vanadium	1.42E+02	mg/kg	N/A	N/A	N/A	N/A	0.4	3.93E+01	3.93E+02	1.18E+03
4	Cesium-137	1.02E+00	pCi/g	2.9E-05	3.51E-02	3.51E-01	3.51E+00	N/A	N/A	N/A	N/A
4	Neptunium-237	2.80E+00	pCi/g	3.6E-05	7.72E-02	7.72E-01	7.72E+00	N/A	N/A	N/A	N/A
4	Plutonium-239/240	1.35E+01	pCi/g	3.6E-06	3.73E+00	3.73E+01	3.73E+02	N/A	N/A	N/A	N/A
4	Tc-99	8.36E+02	pCi/g	7.8E-06	1.07E+02	1.07E+03	1.07E+04	N/A	N/A	N/A	N/A
4	Thorium-230	5.48E+01	pCi/g	1.1E-05	4.89E+00	4.89E+01	4.89E+02	N/A	N/A	N/A	N/A
4	Uranium-234	2.15E+02	pCi/g	3.8E-05	5.73E+00	5.73E+01	5.73E+02	N/A	N/A	N/A	N/A
4	Uranium-235	1.52E+01	pCi/g	1.3E-04	1.14E-01	1.14E+00	1.14E+01	N/A	N/A	N/A	N/A
4	Uranium-238	8.49E+02	pCi/g	1.7E-03	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
4	**Cumulative**			**2.5E-03**				**14.2**			

Grayed cells indicate EPC value is lower than RGO value or an RGO value is not applicable.
N/A = Not applicable because the COC was not applicable (i.e., the COC was of concern for HI, but not ELCR or it was of concern for ELCR by not HI).
[1] See Tables D.6 and D.7 (Appendix D) for EPC values.
[2] See Appendix D, Exhibit D.6, for ELCR.
[3] See Table D.47 for RGOs.
[4] See Appendix D, Exhibit D.6, for HI.
[5] RGOs for residential land use are based on exposure to a resident age 1-27. For carcinogens, the dose method incorporates age-adjusted values for the 26-year exposure duration. Because child soil ingestion rates are higher and body weights are lower, noncancer RGOs are based on the child resident exposure assumptions.

Table 5.3.4. Ecological Screening for SWMU 26

Ground Cover	Near a Surface Water Body?	Total HI[a]	Priority COPECs[b]	Background (mg/kg)[c]	Soil ESV (mg/kg)[d]	Maximum (mg/kg)	HQ (max conc)[a]	EPC (mg/kg)	HQ (EPC)[a]
soil/gravel mix	Yes	1,125	Aluminum	13,000	50	34,600	692	17,359	347.2
			Antimony	0.21	0.27	8.95	33.15	6.596	24.4
			High molecular weight PAHs	N/A	1.1	29.4	26.73	15.07	13.7
			Iron	28,000	200	85,100	425.5	30,020	150.1
			Mercury	0.2	0.1	20	200	21.16	211.6
			PCB, Total	N/A	0.02	2.5	125	2.115	105.8
			Uranium	4.9	5	3100	620	792.6	158.5
			Vanadium	38	7.8	195	25	141.6	18.2

Table is from Appendix E, Table E.1.
[a] Total HI includes concentrations from all of the COPECs (listed in Table E4.1), only priority COPECs (i.e., the COPECs with HQs greater than 10, using the EPCs) are shown in this table.
[b] Only priority COPECs are listed. See Appendix E for additional COPECs.
[c] Background value is from DOE 2015b.
[d] ESVs from DOE 2015c and Appendix E of this report.

Goal 2. Determine Surface and Subsurface Transport Mechanisms and Pathways

The metal and radionuclide contaminants at SWMU 26 are readily adsorbed to soil particles, so they do not migrate without a direct connection to surface water. Tc-99 was modeled for groundwater transport, and the modeling does not indicate that contamination reaches the RGA (Appendix C). Organic contaminants are likely from the contaminant plume that originates at the south end of the C-400 Building and flows northwest under SWMU 26. Organic contamination at C-400 is being addressed by the VOC contamination at the C-400 Cleaning Building ROD (DOE 2005). The CSM can be found in Appendix D.

Goal 3. Complete a Baseline Risk Assessment for the Soils OU

Cumulative ELCRs or HIs exceeded benchmarks of 1E-06 and 1, respectively, for the future industrial worker, excavation worker, and hypothetical residential scenarios. COCs for these scenarios for SWMU 26 are as follows:

- Future Industrial worker
    - Arsenic
    - Cobalt
    - Thallium
    - Uranium
    - Total PAHs
    - Total PCBs
    - Cesium-137
    - Neptunium-237
    - Plutonium-239/240
    - Radium-228
    - Tc-99
    - Thorium-230
    - Uranium-234

— Uranium-235
— Uranium-238

- Excavation worker

  — Antimony
  — Arsenic
  — Cobalt
  — Copper
  — Iron
  — Manganese
  — Mercury
  — Nickel
  — Thallium
  — Uranium
  — Vanadium
  — Total PAHs
  — Total PCBs
  — Cesium-137
  — Neptunium-237
  — Plutonium-239/240
  — Radium-228
  — Tc-99
  — Thorium-230
  — Uranium-234
  — Uranium-235
  — Uranium-238

- Hypothetical Resident (hazards evaluated against the child resident)

  — Aluminum
  — Arsenic
  — Cobalt
  — Iron
  — Mercury
  — Molybdenum
  — Thallium
  — Uranium
  — Vanadium
  — Total PAHs
  — Total PCBs
  — Cesium-137
  — Neptunium-237
  — Plutonium-239/240
  — Radium-228
  — Tc-99
  — Thorium-230
  — Uranium-234
  — Uranium-235
  — Uranium-238

Figure 5.3.8 shows the COCs exceeding RGOs for the future industrial worker.

Priority COCs (i.e., HQ > 1 or chemical-specific ELCR > 1E-04) for SWMU 26 are located in all EUs. The priority COCs are thallium and uranium-238 for the industrial worker; and Total PAHs, Total PCBs, arsenic, cobalt, mercury, thallium, uranium, cesium-137, uranium-235, and uranium-238 for the hypothetical resident. Priority COCs for other scenarios are described in Appendix D.

No priority COCs were identified for groundwater modeled from soil.

For SWMU 26, COPECs exceed ESVs. Priority COPECs (i.e., maximum HQ ≥ 10) are the following:

- Aluminum
- Antimony
- High Molecular Weight PAHs
- Mercury
- Total PCBs
- Uranium
- Vanadium

Goal 4. Support Evaluation of Remedial Alternatives

The representative data set used for SWMU 26 is sufficient to support decision making and indicates that an FS is appropriate. An uncertainty concerning depth of contamination should be considered in the FS. Possible remedial technologies applicable for this unit are, as discussed in the Work Plan (DOE 2010a), posting, fencing (or other means of limiting access), excavation, and/or other remedial technologies that will be described in the FS.

SWMU 26 is adjacent to the SWMU 97 (C-601 Diesel Spill), which was the subject of a SWOU CERCLA removal action in the summer of 2010, and SWMU 59 (NSDD), which was the subject of a CERCLA remedial action in the spring of 2004. Additionally, SWMU 26 is adjacent and partially overlaps SWMU 165 (C-616-L Pipeline & Vault Soil Contamination) and SWMU 200 (Soil Contamination South of Toxic Substances Control Act Waste Storage Facility), both of which were addressed during the Soils OU RI. Further, SWMU 26 connected the C-403 Neutralization Tank at the C-400 Cleaning Building (which is SWMU 40, part of post-GDP Soils and Slabs OU) to the C 404 Lagoon (which is SWMU 3, part of the BGOU). A response action at SWMU 26 could have an effect on all of these SWMUs.

5.3.8 SWMU 26 Conclusion

The RI defined the nature and extent of contamination in soils at SWMU 26; an FS is appropriate for the SWMU due to cancer risks and/or noncancer hazards exceeding the decision rule benchmarks for scenarios including the future industrial worker, excavation worker, and hypothetical resident (DOE 2010a). The reasonably anticipated future land use of this SWMU is industrial, as shown in the SMP (DOE 2015a).

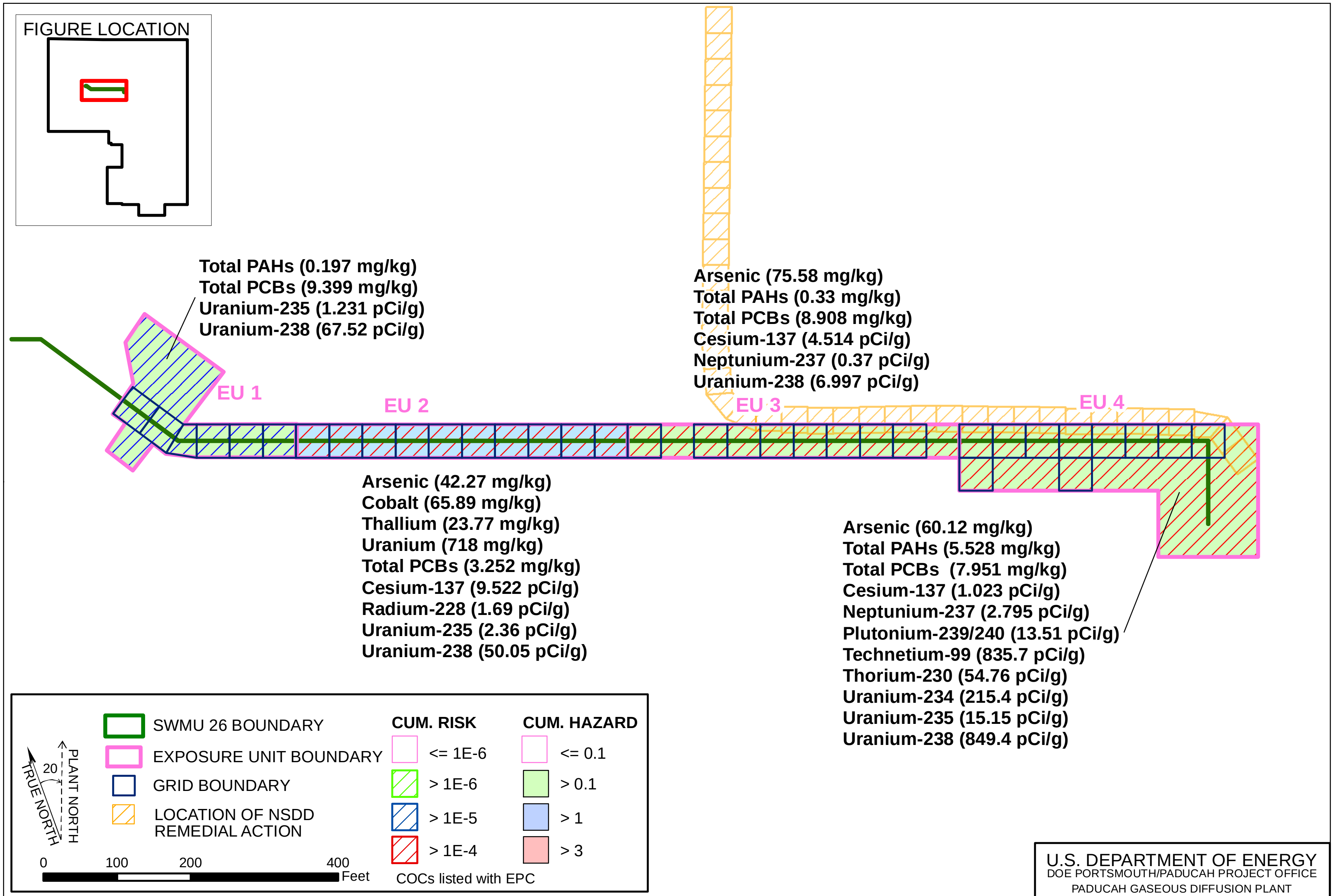

Figure 5.3.8. Summary of COCs Contributing to Risk to the Future Industrial Worker at SWMU 26

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5.4 SWMU 77, C-634-B, Sulfuric Acid Storage Tank

5.4.1 Background

The C-634-B Sulfuric Acid Storage Tank (SWMU 77) is located in the southeast portion of the plant site. The tank has been removed, but the concrete dike still is in place. The tank was used for the storage of sulfuric acid. Spills and/or releases of sulfuric acid from the storage tank potentially occurred when the unit was in use. There is no direct connection between this SWMU and surface water and it is less than 0.5 acres. This SWMU will be addressed as part of the Soils and Slabs OU, which is scheduled to occur during post-GDP shutdown activities.

5.4.2 Fieldwork Summary

SWMU 77 has a concrete surface; therefore, during the first RI for the Soils OU, characterization entailed only a radiation evaluation and a visual inspection for oil staining. No staining was noted. A gamma walkover survey was not performed due to the unit's proximity to a cylinder yard.

During RI 2, one grid sample was planned and collected. The subsurface five-point composite was obtained from two locations next to the pump station, two locations along the west wall of the unit, and one location within the grass area between the concrete pad and road on the east side of the unit. Ground surface along the west wall consisted of gravel; therefore, the surface sample consisted of a 3-point composite from the two locations next to the pump station and one location within the grass area between the concrete pad and road on the east side of the unit. Field laboratory results indicated that contingency samples were needed to determine the nature and extent of contamination because of elevated concentrations of uranium and PCBs. Three contingency samples were planned and collected.

5.4.3 Nature and Extent of Contamination—Surface Soils

The representative data set presented in Table 5.4.1 provides the nature of the contamination in SWMU 77 surface soils, and Figures 5.4.1–5.4.3 illustrate the horizontal extent. A complete list of sampling results is provided in Appendix F (samples with ending depths of 1 ft bgs or less or null are considered surface soils).

The lateral extent of SWMU 77 surface soil contamination is considered defined adequately for supporting the BRA and FS. SWMU 77 consists of 1 EU.

<u>Metals</u>

No metals were detected in the surface soil above both the background screening level and the industrial worker NAL. None were detected above both the background screening level and industrial worker ALs.

The following metals were detected in the SWMU 77 surface soil above both the SSLs for the protection of UCRS groundwater and the background screening levels (if available): antimony, cadmium, copper, iron, molybdenum, nickel, uranium, vanadium, and zinc in grid 1 and lead in grid 1A. Iron was detected above the SSL for the protection of RGA groundwater and the background screening level in grids 1, 1B, and 1C.

<u>PCBs</u>

Total PCBs were detected above the industrial worker NAL in the surface soil in SWMU 77 in grid 1. None were detected above industrial worker ALs.

Table 5.4.1. Surface Soil Data Summary: SWMU 77

Type	Analysis	Unit	Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
			Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
METAL	Aluminum	mg/kg	2.30E+03	2.30E+03	2.30E+03	0/1	1/1	0/1	1.30E+04	0/1	1.00E+05	0/1	1.00E+05	0/1	0/1	4.3–4.3
METAL	Antimony	mg/kg	3.80E-01	3.80E-01	3.80E-01	0/1	1/1	1/1	2.10E-01	0/1	9.34E+01	0/1	2.80E+03	0/1	1/1	0.026–0.026
METAL	Arsenic	mg/kg	3.70E+00	3.70E+00	3.70E+00	0/5	1/5	0/5	1.20E+01	1/5	1.41E+00	0/5	1.41E+02	0/5	1/5	0.17–10
METAL	Barium	mg/kg	1.00E+02	1.00E+02	1.00E+02	0/1	1/1	0/1	2.00E+02	0/1	4.04E+04	0/1	1.00E+05	0/1	1/1	0.087–0.087
METAL	Beryllium	mg/kg	1.80E-01	1.80E-01	1.80E-01	0/1	1/1	0/1	6.70E-01	0/1	4.50E+02	0/1	1.35E+04	0/1	0/1	0.043–0.043
METAL	Cadmium	mg/kg	5.30E-01	5.30E-01	5.30E-01	0/1	1/1	1/1	2.10E-01	0/1	6.12E+01	0/1	1.84E+03	0/1	1/1	0.026–0.026
METAL	Calcium	mg/kg	2.20E+05	2.20E+05	2.20E+05	0/1	1/1	1/1	2.00E+05	0/1	N/A	0/1	N/A	N/A	N/A	87–87
METAL	Chromium	mg/kg	4.50E+01	8.30E+01	5.45E+01	0/5	2/5	2/5	1.60E+01	0/5	1.98E+02	0/5	1.98E+04	0/5	0/5	0.87–12
METAL	Cobalt	mg/kg	2.50E+00	2.50E+00	2.50E+00	0/1	1/1	0/1	1.40E+01	0/1	6.87E+01	0/1	2.06E+03	1/1	1/1	0.087–0.087
METAL	Copper	mg/kg	4.30E+01	1.70E+02	8.77E+01	0/5	5/5	5/5	1.90E+01	0/5	9.34E+03	0/5	1.00E+05	0/5	3/5	0.87–4
METAL	Iron	mg/kg	2.28E+04	5.03E+04	3.14E+04	0/5	5/5	3/5	2.80E+04	0/5	1.00E+05	0/5	1.00E+05	5/5	5/5	8.7–12
METAL	Lead	mg/kg	1.80E+01	5.00E+01	2.60E+01	0/5	2/5	1/5	3.60E+01	0/5	8.00E+02	0/5	8.00E+02	0/5	2/5	0.043–3
METAL	Magnesium	mg/kg	7.60E+03	7.60E+03	7.60E+03	0/1	1/1	0/1	7.70E+03	0/1	N/A	0/1	N/A	N/A	N/A	8.7–8.7
METAL	Manganese	mg/kg	9.30E+01	6.50E+02	3.31E+02	0/5	5/5	0/5	1.50E+03	0/5	4.72E+03	0/5	1.00E+05	3/5	5/5	0.17–24
METAL	Mercury	mg/kg	3.80E-02	3.80E-02	3.80E-02	0/5	1/5	0/5	2.00E-01	0/5	7.01E+01	0/5	2.10E+03	0/5	1/5	0.024–40
METAL	Molybdenum	mg/kg	6.00E-01	6.00E-01	6.00E-01	0/5	1/5	0/5	N/A	0/5	1.17E+03	0/5	3.51E+04	0/5	1/5	0.087–3
METAL	Nickel	mg/kg	1.60E+01	4.00E+01	2.68E+01	0/5	4/5	3/5	2.10E+01	0/5	4.30E+03	0/5	1.00E+05	0/5	4/5	0.43–4
METAL	Selenium	mg/kg	3.40E-01	3.40E-01	3.40E-01	0/5	1/5	0/5	8.00E-01	0/5	1.17E+03	0/5	3.51E+04	0/5	1/5	0.087–3
METAL	Silver	mg/kg	5.80E-02	5.80E-02	5.80E-02	0/5	1/5	0/5	2.30E+00	0/5	1.17E+03	0/5	3.51E+04	0/5	0/5	0.0087–50
METAL	Sodium	mg/kg	1.60E+02	1.60E+02	1.60E+02	0/1	1/1	0/1	3.20E+02	0/1	N/A	0/1	N/A	N/A	N/A	87–87
METAL	Thallium	mg/kg	6.00E-02	6.00E-02	6.00E-02	0/1	1/1	0/1	2.10E-01	0/1	2.34E+00	0/1	7.02E+01	0/1	0/1	0.017–0.017
METAL	Uranium	mg/kg	6.50E+01	6.66E+02	3.81E+02	0/5	4/5	4/5	4.90E+00	0/5	6.81E+02	0/5	2.04E+04	0/5	4/5	0.0087–10
METAL	Vanadium	mg/kg	8.90E+01	1.68E+02	1.15E+02	0/5	5/5	5/5	3.80E+01	0/5	1.15E+03	0/5	3.45E+04	0/5	5/5	0.087–5
METAL	Zinc	mg/kg	4.00E+01	1.78E+02	1.31E+02	0/5	5/5	4/5	6.50E+01	0/5	7.01E+04	0/5	1.00E+05	0/5	5/5	1–1.7
PPCB	PCB, Total	mg/kg	4.00E+00	5.00E+00	4.67E+00	0/6	2/6	0/6	N/A	2/6	3.05E-01	0/6	3.05E+01	1/6	2/6	0.05–0.05
SVOA	1,2,4-Trichlorobenzene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	1,2-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	1,3-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	1,4-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	2,4,5-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	2,4,6-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	2,4-Dichlorophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	2,4-Dimethylphenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	2,4-Dinitrophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.71–0.71
SVOA	2,4-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.21–0.21
SVOA	2,6-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.21–0.21
SVOA	2-Chloronaphthalene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	2-Chlorophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	2-Methyl-4,6-dinitrophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.71–0.71
SVOA	2-Methylnaphthalene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	2-Methylphenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	2-Nitrobenzenamine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	2.91E+02	0/1	8.73E+03	0/1	0/1	0.71–0.71
SVOA	2-Nitrophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	3,3'-Dichlorobenzidine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.21–0.21
SVOA	3-Nitrobenzenamine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.71–0.71
SVOA	4-Bromophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	4-Chloro-3-methylphenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	4-Chlorobenzenamine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	4-Chlorophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	4-Nitrophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.71–0.71
SVOA	Acenaphthene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	1.40E+03	0/1	4.20E+04	0/1	0/1	0.36–0.36
SVOA	Acenaphthylene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	1.40E+03	0/1	4.20E+04	N/A	N/A	0.36–0.36
SVOA	Anthracene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	6.99E+03	0/1	2.10E+05	0/1	0/1	0.36–0.36

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.4.1. Surface Soil Data Summary: SWMU 77 (Continued)

Type	Analysis	Unit	Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
			Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
SVOA	Benzenemethanol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	Benzo(ghi)perylene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	Benzoic Acid	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	1.8–1.8
SVOA	bis(2-chloroethoxy)methane	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	bis(2-Chloroethyl) ether	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	bis(2-Chloroisopropyl) ether	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	bis(2-ethylhexyl)phthalate	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	5.88E+01	0/1	5.88E+03	0/1	0/1	0.36–0.36
SVOA	Butyl benzyl phthalate	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	Dibenzofuran	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	Diethyl phthalate	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	Dimethyl phthalate	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	Di-n-butyl phthalate	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	Di-n-octylPhthalate	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	Fluoranthene	mg/kg	1.50E-01	1.50E-01	1.50E-01	1/1	1/1	0/1	N/A	0/1	9.32E+02	0/1	2.80E+04	0/1	0/1	0.36–0.36
SVOA	Fluorene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	9.32E+02	0/1	2.80E+04	0/1	0/1	0.36–0.36
SVOA	Hexachlorobenzene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	5.15E-01	0/1	5.15E+01	0/1	0/1	0.0036–0.0036
SVOA	Hexachlorobutadiene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.21–0.21
SVOA	Hexachlorocyclopentadiene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	Hexachloroethane	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	Isophorone	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	m,p-cresol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	Naphthalene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	1.67E+01	0/1	1.61E+03	0/1	0/1	0.36–0.36
SVOA	Nitrobenzene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	N-Nitroso-di-n-propylamine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	1.18E-01	0/1	1.18E+01	0/1	0/1	0.36–0.36
SVOA	N-Nitrosodiphenylamine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	PAH, Total	mg/kg	7.02E-02	7.02E-02	7.02E-02	0/1	1/1	0/1	N/A	0/1	8.94E-02	0/1	8.94E+00	0/1	0/1	–
SVOA	Pentachlorophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	8.91E-01	0/1	8.91E+01	N/A	N/A	0.64–0.64
SVOA	Phenanthrene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	1.40E+03	0/1	4.20E+04	0/1	0/1	0.36–0.36
SVOA	Phenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
SVOA	p-Nitroaniline	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.71–0.71
SVOA	Pyrene	mg/kg	1.50E-01	1.50E-01	1.50E-01	1/1	1/1	0/1	N/A	0/1	6.99E+02	0/1	2.10E+04	0/1	0/1	0.36–0.36
SVOA	Pyridine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.36–0.36
RADS	Americium-241	pCi/g	4.37E-02	4.37E-02	4.37E-02	0/2	1/2	0/2	N/A	0/2	5.99E+00	0/2	5.99E+02	0/2	0/2	0.0335–0.0335
RADS	Cesium-137	pCi/g	4.70E-02	4.70E-02	4.70E-02	0/2	1/2	0/2	4.90E-01	0/2	1.02E-01	0/2	1.02E+01	0/2	0/2	0.0159–0.0159
RADS	Cobalt-60	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	–
RADS	Neptunium-237	pCi/g	2.10E-01	2.10E-01	2.10E-01	0/2	1/2	1/2	1.00E-01	0/2	2.29E-01	0/2	2.29E+01	0/2	1/2	0.0544–0.0544
RADS	Plutonium-238	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	7.30E-02	0/1	2.87E+01	0/1	2.87E+03	0/1	0/1	0.0178–0.0178
RADS	Plutonium-239/240	pCi/g	2.83E-01	2.83E-01	2.83E-01	0/2	1/2	1/2	2.50E-02	0/2	2.47E+01	0/2	2.47E+03	0/2	1/2	0.00724–0.00724
RADS	Technetium-99	pCi/g	1.85E+00	1.85E+00	1.85E+00	0/2	1/2	0/2	2.50E+00	0/2	1.20E+03	0/2	1.20E+05	1/2	1/2	0.686–0.686
RADS	Thorium-228	pCi/g	4.03E-01	4.03E-01	4.03E-01	0/1	1/1	0/1	1.60E+00	0/1	N/A	0/1	N/A	N/A	N/A	0.104–0.104
RADS	Thorium-230	pCi/g	1.03E+01	1.03E+01	1.03E+01	0/2	1/2	1/2	1.50E+00	0/2	3.39E+01	0/2	3.39E+03	0/2	1/2	0.105–0.105
RADS	Thorium-232	pCi/g	4.71E-01	4.71E-01	4.71E-01	0/1	1/1	0/1	1.50E+00	0/1	N/A	0/1	N/A	N/A	N/A	0.0281–0.0281
RADS	Uranium-234	pCi/g	4.18E+00	4.18E+00	4.18E+00	0/1	1/1	1/1	1.20E+00	0/1	5.53E+01	0/1	5.53E+03	1/1	1/1	0.0481–0.0481
RADS	Uranium-235	pCi/g	3.14E-01	3.14E-01	3.14E-01	0/1	1/1	1/1	6.00E-02	0/1	3.40E-01	0/1	3.40E+01	0/1	1/1	0.0161–0.0161
RADS	Uranium-238	pCi/g	1.53E+01	1.53E+01	1.53E+01	0/1	1/1	1/1	1.20E+00	1/1	1.60E+00	0/1	1.60E+02	1/1	1/1	0.0452–0.0452

One or more samples exceed AL value
One or more samples exceed NAL value
One or more samples exceed background value
One or more samples exceed SSLs of RGA and UCRS groundwater protection

Counts of analyses are based on the maximum detected result from a sample (i.e., if a sample has analytical results from two different labs, only the maximum value is counted).
Field replicates, or separate samples are counted independently.

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.4.1. Surface Soil Data Summary: SWMU 77 (Continued)

Type	Analysis	Unit	Detected Results			J-qualified	FOD	Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		DL Range
			Min	Max	Avg	FOD		FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	

The uranium (metal)/uranium (isotopic) may not be from the same sample thus a correlation between uranium (metal)/uranium (isotopic) data may not be possible.
Uranium-238 that was analyzed using method RL-7128NITRIC is compared to a background value of 0.4 pCi/g for surface and subsurface.

Screening values are shown in Appendices C and D.

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

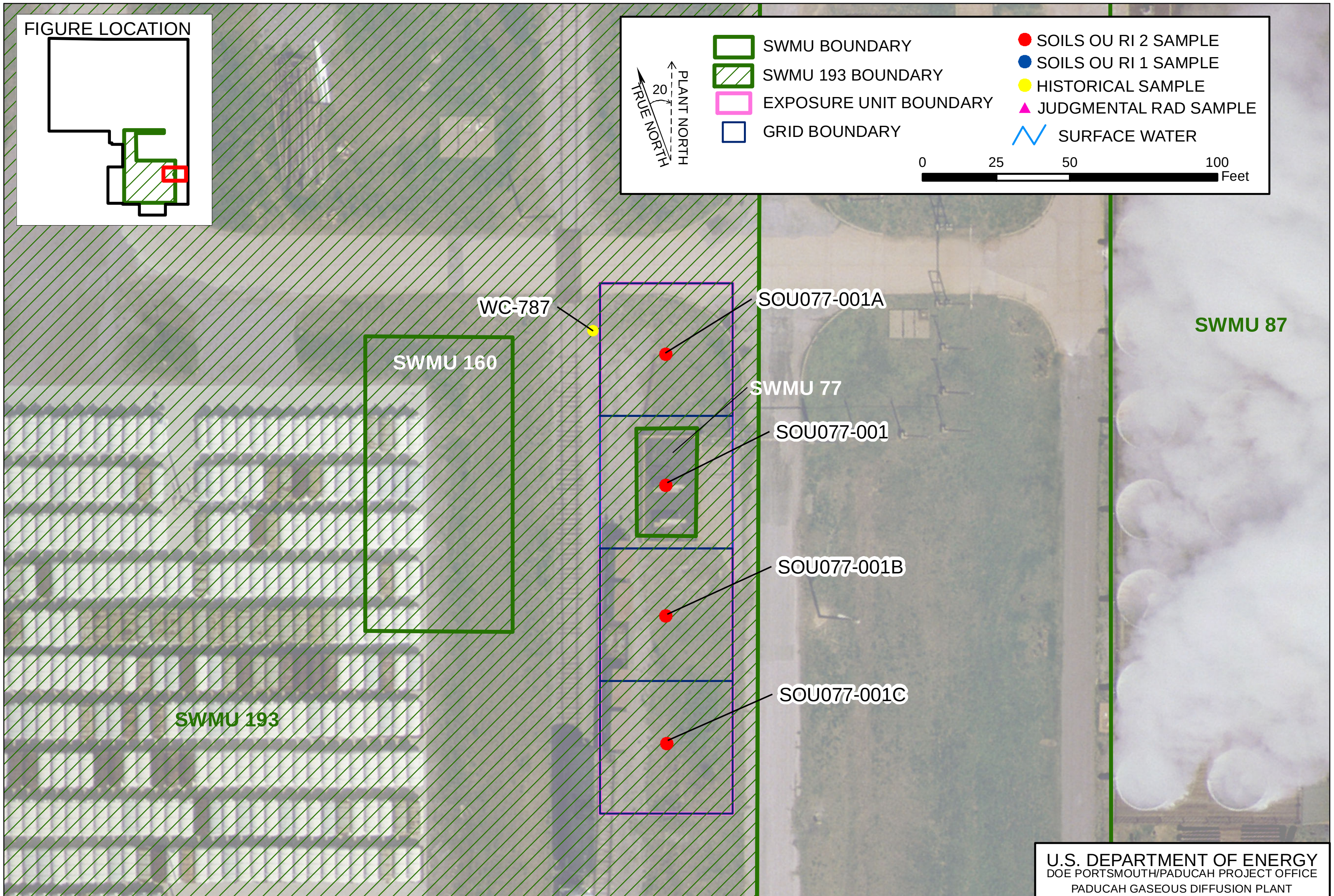

Figure 5.4.1. SWMU 77 Sample Locations—Surface Soil

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3/12/2015

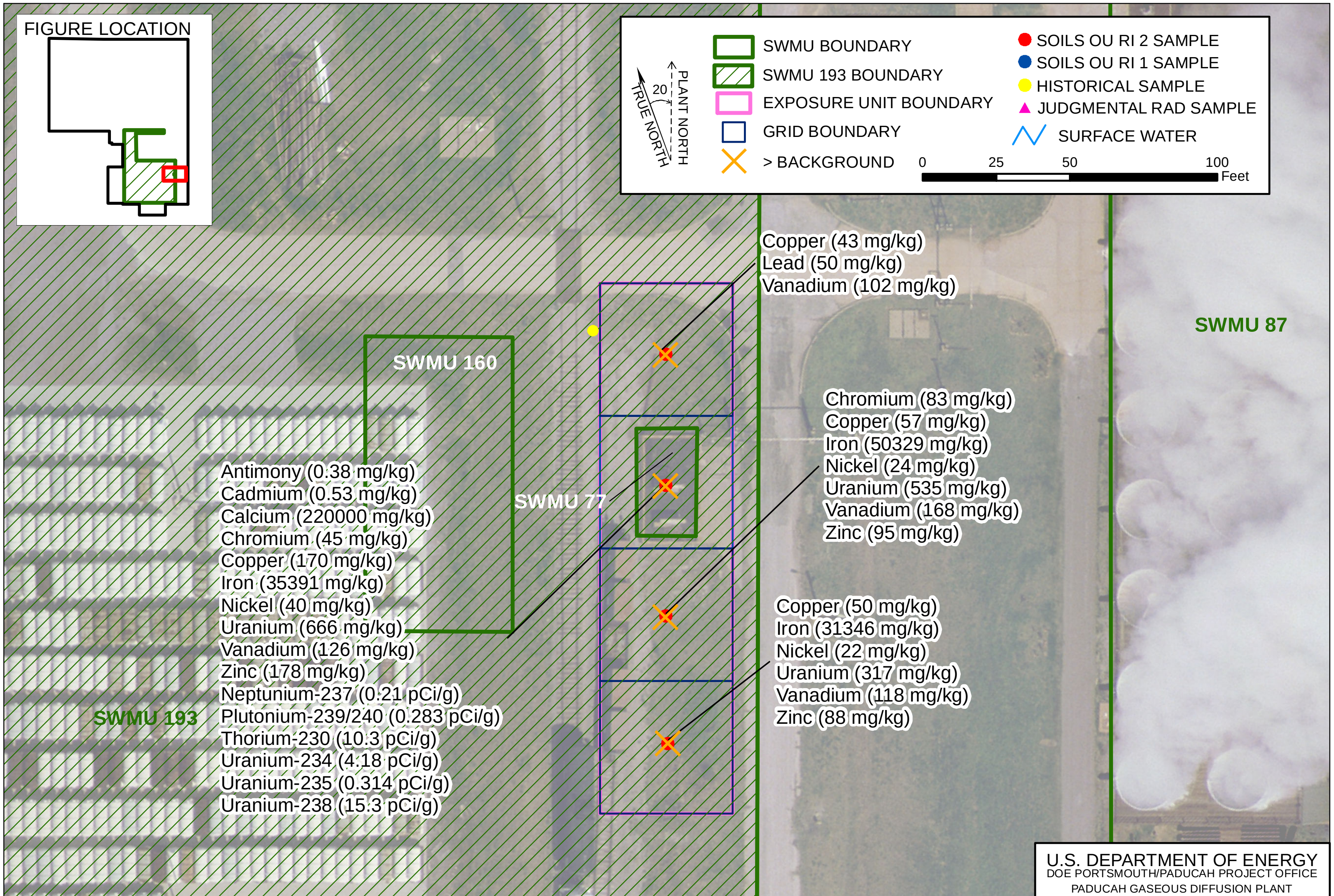

Figure 5.4.2. SWMU 77 Background Exceedances—Surface Soil

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3/12/2015

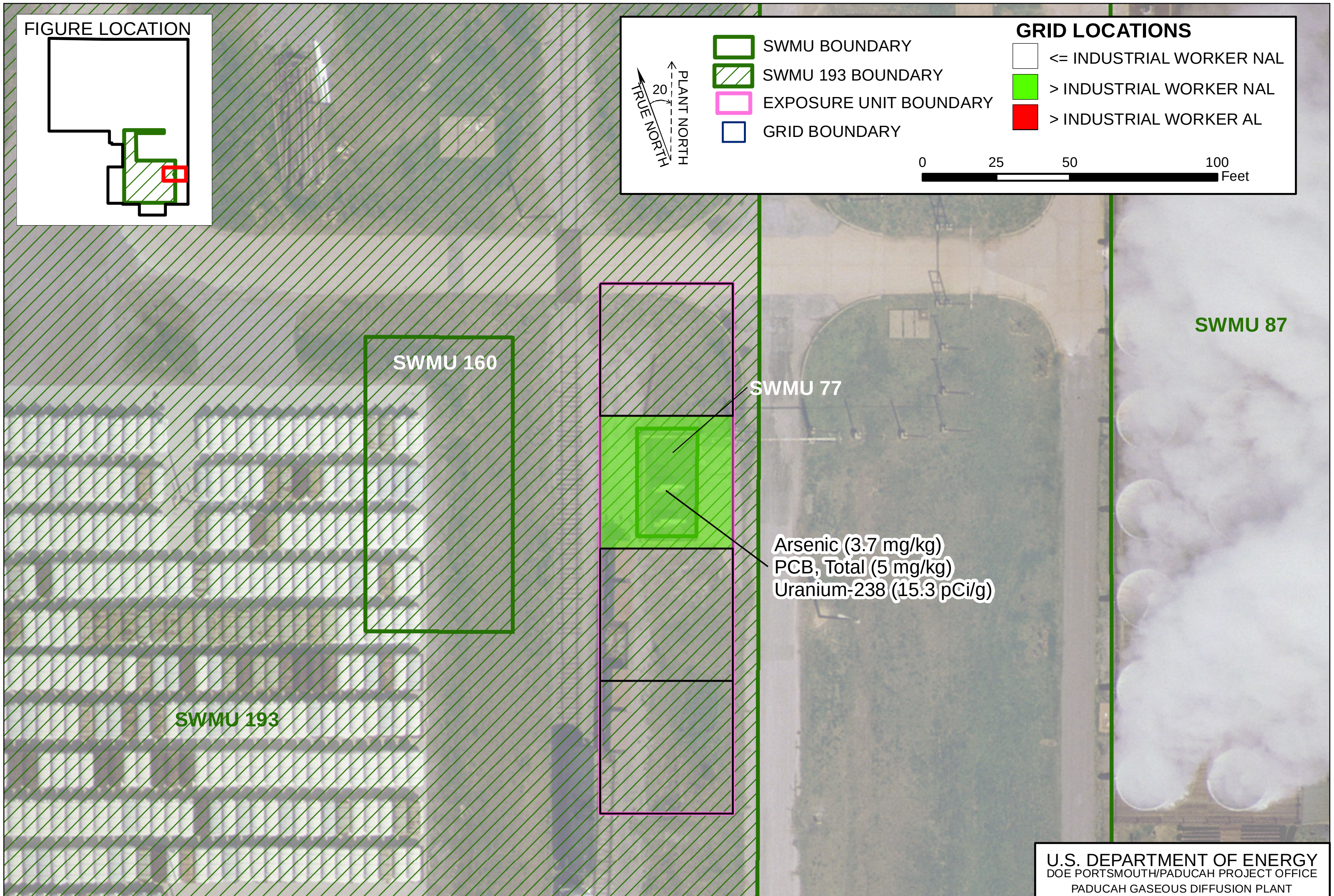

Figure 5.4.3. SWMU 77 NAL Exceedances—Surface Soil

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Total PCBs were detected in the SWMU 77 surface soil above the SSLs for the protection of both UCRS groundwater and RGA groundwater.

SVOCs

SVOCs were not detected above industrial worker NALs or ALs in the surface soil in SWMU 77 or above the SSLs for the protection of either UCRS groundwater or RGA groundwater.

VOCs

No VOCs were analyzed in the SWMU 77 surface soil.

Radionuclides

Uranium-238 was detected above both the background screening level and the industrial worker NAL in grid 1. No radionuclides were detected above industrial worker ALs in the SWMU 77 surface soil.

The following were detected in grid 1 above both the background screening levels and SSLs for the protection of UCRS: neptunium-237, plutonium-239/240, thorium-230, uranium-234, uranium-235, and uranium-238. Additionally, uranium-234 and uranium-238 were detected above both the background screening levels and the SSL for the protection of RGA groundwater.

pH

Analytical parameters for this unit included pH. The pH in the surface sample was 8.12.

5.4.4 Nature and Extent of Contamination—Subsurface Soils

The representative data set presented in Table 5.4.2 provides the nature of contamination in SWMU 77 subsurface soils, and Figures 5.4.4–5.4.6 illustrate the horizontal extent. A complete list of detailed sampling results, including sampling depths, is provided in Appendix F (samples with ending depths greater than 1 ft bgs are considered subsurface soils in this nature and extent section).

The horizontal and vertical extent of SWMU 77 subsurface soil contamination is considered defined adequately for supporting the BRA and FS. There is some uncertainty with vertical extent; however, this will be addressed in the FS.

Metals

No metals were detected above both the industrial worker NALs and background screening levels in the SWMU 77 subsurface soil. None were detected above both the industrial worker ALs and background screening levels.

The following metals were detected in the SWMU 77 subsurface soil above both the background screening levels (if available) and the SSLs for the protection of UCRS groundwater: iron, molybdenum, selenium, uranium, vanadium, and zinc in grid 1; nickel in grid 1A; and copper in grid 1C. Iron was detected above both its subsurface background screening level and the SSL for the protection of RGA groundwater in all four grids.

PCBs

Total PCBs were not detected above industrial worker NALs or ALs in the subsurface soil.

Table 5.4.2. Subsurface Soil Data Summary: SWMU 77

Type	Analysis	Unit	Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		DL Range
			Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	
METAL	Aluminum	mg/kg	8.30E+03	8.30E+03	8.30E+03	0/1	1/1	0/1	1.20E+04	0/1	1.00E+05	0/1	1.00E+05	0/1	1/1	5–5
METAL	Antimony	mg/kg	1.30E-01	1.30E-01	1.30E-01	0/1	1/1	0/1	2.10E-01	0/1	9.34E+01	0/1	2.80E+03	0/1	0/1	0.03–0.03
METAL	Arsenic	mg/kg	5.70E+00	5.70E+00	5.70E+00	0/5	1/5	0/5	7.90E+00	1/5	1.41E+00	0/5	1.41E+02	0/5	1/5	0.2–10
METAL	Barium	mg/kg	1.40E+02	1.40E+02	1.40E+02	0/1	1/1	0/1	1.70E+02	0/1	4.04E+04	0/1	1.00E+05	0/1	1/1	0.1–0.1
METAL	Beryllium	mg/kg	5.20E-01	5.20E-01	5.20E-01	0/1	1/1	0/1	6.90E-01	0/1	4.50E+02	0/1	1.35E+04	0/1	0/1	0.05–0.05
METAL	Cadmium	mg/kg	1.50E-01	1.50E-01	1.50E-01	0/1	1/1	0/1	2.10E-01	0/1	6.12E+01	0/1	1.84E+03	0/1	0/1	0.03–0.03
METAL	Calcium	mg/kg	3.90E+04	3.90E+04	3.90E+04	0/1	1/1	1/1	6.10E+03	0/1	N/A	0/1	N/A	N/A	N/A	100–100
METAL	Chromium	mg/kg	2.10E+01	2.10E+01	2.10E+01	0/5	1/5	0/5	4.30E+01	0/5	1.98E+02	0/5	1.98E+04	0/5	0/5	1–12
METAL	Cobalt	mg/kg	7.80E+00	7.80E+00	7.80E+00	0/1	1/1	0/1	1.30E+01	0/1	6.87E+01	0/1	2.06E+03	1/1	1/1	0.1–0.1
METAL	Copper	mg/kg	3.40E+01	7.20E+01	4.38E+01	0/5	4/5	4/5	2.50E+01	0/5	9.34E+03	0/5	1.00E+05	0/5	1/5	1–4
METAL	Iron	mg/kg	2.93E+04	3.90E+04	3.32E+04	0/5	5/5	5/5	2.80E+04	0/5	1.00E+05	0/5	1.00E+05	5/5	5/5	10–12
METAL	Lead	mg/kg	8.30E+00	8.30E+00	8.30E+00	0/5	1/5	0/5	2.30E+01	0/5	8.00E+02	0/5	8.00E+02	0/5	0/5	0.05–3
METAL	Magnesium	mg/kg	3.10E+03	3.10E+03	3.10E+03	0/1	1/1	1/1	2.10E+03	0/1	N/A	0/1	N/A	N/A	N/A	10–10
METAL	Manganese	mg/kg	8.90E+01	4.85E+02	2.83E+02	0/5	5/5	0/5	8.20E+02	0/5	4.72E+03	0/5	1.00E+05	3/5	5/5	0.2–24
METAL	Mercury	mg/kg	1.90E-02	1.90E-02	1.90E-02	1/5	1/5	0/5	1.30E-01	0/5	7.01E+01	0/5	2.10E+03	0/5	0/5	0.029–40
METAL	Molybdenum	mg/kg	5.10E-01	5.10E-01	5.10E-01	0/5	1/5	0/5	N/A	0/5	1.17E+03	0/5	3.51E+04	0/5	1/5	0.1–3
METAL	Nickel	mg/kg	1.20E+01	2.60E+01	1.88E+01	0/5	5/5	1/5	2.20E+01	0/5	4.30E+03	0/5	1.00E+05	0/5	5/5	0.5–4
METAL	Selenium	mg/kg	1.20E+00	1.20E+00	1.20E+00	0/5	1/5	1/5	7.00E-01	0/5	1.17E+03	0/5	3.51E+04	0/5	1/5	0.1–3
METAL	Silver	mg/kg	3.50E-02	3.50E-02	3.50E-02	0/5	1/5	0/5	2.70E+00	0/5	1.17E+03	0/5	3.51E+04	0/5	0/5	0.01–50
METAL	Sodium	mg/kg	7.80E+01	7.80E+01	7.80E+01	1/1	1/1	0/1	3.40E+02	0/1	N/A	0/1	N/A	N/A	N/A	100–100
METAL	Thallium	mg/kg	1.20E-01	1.20E-01	1.20E-01	0/1	1/1	0/1	3.40E-01	0/1	2.34E+00	0/1	7.02E+01	0/1	0/1	0.02–0.02
METAL	Uranium	mg/kg	2.20E+01	1.20E+02	5.47E+01	0/5	2/5	2/5	4.60E+00	0/5	6.81E+02	0/5	2.04E+04	0/5	2/5	0.01–10
METAL	Vanadium	mg/kg	9.90E+01	1.47E+02	1.31E+02	0/5	5/5	5/5	3.70E+01	0/5	1.15E+03	0/5	3.45E+04	0/5	5/5	0.1–5
METAL	Zinc	mg/kg	5.50E+01	1.15E+02	8.65E+01	0/5	5/5	4/5	6.00E+01	0/5	7.01E+04	0/5	1.00E+05	0/5	5/5	1–2
PPCB	PCB, Total	mg/kg	1.10E-01	1.10E-01	1.10E-01	0/5	1/5	0/5	N/A	0/5	3.05E-01	0/5	3.05E+01	0/5	1/5	0.05–0.05
SVOA	1,2,4-Trichlorobenzene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	1,2-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	1,3-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	1,4-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	2,4,5-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	2,4,6-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	2,4-Dichlorophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	2,4-Dimethylphenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	2,4-Dinitrophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.78–0.78
SVOA	2,4-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.23–0.23
SVOA	2,6-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.23–0.23
SVOA	2-Chloronaphthalene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	2-Chlorophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	2-Methyl-4,6-dinitrophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.78–0.78
SVOA	2-Methylnaphthalene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	2-Methylphenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	2-Nitrobenzenamine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	2.91E+02	0/1	8.73E+03	0/1	0/1	0.78–0.78
SVOA	2-Nitrophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	3,3'-Dichlorobenzidine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.23–0.23
SVOA	3-Nitrobenzenamine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.78–0.78
SVOA	4-Bromophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	4-Chloro-3-methylphenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	4-Chlorobenzenamine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	4-Chlorophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	4-Nitrophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.78–0.78
SVOA	Acenaphthene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	1.40E+03	0/1	4.20E+04	0/1	0/1	0.39–0.39
SVOA	Acenaphthylene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	1.40E+03	0/1	4.20E+04	N/A	N/A	0.39–0.39
SVOA	Anthracene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	6.99E+03	0/1	2.10E+05	0/1	0/1	0.39–0.39

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.4.2. Subsurface Soil Data Summary: SWMU 77 (Continued)

			Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
Type	Analysis	Unit	Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
SVOA	Benzenemethanol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	Benzo(ghi)perylene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	BENZOIC ACID	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	1.9–1.9
SVOA	bis(2-chloroethoxy)methane	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	bis(2-Chloroethyl) ether	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	bis(2-Chloroisopropyl) ether	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	bis(2-ethylhexyl)phthalate	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	5.88E+01	0/1	5.88E+03	0/1	0/1	0.39–0.39
SVOA	Butyl benzyl phthalate	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	Dibenzofuran	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	Diethyl phthalate	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	Dimethyl phthalate	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	Di-n-butyl phthalate	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	Di-n-octylPhthalate	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	Fluoranthene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	9.32E+02	0/1	2.80E+04	0/1	0/1	0.39–0.39
SVOA	Fluorene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	9.32E+02	0/1	2.80E+04	0/1	0/1	0.39–0.39
SVOA	Hexachlorobenzene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	5.15E-01	0/1	5.15E+01	0/1	0/1	0.0039–0.0039
SVOA	Hexachlorobutadiene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.23–0.23
SVOA	Hexachlorocyclopentadiene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	Hexachloroethane	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	Isophorone	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	m,p-cresol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	Naphthalene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	1.67E+01	0/1	1.61E+03	0/1	0/1	0.39–0.39
SVOA	Nitrobenzene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	N-Nitroso-di-n-propylamine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	1.18E-01	0/1	1.18E+01	0/1	0/1	0.39–0.39
SVOA	N-Nitrosodiphenylamine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	PAH, Total	mg/kg	1.32E-02	1.32E-02	1.32E-02	0/1	1/1	0/1	N/A	0/1	8.94E-02	0/1	8.94E+00	0/1	0/1	–
SVOA	Pentachlorophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	8.91E-01	0/1	8.91E+01	N/A	N/A	0.7–0.7
SVOA	Phenanthrene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	1.40E+03	0/1	4.20E+04	0/1	0/1	0.39–0.39
SVOA	Phenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
SVOA	p-Nitroaniline	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.78–0.78
SVOA	Pyrene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	6.99E+02	0/1	2.10E+04	0/1	0/1	0.39–0.39
SVOA	Pyridine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.39–0.39
RADS	Americium-241	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	5.99E+00	0/1	5.99E+02	0/1	0/1	0.0383–0.0383
RADS	Cesium-137	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	2.80E-01	0/1	1.02E-01	0/1	1.02E+01	0/1	0/1	0.0202–0.0202
RADS	Neptunium-237	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	2.29E-01	0/1	2.29E+01	0/1	0/1	0.04–0.04
RADS	Plutonium-238	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	2.87E+01	0/1	2.87E+03	0/1	0/1	0.0295–0.0295
RADS	Plutonium-239/240	pCi/g	4.11E-02	4.11E-02	4.11E-02	0/1	1/1	0/1	N/A	0/1	2.47E+01	0/1	2.47E+03	0/1	0/1	0.0206–0.0206
RADS	Technetium-99	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	2.80E+00	0/1	1.20E+03	0/1	1.20E+05	0/1	0/1	0.603–0.603
RADS	Thorium-228	pCi/g	8.22E-01	8.22E-01	8.22E-01	0/1	1/1	0/1	1.60E+00	0/1	N/A	0/1	N/A	N/A	N/A	0.0732–0.0732
RADS	Thorium-230	pCi/g	1.23E+00	1.23E+00	1.23E+00	0/1	1/1	0/1	1.40E+00	0/1	3.39E+01	0/1	3.39E+03	0/1	0/1	0.0752–0.0752
RADS	Thorium-232	pCi/g	7.87E-01	7.87E-01	7.87E-01	0/1	1/1	0/1	1.50E+00	0/1	N/A	0/1	N/A	N/A	N/A	0.00515–0.00515
RADS	Uranium-234	pCi/g	1.48E+00	1.48E+00	1.48E+00	0/1	1/1	1/1	1.20E+00	0/1	5.53E+01	0/1	5.53E+03	0/1	1/1	0.0397–0.0397
RADS	Uranium-235	pCi/g	1.69E-01	1.69E-01	1.69E-01	0/1	1/1	1/1	6.00E-02	0/1	3.40E-01	0/1	3.40E+01	0/1	1/1	0.0153–0.0153
RADS	Uranium-238	pCi/g	5.87E+00	5.87E+00	5.87E+00	0/1	1/1	1/1	1.20E+00	1/1	1.60E+00	0/1	1.60E+02	1/1	1/1	0.0361–0.0361

One or more samples exceed AL value
One or more samples exceed NAL value
One or more samples exceed background value
One or more samples exceed SSLs of RGA and UCRS groundwater protection

Counts of analyses are based on the maximum detected result from a sample (i.e., if a sample has analytical results from two different labs, only the maximum value is counted).
Field replicates, or separate samples are counted independently.

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.4.2. Subsurface Soil Data Summary: SWMU 77 (Continued)

			Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
Type	Analysis	Unit	Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range

The uranium (metal)/uranium (isotopic) may not be from the same sample thus a correlation between uranium (metal)/uranium (isotopic) data may not be possible.
Uranium-238 that was analyzed using method RL-7128NITRIC is compared to a background value of 0.4 pCi/g for surface and subsurface.

Screening values are shown in Appendices C and D.

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

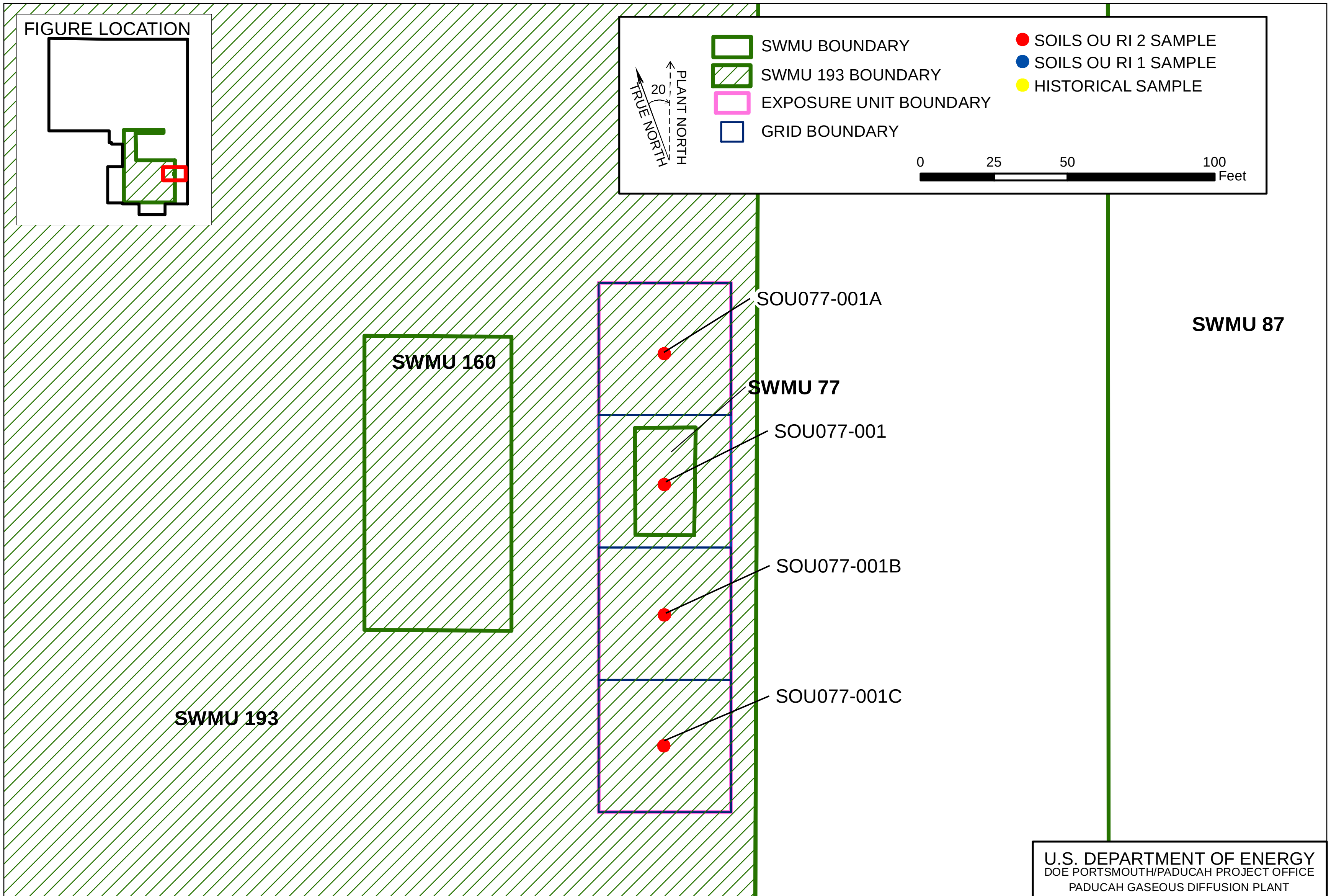

Figure 5.4.4. SWMU 77 Sample Locations—Subsurface Soil

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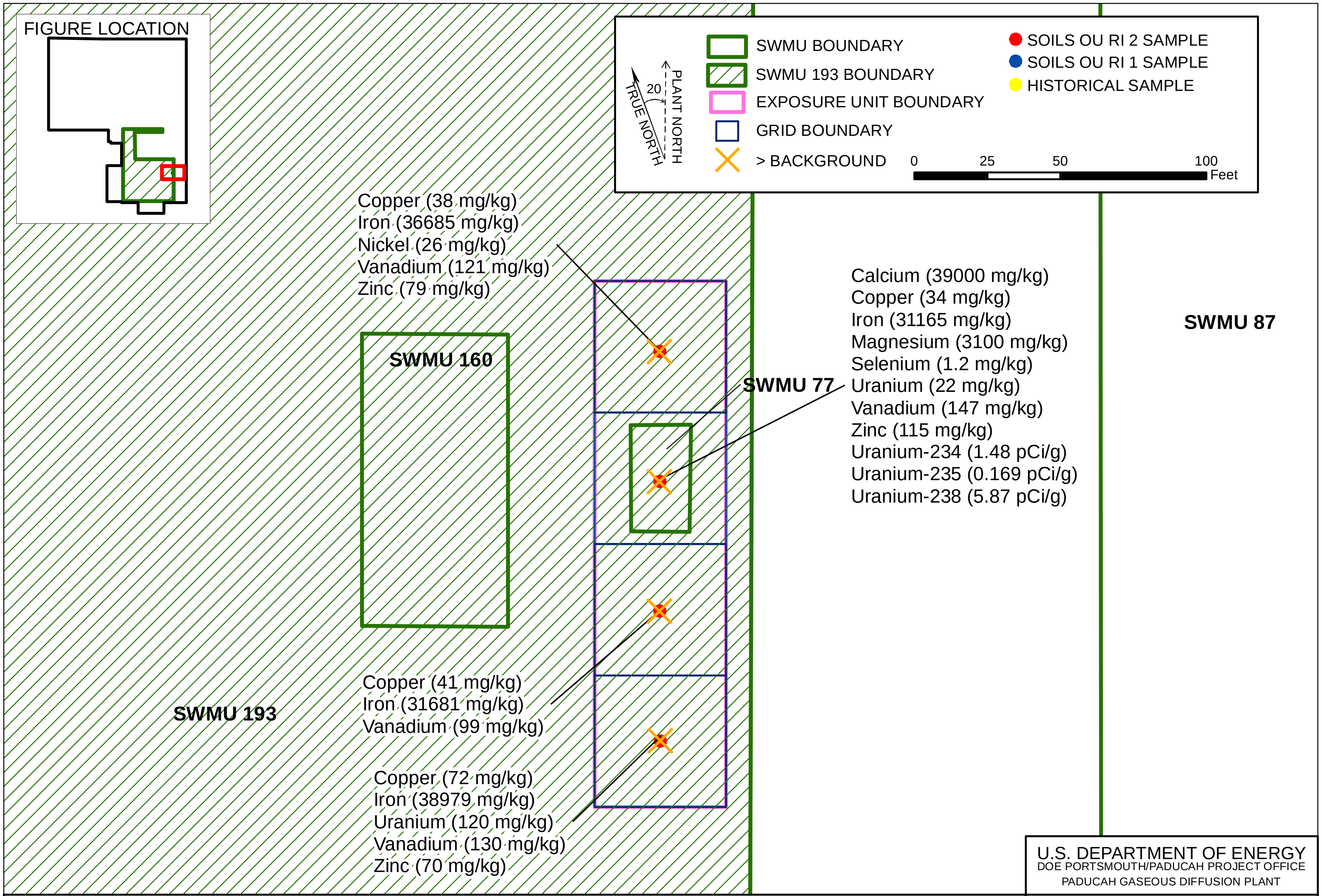
3/12/2015



U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

Figure 5.4.5. SWMU 77 Background Exceedances—Subsurface Soil

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3/12/2015

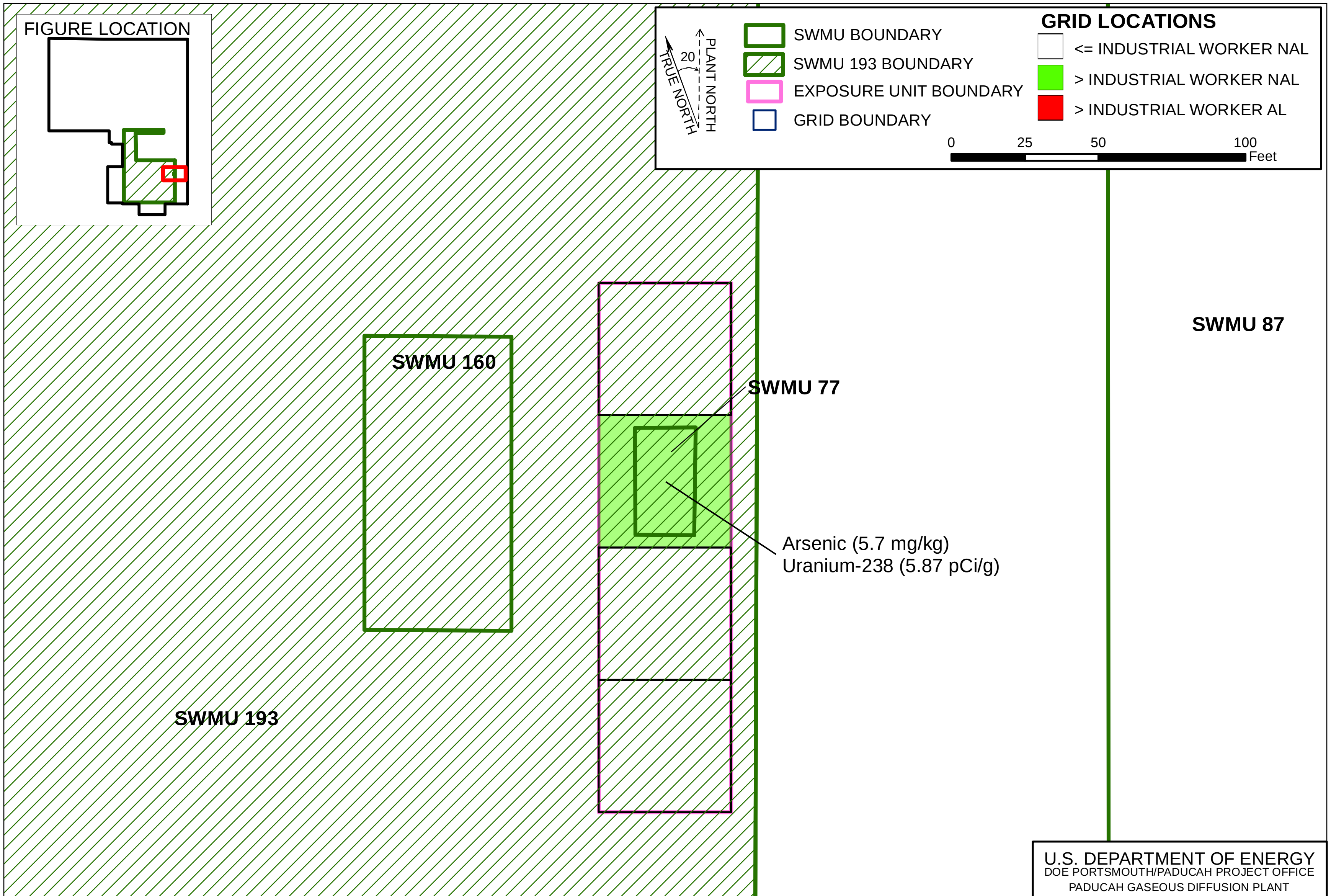

Figure 5.4.6. SWMU 77 NAL Exceedances—Subsurface Soil

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3/12/2015

Total PCBs were detected above the SSLs for the protection of the UCRS in grid 1, but not above the SSLs for the protection of the RGA.

<u>SVOCs</u>

No SVOCs were detected above industrial worker NALs or ALs in the SWMU 77 subsurface soil. There were no SVOCs detected above the SSLs for the protection of UCRS groundwater or above the SSLs for the protection of RGA groundwater.

<u>VOCs</u>

No VOCs were analyzed in subsurface soil samples at SWMU 77.

<u>Radionuclides</u>

Uranium-238 was detected above both the background screening levels and the industrial worker NALs in grid 1 in SWMU 77 subsurface soil. There were no radionuclides detected above both the background screening levels and the industrial worker ALs.

Uranium-234, uranium-235, and uranium-238 were detected in the SWMU 77 subsurface soil above both the background screening levels and the SSLs for the protection of UCRS groundwater. Uranium-238 was detected in the SWMU 77 subsurface soil above the SSLs for the protection of RGA groundwater.

<u>pH</u>

Analytical parameters for this unit included pH. The pH in the subsurface sample was 7.18.

5.4.5 Fate and Transport

No target chemicals were identified for further evaluation under fate and transport (Chapter 4). There is no concern for significant potential runoff for SWMU 77. Contaminants present at this SWMU are unlikely to migrate due to the physical cover at the SWMU, which limits the potential for particulate transport through sheet flow, and there is no direct connection to surface water from this SWMU. A removal action for the contaminated sediment associated with SWOU (On-Site) (DOE 2011a) was conducted for Outfalls 001, 008, 010, 011, 015, and associated internal ditches. A final response action for internal ditches, outfalls, and creeks will be addressed by the SWOU, as described in the SMP (DOE 2015a).

5.4.6 Baseline Risk Assessment

Human Health. Potential risks and hazards for current/future human health for SWMU 77 were evaluated for direct contact. These results are summarized in Appendix D and in the subsections that follow, including the COCs and relative contributions to the overall ELCR/HI.

The cumulative ELCR and the cumulative HI for SWMU 77 exceed the benchmarks of cumulative ELCR of 1E-06 and cumulative HI greater than 1, respectively, for one or more scenarios; therefore, as stated in the Work Plan, Decision Rule D1a, (DOE 2010a), this SWMU will be evaluated in the FS. As described in the BHHRA (Appendix D), COCs were identified after considering the results of the risk characterization and the uncertainties affecting the results.

COCs were identified as those COPCs considered to contribute at least 1E-06 ELCR or 0.1 HI to a scenario of concern. The basis for COC identification is presented in Appendix D.

The identified COCs considered to contribute to the ELCR/HI, the EPC, and the RGOs calculated for a range of ELCR/HI benchmarks are presented in Table 5.4.3 for the future industrial worker, excavation worker, and the hypothetical resident. Table 5.4.3 also compares the EPC to the RGO for each COC under each exposure scenario. Table 5.4.3 summarizes the ELCR/HI posed by the COCs for this SWMU under each exposure scenario by depicting the maximum ELCR/HI contribution per COC.

Ecological Screening. COPECs for SWMU 77 include metals, PCBs, and SVOCs. Potential hazards for ecological receptors and the associated priority COPECs (maximum HQ $\geq$ 10) are summarized in Table 5.4.4.

5.4.7 SWMU 77 Summary

Goal 1. Characterize Nature and Extent of Source Zone

Plant processes that could have contributed to contamination at this SWMU are spills and releases from the sulfuric acid tank.

COPCs for subsurface soils from SWMU 77 are shown on Tables 5.4.1 and 5.4.2 as those analytes with green boxes under the "Industrial Worker/FOE" columns for surface and shallow subsurface soil, and those with blue boxes under the "GW Protection Screen/RGA/UCRS" columns for groundwater. For metals and radioisotopes, an orange box under the "Provisional Background" must accompany the green and blue boxes. Contaminants were detected greater than background and greater than industrial worker NALs to a maximum depth of 4 ft bgs. The COPCs for SWMU 77 are metals, PCBs, and radioisotopes in both the surface and subsurface.

Goal 2. Determine Surface and Subsurface Transport Mechanisms and Pathways

The contaminants at SWMU 77 are readily adsorbed to soil particles, so they do not migrate without a direct connection to surface water. There are no known underground pipelines at SWMU 77. The CSM can be found in Appendix D.

Goal 3. Complete a Baseline Risk Assessment for the Soils OU

Cumulative ELCRs or HIs exceeded benchmarks of 1E-06 and 1, respectively, for the future industrial worker, excavation worker, and hypothetical residential scenarios. COCs for these scenarios for SWMU 77 are as follows:

- Future Industrial worker
  - Total PCBs
  - Uranium-238
- Excavation worker
  - Iron
  - Uranium
  - Vanadium
  - Total PCBs
  - Uranium-238

Table 5.4.3. RGOs for SWMU 77

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3]			HI[4]	RGOs for HI[3]		
					1E-06	1E-05	1E-04		0.1	1	3
Future Industrial Worker											
1	PCB, Total	5.00E+00	mg/kg	1.6E-05	3.05E-01	3.05E+00	3.05E+01	< 0.1	N/A	N/A	N/A
1	Uranium-238	1.53E+01	pCi/g	9.3E-06	1.65E+00	1.65E+01	1.65E+02	N/A	N/A	N/A	N/A
1	**Cumulative**			**2.7E-05**				**< 1**			
Excavation Worker											
1	Iron	5.03E+04	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.2	2.30E+04	2.30E+05	6.91E+05
1	PCB, Total	5.00E+00	mg/kg	4.4E-06	1.14E+00	1.14E+01	1.14E+02	< 0.1	N/A	N/A	N/A
1	Uranium	6.66E+02	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.7	9.80E+01	9.80E+02	2.94E+03
1	Vanadium	1.68E+02	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	1.65E+02	1.65E+03	4.95E+03
1	Uranium-238	1.53E+01	pCi/g	2.6E-06	5.95E+00	5.95E+01	5.95E+02	N/A	N/A	N/A	N/A
1	**Cumulative**			**7.9E-06**				**1.0**			
Hypothetical Resident[5]											
1	Iron	5.03E+04	mg/kg	N/A	N/A	N/A	N/A	0.9	5.47E+03	5.48E+04	1.64E+05
1	PAH, Total	7.02E-02	mg/kg	3.1E-06	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
1	PCB, Total	5.00E+00	mg/kg	6.4E-05	7.82E-02	7.82E-01	7.82E+00	N/A	N/A	N/A	N/A
1	Uranium	6.66E+02	mg/kg	N/A	N/A	N/A	N/A	2.9	2.34E+01	2.34E+02	7.01E+02
1	Vanadium	1.68E+02	mg/kg	N/A	N/A	N/A	N/A	0.4	3.93E+01	3.93E+02	1.18E+03
1	Thorium-230	1.03E+01	pCi/g	2.1E-06	4.89E+00	4.89E+01	4.89E+02	N/A	N/A	N/A	N/A
1	Uranium-238	1.53E+01	pCi/g	3.1E-05	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
1	**Cumulative**			**1.0E-04**				**4.2**			

Grayed cells indicate EPC value is lower than RGO value or an RGO value is not applicable.
N/A = Not applicable because the COC was not applicable (i.e., the COC was of concern for HI, but not ELCR or it was of concern for ELCR by not HI).
[1] See Tables D.6 and D.7 (Appendix D) for EPC values.
[2] See Appendix D, Exhibit D.6, for ELCR.
[3] See Table D.47 for RGOs.
[4] See Appendix D, Exhibit D.6, for HI.
[5] RGOs for residential land use are based on exposure to a resident age 1-27. For carcinogens, the dose method incorporates age-adjusted values for the 26-year exposure duration. Because child soil ingestion rates are higher and body weights are lower, noncancer RGOs are based on the child resident exposure assumptions.

Table 5.4.4. Ecological Screening for SWMU 77

Ground Cover	Near a Surface Water Body?	Total HI[a]	Priority COPECs[b]	Background (mg/kg)[c]	Soil ESV (mg/kg)[d]	Maximum (mg/kg)	HQ (max conc)[a]	EPC (mg/kg)	HQ (EPC)[a]
concrete with some gravel	No	765	Iron	28,000	200	50,329	251.65	50,329	251.6
			Mercury	0.2	0.1	20	200	20	200.0
			PCB, Total	N/A	0.02	2.5	125	2.5	125.0
			Uranium	4.9	5	666	133.2	666	133.2
			Vanadium	38	7.8	168	21.54	168	21.5

Table is from Appendix E, Table E.1.
[a] Total HI includes concentrations from all of the COPECs (listed in Table E4.1), only priority COPECs (i.e., the COPECs with HQs greater than 10, using the EPCs) are shown in this table.
[b] Only priority COPECs are listed. See Appendix E for additional COPECs.
[c] Background value is from DOE 2015b.
[d] ESV from DOE 2015c and Appendix E of this report.

- Hypothetical Resident (hazards evaluated against the child resident)
  - Iron
  - Uranium
  - Vanadium
  - Total PAHs
  - Total PCBs
  - Thorium-230
  - Uranium-238

Figure 5.4.7 shows the COCs exceeding RGOs for the future industrial worker.

One priority COC (i.e., HQ > 1 or chemical-specific ELCR > 1E-04) is located in SWMU 77 for the hypothetical resident: uranium. Priority COCs for other scenarios are described in Appendix D.

No priority COCs were identified for groundwater modeled from soil.

For SWMU 77, COPECs exceed ESVs. Priority COPECs (i.e., maximum HQ ≥ 10) are the following:

- Mercury
- Total PCBs
- Uranium
- Vanadium

Goal 4. Support Evaluation of Remedial Alternatives

The representative data set used for SWMU 77 is sufficient to support decision making and indicates that an FS is appropriate. An uncertainty concerning depth of contamination should be considered in the FS. Possible remedial technologies applicable for this unit are, as discussed in the Work Plan (DOE 2010a), posting, fencing (or other means of limiting access), excavation, and/or other remedial technologies that will be described in the FS.

SWMU 77 is across the railroad tracks from SWMU 160, C-745 Cylinder Yard Spoils (PCB Soils), which was addressed during the Soils OU RI. Both of these two SWMUs are within the boundaries of SWMU 193, McGraw Construction Facilities (Southside Cylinder Yards), which is scheduled to be

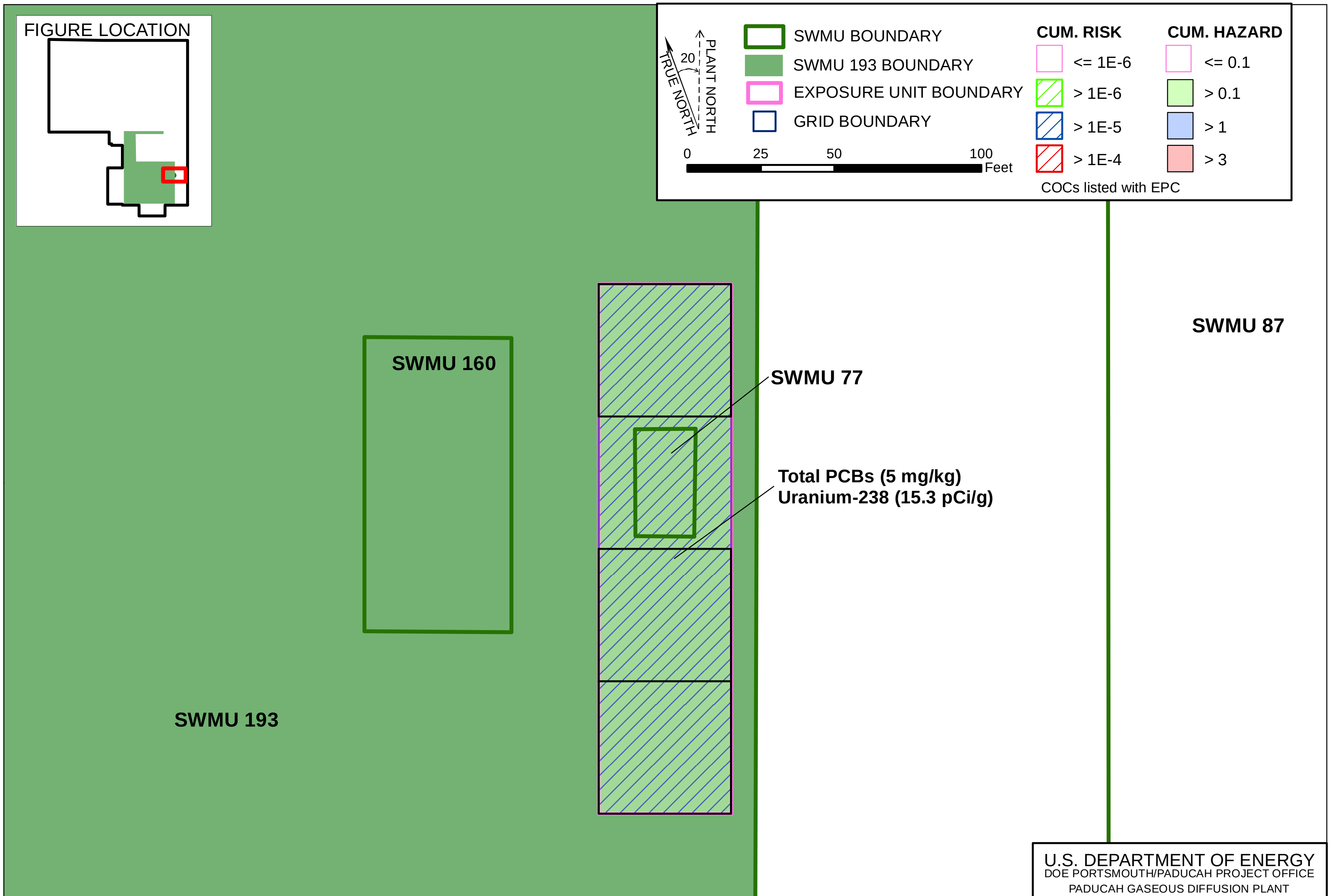

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Figure 5.4.7. Summary of COCs Contributing to Risk to the Future Industrial Worker at SWMU 77

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addressed by the GDP D&D OU (DUF_6 D&D subproject). A response action at SWMU 77 would not have an effect on either of the other two SWMUs mentioned, nor would it affect groundwater or surface water.

5.4.8 SWMU 77 Conclusion

The RI defined adequately the nature and extent of contamination in soils at SWMU 77; an FS is appropriate for the SWMU due to cancer risk and/or noncancer hazards exceeding the decision rule benchmarks for scenarios including the future industrial worker, excavation worker, and hypothetical resident (DOE 2010a). The reasonably anticipated future land use of this SWMU is industrial, as shown in the SMP (DOE 2015a). SWMU 77 will be addressed as part of the Soils and Slabs OU, which is scheduled to occur during post-GDP shutdown activities (DOE 2015c).

5.5 SWMUS 56 AND 80, C-540-A PCB Staging Area and C-540 PCB Spill Site

5.5.1 Background

The C-540-A PCB Staging Area (SWMU 56) and the C-540 PCB Spill Site (SWMU 80) are located in the east-central portion of the plant site. SWMUs 56 and 80 are made up of leaks and spills of oils containing PCBs as a result of past operations that contaminated the soils.

Soil boring samples were obtained during the Phase I and Phase II SIs (CH2M HILL 1991; CH2M HILL 1992) and during the WAG 23 RI (DOE 1994b). Results of these investigations indicate the presence of PCBs.

In 1997, as part of the WAG 23 non-time-critical removal action, 23 yd^3 of soil contaminated with dioxins and 72 yd^3 of soil contaminated with PCBs were excavated from SWMUs 56 and 80 (DOE 1998b).

5.5.2 Fieldwork Summary

During the first RI for the Soils OU, 14 grid samples were collected of the 16 planned for this unit. Field laboratory results indicated contingency samples were needed for manganese and zinc, and 24 of 46 contingency samples were collected. Some locations were not collected due to a building, a road, and concrete. Appendix A contains the sampling rectification map.

The unit underwent a gamma radiological walkover survey (Figure 5.5.1) using a FIDLER; the 1,377 measurements ranged from 4,008 to 15,680 cpm. This area consists of gravel, soil, and grass with gravel driveways and concrete pads. A judgmental grab sample was collected for radiological constituents.

During RI 2, 13 grid samples were planned and collected for the unit. One grid (SOU080-001Q) was placed south of SWMU 224 encompassing the culvert. One grid (SOU080-001E) was placed across the road to the east of the unit encompassing the culvert. The five-point composite collected from these grids was modified from the “X” orientation consisting of a grab sample collected from the center of the grid and 15 ft from the center point in each cardinal direction (north, south, east, and west) to obtain a more representative sample of the grid. The alternate sampling approach [e.g., grab samples collected from the center of the grid and 15 ft from the center point in each secondary direction (northeast, northwest, southeast, and southwest)] also was considered, but determined also not to be representative. Using the composite approach required by the Work Plan (DOE 2010a) would have placed some of the composite

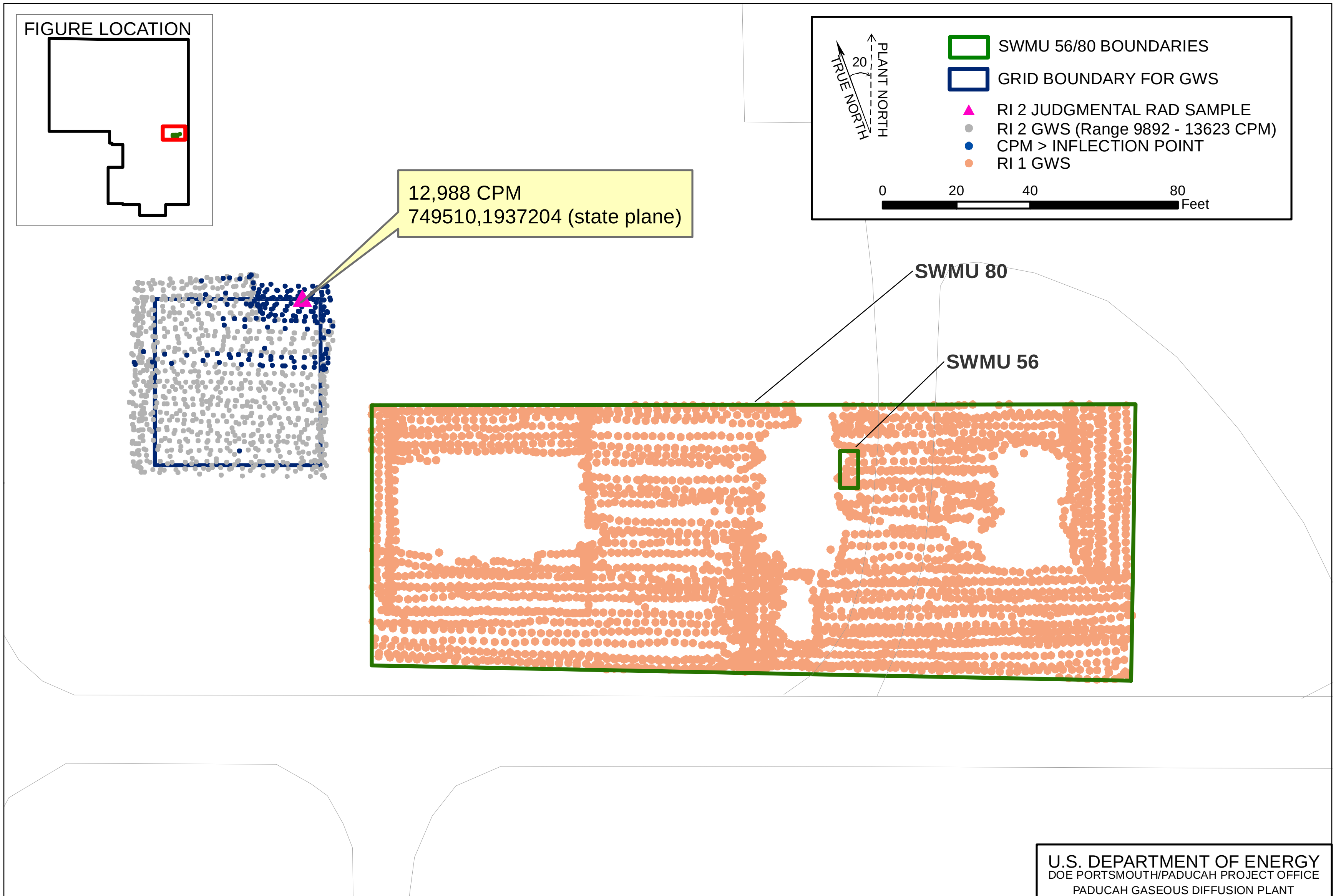

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Figure 5.5.1. SWMUs 56 and 80 Gamma Walkover Survey

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location on the bank of the ditch. These grid locations were intended to investigate whether any contamination had entered and exited the culvert.

Additionally, three grids were placed across the road to the south of the unit between the road and fence. The remaining grids encompassed grid SOU080-002. Field laboratory results indicated that contingency samples were needed to determine the nature and extent of contamination because of elevated concentrations of PCBs. Six contingency samples were planned and collected. No additional step-outs to the south were implemented as per the Work Plan (DOE 2014a).

Grid SOU080-002 underwent a gamma radiological walkover survey (Figure 5.5.1) during RI 2 using a FIDLER; the 1,064 measurements ranged from 9,892 to 13,623 cpm. The survey was conducted to verify historical data from the Department of Justice location JP-0153. A judgmental grab sample was collected for radiological constituents.

5.5.3 Nature and Extent of Contamination—Surface Soils

The representative data set presented in Table 5.5.1 provides the nature of the contamination in SWMUs 56 and 80 surface soils, and Figures 5.5.2–5.5.4 illustrate the horizontal extent. A complete list of sampling results is provided in Appendix F (samples with ending depths of 1 ft bgs or less or null are considered surface soils). Grid numbers shown below are truncated from the figures. Figures contain the SWMU#–grid#, with zeros filling the appropriate spaces to make three digits.

The lateral extent of SWMUs 56 and 80 surface soil contamination is considered defined adequately for supporting the BRA and FS. SWMUs 56 and 80 consist of 3 EUs.

Metals

Uranium metal was detected in the surface soil at SWMUs 56 and 80 above both background screening levels and the industrial worker NAL. There were no metals detected above both the background screening levels and the industrial worker ALs.

The following metals were detected in the SWMUs 56 and 80 surface soil above both the SSLs for the protection of UCRS groundwater and the background screening levels.

Metal	Grid	EU
Antimony	2	2
Barium	1L, 2	2, 3
Cobalt	2C	2
Iron	1C, 1M, 1O, 1S, 2C, 2D	2, 3
Lead	1E, 2C	2, 3
Manganese	1Q	3
Mercury	2	2
Molybdenum[1]	1A, 1N, 2, 2C	2, 3
Nickel	2A, 2B, 2E	2
Selenium	1M, 1N, 2, 2C	2, 3
Uranium	1D, 1E, 2, 2D, 2E, 5, 6	1, 2, 3
Vanadium	1A, 1B, 1C, 1D, 1E, 1M, 1N, 1O, 1Q, 1R, 1S, 2A, 2B, 2C, 2D, 2E, 2F, 2G, 2H	2, 3
Zinc	1A, 1B, 1C, 1D, 1E, 1M, 1S, 2A, 2B, 2C, 2D, 2E, 2F, 2G, 2H	2, 3

[1] No soil background value is available.

Table 5.5.1. Surface Soil Data Summary: SWMUs 56 and 80

Type	Analysis	Unit	Detected Results Min	Detected Results Max	Detected Results Avg	J-qualified FOD	FOD	Provisional Background FOE	Provisional Background Bkgd	Industrial Worker FOE	Industrial Worker NAL	Industrial Worker FOE	Industrial Worker AL	GW Protection Screen RGA	GW Protection Screen UCRS	DL Range
METAL	Aluminum	mg/kg	7.40E+03	9.32E+03	8.18E+03	0/4	4/4	0/4	1.30E+04	0/4	1.00E+05	0/4	1.00E+05	0/4	4/4	4.7–5.4
METAL	Antimony	mg/kg	1.60E-01	5.82E+01	1.96E+01	0/6	4/6	3/6	2.10E-01	0/6	9.34E+01	0/6	2.80E+03	1/6	2/6	0.028–30
METAL	Arsenic	mg/kg	7.90E+00	1.20E+01	9.32E+00	0/25	5/25	0/25	1.20E+01	5/25	1.41E+00	0/25	1.41E+02	0/25	5/25	0.19–11
METAL	Barium	mg/kg	8.10E+01	3.14E+02	2.23E+02	0/6	6/6	4/6	2.00E+02	0/6	4.04E+04	0/6	1.00E+05	0/6	5/6	0.094–100
METAL	Beryllium	mg/kg	3.90E-01	7.80E-01	5.22E-01	0/5	5/5	1/5	6.70E-01	0/5	4.50E+02	0/5	1.35E+04	0/5	0/5	0.047–0.5
METAL	Cadmium	mg/kg	2.20E-02	2.20E-01	1.34E-01	1/6	4/6	1/6	2.10E-01	0/6	6.12E+01	0/6	1.84E+03	0/6	0/6	0.028–12
METAL	Calcium	mg/kg	2.40E+03	6.30E+04	3.40E+04	0/4	4/4	0/4	2.00E+05	0/4	N/A	0/4	N/A	N/A	N/A	54–269
METAL	Chromium	mg/kg	1.33E+01	1.65E+02	3.17E+01	0/26	6/26	2/26	1.60E+01	0/26	1.98E+02	0/26	1.98E+04	0/26	0/26	0.94–85
METAL	Cobalt	mg/kg	5.60E+00	1.90E+01	9.95E+00	0/4	4/4	1/4	1.40E+01	0/4	6.87E+01	0/4	2.06E+03	4/4	4/4	0.094–0.22
METAL	Copper	mg/kg	9.00E+00	4.50E+01	3.30E+01	0/25	22/25	19/25	1.90E+01	0/25	9.34E+03	0/25	1.00E+05	0/25	0/25	0.94–35
METAL	Iron	mg/kg	1.37E+03	4.13E+04	2.52E+04	0/25	25/25	7/25	2.80E+04	0/25	1.00E+05	0/25	1.00E+05	24/25	25/25	5.4–100
METAL	Lead	mg/kg	1.20E+01	1.13E+02	3.53E+01	0/25	7/25	2/25	3.60E+01	0/25	8.00E+02	0/25	8.00E+02	0/25	5/25	0.047–13
METAL	Magnesium	mg/kg	9.00E+02	7.80E+03	3.54E+03	0/4	4/4	1/4	7.70E+03	0/4	N/A	0/4	N/A	N/A	N/A	9.4–54
METAL	Manganese	mg/kg	1.98E+02	2.07E+03	6.07E+02	0/25	24/25	1/25	1.50E+03	0/25	4.72E+03	0/25	1.00E+05	24/25	24/25	0.19–85
METAL	Mercury	mg/kg	2.52E-02	4.50E-01	9.77E-02	1/26	4/26	1/26	2.00E-01	0/26	7.01E+01	0/26	2.10E+03	0/26	3/26	0.034–40
METAL	Molybdenum	mg/kg	5.50E-01	4.60E+01	1.31E+01	0/25	5/25	0/25	N/A	0/25	1.17E+03	0/25	3.51E+04	2/25	5/25	0.094–15
METAL	Nickel	mg/kg	9.40E+00	2.30E+01	1.65E+01	0/25	20/25	3/25	2.10E+01	0/25	4.30E+03	0/25	1.00E+05	0/25	20/25	0.47–65
METAL	Selenium	mg/kg	9.40E-01	5.00E+00	1.54E+00	0/25	5/25	5/25	8.00E-01	0/25	1.17E+03	0/25	3.51E+04	0/25	5/25	0.094–20
METAL	Silver	mg/kg	0.00E+00	4.50E-02	2.80E-02	0/25	5/25	0/25	2.30E+00	0/25	1.17E+03	0/25	3.51E+04	0/25	0/25	0.0094–50
METAL	Sodium	mg/kg	2.50E+01	6.80E+01	4.53E+01	2/4	4/4	0/4	3.20E+02	0/4	N/A	0/4	N/A	N/A	N/A	21.5–100
METAL	Thallium	mg/kg	1.20E-01	1.70E-01	1.55E-01	0/4	4/4	0/4	2.10E-01	0/4	2.34E+00	0/4	7.02E+01	0/4	3/4	0.019–0.22
METAL	Uranium	mg/kg	4.50E+00	5.72E+03	2.64E+02	0/30	15/30	14/30	4.90E+00	1/30	6.81E+02	0/30	2.04E+04	1/30	12/30	0.0094–20
METAL	Vanadium	mg/kg	1.60E+01	1.38E+02	9.93E+01	0/25	23/25	20/25	3.80E+01	0/25	1.15E+03	0/25	3.45E+04	0/25	23/25	0.094–70
METAL	Zinc	mg/kg	2.47E+01	6.38E+02	1.21E+02	0/25	24/25	16/25	6.50E+01	0/25	7.01E+04	0/25	1.00E+05	0/25	19/25	1–25
DI/FURA	Dioxins/Furans, Total	mg/kg	2.95E-05	8.82E-05	4.68E-05	0/4	4/4	0/4	N/A	4/4	1.63E-05	0/4	1.59E-03	0/4	0/4	–
PPCB	PCB, Total	mg/kg	1.90E-02	4.75E+02	1.49E+01	3/88	52/88	0/88	N/A	37/88	3.05E-01	4/88	3.05E+01	21/88	49/88	0.0005–5
SVOA	1,2,4-Trichlorobenzene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.39
SVOA	1,2-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.39
SVOA	1,3-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.39
SVOA	1,4-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.39
SVOA	2,4,5-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.39
SVOA	2,4,6-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.39
SVOA	2,4-Dichlorophenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.39
SVOA	2,4-Dimethylphenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.39
SVOA	2,4-Dinitrophenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.77–1.7
SVOA	2,4-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.23–0.36
SVOA	2,6-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.23–0.36
SVOA	2-Chloronaphthalene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.39
SVOA	2-Chlorophenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.39
SVOA	2-Methyl-4,6-dinitrophenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.77–1.7
SVOA	2-Methylnaphthalene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.39
SVOA	2-Methylphenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.39
SVOA	2-Nitrobenzenamine	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	2.91E+02	0/4	8.73E+03	0/4	0/4	0.77–1.7
SVOA	2-Nitrophenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.39
SVOA	3,3'-Dichlorobenzidine	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.23–1.7
SVOA	3-Nitrobenzenamine	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.77–1.7
SVOA	4-Bromophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.39
SVOA	4-Chloro-3-methylphenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.39
SVOA	4-Chlorobenzenamine	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.39
SVOA	4-Chlorophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.39
SVOA	4-Nitrophenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.77–1.7
SVOA	Acenaphthene	mg/kg	9.40E-02	9.40E-02	9.40E-02	1/4	1/4	0/4	N/A	0/4	1.40E+03	0/4	4.20E+04	0/4	0/4	0.35–0.39
SVOA	Acenaphthylene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	1.40E+03	0/4	4.20E+04	N/A	N/A	0.35–0.39

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.5.1. Surface Soil Data Summary: SWMUs 56 and 80 (Continued)

Type	Analysis	Unit	Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
			Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
SVOA	Anthracene	mg/kg	1.70E-01	1.70E-01	1.70E-01	1/4	1/4	0/4	N/A	0/4	6.99E+03	0/4	2.10E+05	0/4	0/4	0.35–0.39
SVOA	Benzenemethanol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.39
SVOA	Benzo(ghi)perylene	mg/kg	8.70E-02	3.60E-01	2.09E-01	2/4	3/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.39
SVOA	Benzoic Acid	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	1.7–1.9
SVOA	bis(2-chloroethoxy)methane	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.39
SVOA	bis(2-chloroethyl) ether	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.0071–0.39
SVOA	bis(2-chloroisopropyl) ether	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.39
SVOA	bis(2-ethylhexyl)phthalate	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	5.88E+01	0/4	5.88E+03	0/4	0/4	0.35–0.39
SVOA	Butyl benzyl phthalate	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.39
SVOA	Dibenzofuran	mg/kg	4.90E-02	4.90E-02	4.90E-02	1/4	1/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.39
SVOA	Diethyl phthalate	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.39
SVOA	Dimethyl phthalate	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.39
SVOA	Di-n-butyl phthalate	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.39
SVOA	Di-n-octylphthalate	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.39
SVOA	Fluoranthene	mg/kg	1.70E-01	1.20E+00	5.23E-01	2/4	3/4	0/4	N/A	0/4	9.32E+02	0/4	2.80E+04	0/4	0/4	0.35–0.39
SVOA	Fluorene	mg/kg	9.20E-02	9.20E-02	9.20E-02	1/4	1/4	0/4	N/A	0/4	9.32E+02	0/4	2.80E+04	0/4	0/4	0.35–0.39
SVOA	Hexachlorobenzene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	5.15E-01	0/4	5.15E+01	0/4	0/4	0.0039–0.36
SVOA	Hexachlorobutadiene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.23–0.36
SVOA	Hexachlorocyclopentadiene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–1.7
SVOA	Hexachloroethane	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.39
SVOA	Isophorone	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.39
SVOA	m,p-cresol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.71
SVOA	Naphthalene	mg/kg	7.40E-02	7.40E-02	7.40E-02	1/4	1/4	0/4	N/A	0/4	1.67E+01	0/4	1.61E+03	1/4	1/4	0.35–0.39
SVOA	Nitrobenzene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–1.7
SVOA	N-Nitroso-di-n-propylamine	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	1.18E-01	0/4	1.18E+01	0/4	0/4	0.0071–0.39
SVOA	N-Nitrosodiphenylamine	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.39
SVOA	PAH, Total	mg/kg	4.95E-03	7.21E-01	3.01E-01	0/4	4/4	0/4	N/A	3/4	8.94E-02	0/4	8.94E+00	0/4	2/4	–
SVOA	Pentachlorophenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	8.91E-01	0/4	8.91E+01	N/A	N/A	0.69–1.7
SVOA	Phenanthrene	mg/kg	1.10E-01	7.80E-01	4.45E-01	1/4	2/4	0/4	N/A	0/4	1.40E+03	0/4	4.20E+04	1/4	2/4	0.35–0.39
SVOA	Phenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.39
SVOA	p-Nitroaniline	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.77–1.7
SVOA	Pyrene	mg/kg	1.70E-01	1.00E+00	5.50E-01	1/4	3/4	0/4	N/A	0/4	6.99E+02	0/4	2.10E+04	0/4	0/4	0.35–0.39
SVOA	Pyridine	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.71
VOA	1,1,1-Trichloroethane	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	3.58E+03	0/3	1.07E+05	0/3	0/3	0.006–0.006
VOA	1,1,2,2-Tetrachloroethane	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.006–0.006
VOA	1,1,2-Trichloroethane	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	6.32E-01	0/3	1.90E+01	0/3	0/3	0.006–0.006
VOA	1,1-Dichloroethane	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	1.58E+01	0/3	1.58E+03	0/3	0/3	0.006–0.006
VOA	1,1-Dichloroethene	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	1.00E+02	0/3	3.00E+03	0/3	0/3	0.006–0.006
VOA	1,2-Dichloroethane	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	2.09E+00	0/3	2.09E+02	0/3	0/3	0.006–0.006
VOA	1,2-Dichloroethene	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	2.10E+03	0/3	6.30E+04	0/3	0/3	0.006–0.006
VOA	1,2-Dichloropropane	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.006–0.006
VOA	2-Butanone	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.011–0.012
VOA	2-Hexanone	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.011–0.012
VOA	4-Methyl-2-pentanone	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.011–0.012
VOA	Acetone	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.011–0.012
VOA	Benzene	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	5.31E+00	0/3	5.31E+02	0/3	0/3	0.006–0.006
VOA	Bromodichloromethane	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	1.30E+00	0/3	1.30E+02	0/3	0/3	0.006–0.006
VOA	Bromoform	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.006–0.006
VOA	Bromomethane	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.011–0.012
VOA	Carbon disulfide	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.006–0.006
VOA	Carbon tetrachloride	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	2.96E+00	0/3	2.96E+02	0/3	0/3	0.006–0.006
VOA	Chlorobenzene	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.006–0.006
VOA	Chloroethane	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.011–0.012

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.5.1. Surface Soil Data Summary: SWMUs 56 and 80 (Continued)

			Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
Type	Analysis	Unit	Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
VOA	Chloroform	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	1.39E+00	0/3	1.39E+02	0/3	0/3	0.006–0.006
VOA	Chloromethane	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.011–0.012
VOA	*cis* -1,3-Dichloropropene	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.006–0.006
VOA	Dibromochloromethane	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.006–0.006
VOA	Ethylbenzene	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	2.66E+01	0/3	2.66E+03	0/3	0/3	0.006–0.006
VOA	Methylene chloride	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.006–0.029
VOA	Styrene	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.006–0.006
VOA	Tetrachloroethene	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	4.00E+01	0/3	1.20E+03	N/A	N/A	0.006–0.006
VOA	Toluene	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	6.25E+03	0/3	1.88E+05	0/3	0/3	0.006–0.006
VOA	Total Xylene	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	2.54E+02	0/3	7.62E+03	0/3	0/3	0.006–0.006
VOA	*trans* -1,3-Dichloropropene	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.006–0.006
VOA	Trichloroethene	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	1.90E+00	0/3	5.70E+01	0/3	0/3	0.006–0.006
VOA	Vinyl acetate	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	N/A	0/3	N/A	N/A	N/A	0.011–0.012
VOA	Vinyl chloride	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	2.06E+00	0/3	2.06E+02	0/3	0/3	0.011–0.012
RADS	Actinium-228	pCi/g	2.98E-01	2.98E-01	2.98E-01	0/1	1/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.1958–0.1958
RADS	Americium-241	pCi/g	6.40E+00	6.40E+00	6.40E+00	0/6	1/6	0/6	N/A	1/6	5.99E+00	0/6	5.99E+02	0/6	1/6	0.0067–0.943
RADS	Antimony-124	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.07009–0.07009
RADS	Antimony-125	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.1998–0.1998
RADS	Barium-133	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.09428–0.09428
RADS	Barium-140	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.3331–0.3331
RADS	Bismuth-211	pCi/g	1.07E+00	1.07E+00	1.07E+00	0/1	1/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.4771–0.4771
RADS	Bismuth-212	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.6021–0.6021
RADS	Bismuth-214	pCi/g	6.33E-01	6.33E-01	6.33E-01	0/1	1/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.1373–0.1373
RADS	Cerium-139	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.1003–0.1003
RADS	Cerium-141	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.2248–0.2248
RADS	Cerium-144	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.8123–0.8123
RADS	Cesium-134	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.066–0.066
RADS	Cesium-136	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.0507–0.0507
RADS	Cesium-137	pCi/g	5.06E-02	8.40E-01	3.23E-01	0/6	4/6	1/6	4.90E-01	3/6	1.02E-01	0/6	1.02E+01	0/6	1/6	0.019–0.12
RADS	Chromium-51	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.6572–0.6572
RADS	Cobalt-56	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.06088–0.06088
RADS	Cobalt-57	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.1072–0.1072
RADS	Cobalt-58	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.06668–0.06668
RADS	Cobalt-60	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.0314–0.0314
RADS	Europium-152	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.2177–0.2177
RADS	Europium-154	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.2222–0.2222
RADS	Europium-155	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.5257–0.5257
RADS	Iridium-192	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.07355–0.07355
RADS	Iron-59	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.06164–0.06164
RADS	Lead-210	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	14.31–14.31
RADS	Lead-211	pCi/g	1.07E+00	1.07E+00	1.07E+00	0/1	1/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.4771–0.4771
RADS	Lead-212	pCi/g	2.00E-01	2.00E-01	2.00E-01	0/1	1/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.1448–0.1448
RADS	Lead-214	pCi/g	4.11E-01	4.11E-01	4.11E-01	0/1	1/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.1528–0.1528
RADS	Manganese-54	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.06121–0.06121
RADS	Mercury-203	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.08251–0.08251
RADS	Neodymium-147	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	1.74–1.74
RADS	Neptunium-237	pCi/g	5.05E-01	5.05E-01	5.05E-01	0/6	1/6	1/6	1.00E-01	1/6	2.29E-01	0/6	2.29E+01	0/6	1/6	0.015–0.15
RADS	Neptunium-239	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	1.669–1.669
RADS	Niobium-94	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.0539–0.0539
RADS	Niobium-95	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.2431–0.2431
RADS	Plutonium-238	pCi/g	N/A	N/A	N/A	0/6	0/6	0/6	7.30E-02	0/6	2.87E+01	0/6	2.87E+03	0/6	0/6	0.014–0.17
RADS	Plutonium-239/240	pCi/g	6.50E-03	4.38E-01	1.91E-01	0/6	4/6	2/6	2.50E-02	0/6	2.47E+01	0/6	2.47E+03	0/6	1/6	0.0059–0.096

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.5.1. Surface Soil Data Summary: SWMUs 56 and 80 (Continued)

Type	Analysis	Unit	Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		DL Range
			Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	
RADS	Potassium-40	pCi/g	3.98E+00	3.98E+00	3.98E+00	0/1	1/1	0/1	1.60E+01	0/1	N/A	0/1	N/A	N/A	N/A	0.29–0.29
RADS	Promethium-146	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.09738–0.09738
RADS	Protactinium-231	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	3.199–3.199
RADS	Protactinium-233	pCi/g	3.00E-01	3.00E-01	3.00E-01	0/1	1/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.1775–0.1775
RADS	Protactinium-234m	pCi/g	1.33E+03	1.33E+03	1.33E+03	0/1	1/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	8.39–8.39
RADS	Radium-223	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.4446–0.4446
RADS	Radium-226	pCi/g	3.19E-01	3.19E-01	3.19E-01	0/1	1/1	0/1	1.50E+00	0/1	N/A	0/1	N/A	N/A	N/A	0.166–0.166
RADS	Radium-228	pCi/g	3.38E-01	3.38E-01	3.38E-01	0/1	1/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.1685–0.1685
RADS	Radon-219	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.5767–0.5767
RADS	Ruthenium-106	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.6539–0.6539
RADS	Silver-110m	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.07081–0.07081
RADS	Sodium-22	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.03211–0.03211
RADS	Strontium-90	pCi/g	6.70E+00	6.70E+00	6.70E+00	0/1	1/1	1/1	4.70E+00	0/1	N/A	0/1	N/A	N/A	N/A	0.53–0.53
RADS	Technetium-99	pCi/g	2.01E+00	2.95E+01	1.58E+01	0/7	2/7	1/7	2.50E+00	0/7	1.20E+03	0/7	1.20E+05	2/7	2/7	0.3–4.07
RADS	Thallium-208	pCi/g	1.66E-01	1.66E-01	1.66E-01	0/1	1/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.07618–0.07618
RADS	Thorium-227	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.5615–0.5615
RADS	Thorium-228	pCi/g	2.00E-01	1.04E+00	6.91E-01	0/6	6/6	0/6	1.60E+00	0/6	N/A	0/6	N/A	N/A	N/A	0.03–0.1492
RADS	Thorium-229	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.4038–0.4038
RADS	Thorium-230	pCi/g	8.50E-01	4.40E+00	1.61E+00	0/6	6/6	1/6	1.50E+00	0/6	3.39E+01	0/6	3.39E+03	0/6	1/6	0.02–0.132
RADS	Thorium-232	pCi/g	1.79E-01	9.50E-01	6.39E-01	0/6	6/6	0/6	1.50E+00	0/6	N/A	0/6	N/A	N/A	N/A	0.0064–0.0953
RADS	Thorium-234	pCi/g	1.33E+03	1.33E+03	1.33E+03	0/1	1/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	8.39–8.39
RADS	Tin-113	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.0912–0.0912
RADS	Uranium-234	pCi/g	8.87E-01	2.29E+02	6.67E+01	0/6	6/6	4/6	1.20E+00	1/6	5.53E+01	0/6	5.53E+03	2/6	6/6	0.01–5.6
RADS	Uranium-235	pCi/g	4.91E-02	3.00E+01	5.17E+00	0/6	6/6	5/6	6.00E-02	2/6	3.40E-01	0/6	3.40E+01	1/6	6/6	0.02–3.7
RADS	Uranium-238	pCi/g	1.59E+00	1.92E+03	5.55E+02	0/6	6/6	6/6	1.20E+00	5/6	1.60E+00	1/6	1.60E+02	5/6	6/6	0.02–7.12
RADS	Yttrium-88	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.02669–0.02669
RADS	Zinc-65	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.06719–0.06719
RADS	Zirconium-95	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.2338–0.2338

One or more samples exceed AL value
One or more samples exceed NAL value
One or more samples exceed background value
One or more samples exceed SSLs of RGA and UCRS groundwater protection

Counts of analyses are based on the maximum detected result from a sample (i.e., if a sample has analytical results from two different labs, only the maximum value is counted).
Field replicates, or separate samples are counted independently.

The uranium (metal)/uranium (isotopic) may not be from the same sample thus a correlation between uranium (metal)/uranium (isotopic) data may not be possible.
Uranium-238 that was analyzed using method RL-7128NITRIC is compared to a background value of 0.4 pCi/g for surface and subsurface.

Screening values are shown in Appendices C and D.

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

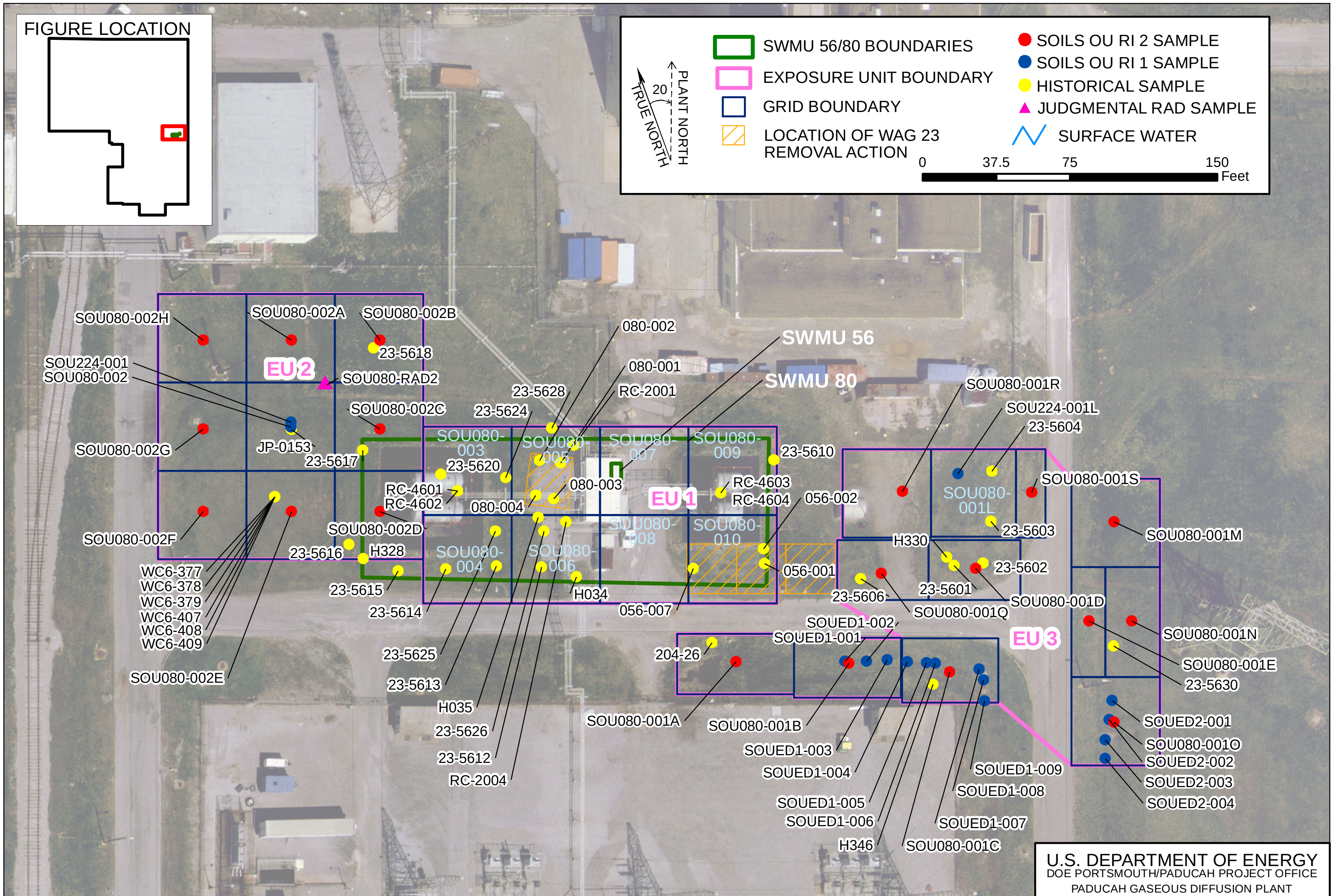

Figure 5.5.2. SWMUs 56 and 80 Sample Locations—Surface Soil

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3/26/2015

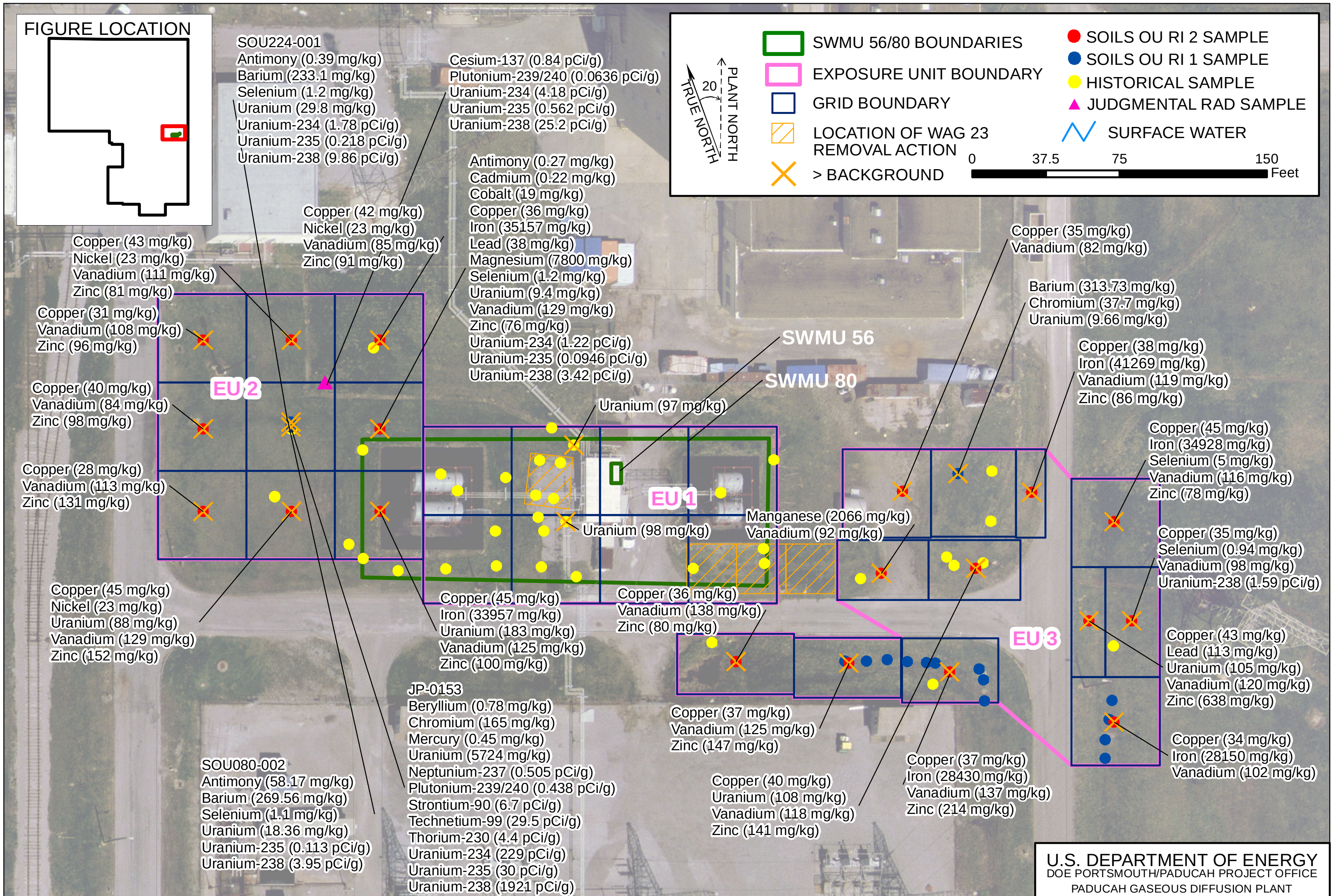

Figure 5.5.3. SWMUs 56 and 80 Background Exceedances—Surface Soil

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3/26/2015

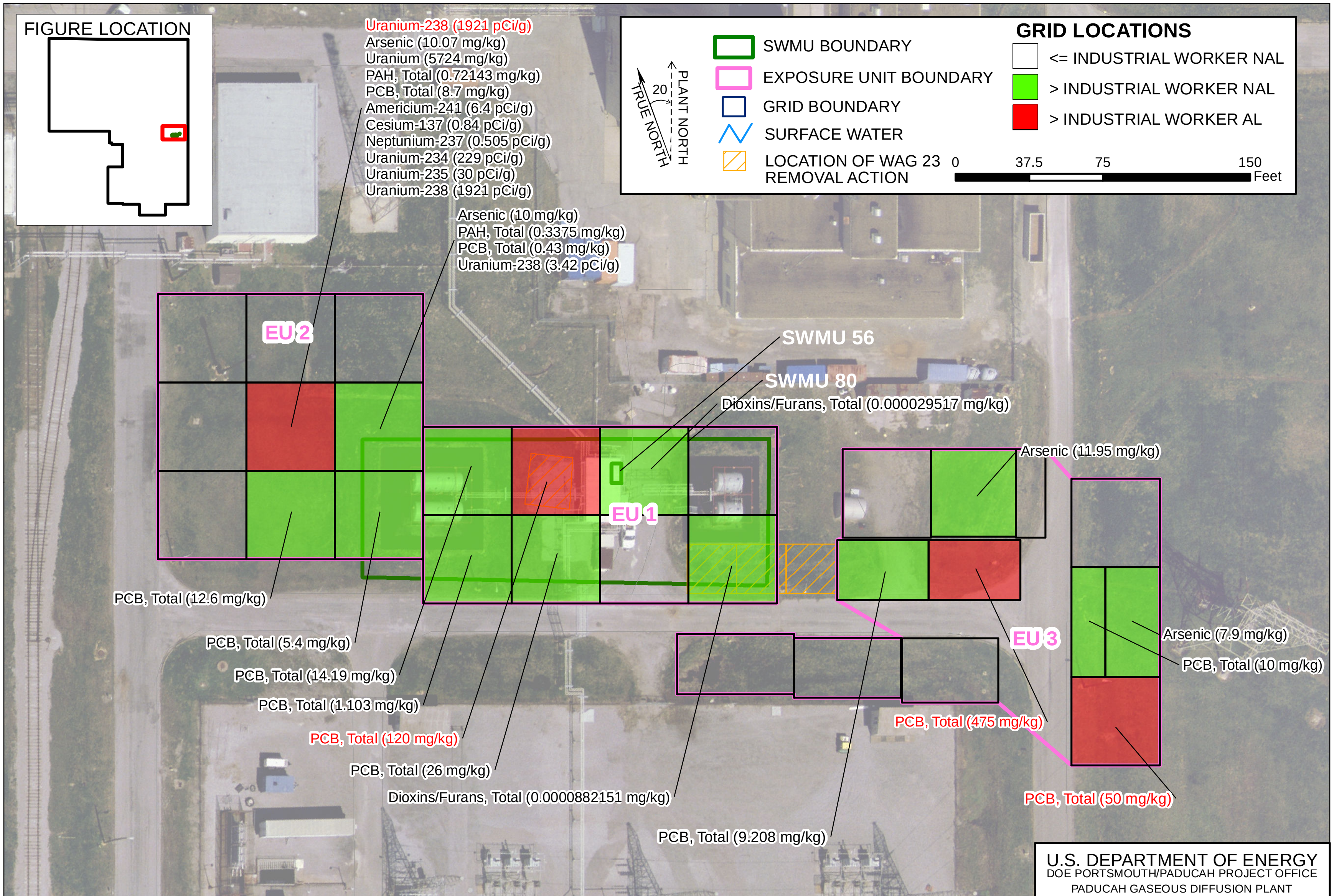

Figure 5.5.4. SWMUs 56 and 80 NAL Exceedances—Surface Soil

U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

FLUOR.

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3/16/2015

The following were detected above the SSLs for the protection of RGA groundwater and the background screening levels.

Metal	Grid	EU
Antimony	2	2
Cobalt	2C	2
Iron	1C, 1M, 1O, 1S, 2C, 2D	2, 3
Manganese	1Q	3
Molybdenum[1]	1A, 2C	2, 3
Uranium	2	2

[1] No soil background value is available.

Dioxins/Furans

Total Dioxins/Furans were detected above the industrial worker NALs in the surface soil in grids 6 and 10 of EU 1, but they were above no other screening criteria.

PCBs

Total PCBs were detected above the industrial worker NALs in the surface soil in grids 1D and 1E (EU 3); grids 2, 2C, 2D, and 2E, (EU 2); and grids 3, 4, 5, and 6 (EU 1). Total PCBs in grid 1D, 1O, and 5 were detected above the industrial worker ALs.

For Soils OU grid 1O, located on the investigation area boundary, historical data indicate a PCB concentration of 50 mg/kg in surface soil. The RI 2 investigation did not perform step-outs based on historical data.

Surface soil sampling previously was conducted within the drainage ditch that is partially located within grid 1O Note: Data that fall outside of grid 1O were not evaluated by Soils OU RI 2. The data indicate that higher concentrations of contamination are located near the head of the drainage ditch, as would be expected. The head of the drainage ditch is located within grid 1O. Data from the surface soil sampling also indicate that, in general, contaminant concentrations do decrease along the length of the drainage ditch. Although the diminishing contaminant concentrations are not linear, a general decreasing concentration as the flow moves southward is apparent. The drainage ditch runs parallel to C-533 Switchyard, from which it receives rainfall runoff. There is a potential for PCB contaminants in the switchyard to have migrated into the drainage ditch; therefore, it is uncertain as to whether the extent of PCB surface contamination south of grid 1O is related to SWMUs 56 and 80 or to the C-533 Switchyard.

Total PCBs were detected in the SWMUs 56 and 80 surface soil above the SSLs for the protection of UCRS groundwater in grids 1A, 1C, 1D, 1E, 1O, and 1Q (EU 3); grids 2, 2B, 2C, 2D, and 2E, (EU 2); and grids 3, 4, 5, 6, and 9 (EU 1). Grids 1D, 1E, 1O, 1Q, 2, 2D, 2E, 3, 5, and 6 also contained total PCBs detected above SSLs for the protection of RGA groundwater.

SVOCs

Total PAHs were detected above industrial worker NALs in the surface soil in grids 2 and 2C (EU 2). No SVOCs were detected in the SWMUs 56 and 80 surface soils above industrial worker ALs.

The Total PAHs detected in grids 2 and 2C also were detected above the SSL for the protection of UCRS groundwater. Additionally, Total PAHs, naphthalene, and phenanthrene were detected above the SSL for the protection of UCRS groundwater in grid 2 surface soils. Naphthalene and phenanthrene were detected above the SSLs for the protection of RGA groundwater in grid 2.

VOCs

No VOCs were detected in surface soils.

Radionuclides

Uranium-238 was above both the background screening levels and the industrial worker NAL in surface soil at grid 2C (EU 2). Americium-241, cesium-137, neptunium-237, uranium-234, uranium-235, and uranium-238 were above both the background screening levels (if available) and the industrial worker NAL in surface at grid 2 (EU 2). Uranium-238 was above both the background screening levels and the industrial worker ALs in grid 2.

Americium-241, cesium-137, neptunium-237, plutonium-239/240, Tc-99, thorium-230, uranium-234, uranium-235, and uranium-238 were detected above both the background screening levels (if available) and SSLs for the protection of UCRS groundwater in grid 2 surface soils. Additionally, uranium-234 [grid 2C (EU 2)], uranium-235 [grid 2C (EU 2)], and uranium-238 [grids 1N (EU 1) and 2C (EU 2)] were detected above both the background screening levels and SSLs for the protection of UCRS.

Tc-99, uranium-234, uranium-235, and uranium-238 in grid 2 and uranium-238 in grid 2C were detected above the SSL for the protection of RGA groundwater.

5.5.4 Nature and Extent of Contamination—Subsurface Soils

The representative data set presented in Table 5.5.2 provides the nature of contamination in SWMUs 56 and 80 subsurface soils, and Figures 5.5.5–5.5.7 illustrate the horizontal extent. A complete list of detailed sampling results, including sampling depths, is provided in Appendix F (samples with ending depths greater than 1 ft bgs are considered subsurface soils in this nature and extent section).

The horizontal and vertical extent of SWMUs 56 and 80 subsurface soil contamination is considered defined adequately for supporting the BRA and FS. There is some uncertainty with vertical extent; however, this will be addressed in the FS.

Metals

Antimony (grid 1L in EU 3) and arsenic (grids 1D in EU 3 and 2 in EU 2) were detected in the subsurface soil at SWMUs 56 and 80 above both background screening levels and the industrial worker NALs. The metals were detected above industrial worker NALs to a maximum depth of 7 ft bgs. No metals were detected above background screening levels and ALs.

Table 5.5.2. Subsurface Soil Data Summary: SWMUs 56 and 80

			Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
Type	Analysis	Unit	Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
METAL	Aluminum	mg/kg	9.30E+03	9.90E+03	9.60E+03	0/2	2/2	0/2	1.20E+04	0/2	1.00E+05	0/2	1.00E+05	0/2	2/2	4–5.2
METAL	Antimony	mg/kg	1.50E-01	9.60E+01	4.93E+01	0/7	7/7	5/7	2.10E-01	1/7	9.34E+01	0/7	2.80E+03	5/7	5/7	0.024–30
METAL	Arsenic	mg/kg	5.85E+00	1.00E+01	8.31E+00	0/30	6/30	3/30	7.90E+00	6/30	1.41E+00	0/30	1.41E+02	0/30	6/30	0.16–11
METAL	Barium	mg/kg	1.30E+02	5.23E+02	3.65E+02	0/7	7/7	5/7	1.70E+02	0/7	4.04E+04	0/7	1.00E+05	0/7	7/7	0.08–100
METAL	Beryllium	mg/kg	6.60E-01	6.70E-01	6.65E-01	0/2	2/2	0/2	6.90E-01	0/2	4.50E+02	0/2	1.35E+04	0/2	0/2	0.04–0.052
METAL	Cadmium	mg/kg	1.70E-01	1.77E+01	6.01E+00	0/7	3/7	1/7	2.10E-01	0/7	6.12E+01	0/7	1.84E+03	0/7	1/7	0.024–12
METAL	Calcium	mg/kg	7.10E+03	7.10E+03	7.10E+03	0/2	2/2	2/2	6.10E+03	0/2	N/A	0/2	N/A	N/A	N/A	80–100
METAL	Chromium	mg/kg	1.40E+01	4.65E+01	2.60E+01	0/30	5/30	1/30	4.30E+01	0/30	1.98E+02	0/30	1.98E+04	0/30	0/30	0.8–85
METAL	Cobalt	mg/kg	7.60E+00	8.50E+00	8.05E+00	0/2	2/2	0/2	1.30E+01	0/2	6.87E+01	0/2	2.06E+03	2/2	2/2	0.08–0.1
METAL	Copper	mg/kg	1.30E+01	5.00E+01	3.48E+01	0/30	24/30	22/30	2.50E+01	0/30	9.34E+03	0/30	1.00E+05	0/30	1/30	0.8–35
METAL	Iron	mg/kg	8.66E+03	3.70E+04	2.60E+04	0/30	30/30	12/30	2.80E+04	0/30	1.00E+05	0/30	1.00E+05	30/30	30/30	8–100
METAL	Lead	mg/kg	6.95E+00	1.11E+02	2.22E+01	0/30	7/30	1/30	2.30E+01	0/30	8.00E+02	0/30	8.00E+02	0/30	2/30	0.04–13
METAL	Magnesium	mg/kg	1.80E+03	1.80E+03	1.80E+03	0/2	2/2	0/2	2.10E+03	0/2	N/A	0/2	N/A	N/A	N/A	8–10
METAL	Manganese	mg/kg	7.20E+01	1.14E+03	3.72E+02	0/30	30/30	2/30	8.20E+02	0/30	4.72E+03	0/30	1.00E+05	23/30	30/30	0.16–85
METAL	Mercury	mg/kg	6.88E+00	6.88E+00	6.88E+00	0/30	1/30	1/30	1.30E-01	0/30	7.01E+01	0/30	2.10E+03	1/30	1/30	0.031–40
METAL	Molybdenum	mg/kg	5.70E-01	3.70E+01	1.42E+01	0/30	5/30	0/30	N/A	0/30	1.17E+03	0/30	3.51E+04	3/30	5/30	0.08–15
METAL	Nickel	mg/kg	1.20E+01	7.11E+01	2.12E+01	0/30	22/30	5/30	2.20E+01	0/30	4.30E+03	0/30	1.00E+05	0/30	22/30	0.4–65
METAL	Selenium	mg/kg	1.30E+00	1.60E+00	1.45E+00	0/30	2/30	2/30	7.00E-01	0/30	1.17E+03	0/30	3.51E+04	0/30	2/30	0.08–20
METAL	Silver	mg/kg	5.40E-02	6.10E-02	5.75E-02	0/30	2/30	0/30	2.70E+00	0/30	1.17E+03	0/30	3.51E+04	0/30	0/30	0.008–50
METAL	Sodium	mg/kg	6.90E+01	9.80E+01	8.35E+01	1/2	2/2	0/2	3.40E+02	0/2	N/A	0/2	N/A	N/A	N/A	80–100
METAL	Thallium	mg/kg	1.50E-01	1.50E-01	1.50E-01	0/2	2/2	0/2	3.40E-01	0/2	2.34E+00	0/2	7.02E+01	0/2	2/2	0.016–0.021
METAL	Uranium	mg/kg	1.00E+01	4.27E+01	1.62E+01	0/30	4/30	4/30	4.60E+00	0/30	6.81E+02	0/30	2.04E+04	0/30	1/30	0.008–20
METAL	Vanadium	mg/kg	8.70E+01	1.33E+02	1.10E+02	0/30	25/30	25/30	3.70E+01	0/30	1.15E+03	0/30	3.45E+04	0/30	25/30	0.08–70
METAL	Zinc	mg/kg	2.39E+01	9.00E+01	5.48E+01	0/30	30/30	12/30	6.00E+01	0/30	7.01E+04	0/30	1.00E+05	0/30	25/30	1–25
PPCB	4,4'-DDD	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.18–4.5
PPCB	4,4'-DDE	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.064–1.6
PPCB	4,4'-DDT	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.19–4.8
PPCB	Aldrin	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.064–1.6
PPCB	alpha-BHC	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.048–1.2
PPCB	alpha-Chlordane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.079–2
PPCB	beta-BHC	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.095–2.4
PPCB	delta-BHC	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.095–2.4
PPCB	Dieldrin	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	5.15E-02	0/2	5.15E+00	0/2	0/2	0.031–0.78
PPCB	Endosulfan I	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.095–2.4
PPCB	Endosulfan II	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.064–1.6
PPCB	Endosulfan sulfate	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.19–4.8
PPCB	Endrin	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.095–2.4
PPCB	Endrin ketone	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.19–4.8
PPCB	gamma-Chlordane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.079–2
PPCB	Heptachlor	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.048–1.2
PPCB	Heptachlor epoxide	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.095–2.4
PPCB	Lindane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.064–1.6
PPCB	Methoxychlor	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.38–9.6
PPCB	PCB, Total	mg/kg	5.00E-03	7.30E+01	1.47E+01	0/102	18/102	0/102	N/A	7/102	3.05E-01	3/102	3.05E+01	5/102	9/102	0.05–5
PPCB	Toxaphene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	1.6–40
SVOA	1,2,4-Trichlorobenzene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42
SVOA	1,2-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42
SVOA	1,2-Diphenylhydrazine	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.39–0.4
SVOA	1,3-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42
SVOA	1,4-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42
SVOA	2,4,5-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.41–1.9
SVOA	2,4,6-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42
SVOA	2,4-Dichlorophenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.5.2. Subsurface Soil Data Summary: SWMUs 56 and 80 (Continued)

			Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
Type	Analysis	Unit	Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
SVOA	2,4-Dimethylphenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42
SVOA	2,4-Dinitrophenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.83–1.9
SVOA	2,4-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.25–0.4
SVOA	2,6-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.25–0.4
SVOA	2-Chloronaphthalene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42
SVOA	2-Chlorophenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42
SVOA	2-Methyl-4,6-dinitrophenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.83–1.9
SVOA	2-Methylnaphthalene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42
SVOA	2-Methylphenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42
SVOA	2-Nitrobenzenamine	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	2.91E+02	0/4	8.73E+03	0/4	0/4	0.83–1.9
SVOA	2-Nitrophenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42
SVOA	3,3'-Dichlorobenzidine	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.25–0.8
SVOA	3-Nitrobenzenamine	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.83–1.9
SVOA	4-Bromophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42
SVOA	4-Chloro-3-methylphenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42
SVOA	4-Chlorobenzenamine	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42
SVOA	4-Chlorophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42
SVOA	4-Methylphenol	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.39–0.4
SVOA	4-Nitrophenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.83–1.9
SVOA	Acenaphthene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	1.40E+03	0/4	4.20E+04	0/4	0/4	0.39–0.42
SVOA	Acenaphthylene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	1.40E+03	0/4	4.20E+04	N/A	N/A	0.39–0.42
SVOA	Anthracene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	6.99E+03	0/4	2.10E+05	0/4	0/4	0.39–0.42
SVOA	Benzenemethanol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42
SVOA	Benzo(ghi)perylene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42
SVOA	Benzoic acid	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	1.9–2.1
SVOA	Bis(2-chloroethoxy)methane	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42
SVOA	Bis(2-chloroethyl) ether	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42
SVOA	Bis(2-chloroisopropyl) ether	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42
SVOA	Bis(2-ethylhexyl)phthalate	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	5.88E+01	0/4	5.88E+03	0/4	0/4	0.39–0.42
SVOA	Butyl benzyl phthalate	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42
SVOA	Dibenzofuran	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42
SVOA	Diethyl phthalate	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42
SVOA	Dimethyl phthalate	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42
SVOA	Di-n-butyl phthalate	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42
SVOA	Di-n-octylphthalate	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42
SVOA	Fluoranthene	mg/kg	3.60E-01	4.90E-01	4.25E-01	1/4	2/4	0/4	N/A	0/4	9.32E+02	0/4	2.80E+04	0/4	0/4	0.39–0.42
SVOA	Fluorene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	9.32E+02	0/4	2.80E+04	0/4	0/4	0.39–0.42
SVOA	Hexachlorobenzene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	5.15E-01	0/4	5.15E+01	0/4	0/4	0.0041–0.4
SVOA	Hexachlorobutadiene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.25–0.4
SVOA	Hexachlorocyclopentadiene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42
SVOA	Hexachloroethane	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42
SVOA	Isophorone	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42
SVOA	m,p-cresol	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.41–0.42
SVOA	Naphthalene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	1.67E+01	0/4	1.61E+03	0/4	0/4	0.39–0.42
SVOA	Nitrobenzene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42
SVOA	N-Nitroso-di-n-propylamine	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	1.18E-01	0/4	1.18E+01	0/4	0/4	0.39–0.42
SVOA	N-Nitrosodiphenylamine	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42
SVOA	PAH, Total	mg/kg	1.63E-01	5.79E-01	3.71E-01	0/4	2/4	0/4	N/A	2/4	8.94E-02	0/4	8.94E+00	0/4	1/4	–
SVOA	Pentachlorophenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	8.91E-01	0/4	8.91E+01	N/A	N/A	0.74–1.9
SVOA	Phenanthrene	mg/kg	1.50E-01	2.70E-01	2.10E-01	2/4	2/4	0/4	N/A	0/4	1.40E+03	0/4	4.20E+04	0/4	2/4	0.39–0.42
SVOA	Phenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.39–0.42
SVOA	p-Nitroaniline	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.83–1.9
SVOA	Pyrene	mg/kg	3.30E-01	4.40E-01	3.85E-01	1/4	2/4	0/4	N/A	0/4	6.99E+02	0/4	2.10E+04	0/4	0/4	0.39–0.42

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.5.2. Subsurface Soil Data Summary: SWMUs 56 and 80 (Continued)

			Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
Type	Analysis	Unit	Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
SVOA	Pyridine	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.41–0.42
VOA	1,1,1-Trichloroethane	mg/kg	N/A	N/A	N/A	0/6	0/6	0/6	N/A	0/6	3.58E+03	0/6	1.07E+05	0/6	0/6	0.006–0.006
VOA	1,1,2,2-Tetrachloroethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.006–0.006
VOA	1,1,2-Trichloro-1,2,2-trifluoroethane	mg/kg	1.10E-02	1.10E-02	1.10E-02	1/1	1/1	0/1	N/A	0/1	1.69E+04	0/1	5.07E+05	0/1	0/1	–
VOA	1,1,2-Trichloroethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	6.32E-01	0/2	1.90E+01	0/2	0/2	0.006–0.006
VOA	1,1-Dichloroethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	1.58E+01	0/2	1.58E+03	0/2	0/2	0.006–0.006
VOA	1,1-Dichloroethene	mg/kg	N/A	N/A	N/A	0/6	0/6	0/6	N/A	0/6	1.00E+02	0/6	3.00E+03	0/6	0/6	0.006–0.006
VOA	1,2-Dichloroethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	2.09E+00	0/2	2.09E+02	0/2	0/2	0.006–0.006
VOA	1,2-Dichloroethene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	2.10E+03	0/2	6.30E+04	0/2	0/2	0.006–0.006
VOA	1,2-Dichloropropane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.006–0.006
VOA	2-Hexanone	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.013–0.013
VOA	4-Methyl-2-pentanone	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.013–0.013
VOA	Acetone	mg/kg	1.10E-01	1.10E-01	1.10E-01	0/2	1/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.013–0.013
VOA	Benzene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	5.31E+00	0/2	5.31E+02	0/2	0/2	0.006–0.006
VOA	Bromodichloromethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	1.30E+00	0/2	1.30E+02	0/2	0/2	0.006–0.006
VOA	Bromoform	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.006–0.006
VOA	Bromomethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.013–0.013
VOA	Carbon disulfide	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.006–0.006
VOA	Carbon tetrachloride	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	2.96E+00	0/2	2.96E+02	0/2	0/2	0.006–0.006
VOA	Chlorobenzene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.006–0.006
VOA	Chloroethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.013–0.013
VOA	Chloroform	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	1.39E+00	0/2	1.39E+02	0/2	0/2	0.006–0.006
VOA	Chloromethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.013–0.013
VOA	*cis*-1,3-Dichloropropene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.006–0.006
VOA	Dibromochloromethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.006–0.006
VOA	Ethylbenzene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	2.66E+01	0/2	2.66E+03	0/2	0/2	0.006–0.006
VOA	Methylene chloride	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.006–0.006
VOA	Styrene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.006–0.006
VOA	Tetrachloroethene	mg/kg	N/A	N/A	N/A	0/6	0/6	0/6	N/A	0/6	4.00E+01	0/6	1.20E+03	N/A	N/A	0.006–0.006
VOA	Toluene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	6.25E+03	0/2	1.88E+05	0/2	0/2	0.006–0.006
VOA	Total Xylene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	2.54E+02	0/2	7.62E+03	0/2	0/2	0.006–0.006
VOA	*trans*-1,3-Dichloropropene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.006–0.006
VOA	Trichloroethene	mg/kg	N/A	N/A	N/A	0/6	0/6	0/6	N/A	0/6	1.90E+00	0/6	5.70E+01	0/6	0/6	0.006–0.006
VOA	Vinyl acetate	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.013–0.013
VOA	Vinyl chloride	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	2.06E+00	0/2	2.06E+02	0/2	0/2	0.013–0.013
RADS	Americium-241	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	5.99E+00	0/2	5.99E+02	0/2	0/2	0.0385–0.04
RADS	Cesium-137	pCi/g	7.14E-02	7.25E-02	7.20E-02	0/2	2/2	0/2	2.80E-01	0/2	1.02E-01	0/2	1.02E+01	0/2	0/2	0.0233–0.0274
RADS	Neptunium-237	pCi/g	4.53E-02	4.96E-02	4.75E-02	0/2	2/2	0/2	N/A	0/2	2.29E-01	0/2	2.29E+01	0/2	0/2	0.0316–0.0432
RADS	Plutonium-238	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	2.87E+01	0/2	2.87E+03	0/2	0/2	0.0197–0.0292
RADS	Plutonium-239/240	pCi/g	3.25E-02	6.20E-02	4.73E-02	0/2	2/2	0/2	N/A	0/2	2.47E+01	0/2	2.47E+03	0/2	0/2	0.00801–0.0203
RADS	Technetium-99	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	2.80E+00	0/2	1.20E+03	0/2	1.20E+05	0/2	0/2	0.665–0.701
RADS	Thorium-228	pCi/g	1.04E+00	1.09E+00	1.07E+00	0/2	2/2	0/2	1.60E+00	0/2	N/A	0/2	N/A	N/A	N/A	0.0589–0.0855
RADS	Thorium-230	pCi/g	1.14E+00	1.33E+00	1.24E+00	0/2	2/2	0/2	1.40E+00	0/2	3.39E+01	0/2	3.39E+03	0/2	0/2	0.0696–0.0894
RADS	Thorium-232	pCi/g	1.02E+00	1.07E+00	1.05E+00	0/2	2/2	0/2	1.50E+00	0/2	N/A	0/2	N/A	N/A	N/A	0.0161–0.0273
RADS	Uranium-234	pCi/g	1.10E+00	1.29E+00	1.20E+00	0/2	2/2	1/2	1.20E+00	0/2	5.53E+01	0/2	5.53E+03	0/2	2/2	0.0581–0.0628
RADS	Uranium-235	pCi/g	8.33E-02	9.10E-02	8.72E-02	0/2	2/2	2/2	6.00E-02	0/2	3.40E-01	0/2	3.40E+01	0/2	2/2	0.0301–0.0474
RADS	Uranium-238	pCi/g	3.47E+00	3.75E+00	3.61E+00	0/2	2/2	2/2	1.20E+00	2/2	1.60E+00	0/2	1.60E+02	2/2	2/2	0.0416–0.0602

One or more samples exceed AL value
One or more samples exceed NAL value
One or more samples exceed background value
One or more samples exceed SSLs of RGA and UCRS groundwater protection

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.5.2. Subsurface Soil Data Summary: SWMUs 56 and 80 (Continued)

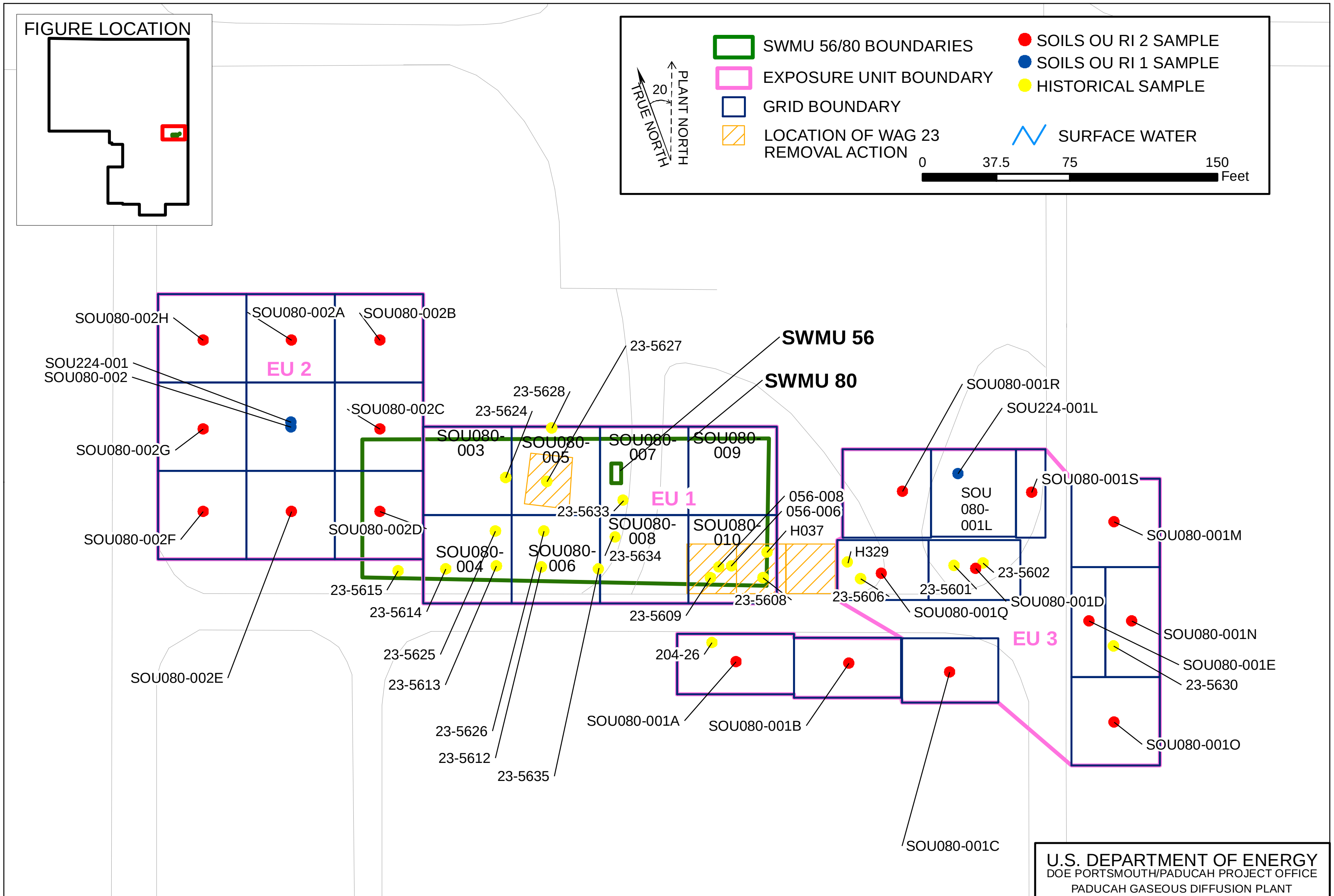
Type	Analysis	Unit	Detected Results			J-qualified	FOD	Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		DL Range
			Min	Max	Avg	FOD		FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	

Counts of analyses are based on the maximum detected result from a sample (i.e., if a sample has analytical results from two different labs, only the maximum value is counted).
Field replicates, or separate samples are counted independently.

The uranium (metal)/uranium (isotopic) may not be from the same sample thus a correlation between uranium (metal)/uranium (isotopic) data may not be possible.
Uranium-238 that was analyzed using method RL-7128NITRIC is compared to a background value of 0.4 pCi/g for surface and subsurface.

Screening values are shown in Appendices C and D.

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable



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FLUOR.

Figure 5.5.5. SWMUs 56 and 80 Sample Locations—Subsurface Soil

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3/26/2015

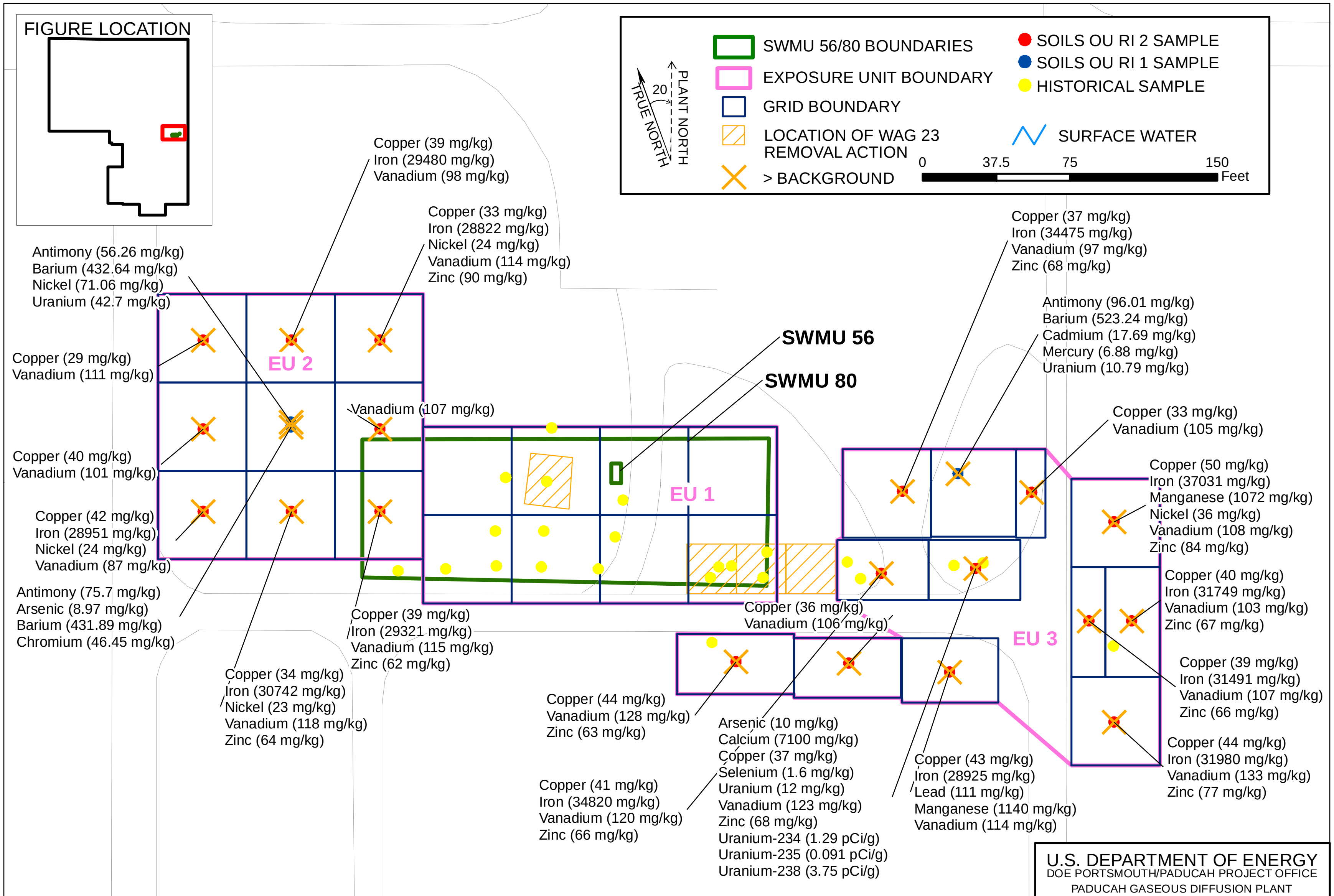

Figure 5.5.6. SWMUs 56 and 80 Background Exceedances—Subsurface Soil

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3/26/2015

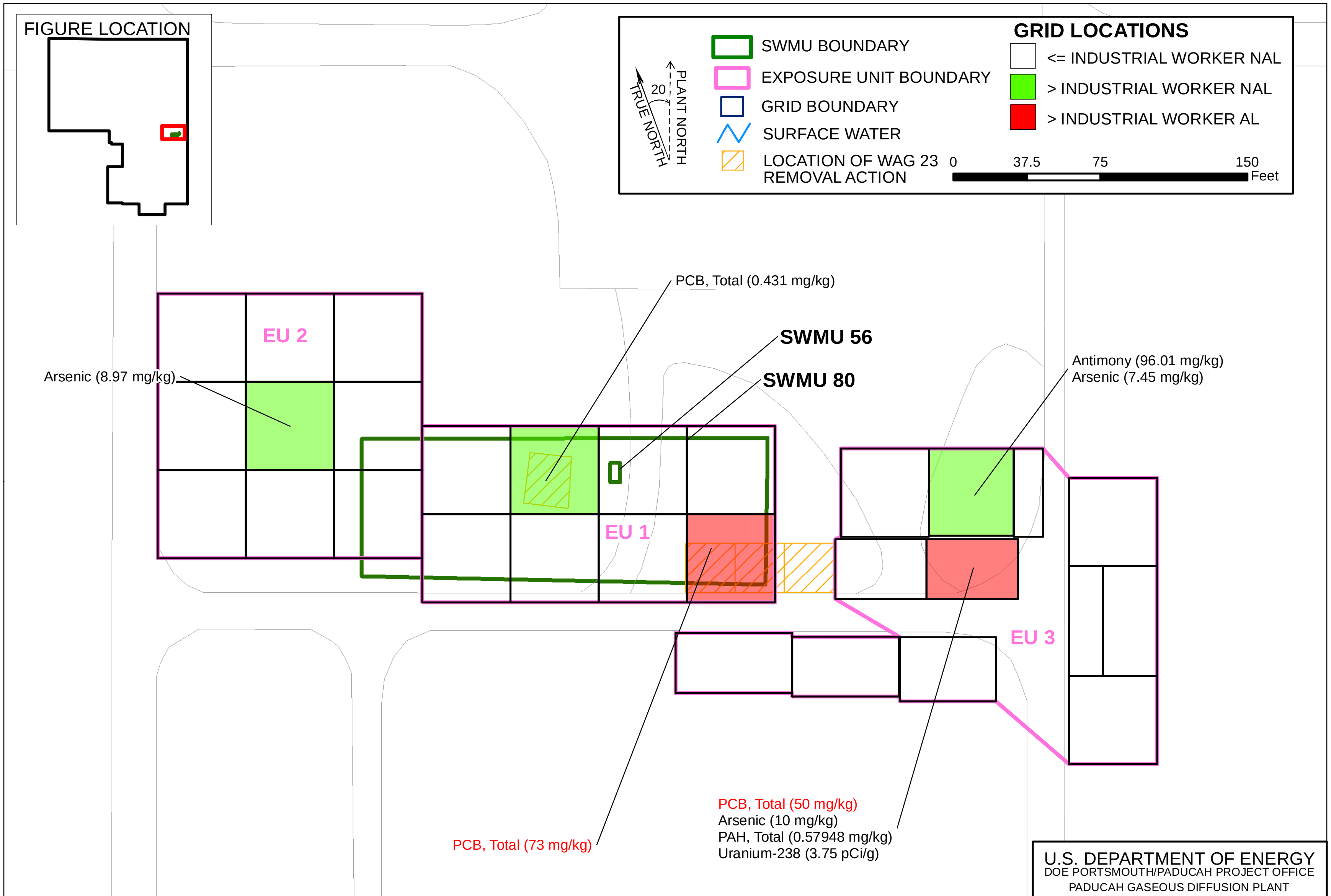

Figure 5.5.7. SWMUs 56 and 80 NAL Exceedances—Subsurface Soil

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3/12/2015

The following metals were detected in the SWMUs 56 and 80 subsurface soil above both the SSLs for the protection of UCRS groundwater and the background screening levels.

Metal	Grid	EU
Antimony	1L, 2	2, 3
Arsenic	1D, 2	2, 3
Barium	1L, 2	2, 3
Cadmium	1L	3
Copper	1M	3
Iron	1C, 1E, 1M, 1N, 1O, 1Q, 1R, 2A, 2B, 2D, 2E, 2F	2, 3
Lead	1C	3
Manganese	1C, 1M	3
Mercury	1L	3
Molybdenum[1]	1B, 1D, 1M, 1N	3
Nickel	1M, 2, 2B, 2E, 2F	2, 3
Selenium	1D	3
Uranium	2	2
Vanadium	1A, 1B, 1C, 1D, 1E, 1M, 1N, 1O, 1Q, 1R, 1S, 2A, 2B, 2C, 2D, 2E, 2F, 2G, 2H	2, 3
Zinc	1A, 1D, 1E, 1M, 1N, 1O, 1Q, 1R, 2B, 2D, 2E	2, 3

[1] No soil background value is available.

The following were detected above the SSLs for the protection of RGA groundwater and the background screening levels.

Metal	Grid	EU
Antimony	1L, 2	2, 3
Iron	1C, 1E, 1M, 1N, 1O, 1Q, 1R, 1S, 2A, 2B, 2D, 2E, 2F, 2G, 2H	2, 3
Manganese	1C, 1M	3
Mercury	1L	3
Molybdenum[1]	1B, 1M, 1N	3

[1] No soil background value is available.

Pesticides

Pesticides were not detected in the subsurface soil at SWMUs 56 and 80.

PCBs

Total PCBs were detected above the industrial worker NALs in the subsurface soil in grids 1D (EU 3) and grids 5 and 10 (EU 1). The PCBs were detected above industrial worker NALs to a maximum depth of 6 ft bgs. Total PCBs in grids 1D and 1O were detected above the industrial worker ALs.

Total PCBs were detected in the SWMUs 56 and 80 subsurface soil above the SSLs for the protection of UCRS groundwater in grids 1D and 1Q (EU 3) and grids 5 and 10 (EU 1). Grids 1D and 10 also contained Total PCBs detected above SSLs for the protection of RGA groundwater.

SVOCs

Total PAHs were detected above industrial worker NALs in the subsurface soil in grid 1D (EU 3). The PAHs were detected above industrial worker NALs to a maximum depth of 4 ft bgs. No SVOCs were detected in the SWMUs 56 and 80 subsurface soil above industrial worker ALs.

Phenanthrene and Total PAHs were detected in grid 1D above the SSL for the protection of UCRS groundwater. None were detected above the SSLs for the protection of RGA groundwater.

VOCs

No VOCs were detected above screening levels in subsurface soils.

Radionuclides

Uranium-238 was above both the background screening levels and the industrial worker NAL in subsurface soil at grid 1D (EU 3). The radionuclide was detected above industrial worker NALs to a maximum depth of 4 ft bgs. No radionuclides were detected above both the background screening levels and industrial worker ALs in the SWMUs 56 and 80 subsurface soil.

Uranium-234, uranium-235, and uranium-238 (all in grid 1D of EU 3) were detected above both the background screening levels and SSLs for the protection of UCRS. Uranium-238 in grid 1D also was detected above the SSL for the protection of RGA groundwater.

5.5.5 Fate and Transport

PCBs appear to be migrating along drainage ways east of this area. The potential for runoff at SWMUs 56 and 80 is not considered to be significant because the unit is grass-covered or otherwise stabilized, and the contaminants are not likely to be transported attached to suspended soil particles.

Uranium-234 at SWMUs 56 and 80 was identified for further evaluation under fate and transport (Chapter 4). SESOIL and AT123D simulation modeling results are summarized in Appendix C.

Uranium-234 was detected at an activity concentration greater than both the background value and SSL; however, the mass concentration of uranium assumed to be present based upon the assumption that the uranium isotopes were present at natural abundance would be 148 mg/kg. At 148 mg/kg, the average concentration is less than the average uranium concentration at SWMU 81 (2,502 mg/kg) that modeling in the Soils OU RI Report (DOE 2013) found not to migrate to the RGA within 1,000 years. Based on this, uranium-234 was not modeled at SWMUs 56 and 80.

5.5.6 Baseline Risk Assessment

Human Health. Potential risks and hazards for current/future human health for SWMUs 56 and 80 were evaluated for each of three EUs (~ 0.5 acres each) for direct contact. These results are summarized in Appendix D and in the subsections that follow, including the COCs and relative contributions to the overall ELCR/HI.

The cumulative ELCR and the cumulative HI for one or more EUs at SWMUs 56 and 80 exceed the benchmarks of cumulative ELCR of 1E-06 and cumulative HI greater than 1, respectively, for one or more scenarios; therefore, as stated in the Work Plan, Decision Rule D1a, (DOE 2010a), these SWMUs will be evaluated in the FS. As described in the BHHRA (Appendix D), COCs were identified after considering the results of the risk characterization and the uncertainties affecting the results.

COCs were identified as those COPCs considered to contribute at least 1E-06 ELCR or 0.1 HI to a scenario of concern. The basis for COC identification is presented in Appendix D. The identified COCs considered to contribute to the ELCR/HI, the EPC, and the RGOs calculated for a range of ELCR/HI benchmarks are presented in Table 5.5.3 for the future industrial worker, excavation worker, and the

Table 5.5.3. RGOs for SWMUs 56 and 80

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3]			HI[4]	RGOs for HI[3]		
					1E-06	1E-05	1E-04		0.1	1	3
Future Industrial Worker											
1	Dioxins/Furans, Total	8.82E-05	mg/kg	5.4E-06	1.63E-05	1.63E-04	1.63E-03	< 0.1	N/A	N/A	N/A
1	PCB, Total	1.20E+02	mg/kg	3.9E-04	3.05E-01	3.05E+00	3.05E+01	< 0.1	N/A	N/A	N/A
1	**Cumulative**			**4.0E-04**				**< 1**			
2	PAH, Total	7.21E-01	mg/kg	8.1E-06	8.94E-02	8.94E-01	8.94E+00	< 0.1	N/A	N/A	N/A
2	PCB, Total	1.26E+01	mg/kg	4.1E-05	3.05E-01	3.05E+00	3.05E+01	< 0.1	N/A	N/A	N/A
2	Americium-241	6.40E+00	pCi/g	1.2E-06	5.45E+00	5.45E+01	5.45E+02	N/A	N/A	N/A	N/A
2	Cesium-137	8.40E-01	pCi/g	7.4E-06	1.14E-01	1.14E+00	1.14E+01	N/A	N/A	N/A	N/A
2	Neptunium-237	5.05E-01	pCi/g	2.0E-06	2.53E-01	2.53E+00	2.53E+01	N/A	N/A	N/A	N/A
2	Uranium-234	2.29E+02	pCi/g	1.1E-05	2.01E+01	2.01E+02	2.01E+03	N/A	N/A	N/A	N/A
2	Uranium-235	3.00E+01	pCi/g	8.0E-05	3.73E-01	3.73E+00	3.73E+01	N/A	N/A	N/A	N/A
2	Uranium-238	1.92E+03	pCi/g	1.2E-03	1.65E+00	1.65E+01	1.65E+02	N/A	N/A	N/A	N/A
2	**Cumulative**			**1.3E-03**				**< 1**			
3	PCB, Total	5.66E+02	mg/kg	1.9E-03	3.05E-01	3.05E+00	3.05E+01	< 0.1	N/A	N/A	N/A
3	**Cumulative**			**1.9E-03**				**< 1**			
Excavation Worker											
1	PCB, Total	1.20E+02	mg/kg	1.0E-04	1.14E+00	1.14E+01	1.14E+02	< 0.1	N/A	N/A	N/A
1	**Cumulative**			**1.1E-04**				**< 1**			
2	Antimony	7.57E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.6	1.32E+01	1.32E+02	3.95E+02
2	Arsenic	1.01E+01	mg/kg	4.0E-06	2.52E+00	2.52E+01	2.52E+02	0.1	8.09E+00	8.09E+01	2.43E+02
2	Cobalt	1.90E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.2	9.82E+00	9.82E+01	2.95E+02
2	Iron	3.52E+04	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.2	2.30E+04	2.30E+05	6.91E+05
2	Manganese	1.20E+03	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.2	7.57E+02	7.57E+03	2.27E+04
2	PAH, Total	7.21E-01	mg/kg	2.2E-06	3.25E-01	3.25E+00	3.25E+01	< 0.1	N/A	N/A	N/A
2	PCB, Total	1.26E+01	mg/kg	1.1E-05	1.14E+00	1.14E+01	1.14E+02	< 0.1	N/A	N/A	N/A
2	Uranium	5.72E+03	mg/kg	< 1.0E-06	N/A	N/A	N/A	5.8	9.80E+01	9.80E+02	2.94E+03
2	Cesium-137	8.40E-01	pCi/g	1.4E-06	6.12E-01	6.12E+00	6.12E+01	N/A	N/A	N/A	N/A
2	Uranium-234	2.29E+02	pCi/g	1.5E-05	1.51E+01	1.51E+02	1.51E+03	N/A	N/A	N/A	N/A
2	Uranium-235	3.00E+01	pCi/g	1.4E-05	2.18E+00	2.18E+01	2.18E+02	N/A	N/A	N/A	N/A
2	Uranium-238	1.92E+03	pCi/g	3.2E-04	5.95E+00	5.95E+01	5.95E+02	N/A	N/A	N/A	N/A
2	**Cumulative**			**3.7E-04**				**7.1**			

Table 5.5.3. RGOs for SWMUs 56 and 80 (Continued)

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3]			HI[4]	RGOs for HI[3]		
					1E-06	1E-05	1E-04		0.1	1	3
Excavation Worker (Continued)											
3	Antimony	9.99E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.8	1.32E+01	1.32E+02	3.95E+02
3	Arsenic	1.04E+01	mg/kg	4.1E-06	2.52E+00	2.52E+01	2.52E+02	0.1	8.09E+00	8.09E+01	2.43E+02
3	Iron	3.41E+04	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	2.30E+04	2.30E+05	6.91E+05
3	Manganese	1.00E+03	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	7.57E+02	7.57E+03	2.27E+04
3	Mercury	7.98E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.8	9.86E+00	9.86E+01	2.96E+02
3	PAH, Total	4.46E-01	mg/kg	1.4E-06	3.25E-01	3.25E+00	3.25E+01	< 0.1	N/A	N/A	N/A
3	PCB, Total	5.68E+02	mg/kg	5.0E-04	1.14E+00	1.14E+01	1.14E+02	< 0.1	N/A	N/A	N/A
3	**Cumulative**			**5.0E-04**				**2.2**			
Hypothetical Resident[5]											
1	Dioxins/Furans, Total	8.82E-05	mg/kg	2.9E-05	3.08E-06	3.08E-05	3.08E-04	1.6	5.47E-06	5.47E-05	1.64E-04
1	PCB, Total	1.20E+02	mg/kg	1.5E-03	7.82E-02	7.82E-01	7.82E+00	N/A	N/A	N/A	N/A
1	Uranium	9.80E+01	mg/kg	N/A	N/A	N/A	N/A	0.4	2.34E+01	2.34E+02	7.01E+02
1	**Cumulative**			**1.6E-03**				**1.5**			
2	Antimony	5.82E+01	mg/kg	N/A	N/A	N/A	N/A	1.9	3.13E+00	3.13E+01	9.39E+01
2	Cobalt	1.90E+01	mg/kg	N/A	N/A	N/A	N/A	0.8	2.34E+00	2.34E+01	7.02E+01
2	Iron	3.52E+04	mg/kg	N/A	N/A	N/A	N/A	0.6	5.47E+03	5.48E+04	1.64E+05
2	PAH, Total	7.21E-01	mg/kg	3.2E-05	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
2	PCB, Total	1.26E+01	mg/kg	1.6E-04	7.82E-02	7.82E-01	7.82E+00	N/A	N/A	N/A	N/A
2	Uranium	5.72E+03	mg/kg	N/A	N/A	N/A	N/A	24.5	2.34E+01	2.34E+02	7.01E+02
2	Vanadium	1.29E+02	mg/kg	N/A	N/A	N/A	N/A	0.3	3.93E+01	3.93E+02	1.18E+03
2	Americium-241	6.40E+00	pCi/g	3.9E-06	1.63E+00	1.63E+01	1.63E+02	N/A	N/A	N/A	N/A
2	Cesium-137	8.40E-01	pCi/g	2.4E-05	3.51E-02	3.51E-01	3.51E+00	N/A	N/A	N/A	N/A
2	Neptunium-237	5.05E-01	pCi/g	6.5E-06	7.72E-02	7.72E-01	7.72E+00	N/A	N/A	N/A	N/A
2	Uranium-234	2.29E+02	pCi/g	4.0E-05	5.73E+00	5.73E+01	5.73E+02	N/A	N/A	N/A	N/A
2	Uranium-235	3.00E+01	pCi/g	2.6E-04	1.14E-01	1.14E+00	1.14E+01	N/A	N/A	N/A	N/A
2	Uranium-238	1.92E+03	pCi/g	3.9E-03	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
2	**Cumulative**			**4.4E-03**				**28.2**			

Table 5.5.3. RGOs for SWMUs 56 and 80 (Continued)

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3]			HI[4]	RGOs for HI[3]		
					1E-06	1E-05	1E-04		0.1	1	3
Hypothetical Resident[5] (Continued)											
3	Iron	3.05E+04	mg/kg	N/A	N/A	N/A	N/A	0.6	5.47E+03	5.48E+04	1.64E+05
3	Manganese	9.46E+02	mg/kg	N/A	N/A	N/A	N/A	0.5	1.82E+02	1.82E+03	5.47E+03
3	PCB, Total	5.66E+02	mg/kg	7.2E-03	7.82E-02	7.82E-01	7.82E+00	N/A	N/A	N/A	N/A
3	Uranium	7.32E+01	mg/kg	N/A	N/A	N/A	N/A	0.3	2.34E+01	2.34E+02	7.01E+02
3	Vanadium	1.21E+02	mg/kg	N/A	N/A	N/A	N/A	0.3	3.93E+01	3.93E+02	1.18E+03
3	Uranium-238	1.59E+00	pCi/g	3.2E-06	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
3	**Cumulative**			**7.2E-03**				**1.8**			

Grayed cells indicate EPC value is lower than RGO value or an RGO value is not applicable.
N/A = Not applicable because the COC was not applicable (i.e., the COC was of concern for HI, but not ELCR or it was of concern for ELCR by not HI).
[1] See Tables D.6 and D.7 (Appendix D) for EPC values.
[2] See Appendix D, Exhibit D.6, for ELCR.
[3] See Table D.47 for RGOs.
[4] See Appendix D, Exhibit D.6, for HI.
[5] RGOs for residential land use are based on exposure to a resident age 1-27. For carcinogens, the dose method incorporates age-adjusted values for the 26-year exposure duration. Because child soil ingestion rates are higher and body weights are lower, noncancer RGOs are based on the child resident exposure assumptions.

hypothetical resident. Table 5.5.3 also compares the EPC to the RGO for each COC under each exposure scenario. Table 5.5.3 summarizes the ELCR/HI posed by the COCs for this SWMU under each exposure scenario by depicting the maximum ELCR/HI contribution per COC.

Ecological Screening. COPECs for SWMUs 56 and 80 include metals, radionuclides, SVOCs, and PCBs. Potential hazards for ecological receptors and the associated priority COPECs (maximum HQ ≥ 10) are summarized in Table 5.5.4.

Table 5.5.4. Ecological Screening for SWMUs 56 and 80

Ground Cover	Near a Surface Water Body?	Total HI[a]	Priority COPECs[b]	Background (mg/kg)[c]	Soil ESV (mg/kg)[d]	Maximum (mg/kg)	HQ (max conc)[a]	EPC (mg/kg)	HQ (EPC)[a]
gravel/soil/grass with gravel driveways, and concrete pads	Yes	2,865	Aluminum	13,000	50	9,320	186.4	9,320	186.4
			Antimony	0.21	0.27	58.17	215.44	40.4	149.6
			Cadmium	0.21	0.36	6	16.7	6.72	18.7
			Iron	28,000	200	41,269	206.35	28,735	143.7
			Mercury	0.2	0.1	20	200	19.9	198.9
			PCB, Total	N/A	0.02	475	23,750	41.8	2091.5
			Selenium	0.8	0.52	10	19.2	5.62	10.8
			Uranium	4.9	5	5724	1144.8	77.4	15.5
			Vanadium	38	7.8	138	17.7	113	14.5

Table is from Appendix E, Table E.1.
[a] Total HI includes concentrations from all of the COPECs (listed in Table E4.1), only priority COPECs(i.e., the COPECs with HQs greater than 10, using the EPCs) are shown in this table.
[b] Only priority COPECs are listed. See Appendix E for additional COPECs.
[c] Background value is from DOE 2015b.
[d] ESVs from DOE 2015c and Appendix E of this report.

5.5.7 SWMUs 56 and 80 Summary

Goal 1. Characterize Nature and Extent of Source Zone

Plant processes that could have contributed to contamination at this SWMU are releases from the PCB spill that occurred in the past.

COPCs for surface and subsurface soils from SWMU 80 are shown on Tables 5.5.1 and 5.5.2 as those analytes with green boxes under the “Industrial Worker/FOE” columns for surface and shallow subsurface soil, and those with blue boxes under the “GW Protection Screen/RGA/UCRS” columns for groundwater. For metals and radioisotopes, an orange box under the “Provisional Background” must accompany the green and blue boxes. Contaminants were detected greater than background and the industrial worker NALs to a maximum depth of 7 ft bgs. The COPCs for each EU are as shown below:

- EU 1

— Surface—metals, Dioxin/Furans, PCBs, radionuclides
— Subsurface—PCBs

- EU 2

— Surface—metals, PCBs, PAHs, SVOCs, radionuclides
— Subsurface—metals

- EU 3

— Surface—metals, PCBs
— Subsurface—metals, PCBs, PAHs, SVOCs, radionuclides

Goal 2. Determine Surface and Subsurface Transport Mechanisms and Pathways

The SWOU On-site SI/BRA indicates this area drains to Outfall 012 (DOE 2008b). There are no known underground pipelines at SWMUs 56 and 80. The CSM can be found in Appendix D.

Goal 3. Complete a Baseline Risk Assessment for the Soils OU

Cumulative ELCRs or HIs exceeded benchmarks of 1E-06 and 1, respectively, for the future industrial worker, excavation worker, and hypothetical residential scenarios. COCs for these scenarios for SWMUs 56 and 80 are as follows:

- Future Industrial worker

  — Total dioxins/furans
  — Total PAHs
  — Total PCBs
  — Americium-241
  — Cesium-137
  — Neptunium-237
  — Uranium-234
  — Uranium-235
  — Uranium-238

- Excavation worker

  — Antimony
  — Arsenic
  — Cobalt
  — Iron
  — Manganese
  — Mercury
  — Uranium
  — Total dioxins/furans
  — Total PAHs
  — Total PCBs
  — Cesium-137
  — Uranium-234
  — Uranium-235
  — Uranium-238

- Hypothetical Resident (hazards evaluated against the child resident)

  — Antimony
  — Cobalt
  — Iron

— Manganese
— Uranium
— Vanadium
— Total dioxins/furans
— Total PAHs
— Total PCBs
— Americium-241
— Cesium-137
— Neptunium-237
— Uranium-234
— Uranium-235
— Uranium-238

Figure 5.5.8 shows the COCs exceeding RGOs for the future industrial worker.

Priority COCs (i.e., HQ > 1 or chemical-specific ELCR > 1E-04) for SWMUs 56 and 80 are located in all EUs. The priority COCs are Total PCBs, and uranium-238 for the industrial worker; and antimony, uranium, dioxins/furans, total PCBs, uranium-235, and uranium-238 for the hypothetical resident. Priority COCs for other scenarios are described in Appendix D.

For SWMUs 56 and 80, COPECs exceed ESVs. Priority COPECs (i.e., maximum HQ ≥ 10) are the following:

- Aluminum
- Antimony
- Cadmium
- Fluoranthene
- Mercury
- Selenium
- Total PCBs
- Uranium
- Vanadium

Goal 4. Support Evaluation of Remedial Alternatives

The representative data set used for SWMUs 56 and 80 is sufficient to support decision making and indicates that an FS is appropriate. An uncertainty concerning depth of contamination should be considered in the FS. Possible remedial technologies applicable for this unit are, as discussed in the Work Plan (DOE 2010a), posting, fencing (or other means of limiting access), excavation, and/or other remedial technologies that will be described in the FS.

SWMUs 56 and 80 are next to SWMU 83, the C-533 Electric Switchyard, which is part of the GDP D&D OU, and SWMU 224, which is discussed within this RI Report. A response action at SWMUs 56 and 80 would not have an impact on SWMU 83. A response action at SWMUs 56 and 80 would not have an impact on groundwater or surface water.

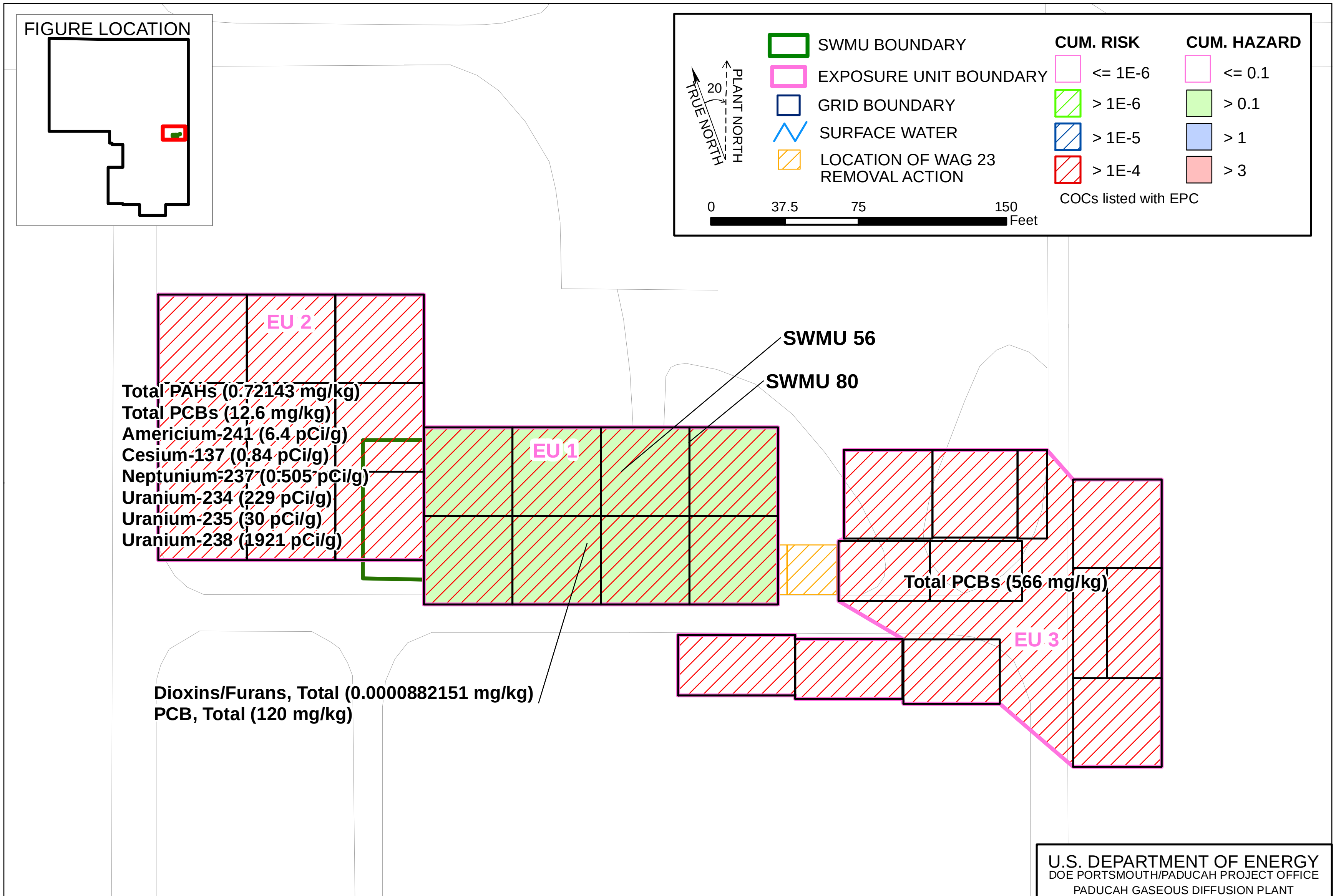

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Figure 5.5.8. Summary of COCs Contributing to Risk to the Future Industrial Worker at SWMUs 56 and 80

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5.5.8 SWMUs 56 and 80 Conclusion

The RI defined adequately the nature and extent of contamination in soils at SWMUs 56 and 80; an FS is appropriate for the SWMUs due to cancer risk and/or noncancer hazards of exceeding the decision rule benchmarks for scenarios including future industrial worker, excavation worker, and hypothetical resident (DOE 2010a). The reasonably anticipated land use for SWMUs 56 and 80 is industrial as shown in the SMP (DOE 2015a).

5.6 AOC 204, Historical Staging Area

5.6.1 Background

The Dyke Road Historical Staging Area (AOC 204) is located between the eastern boundary of the plant and Dyke Road and between Outfall 010 to the north and Outfall 011 to the south. AOC 204 is a mounded area, of approximately 3 acres, with heavy vegetation and several trees. A small ditch (approximately 4-ft wide and 3-ft deep) is situated across the mound from north to south.

AOC 204 is suspected of having been a staging area or construction debris burial ground during construction of the PGDP (approximately 1951 through the mid-1950s).

The types of debris identified on the mound include asphalt, concrete, telephone poles, railroad ties, and cable. Debris was not reported in subsurface samples collected during the drilling of WAG 28 (DOE 2000) borings within the mound. A geophysical survey conducted during the site investigation using electromagnetometer equipment indicated four anomalies in the AOC 204 area, but not the presence of a landfill. The EM-31 and EM-61 geophysical survey results are shown in the Soils OU RI/FS Work Plan (DOE 2010a).

The AOC was sampled during the Site Evaluation (DOE 1995b) at KPDES Outfalls 010, 011, and 012 in September 1995 and again as part of the WAG 28 RI/FS in 1999, which shows TCE is a concern at this location (DOE 1998c).

5.6.2 Fieldwork Summary

During the first RI for the Soils OU, it had been determined that historical data were representative of the nature and adequately delineate the extent of the contamination; therefore, no samples were collected from AOC 204 during the Soils OU RI sampling effort (DOE 2010a).

The unit underwent a gamma radiological walkover survey (Figure 5.6.1) using a FIDLER; the 25,759 measurements ranged from 4,104 to 135,738 cpm. The area consists entirely of soil and grass. A judgmental grab sample was collected for radiological constituents.

During RI 2, 186 grid samples were planned and collected except for two surface samples; one each in grids 204-182 and 204-183. The two surface samples could not be collected due to the ground surface consisting of gravel. Sampling was not conducted in the grids located in the removal action areas of Outfall 011 or in the areas along Outfall 010 previously sampled by the Surface Water OU as per the work plan (DOE 2014a). Appendix A contains the sampling rectification map.

The northern portion of the unit between Outfall 010 and a wooded area underwent a gamma radiological walkover survey (Figure 5.6.1) during RI 2 using a FIDLER; the 19,311 measurements ranged from 3,540 to 14,208 cpm. A judgmental grab sample was collected for radiological constituents.

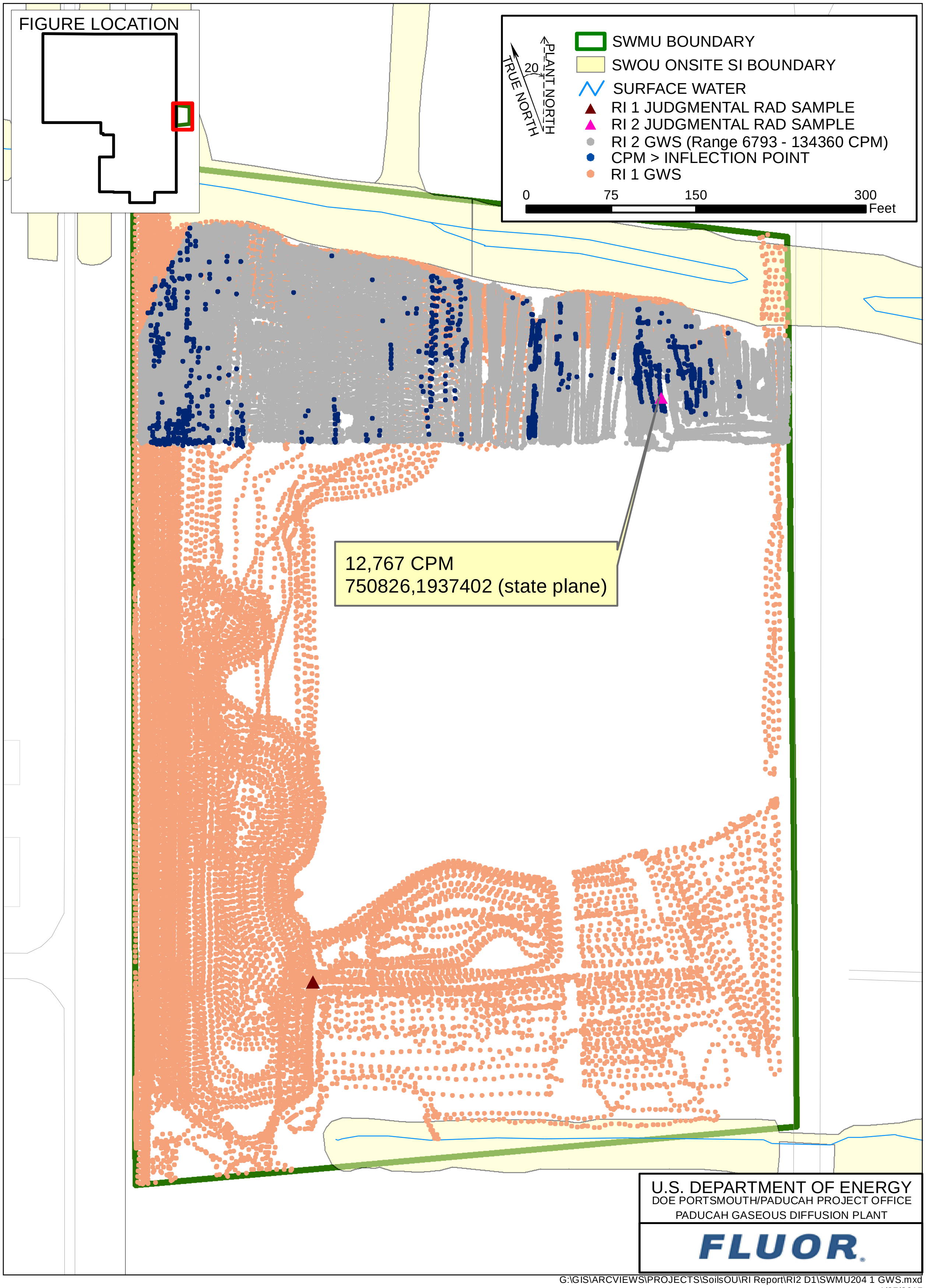


Figure 5.6.1. AOC 204 Gamma Walkover Survey

5.6.3 Nature and Extent of Contamination—Surface Soils

The representative data set presented in Table 5.6.1 provides the nature of the contamination in AOC 204 surface soils, and Figures 5.6.2–5.6.4 illustrate the horizontal extent. A complete list of sampling results is provided in Appendix F (samples with ending depths of 1 ft bgs or less or null are considered surface soils). Grid numbers shown below are truncated from the figures. Figures contain the SWMU#–grid#, with zeros filling the appropriate spaces to make three digits.

The lateral extent of AOC 204 surface soil contamination is considered defined adequately for supporting the BRA and FS. AOC 204 consists of 21 EUs.

Metals

Arsenic [grid 7 (EU 2), grid 37 (EU 5), and grid 148 (EU 14)] and uranium [grid 168 (EU 20)] were detected above both the teen recreator NALs and background screening levels in the AOC 204 surface soil, and also above the teen recreator ALs.

The following metals were detected in the AOC 204 surface soils above both the background screening levels (if available) and the SSLs for the protection of UCRS groundwater.

Metal	Grid	EU
Aluminum	5	1
Antimony	15, 32, 113, 148	5, 3, 10, 14
Arsenic	7, 37, 148	2, 5, 14
Cadmium	15, 113, 148	5, 10, 14
Cobalt	181	21
Copper	13, 18, 21, 22, 27, 32, 33, 38, 40, 42, 47, 48, 59, 86, 94, 95, 97, 103, 117, 118, 123, 127, 128, 130, 133, 140, 141, 148, 184	1–5, 8, 9, 11–18
Iron	48, 55, 82, 84, 86, 100, 103, 104, 119, 126, 130, 143, 145, 148, 149, 152, 162, 174, 185	4, 7–12, 14–18
Lead	26, 77, 78, 98, 108, 113, 130, 132, 137, 148, 160	5, 6, 10, 12–14, 16, 18
Manganese	68	7
Molybdenum[1]	13, 15, 17, 29, 32, 36, 40, 46, 51, 55, 64, 76, 83, 85, 91, 93, 98, 106, 113, 123, 130, 134, 139, 147, 148, 152, 156, 159, 164, 166, 168, 174, 181	1–21
Nickel	30, 50, 59, 66, 78, 84, 86, 103, 113, 114, 115, 118, 128, 137, 148, 160, 175, 178, 181, 186	2, 5, 6, 8–12, 14, 15, 18–21
Selenium	13, 17, 32, 36, 55, 64, 83, 85, 91, 98, 106, 134, 139, 148, 156, 164, 168, 174, 181	1–4, 6–9, 11–21
Silver	31, 46, 165	3, 4, 19
Uranium	148, 151, 160, 168, 176, 180	14, 15, 18–20
Vanadium	1–123, 125–175, 177, 178, 181, 184, 185, 186	1–21
Zinc	9, 15–18, 20, 21, 22, 28, 30–33, 43, 44, 45, 47–52, 54, 56, 59, 60, 61, 65, 67, 68, 73, 77, 78, 82, 83, 84, 86, 88, 91, 94, 97, 98, 100, 101, 103, 105, 106, 108, 109, 111–121, 124–127, 130, 132, 136–139, 141, 143, 148, 149, 154, 158, 160, 161, 162, 170, 172–176, 178–181, 184	1–21

[1] No soil background value is available.

Table 5.6.1. Surface Soil Data Summary: AOC 204

Type	Analysis	Unit	Detected Results*			J-qualified		Provisional Background		Teen Recreator		Teen Recreator		GW Protection Screen		
			Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
METAL	Aluminum	mg/kg	4.39E+03	1.37E+04	7.95E+03	0/27	27/27	1/27	1.30E+04	0/27	1.00E+05	0/27	1.00E+05	0/27	27/27	4.5–48.3HH
METAL	Antimony	mg/kg	9.80E-02	1.20E+01	7.78E-01	0/27	23/27	8/27	2.10E-01	0/27	4.48E+01	0/27	1.34E+03	0/27	5/27	0.027–20
METAL	Arsenic	mg/kg	3.00E+00	1.36E+02	1.93E+01	0/195	26/195	3/195	1.20E+01	26/195	6.14E-01	3/195	6.14E+01	3/195	26/195	0.18–10
METAL	Barium	mg/kg	2.60E+01	2.00E+02	9.10E+01	0/27	27/27	0/27	2.00E+02	0/27	2.24E+04	0/27	1.00E+05	0/27	16/27	0.09–48.3
METAL	Beryllium	mg/kg	2.80E-01	1.33E+00	5.43E-01	0/29	26/29	4/29	6.70E-01	0/29	2.24E+02	0/29	6.72E+03	0/29	0/29	0.045–1.2
METAL	Boron	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	2.24E+04	0/4	1.00E+05	0/4	0/4	48.3–200
METAL	Cadmium	mg/kg	3.70E-02	6.10E-01	1.86E-01	0/27	23/27	4/27	2.10E-01	0/27	2.80E+01	0/27	8.40E+02	0/27	4/27	0.027–2
METAL	Calcium	mg/kg	9.20E+02	2.30E+05	2.03E+04	0/27	27/27	1/27	2.00E+05	0/27	N/A	0/27	N/A	N/A	N/A	90–1210
METAL	Chromium	mg/kg	7.30E+00	1.75E+02	1.88E+01	0/197	29/197	12/197	1.60E+01	0/197	2.04E+02	0/197	2.04E+04	0/197	0/197	0.9–12
METAL	Cobalt	mg/kg	3.00E+00	1.80E+01	6.82E+00	0/27	26/27	1/27	1.40E+01	0/27	3.36E+01	0/27	1.01E+03	26/27	26/27	0.09–12.1
METAL	Copper	mg/kg	6.55E+00	5.70E+01	3.91E+01	0/195	189/195	184/195	1.90E+01	0/195	4.48E+03	0/195	1.00E+05	0/195	29/195	0.9–6
METAL	Iron	mg/kg	5.43E+03	3.35E+04	2.35E+04	0/195	195/195	19/195	2.80E+04	0/195	7.85E+04	0/195	1.00E+05	195/195	195/195	9–24.2
METAL	Lead	mg/kg	9.30E+00	2.20E+02	4.03E+01	0/195	31/195	11/195	3.60E+01	0/195	4.00E+02	0/195	4.00E+02	0/195	21/195	0.045–20
METAL	Magnesium	mg/kg	7.31E+02	7.90E+03	1.86E+03	0/27	27/27	1/27	7.70E+03	0/27	N/A	0/27	N/A	N/A	N/A	4.83–1210
METAL	Manganese	mg/kg	8.27E+01	1.94E+03	5.26E+02	0/195	195/195	1/195	1.50E+03	0/195	2.69E+03	0/195	8.07E+04	194/195	195/195	0.18–24
METAL	Mercury	mg/kg	3.20E-02	1.20E-01	5.21E-02	2/197	23/197	0/197	2.00E-01	0/197	3.36E+01	0/197	1.01E+03	0/197	23/197	0.025–40
METAL	Molybdenum	mg/kg	3.10E-01	4.10E+01	8.91E+00	0/195	34/195	0/195	N/A	0/195	5.61E+02	0/195	1.68E+04	13/195	34/195	0.09–9.7
METAL	Nickel	mg/kg	6.08E+00	2.90E+01	1.63E+01	0/195	152/195	19/195	2.10E+01	0/195	2.24E+03	0/195	6.72E+04	0/195	152/195	0.45–9.7
METAL	Potassium	mg/kg	3.26E+02	1.19E+03	7.61E+02	0/6	6/6	0/6	1.30E+03	0/6	N/A	0/6	N/A	N/A	N/A	96.6–1210
METAL	Selenium	mg/kg	7.10E-01	1.60E+00	1.13E+00	0/195	21/195	19/195	8.00E-01	0/195	5.61E+02	0/195	1.68E+04	0/195	21/195	0.09–19.4
METAL	Silicon	mg/kg	4.98E+02	4.98E+02	4.98E+02	0/2	2/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	121–121
METAL	Silver	mg/kg	1.70E-02	5.90E+01	3.68E+00	0/195	24/195	3/195	2.30E+00	0/195	5.61E+02	0/195	1.68E+04	3/195	3/195	0.009–50
METAL	Sodium	mg/kg	1.90E+01	1.83E+02	6.10E+01	19/27	25/27	0/27	3.20E+02	0/27	N/A	0/27	N/A	N/A	N/A	90–1210
METAL	Thallium	mg/kg	8.60E-02	2.10E-01	1.41E-01	0/27	21/27	0/27	2.10E-01	0/27	1.12E+00	0/27	3.36E+01	0/27	8/27	0.018–20
METAL	Uranium	mg/kg	1.10E+00	1.31E+04	2.76E+02	0/194	27/194	17/194	4.90E+00	1/194	3.36E+02	1/194	1.01E+04	1/194	6/194	0.009–12
METAL	Vanadium	mg/kg	8.11E+00	1.51E+02	1.06E+02	0/195	191/195	185/195	3.80E+01	0/195	5.65E+02	0/195	1.70E+04	0/195	190/195	0.09–12.1
METAL	Zinc	mg/kg	2.78E+01	8.69E+02	7.82E+01	0/195	195/195	95/195	6.50E+01	0/195	3.36E+04	0/195	1.00E+05	0/195	191/195	1–20
PPCB	PCB, Total	mg/kg	1.50E-02	7.90E+01	1.98E+01	2/219	3/219	0/219	N/A	1/219	1.89E-01	1/219	1.89E+01	1/219	2/219	0.05–2.7
SVOA	1,2,4-Trichlorobenzene	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	1,2-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	1,3-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	1,4-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	2,4,5-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	2,4,6-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	2,4-Dichlorophenol	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	2,4-Dimethylphenol	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	2,4-Dinitrophenol	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.73–0.93
SVOA	2,4-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.22–0.28
SVOA	2,6-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.22–0.28
SVOA	2-Chloronaphthalene	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	2-Chlorophenol	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	2-Methyl-4,6-dinitrophenol	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.73–0.93
SVOA	2-Methylnaphthalene	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	2-Methylphenol	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	2-Nitrobenzenamine	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	1.32E+02	0/21	3.96E+03	0/21	0/21	0.73–0.93
SVOA	2-Nitrophenol	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	3,3'-Dichlorobenzidine	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.22–0.28
SVOA	3-Nitrobenzenamine	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.73–0.93
SVOA	4-Bromophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	4-Chloro-3-methylphenol	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	4-Chlorobenzenamine	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	4-Chlorophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	4-Nitrophenol	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.73–0.93

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable
* For RADS, all results are reported.

Table 5.6.1. Surface Soil Data Summary: AOC 204 (Continued)

Type	Analysis	Unit	Detected Results*			J-qualified		Provisional Background		Teen Recreator		Teen Recreator		GW Protection Screen		
			Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
SVOA	Acenaphthene	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	6.26E+02	0/23	1.88E+04	0/23	0/23	0.36–0.49
SVOA	Acenaphthylene	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	6.26E+02	0/23	1.88E+04	N/A	N/A	0.36–0.49
SVOA	Anthracene	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	3.13E+03	0/23	9.39E+04	0/23	0/23	0.36–0.49
SVOA	Benzenemethanol	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	Benzo(ghi)perylene	mg/kg	5.70E-01	5.70E-01	5.70E-01	0/23	1/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.49
SVOA	Benzoic Acid	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	1.8–2.3
SVOA	bis(2-chloroethoxy)methane	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	bis(2-chloroethyl) ether	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	bis(2-chloroisopropyl) ether	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	bis(2-ethylhexyl)phthalate	mg/kg	2.10E-01	2.10E-01	2.10E-01	1/21	1/21	0/21	N/A	0/21	3.47E+01	0/21	3.47E+03	0/21	0/21	0.36–0.46
SVOA	Butyl benzyl phthalate	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	Dibenzofuran	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	Diethyl phthalate	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	Dimethyl phthalate	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	Di-n-butyl phthalate	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	Di-n-octylPhthalate	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	Fluoranthene	mg/kg	1.80E-01	9.90E-01	5.24E-01	2/23	5/23	0/23	N/A	0/23	4.17E+02	0/23	1.25E+04	0/23	0/23	0.36–0.49
SVOA	Fluorene	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	4.17E+02	0/23	1.25E+04	0/23	0/23	0.36–0.49
SVOA	Hexachlorobenzene	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	3.04E-01	0/21	3.04E+01	0/21	0/21	0.0036–0.0046
SVOA	Hexachlorobutadiene	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.22–0.28
SVOA	Hexachlorocyclopentadiene	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	Hexachloroethane	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	Isophorone	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	m,p-cresol	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	Naphthalene	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	5.72E+01	0/23	5.72E+03	0/23	0/23	0.36–0.49
SVOA	Nitrobenzene	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	N-Nitroso-di-n-propylamine	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	6.95E-02	0/21	6.95E+00	0/21	0/21	0.36–0.46
SVOA	N-Nitrosodiphenylamine	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	PAH, Total	mg/kg	3.42E-03	5.01E+00	3.03E-01	0/23	21/23	0/23	N/A	15/23	1.38E-02	1/23	1.38E+00	0/23	2/23	–
SVOA	Pentachlorophenol	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	5.84E-01	0/21	5.84E+01	N/A	N/A	0.65–0.83
SVOA	Phenanthrene	mg/kg	1.10E-01	3.70E-01	2.20E-01	3/23	4/23	0/23	N/A	0/23	6.26E+02	0/23	1.88E+04	0/23	4/23	0.36–0.49
SVOA	Phenol	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
SVOA	p-Nitroaniline	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.73–0.93
SVOA	Pyrene	mg/kg	1.40E-01	1.20E+00	6.28E-01	2/23	4/23	0/23	N/A	0/23	3.13E+02	0/23	9.39E+03	0/23	1/23	0.36–0.49
SVOA	Pyridine	mg/kg	N/A	N/A	N/A	0/21	0/21	0/21	N/A	0/21	N/A	0/21	N/A	N/A	N/A	0.36–0.46
VOA	1,1,1-Trichloroethane	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	1.00E+05	0/4	3.00E+06	0/4	0/4	0.005–0.005
VOA	1,1-Dichloroethane	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	4.64E+01	0/1	4.64E+03	0/1	0/1	–
VOA	1,1-Dichloroethene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	5.61E+03	0/2	1.68E+05	0/2	0/2	–
VOA	Tetrachloroethene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	2.61E+02	0/2	2.02E+04	N/A	N/A	–
VOA	Trichloroethene	mg/kg	1.50E-02	1.50E-02	1.50E-02	0/4	1/4	0/4	N/A	0/4	8.99E+00	0/4	8.99E+02	0/4	1/4	0.005–0.005
RADS	Actinium-228	pCi/g	8.42E-01	1.09E+00	9.66E-01	0/2	2/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.1394–0.4581
RADS	Americium-241	pCi/g	3.71E+00	3.71E+00	3.71E+00	0/29	1/29	0/29	N/A	0/29	8.43E+00	0/29	8.43E+02	0/29	1/29	0.021–1.433
RADS	Antimony-124	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.03396–0.156
RADS	Antimony-125	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.08222–0.4018
RADS	Barium-133	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.03884–0.1773
RADS	Barium-140	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.15–0.766
RADS	Bismuth-211	pCi/g	2.20E+00	2.22E+00	2.21E+00	0/2	2/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.4085–0.895
RADS	Bismuth-212	pCi/g	8.13E-01	8.13E-01	8.13E-01	0/2	1/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.2858–1.363
RADS	Bismuth-214	pCi/g	7.39E-01	1.04E+00	8.88E-01	0/2	2/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.06546–0.3064
RADS	Cerium-139	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0247–0.1484

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable
* For RADS, all results are reported.

Table 5.6.1. Surface Soil Data Summary: AOC 204 (Continued)

Type	Analysis	Unit	Detected Results*			J-qualified		Provisional Background		Teen Recreator		Teen Recreator		GW Protection Screen		
			Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
RADS	Cerium-141	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.04714–0.3014
RADS	Cerium-144	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.1788–1.175
RADS	Cesium-134	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.03078–0.1467
RADS	Cesium-136	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.06421–0.1348
RADS	Cesium-137	pCi/g	3.29E-02	1.17E+00	2.74E-01	0/27	21/27	2/27	4.90E-01	2/27	3.23E-01	0/27	3.23E+01	0/27	2/27	0.0209–0.1684
RADS	Chromium-51	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.2618–1.197
RADS	Cobalt-56	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.03773–0.1374
RADS	Cobalt-57	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.02225–0.1547
RADS	Cobalt-58	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.03444–0.1559
RADS	Cobalt-60	pCi/g	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.03919–0.07778
RADS	Europium-152	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.083–0.4013
RADS	Europium-154	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.04672–0.3191
RADS	Europium-155	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.1081–0.797
RADS	Iridium-192	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.02867–0.1315
RADS	Iron-59	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.07412–0.1558
RADS	Lead-210	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	2.21–18.18
RADS	Lead-211	pCi/g	2.20E+00	2.22E+00	2.21E+00	0/2	2/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.4085–0.895
RADS	Lead-212	pCi/g	7.16E-01	7.35E-01	7.25E-01	0/2	2/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.06394–0.2351
RADS	Lead-214	pCi/g	8.32E-01	9.28E-01	8.80E-01	0/2	2/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.06001–0.2835
RADS	Manganese-54	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.04173–0.1363
RADS	Mercury-203	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.03019–0.143
RADS	Neodymium-147	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.22–1.287
RADS	Neptunium-237	pCi/g	5.10E-03	6.10E-02	2.69E-02	0/27	5/27	0/27	1.00E-01	0/27	6.68E-01	0/27	6.68E+01	0/27	1/27	0.00461–0.2644
RADS	Neptunium-237/Protactinium-233	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	1.00E-01	0/2	N/A	0/2	N/A	N/A	N/A	0.06525–0.0769
RADS	Neptunium-239	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.457–3.868
RADS	Niobium-94	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.03329–0.1215
RADS	Niobium-95	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.06004–0.5742
RADS	Plutonium-238	pCi/g	1.10E-02	3.79E-02	2.15E-02	0/29	8/29	0/29	7.30E-02	0/29	1.23E+01	0/29	1.23E+03	0/29	0/29	0.00746–0.222
RADS	Plutonium-239/240	pCi/g	1.05E-02	9.80E-02	4.27E-02	0/29	6/29	2/29	2.50E-02	0/29	1.08E+01	0/29	1.08E+03	0/29	0/29	0.0057–0.09
RADS	Potassium-40	pCi/g	1.01E+01	1.13E+01	1.07E+01	0/2	2/2	0/2	1.60E+01	0/2	N/A	0/2	N/A	N/A	N/A	0.2843–0.7955
RADS	Promethium-146	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.03921–0.1875
RADS	Protactinium-231	pCi/g	3.65E+01	3.65E+01	3.65E+01	0/2	1/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.3748–2.444
RADS	Protactinium-233	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.06335–0.3074
RADS	Protactinium-234m	pCi/g	8.13E+00	4.38E+03	1.11E+03	0/4	4/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.5703–5.195
RADS	Radium-223	pCi/g	2.02E-01	2.02E-01	2.02E-01	0/2	1/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.1866–0.7466
RADS	Radium-226	pCi/g	7.67E-01	7.74E-01	7.70E-01	0/2	2/2	0/2	1.50E+00	0/2	N/A	0/2	N/A	N/A	N/A	0.1416–0.3136
RADS	Radium-228	pCi/g	9.62E-01	9.62E-01	9.62E-01	0/2	1/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.2848–0.3786
RADS	Radon-219	pCi/g	1.14E+00	1.14E+00	1.14E+00	0/2	1/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.2312–0.9859
RADS	Ruthenium-106	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.3156–1.446
RADS	Silver-110m	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.03423–0.1543

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable
* For RADS, all results are reported.

Table 5.6.1. Surface Soil Data Summary: AOC 204 (Continued)

			Detected Results*			J-qualified		Provisional Background		Teen Recreator		Teen Recreator		GW Protection Screen		
Type	Analysis	Unit	Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
RADS	Sodium-22	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.03639–0.08584
RADS	Strontium-90	pCi/g	4.70E+00	4.70E+00	4.70E+00	0/2	1/2	0/2	4.70E+00	0/2	N/A	0/2	N/A	N/A	N/A	1.2–1.3
RADS	Technetium-99	pCi/g	7.74E-01	7.64E+00	2.21E+00	0/29	8/29	2/29	2.50E+00	0/29	3.26E+02	0/29	3.26E+04	8/29	8/29	0.29621–4.25
RADS	Thallium-208	pCi/g	2.22E-01	2.45E-01	2.34E-01	0/2	2/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.03423–0.1706
RADS	Thorium-227	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.192–0.8978
RADS	Thorium-228	pCi/g	2.67E-01	1.17E+00	8.85E-01	0/27	27/27	0/27	1.60E+00	0/27	N/A	0/27	N/A	N/A	N/A	0.0283–0.2524
RADS	Thorium-229	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.09751–0.5981
RADS	Thorium-230	pCi/g	2.83E-01	1.30E+00	1.05E+00	0/27	26/27	0/27	1.50E+00	0/27	1.45E+01	0/27	1.45E+03	0/27	0/27	0.01–0.2
RADS	Thorium-232	pCi/g	3.02E-01	1.12E+00	8.24E-01	0/27	27/27	0/27	1.50E+00	0/27	N/A	0/27	N/A	N/A	N/A	0.00426–0.1804
RADS	Thorium-234	pCi/g	3.03E+00	3.26E+03	8.24E+02	0/4	4/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.3246–16.84
RADS	Tin-113	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.03884–0.1758
RADS	Uranium-234	pCi/g	2.20E-01	4.45E+02	3.10E+01	0/29	28/29	18/29	1.20E+00	1/29	1.65E+01	0/29	1.65E+03	1/29	28/29	0.0126–7.1
RADS	Uranium-235	pCi/g	4.23E-02	5.70E+01	2.30E+00	0/29	25/29	21/29	6.00E-02	1/29	9.68E-01	0/29	9.68E+01	1/29	22/29	0.005845–1.5
RADS	Uranium-238	pCi/g	1.68E-01	4.39E+03	2.87E+02	0/29	29/29	26/29	1.20E+00	7/29	3.57E+00	1/29	3.57E+02	15/29	29/29	0.0118–10.8
RADS	Yttrium-88	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.03562–0.05537
RADS	Zinc-65	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.07534–0.1567
RADS	Zirconium-95	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.05714–0.5447

One or more samples exceed AL value
One or more samples exceed NAL value
One or more samples exceed background value
One or more samples exceed SSLs of RGA and UCRS groundwater protection

Counts of analyses are based on the maximum detected result from a sample (i.e., if a sample has analytical results from two different labs, only the maximum value is counted).
Field replicates, or separate samples are counted independently.

The uranium (metal)/uranium (isotopic) may not be from the same sample thus a correlation between uranium (metal)/uranium (isotopic) data may not be possible.
Uranium-238 that was analyzed using method RL-7128NITRIC is compared to a background value of 0.4 pCi/g for surface and subsurface.

Screening values are shown in Appendices C and D.

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable
* For RADS, all results are reported.

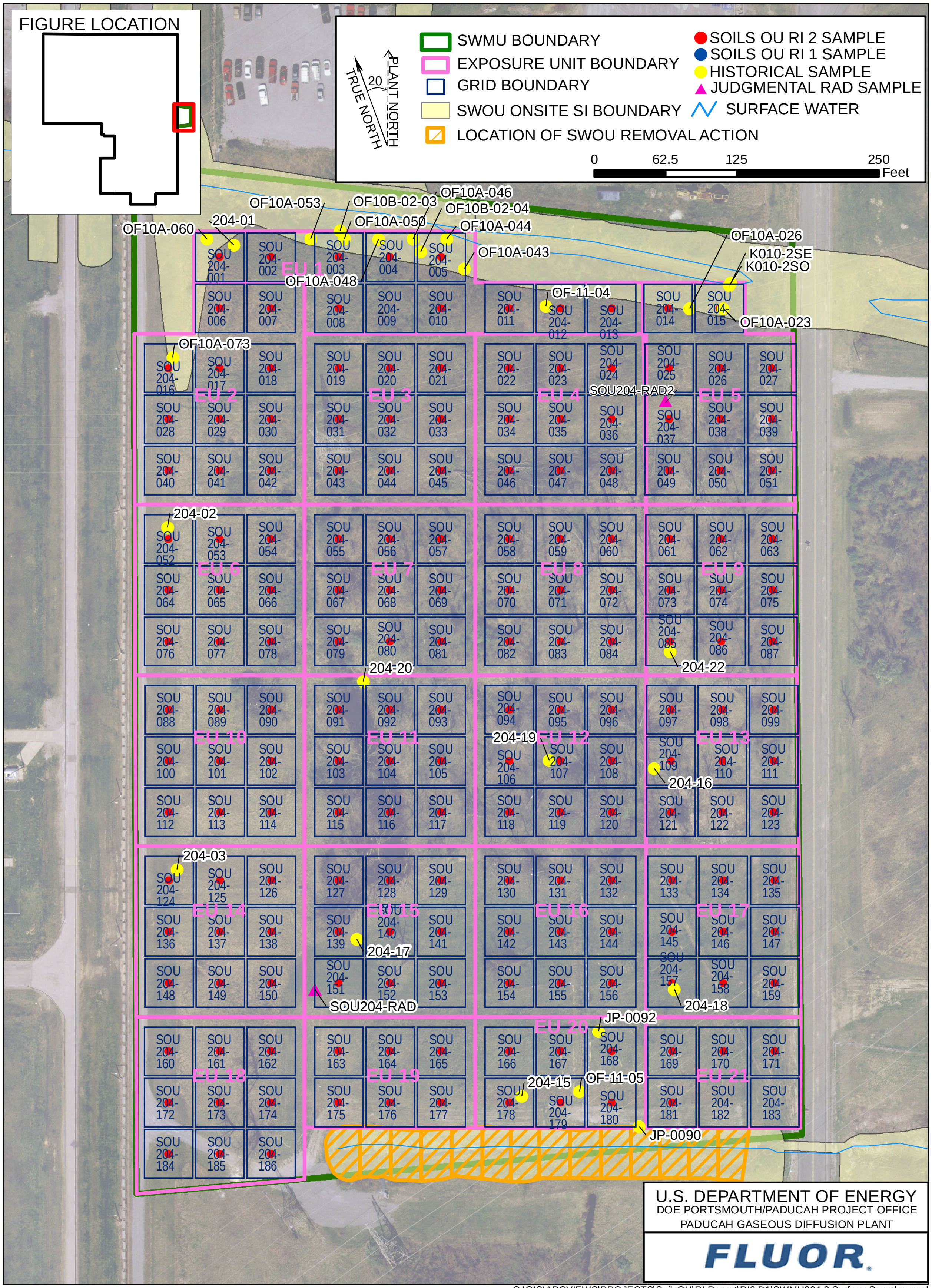


Figure 5.6.2. AOC 204 Sample Locations—Surface Soil

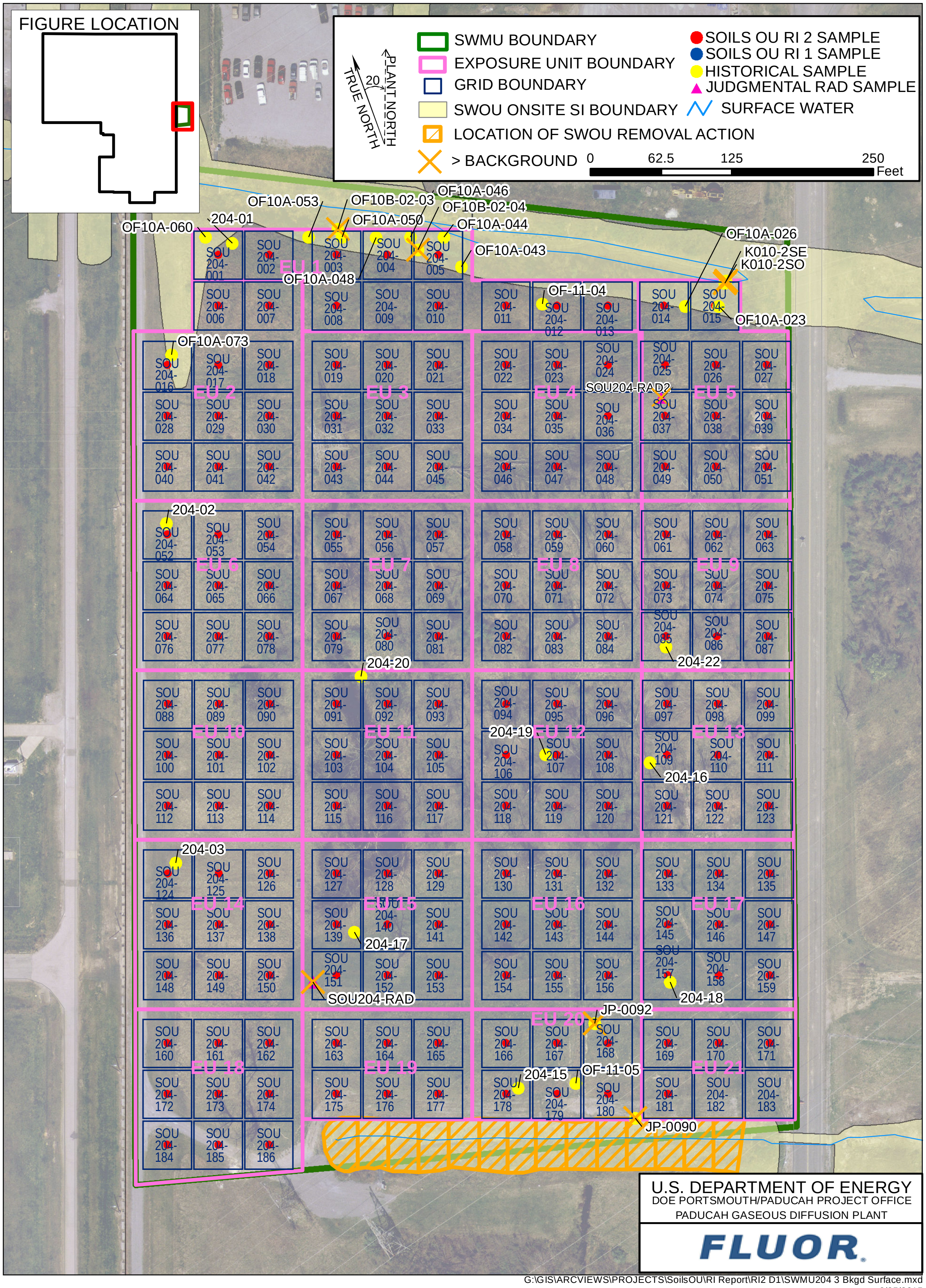


Figure 5.6.3. AOC 204 Background Exceedances—Surface Soil

JP-0090	Beryllium (0.68 mg/kg) Chromium (18 mg/kg) Uranium (64 mg/kg) Uranium-234 (2.8 pCi/g) Uranium-235 (0.372 pCi/g) Uranium-238 (22 pCi/g)
JP-0092	Beryllium (1.33 mg/kg) Chromium (175 mg/kg) Uranium (13070 mg/kg) Cesium-137 (1.172 pCi/g) Plutonium-239/240 (0.098 pCi/g) Technetium-99 (7.64 pCi/g) Uranium-234 (445 pCi/g) Uranium-235 (57 pCi/g) Uranium-238 (4386 pCi/g)
K010-2SE	Antimony (1.1 mg/kg) Cadmium (0.61 mg/kg) Chromium (28.9 mg/kg) Copper (26.9 mg/kg) Zinc (166 mg/kg) Technetium-99 (4.17 pCi/g) Uranium-234 (2.095 pCi/g) Uranium-235 (0.1878 pCi/g) Uranium-238 (9.723 pCi/g)
K010-2SO	Antimony (1.1 mg/kg) Cadmium (0.61 mg/kg) Chromium (28.9 mg/kg) Copper (26.9 mg/kg) Zinc (166 mg/kg) Uranium-235 (0.06624 pCi/g) Uranium-238 (1.738 pCi/g)
OF10B-02-03	Chromium (16.3 mg/kg)
OF10B-02-04	Aluminum (13700 mg/kg) Chromium (18 mg/kg)
SOU204-001	Vanadium (110 mg/kg)
SOU204-002	Copper (31 mg/kg) Vanadium (128 mg/kg)
SOU204-003	Copper (38 mg/kg) Vanadium (111 mg/kg)
SOU204-004	Copper (32 mg/kg) Vanadium (131 mg/kg)
SOU204-005	Copper (37 mg/kg) Vanadium (90 mg/kg)
SOU204-006	Copper (35 mg/kg) Vanadium (117 mg/kg)
SOU204-007	Arsenic (84 mg/kg) Copper (36 mg/kg) Vanadium (126 mg/kg)
SOU204-008	Copper (40 mg/kg) Vanadium (101 mg/kg)
SOU204-009	Copper (37 mg/kg) Vanadium (125 mg/kg) Zinc (84 mg/kg)
SOU204-010	Copper (42 mg/kg) Vanadium (114 mg/kg)
SOU204-011	Copper (37 mg/kg) Vanadium (114 mg/kg)
SOU204-012	Copper (37 mg/kg) Vanadium (121 mg/kg)
SOU204-013	Copper (55 mg/kg) Selenium (0.97 mg/kg) Vanadium (91 mg/kg) Uranium-234 (1.26 pCi/g) Uranium-235 (0.068 pCi/g) Uranium-238 (1.76 pCi/g)
SOU204-014	Copper (31 mg/kg) Vanadium (95 mg/kg)
SOU204-015	Copper (44 mg/kg) Vanadium (99 mg/kg)
SOU204-016	Copper (43 mg/kg) Vanadium (109 mg/kg) Zinc (112 mg/kg)
SOU204-017	Chromium (37 mg/kg) Copper (41 mg/kg) Selenium (1.1 mg/kg) Uranium (12 mg/kg) Vanadium (118 mg/kg) Zinc (84 mg/kg) Uranium-234 (1.78 pCi/g) Uranium-235 (0.0871 pCi/g) Uranium-238 (3.92 pCi/g)
SOU204-018	Copper (48 mg/kg) Vanadium (116 mg/kg) Zinc (80 mg/kg)
SOU204-019	Copper (36 mg/kg) Vanadium (95 mg/kg)
SOU204-020	Copper (45 mg/kg) Vanadium (105 mg/kg) Zinc (91 mg/kg)
SOU204-021	Copper (46 mg/kg) Vanadium (88 mg/kg) Zinc (75 mg/kg)
SOU204-022	Copper (48 mg/kg) Vanadium (105 mg/kg) Zinc (106 mg/kg)
SOU204-023	Vanadium (96 mg/kg)
SOU204-024	Copper (41 mg/kg) Vanadium (139 mg/kg)
SOU204-025	Copper (43 mg/kg) Vanadium (118 mg/kg)
SOU204-026	Copper (44 mg/kg) Lead (63 mg/kg) Vanadium (119 mg/kg)
SOU204-027	Copper (50 mg/kg) Vanadium (127 mg/kg)
SOU204-028	Copper (38 mg/kg) Vanadium (96 mg/kg) Zinc (84 mg/kg)
SOU204-029	Copper (42 mg/kg) Vanadium (90 mg/kg)
SOU204-030	Nickel (24 mg/kg) Vanadium (132 mg/kg) Zinc (73 mg/kg)
SOU204-031	Copper (31 mg/kg) Silver (54 mg/kg) Vanadium (99 mg/kg) Zinc (869 mg/kg)
SOU204-032	Antimony (0.28 mg/kg) Chromium (18 mg/kg) Copper (47 mg/kg) Selenium (1.3 mg/kg) Uranium (7.4 mg/kg) Vanadium (112 mg/kg) Zinc (110 mg/kg) Zinc (87 mg/kg) Uranium-234 (1.41 pCi/g) Uranium-235 (0.0775 pCi/g) Uranium-238 (2.31 pCi/g)
SOU204-033	Copper (52 mg/kg) Vanadium (122 mg/kg) Zinc (67 mg/kg)
SOU204-034	Copper (38 mg/kg) Vanadium (112 mg/kg)
SOU204-035	Copper (45 mg/kg) Vanadium (128 mg/kg)
SOU204-036	Antimony (0.23 mg/kg) Copper (35 mg/kg) Selenium (1.1 mg/kg) Vanadium (119 mg/kg) Uranium-234 (1.43 pCi/g) Uranium-238 (1.82 pCi/g)

Figure 5.6.3. AOC204 Background Exceedances—Surface Soil (Continued)

SOU204-037	Arsenic (107 mg/kg) Copper (37 mg/kg) Vanadium (132 mg/kg)
SOU204-038	Copper (57 mg/kg) Vanadium (127 mg/kg)
SOU204-039	Copper (33 mg/kg) Vanadium (116 mg/kg)
SOU204-040	Copper (46 mg/kg) Vanadium (126 mg/kg)
SOU204-041	Copper (30 mg/kg) Vanadium (110 mg/kg)
SOU204-042	Copper (49 mg/kg) Vanadium (105 mg/kg)
SOU204-043	Copper (39 mg/kg) Vanadium (109 mg/kg) Zinc (201 mg/kg)
SOU204-044	Copper (45 mg/kg) Vanadium (84 mg/kg) Zinc (109 mg/kg)
SOU204-045	Vanadium (97 mg/kg) Zinc (77 mg/kg)
SOU204-046	Copper (36 mg/kg) Silver (59 mg/kg) Vanadium (113 mg/kg)
SOU204-047	Copper (49 mg/kg) Vanadium (109 mg/kg) Zinc (76 mg/kg)
SOU204-048	Copper (46 mg/kg) Iron (29217 mg/kg) Vanadium (135 mg/kg) Zinc (85 mg/kg)
SOU204-049	Copper (45 mg/kg) Vanadium (95 mg/kg) Zinc (70 mg/kg)
SOU204-050	Copper (37 mg/kg) Nickel (23 mg/kg) Vanadium (109 mg/kg) Zinc (69 mg/kg)
SOU204-051	Copper (38 mg/kg) Vanadium (118 mg/kg) Zinc (71 mg/kg) Uranium-238 (1.5 pCi/g)
SOU204-052	Vanadium (101 mg/kg) Zinc (118 mg/kg)
SOU204-053	Copper (45 mg/kg) Vanadium (101 mg/kg)
SOU204-054	Copper (41 mg/kg) Vanadium (125 mg/kg) Zinc (73 mg/kg)
SOU204-055	Copper (38 mg/kg) Iron (29466 mg/kg) Selenium (1 mg/kg) Uranium (7 mg/kg) Vanadium (94 mg/kg) Uranium-235 (0.0678 pCi/g) Uranium-238 (2.04 pCi/g)
SOU204-056	Copper (36 mg/kg) Vanadium (119 mg/kg) Zinc (67 mg/kg)
SOU204-057	Copper (45 mg/kg) Vanadium (105 mg/kg)
SOU204-058	Copper (41 mg/kg) Vanadium (104 mg/kg)
SOU204-059	Copper (48 mg/kg) Nickel (22 mg/kg) Vanadium (118 mg/kg) Zinc (73 mg/kg)
SOU204-060	Copper (40 mg/kg) Vanadium (132 mg/kg) Zinc (90 mg/kg)
SOU204-061	Copper (36 mg/kg) Vanadium (137 mg/kg) Zinc (90 mg/kg)
SOU204-062	Copper (37 mg/kg) Vanadium (91 mg/kg)
SOU204-063	Copper (29 mg/kg) Vanadium (105 mg/kg)
SOU204-064	Copper (35 mg/kg) Selenium (1.3 mg/kg) Uranium (11 mg/kg) Vanadium (105 mg/kg) Uranium-234 (1.62 pCi/g) Uranium-235 (0.0943 pCi/g) Uranium-238 (3.63 pCi/g)
SOU204-065	Copper (43 mg/kg) Vanadium (101 mg/kg) Zinc (70 mg/kg)
SOU204-066	Copper (38 mg/kg) Nickel (23 mg/kg) Vanadium (88 mg/kg)
SOU204-067	Copper (43 mg/kg) Vanadium (109 mg/kg) Zinc (90 mg/kg)
SOU204-068	Copper (38 mg/kg) Manganese (1939 mg/kg) Vanadium (102 mg/kg) Zinc (66 mg/kg)
SOU204-069	Copper (31 mg/kg) Vanadium (127 mg/kg)
SOU204-070	Copper (44 mg/kg) Vanadium (115 mg/kg)
SOU204-071	Copper (33 mg/kg) Vanadium (113 mg/kg)
SOU204-072	Copper (40 mg/kg) Vanadium (112 mg/kg)
SOU204-073	Copper (41 mg/kg) Vanadium (101 mg/kg) Zinc (85 mg/kg)
SOU204-074	Copper (35 mg/kg) Vanadium (119 mg/kg)
SOU204-075	Copper (40 mg/kg) Vanadium (122 mg/kg)
SOU204-076	Copper (34 mg/kg) Vanadium (100 mg/kg)
SOU204-077	Copper (42 mg/kg) Lead (75 mg/kg) Vanadium (110 mg/kg) Zinc (66 mg/kg)
SOU204-078	Copper (44 mg/kg) Lead (89 mg/kg) Nickel (22 mg/kg) Vanadium (116 mg/kg) Zinc (77 mg/kg)
SOU204-079	Copper (35 mg/kg) Vanadium (104 mg/kg)
SOU204-080	Copper (42 mg/kg) Vanadium (100 mg/kg)
SOU204-081	Copper (38 mg/kg) Vanadium (111 mg/kg)
SOU204-082	Copper (41 mg/kg) Iron (28457 mg/kg) Vanadium (111 mg/kg) Zinc (71 mg/kg)
SOU204-083	Antimony (0.23 mg/kg) Chromium (17 mg/kg) Copper (37 mg/kg) Selenium (1.3 mg/kg) Vanadium (128 mg/kg) Zinc (84 mg/kg)

Figure 5.6.3. AOC204 Background Exceedances—Surface Soil (Continued)

SOU204-083 (cont)	Uranium-234 (1.27 pCi/g) Uranium-235 (0.072 pCi/g) Uranium-238 (2.01 pCi/g)
SOU204-084	Iron (29412 mg/kg) Nickel (22 mg/kg) Vanadium (115 mg/kg) Zinc (87 mg/kg)
SOU204-085	Antimony (0.23 mg/kg) Chromium (18 mg/kg) Copper (42 mg/kg) Selenium (1.3 mg/kg) Vanadium (114 mg/kg) Uranium-234 (1.28 pCi/g) Uranium-235 (0.0921 pCi/g) Uranium-238 (2.22 pCi/g)
SOU204-086	Copper (46 mg/kg) Iron (29620 mg/kg) Nickel (26 mg/kg) Vanadium (134 mg/kg) Zinc (72 mg/kg)
SOU204-087	Copper (37 mg/kg) Vanadium (114 mg/kg)
SOU204-088	Copper (43 mg/kg) Vanadium (112 mg/kg) Zinc (125 mg/kg)
SOU204-089	Copper (35 mg/kg) Vanadium (104 mg/kg)
SOU204-090	Copper (29 mg/kg) Vanadium (83 mg/kg)
SOU204-091	Selenium (1.3 mg/kg) Uranium (6.5 mg/kg) Vanadium (95 mg/kg) Zinc (99 mg/kg) Uranium-234 (1.64 pCi/g) Uranium-235 (0.093 pCi/g) Uranium-238 (3.09 pCi/g)
SOU204-092	Copper (31 mg/kg) Vanadium (91 mg/kg)
SOU204-093	Copper (26 mg/kg) Vanadium (94 mg/kg)
SOU204-094	Copper (47 mg/kg) Vanadium (91 mg/kg) Zinc (73 mg/kg)
SOU204-095	Copper (46 mg/kg) Vanadium (130 mg/kg)
SOU204-096	Copper (44 mg/kg) Vanadium (127 mg/kg)
SOU204-097	Copper (48 mg/kg) Vanadium (117 mg/kg) Zinc (78 mg/kg)
SOU204-098	Chromium (17 mg/kg) Copper (41 mg/kg) Lead (106 mg/kg) Selenium (1.2 mg/kg) Uranium (5 mg/kg) Vanadium (132 mg/kg) Zinc (72 mg/kg) Plutonium-239/240 (0.0271 pCi/g) Uranium-234 (1.55 pCi/g) Uranium-235 (0.0936 pCi/g) Uranium-238 (2.98 pCi/g)
SOU204-099	Copper (41 mg/kg) Vanadium (101 mg/kg)
SOU204-100	Copper (40 mg/kg) Iron (30843 mg/kg) Vanadium (113 mg/kg) Zinc (242 mg/kg)
SOU204-101	Copper (41 mg/kg) Vanadium (119 mg/kg) Zinc (82 mg/kg)
SOU204-102	Copper (32 mg/kg) Vanadium (108 mg/kg)
SOU204-103	Copper (48 mg/kg) Iron (30117 mg/kg) Nickel (29 mg/kg) Vanadium (122 mg/kg) Zinc (102 mg/kg)
SOU204-104	Copper (36 mg/kg) Iron (30516 mg/kg) Vanadium (113 mg/kg)
SOU204-105	Copper (39 mg/kg) Vanadium (143 mg/kg) Zinc (69 mg/kg)
SOU204-106	Copper (36 mg/kg) Selenium (1.6 mg/kg) Uranium (7.9 mg/kg) Vanadium (104 mg/kg) Zinc (70 mg/kg) Uranium-234 (1.63 pCi/g) Uranium-235 (0.115 pCi/g) Uranium-238 (3.26 pCi/g)
SOU204-107	Copper (41 mg/kg) Vanadium (118 mg/kg)
SOU204-108	Copper (43 mg/kg) Lead (121 mg/kg) Vanadium (135 mg/kg) Zinc (67 mg/kg)
SOU204-109	Copper (37 mg/kg) Vanadium (117 mg/kg) Zinc (68 mg/kg)
SOU204-110	Copper (34 mg/kg) Vanadium (120 mg/kg)
SOU204-111	Copper (39 mg/kg) Vanadium (138 mg/kg) Zinc (73 mg/kg)
SOU204-112	Copper (35 mg/kg) Vanadium (75 mg/kg) Zinc (118 mg/kg)
SOU204-113	Antimony (12 mg/kg) Cadmium (0.52 mg/kg) Calcium (230000 mg/kg) Copper (35 mg/kg) Lead (220 mg/kg) Magnesium (7900 mg/kg) Nickel (24 mg/kg) Uranium (8 mg/kg) Vanadium (79 mg/kg) Zinc (168 mg/kg) Uranium-234 (1.23 pCi/g) Uranium-238 (3.15 pCi/g)
SOU204-114	Copper (35 mg/kg) Nickel (26 mg/kg) Vanadium (93 mg/kg) Zinc (200 mg/kg)
SOU204-115	Copper (34 mg/kg) Nickel (23 mg/kg) Vanadium (58 mg/kg) Zinc (110 mg/kg)
SOU204-116	Copper (38 mg/kg) Vanadium (131 mg/kg) Zinc (94 mg/kg)
SOU204-117	Copper (47 mg/kg) Vanadium (133 mg/kg) Zinc (73 mg/kg)
SOU204-118	Copper (53 mg/kg) Nickel (25 mg/kg) Vanadium (128 mg/kg) Zinc (75 mg/kg)
SOU204-119	Copper (45 mg/kg)

Figure 5.6.3. AOC204 Background Exceedances—Surface Soil (Continued)

Station	Exceedances
	Iron (28613 mg/kg) Vanadium (144 mg/kg) Zinc (81 mg/kg)
SOU204-120	Copper (39 mg/kg) Vanadium (113 mg/kg) Zinc (70 mg/kg)
SOU204-121	Copper (39 mg/kg) Vanadium (145 mg/kg) Zinc (76 mg/kg)
SOU204-122	Copper (38 mg/kg) Vanadium (99 mg/kg)
SOU204-123	Copper (46 mg/kg) Vanadium (100 mg/kg)
SOU204-124	Copper (36 mg/kg) Zinc (125 mg/kg)
SOU204-125	Copper (28 mg/kg) Vanadium (61 mg/kg) Zinc (73 mg/kg)
SOU204-126	Copper (40 mg/kg) Iron (31708 mg/kg) Vanadium (128 mg/kg) Zinc (87 mg/kg)
SOU204-127	Copper (47 mg/kg) Vanadium (113 mg/kg) Zinc (94 mg/kg)
SOU204-128	Copper (50 mg/kg) Vanadium (110 mg/kg)
SOU204-129	Copper (28 mg/kg) Vanadium (92 mg/kg)
SOU204-130	Copper (52 mg/kg) Iron (28191 mg/kg) Lead (58 mg/kg) Vanadium (120 mg/kg) Zinc (66 mg/kg)
SOU204-131	Copper (40 mg/kg) Vanadium (112 mg/kg)
SOU204-132	Copper (38 mg/kg) Lead (52 mg/kg) Vanadium (114 mg/kg) Zinc (66 mg/kg)
SOU204-133	Copper (46 mg/kg) Vanadium (108 mg/kg)
SOU204-134	Copper (40 mg/kg) Selenium (1.3 mg/kg) Uranium (6.3 mg/kg) Vanadium (103 mg/kg) Uranium-234 (1.35 pCi/g) Uranium-235 (0.0775 pCi/g) Uranium-238 (2.5 pCi/g)
SOU204-135	Copper (41 mg/kg) Vanadium (98 mg/kg)
SOU204-136	Copper (44 mg/kg) Vanadium (121 mg/kg) Zinc (144 mg/kg)
SOU204-137	Copper (41 mg/kg) Lead (123 mg/kg) Nickel (28 mg/kg) Vanadium (109 mg/kg) Zinc (130 mg/kg)
SOU204-138	Copper (45 mg/kg) Vanadium (96 mg/kg) Zinc (66 mg/kg)
SOU204-139	Copper (38 mg/kg) Selenium (1.3 mg/kg) Uranium (5.7 mg/kg) Vanadium (88 mg/kg) Zinc (79 mg/kg) Uranium-235 (0.127 pCi/g) Uranium-238 (2.46 pCi/g)
SOU204-140	Copper (48 mg/kg) Vanadium (88 mg/kg)
SOU204-141	Copper (47 mg/kg) Vanadium (108 mg/kg) Zinc (84 mg/kg)
SOU204-142	Copper (31 mg/kg) Vanadium (93 mg/kg)
SOU204-143	Copper (39 mg/kg) Iron (28925 mg/kg) Vanadium (112 mg/kg) Zinc (70 mg/kg)
SOU204-144	Copper (36 mg/kg) Vanadium (103 mg/kg)
SOU204-145	Copper (39 mg/kg) Iron (29806 mg/kg) Vanadium (122 mg/kg)
SOU204-146	Copper (40 mg/kg) Vanadium (80 mg/kg)
SOU204-147	Copper (42 mg/kg) Vanadium (96 mg/kg)
SOU204-148	Antimony (0.28 mg/kg) Arsenic (136 mg/kg) Beryllium (0.74 mg/kg) Cadmium (0.44 mg/kg) Chromium (17 mg/kg) Copper (54 mg/kg) Iron (29335 mg/kg) Lead (94 mg/kg) Nickel (26 mg/kg) Selenium (1 mg/kg) Uranium (134 mg/kg) Vanadium (143 mg/kg) Zinc (185 mg/kg) Uranium-234 (1.23 pCi/g) Uranium-235 (0.134 pCi/g) Uranium-238 (4.25 pCi/g)
SOU204-149	Copper (42 mg/kg) Iron (29204 mg/kg) Vanadium (116 mg/kg) Zinc (69 mg/kg)
SOU204-150	Copper (37 mg/kg) Vanadium (95 mg/kg)
SOU204-151	Copper (38 mg/kg) Vanadium (94 mg/kg)
SOU204-152	Copper (34 mg/kg) Iron (29042 mg/kg) Vanadium (107 mg/kg)
SOU204-153	Copper (36 mg/kg) Vanadium (107 mg/kg)
SOU204-154	Copper (36 mg/kg) Vanadium (95 mg/kg) Zinc (68 mg/kg)
SOU204-155	Copper (34 mg/kg) Vanadium (107 mg/kg)
SOU204-156	Copper (45 mg/kg) Selenium (1.2 mg/kg) Uranium (5.3 mg/kg) Vanadium (122 mg/kg) Uranium-238 (1.23 pCi/g)
SOU204-157	Copper (38 mg/kg) Vanadium (86 mg/kg)
SOU204-158	Copper (42 mg/kg) Vanadium (89 mg/kg) Zinc (81 mg/kg)
SOU204-159	Copper (45 mg/kg) Vanadium (105 mg/kg)

Figure 5.6.3. AOC204 Background Exceedances—Surface Soil (Continued)

SOU204-160	Copper (45 mg/kg) Lead (74 mg/kg) Nickel (23 mg/kg) Uranium (109 mg/kg) Vanadium (109 mg/kg) Zinc (145 mg/kg)
SOU204-161	Copper (45 mg/kg) Vanadium (96 mg/kg) Zinc (89 mg/kg)
SOU204-162	Copper (45 mg/kg) Iron (33542 mg/kg) Vanadium (151 mg/kg) Zinc (89 mg/kg)
SOU204-163	Copper (31 mg/kg) Vanadium (98 mg/kg)
SOU204-164	Copper (36 mg/kg) Selenium (1.2 mg/kg) Vanadium (104 mg/kg) Uranium-238 (2.65 pCi/g)
SOU204-165	Copper (32 mg/kg) Silver (55 mg/kg) Vanadium (99 mg/kg)
SOU204-166	Copper (43 mg/kg) Vanadium (110 mg/kg)
SOU204-167	Copper (39 mg/kg) Vanadium (81 mg/kg)
SOU204-168	Copper (35 mg/kg) Selenium (0.82 mg/kg) Vanadium (100 mg/kg) Uranium-235 (0.0801 pCi/g) Uranium-238 (1.28 pCi/g)
SOU204-169	Copper (38 mg/kg) Vanadium (94 mg/kg)
SOU204-170	Copper (41 mg/kg) Vanadium (119 mg/kg) Zinc (69 mg/kg)
SOU204-171	Copper (41 mg/kg) Vanadium (83 mg/kg)
SOU204-172	Copper (32 mg/kg) Vanadium (114 mg/kg) Zinc (75 mg/kg)
SOU204-173	Copper (32 mg/kg) Vanadium (113 mg/kg) Zinc (83 mg/kg)
SOU204-174	Copper (38 mg/kg) Iron (28373 mg/kg) Selenium (0.85 mg/kg) Vanadium (129 mg/kg) Zinc (101 mg/kg) Uranium-235 (0.0741 pCi/g) Uranium-238 (1.81 pCi/g)
SOU204-175	Copper (43 mg/kg) Nickel (22 mg/kg) Vanadium (106 mg/kg) Zinc (73 mg/kg)
SOU204-176	Copper (34 mg/kg) Uranium (85 mg/kg) Zinc (85 mg/kg)
SOU204-177	Copper (39 mg/kg) Vanadium (52 mg/kg)
SOU204-178	Copper (38 mg/kg) Nickel (27 mg/kg) Vanadium (114 mg/kg) Zinc (84 mg/kg)
SOU204-179	Copper (42 mg/kg) Zinc (73 mg/kg)
SOU204-180	Copper (43 mg/kg) Zinc (74 mg/kg)
SOU204-181	Beryllium (0.88 mg/kg) Cobalt (18 mg/kg) Copper (41 mg/kg) Nickel (23 mg/kg) Selenium (1.3 mg/kg) Vanadium (97 mg/kg) Zinc (81 mg/kg)
SOU204-184	Copper (52 mg/kg) Vanadium (107 mg/kg) Zinc (130 mg/kg)
SOU204-185	Copper (42 mg/kg) Iron (33126 mg/kg) Vanadium (61 mg/kg)
SOU204-186	Copper (31 mg/kg) Nickel (23 mg/kg) Vanadium (62 mg/kg)
SOU204-RAD	Uranium (16 mg/kg) Cesium-137 (0.63 pCi/g) Uranium-234 (2.27 pCi/g) Uranium-235 (0.125 pCi/g) Uranium-238 (5.37 pCi/g)
SOU204-RAD2	Uranium-234 (1.64 pCi/g) Uranium-235 (0.125 pCi/g) Uranium-238 (2.41 pCi/g)

Figure 5.6.3. AOC204 Background Exceedances—Surface Soil (Continued)

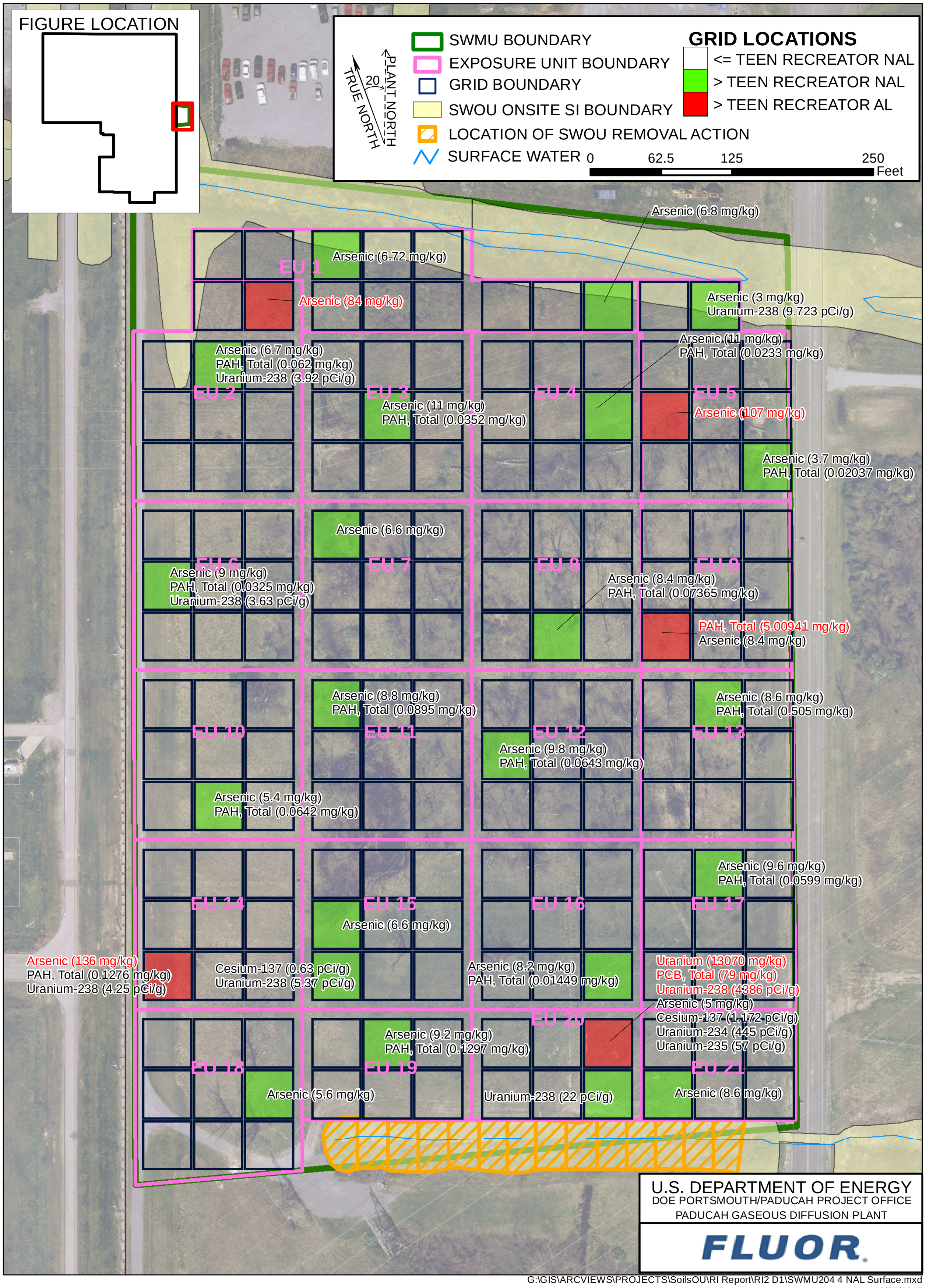


Figure 5.6.4. AOC 204 NAL Exceedances—Surface Soil

For the protection of RGA groundwater, the following metals were detected in the AOC 204 surface soil above both the SSLs and background screening levels (if available).

Metal	Grid	EU
Arsenic	7, 37, 148	2, 5, 14
Cobalt	181	21
Iron	48, 55, 82, 84, 86, 100, 103, 104, 119, 126, 130, 143, 145, 148, 149, 152, 162, 174, 185	4, 7–12, 14–18
Manganese	68	7
Molybdenum[1]	13, 29, 36, 40, 46, 76, 93, 123, 130, 147, 152, 159, 166	1, 2, 4, 6, 11, 13, 15–17, 20
Silver	31, 46, 165	3, 4, 19
Uranium	168	20

[1] No soil background value is available.

PCBs

Total PCBs were detected above the teen recreator NALs in the AOC 204 surface soil in grid 168 from EU 20. This grid also detected PCBs above the teen recreator ALs.

Total PCBs were detected in the AOC 204 surface soil above the SSLs for the protection of UCRS groundwater in grids 168 and 180 (EU 20). Total PCBs also were detected above SSLs for the protection of RGA groundwater in grid 168.

SVOCs

Total PAHs were detected above teen recreator NALs in the surface soil in the following grids: grid 17 (EU 2), grid 32 (EU 3), grid 36 (EU 4), grid 51 (EU 5), grid 64 (EU 6), grid 83 (EU 8), grid 85 (EU 9), grid 91 (EU 11), grid 98 (EU 13), grid 106 (EU 12), grid 113 (EU 10), grid 134 (EU 17), grid 148 (EU 14), grid 156 (EU 16), and grid 164 (EU 19). Total PAHs also were detected in the AOC 204 surface soil above teen recreator ALs at grid 85.

Of the SVOCs, phenanthrene [grids 83 (EU 8), 85 (EU 9), 113 (EU 10), and 148 (EU 14)]; pyrene [grid 85 (EU 9)]; and Total PAHs [grids 85 (EU 9) and 98 (EU 13)] were detected above the SSLs for the protection of UCRS groundwater. No SVOCs were detected above the SSLs for the protection of RGA groundwater.

VOCs

No VOCs were detected above teen recreator NALs or ALs in AOC 204 surface soils. TCE in grid 179 (EU 20) was detected above the SSL for the protection of UCRS groundwater. No VOCs were detected above the SSLs for protection of RGA groundwater.

Radionuclides

The following are the radionuclides that were above both the background screening levels and the recreator NALs and the grids and EUs in which they were found.

Radioisotope	Grid	EU
Cesium-137	151, 168	15, 20
Uranium-234	168	20
Uranium-235	168	20
Uranium-238	15, 17, 64, 148, 151, 168, 180	2, 5, 6, 14, 15, 20

Uranium-238 in grid 168 (EU 20) was detected above the recreator AL in AOC 204 surface soil.

Radionuclides detected above both the background screening levels (if available) and SSLs for the protection of UCRS groundwater are as follows.

Radioisotope	Grid	EU
Americium-241[1]	168	20
Cesium-137	151, 168	15, 20
Tc-99	15, 168	5, 20
Uranium-234	13, 15, 17, 32, 36, 37, 64, 83, 85, 91, 98, 106, 113, 134, 148, 151, 168, 180	1–6, 8–15, 17, 20
Uranium-235	13, 15, 17, 32, 37, 55, 64, 83, 85, 91, 98, 106, 134, 139, 148, 151, 168, 168, 174, 180	1–3, 5–9, 11–15, 17, 18, 20
Uranium-238	13, 15, 17, 32, 36, 37, 51, 55, 64, 83, 85, 91, 98, 106, 113, 134, 139, 148, 151, 156, 164, 168, 174, 180	1–20

[1] No soil background value is available.

Additionally, Tc-99 in grids 15 and 168 (EUs 5 and 20), uranium-234 and uranium-235 in grid 168 (EU 20), and uranium-238 in grids 15 (EU 1), 17 (EU 5), 37 (EU 5), 64 (EU 2), 91 (EU 3), 98 (EU 4), 106 (EU 7), 113 (EU 6), 134 (EU 8), 139 (EU 9), 148 (EU 11), 151 (EU 13), 164 (EU 12), 168 (EU 10), and 180 (EU 17) were detected above both the background screening levels and SSLs for the protection of RGA groundwater.

5.6.4 Nature and Extent of Contamination—Subsurface Soils

The representative data set presented in Table 5.6.2 provides the nature of contamination in AOC 204 subsurface soils, and Figures 5.6.5–5.6.7 illustrate the horizontal extent. A complete list of detailed sampling results, including sampling depths, is provided in Appendix F (samples with ending depths greater than 1 ft bgs are considered subsurface soils in this nature and extent section). Grid numbers shown below are truncated from the figures. Figures contain the SWMU#–grid#, with zeros filling the appropriate spaces to make three digits.

The horizontal and vertical extent of AOC 204 subsurface soil contamination is considered defined adequately for supporting the BRA and FS. There is some uncertainty with vertical extent; however, this will be addressed in the FS.

Table 5.6.2. Subsurface Soil Data Summary: AOC 204

			Detected Results			J-qualified		Provisional Background		Teen Recreator		Teen Recreator		GW Protection Screen		
Type	**Analysis**	**Unit**	**Min**	**Max**	**Avg**	**FOD**	**FOD**	**FOE**	**Bkgd**	**FOE**	**NAL**	**FOE**	**AL**	**RGA**	**UCRS**	**DL Range**
METAL	Aluminum	mg/kg	6.70E+03	1.10E+04	8.71E+03	0/23	23/23	0/23	1.20E+04	0/23	1.00E+05	0/23	1.00E+05	0/23	23/23	4.2–5.7
METAL	Antimony	mg/kg	7.90E-02	4.60E-01	1.88E-01	0/23	23/23	6/23	2.10E-01	0/23	4.48E+01	0/23	1.34E+03	0/23	3/23	0.025–0.034
METAL	Arsenic	mg/kg	3.50E+00	1.70E+01	8.47E+00	0/191	23/191	11/191	7.90E+00	23/191	6.14E-01	0/191	6.14E+01	1/191	23/191	0.17–10
METAL	Barium	mg/kg	7.40E+01	3.50E+02	1.25E+02	0/23	23/23	3/23	1.70E+02	0/23	2.24E+04	0/23	1.00E+05	0/23	21/23	0.085–0.11
METAL	Beryllium	mg/kg	4.00E-01	1.40E+00	5.60E-01	0/23	23/23	2/23	6.90E-01	0/23	2.24E+02	0/23	6.72E+03	0/23	0/23	0.042–0.057
METAL	Cadmium	mg/kg	2.60E-02	3.10E-01	6.99E-02	4/23	22/23	1/23	2.10E-01	0/23	2.80E+01	0/23	8.40E+02	0/23	0/23	0.025–0.034
METAL	Calcium	mg/kg	6.80E+02	1.10E+05	1.45E+04	0/23	23/23	7/23	6.10E+03	0/23	N/A	0/23	N/A	N/A	N/A	85–110
METAL	Chromium	mg/kg	8.70E+00	2.50E+01	1.34E+01	0/191	23/191	0/191	4.30E+01	0/191	2.04E+02	0/191	2.04E+04	0/191	0/191	0.85–12
METAL	Cobalt	mg/kg	4.30E+00	1.70E+01	7.72E+00	0/23	23/23	2/23	1.30E+01	0/23	3.36E+01	0/23	1.01E+03	23/23	23/23	0.085–0.11
METAL	Copper	mg/kg	8.60E+00	4.80E+01	3.37E+01	0/191	171/191	168/191	2.50E+01	0/191	4.48E+03	0/191	1.00E+05	0/191	1/191	0.85–4
METAL	Iron	mg/kg	1.64E+04	4.60E+04	2.38E+04	0/191	191/191	25/191	2.80E+04	0/191	7.85E+04	0/191	1.00E+05	191/191	191/191	8.5–12
METAL	Lead	mg/kg	7.60E+00	6.50E+01	1.80E+01	0/191	30/191	8/191	2.30E+01	0/191	4.00E+02	0/191	4.00E+02	0/191	13/191	0.042–3
METAL	Magnesium	mg/kg	8.90E+02	4.60E+03	1.83E+03	0/23	23/23	5/23	2.10E+03	0/23	N/A	0/23	N/A	N/A	N/A	8.5–11
METAL	Manganese	mg/kg	7.50E+01	2.80E+03	7.08E+02	0/191	191/191	47/191	8.20E+02	1/191	2.69E+03	0/191	8.07E+04	187/191	191/191	0.17–24
METAL	Mercury	mg/kg	1.60E-02	5.10E-02	3.82E-02	4/191	23/191	0/191	1.30E-01	0/191	3.36E+01	0/191	1.01E+03	0/191	19/191	0.024–40
METAL	Molybdenum	mg/kg	3.10E-01	3.70E+01	8.40E+00	0/191	38/191	0/191	N/A	0/191	5.61E+02	0/191	1.68E+04	16/191	38/191	0.085–3
METAL	Nickel	mg/kg	6.80E+00	3.00E+01	1.48E+01	0/191	144/191	4/191	2.20E+01	0/191	2.24E+03	0/191	6.72E+04	0/191	144/191	0.42–4
METAL	Selenium	mg/kg	5.90E-01	1.50E+00	1.09E+00	0/191	23/191	22/191	7.00E-01	0/191	5.61E+02	0/191	1.68E+04	0/191	23/191	0.085–3
METAL	Silver	mg/kg	1.80E-02	8.90E+01	8.18E+00	0/191	27/191	6/191	2.70E+00	0/191	5.61E+02	0/191	1.68E+04	6/191	6/191	0.0085–50
METAL	Sodium	mg/kg	2.80E+01	4.80E+02	1.37E+02	10/23	23/23	2/23	3.40E+02	0/23	N/A	0/23	N/A	N/A	N/A	85–110
METAL	Thallium	mg/kg	8.20E-02	2.20E-01	1.49E-01	0/23	23/23	0/23	3.40E-01	0/23	1.12E+00	0/23	3.36E+01	0/23	13/23	0.017–0.023
METAL	Uranium	mg/kg	5.30E-01	2.80E+00	1.33E+00	0/191	23/191	0/191	4.60E+00	0/191	3.36E+02	0/191	1.01E+04	0/191	0/191	0.0085–10
METAL	Vanadium	mg/kg	6.20E+01	1.46E+02	9.28E+01	0/191	191/191	191/191	3.70E+01	0/191	5.65E+02	0/191	1.70E+04	0/191	191/191	0.085–5
METAL	Zinc	mg/kg	2.30E+01	2.30E+02	4.56E+01	0/191	191/191	23/191	6.00E+01	0/191	3.36E+04	0/191	1.00E+05	0/191	131/191	1–2.3
PPCB	PCB, Total	mg/kg	1.40E-02	1.40E-02	1.40E-02	1/223	1/223	0/223	N/A	0/223	1.89E-01	0/223	1.89E+01	0/223	0/223	0.05–0.05
SVOA	1,2,4-Trichlorobenzene	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	1,2-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	1,3-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	1,4-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	2,4,5-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	2,4,6-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	2,4-Dichlorophenol	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	2,4-Dimethylphenol	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	2,4-Dinitrophenol	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.73–0.8
SVOA	2,4-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.22–0.24
SVOA	2,6-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.22–0.24
SVOA	2-Chloronaphthalene	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	2-Chlorophenol	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	2-Methyl-4,6-dinitrophenol	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.73–0.8
SVOA	2-Methylnaphthalene	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	2-Methylphenol	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	2-Nitrobenzenamine	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	1.32E+02	0/23	3.96E+03	0/23	0/23	0.73–0.8
SVOA	2-Nitrophenol	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	3,3'-Dichlorobenzidine	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.22–0.24
SVOA	3-Nitrobenzenamine	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.73–0.8
SVOA	4-Bromophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	4-Chloro-3-methylphenol	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	4-Chlorobenzenamine	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	4-Chlorophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	4-Nitrophenol	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.73–0.8
SVOA	Acenaphthene	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	6.26E+02	0/23	1.88E+04	0/23	0/23	0.36–0.4
SVOA	Acenaphthylene	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	6.26E+02	0/23	1.88E+04	N/A	N/A	0.36–0.4
SVOA	Anthracene	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	3.13E+03	0/23	9.39E+04	0/23	0/23	0.36–0.4

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.6.2. Subsurface Soil Data Summary: AOC 204 (Continued)

			Detected Results			J-qualified		Provisional Background		Teen Recreator		Teen Recreator		GW Protection Screen		
Type	Analysis	Unit	Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
SVOA	Benzenemethanol	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	Benzo(ghi)perylene	mg/kg	1.90E-01	1.90E-01	1.90E-01	1/23	1/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	Benzoic Acid	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	1.8–2
SVOA	bis(2-chloroethoxy)methane	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	bis(2-chloroethyl) ether	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	bis(2-chloroisopropyl) ether	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	bis(2-ethylhexyl)phthalate	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	3.47E+01	0/23	3.47E+03	0/23	0/23	0.36–0.4
SVOA	Butyl benzyl phthalate	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	Dibenzofuran	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	Diethyl phthalate	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	Dimethyl phthalate	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	Di-n-butyl phthalate	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	Di-n-octylPhthalate	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	Fluoranthene	mg/kg	3.00E-01	4.40E-01	3.70E-01	1/23	2/23	0/23	N/A	0/23	4.17E+02	0/23	1.25E+04	0/23	0/23	0.36–0.4
SVOA	Fluorene	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	4.17E+02	0/23	1.25E+04	0/23	0/23	0.36–0.4
SVOA	Hexachlorobenzene	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	3.04E-01	0/23	3.04E+01	0/23	0/23	0.0037–0.004
SVOA	Hexachlorobutadiene	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.22–0.24
SVOA	Hexachlorocyclopentadiene	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	Hexachloroethane	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	Isophorone	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	m,p-cresol	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	Naphthalene	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	5.72E+01	0/23	5.72E+03	0/23	0/23	0.36–0.4
SVOA	Nitrobenzene	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	N-Nitroso-di-n-propylamine	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	6.95E-02	0/23	6.95E+00	0/23	0/23	0.36–0.4
SVOA	N-Nitrosodiphenylamine	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	PAH, Total	mg/kg	1.20E-04	1.89E-01	3.59E-02	0/18	18/18	0/18	N/A	9/18	1.38E-02	0/18	1.38E+00	0/18	0/18	–
SVOA	Pentachlorophenol	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	5.84E-01	0/23	5.84E+01	N/A	N/A	0.66–0.72
SVOA	Phenanthrene	mg/kg	1.50E-01	1.70E-01	1.60E-01	2/23	2/23	0/23	N/A	0/23	6.26E+02	0/23	1.88E+04	0/23	2/23	0.36–0.4
SVOA	Phenol	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
SVOA	p-Nitroaniline	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.73–0.8
SVOA	Pyrene	mg/kg	2.40E-01	5.20E-01	3.80E-01	1/23	2/23	0/23	N/A	0/23	3.13E+02	0/23	9.39E+03	0/23	0/23	0.36–0.4
SVOA	Pyridine	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.36–0.4
VOA	1,1,1,2-Tetrachloroethane	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.0049–0.0058
VOA	1,1,1-Trichloroethane	mg/kg	1.30E-02	2.40E-02	1.92E-02	0/64	5/64	0/64	N/A	0/64	1.00E+05	0/64	3.00E+06	0/64	0/64	0.0049–0.01
VOA	1,1,2,2-Tetrachloroethane	mg/kg	N/A	N/A	N/A	0/32	0/32	0/32	N/A	0/32	N/A	0/32	N/A	N/A	N/A	0.0049–0.01
VOA	1,1,2-Trichloroethane	mg/kg	N/A	N/A	N/A	0/32	0/32	0/32	N/A	0/32	1.17E+01	0/32	1.17E+03	0/32	0/32	0.0049–0.01
VOA	1,1-Dichloroethane	mg/kg	N/A	N/A	N/A	0/36	0/36	0/36	N/A	0/36	4.64E+01	0/36	4.64E+03	0/36	0/36	0.0049–0.01
VOA	1,1-Dichloroethene	mg/kg	N/A	N/A	N/A	0/64	0/64	0/64	N/A	0/64	5.61E+03	0/64	1.68E+05	0/64	0/64	0.0049–0.427
VOA	1,2,3-Trichloropropane	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.0049–0.0058
VOA	1,2-Dichloroethane	mg/kg	N/A	N/A	N/A	0/32	0/32	0/32	N/A	0/32	5.34E+00	0/32	5.34E+02	0/32	0/32	0.0049–0.01
VOA	1,2-Dichloropropane	mg/kg	N/A	N/A	N/A	0/32	0/32	0/32	N/A	0/32	N/A	0/32	N/A	N/A	N/A	0.0049–0.01
VOA	1,2-Dimethylbenzene	mg/kg	N/A	N/A	N/A	0/32	0/32	0/32	N/A	0/32	2.24E+04	0/32	6.72E+05	0/32	0/32	0.0049–0.01
VOA	2-Butanone	mg/kg	N/A	N/A	N/A	0/32	0/32	0/32	N/A	0/32	N/A	0/32	N/A	N/A	N/A	0.01–0.023
VOA	2-Chloroethyl Vinyl Ether	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.0049–0.0058
VOA	2-Hexanone	mg/kg	N/A	N/A	N/A	0/32	0/32	0/32	N/A	0/32	N/A	0/32	N/A	N/A	N/A	0.01–0.023
VOA	4-Methyl-2-pentanone	mg/kg	N/A	N/A	N/A	0/32	0/32	0/32	N/A	0/32	N/A	0/32	N/A	N/A	N/A	0.01–0.023
VOA	Acetone	mg/kg	N/A	N/A	N/A	0/32	0/32	0/32	N/A	0/32	N/A	0/32	N/A	N/A	N/A	0.01–0.023
VOA	Acrolein	mg/kg	N/A	N/A	N/A	0/22	0/22	0/22	N/A	0/22	N/A	0/22	N/A	N/A	N/A	0.049–0.058
VOA	Acrylonitrile	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	1.93E+00	0/23	1.93E+02	0/23	0/23	0.049–0.058
VOA	Benzene	mg/kg	N/A	N/A	N/A	0/32	0/32	0/32	N/A	0/32	1.19E+01	0/32	1.19E+03	0/32	0/32	0.0049–0.01
VOA	Bromodichloromethane	mg/kg	N/A	N/A	N/A	0/32	0/32	0/32	N/A	0/32	3.88E+00	0/32	3.88E+02	0/32	0/32	0.0049–0.01
VOA	Bromoform	mg/kg	N/A	N/A	N/A	0/32	0/32	0/32	N/A	0/32	N/A	0/32	N/A	N/A	N/A	0.0049–0.01
VOA	Bromomethane	mg/kg	N/A	N/A	N/A	0/32	0/32	0/32	N/A	0/32	N/A	0/32	N/A	N/A	N/A	0.0049–0.01

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.6.2. Subsurface Soil Data Summary: AOC 204 (Continued)

			Detected Results			J-qualified		Provisional Background		Teen Recreator		Teen Recreator		GW Protection Screen		
Type	Analysis	Unit	Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
VOA	Carbon Disulfide	mg/kg	N/A	N/A	N/A	0/32	0/32	0/32	N/A	0/32	N/A	0/32	N/A	N/A	N/A	0.0049–0.01
VOA	Carbon Tetrachloride	mg/kg	N/A	N/A	N/A	0/32	0/32	0/32	N/A	0/32	7.38E+00	0/32	7.38E+02	0/32	0/32	0.0049–0.01
VOA	Chlorobenzene	mg/kg	N/A	N/A	N/A	0/32	0/32	0/32	N/A	0/32	N/A	0/32	N/A	N/A	N/A	0.0049–0.01
VOA	Chloroethane	mg/kg	N/A	N/A	N/A	0/32	0/32	0/32	N/A	0/32	N/A	0/32	N/A	N/A	N/A	0.0049–0.01
VOA	Chloroform	mg/kg	N/A	N/A	N/A	0/32	0/32	0/32	N/A	0/32	4.42E+00	0/32	4.42E+02	0/32	0/32	0.0049–0.01
VOA	Chloromethane	mg/kg	N/A	N/A	N/A	0/32	0/32	0/32	N/A	0/32	N/A	0/32	N/A	N/A	N/A	0.0049–0.01
VOA	*cis* -1,2-Dichloroethene	mg/kg	N/A	N/A	N/A	0/32	0/32	0/32	N/A	0/32	2.24E+02	0/32	6.72E+03	0/32	0/32	0.0049–0.427
VOA	*cis* -1,3-Dichloropropene	mg/kg	N/A	N/A	N/A	0/32	0/32	0/32	N/A	0/32	N/A	0/32	N/A	N/A	N/A	0.0049–0.01
VOA	Dibromochloromethane	mg/kg	N/A	N/A	N/A	0/32	0/32	0/32	N/A	0/32	N/A	0/32	N/A	N/A	N/A	0.0049–0.01
VOA	Dibromomethane	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.0049–0.0058
VOA	Dichlorodifluoromethane	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	2.24E+04	0/23	6.72E+05	0/23	0/23	0.0049–0.0058
VOA	Ethyl Methacrylate	mg/kg	N/A	N/A	N/A	0/22	0/22	0/22	N/A	0/22	N/A	0/22	N/A	N/A	N/A	0.0049–0.0058
VOA	Ethylbenzene	mg/kg	N/A	N/A	N/A	0/32	0/32	0/32	N/A	0/32	5.96E+01	0/32	5.96E+03	0/32	0/32	0.0049–0.01
VOA	Iodomethane	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.0049–0.0058
VOA	m,p-Xylene	mg/kg	3.20E-03	3.20E-03	3.20E-03	1/32	1/32	0/32	N/A	0/32	2.24E+04	0/32	6.72E+05	0/32	0/32	0.0049–0.02
VOA	Methylene Chloride	mg/kg	2.40E-03	4.90E-03	3.06E-03	5/32	5/32	0/32	N/A	0/32	N/A	0/32	N/A	N/A	N/A	0.0049–0.01
VOA	Styrene	mg/kg	N/A	N/A	N/A	0/32	0/32	0/32	N/A	0/32	N/A	0/32	N/A	N/A	N/A	0.0049–0.01
VOA	Tetrachloroethene	mg/kg	N/A	N/A	N/A	0/64	0/64	0/64	N/A	0/64	2.61E+02	0/64	2.02E+04	N/A	N/A	0.0049–0.01
VOA	Toluene	mg/kg	1.20E-02	2.20E+00	7.19E-01	0/32	23/32	0/32	N/A	0/32	8.97E+03	0/32	2.69E+05	0/32	8/32	0.0054–0.29
VOA	*trans* -1,2-Dichloroethene	mg/kg	N/A	N/A	N/A	0/32	0/32	0/32	N/A	0/32	2.24E+03	0/32	6.72E+04	0/32	0/32	0.0049–0.427
VOA	*trans* -1,3-Dichloropropene	mg/kg	N/A	N/A	N/A	0/32	0/32	0/32	N/A	0/32	N/A	0/32	N/A	N/A	N/A	0.0049–0.01
VOA	*trans* -1,4-Dichloro-2-Butene	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.0049–0.0058
VOA	Trichloroethene	mg/kg	4.80E-02	7.30E-02	6.53E-02	0/64	3/64	0/64	N/A	0/64	8.99E+00	0/64	8.99E+02	0/64	3/64	0.002–0.427
VOA	Trichlorofluoromethane	mg/kg	N/A	N/A	N/A	0/23	0/23	0/23	N/A	0/23	N/A	0/23	N/A	N/A	N/A	0.0049–0.0058
VOA	Vinyl Acetate	mg/kg	N/A	N/A	N/A	0/22	0/22	0/22	N/A	0/22	N/A	0/22	N/A	N/A	N/A	0.02–0.023
VOA	Vinyl Chloride	mg/kg	N/A	N/A	N/A	0/32	0/32	0/32	N/A	0/32	6.79E-02	0/32	6.79E+00	0/32	0/32	0.0049–10
RADS	Americium-241	pCi/g	N/A	N/A	N/A	0/32	0/32	0/32	N/A	0/32	8.43E+00	0/32	8.43E+02	0/32	0/32	0.0308–9.2
RADS	Cesium-137	pCi/g	2.43E-02	6.83E-02	4.07E-02	0/32	3/32	0/32	2.80E-01	0/32	3.23E-01	0/32	3.23E+01	0/32	0/32	0.0174–2.9
RADS	Cobalt-60	pCi/g	N/A	N/A	N/A	0/9	0/9	0/9	N/A	0/9	N/A	0/9	N/A	N/A	N/A	0.95–1.3
RADS	Neptunium-237	pCi/g	1.18E-02	1.18E-02	1.18E-02	0/23	1/23	0/23	N/A	0/23	6.68E-01	0/23	6.68E+01	0/23	0/23	0.0101–0.0496
RADS	Plutonium-238	pCi/g	8.72E-03	2.27E-02	1.69E-02	0/23	8/23	0/23	N/A	0/23	1.23E+01	0/23	1.23E+03	0/23	0/23	0.00759–0.0388
RADS	Plutonium-239/240	pCi/g	9.33E-03	2.95E-02	2.08E-02	0/23	6/23	0/23	N/A	0/23	1.08E+01	0/23	1.08E+03	0/23	0/23	0.00788–0.043
RADS	Protactinium-234m	pCi/g	N/A	N/A	N/A	0/9	0/9	0/9	N/A	0/9	N/A	0/9	N/A	N/A	N/A	130–450
RADS	Technetium-99	pCi/g	N/A	N/A	N/A	0/29	0/29	0/29	2.80E+00	0/29	3.26E+02	0/29	3.26E+04	0/29	0/29	0.6–3.86
RADS	Thorium-228	pCi/g	7.72E-01	1.16E+00	1.06E+00	0/23	23/23	0/23	1.60E+00	0/23	N/A	0/23	N/A	N/A	N/A	0.0261–0.07
RADS	Thorium-230	pCi/g	9.68E-01	1.46E+00	1.17E+00	0/23	23/23	1/23	1.40E+00	0/23	1.45E+01	0/23	1.45E+03	0/23	0/23	0.0618–0.0865
RADS	Thorium-232	pCi/g	7.09E-01	1.18E+00	1.03E+00	0/23	23/23	0/23	1.50E+00	0/23	N/A	0/23	N/A	N/A	N/A	0.00423–0.0265
RADS	Thorium-234	pCi/g	N/A	N/A	N/A	0/9	0/9	0/9	N/A	0/9	N/A	0/9	N/A	N/A	N/A	5–18
RADS	Uranium-234	pCi/g	6.01E-01	1.04E+00	9.25E-01	0/23	23/23	0/23	1.20E+00	0/23	1.65E+01	0/23	1.65E+03	0/23	23/23	0.0121–0.0694
RADS	Uranium-235	pCi/g	3.14E-02	9.16E-02	6.46E-02	0/32	16/32	12/32	6.00E-02	0/32	9.68E-01	0/32	9.68E+01	0/32	14/32	0.0139–9
RADS	Uranium-238	pCi/g	7.23E-01	1.46E+00	1.09E+00	0/23	23/23	5/23	1.20E+00	0/23	3.57E+00	0/23	3.57E+02	0/23	23/23	0.0135–0.061

One or more samples exceed AL value
One or more samples exceed NAL value
One or more samples exceed background value
One or more samples exceed SSLs of RGA and UCRS groundwater protection

Counts of analyses are based on the maximum detected result from a sample (i.e., if a sample has analytical results from two different labs, only the maximum value is counted).
Field replicates, or separate samples are counted independently.

The uranium (metal)/uranium (isotopic) may not be from the same sample thus a correlation between uranium (metal)/uranium (isotopic) data may not be possible.
Uranium-238 that was analyzed using method RL-7128NITRIC is compared to a background value of 0.4 pCi/g for surface and subsurface.

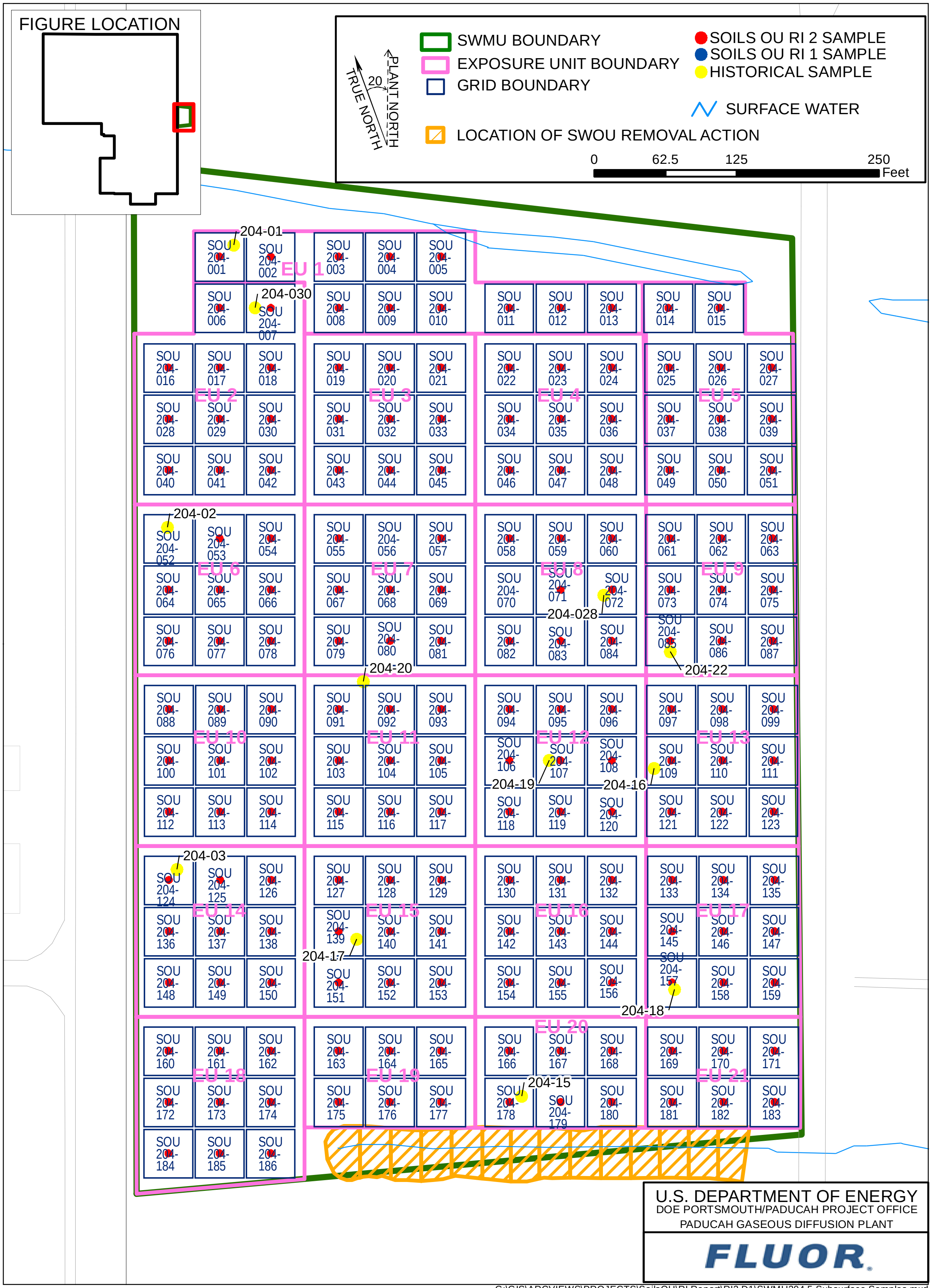
FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.6.2. Subsurface Soil Data Summary: AOC 204 (Continued)

Type	Analysis	Unit	Detected Results			J-qualified	FOD	Provisional Background		Teen Recreator		Teen Recreator		GW Protection Screen		DL Range
			Min	Max	Avg	FOD		FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	

Screening values are shown in Appendices C and D.

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable



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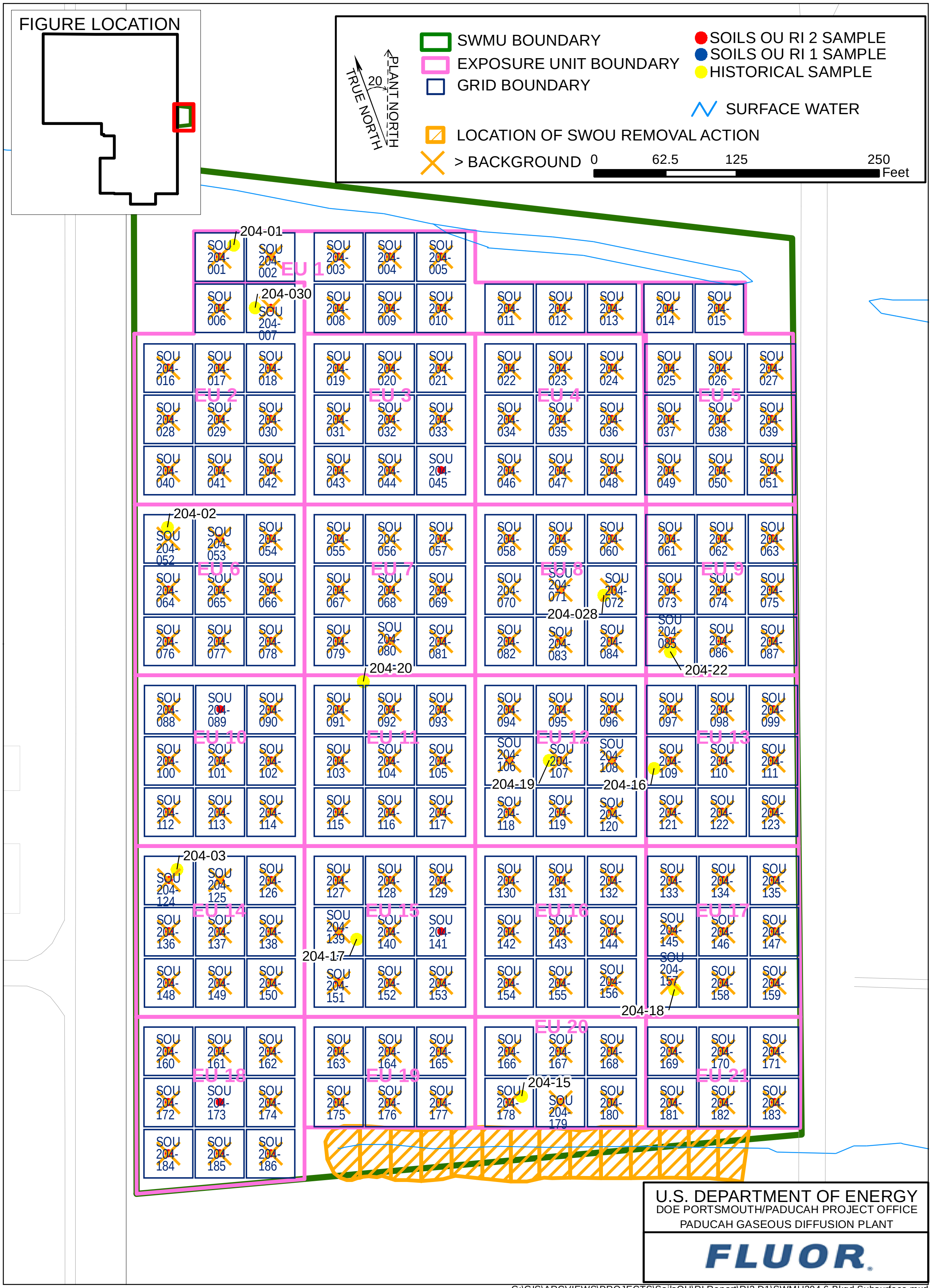
1/9/2015

Figure 5.6.5. AOC 204 Sample Locations—Subsurface Soil



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2/25/2015

Figure 5.6.6. AOC 204 Background Exceedances—Subsurface Soil

Sample	Exceedances
SOU204-001	Copper (41 mg/kg) Vanadium (106 mg/kg) Zinc (61 mg/kg)
SOU204-002	Copper (35 mg/kg) Vanadium (89 mg/kg)
SOU204-003	Vanadium (116 mg/kg)
SOU204-004	Copper (32 mg/kg) Selenium (1 mg/kg) Vanadium (90 mg/kg) Uranium-235 (0.0708 pCi/g)
SOU204-005	Copper (35 mg/kg) Manganese (828 mg/kg) Vanadium (86 mg/kg)
SOU204-006	Copper (34 mg/kg) Vanadium (74 mg/kg)
SOU204-007	Vanadium (95 mg/kg)
SOU204-008	Copper (38 mg/kg) Vanadium (92 mg/kg) Zinc (74 mg/kg)
SOU204-009	Copper (35 mg/kg) Silver (38 mg/kg) Vanadium (82 mg/kg)
SOU204-010	Copper (30 mg/kg) Vanadium (103 mg/kg)
SOU204-011	Copper (36 mg/kg) Vanadium (104 mg/kg)
SOU204-012	Copper (40 mg/kg) Vanadium (102 mg/kg)
SOU204-013	Copper (31 mg/kg) Vanadium (102 mg/kg)
SOU204-014	Copper (36 mg/kg) Manganese (885 mg/kg) Vanadium (100 mg/kg)
SOU204-015	Copper (28 mg/kg) Vanadium (81 mg/kg)
SOU204-016	Copper (33 mg/kg) Iron (28020 mg/kg) Vanadium (119 mg/kg)
SOU204-017	Vanadium (91 mg/kg)
SOU204-018	Copper (33 mg/kg) Manganese (1173 mg/kg) Vanadium (85 mg/kg)
SOU204-019	Antimony (0.28 mg/kg) Arsenic (10 mg/kg) Copper (34 mg/kg) Manganese (870 mg/kg) Selenium (1.2 mg/kg) Vanadium (82 mg/kg) Uranium-235 (0.0625 pCi/g) Uranium-238 (1.22 pCi/g)
SOU204-020	Copper (31 mg/kg) Vanadium (95 mg/kg)
SOU204-021	Copper (35 mg/kg) Vanadium (84 mg/kg)
SOU204-022	Copper (38 mg/kg) Vanadium (88 mg/kg)
SOU204-023	Copper (34 mg/kg) Vanadium (94 mg/kg)
SOU204-024	Copper (32 mg/kg) Vanadium (75 mg/kg)
SOU204-025	Copper (35 mg/kg) Manganese (992 mg/kg) Vanadium (86 mg/kg)
SOU204-026	Arsenic (9.5 mg/kg) Barium (190 mg/kg) Cobalt (17 mg/kg) Copper (28 mg/kg) Manganese (1500 mg/kg) Selenium (1.5 mg/kg) Vanadium (69 mg/kg) Uranium-235 (0.0658 pCi/g)
SOU204-027	Copper (33 mg/kg) Manganese (847 mg/kg) Vanadium (75 mg/kg)
SOU204-028	Copper (42 mg/kg) Manganese (875 mg/kg) Nickel (25 mg/kg) Vanadium (93 mg/kg)
SOU204-029	Copper (31 mg/kg) Vanadium (87 mg/kg)
SOU204-030	Copper (45 mg/kg) Vanadium (92 mg/kg)
SOU204-031	Copper (30 mg/kg) Vanadium (98 mg/kg) Zinc (230 mg/kg)
SOU204-032	Copper (35 mg/kg) Vanadium (92 mg/kg)
SOU204-033	Copper (38 mg/kg) Vanadium (80 mg/kg)
SOU204-034	Copper (31 mg/kg) Vanadium (95 mg/kg)
SOU204-035	Arsenic (8 mg/kg) Copper (36 mg/kg) Selenium (1.1 mg/kg) Vanadium (82 mg/kg)
SOU204-036	Copper (37 mg/kg) Vanadium (88 mg/kg)
SOU204-037	Copper (30 mg/kg) Lead (50 mg/kg) Vanadium (97 mg/kg)
SOU204-038	Vanadium (93 mg/kg)
SOU204-039	Copper (35 mg/kg) Vanadium (84 mg/kg)
SOU204-040	Antimony (0.24 mg/kg) Arsenic (10 mg/kg) Copper (39 mg/kg) Iron (29419 mg/kg) Magnesium (2300 mg/kg) Selenium (1.3 mg/kg) Vanadium (105 mg/kg) Zinc (61 mg/kg) Thorium-230 (1.46 pCi/g) Uranium-235 (0.066 pCi/g)
SOU204-041	Copper (39 mg/kg) Manganese (873 mg/kg) Vanadium (76 mg/kg)
SOU204-042	Copper (34 mg/kg) Vanadium (91 mg/kg)
SOU204-043	Copper (34 mg/kg) Silver (29 mg/kg) Vanadium (71 mg/kg)
SOU204-044	Copper (31 mg/kg) Manganese (1054 mg/kg) Vanadium (100 mg/kg)
SOU204-045	Copper (34 mg/kg) Vanadium (73 mg/kg)
SOU204-046	Manganese (897 mg/kg) Vanadium (99 mg/kg)
SOU204-047	Vanadium (84 mg/kg)
SOU204-048	Copper (28 mg/kg) Vanadium (83 mg/kg)
SOU204-049	Copper (43 mg/kg) Vanadium (85 mg/kg)
SOU204-050	Copper (28 mg/kg) Vanadium (98 mg/kg)

Figure 5.6.6. AOC204 Background Exceedances—Subsurface Soil (Continued)

SOU204-051	Manganese (878 mg/kg) Vanadium (88 mg/kg)
SOU204-052	Copper (37 mg/kg) Iron (31705 mg/kg) Lead (35 mg/kg) Vanadium (96 mg/kg)
SOU204-053	Copper (30 mg/kg) Vanadium (85 mg/kg)
SOU204-054	Copper (32 mg/kg) Vanadium (73 mg/kg)
SOU204-055	Antimony (0.44 mg/kg) Arsenic (17 mg/kg) Barium (210 mg/kg) Beryllium (1 mg/kg) Cobalt (15 mg/kg) Copper (36 mg/kg) Manganese (2800 mg/kg) Selenium (1.3 mg/kg) Vanadium (86 mg/kg)
SOU204-056	Copper (31 mg/kg) Vanadium (94 mg/kg)
SOU204-057	Copper (27 mg/kg) Vanadium (85 mg/kg)
SOU204-058	Copper (36 mg/kg) Vanadium (96 mg/kg)
SOU204-059	Copper (32 mg/kg) Manganese (1072 mg/kg) Vanadium (87 mg/kg)
SOU204-060	Copper (32 mg/kg) Manganese (1138 mg/kg) Vanadium (81 mg/kg)
SOU204-061	Copper (31 mg/kg) Vanadium (79 mg/kg)
SOU204-062	Vanadium (82 mg/kg)
SOU204-063	Vanadium (94 mg/kg)
SOU204-064	Copper (35 mg/kg) Iron (29000 mg/kg) Vanadium (102 mg/kg)
SOU204-065	Antimony (0.25 mg/kg) Arsenic (10 mg/kg) Copper (32 mg/kg) Manganese (1800 mg/kg) Selenium (1 mg/kg) Vanadium (75 mg/kg) Uranium-235 (0.0662 pCi/g)

SOU204-066	Copper (34 mg/kg) Lead (57 mg/kg) Vanadium (70 mg/kg)
SOU204-067	Copper (33 mg/kg) Vanadium (81 mg/kg)
SOU204-068	Copper (30 mg/kg) Vanadium (75 mg/kg)
SOU204-069	Copper (34 mg/kg) Vanadium (89 mg/kg)
SOU204-070	Copper (34 mg/kg) Manganese (1000 mg/kg) Manganese (940 mg/kg) Selenium (1.1 mg/kg) Vanadium (83 mg/kg) Uranium-235 (0.0916 pCi/g)
SOU204-071	Copper (35 mg/kg) Manganese (1385 mg/kg) Vanadium (91 mg/kg)
SOU204-072	Copper (35 mg/kg) Vanadium (83 mg/kg)
SOU204-073	Copper (29 mg/kg) Vanadium (93 mg/kg)
SOU204-074	Copper (28 mg/kg) Manganese (867 mg/kg) Vanadium (66 mg/kg)
SOU204-075	Copper (31 mg/kg) Manganese (865 mg/kg) Selenium (1.2 mg/kg) Vanadium (90 mg/kg) Uranium-235 (0.0721 pCi/g)
SOU204-076	Copper (38 mg/kg) Iron (29973 mg/kg) Vanadium (96 mg/kg)
SOU204-077	Copper (30 mg/kg) Lead (49 mg/kg) Vanadium (68 mg/kg)
SOU204-078	Copper (33 mg/kg) Lead (51 mg/kg) Manganese (2648 mg/kg) Vanadium (84 mg/kg)
SOU204-079	Copper (37 mg/kg) Iron (28501 mg/kg) Vanadium (99 mg/kg)
SOU204-080	Copper (31 mg/kg) Manganese (1839 mg/kg) Silver (18 mg/kg) Vanadium (70 mg/kg)

SOU204-081	Copper (33 mg/kg) Vanadium (85 mg/kg)
SOU204-082	Copper (30 mg/kg) Manganese (1076 mg/kg) Vanadium (96 mg/kg)
SOU204-083	Manganese (1019 mg/kg) Vanadium (80 mg/kg)
SOU204-084	Copper (30 mg/kg) Iron (30943 mg/kg) Manganese (1327 mg/kg) Vanadium (74 mg/kg)
SOU204-085	Copper (35 mg/kg) Iron (30596 mg/kg) Vanadium (112 mg/kg) Zinc (64 mg/kg)
SOU204-086	Copper (31 mg/kg) Manganese (910 mg/kg) Vanadium (84 mg/kg)
SOU204-087	Copper (40 mg/kg) Iron (29139 mg/kg) Manganese (827 mg/kg) Vanadium (87 mg/kg)
SOU204-088	Copper (41 mg/kg) Iron (28915 mg/kg) Vanadium (91 mg/kg) Zinc (62 mg/kg)
SOU204-089	Copper (29 mg/kg) Vanadium (83 mg/kg)
SOU204-090	Calcium (14000 mg/kg) Copper (37 mg/kg) Magnesium (2200 mg/kg) Selenium (0.94 mg/kg) Vanadium (92 mg/kg) Zinc (68 mg/kg) Uranium-235 (0.0696 pCi/g)
SOU204-091	Copper (41 mg/kg) Vanadium (92 mg/kg) Zinc (64 mg/kg)
SOU204-092	Copper (42 mg/kg) Vanadium (129 mg/kg) Zinc (65 mg/kg)
SOU204-093	Copper (39 mg/kg) Vanadium (146 mg/kg) Zinc (66 mg/kg)
SOU204-094	Copper (42 mg/kg) Vanadium (125 mg/kg) Zinc (72 mg/kg)

Figure 5.6.6. AOC204 Background Exceedances—Subsurface Soil (Continued)

SOU204-095	Selenium (1 mg/kg) Vanadium (93 mg/kg) Uranium-235 (0.0768 pCi/g)
SOU204-096	Copper (33 mg/kg) Vanadium (94 mg/kg)
SOU204-097	Copper (35 mg/kg) Vanadium (94 mg/kg)
SOU204-098	Vanadium (87 mg/kg)
SOU204-099	Copper (33 mg/kg) Vanadium (62 mg/kg)
SOU204-100	Copper (41 mg/kg) Iron (28605 mg/kg) Vanadium (115 mg/kg) Zinc (66 mg/kg)
SOU204-101	Copper (31 mg/kg) Vanadium (79 mg/kg)
SOU204-102	Copper (48 mg/kg) Iron (40950 mg/kg) Vanadium (133 mg/kg) Zinc (74 mg/kg)
SOU204-103	Cadmium (0.31 mg/kg) Calcium (110000 mg/kg) Copper (38 mg/kg) Iron (31353 mg/kg) Magnesium (4600 mg/kg) Selenium (0.93 mg/kg) Vanadium (124 mg/kg) Zinc (75 mg/kg) Uranium-235 (0.0722 pCi/g) Uranium-238 (1.25 pCi/g)
SOU204-104	Copper (32 mg/kg) Vanadium (94 mg/kg)
SOU204-105	Copper (35 mg/kg) Manganese (871 mg/kg) Vanadium (93 mg/kg)
SOU204-106	Copper (32 mg/kg) Vanadium (105 mg/kg)
SOU204-107	Copper (31 mg/kg) Manganese (879 mg/kg) Vanadium (115 mg/kg)
SOU204-108	Copper (34 mg/kg) Vanadium (101 mg/kg)
SOU204-109	Copper (33 mg/kg) Vanadium (97 mg/kg)
SOU204-110	Vanadium (86 mg/kg)
SOU204-111	Copper (38 mg/kg) Selenium (1.1 mg/kg) Vanadium (88 mg/kg)
SOU204-112	Copper (35 mg/kg) Vanadium (92 mg/kg)
SOU204-113	Copper (40 mg/kg) Iron (34176 mg/kg) Vanadium (100 mg/kg)
SOU204-114	Copper (29 mg/kg) Vanadium (91 mg/kg)
SOU204-115	Copper (41 mg/kg) Vanadium (88 mg/kg)
SOU204-116	Copper (31 mg/kg) Vanadium (111 mg/kg)
SOU204-117	Copper (31 mg/kg) Manganese (985 mg/kg) Vanadium (94 mg/kg)
SOU204-118	Copper (35 mg/kg) Manganese (2115 mg/kg) Vanadium (93 mg/kg)
SOU204-119	Copper (28 mg/kg) Manganese (1131 mg/kg) Vanadium (78 mg/kg)
SOU204-120	Copper (26 mg/kg) Manganese (1093 mg/kg) Vanadium (90 mg/kg)
SOU204-121	Manganese (1042 mg/kg) Vanadium (87 mg/kg)
SOU204-122	Copper (31 mg/kg) Manganese (963 mg/kg) Vanadium (74 mg/kg)
SOU204-123	Copper (36 mg/kg) Vanadium (84 mg/kg)
SOU204-124	Vanadium (86 mg/kg)
SOU204-125	Copper (37 mg/kg) Vanadium (101 mg/kg)
SOU204-126	Copper (28 mg/kg) Vanadium (83 mg/kg)
SOU204-127	Copper (32 mg/kg) Vanadium (105 mg/kg)
SOU204-128	Copper (33 mg/kg) Vanadium (90 mg/kg)
SOU204-129	Copper (28 mg/kg) Manganese (878 mg/kg) Vanadium (98 mg/kg)
SOU204-130	Copper (36 mg/kg) Vanadium (89 mg/kg)
SOU204-131	Copper (36 mg/kg) Vanadium (110 mg/kg)
SOU204-132	Copper (31 mg/kg) Silver (51 mg/kg) Vanadium (93 mg/kg)
SOU204-133	Copper (37 mg/kg) Vanadium (79 mg/kg)
SOU204-134	Arsenic (9.6 mg/kg) Copper (30 mg/kg) Selenium (1.1 mg/kg) Vanadium (84 mg/kg)
SOU204-135	Copper (32 mg/kg) Vanadium (90 mg/kg)
SOU204-136	Arsenic (9.2 mg/kg) Calcium (90000 mg/kg) Copper (43 mg/kg) Iron (29167 mg/kg) Magnesium (4600 mg/kg) Selenium (1.2 mg/kg) Vanadium (101 mg/kg) Uranium-235 (0.0747 pCi/g) Uranium-238 (1.46 pCi/g)
SOU204-137	Copper (35 mg/kg) Iron (31433 mg/kg) Vanadium (96 mg/kg)
SOU204-138	Copper (37 mg/kg) Iron (28742 mg/kg) Vanadium (113 mg/kg)
SOU204-139	Iron (45884 mg/kg) Vanadium (136 mg/kg) Zinc (74 mg/kg)
SOU204-140	Copper (33 mg/kg) Vanadium (88 mg/kg)
SOU204-141	Copper (35 mg/kg) Vanadium (116 mg/kg)
SOU204-142	Copper (41 mg/kg) Vanadium (98 mg/kg)
SOU204-143	Copper (39 mg/kg) Vanadium (104 mg/kg)
SOU204-144	Copper (37 mg/kg) Vanadium (87 mg/kg)

Figure 5.6.6. AOC204 Background Exceedances—Subsurface Soil (Continued)

SOU204-145	Copper (30 mg/kg) Lead (64 mg/kg) Vanadium (85 mg/kg)
SOU204-146	Copper (28 mg/kg) Manganese (833 mg/kg) Vanadium (71 mg/kg)
SOU204-147	Copper (26 mg/kg) Vanadium (77 mg/kg)
SOU204-148	Copper (42 mg/kg) Iron (34918 mg/kg) Nickel (30 mg/kg) Vanadium (136 mg/kg) Zinc (109 mg/kg)
SOU204-149	Copper (35 mg/kg) Iron (35182 mg/kg) Vanadium (126 mg/kg) Zinc (67 mg/kg)
SOU204-150	Copper (30 mg/kg) Vanadium (74 mg/kg)
SOU204-151	Copper (35 mg/kg) Manganese (848 mg/kg) Vanadium (91 mg/kg)
SOU204-152	Copper (28 mg/kg) Iron (28469 mg/kg) Vanadium (106 mg/kg) Zinc (61 mg/kg)
SOU204-153	Calcium (44000 mg/kg) Copper (37 mg/kg) Vanadium (83 mg/kg) Uranium-235 (0.062 pCi/g) Uranium-238 (1.36 pCi/g)
SOU204-154	Calcium (6600 mg/kg) Copper (34 mg/kg) Manganese (1800 mg/kg) Selenium (1.1 mg/kg) Vanadium (98 mg/kg)
SOU204-155	Copper (35 mg/kg) Vanadium (93 mg/kg)
SOU204-156	Vanadium (93 mg/kg)
SOU204-157	Copper (29 mg/kg) Vanadium (86 mg/kg)
SOU204-158	Copper (36 mg/kg) Vanadium (89 mg/kg)
SOU204-159	Copper (36 mg/kg) Vanadium (106 mg/kg)
SOU204-160	Copper (35 mg/kg) Iron (29960 mg/kg) Vanadium (106 mg/kg) Zinc (67 mg/kg)
SOU204-161	Copper (32 mg/kg) Manganese (895 mg/kg) Vanadium (72 mg/kg)
SOU204-162	Copper (36 mg/kg) Manganese (990 mg/kg) Vanadium (75 mg/kg)
SOU204-163	Antimony (0.25 mg/kg) Arsenic (12 mg/kg) Copper (34 mg/kg) Lead (26 mg/kg) Manganese (1200 mg/kg) Selenium (1.2 mg/kg) Vanadium (97 mg/kg) Uranium-238 (1.25 pCi/g)
SOU204-164	Copper (36 mg/kg) Vanadium (101 mg/kg)
SOU204-165	Lead (65 mg/kg) Vanadium (110 mg/kg)
SOU204-166	Vanadium (90 mg/kg)
SOU204-167	Vanadium (107 mg/kg)
SOU204-168	Copper (35 mg/kg) Vanadium (82 mg/kg)
SOU204-169	Copper (38 mg/kg) Manganese (1131 mg/kg) Vanadium (87 mg/kg)
SOU204-170	Copper (37 mg/kg) Manganese (920 mg/kg) Vanadium (70 mg/kg)
SOU204-171	Copper (32 mg/kg) Selenium (0.82 mg/kg) Vanadium (103 mg/kg)
SOU204-172	Copper (34 mg/kg) Vanadium (104 mg/kg)
SOU204-173	Copper (38 mg/kg) Vanadium (109 mg/kg)
SOU204-174	Copper (31 mg/kg) Vanadium (97 mg/kg)
SOU204-175	Vanadium (109 mg/kg) Zinc (61 mg/kg)
SOU204-176	Copper (33 mg/kg) Vanadium (103 mg/kg) Zinc (65 mg/kg)
SOU204-177	Copper (37 mg/kg) Vanadium (121 mg/kg)
SOU204-178	Copper (37 mg/kg) Manganese (839 mg/kg) Vanadium (109 mg/kg)
SOU204-179	Copper (31 mg/kg) Vanadium (110 mg/kg)
SOU204-180	Antimony (0.46 mg/kg) Arsenic (14 mg/kg) Barium (350 mg/kg) Beryllium (1.4 mg/kg) Calcium (11000 mg/kg) Copper (31 mg/kg) Iron (46000 mg/kg) Nickel (29 mg/kg) Selenium (1.4 mg/kg) Silver (47 mg/kg) Sodium (480 mg/kg) Vanadium (105 mg/kg)
SOU204-181	Copper (37 mg/kg) Vanadium (120 mg/kg)
SOU204-182	Copper (44 mg/kg) Vanadium (113 mg/kg) Zinc (61 mg/kg)
SOU204-183	Copper (33 mg/kg) Vanadium (96 mg/kg) Zinc (72 mg/kg)
SOU204-184	Copper (40 mg/kg) Iron (32690 mg/kg) Manganese (1069 mg/kg) Vanadium (102 mg/kg)
SOU204-185	Calcium (15000 mg/kg) Copper (30 mg/kg) Magnesium (2500 mg/kg) Manganese (897 mg/kg) Selenium (0.94 mg/kg) Silver (89 mg/kg) Vanadium (94 mg/kg)
SOU204-186	Copper (30 mg/kg) Vanadium (67 mg/kg)

Figure 5.6.6. AOC204 Background Exceedances—Subsurface Soil (Continued)

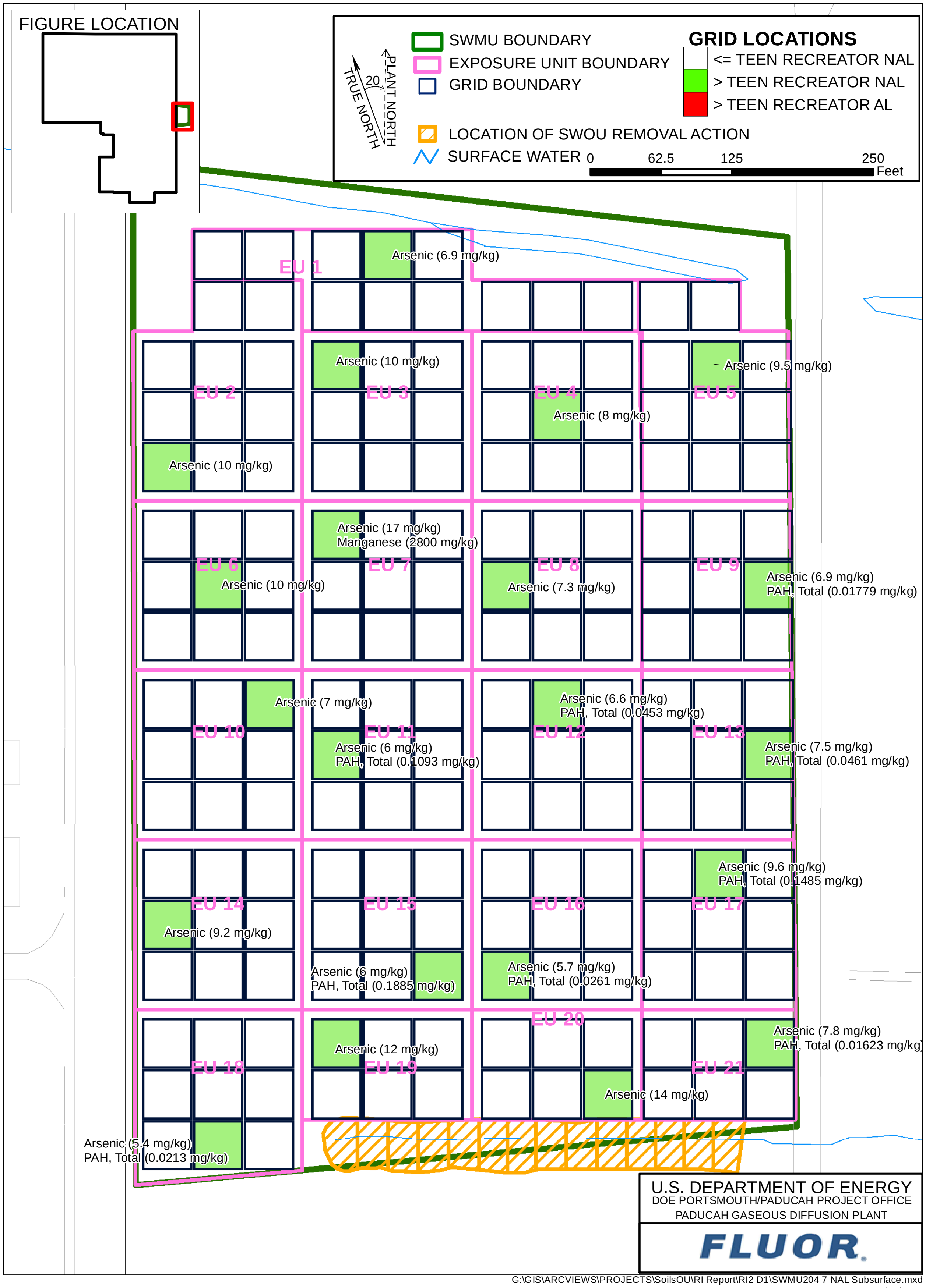

Figure 5.6.7. AOC 204 NAL Exceedances—Subsurface Soil

Metals

Arsenic [grid 19 (EU 3), grid 26 (EU 5), grid 35 (EU 4), grid 40 (EU 2), grid 55 (EU 7), grid 65 (EU 6), grid 134 (EU 17), grid 136 (EU 14), grid 163 (EU 19), and grid 180 (EU 20)] and manganese in grid 55 (EU 7) were detected above both the teen recreator NAL and background screening levels in the AOC 204 subsurface soil. The metals were detected above industrial worker NALs to a maximum depth of 4 ft bgs. No metals were detected above both the teen recreator ALs and background screening level.

The following metals were detected in the AOC 204 subsurface soils above both the background screening levels (if available) and the SSLs for the protection of UCRS groundwater.

Metal	Grid	EU
Antimony	19, 55, 180	3, 7, 20
Arsenic	19, 26, 35, 40, 55, 65, 134, 136, 163, 180	2–7, 14, 17, 19, 20
Barium	26, 55, 180	5, 7, 20
Cobalt	26, 55	5, 7
Copper	102	10
Iron	16, 40, 52, 64, 76, 79, 84, 85, 87, 88, 100, 102, 103, 113, 136, 137, 138, 139, 148, 149, 152, 160, 180, 184	2, 6–11, 14, 15, 18, 20
Lead	37, 52, 66, 77, 78, 145, 163, 165	5, 6, 17, 19
Manganese	5, 14, 18, 19, 25–28, 41, 44, 46, 51, 55, 59, 60, 65, 70, 71, 74, 75, 78, 80, 82, 83, 84, 86, 87, 105, 107, 117–122, 129, 146, 151, 154, 161, 162, 163, 169, 170, 178, 184, 185	1–9, 11–13, 15–21
Molybdenum[1]	4, 8, 19, 20, 26, 35, 40, 49, 52, 53, 55, 65, 70, 74, 75, 84, 86, 90, 95, 97, 103, 107, 111, 113, 127, 130, 134, 136, 153, 154, 156, 163, 171, 180, 182, 185	1–21
Nickel	28, 148, 180	2, 14, 20
Selenium	4, 19, 26, 35, 40, 55, 65, 70, 75, 90, 95, 103, 111, 134, 136, 154, 163, 171, 180, 185	1–14, 16–21
Silver	9, 43, 80, 132, 180, 185	1, 3, 7, 16, 18, 20
Vanadium	1–186	1–21
Zinc	1, 8, 31, 40, 85, 88, 90–94, 100, 102, 103, 139, 148, 149, 152, 160, 175, 176, 182, 183	1, 2, 3, 9–12, 14, 15, 18, 19, 21

[1] No soil background value is available.

For the protection of RGA groundwater, the following metals were detected in the AOC 204 surface soil above both the SSLs and background screening levels (if available).

Metal	Grid	EU
Arsenic	55	7
Cobalt	26, 55	5, 7
Iron	16, 40, 52, 64, 76, 79, 84, 85, 87, 88, 100, 102, 103, 113, 136, 137, 138, 139, 148, 149, 152, 160, 180, 184	2, 6–11, 14, 15, 18, 20
Manganese	5, 14, 18, 19, 25–28, 41, 44, 46, 51, 55, 59, 60, 65, 70, 71, 74, 75, 78, 80, 82, 83, 84, 86, 87, 105, 107, 117–122, 129, 146, 151, 154, 161, 162, 163, 169, 170, 178, 184, 185	1–9, 11–13, 15–21
Molybdenum[1]	4, 8, 20, 49, 52, 53, 74, 84, 86, 97, 107, 113, 127, 130, 156, 182	1, 3, 5, 6, 8–10, 12, 13, 15, 16, 21
Silver	9, 43, 80, 132, 180, 185	1, 3, 7, 16, 18, 20

[1] No soil background value is available.

PCBs

Total PCBs were not detected above any screening levels in the AOC 204 subsurface soils.

SVOCs

Total PAHs were detected above teen recreator NALs in the subsurface soil in grids 75 (EU 9), 95 (EU 12), 103 (EU 11), 111 (EU 13), 134 (EU 17), 153 (EU 15), 154 (EU 16), 171 (EU 21), and 185 (EU 18). The SVOCs were detected above industrial worker NALs to a maximum depth of 4 ft bgs. No SVOCs were detected in the AOC 204 subsurface soil above teen recreator ALs.

Of the SVOCs, phenanthrene [grids 75 (EU 9) and 153 (EU 15)] was detected above the SSLs for the protection of UCRS groundwater. None were detected above the SSLs for the protection of RGA groundwater.

VOCs

No VOCs were detected above teen recreator NALs or ALs in AOC 204 subsurface soils. TCE in grid 178 (EU 20) and toluene in grids 4 (EU 1), 26 (EU 5), 40 (EU 2), 95 (EU 12), 134 (EU 17), 153 (EU 15), 171 (EU 21), and 185 (EU 18) were detected above the SSL for the protection of UCRS groundwater. No VOCs were detected above the SSLs for protection of RGA groundwater.

Radionuclides

No radionuclides were detected above both the background screening levels and the recreator NALs or ALs in AOC 204 subsurface soils.

Uranium-235 [grids 4 (EU 1), 19 (EU 3), 26 (EU 5), 40 (EU 2), 65 (EU 6), 70 (EU 8), 75 (EU 9), 90 (EU 10), 95 (EU 12), 103 (EU 11), 136 (EU 14), and 153 (EU 15)] and uranium-238 [grids 19 (EU 3), 103 (EU 11), 136 (EU 14), 153 (EU 15), and 163 (EU 19)] were detected above both the background screening levels (if available) and SSLs for the protection of UCRS groundwater. None were detected above both the background screening levels and SSLs for the protection of RGA groundwater.

5.6.5 Fate and Transport

No target chemicals were identified for further evaluation under fate and transport (Chapter 4). There is potential for runoff because this AOC is between Outfall 010 to the north and Outfall 011 to the south; however, AOC 204 is grass-covered or otherwise stabilized, and the contaminants are not likely to be transported attached to suspended soil particles. The SE Report for Outfalls 010, 011, and 012 concluded that TCE and PCBs are not migrating from AOC 204 (DOE 1995b).

5.6.6 Baseline Risk Assessment

Human Health. Potential risks and hazards for current/future human health for AOC 204 were evaluated for each of 21 EUs (~ 0.5 acres each) for direct contact. These results are summarized in Appendix D and in the subsections that follow, including the COCs and relative contributions to the overall ELCR/HI.

The cumulative ELCR and the cumulative HI for one or more EUs at AOC 204 exceed the benchmarks of cumulative ELCR of 1E-06 and cumulative HI greater than 1, respectively, for one or more scenarios; therefore, as stated in the Work Plan, Decision Rule D1a, (DOE 2010a), this AOC will be evaluated in the

FS. As described in the BHHRA (Appendix D), COCs were identified after considering the results of the risk characterization and the uncertainties affecting the results.

COCs were identified as those COPCs considered to contribute at least 1E-06 ELCR or 0.1 HI to a scenario of concern. The basis for COC identification is presented in Appendix D. The identified COCs considered to contribute to the ELCR/HI, the EPC, and the RGOs calculated for a range of ELCR/HI benchmarks are presented in Table 5.6.3 for the teen recreational user, excavation worker, outdoor worker exposed to surface soil, and the hypothetical resident. Table 5.6.3 also compares the EPC to the RGO for each COC under each exposure scenario. Table 5.6.3 summarizes the ELCR/HI posed by the COCs for this SWMU under each exposure scenario by depicting the maximum ELCR/HI contribution per COC.

Table 5.6.3. RGOs for AOC 204

					RGOs for ELCR[3]				RGOs for HI[3]		
EU	**COC**	**EPC[1]**	**Units**	**ELCR[2]**	**1E-06**	**1E-05**	**1E-04**	**HI[4]**	**0.1**	**1**	**3**
					Teen Recreational User						
1	PAH, Total	4.93E-01	mg/kg	9.8E-06	5.03E-02	5.03E-01	5.03E+00	N/A	N/A	N/A	N/A
1	**Cumulative**			**1.0E-05**				**< 1**			
2	Arsenic	4.59E+01	mg/kg	7.5E-05	6.14E-01	6.14E+00	6.14E+01	< 0.1	N/A	N/A	N/A
2	PAH, Total	6.20E-02	mg/kg	1.2E-06	5.03E-02	5.03E-01	5.03E+00	N/A	N/A	N/A	N/A
2	Uranium-238	3.92E+00	pCi/g	1.2E-06	3.29E+00	3.29E+01	3.29E+02	N/A	N/A	N/A	N/A
2	**Cumulative**			**7.7E-05**				**< 1**			
3	**Cumulative**			**1.4E-06**				**< 1**			
4	**Cumulative**			**1.0E-06**				**< 1**			
5	Arsenic	5.67E+01	mg/kg	9.2E-05	6.14E-01	6.14E+00	6.14E+01	< 0.1	N/A	N/A	N/A
5	Uranium-238	5.65E+00	pCi/g	1.7E-06	3.29E+00	3.29E+01	3.29E+02	N/A	N/A	N/A	N/A
5	**Cumulative**			**9.5E-05**				**< 1**			
6	Uranium-238	3.63E+00	pCi/g	1.1E-06	3.29E+00	3.29E+01	3.29E+02	N/A	N/A	N/A	N/A
6	**Cumulative**			**1.7E-06**				**< 1**			
7	**Cumulative**			**< 1.0E-06**				**< 1**			
8	PAH, Total	7.37E-02	mg/kg	1.5E-06	5.03E-02	5.03E-01	5.03E+00	N/A	N/A	N/A	N/A
8	**Cumulative**			**2.1E-06**				**< 1**			
9	PAH, Total	5.01E+00	mg/kg	1.0E-04	5.03E-02	5.03E-01	5.03E+00	N/A	N/A	N/A	N/A
9	**Cumulative**			**1.0E-04**				**< 1**			
10	PAH, Total	6.42E-02	mg/kg	1.3E-06	5.03E-02	5.03E-01	5.03E+00	N/A	N/A	N/A	N/A
10	**Cumulative**			**2.2E-06**				**< 1**			
11	PAH, Total	8.95E-02	mg/kg	1.8E-06	5.03E-02	5.03E-01	5.03E+00	N/A	N/A	N/A	N/A
11	**Cumulative**			**2.7E-06**				**< 1**			
12	PAH, Total	6.43E-02	mg/kg	1.3E-06	5.03E-02	5.03E-01	5.03E+00	N/A	N/A	N/A	N/A
12	**Cumulative**			**2.3E-06**				**< 1**			
13	PAH, Total	5.05E-01	mg/kg	1.0E-05	5.03E-02	5.03E-01	5.03E+00	N/A	N/A	N/A	N/A
13	**Cumulative**			**1.1E-05**				**< 1**			
14	Arsenic	1.36E+02	mg/kg	2.2E-04	6.14E-01	6.14E+00	6.14E+01	1.3	1.03E+01	1.03E+02	3.10E+02
14	PAH, Total	1.28E-01	mg/kg	2.5E-06	5.03E-02	5.03E-01	5.03E+00	N/A	N/A	N/A	N/A
14	Uranium-238	4.25E+00	pCi/g	1.3E-06	3.29E+00	3.29E+01	3.29E+02	N/A	N/A	N/A	N/A
14	**Cumulative**			**2.2E-04**				**1.4**			

Table 5.6.3. RGOs for AOC 204 (Continued)

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3]			HI[4]	RGOs for HI[3]		
					1E-06	1E-05	1E-04		0.1	1	3
Teen Recreational User (Continued)											
15	Cesium-137	6.30E-01	pCi/g	2.3E-06	2.79E-01	2.79E+00	2.79E+01	N/A	N/A	N/A	N/A
15	Uranium-238	5.37E+00	pCi/g	1.6E-06	3.29E+00	3.29E+01	3.29E+02	N/A	N/A	N/A	N/A
15	**Cumulative**			**4.1E-06**				**< 1**			
16	**Cumulative**			**< 1.0E-06**				**< 1**			
17	PAH, Total	5.99E-02	mg/kg	1.2E-06	5.03E-02	5.03E-01	5.03E+00	N/A	N/A	N/A	N/A
17	**Cumulative**			**2.0E-06**				**< 1**			
18	**Cumulative**			**< 1.0E-06**				**< 1**			
19	PAH, Total	1.30E-01	mg/kg	2.6E-06	5.03E-02	5.03E-01	5.03E+00	N/A	N/A	N/A	N/A
19	**Cumulative**			**3.4E-06**				**< 1**			
20	PCB, Total	7.90E+01	mg/kg	4.6E-04	1.73E-01	1.73E+00	1.73E+01	N/A	N/A	N/A	N/A
20	Uranium	1.31E+04	mg/kg	N/A	N/A	N/A	N/A	3.9	3.34E+02	3.34E+03	1.00E+04
20	Cesium-137	1.17E+00	pCi/g	4.2E-06	2.79E-01	2.79E+00	2.79E+01	N/A	N/A	N/A	N/A
20	Protactinium-231	3.65E+01	pCi/g	1.3E-05	2.76E+00	2.76E+01	2.76E+02	N/A	N/A	N/A	N/A
20	Uranium-234	4.45E+02	pCi/g	2.8E-05	1.61E+01	1.61E+02	1.61E+03	N/A	N/A	N/A	N/A
20	Uranium-235	5.70E+01	pCi/g	6.5E-05	8.75E-01	8.75E+00	8.75E+01	N/A	N/A	N/A	N/A
20	Uranium-238	4.39E+03	pCi/g	1.3E-03	3.29E+00	3.29E+01	3.29E+02	N/A	N/A	N/A	N/A
20	**Cumulative**			**1.9E-03**				**3.9**			
21	**Cumulative**			**< 1.0E-06**				**< 1**			
Excavation Worker											
1	PAH, Total	4.93E-01	mg/kg	1.5E-06	3.25E-01	3.25E+00	3.25E+01	< 0.1	N/A	N/A	N/A
1	**Cumulative**			**1.8E-06**				**< 1**			
2	Arsenic	4.59E+01	mg/kg	1.8E-05	2.52E+00	2.52E+01	2.52E+02	0.6	8.09E+00	8.09E+01	2.43E+02
2	**Cumulative**			**1.9E-05**				**< 1**			
3	Arsenic	1.10E+01	mg/kg	4.4E-06	2.52E+00	2.52E+01	2.52E+02	0.1	8.09E+00	8.09E+01	2.43E+02
3	**Cumulative**			**4.9E-06**				**< 1**			
4	Arsenic	1.10E+01	mg/kg	4.4E-06	2.52E+00	2.52E+01	2.52E+02	0.1	8.09E+00	8.09E+01	2.43E+02
4	**Cumulative**			**4.7E-06**				**< 1**			
5	Arsenic	5.67E+01	mg/kg	2.2E-05	2.52E+00	2.52E+01	2.52E+02	0.7	8.09E+00	8.09E+01	2.43E+02
5	Cobalt	1.04E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	9.82E+00	9.82E+01	2.95E+02
5	Manganese	9.75E+02	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	7.57E+02	7.57E+03	2.27E+04
5	Uranium-238	6.60E+00	pCi/g	1.1E-06	5.95E+00	5.95E+01	5.95E+02	N/A	N/A	N/A	N/A
5	**Cumulative**			**2.4E-05**				**1.0**			

Table 5.6.3. RGOs for AOC 204 (Continued)

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3] 1E-06	1E-05	1E-04	HI[4]	RGOs for HI[3] 0.1	1	3
Excavation Worker (Continued)											
6	Arsenic	1.00E+01	mg/kg	4.0E-06	2.52E+00	2.52E+01	2.52E+02	0.1	8.09E+00	8.09E+01	2.43E+02
6	**Cumulative**			**4.7E-06**				**< 1**			
7	Arsenic	1.70E+01	mg/kg	6.7E-06	2.52E+00	2.52E+01	2.52E+02	0.2	8.09E+00	8.09E+01	2.43E+02
7	**Cumulative**			**7.1E-06**				**< 1**			
8	Arsenic	8.40E+00	mg/kg	3.3E-06	2.52E+00	2.52E+01	2.52E+02	0.1	8.09E+00	8.09E+01	2.43E+02
8	**Cumulative**			**3.9E-06**				**< 1**			
9	Arsenic	8.40E+00	mg/kg	3.3E-06	2.52E+00	2.52E+01	2.52E+02	0.1	8.09E+00	8.09E+01	2.43E+02
9	PAH, Total	5.01E+00	mg/kg	1.5E-05	3.25E-01	3.25E+00	3.25E+01	< 0.1	N/A	N/A	N/A
9	**Cumulative**			**1.9E-05**				**< 1**			
10	**Cumulative**			**1.2E-06**				**< 1**			
11	Arsenic	8.80E+00	mg/kg	3.5E-06	2.52E+00	2.52E+01	2.52E+02	0.1	8.09E+00	8.09E+01	2.43E+02
11	**Cumulative**			**4.3E-06**				**< 1**			
12	Arsenic	9.80E+00	mg/kg	3.9E-06	2.52E+00	2.52E+01	2.52E+02	0.1	8.09E+00	8.09E+01	2.43E+02
12	**Cumulative**			**5.1E-06**				**< 1**			
13	Arsenic	8.60E+00	mg/kg	3.4E-06	2.52E+00	2.52E+01	2.52E+02	0.1	8.09E+00	8.09E+01	2.43E+02
13	PAH, Total	5.05E-01	mg/kg	1.6E-06	3.25E-01	3.25E+00	3.25E+01	< 0.1	N/A	N/A	N/A
13	**Cumulative**			**5.9E-06**				**< 1**			
14	Arsenic	1.36E+02	mg/kg	5.4E-05	2.52E+00	2.52E+01	2.52E+02	1.7	8.09E+00	8.09E+01	2.43E+02
14	Iron	3.52E+04	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.2	2.30E+04	2.30E+05	6.91E+05
14	Manganese	8.21E+02	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	7.57E+02	7.57E+03	2.27E+04
14	Uranium	1.34E+02	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	9.80E+01	9.80E+02	2.94E+03
14	**Cumulative**			**5.5E-05**				**2.2**			
15	Cesium-137	6.30E-01	pCi/g	1.0E-06	6.12E-01	6.12E+00	6.12E+01	N/A	N/A	N/A	N/A
15	**Cumulative**			**2.5E-06**				**< 1**			
16	Arsenic	8.20E+00	mg/kg	3.3E-06	2.52E+00	2.52E+01	2.52E+02	0.1	8.09E+00	8.09E+01	2.43E+02
16	**Cumulative**			**3.3E-06**				**< 1**			
17	Arsenic	9.60E+00	mg/kg	3.8E-06	2.52E+00	2.52E+01	2.52E+02	0.1	8.09E+00	8.09E+01	2.43E+02
17	**Cumulative**			**4.7E-06**				**< 1**			
18	**Cumulative**			**< 1.0E-06**				**< 1**			
19	Arsenic	1.20E+01	mg/kg	4.8E-06	2.52E+00	2.52E+01	2.52E+02	0.1	8.09E+00	8.09E+01	2.43E+02
19	**Cumulative**			**5.6E-06**				**< 1**			

Table 5.6.3. RGOs for AOC 204 (Continued)

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3]			HI[4]	RGOs for HI[3]		
					1E-06	1E-05	1E-04		0.1	1	3
Excavation Worker (Continued)											
20	Arsenic	1.40E+01	mg/kg	5.6E-06	2.52E+00	2.52E+01	2.52E+02	0.2	8.09E+00	8.09E+01	2.43E+02
20	Cobalt	1.30E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	9.82E+00	9.82E+01	2.95E+02
20	Iron	4.60E+04	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.2	2.30E+04	2.30E+05	6.91E+05
20	Manganese	8.39E+02	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	7.57E+02	7.57E+03	2.27E+04
20	PCB, Total	7.90E+01	mg/kg	6.9E-05	1.14E+00	1.14E+01	1.14E+02	< 0.1	N/A	N/A	N/A
20	Uranium	1.31E+04	mg/kg	< 1.0E-06	N/A	N/A	N/A	13.3	9.80E+01	9.80E+02	2.94E+03
20	Cesium-137	1.17E+00	pCi/g	1.9E-06	6.12E-01	6.12E+00	6.12E+01	N/A	N/A	N/A	N/A
20	Protactinium-231	3.65E+01	pCi/g	8.0E-06	4.57E+00	4.57E+01	4.57E+02	N/A	N/A	N/A	N/A
20	Uranium-234	4.45E+02	pCi/g	2.9E-05	1.51E+01	1.51E+02	1.51E+03	N/A	N/A	N/A	N/A
20	Uranium-235	5.70E+01	pCi/g	2.6E-05	2.18E+00	2.18E+01	2.18E+02	N/A	N/A	N/A	N/A
20	Uranium-238	4.39E+03	pCi/g	7.4E-04	5.95E+00	5.95E+01	5.95E+02	N/A	N/A	N/A	N/A
20	**Cumulative**			**8.8E-04**				**14.1**			
21	Arsenic	8.60E+00	mg/kg	3.4E-06	2.52E+00	2.52E+01	2.52E+02	0.1	8.09E+00	8.09E+01	2.43E+02
21	**Cumulative**			**3.5E-06**				**< 1**			
Outdoor Worker (exposed to surface soil)											
1	PAH, Total	4.93E-01	mg/kg	7.6E-06	6.50E-02	6.50E-01	6.50E+00	< 0.1	N/A	N/A	N/A
1	Uranium-238	1.27E+00	pCi/g	1.1E-06	1.19E+00	1.19E+01	1.19E+02	N/A	N/A	N/A	N/A
1	**Cumulative**			**8.7E-06**				**< 1**			
2	Arsenic	4.59E+01	mg/kg	9.1E-05	5.04E-01	5.04E+00	5.04E+01	0.6	8.09E+00	8.09E+01	2.43E+02
2	Uranium-238	3.92E+00	pCi/g	3.3E-06	1.19E+00	1.19E+01	1.19E+02	N/A	N/A	N/A	N/A
2	**Cumulative**			**9.5E-05**				**< 1**			
3	Uranium-238	2.31E+00	pCi/g	1.9E-06	1.19E+00	1.19E+01	1.19E+02	N/A	N/A	N/A	N/A
3	**Cumulative**			**2.5E-06**				**< 1**			
4	Uranium-238	1.82E+00	pCi/g	1.5E-06	1.19E+00	1.19E+01	1.19E+02	N/A	N/A	N/A	N/A
4	**Cumulative**			**1.9E-06**				**< 1**			
5	Arsenic	5.67E+01	mg/kg	1.1E-04	5.04E-01	5.04E+00	5.04E+01	0.7	8.09E+00	8.09E+01	2.43E+02
5	Uranium-238	5.65E+00	pCi/g	4.7E-06	1.19E+00	1.19E+01	1.19E+02	N/A	N/A	N/A	N/A
5	**Cumulative**			**1.2E-04**				**< 1**			
6	Uranium-238	3.63E+00	pCi/g	3.1E-06	1.19E+00	1.19E+01	1.19E+02	N/A	N/A	N/A	N/A
6	**Cumulative**			**3.6E-06**				**< 1**			

Table 5.6.3. RGOs for AOC 204 (Continued)

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3] 1E-06	1E-05	1E-04	HI[4]	RGOs for HI[3] 0.1	1	3
Outdoor Worker (exposed to surface soil) (Continued)											
7	Uranium-238	2.04E+00	pCi/g	1.7E-06	1.19E+00	1.19E+01	1.19E+02	N/A	N/A	N/A	N/A
7	**Cumulative**			**1.9E-06**				**< 1**			
8	PAH, Total	7.37E-02	mg/kg	1.1E-06	6.50E-02	6.50E-01	6.50E+00	< 0.1	N/A	N/A	N/A
8	Uranium-238	2.01E+00	pCi/g	1.7E-06	1.19E+00	1.19E+01	1.19E+02	N/A	N/A	N/A	N/A
8	**Cumulative**			**2.8E-06**				**< 1**			
9	PAH, Total	5.01E+00	mg/kg	7.7E-05	6.50E-02	6.50E-01	6.50E+00	< 0.1	N/A	N/A	N/A
9	Uranium-238	2.22E+00	pCi/g	1.9E-06	1.19E+00	1.19E+01	1.19E+02	N/A	N/A	N/A	N/A
9	**Cumulative**			**7.9E-05**				**< 1**			
10	Uranium-238	3.15E+00	pCi/g	2.6E-06	1.19E+00	1.19E+01	1.19E+02	N/A	N/A	N/A	N/A
10	**Cumulative**			**3.6E-06**				**< 1**			
11	PAH, Total	8.95E-02	mg/kg	1.4E-06	6.50E-02	6.50E-01	6.50E+00	< 0.1	N/A	N/A	N/A
11	Uranium-238	3.09E+00	pCi/g	2.6E-06	1.19E+00	1.19E+01	1.19E+02	N/A	N/A	N/A	N/A
11	**Cumulative**			**4.0E-06**				**< 1**			
12	Uranium-238	3.26E+00	pCi/g	2.7E-06	1.19E+00	1.19E+01	1.19E+02	N/A	N/A	N/A	N/A
12	**Cumulative**			**3.7E-06**				**< 1**			
13	PAH, Total	5.05E-01	mg/kg	7.8E-06	6.50E-02	6.50E-01	6.50E+00	< 0.1	N/A	N/A	N/A
13	Uranium-238	2.98E+00	pCi/g	2.5E-06	1.19E+00	1.19E+01	1.19E+02	N/A	N/A	N/A	N/A
13	**Cumulative**			**1.0E-05**				**< 1**			
14	Arsenic	1.36E+02	mg/kg	2.7E-04	5.04E-01	5.04E+00	5.04E+01	1.7	8.09E+00	8.09E+01	2.43E+02
14	Iron	3.17E+04	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	2.30E+04	2.30E+05	6.91E+05
14	PAH, Total	1.28E-01	mg/kg	2.0E-06	6.50E-02	6.50E-01	6.50E+00	< 0.1	N/A	N/A	N/A
14	Uranium	1.34E+02	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.1	9.80E+01	9.80E+02	2.94E+03
14	Uranium-238	4.25E+00	pCi/g	3.6E-06	1.19E+00	1.19E+01	1.19E+02	N/A	N/A	N/A	N/A
14	**Cumulative**			**2.8E-04**				**2.1**			
15	Cesium-137	6.30E-01	pCi/g	4.1E-06	1.52E-01	1.52E+00	1.52E+01	N/A	N/A	N/A	N/A
15	Uranium-238	5.37E+00	pCi/g	4.5E-06	1.19E+00	1.19E+01	1.19E+02	N/A	N/A	N/A	N/A
15	**Cumulative**			**8.9E-06**				**< 1**			
16	**Cumulative**			**< 1.0E-06**				**< 1**			
17	Uranium-238	2.50E+00	pCi/g	2.1E-06	1.19E+00	1.19E+01	1.19E+02	N/A	N/A	N/A	N/A
17	**Cumulative**			**3.0E-06**				**< 1**			

Table 5.6.3. RGOs for AOC 204 (Continued)

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3]			HI[4]	RGOs for HI[3]		
					1E-06	1E-05	1E-04		0.1	1	3
Outdoor Worker (exposed to surface soil) (Continued)											
18	Uranium-238	1.81E+00	pCi/g	1.5E-06	1.19E+00	1.19E+01	1.19E+02	N/A	N/A	N/A	N/A
18	**Cumulative**			**1.6E-06**				**< 1**			
19	PAH, Total	1.30E-01	mg/kg	2.0E-06	6.50E-02	6.50E-01	6.50E+00	< 0.1	N/A	N/A	N/A
19	Uranium-238	2.65E+00	pCi/g	2.2E-06	1.19E+00	1.19E+01	1.19E+02	N/A	N/A	N/A	N/A
19	**Cumulative**			**4.2E-06**				**< 1**			
20	PCB, Total	7.90E+01	mg/kg	3.5E-04	2.29E-01	2.29E+00	2.29E+01	< 0.1	N/A	N/A	N/A
20	Uranium	1.31E+04	mg/kg	< 1.0E-06	N/A	N/A	N/A	13.3	9.80E+01	9.80E+02	2.94E+03
20	Americium-241	3.71E+00	pCi/g	1.8E-06	2.02E+00	2.02E+01	2.02E+02	N/A	N/A	N/A	N/A
20	Cesium-137	1.17E+00	pCi/g	7.7E-06	1.52E-01	1.52E+00	1.52E+01	N/A	N/A	N/A	N/A
20	Protactinium-231	3.65E+01	pCi/g	4.0E-05	9.13E-01	9.13E+00	9.13E+01	N/A	N/A	N/A	N/A
20	Uranium-234	4.45E+02	pCi/g	1.5E-04	3.02E+00	3.02E+01	3.02E+02	N/A	N/A	N/A	N/A
20	Uranium-235	5.70E+01	pCi/g	1.3E-04	4.37E-01	4.37E+00	4.37E+01	N/A	N/A	N/A	N/A
20	Uranium-238	4.39E+03	pCi/g	3.7E-03	1.19E+00	1.19E+01	1.19E+02	N/A	N/A	N/A	N/A
20	**Cumulative**			**4.4E-03**				**13.4**			
Hypothetical Resident[5]											
1	PAH, Total	4.93E-01	mg/kg	2.20E-05	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
1	Uranium-238	1.27E+00	pCi/g	2.60E-06	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
1	**Cumulative**			**2.4E-05**				**< 1**			
2	Arsenic	4.59E+01	mg/kg	1.70E-04	2.67E-01	2.67E+00	2.67E+01	2.7	1.67E+00	1.67E+01	5.01E+01
2	PAH, Total	6.20E-02	mg/kg	2.70E-06	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
2	Vanadium	1.20E+02	mg/kg	N/A	N/A	N/A	N/A	0.3	3.93E+01	3.93E+02	1.18E+03
2	Uranium-238	3.92E+00	pCi/g	7.9E-06	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
2	**Cumulative**			**1.8E-04**				**3.1**			
3	PAH, Total	3.52E-02	mg/kg	1.60E-06	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
3	Uranium-238	2.31E+00	pCi/g	4.60E-06	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
3	**Cumulative**			**6.2E-06**				**< 1**			
4	Iron	2.92E+04	mg/kg	N/A	N/A	N/A	N/A	0.5	5.48E+03	5.48E+04	1.64E+05
4	Molybdenum	4.10E+01	mg/kg	N/A	N/A	N/A	N/A	0.1	3.91E+01	3.91E+02	1.17E+03
4	PAH, Total	2.33E-02	mg/kg	1.0E-06	2.27E-02	2.27E-01	2.27E+00				
4	Silver	5.90E+01	mg/kg	N/A	N/A	N/A	N/A	0.2	3.91E+01	3.91E+02	1.17E+03
4	Vanadium	1.39E+02	mg/kg	N/A	N/A	N/A	N/A	0.4	3.93E+01	3.93E+02	1.18E+03
4	Uranium-238	1.82E+00	pCi/g	3.6E-06	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
4	**Cumulative**			**4.7E-06**				**1.1**			

Table 5.6.3. RGOs for AOC 204 (Continued)

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3]			HI[4]	RGOs for HI[3]		
					1E-06	1E-05	1E-04		0.1	1	3
Hypothetical Resident[5] (Continued)											
5	Arsenic	5.67E+01	mg/kg	2.10E-04	2.67E-01	2.67E+00	2.67E+01	3.4	1.67E+00	1.67E+01	5.01E+01
5	Vanadium	1.21E+02	mg/kg	N/A	N/A	N/A	N/A	0.3	3.93E+01	3.93E+02	1.18E+03
5	Uranium-238	5.65E+00	pCi/g	1.1E-05	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
5	**Cumulative**			**2.3E-04**				**3.7**			
6	PAH, Total	3.25E-02	mg/kg	1.40E-06	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
6	Uranium-238	3.63E+00	pCi/g	7.30E-06	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
6	**Cumulative**			**8.7E-06**				**< 1**			
7	Iron	2.95E+04	mg/kg	N/A	N/A	N/A	N/A	0.5	5.47E+03	5.48E+04	1.64E+05
7	Manganese	1.94E+03	mg/kg	N/A	N/A	N/A	N/A	1.1	1.82E+02	1.82E+03	5.47E+03
7	Vanadium	1.27E+02	mg/kg	N/A	N/A	N/A	N/A	0.3	3.93E+01	3.93E+02	1.18E+03
7	Uranium-238	2.04E+00	pCi/g	4.1E-06	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
7	**Cumulative**			**4.5E-06**				**1.9**			
8	Cobalt	1.40E+01	mg/kg	N/A	N/A	N/A	N/A	0.6	2.34E+00	2.34E+01	7.02E+01
8	Iron	2.94E+04	mg/kg	N/A	N/A	N/A	N/A	0.5	5.47E+03	5.48E+04	1.64E+05
8	PAH, Total	7.37E-02	mg/kg	3.2E-06	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
8	Vanadium	1.32E+02	mg/kg	N/A	N/A	N/A	N/A	0.3	3.93E+01	3.93E+02	1.18E+03
8	Uranium-238	2.01E+00	pCi/g	4.0E-06	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
8	**Cumulative**			**7.3E-06**				**1.5**			
9	PAH, Total	5.01E+00	mg/kg	2.20E-04	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
9	Uranium-238	2.22E+00	pCi/g	4.50E-06	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
9	**Cumulative**			**2.3E-04**				**< 1**			
10	Antimony	1.20E+01	mg/kg	N/A	N/A	N/A	N/A	0.4	3.13E+00	3.13E+01	9.39E+01
10	Iron	3.08E+04	mg/kg	N/A	N/A	N/A	N/A	0.6	5.47E+03	5.48E+04	1.64E+05
10	PAH, Total	6.42E-02	mg/kg	2.8E-06	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
10	Vanadium	1.19E+02	mg/kg	N/A	N/A	N/A	N/A	0.3	3.93E+01	3.93E+02	1.18E+03
10	Uranium-238	3.15E+00	pCi/g	6.3E-06	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
10	**Cumulative**			**9.2E-06**				**1.2**			
11	PAH, Total	8.95E-02	mg/kg	3.90E-06	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
11	Uranium-238	3.09E+00	pCi/g	6.20E-06	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
11	**Cumulative**			**1.0E-05**				**< 1**			

Table 5.6.3. RGOs for AOC 204 (Continued)

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3]			HI[4]	RGOs for HI[3]		
					1E-06	1E-05	1E-04		0.1	1	3
Hypothetical Resident[5] (Continued)											
12	Iron	2.86E+04	mg/kg	N/A	N/A	N/A	N/A	0.5	5.47E+03	5.48E+04	1.64E+05
12	PAH, Total	6.43E-02	mg/kg	2.8E-06	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
12	Thallium	2.10E-01	mg/kg	N/A	N/A	N/A	N/A	0.3	7.82E-02	7.82E-01	2.35E+00
12	Vanadium	1.44E+02	mg/kg	N/A	N/A	N/A	N/A	0.4	3.93E+01	3.93E+02	1.18E+03
12	Uranium-238	3.26E+00	pCi/g	6.5E-06	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
12	**Cumulative**			**9.4E-06**				**1.2**			
13	PAH, Total	5.05E-01	mg/kg	2.20E-05	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
13	Uranium-238	2.98E+00	pCi/g	6.00E-06	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
13	**Cumulative**			**2.8E-05**				**< 1**			
14	Arsenic	1.36E+02	mg/kg	5.10E-04	2.67E-01	2.67E+00	2.67E+01	8.1	1.67E+00	1.67E+01	5.01E+01
14	Iron	3.17E+04	mg/kg	N/A	N/A	N/A	N/A	0.6	5.47E+03	5.48E+04	1.64E+05
14	PAH, Total	1.28E-01	mg/kg	5.6E-06	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
14	Uranium	1.34E+02	mg/kg	N/A	N/A	N/A	N/A	0.6	2.34E+01	2.34E+02	7.01E+02
14	Vanadium	1.43E+02	mg/kg	N/A	N/A	N/A	N/A	0.4	3.93E+01	3.93E+02	1.18E+03
14	Uranium-238	4.25E+00	pCi/g	8.5E-06	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
14	**Cumulative**			**5.2E-04**				**9.7**			
15	Cesium-137	6.30E-01	pCi/g	1.80E-05	3.51E-02	3.51E-01	3.51E+00	N/A	N/A	N/A	N/A
15	Uranium-238	5.37E+00	pCi/g	1.10E-05	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
15	**Cumulative**			**2.9E-05**				**< 1**			
16	**Cumulative**			**< 1.0E-06**				**< 1**			
17	PAH, Total	5.99E-02	mg/kg	2.60E-06	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
17	Uranium-238	2.50E+00	pCi/g	5.00E-06	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
17	**Cumulative**			**7.7E-06**				**< 1**			
18	Iron	3.35E+04	mg/kg	N/A	N/A	N/A	N/A	0.6	5.47E+03	5.48E+04	1.64E+05
18	Uranium	1.09E+02	mg/kg	N/A	N/A	N/A	N/A	0.5	2.34E+01	2.34E+02	7.01E+02
18	Vanadium	1.51E+02	mg/kg	N/A	N/A	N/A	N/A	0.4	3.93E+01	3.93E+02	1.18E+03
18	Uranium-238	1.81E+00	pCi/g	3.6E-06	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
18	**Cumulative**			**3.9E-06**				**1.5**			
19	PAH, Total	1.30E-01	mg/kg	5.70E-06	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
19	Uranium-238	2.65E+00	pCi/g	5.30E-06	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
19	**Cumulative**			**1.1E-05**				**< 1**			

Table 5.6.3. RGOs for AOC 204 (Continued)

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3]			HI[4]	RGOs for HI[3]		
					1E-06	1E-05	1E-04		0.1	1	3
Hypothetical Resident[5] (Continued)											
20	PCB, Total	7.90E+01	mg/kg	1.00E-03	7.82E-02	7.82E-01	7.82E+00	N/A	N/A	N/A	N/A
20	Uranium	1.31E+04	mg/kg	N/A	N/A	N/A	N/A	56	2.34E+01	2.34E+02	7.01E+02
20	Vanadium	1.14E+02	mg/kg	N/A	N/A	N/A	N/A	0.3	3.93E+01	3.93E+02	1.18E+03
20	Americium-241	3.71E+00	pCi/g	2.3E-06	1.63E+00	1.63E+01	1.63E+02	N/A	N/A	N/A	N/A
20	Cesium-137	1.17E+00	pCi/g	3.30E-05	3.51E-02	3.51E-01	3.51E+00	N/A	N/A	N/A	N/A
20	Protactinium-231	3.65E+01	pCi/g	8.20E-05	4.45E-01	4.45E+00	4.45E+01	N/A	N/A	N/A	N/A
20	Uranium-234	4.45E+02	pCi/g	7.80E-05	5.73E+00	5.73E+01	5.73E+02	N/A	N/A	N/A	N/A
20	Uranium-235	5.70E+01	pCi/g	5.00E-04	1.14E-01	1.14E+00	1.14E+01	N/A	N/A	N/A	N/A
20	Uranium-238	4.39E+03	pCi/g	8.80E-03	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
20	**Cumulative**			**1.0E-02**				**56.2**			
21	Cobalt	1.80E+01	mg/kg	N/A	N/A	N/A	N/A	0.8	2.34E+00	2.34E+01	7.02E+01
21	Vanadium	1.19E+02	mg/kg	N/A	N/A	N/A	N/A	0.3	3.93E+01	3.93E+02	1.18E+03
21	**Cumulative**			**< 1.0E-06**				**1.1**			

Grayed cells indicate EPC value is lower than RGO value or an RGO value is not applicable.
N/A = Not applicable because the COC was not applicable (i.e., the COC was of concern for HI, but not ELCR or it was of concern for ELCR by not HI).
[1] See Tables D.6 and D.7 (Appendix D) for EPC values.
[2] See Appendix D, Exhibit D.6, for ELCR.
[3] See Table D.47 for RGOs.
[4] See Appendix D, Exhibit D.6, for HI.
[5] RGOs for residential land use are based on exposure to a resident age 1-27. For carcinogens, the dose method incorporates age-adjusted values for the 26-year exposure duration. Because child soil ingestion rates are higher and body weights are lower, noncancer RGOs are based on the child resident exposure assumptions.

Ecological Screening. COPECs for AOC 204 include metals, radionuclides, SVOCs, VOCs, and PCBs. Potential hazards for ecological receptors and the associated priority COPECs (maximum HQ ≥ 10) are summarized in Table 5.6.4.

Table 5.6.4. Ecological Screening for AOC 204

Ground Cover	Near a Surface Water Body?	Total HI[a]	Priority COPECs[b]	Background (mg/kg)[c]	Soil ESV (mg/kg)[d]	Maximum (mg/kg)	HQ (max conc)[a]	EPC (mg/kg)	HQ (EPC)[a]
soil/grass mix	Yes	1,192	Aluminum	13,000	50	13,700	274	8,971	179.4
			Antimony	0.21	0.27	10	37.04	4.35	16.1
			Iron	28,000	200	33,542	167.71	24,076	120.4
			Mercury	0.2	0.1	20	200	20.5	204.8
			PCB, Total	N/A	0.02	79	3,950	2.47	123.5
			Trichloroethene	N/A	0.001	0.5	500	0.5	500.0
			Vanadium	38	7.8	151	19.4	113	14.5

Table is from Appendix E, Table E.1.
[a] Total HI includes concentrations from all of the COPECs (listed in Table E4.1); only priority COPECs (i.e., the COPECs with HQs greater than 10, using the EPCs) are shown in this table.
[b] Only priority COPECs are listed. See Appendix E for additional COPECs.
[c] Background value is from DOE 2015b.
[d] ESV from DOE 2015c and Appendix E of this report.

5.6.7 AOC 204 Summary

Goal 1. Characterize Nature and Extent of Source Zone

Plant processes that could have contributed to contamination at this AOC are releases from storing materials in the elements.

COPCs for surface and subsurface soils from AOC 204 are shown on Tables 5.6.1 and 5.6.2 as those analytes with green boxes under the "Industrial Worker/FOE" columns for surface and shallow subsurface soil, and those with blue boxes under the "GW Protection Screen/RGA/UCRS" columns for groundwater. For metals and radioisotopes, an orange box under the "Provisional Background" must accompany the green and blue boxes. Contaminants were detected greater than background and greater than teen recreator NALs to a maximum depth of 4 ft bgs. The COPCs identified for SWMU 204 for each EU are as follows:

- EU 1
  - Surface—metals, radionuclides
  - Subsurface—metals, VOCs, uranium isotopes
- EU 2
  - Surface—metals, PAHs, radionuclides
  - Subsurface—metals, VOCs, uranium isotopes
- EU 3
  - Surface—metals, PAHs, radionuclides
  - Subsurface—metals, uranium isotopes

- EU 4

  — Surface—metals, PAHs, radionuclides
  — Subsurface—metals

- EU 5

  — Surface—metals, PAHs, radionuclides
  — Subsurface—metals, VOCs, uranium isotopes

- EU 6

  — Surface—metals, PAHs, radionuclides
  — Subsurface—metals, uranium isotopes

- EU 7

  — Surface—metals, radionuclides
  — Subsurface—metals

- EU 8

  — Surface—metals, PAHs, SVOCs, radionuclides
  — Subsurface—metals, uranium isotopes

- EU 9

  — Surface—metals, PAHs, SVOCs, radionuclides
  — Subsurface—metals, PAHs, SVOCs, uranium isotopes

- EU 10

  — Surface— metals, PAHs, SVOCs, radionuclides
  — Subsurface—metals, uranium isotopes

- EU 11

  — Surface—metals, PAHs, radionuclides
  — Subsurface—metals, PAHs, uranium isotopes

- EU 12

  — Surface—metals, PAHs, radionuclides
  — Subsurface—metals, PAHs, VOCs, uranium isotopes

- EU 13

  — Surface—metals, PAHs, radionuclides
  — Subsurface—metals, PAHs

- EU 14
  - Surface—metals, PAHs, SVOCs, radionuclides
  - Subsurface—metals, uranium isotopes
- EU 15
  - Surface—metals, radionuclides
  - Subsurface—metals, PAHs, SVOCs, VOCs, uranium isotopes
- EU 16
  - Surface—metals, PAHs, radionuclides
  - Subsurface—metals, PAHs
- EU 17
  - Surface—metals, PAHs, radionuclides
  - Subsurface—metals, PAHs, VOCs
- EU 18
  - Surface—metals, radionuclides
  - Subsurface—metals, PAHs, VOCs
- EU 19
  - Surface—metals, PAHs, radionuclides
  - Subsurface—metals, uranium isotopes
- EU 20
  - Surface—metals, PCBs, VOCs, radionuclides
  - Subsurface—metals, VOCs
- EU 21
  - Surface— metals, radionuclides
  - Subsurface—metals, PAHs, VOCs

Goal 2. Determine Surface and Subsurface Transport Mechanisms and Pathways

The contaminants at AOC 204 are readily adsorbed to soil particles, so they do not migrate without a direct connection to surface water. There are no known underground pipelines at AOC 204. The CSM can be found in Appendix D.

Goal 3. Complete a Baseline Risk Assessment for the Soils OU

Cumulative ELCRs or HIs exceeded benchmarks of 1E-06 and 1, respectively, for the teen recreational user, excavation worker, and hypothetical residential scenarios. COCs for these scenarios for AOC 204 are as follows:

- Teen recreational user
  - Arsenic
  - Uranium
  - Total PCBs
  - Cesium-137
  - Protactinium-231
  - Uranium-234
  - Uranium-235
  - Uranium-238
- Excavation worker
  - Arsenic
  - Uranium
  - Total PAHs
  - Total PCBs
  - Cesium-137
  - Protactinium-231
  - Uranium-234
  - Uranium-235
  - Uranium-238
- Hypothetical Resident (hazards evaluated against the child resident)
  - Antimony
  - Arsenic
  - Cobalt
  - Iron
  - Manganese
  - Molybdenum
  - Silver
  - Thallium
  - Uranium
  - Vanadium
  - Total PAHs
  - Total PCBs
  - Americium-241
  - Cesium-137
  - Protactinium-231
  - Uranium-234
  - Uranium-235
  - Uranium-238

Figure 5.6.8 shows the COCs exceeding RGOs for the teen recreational user.

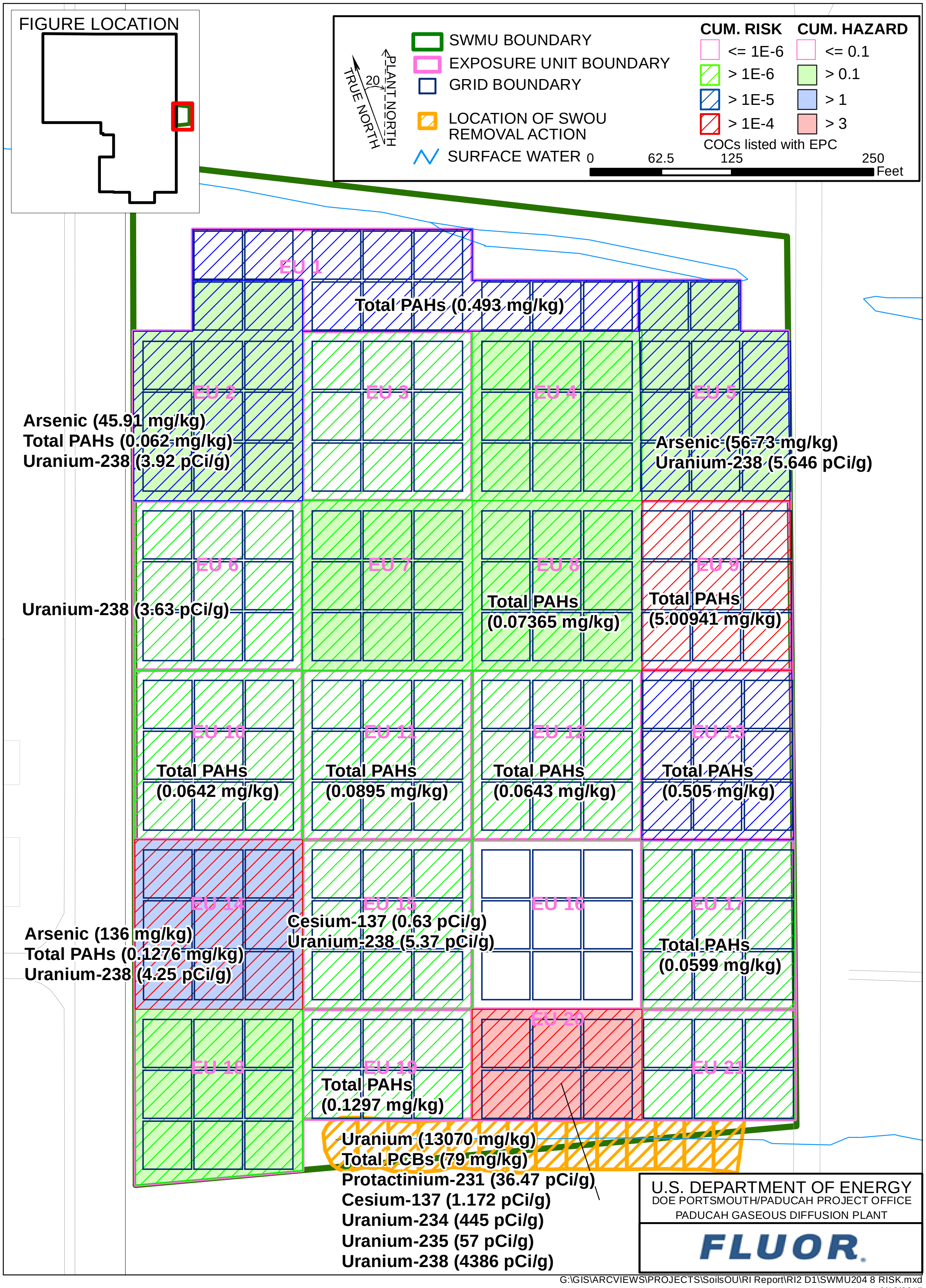

Figure 5.6.8. Summary of COCs Contributing to Risk to the Teen Recreational User at AOC 204

Priority COCs (i.e., HQ > 1 or chemical-specific ELCR > 1E-04) for AOC 204 are located in 7 of the 21 EUs. The priority COCs are arsenic, uranium, total PCBs, and uranium-238 for the teen recreational user; and arsenic, manganese, uranium, totals PAHs, total PCBs, uranium-235, and uranium-238 for the hypothetical resident. Priority COCs for other scenarios are described in Appendix D.

No priority COCs were identified for groundwater modeled from soil.

For AOC 204, COPECs exceed ESVs. Priority COPECs (i.e., maximum HQ ≥ 10) are the following:

- Aluminum
- Antimony
- Mercury
- Total PCBs
- Trichloroethene
- Vanadium

Goal 4. Support Evaluation of Remedial Alternatives

The representative data set used for AOC 204 is sufficient to support decision making and indicates that an FS is appropriate. An uncertainty concerning depth of contamination should be considered in the FS. Possible remedial technologies applicable for this unit, as discussed in the Work Plan (DOE 2010a), are posting, fencing (or other means of limiting access), excavation, and/or other remedial technologies that will be described in the FS.

AOC 204 is adjacent to SWMUs 66 and 67, KPDES Outfalls 010 and 011, respectively, which were the subject of a SWOU CERCLA removal action in the summer of 2010. A response action at AOC 204 could have an impact on those SWOU SWMUs.

5.6.8 AOC 204 Conclusion

The RI defined adequately the nature and extent of contamination in soils at AOC 204; an FS is appropriate for the AOC due to cancer risk and/or noncancer hazards exceeding the decision rule benchmarks for scenarios including teen recreational user, excavation worker, and hypothetical resident (DOE 2010a). The reasonably anticipated future land use of this AOC is recreational as shown in the SMP (DOE 2015a).

5.7 SWMU 211-A, C-720 TCE Spill Site Northeast

5.7.1 Background

The C-720 TCE Spill Site Northeast (SWMU 211-A) is located northeast of the C-720 Building in the central portion of the plant site. This SWMU is part of the Soils OU and the GWOU. This SWMU does not have any direct connection to surface water and is less than 0.5 acres.

Suspected past practices were to rinse and clean parts with TCE and to dispose of the solvent on the ground.

Subsurface soil borings and groundwater samples were collected and analyzed as part of the WAG 27 RI/FS for the C-720 Complex. Results of the investigation detected the presence of metals and VOCs in subsurface soils (DOE 1999a).

Note: The VOC contaminated soils at SWMU 211-A are being addressed by the Southwest Plumes Source project as defined in the Southwest Plumes Source ROD (DOE 2012).

5.7.2 Fieldwork Summary

During the first RI for the Soils OU, four grid samples were planned and collected for the unit. Prior to compositing, the soil core from the center location of each grid was submitted for VOC analysis. Field laboratory results indicated that contingency samples were required to define the extent of contamination due to concentrations of uranium and PCBs. Of 38 planned contingency samples, 16 were collected. Two pipeline samples were planned, but one was inaccessible due to a storage trailer being located on the designated sampling location. Pipeline sampling at this unit included VOCs. Samples not collected were due to utilities, asphalt, concrete, and a storage trailer. Appendix A contains the sampling rectification map.

The unit underwent a gamma radiological walkover survey (Figure 5.7.1) using a FIDLER; the 728 measurements ranged from 4,253 to 33,356 cpm. This area is mostly grass, but has a gravel patch on the south side of the SWMU. The highest count rate was located within the gravel patch; therefore, a judgmental grab sample was not collected.

During RI 2, eight grid samples were planned and collected for the unit. Sampling followed the protocol within the 2010 work plan (DOE 2010a) except for the following. This exception was documented and agreed to in the 2014 work plan addendum (DOE 2014a).

- In grid SOU211-001G, samples were collected from intervals 0 to 1 ft bgs, 1 to 4 ft bgs, and 4 to 7 ft bgs and analyzed for Total PCBs using PCB test kits. Additionally, sampling extended below the defined 10 ft bgs to fully delineate the extent of PCBs found in the 7 to 10 ft bgs sample interval. Two additional soil intervals were collected, 10 to 13 ft bgs and 13 to 16 ft bgs; these were analyzed for Total PCBs using PCB test kits.

- The locations of the five-point composite for grid SOU211-001H are identified on Figure 9 of the 2014 work plan addendum (DOE 2014a).

Field laboratory results indicated that contingency samples were needed to determine the nature and extent of contamination because of elevated concentrations of silver in grid 211-001G; however, step-outs and a step-down (to 16 ft bgs) already were performed for this grid. No additional step-outs or step-downs were conducted.

During a call December 10, 2014, FFA parties discussed the elevated PCB concentrations to the west of SWMU 211-A. PCB concentrations found in grids to the west of SWMU 211-A ranged from less than 5 ppm to greater than 50 ppm, while concentrations to the north, south, and east were less than 10 ppm. The FFA parties agreed that SWMU 211-A is not the source of the PCB contamination, but rather a more likely source is SWMU 32, C-728 Clean Waste Oil Tanks, and SWMU 33, C-728 Motor Cleaning Facility. The FFA parties concluded that the data should be added to the SWMU 32 and SWMU 33 SARs and should not be used to characterize SWMU 211-A. The data includes that from grids SOU211-001G, SOU211-001H, SOU211-001I, SOU211-001J, SOU211-001L, and SOU211-001M.

No additional gamma radiological walkover survey was required for this unit during RI 2; however, a new judgmental grab sample was collected for radiological constituents (Figure 5.7.1).

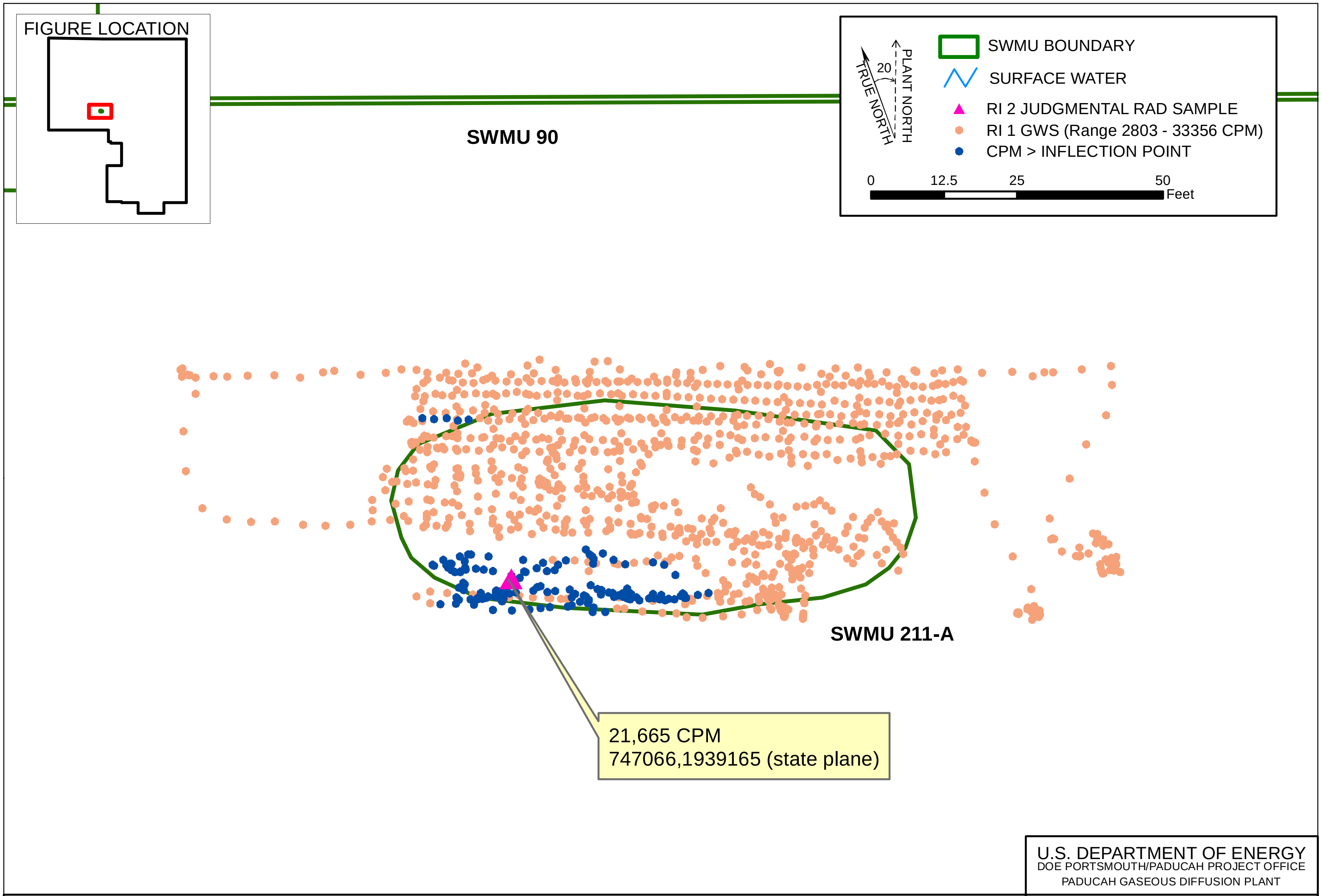

Figure 5.7.1. SWMU 211-A Gamma Walkover Survey

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1/28/2015

5.7.3 Nature and Extent of Contamination—Surface Soils

The representative data set presented in Table 5.7.1 provides the nature of the contamination in SWMU 211-A surface soils, and Figures 5.7.2–5.7.4 illustrate the horizontal extent. A complete list of sampling results is provided in Appendix F (samples with ending depths of 1 ft bgs or less or null are considered surface soils).

The lateral extent of SWMU 211-A surface soil contamination is considered defined adequately for supporting the BRA and FS. SWMU 211-A consists of 1 EU.

Metals

No metals were detected in the surface soil above both the background screening level and the industrial worker NALs or ALs.

Antimony (grids 1 and 2), barium (grids 1 and 2), iron (grids 1O and 1P), molybdenum (grid 1 and 1A), selenium (grids 1 and 1A), silver (grid 1N), thallium (grid 1), uranium (grid 1), vanadium (grid 1N, 1O, and 1P) were detected in the SWMU 211-A surface soil above both the SSLs for the protection of UCRS groundwater and the background screening levels (if available). Additionally, antimony (grid 2), iron (grids 1O and 1P), and silver (grid 1N) were detected above the SSL for the protection of RGA groundwater and the background screening level.

PCBs

Total PCBs were detected above the industrial worker NALs in grid 1 in the surface soil in SWMU 211-A, but not above the AL. Total PCBs also were detected in grid 1 surface soil above the SSL for the protection of UCRS groundwater, but not above the SSL for the protection of RGA groundwater.

SVOCs

Total PAHs were detected above industrial worker NAL in grid 1. No SVOCs were detected above ALs in the surface soil in SWMU 211-A. Of the SVOCs, phenanthrene was detected above the SSLs for the protection of UCRS groundwater in grid 1. No SVOCs were detected above the SSL for the protection of RGA groundwater.

VOCs

No VOCs were detected above screening levels in the surface soil in SWMU 211-A.

Radionuclides

Cesium-137, neptunium-237, uranium-234, uranium-235, and uranium-238 (all in grid 1) were detected above both the background screening level and the industrial worker NAL. No radionuclides were detected above both the background screening levels and industrial worker ALs in the SWMU 211-A surface soil.

Cesium-137, neptunium-237, plutonium-239/240, Tc-99, thorium-230, uranium-234, uranium-235, and uranium-238 (all in grid 1) were detected above both the background screening levels and SSLs for the protection of the UCRS. Additionally, neptunium-237, Tc-99, and the uranium isotopes were detected above both the background screening levels and the SSL for the protection of RGA groundwater.

Table 5.7.1. Surface Soil Data Summary: SWMU 211-A

Type	Analysis	Unit	Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
			Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
METAL	Aluminum	mg/kg	3.97E+03	8.80E+03	6.39E+03	0/2	2/2	0/2	1.30E+04	0/2	1.00E+05	0/2	1.00E+05	0/2	2/2	5.3–5.3
METAL	Antimony	mg/kg	2.30E-01	6.52E+01	1.33E+01	0/7	3/7	3/7	2.10E-01	0/7	9.34E+01	0/7	2.80E+03	1/7	2/7	0.53–30
METAL	Arsenic	mg/kg	4.30E+00	8.13E+00	6.43E+00	0/10	3/10	0/10	1.20E+01	3/10	1.41E+00	0/10	1.41E+02	0/10	3/10	1.1–11
METAL	Barium	mg/kg	5.49E+01	4.55E+02	1.71E+02	0/7	6/7	2/7	2.00E+02	0/7	4.04E+04	0/7	1.00E+05	0/7	4/7	2.1–100
METAL	Beryllium	mg/kg	4.00E-01	4.80E-01	4.40E-01	0/2	2/2	0/2	6.70E-01	0/2	4.50E+02	0/2	1.35E+04	0/2	0/2	0.11–0.11
METAL	Cadmium	mg/kg	9.20E-02	2.00E-01	1.46E-01	0/7	2/7	0/7	2.10E-01	0/7	6.12E+01	0/7	1.84E+03	0/7	0/7	0.053–12
METAL	Calcium	mg/kg	5.01E+03	3.00E+04	1.75E+04	0/2	2/2	0/2	2.00E+05	0/2	N/A	0/2	N/A	N/A	N/A	52.6–52.9
METAL	Chromium	mg/kg	1.58E+01	4.48E+01	3.11E+01	0/10	6/10	5/10	1.60E+01	0/10	1.98E+02	0/10	1.98E+04	0/10	0/10	1.1–85
METAL	Cobalt	mg/kg	4.20E+00	7.70E+00	5.95E+00	0/2	2/2	0/2	1.40E+01	0/2	6.87E+01	0/2	2.06E+03	2/2	2/2	0.21–0.21
METAL	Copper	mg/kg	6.70E+00	3.90E+01	1.93E+01	0/10	4/10	2/10	1.90E+01	0/10	9.34E+03	0/10	1.00E+05	0/10	0/10	1.1–35
METAL	Iron	mg/kg	8.19E+03	3.05E+04	1.60E+04	0/10	10/10	2/10	2.80E+04	0/10	1.00E+05	0/10	1.00E+05	10/10	10/10	5.3–100
METAL	Lead	mg/kg	1.00E+01	2.41E+01	1.77E+01	0/10	7/10	0/10	3.60E+01	0/10	8.00E+02	0/10	8.00E+02	0/10	6/10	0.32–13
METAL	Magnesium	mg/kg	1.27E+03	3.32E+03	2.30E+03	0/2	2/2	0/2	7.70E+03	0/2	N/A	0/2	N/A	N/A	N/A	52.6–52.9
METAL	Manganese	mg/kg	1.01E+02	7.01E+02	3.49E+02	0/10	10/10	0/10	1.50E+03	0/10	4.72E+03	0/10	1.00E+05	7/10	10/10	0.21–85
METAL	Mercury	mg/kg	8.43E-02	8.43E-02	8.43E-02	0/10	1/10	0/10	2.00E-01	0/10	7.01E+01	0/10	2.10E+03	0/10	1/10	0.0351–40
METAL	Molybdenum	mg/kg	7.00E-01	1.10E+00	9.00E-01	0/10	2/10	0/10	N/A	0/10	1.17E+03	0/10	3.51E+04	0/10	2/10	0.53–15
METAL	Nickel	mg/kg	7.80E+00	1.78E+01	1.27E+01	0/10	4/10	0/10	2.10E+01	0/10	4.30E+03	0/10	1.00E+05	0/10	4/10	0.53–65
METAL	Selenium	mg/kg	8.40E-01	2.00E+00	1.42E+00	0/10	2/10	2/10	8.00E-01	0/10	1.17E+03	0/10	3.51E+04	0/10	2/10	0.53–20
METAL	Silver	mg/kg	3.40E-02	3.40E+01	6.83E+00	0/10	3/10	1/10	2.30E+00	0/10	1.17E+03	0/10	3.51E+04	1/10	1/10	0.21–50
METAL	Sodium	mg/kg	4.58E+01	5.17E+01	4.88E+01	0/2	2/2	0/2	3.20E+02	0/2	N/A	0/2	N/A	N/A	N/A	21–21.2
METAL	Thallium	mg/kg	1.00E-01	3.30E-01	2.15E-01	0/2	2/2	1/2	2.10E-01	0/2	2.34E+00	0/2	7.02E+01	0/2	1/2	0.21–0.21
METAL	Uranium	mg/kg	3.80E+00	2.19E+01	1.40E+01	0/10	4/10	3/10	4.90E+00	0/10	6.81E+02	0/10	2.04E+04	0/10	2/10	0.06–20
METAL	Vanadium	mg/kg	1.97E+01	1.01E+02	5.28E+01	0/10	5/10	3/10	3.80E+01	0/10	1.15E+03	0/10	3.45E+04	0/10	5/10	1.1–70
METAL	Zinc	mg/kg	2.99E+01	5.25E+01	4.18E+01	0/10	10/10	0/10	6.50E+01	0/10	7.01E+04	0/10	1.00E+05	0/10	7/10	1–25
PPCB	PCB, Total	mg/kg	1.30E-02	3.60E-01	1.35E-01	0/20	5/20	0/20	N/A	1/20	3.05E-01	0/20	3.05E+01	0/20	1/20	0.1–5
SVOA	1,2,4-Trichlorobenzene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	1,2-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	1,3-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	1,4-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	2,4,5-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–2
SVOA	2,4,6-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	2,4-Dichlorophenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	2,4-Dimethylphenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	2,4-Dinitrophenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	1.7–2
SVOA	2,4-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	2,6-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	2-Chloronaphthalene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	2-Chlorophenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	2-Methyl-4,6-dinitrophenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	1.7–2
SVOA	2-Methylnaphthalene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	2-Methylphenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	2-Nitrobenzenamine	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	2.91E+02	0/4	8.73E+03	0/4	0/4	1.7–2
SVOA	2-Nitrophenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	3,3'-Dichlorobenzidine	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.82–1.7
SVOA	3-Nitrobenzenamine	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	1.7–2
SVOA	4-Bromophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	4-Chloro-3-methylphenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	4-Chlorobenzenamine	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	4-Chlorophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	4-Methylphenol	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.41–0.42
SVOA	4-Nitrophenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	1.7–2
SVOA	Acenaphthene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	1.40E+03	0/4	4.20E+04	0/4	0/4	0.35–0.42
SVOA	Acenaphthylene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	1.40E+03	0/4	4.20E+04	N/A	N/A	0.35–0.42

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.7.1. Surface Soil Data Summary: SWMU 211-A (Continued)

			Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
Type	Analysis	Unit	Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
SVOA	Anthracene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	6.99E+03	0/4	2.10E+05	0/4	0/4	0.35–0.42
SVOA	Benzenemethanol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	Benzo(ghi)perylene	mg/kg	4.60E-02	4.60E-02	4.60E-02	1/4	1/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	Benzoic acid	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	1.7–2
SVOA	Bis(2-chloroethoxy)methane	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	Bis(2-chloroethyl) ether	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.0069–0.42
SVOA	Bis(2-chloroisopropyl) ether	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	Bis(2-ethylhexyl)phthalate	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	5.88E+01	0/4	5.88E+03	0/4	0/4	0.35–0.42
SVOA	Butyl benzyl phthalate	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	Dibenzofuran	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	Diethyl phthalate	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	Dimethyl phthalate	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	Di-n-butyl phthalate	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	Di-n-octylphthalate	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	Fluoranthene	mg/kg	1.00E-01	1.10E-01	1.05E-01	2/4	2/4	0/4	N/A	0/4	9.32E+02	0/4	2.80E+04	0/4	0/4	0.35–0.42
SVOA	Fluorene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	9.32E+02	0/4	2.80E+04	0/4	0/4	0.35–0.42
SVOA	Hexachlorobenzene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	5.15E-01	0/4	5.15E+01	0/4	0/4	0.35–0.42
SVOA	Hexachlorobutadiene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	Hexachlorocyclopentadiene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.41–1.7
SVOA	Hexachloroethane	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	Isophorone	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	m,p-Cresol	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.69–0.7
SVOA	Naphthalene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	1.67E+01	0/4	1.61E+03	0/4	0/4	0.35–0.42
SVOA	Nitrobenzene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.41–1.7
SVOA	N-Nitroso-di-n-propylamine	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	1.18E-01	0/4	1.18E+01	0/4	0/4	0.0069–0.42
SVOA	N-Nitrosodiphenylamine	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	PAH, Total	mg/kg	8.39E-02	1.04E-01	9.38E-02	0/4	2/4	0/4	N/A	1/4	8.94E-02	0/4	8.94E+00	0/4	0/4	–
SVOA	Pentachlorophenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	8.91E-01	0/4	8.91E+01	N/A	N/A	1.7–2
SVOA	Phenanthrene	mg/kg	6.60E-02	7.60E-02	7.10E-02	2/4	2/4	0/4	N/A	0/4	1.40E+03	0/4	4.20E+04	0/4	2/4	0.35–0.42
SVOA	Phenol	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.35–0.42
SVOA	p-Nitroaniline	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	1.7–2
SVOA	Pyrene	mg/kg	1.00E-01	1.30E-01	1.15E-01	2/4	2/4	0/4	N/A	0/4	6.99E+02	0/4	2.10E+04	0/4	0/4	0.35–0.42
SVOA	Pyridine	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.69–0.7
VOA	1,1,1-Trichloroethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	3.58E+03	0/2	1.07E+05	0/2	0/2	0.006–0.006
VOA	1,1,2,2-Tetrachloroethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.006–0.006
VOA	1,1,2-Trichloroethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	6.32E-01	0/2	1.90E+01	0/2	0/2	0.006–0.006
VOA	1,1-Dichloroethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	1.58E+01	0/2	1.58E+03	0/2	0/2	0.006–0.006
VOA	1,1-Dichloroethene	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	1.00E+02	0/7	3.00E+03	0/7	0/7	0.006–0.012
VOA	1,2-Dichloroethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	2.09E+00	0/2	2.09E+02	0/2	0/2	0.006–0.006
VOA	1,2-Dichloroethene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	2.10E+03	0/1	6.30E+04	0/1	0/1	0.006–0.006
VOA	1,2-Dichloropropane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.006–0.006
VOA	2-Butanone	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.012–0.013
VOA	2-Hexanone	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.012–0.013
VOA	4-Methyl-2-pentanone	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.012–0.013
VOA	Acetone	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.012–0.013
VOA	Benzene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	5.31E+00	0/2	5.31E+02	0/2	0/2	0.006–0.006
VOA	Bromodichloromethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	1.30E+00	0/2	1.30E+02	0/2	0/2	0.006–0.006
VOA	Bromoform	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.006–0.006
VOA	Bromomethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.012–0.013
VOA	Carbon disulfide	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.006–0.006
VOA	Carbon tetrachloride	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	2.96E+00	0/2	2.96E+02	0/2	0/2	0.006–0.006
VOA	Chlorobenzene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.006–0.006
VOA	Chloroethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.012–0.013

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.7.1. Surface Soil Data Summary: SWMU 211-A (Continued)

			Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
Type	Analysis	Unit	Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
VOA	Chloroform	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	1.39E+00	0/2	1.39E+02	0/2	0/2	0.006–0.006
VOA	Chloromethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.012–0.013
VOA	*cis*-1,2-Dichloroethene	mg/kg	N/A	N/A	N/A	0/6	0/6	0/6	N/A	0/6	4.67E+02	0/6	1.40E+04	0/6	0/6	0.006–0.012
VOA	*cis*-1,3-Dichloropropene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.006–0.006
VOA	Dibromochloromethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.006–0.006
VOA	Ethylbenzene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	2.66E+01	0/2	2.66E+03	0/2	0/2	0.006–0.006
VOA	Methylene chloride	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.006–0.006
VOA	Styrene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.006–0.006
VOA	Tetrachloroethene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	4.00E+01	0/2	1.20E+03	N/A	N/A	0.006–0.006
VOA	Toluene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	6.25E+03	0/2	1.88E+05	0/2	0/2	0.006–0.006
VOA	Total Xylene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	2.54E+02	0/2	7.62E+03	0/2	0/2	0.006–0.006
VOA	*trans*-1,2-Dichloroethene	mg/kg	N/A	N/A	N/A	0/6	0/6	0/6	N/A	0/6	6.51E+01	0/6	1.95E+03	0/6	0/6	0.006–0.012
VOA	*trans*-1,3-Dichloropropene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.006–0.006
VOA	Trichloroethene	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	1.90E+00	0/7	5.70E+01	0/7	0/7	0.006–0.012
VOA	Vinyl acetate	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.012–0.013
VOA	Vinyl chloride	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	2.06E+00	0/7	2.06E+02	0/7	0/7	0.0093–0.013
RADS	Americium-241	pCi/g	1.21E-01	1.21E-01	1.21E-01	0/3	1/3	0/3	N/A	0/3	5.99E+00	0/3	5.99E+02	0/3	0/3	0.013–0.0314
RADS	Cesium-137	pCi/g	1.36E-01	1.67E+00	9.03E-01	0/3	2/3	1/3	4.90E-01	2/3	1.02E-01	0/3	1.02E+01	0/3	1/3	0.0467–0.097
RADS	Neptunium-237	pCi/g	1.29E-01	5.93E+00	2.07E+00	0/3	3/3	3/3	1.00E-01	1/3	2.29E-01	0/3	2.29E+01	1/3	3/3	0.016–0.0233
RADS	Plutonium-238	pCi/g	2.39E-02	2.39E-02	2.39E-02	0/3	1/3	0/3	7.30E-02	0/3	2.87E+01	0/3	2.87E+03	0/3	0/3	0.018–0.022
RADS	Plutonium-239/240	pCi/g	1.80E-02	8.15E-01	4.17E-01	0/3	2/3	1/3	2.50E-02	0/3	2.47E+01	0/3	2.47E+03	0/3	1/3	0.014–0.0289
RADS	Technetium-99	pCi/g	2.06E+00	1.06E+02	3.68E+01	0/3	3/3	1/3	2.50E+00	0/3	1.20E+03	0/3	1.20E+05	3/3	3/3	0.43–1.21
RADS	Thorium-228	pCi/g	6.05E-01	8.40E-01	7.58E-01	0/3	3/3	0/3	1.60E+00	0/3	N/A	0/3	N/A	N/A	N/A	0.02–0.0883
RADS	Thorium-230	pCi/g	8.40E-01	4.56E+00	2.09E+00	0/3	3/3	1/3	1.50E+00	0/3	3.39E+01	0/3	3.39E+03	0/3	1/3	0.01–0.0993
RADS	Thorium-232	pCi/g	5.56E-01	8.80E-01	7.42E-01	0/3	3/3	0/3	1.50E+00	0/3	N/A	0/3	N/A	N/A	N/A	0.01–0.0347
RADS	Uranium-234	pCi/g	2.77E+00	6.69E+01	2.43E+01	0/3	3/3	3/3	1.20E+00	1/3	5.53E+01	0/3	5.53E+03	2/3	3/3	0.03–0.0723
RADS	Uranium-235	pCi/g	2.01E-01	3.86E+00	1.42E+00	0/3	3/3	3/3	6.00E-02	1/3	3.40E-01	0/3	3.40E+01	1/3	3/3	0.009–0.085
RADS	Uranium-238	pCi/g	5.34E+00	1.19E+02	4.34E+01	0/3	3/3	3/3	1.20E+00	3/3	1.60E+00	0/3	1.60E+02	3/3	3/3	0.02–0.125

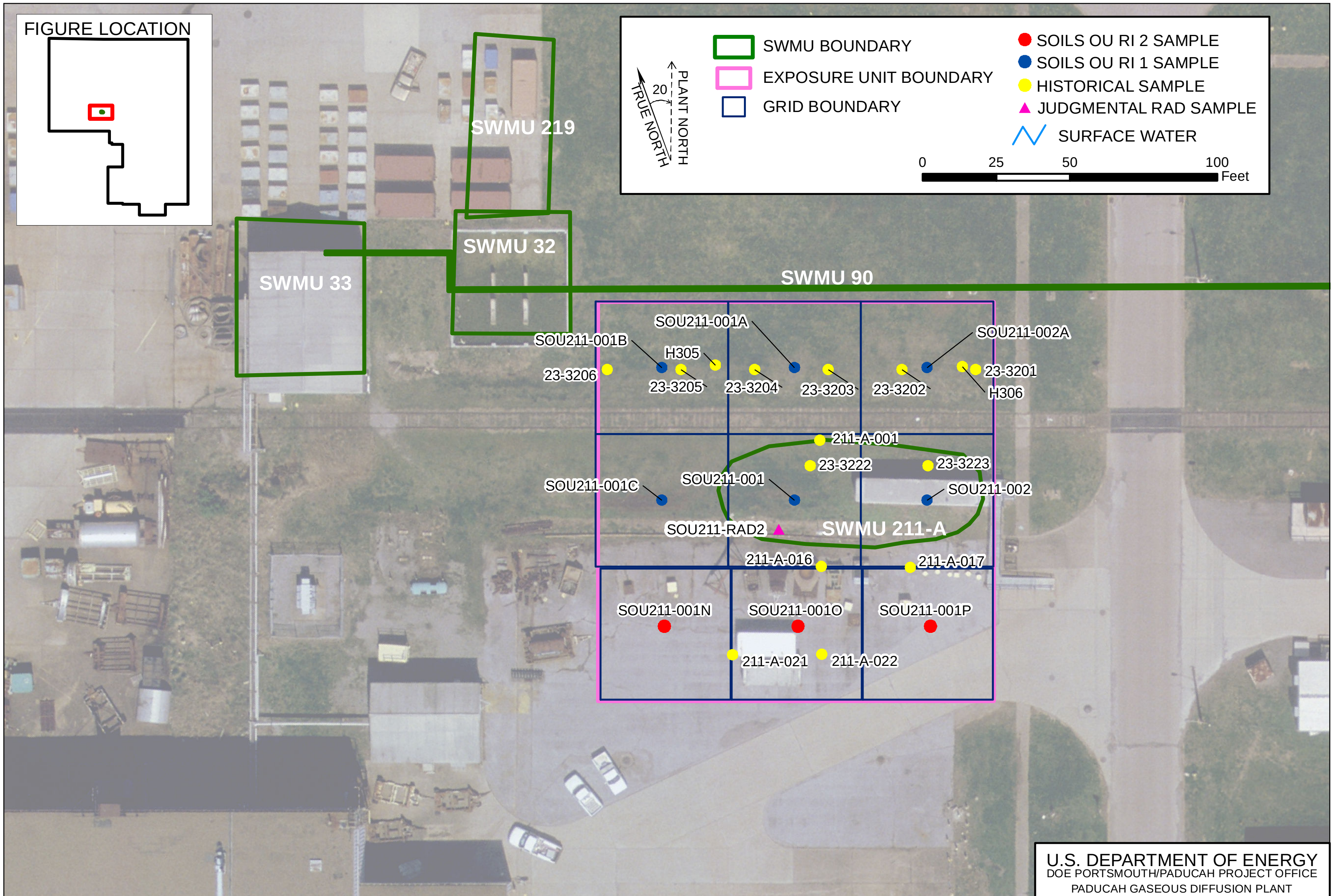
One or more samples exceed AL value
One or more samples exceed NAL value
One or more samples exceed background value
One or more samples exceed SSLs of RGA and UCRS groundwater protection

Counts of analyses are based on the maximum detected result from a sample (i.e., if a sample has analytical results from two different labs, only the maximum value is counted).
Field replicates, or separate samples are counted independently.

The uranium (metal)/uranium (isotopic) may not be from the same sample thus a correlation between uranium (metal)/uranium (isotopic) data may not be possible.
Uranium-238 that was analyzed using method RL-7128NITRIC is compared to a background value of 0.4 pCi/g for surface and subsurface.

Screening values are shown in Appendices C and D.

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable



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PADUCAH GASEOUS DIFFUSION PLANT

FLUOR.

Figure 5.7.2. SWMU 211-A Sample Locations—Surface Soil

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3/13/2015

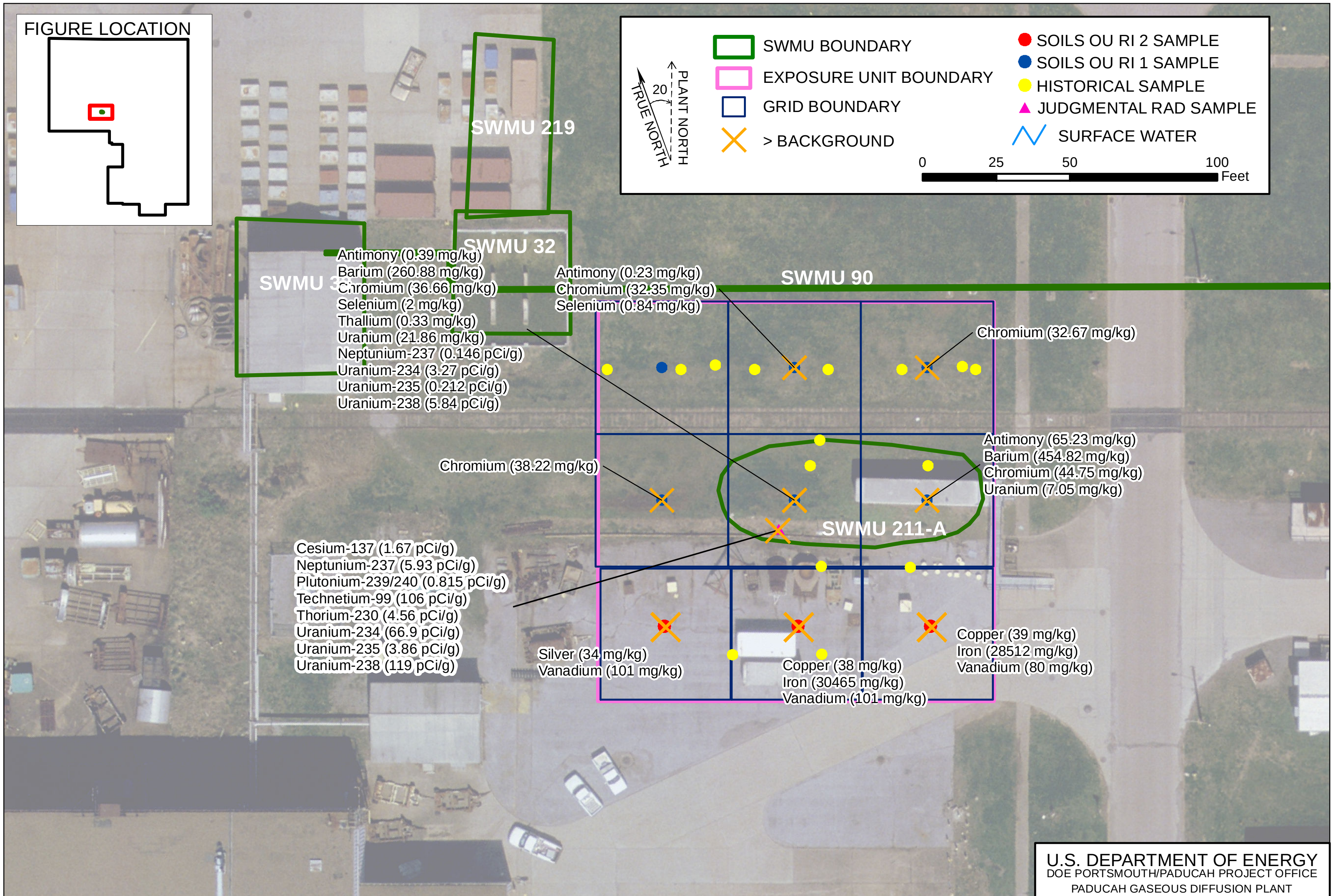

Figure 5.7.3. SWMU 211-A Background Exceedances—Surface Soil

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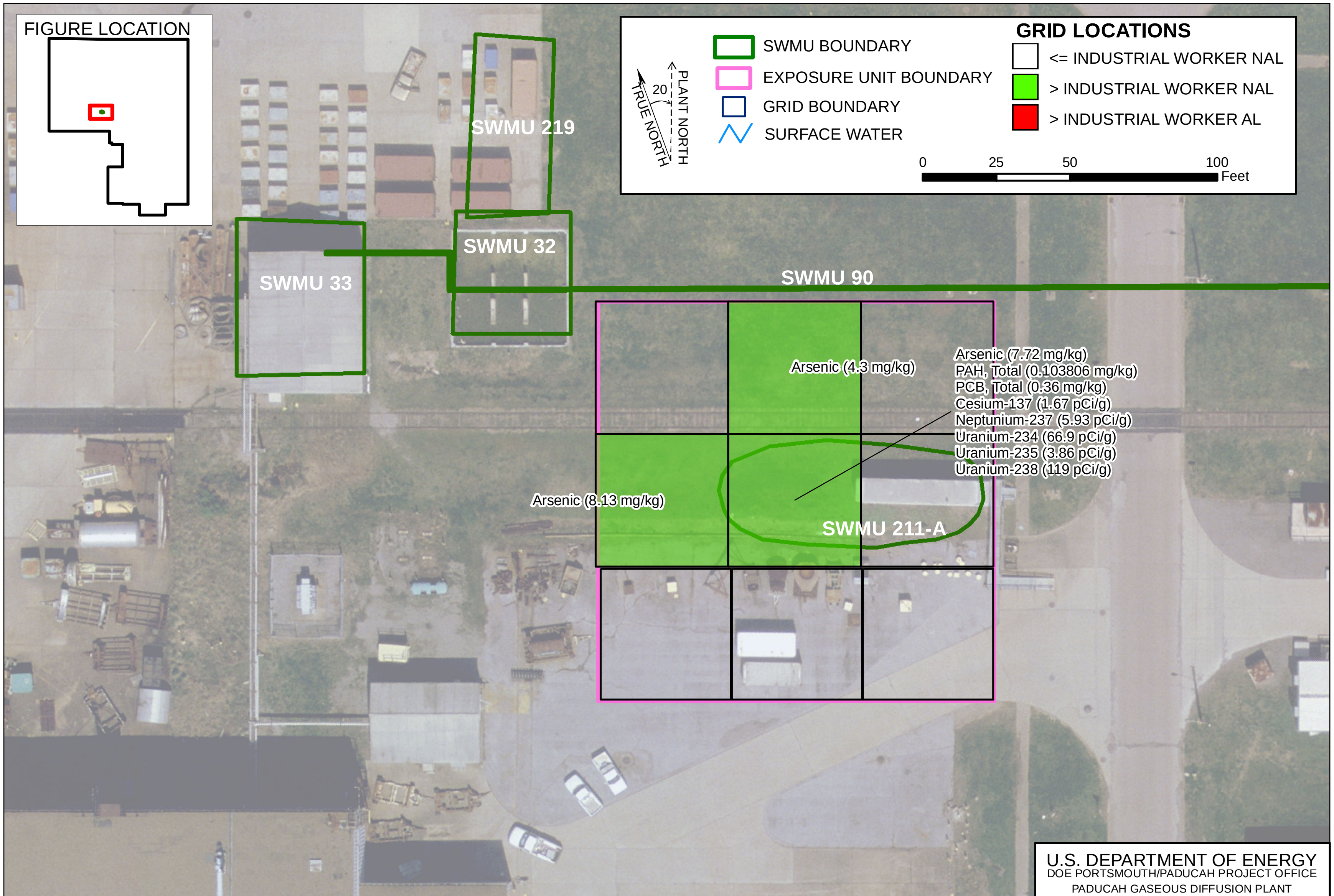

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Figure 5.7.4. SWMU 211-A NAL Exceedances—Surface Soil

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3/16/2015

5.7.4 Nature and Extent of Contamination—Subsurface Soils

The representative data set presented in Table 5.7.2 provides the nature of contamination in SWMU 211-A subsurface soils, and Figures 5.7.5–5.7.7 illustrate the horizontal extent. A complete list of detailed sampling results, including sampling depths, is provided in Appendix F (samples with ending depths greater than 1 ft bgs are considered subsurface soils in this nature and extent section).

The horizontal and vertical extent of SWMU 211-A subsurface soil contamination is considered defined adequately for supporting the BRA and FS. There is some uncertainty with vertical extent; however, this will be addressed in the FS.

Metals

Antimony and arsenic (both in grid 2) were detected above both the industrial worker NALs and background screening levels in the SWMU 211-A subsurface soil. The metals were detected above industrial worker NALs to a maximum depth of 13 ft bgs. No metals were detected above both the background screening levels and the industrial worker ALs in the SWMU 211-A subsurface soil.

The following metals were detected in the SWMU 211-A subsurface soil above both the background screening levels and the SSLs for the protection of UCRS groundwater.

Antimony (grids 1, 1A, 1B, 2, and 2A), cobalt (grid 2), and iron (grid 1N and 1O) also were detected above both the background screening levels and the SSLs for the protection of RGA groundwater.

Metal	Grid
Antimony	1, 1A, 1B, 2, 2A
Arsenic	2
Barium	1, 1A, 1B, 2, 2A
Cadmium	2
Cobalt	2
Iron	1N, 1O
Mercury	2
Molybdenum[1]	1, 2
Nickel	1, 2, 2A
Selenium	1, 2
Thallium	2
Uranium	1
Vanadium	1N, 1O, 1P
Zinc	2

[1] No soil background value is available.

PCBs

Total PCBs were detected in the subsurface soil at SWMU 211-A above industrial worker NALs in grids 1, 1C, and 2. The PCBs were detected above industrial worker NALs to a maximum depth of 4 ft bgs. None were detected above industrial worker ALs. These grids also were detected above the SSLs for protection of UCRS groundwater. Additionally grids 1C and 2 detected Total PCBs above the SSL for protection of RGA groundwater.

SVOCs

No SVOCs were detected in subsurface soil at SWMU 211-A above the industrial worker NALs or ALs. Phenanthrene in grid 1 was detected above the SSL for protection of UCRS groundwater. No SVOCs were detected above the SSL for protection of RGA groundwater.

Table 5.7.2. Subsurface Soil Data Summary: SWMU 211-A

Type	Analysis	Unit	Detected Results Min	Max	Avg	J-qualified FOD	FOD	Provisional Background FOE	Bkgd	Industrial Worker FOE	NAL	Industrial Worker FOE	AL	GW Protection Screen RGA	UCRS	DL Range
METAL	Aluminum	mg/kg	5.33E+03	1.11E+04	7.31E+03	0/7	7/7	0/7	1.20E+04	0/7	1.00E+05	0/7	1.00E+05	0/7	7/7	1.3135–20
METAL	Antimony	mg/kg	3.60E-01	9.74E+01	5.40E+01	0/17	12/17	12/17	2.10E-01	1/17	9.34E+01	0/17	2.80E+03	10/17	12/17	0.5215–30
METAL	Arsenic	mg/kg	9.64E-01	1.00E+01	5.41E+00	0/20	10/20	1/20	7.90E+00	9/20	1.41E+00	0/20	1.41E+02	0/20	10/20	0.0827–11
METAL	Barium	mg/kg	2.88E+01	5.13E+02	3.01E+02	0/17	17/17	11/17	1.70E+02	0/17	4.04E+04	0/17	1.00E+05	0/17	13/17	0.0242–100
METAL	Beryllium	mg/kg	3.00E-01	8.50E-01	5.84E-01	0/7	7/7	3/7	6.90E-01	0/7	4.50E+02	0/7	1.35E+04	0/7	0/7	0.0188–0.5
METAL	Cadmium	mg/kg	2.40E-02	1.42E+01	2.92E+00	0/17	3/17	1/17	2.10E-01	0/17	6.12E+01	0/17	1.84E+03	0/17	1/17	0.0489–12
METAL	Calcium	mg/kg	8.00E+02	3.25E+03	1.50E+03	0/7	7/7	0/7	6.10E+03	0/7	N/A	0/7	N/A	N/A	N/A	0.5097–100
METAL	Chromium	mg/kg	9.06E+00	4.84E+01	2.87E+01	0/20	14/20	3/20	4.30E+01	0/20	1.98E+02	0/20	1.98E+04	0/20	0/20	0.1325–85
METAL	Cobalt	mg/kg	1.83E+00	4.95E+01	1.31E+01	0/7	6/7	1/7	1.30E+01	0/7	6.87E+01	0/7	2.06E+03	6/7	6/7	0.0847–10
METAL	Copper	mg/kg	2.88E+00	3.90E+01	1.58E+01	1/20	11/20	3/20	2.50E+01	0/20	9.34E+03	0/20	1.00E+05	0/20	0/20	0.1067–35
METAL	Iron	mg/kg	2.29E+03	4.71E+04	1.38E+04	0/20	20/20	2/20	2.80E+04	0/20	1.00E+05	0/20	1.00E+05	20/20	20/20	2.3597–100
METAL	Lead	mg/kg	5.33E+00	2.11E+01	1.07E+01	0/20	16/20	0/20	2.30E+01	0/20	8.00E+02	0/20	8.00E+02	0/20	2/20	0.2401–13
METAL	Magnesium	mg/kg	4.21E+02	1.67E+03	9.33E+02	0/7	7/7	0/7	2.10E+03	0/7	N/A	0/7	N/A	N/A	N/A	3.7451–64.8
METAL	Manganese	mg/kg	2.07E+01	6.41E+02	2.19E+02	0/20	19/20	0/20	8.20E+02	0/20	4.72E+03	0/20	1.00E+05	9/20	19/20	0.03–85
METAL	Mercury	mg/kg	2.32E-02	9.61E-01	1.90E-01	0/20	5/20	1/20	1.30E-01	0/20	7.01E+01	0/20	2.10E+03	0/20	4/20	0.0078–40
METAL	Molybdenum	mg/kg	2.60E-01	4.80E-01	3.70E-01	0/15	2/15	0/15	N/A	0/15	1.17E+03	0/15	3.51E+04	0/15	2/15	0.55–15
METAL	Nickel	mg/kg	4.09E+00	8.87E+01	3.41E+01	0/20	8/20	3/20	2.20E+01	0/20	4.30E+03	0/20	1.00E+05	0/20	8/20	0.1277–65
METAL	Potassium	mg/kg	1.37E+02	4.94E+02	2.45E+02	1/5	5/5	0/5	9.50E+02	0/5	N/A	0/5	N/A	N/A	N/A	2.0521–100
METAL	Selenium	mg/kg	1.76E-01	1.40E+00	1.16E+00	0/20	3/20	2/20	7.00E-01	0/20	1.17E+03	0/20	3.51E+04	0/20	2/20	0.0891–20
METAL	Silver	mg/kg	2.60E-02	5.20E-02	3.90E-02	0/20	2/20	0/20	2.70E+00	0/20	1.17E+03	0/20	3.51E+04	0/20	0/20	0.1799–50
METAL	Sodium	mg/kg	4.34E+01	2.84E+02	1.87E+02	0/7	5/7	0/7	3.40E+02	0/7	N/A	0/7	N/A	N/A	N/A	2.7264–200
METAL	Thallium	mg/kg	1.90E-01	6.02E-01	3.44E-01	0/7	3/7	1/7	3.40E-01	0/7	2.34E+00	0/7	7.02E+01	0/7	3/7	0.22–2
METAL	Uranium	mg/kg	2.20E+00	4.85E+01	2.65E+01	0/17	3/17	2/17	4.60E+00	0/17	6.81E+02	0/17	2.04E+04	0/17	1/17	0.03–20
METAL	Vanadium	mg/kg	1.18E+01	1.03E+02	3.99E+01	1/20	10/20	3/20	3.70E+01	0/20	1.15E+03	0/20	3.45E+04	0/20	10/20	0.1449–70
METAL	Zinc	mg/kg	1.09E+01	9.19E+01	3.32E+01	0/20	18/20	1/20	6.00E+01	0/20	7.01E+04	0/20	1.00E+05	0/20	6/20	0.0806–25
PPCB	PCB, Total	mg/kg	3.30E+00	1.00E+01	5.40E+00	0/18	3/18	0/18	N/A	3/18	3.05E-01	0/18	3.05E+01	2/18	3/18	0.098–5
SVOA	1,2,4-Trichlorobenzene	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	1,2-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	1,3-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	1,4-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	2,4,5-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–2
SVOA	2,4,6-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	2,4-Dichlorophenol	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	2,4-Dimethylphenol	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	2,4-Dinitrophenol	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	1.65–2
SVOA	2,4-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	2,6-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	2-Chloronaphthalene	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	2-Chlorophenol	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	2-Methyl-4,6-dinitrophenol	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	1.65–2
SVOA	2-Methylnaphthalene	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	2-Methylphenol	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	2-Nitrobenzenamine	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	2.91E+02	0/7	8.73E+03	0/7	0/7	1.65–2.1
SVOA	2-Nitrophenol	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	3,3'-Dichlorobenzidine	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–1.8
SVOA	3-Nitrobenzenamine	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	1.65–2
SVOA	4-Bromophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	4-Chloro-3-methylphenol	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	4-Chlorobenzenamine	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	4-Chlorophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	4-Methylphenol	mg/kg	N/A	N/A	N/A	0/6	0/6	0/6	N/A	0/6	N/A	0/6	N/A	N/A	N/A	0.33–0.41
SVOA	4-Nitrophenol	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	1.65–2
SVOA	Acenaphthene	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	1.40E+03	0/7	4.20E+04	0/7	0/7	0.33–0.41

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.7.2. Subsurface Soil Data Summary: SWMU 211-A (Continued)

Type	Analysis	Unit	Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
			Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
SVOA	Acenaphthylene	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	1.40E+03	0/7	4.20E+04	N/A	N/A	0.33–0.41
SVOA	Anthracene	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	6.99E+03	0/7	2.10E+05	0/7	0/7	0.33–0.41
SVOA	Benzenemethanol	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	Benzo(ghi)perylene	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	Benzoic acid	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	1.65–2
SVOA	Bis(2-chloroethoxy)methane	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	Bis(2-chloroethyl) ether	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.0073–0.41
SVOA	Bis(2-chloroisopropyl) ether	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	Bis(2-ethylhexyl)phthalate	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	5.88E+01	0/7	5.88E+03	0/7	0/7	0.33–0.41
SVOA	Butyl benzyl phthalate	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	Dibenzofuran	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	Diethyl phthalate	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	Dimethyl phthalate	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	Di-n-butyl phthalate	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	Di-n-octylphthalate	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	Fluoranthene	mg/kg	8.20E-02	8.20E-02	8.20E-02	1/7	1/7	0/7	N/A	0/7	9.32E+02	0/7	2.80E+04	0/7	0/7	0.33–0.41
SVOA	Fluorene	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	9.32E+02	0/7	2.80E+04	0/7	0/7	0.33–0.41
SVOA	Hexachlorobenzene	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	5.15E-01	0/7	5.15E+01	0/7	0/7	0.33–0.41
SVOA	Hexachlorobutadiene	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	Hexachlorocyclopentadiene	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–1.8
SVOA	Hexachloroethane	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	Isophorone	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	m,p-Cresol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.73–0.73
SVOA	Naphthalene	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	1.67E+01	0/7	1.61E+03	0/7	0/7	0.33–0.41
SVOA	Nitrobenzene	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–1.8
SVOA	N-Nitroso-di-n-propylamine	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	1.18E-01	0/7	1.18E+01	0/7	0/7	0.0073–0.41
SVOA	N-Nitrosodiphenylamine	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	PAH, Total	mg/kg	6.23E-02	6.23E-02	6.23E-02	0/7	1/7	0/7	N/A	0/7	8.94E-02	0/7	8.94E+00	0/7	0/7	–
SVOA	Pentachlorophenol	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	8.91E-01	0/7	8.91E+01	N/A	N/A	1.65–2
SVOA	Phenanthrene	mg/kg	4.60E-02	4.60E-02	4.60E-02	1/7	1/7	0/7	N/A	0/7	1.40E+03	0/7	4.20E+04	0/7	1/7	0.33–0.41
SVOA	Phenol	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.33–0.41
SVOA	p-Nitroaniline	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	1.65–2.1
SVOA	Pyrene	mg/kg	7.70E-02	7.70E-02	7.70E-02	1/7	1/7	0/7	N/A	0/7	6.99E+02	0/7	2.10E+04	0/7	0/7	0.33–0.41
SVOA	Pyridine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.73–0.73
VOA	1,1,1,2-Tetrachloroethane	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.005–0.0061
VOA	1,1,1-Trichloroethane	mg/kg	N/A	N/A	N/A	0/9	0/9	0/9	N/A	0/9	3.58E+03	0/9	1.07E+05	0/9	0/9	0.002–0.018
VOA	1,1,2,2-Tetrachloroethane	mg/kg	N/A	N/A	N/A	0/9	0/9	0/9	N/A	0/9	N/A	0/9	N/A	N/A	N/A	0.002–0.018
VOA	1,1,2-Trichloroethane	mg/kg	N/A	N/A	N/A	0/9	0/9	0/9	N/A	0/9	6.32E-01	0/9	1.90E+01	0/9	0/9	0.002–0.018
VOA	1,1-Dichloroethane	mg/kg	N/A	N/A	N/A	0/9	0/9	0/9	N/A	0/9	1.58E+01	0/9	1.58E+03	0/9	0/9	0.002–0.018
VOA	1,1-Dichloroethene	mg/kg	6.10E-03	2.40E-02	1.51E-02	1/62	2/62	0/62	N/A	0/62	1.00E+02	0/62	3.00E+03	0/62	2/62	0.002–0.9
VOA	1,2,3-Trichloropropane	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.005–0.0061
VOA	1,2-Dibromoethane	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.005–0.0061
VOA	1,2-Dichloroethane	mg/kg	N/A	N/A	N/A	0/9	0/9	0/9	N/A	0/9	2.09E+00	0/9	2.09E+02	0/9	0/9	0.002–0.018
VOA	1,2-Dichloroethene	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	2.10E+03	0/3	6.30E+04	0/3	0/3	0.006–0.006
VOA	1,2-Dichloropropane	mg/kg	N/A	N/A	N/A	0/9	0/9	0/9	N/A	0/9	N/A	0/9	N/A	N/A	N/A	0.002–0.018
VOA	1,2-Dimethylbenzene	mg/kg	N/A	N/A	N/A	0/6	0/6	0/6	N/A	0/6	2.81E+02	0/6	8.43E+03	0/6	0/6	0.002–0.018
VOA	2-Butanone	mg/kg	N/A	N/A	N/A	0/9	0/9	0/9	N/A	0/9	N/A	0/9	N/A	N/A	N/A	0.012–0.45
VOA	2-Chloroethyl vinyl ether	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.02–0.024
VOA	2-Hexanone	mg/kg	N/A	N/A	N/A	0/9	0/9	0/9	N/A	0/9	N/A	0/9	N/A	N/A	N/A	0.01–0.091
VOA	4-Methyl-2-pentanone	mg/kg	N/A	N/A	N/A	0/9	0/9	0/9	N/A	0/9	N/A	0/9	N/A	N/A	N/A	0.012–0.45
VOA	Acetone	mg/kg	N/A	N/A	N/A	0/9	0/9	0/9	N/A	0/9	N/A	0/9	N/A	N/A	N/A	0.012–0.45
VOA	Acrolein	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.05–0.061
VOA	Acrylonitrile	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	1.24E+00	0/4	1.24E+02	0/4	0/4	0.05–0.061

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.7.2. Subsurface Soil Data Summary: SWMU 211-A (Continued)

			Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
Type	Analysis	Unit	Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
VOA	Benzene	mg/kg	N/A	N/A	N/A	0/9	0/9	0/9	N/A	0/9	5.31E+00	0/9	5.31E+02	0/9	0/9	0.002–0.018
VOA	Bromodichloromethane	mg/kg	N/A	N/A	N/A	0/9	0/9	0/9	N/A	0/9	1.30E+00	0/9	1.30E+02	0/9	0/9	0.002–0.018
VOA	Bromoform	mg/kg	N/A	N/A	N/A	0/9	0/9	0/9	N/A	0/9	N/A	0/9	N/A	N/A	N/A	0.002–0.018
VOA	Bromomethane	mg/kg	N/A	N/A	N/A	0/9	0/9	0/9	N/A	0/9	N/A	0/9	N/A	N/A	N/A	0.004–0.036
VOA	Carbon disulfide	mg/kg	N/A	N/A	N/A	0/9	0/9	0/9	N/A	0/9	N/A	0/9	N/A	N/A	N/A	0.002–0.018
VOA	Carbon tetrachloride	mg/kg	N/A	N/A	N/A	0/9	0/9	0/9	N/A	0/9	2.96E+00	0/9	2.96E+02	0/9	0/9	0.002–0.018
VOA	Chlorobenzene	mg/kg	N/A	N/A	N/A	0/9	0/9	0/9	N/A	0/9	N/A	0/9	N/A	N/A	N/A	0.002–0.018
VOA	Chloroethane	mg/kg	N/A	N/A	N/A	0/9	0/9	0/9	N/A	0/9	N/A	0/9	N/A	N/A	N/A	0.004–0.036
VOA	Chloroform	mg/kg	N/A	N/A	N/A	0/9	0/9	0/9	N/A	0/9	1.39E+00	0/9	1.39E+02	0/9	0/9	0.002–0.018
VOA	Chloromethane	mg/kg	N/A	N/A	N/A	0/9	0/9	0/9	N/A	0/9	N/A	0/9	N/A	N/A	N/A	0.004–0.036
VOA	*cis*-1,2-Dichloroethene	mg/kg	5.40E-04	2.10E-02	4.43E-03	14/59	17/59	0/59	N/A	0/59	4.67E+02	0/59	1.40E+04	0/59	1/59	0.002–0.9
VOA	*cis*-1,3-Dichloropropene	mg/kg	N/A	N/A	N/A	0/9	0/9	0/9	N/A	0/9	N/A	0/9	N/A	N/A	N/A	0.002–0.018
VOA	Dibromochloromethane	mg/kg	N/A	N/A	N/A	0/9	0/9	0/9	N/A	0/9	N/A	0/9	N/A	N/A	N/A	0.002–0.018
VOA	Dibromomethane	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.005–0.0061
VOA	Dichlorodifluoromethane	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	3.68E+01	0/4	1.10E+03	0/4	0/4	0.01–0.012
VOA	Ethyl methacrylate	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.005–0.0061
VOA	Ethylbenzene	mg/kg	N/A	N/A	N/A	0/9	0/9	0/9	N/A	0/9	2.66E+01	0/9	2.66E+03	0/9	0/9	0.002–0.018
VOA	Iodomethane	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.005–0.0061
VOA	m,p-Xylene	mg/kg	N/A	N/A	N/A	0/6	0/6	0/6	N/A	0/6	2.54E+02	0/6	7.62E+03	0/6	0/6	0.002–0.018
VOA	Methylene chloride	mg/kg	3.70E-03	9.20E-03	5.63E-03	2/9	3/9	0/9	N/A	0/9	N/A	0/9	N/A	N/A	N/A	0.002–0.018
VOA	Styrene	mg/kg	N/A	N/A	N/A	0/9	0/9	0/9	N/A	0/9	N/A	0/9	N/A	N/A	N/A	0.002–0.018
VOA	Tetrachloroethene	mg/kg	N/A	N/A	N/A	0/9	0/9	0/9	N/A	0/9	4.00E+01	0/9	1.20E+03	N/A	N/A	0.002–0.018
VOA	Toluene	mg/kg	8.30E-04	8.30E-04	8.30E-04	1/9	1/9	0/9	N/A	0/9	6.25E+03	0/9	1.88E+05	0/9	0/9	0.002–0.018
VOA	Total Xylene	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	2.54E+02	0/3	7.62E+03	0/3	0/3	0.006–0.006
VOA	*trans*-1,2-Dichloroethene	mg/kg	N/A	N/A	N/A	0/59	0/59	0/59	N/A	0/59	6.51E+01	0/59	1.95E+03	0/59	0/59	0.002–0.9
VOA	*trans*-1,3-Dichloropropene	mg/kg	N/A	N/A	N/A	0/9	0/9	0/9	N/A	0/9	N/A	0/9	N/A	N/A	N/A	0.002–0.018
VOA	*trans*-1,4-Dichloro-2-butene	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.01–0.012
VOA	Trichloroethene	mg/kg	4.60E-04	7.90E-02	1.21E-02	15/64	22/64	0/64	N/A	0/64	1.90E+00	0/64	5.70E+01	0/64	18/64	0.002–5
VOA	Trichlorofluoromethane	mg/kg	N/A	N/A	N/A	0/4	0/4	0/4	N/A	0/4	N/A	0/4	N/A	N/A	N/A	0.005–0.0061
VOA	Vinyl acetate	mg/kg	N/A	N/A	N/A	0/7	0/7	0/7	N/A	0/7	N/A	0/7	N/A	N/A	N/A	0.005–0.012
VOA	Vinyl chloride	mg/kg	5.90E-04	5.90E-04	5.90E-04	1/62	1/62	0/62	N/A	0/62	2.06E+00	0/62	2.06E+02	0/62	0/62	0.001–0.9
RADS	Americium-241	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	5.99E+00	0/1	5.99E+02	0/1	0/1	0.014–0.014
RADS	Cesium-137	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	2.80E-01	0/1	1.02E-01	0/1	1.02E+01	0/1	0/1	0.14–0.14
RADS	Neptunium-237	pCi/g	1.56E-01	1.56E-01	1.56E-01	0/3	1/3	0/3	N/A	0/3	2.29E-01	0/3	2.29E+01	0/3	1/3	0.019–0.0308
RADS	Plutonium-238	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	2.87E+01	0/1	2.87E+03	0/1	0/1	0.014–0.014
RADS	Plutonium-239/240	pCi/g	1.50E-02	1.50E-02	1.50E-02	0/3	1/3	0/3	N/A	0/3	2.47E+01	0/3	2.47E+03	0/3	0/3	0.012–0.0213
RADS	Technetium-99	pCi/g	5.58E+00	5.58E+00	5.58E+00	0/3	1/3	1/3	2.80E+00	0/3	1.20E+03	0/3	1.20E+05	1/3	1/3	0.5–2.88
RADS	Thorium-228	pCi/g	1.42E+00	1.42E+00	1.42E+00	0/1	1/1	0/1	1.60E+00	0/1	N/A	0/1	N/A	N/A	N/A	0.03–0.03
RADS	Thorium-230	pCi/g	1.46E+00	1.46E+00	1.46E+00	0/1	1/1	1/1	1.40E+00	0/1	3.39E+01	0/1	3.39E+03	0/1	0/1	0.02–0.02
RADS	Thorium-232	pCi/g	1.18E+00	1.18E+00	1.18E+00	0/1	1/1	0/1	1.50E+00	0/1	N/A	0/1	N/A	N/A	N/A	0.02–0.02
RADS	Uranium-234	pCi/g	8.06E+00	8.06E+00	8.06E+00	0/3	1/3	1/3	1.20E+00	0/3	5.53E+01	0/3	5.53E+03	1/3	1/3	0.03–0.722
RADS	Uranium-235	pCi/g	5.80E-01	5.80E-01	5.80E-01	0/3	1/3	1/3	6.00E-02	1/3	3.40E-01	0/3	3.40E+01	0/3	1/3	0.02–0.0509
RADS	Uranium-238	pCi/g	1.59E+01	1.59E+01	1.59E+01	0/3	1/3	1/3	1.20E+00	1/3	1.60E+00	0/3	1.60E+02	1/3	1/3	0.01–0.218

One or more samples exceed AL value
One or more samples exceed NAL value
One or more samples exceed background value
One or more samples exceed SSLs of RGA and UCRS groundwater protection

Counts of analyses are based on the maximum detected result from a sample (i.e., if a sample has analytical results from two different labs, only the maximum value is counted). Field replicates, or separate samples are counted independently.

The uranium (metal)/uranium (isotopic) may not be from the same sample thus a correlation between uranium (metal)/uranium (isotopic) data may not be possible.

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.7.2. Subsurface Soil Data Summary: SWMU 211-A (Continued)

Type	Analysis	Unit	Detected Results			J-qualified	FOD	Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		DL Range
			Min	Max	Avg	FOD		FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	

Uranium-238 that was analyzed using method RL-7128NITRIC is compared to a background value of 0.4 pCi/g for surface and subsurface.

Screening values are shown in Appendices C and D.

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

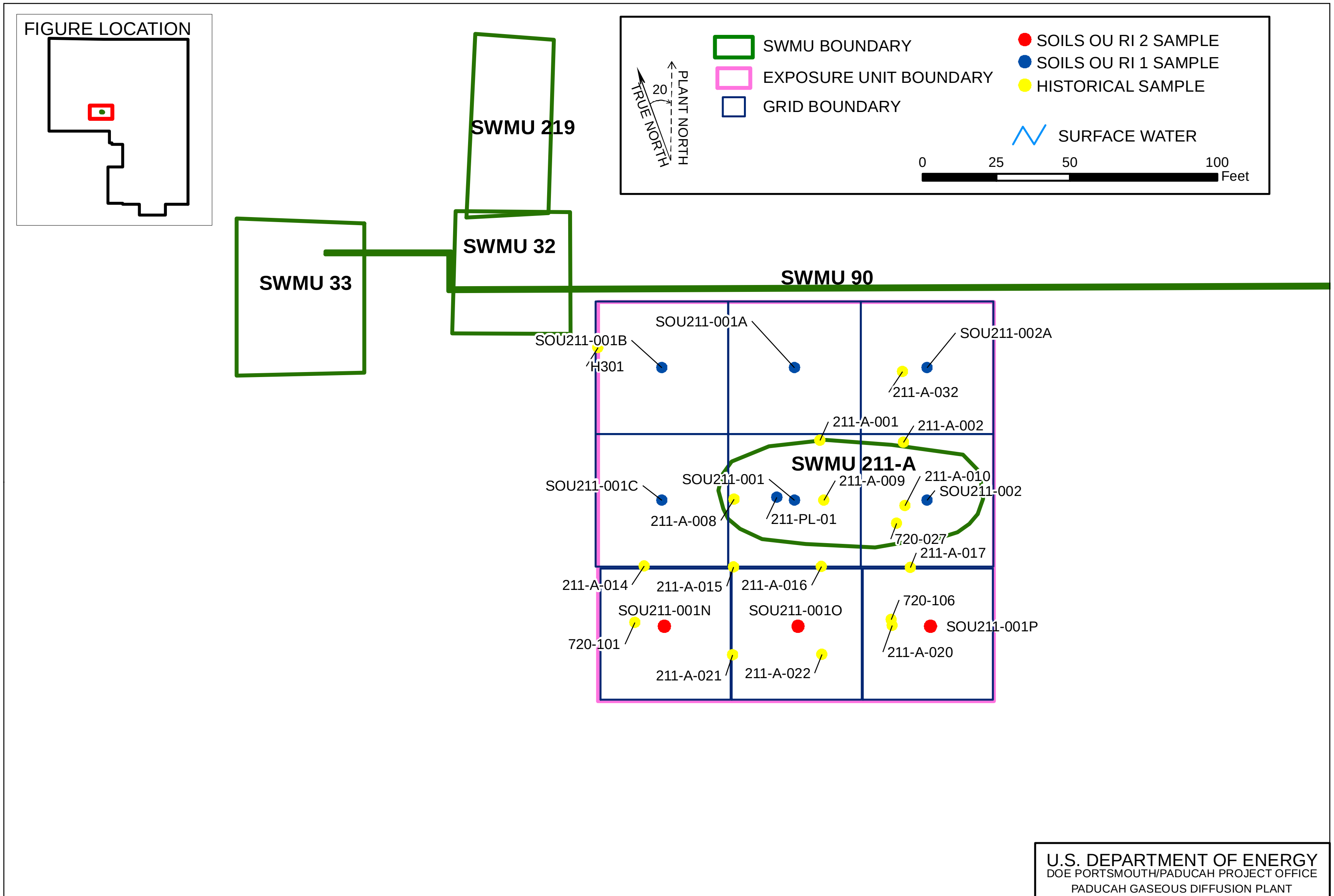

Figure 5.7.5. SWMU 211-A Sample Locations—Subsurface Soil

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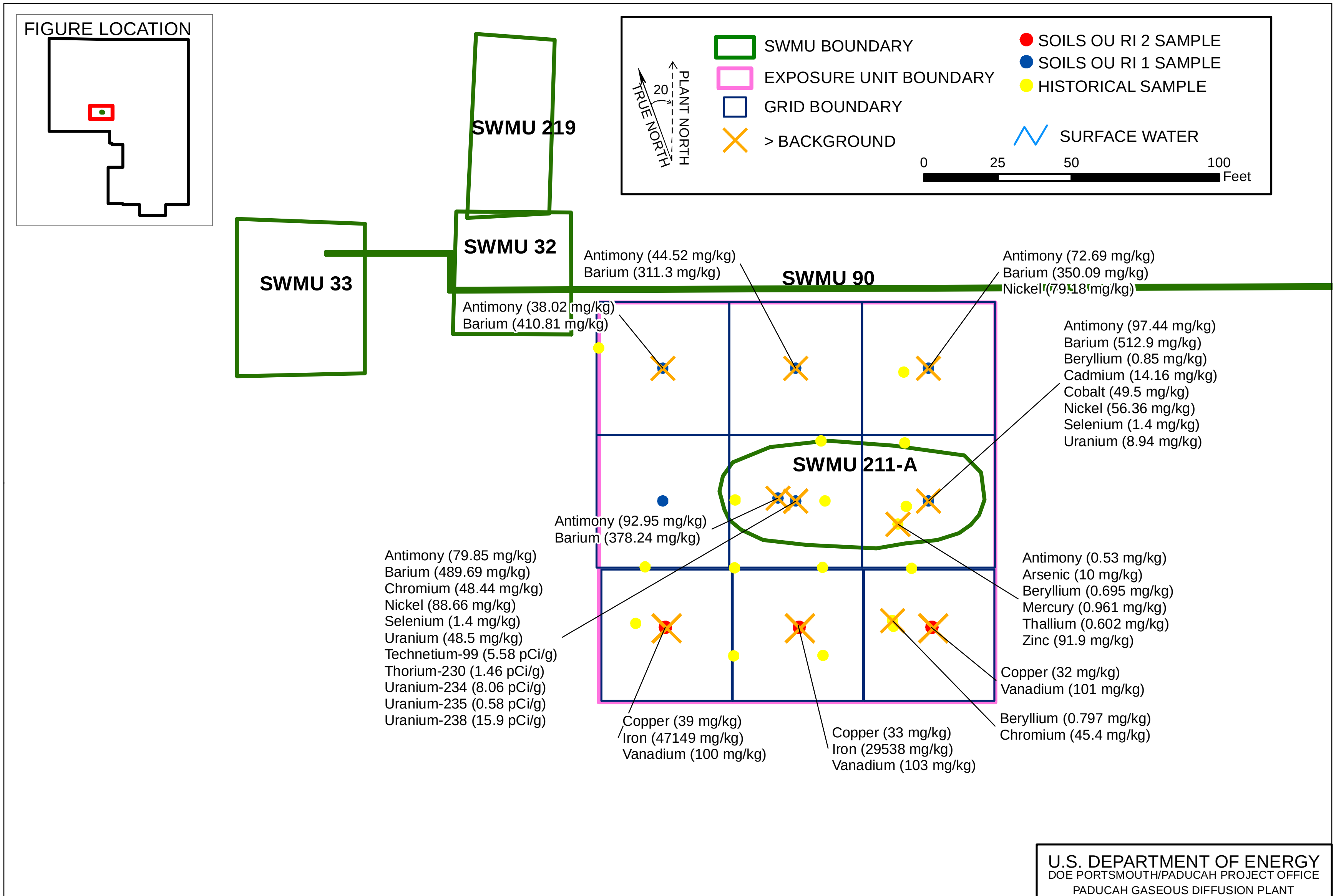
3/13/2015



U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

Figure 5.7.6. SWMU 211-A Background Exceedances—Subsurface Soil

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3/13/2015

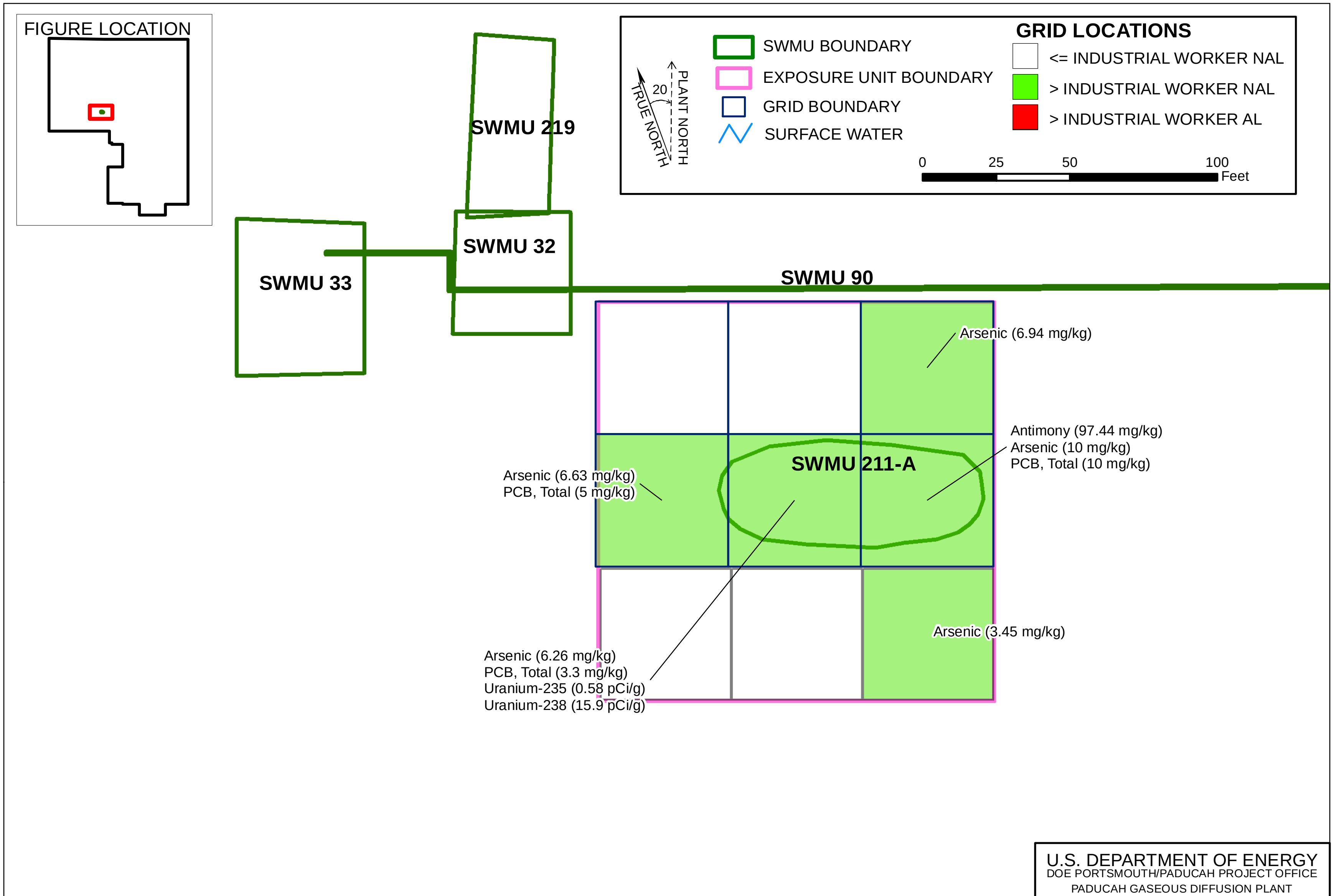

Figure 5.7.7. SWMU 211-A NAL Exceedances—Subsurface Soil

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2/25/2015

VOCs

No VOCs were detected above industrial worker NALs or ALs in the subsurface soil in SWMU 211-A. The following VOCs were detected above the SSL for protection of UCRS groundwater: 1,1-dichloroethene (grid 1C); *cis*-1,2-dichloroethene (grid 2); and TCE (grids 1, 1O, 1P, and 2). None were detected above the SSL for protection of RGA groundwater.

Radionuclides

Uranium-235 and uranium-238 (grid 1) were above both the background screening level and the industrial worker NAL. The radionuclides were detected above industrial worker NALs to a maximum depth of 4 ft bgs. No radionuclides were detected above industrial worker ALs in the SWMU 211-A subsurface soil.

Neptunium-237, Tc-99, uranium-234, uranium-235, and uranium-238 (all in grid 1) were detected above both the background screening levels (if available) and SSLs for the protection of UCRS. Additionally, Tc-99, uranium-234, and uranium-238 were detected above both the background screening levels and the SSL for the protection of RGA groundwater.

5.7.5 Fate and Transport

The VOC contaminated soils at SWMU 211-A are being addressed by the Southwest Plume Source project as defined in the Southwest Plume Source ROD (DOE 2012).

Uranium-234 at SWMU 211-A was identified for further evaluation under fate and transport (Chapter 4). SESOIL and AT123D simulation modeling results are summarized in Appendix C.

Uranium-234 was detected at an activity concentration greater than both the background value and SSL; however, the mass concentration of uranium assumed to be present based upon the assumption that the uranium isotopes were present at natural abundance would be 25 mg/kg. At 25 mg/kg, the average concentration is less than the average uranium concentration at SWMU 81 (2,502 mg/kg) that modeling in the Soils OU RI Report (DOE 2013) found not to migrate to the RGA within 1,000 years. Based on this, uranium-234 was not modeled at SWMU 211-A.

There is no concern for potential runoff from SWMU 211-A. Contaminants present at this SWMU are unlikely to migrate due to the physical cover at the SWMU, which limits the potential for particulate transport through sheet flow, and there is no direct connection to surface water from this SWMU. A removal action for the contaminated sediment associated with SWOU (On-Site) (DOE 2011a) was conducted for Outfalls 001, 008, 010, 011, 015, and associated internal ditches. A final response action for internal ditches, outfalls, and creeks will be addressed by the SWOU, as described in the SMP (DOE 2015a).

5.7.6 Baseline Risk Assessment

Human Health. Potential risks and hazards for current/future human health for SWMU 211-A were evaluated for direct contact. These results are summarized in Appendix D and in the subsections that follow, including the COCs and relative contributions to the overall ELCR/HI.

The cumulative ELCR and the cumulative HI for SWMU 211-A exceed the benchmarks of cumulative ELCR of 1E-06 and cumulative HI greater than 1, respectively for one or more scenarios; therefore, as stated in the Work Plan, Decision Rule D1a, (DOE 2010a), this SWMU will be evaluated in the FS. As described in the BHHRA (Appendix D), COCs were identified after considering the results of the risk characterization and the uncertainties affecting the results.

COCs were identified as those COPCs considered to contribute at least 1E-06 ELCR or 0.1 HI to a scenario of concern. The basis for COC identification is presented in Appendix D. The identified COCs considered to contribute to the ELCR/HI, the EPC, and the RGOs calculated for a range of ELCR/HI benchmarks are presented in Table 5.7.3 for the future industrial worker, excavation worker, and the hypothetical resident. Table 5.7.3 also compares the EPC to the RGO for each COC under each exposure scenario. Table 5.7.3 summarizes the ELCR/HI posed by COCs for this SWMU under each exposure scenario by depicting the maximum ELCR/HI contribution per COC.

Ecological Screening. COPECs for SWMU 211-A include metals, SVOCs, and PCBs. Potential hazards for ecological receptors and the associated priority COPECs (maximum HQ $\geq$ 10) are summarized in Table 5.7.4.

5.7.7 SWMU 211-A Summary

Goal 1. Characterize Nature and Extent of Source Zone

The processes that may have contributed to contamination at this site are rinsing radiologically contaminated parts with TCE and disposing of it on the ground. The VOC contaminated soils at SWMU 211-A are being addressed by the Southwest Plumes Source project as defined in the Southwest Plumes Source ROD (DOE 2012).

COPCs for surface and subsurface soils from SWMU 211-A are shown on Tables 5.7.1 and 5.7.2 as those analytes with green boxes under the "Industrial Worker/FOE" columns for surface and shallow subsurface soil, and those with blue boxes under the "GW Protection Screen/RGA/UCRS" columns for groundwater. For metals and radioisotopes, an orange box under the "Provisional Background" must accompany the green and blue boxes. The COPCs identified for SWMU 211-A surface and subsurface soil are metals, PCBs, PAHs (surface only), SVOAs, and radionuclides.

Contaminants were detected greater than background and greater than industrial worker NALs to a maximum depth of 13 ft bgs.

Goal 2. Determine Surface and Subsurface Transport Mechanisms and Pathways

The contaminants at SWMU 211-A are readily adsorbed to soil particles, so they do not migrate without a direct connection to surface water. Pipelines were sampled at SWMU 211-A, and results were evaluated within this RI, which do not indicate subsurface transport. The CSM can be found in Appendix D.

Goal 3. Complete a Baseline Risk Assessment for the Soils OU

Cumulative ELCRs or HIs exceeded benchmarks of 1E-06 and 1, respectively, for the future industrial worker, excavation worker, and hypothetical residential scenarios. COCs for these scenarios for SWMU 211-A are as follows:

- Future Industrial worker

  — Total PAHs
  — Total PCBs
  — Cesium-137

Table 5.7.3. RGOs for SWMU 211-A

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3]			HI[4]	RGOs for HI[3]		
					1E-06	1E-05	1E-04		0.1	1	3
Future Industrial Worker											
1	PCB, Total	3.60E-01	mg/kg	1.2E-06	3.05E-01	3.05E+00	3.05E+01	< 0.1	N/A	N/A	N/A
1	Cesium-137	1.67E+00	pCi/g	1.5E-05	1.14E-01	1.14E+00	1.14E+01	N/A	N/A	N/A	N/A
1	Neptunium-237	5.93E+00	pCi/g	2.3E-05	2.53E-01	2.53E+00	2.53E+01	N/A	N/A	N/A	N/A
1	Uranium-234	6.69E+01	pCi/g	3.3E-06	2.01E+01	2.01E+02	2.01E+03	N/A	N/A	N/A	N/A
1	Uranium-238	1.19E+02	pCi/g	7.2E-05	1.65E+00	1.65E+01	1.65E+02	N/A	N/A	N/A	N/A
1	**Cumulative**			**1.2E-04**				**< 1**			
Excavation Worker											
1	Antimony	9.74E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.7	1.32E+01	1.32E+02	3.95E+02
1	Arsenic	1.00E+01	mg/kg	4.0E-06	2.52E+00	2.52E+01	2.52E+02	0.1	8.09E+00	8.09E+01	2.43E+02
1	Cobalt	4.95E+01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.5	9.82E+00	9.82E+01	2.95E+02
1	Iron	4.71E+04	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.2	2.30E+04	2.30E+05	6.91E+05
1	PCB, Total	1.00E+01	mg/kg	8.7E-06	1.14E+00	1.14E+01	1.14E+02	< 0.1	N/A	N/A	N/A
1	Thallium	6.02E-01	mg/kg	< 1.0E-06	N/A	N/A	N/A	0.2	3.29E-01	3.29E+00	9.86E+00
1	Uranium-234	6.69E+01	pCi/g	4.4E-06	1.51E+01	1.51E+02	1.51E+03	N/A	N/A	N/A	N/A
1	Uranium-235	3.86E+00	pCi/g	1.8E-06	2.18E+00	2.18E+01	2.18E+02	N/A	N/A	N/A	N/A
1	Uranium-238	1.19E+02	pCi/g	2.0E-05	5.95E+00	5.95E+01	5.95E+02	N/A	N/A	N/A	N/A
1	**Cumulative**			**3.9E-05**				**1.7**			
Hypothetical Resident[5]											
1	Antimony	6.52E+01	mg/kg	N/A	N/A	N/A	N/A	2.1	3.13E+00	3.13E+01	9.39E+01
1	Iron	3.05E+04	mg/kg	N/A	N/A	N/A	N/A	0.6	5.47E+03	5.48E+04	1.64E+05
1	PAH, Total	1.04E-01	mg/kg	4.6E-06	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
1	PCB, Total	3.60E-01	mg/kg	4.6E-06	7.82E-02	7.82E-01	7.82E+00	N/A	N/A	N/A	N/A
1	Thallium	3.30E-01	mg/kg	N/A	N/A	N/A	N/A	0.4	7.82E-02	7.82E-01	2.35E+00
1	Vanadium	1.01E+02	mg/kg	N/A	N/A	N/A	N/A	0.3	3.93E+01	3.93E+02	1.18E+03
1	Cesium-137	1.67E+00	pCi/g	4.8E-05	3.51E-02	3.51E-01	3.51E+00	N/A	N/A	N/A	N/A
1	Neptunium-237	5.93E+00	pCi/g	7.70E-05	7.72E-02	7.72E-01	7.72E+00	N/A	N/A	N/A	N/A
1	Uranium-234	6.69E+01	pCi/g	1.20E-05	5.73E+00	5.73E+01	5.73E+02	N/A	N/A	N/A	N/A
1	Uranium-238	1.19E+02	pCi/g	2.40E-04	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
1	**Cumulative**			**3.8E-04**				**2.5**			

Grayed cells indicate EPC value is lower than RGO value or an RGO value is not applicable.
N/A = Not applicable because the COC was not applicable (i.e., the COC was of concern for HI, but not ELCR or it was of concern for ELCR by not HI).
[1] See Tables D.6 and D.7 (Appendix D) for EPC values.
[2] See Appendix D, Exhibit D.6, for ELCR.
[3] See Table D.47 for RGOs.
[4] See Appendix D, Exhibit D.6, for HI.
[5] RGOs for residential land use are based on exposure to a resident age 1-27. For carcinogens, the dose method incorporates age-adjusted values for the 26-year exposure duration. Because child soil ingestion rates are higher and body weights are lower, noncancer RGOs are based on the child resident exposure assumptions.

Table 5.7.4. Ecological Screening for SWMU 211-A

Ground Cover	Near a Surface Water Body?	Total HI[a]	Priority COPECs[b]	Background (mg/kg)[c]	Soil ESV (mg/kg)[d]	Maximum (mg/kg)	HQ (max conc)[a]	EPC (mg/kg)	HQ (EPC)[a]
mostly grass, but a gravel patch on the south side of the SWMU; asphalt to the south	No	1,042	Aluminum	13,000	50	8,800	176.0	8,800	176.0
			Antimony	0.21	0.27	65.23	241.59	59.9	221.7
			Iron	28,000	200	30,465	16.67	30,465	152.3
			Cadmium	0.21	0.36	6	152.33	6	16.7
			Mercury	0.2	0.1	20	200	20.9	209.0
			PCB, Total	N/A	0.02	2.5	125	4.09	204.7
			Selenium	0.8	0.52	10	19.2	13.3	25.7

Table is from Appendix E, Table E.1.
[a] Total HI includes concentrations from all of the COPECs, only priority COPECs (i.e., the COPECs with HQs greater than 10, using the EPCs) are shown in this table.
[b] Only priority COPECs are listed. See Appendix E for additional COPECs.
[c] Background value is from DOE 2015a.
[d] ESVs from DOE 2015c and Appendix E of this report.

- — Neptunium-237
- — Uranium-234
- — Uranium-238

- Excavation worker
  - — Antimony
  - — Arsenic
  - — Cobalt
  - — Iron
  - — Thallium
  - — Total PCBs
  - — Uranium-234
  - — Uranium-235
  - — Uranium-238

- Hypothetical Resident (hazards evaluated against the child resident)
  - — Antimony
  - — Iron
  - — Thallium
  - — Vanadium
  - — Total PAHs
  - — Total PCBs
  - — Cesium-137
  - — Neptunium-237
  - — Uranium-234
  - — Uranium-238

Figure 5.7.8 shows the COCs exceeding RGOs for the future industrial worker.

Priority COCs (i.e., HQ > 1 or chemical-specific ELCR > 1E-04) for SWMU 211-A are antimony and uranium-238 for the hypothetical resident. Priority COCs for other scenarios are described in Appendix D.

No priority COCs were identified for groundwater modeled from soil.

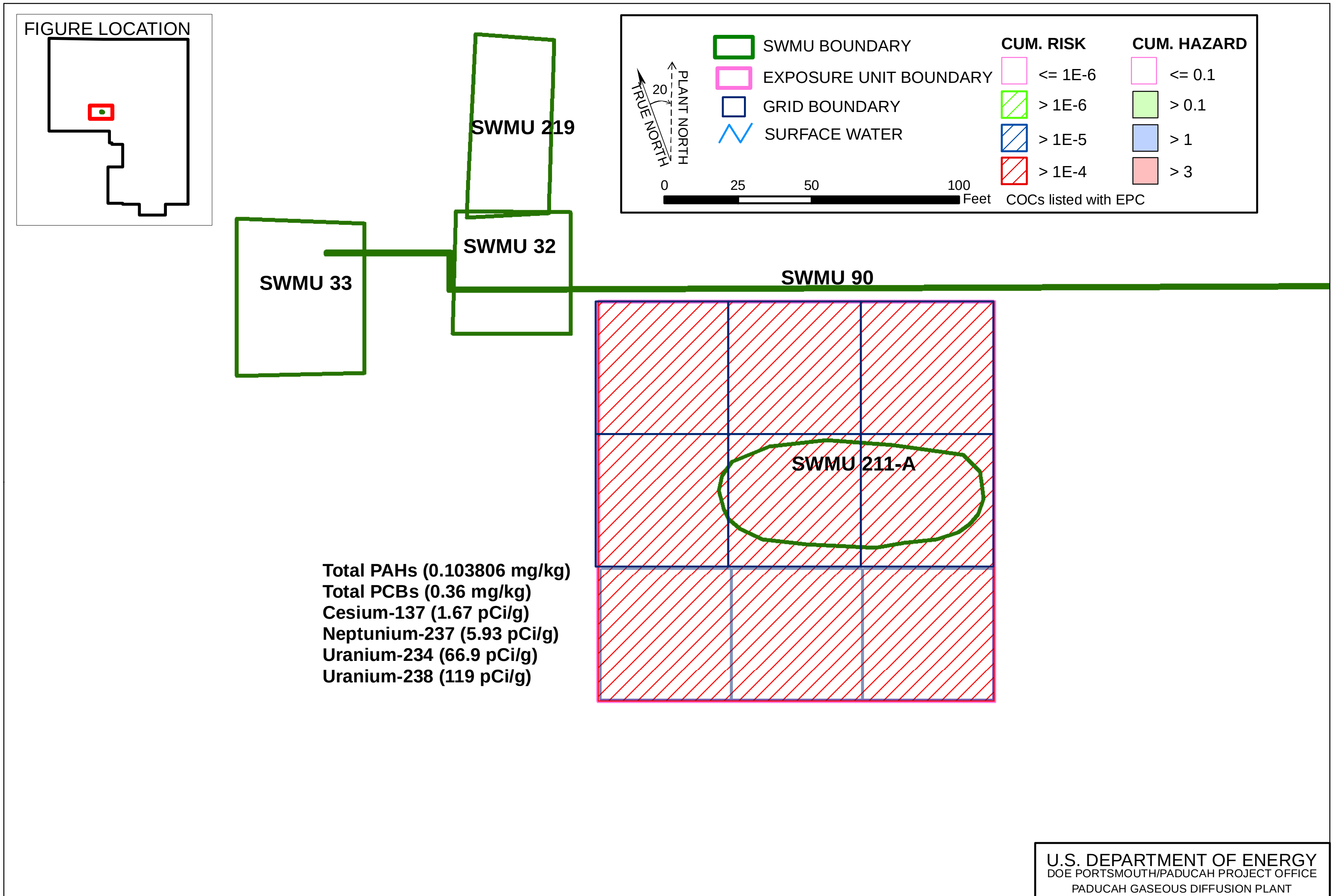

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Figure 5.7.8. Summary of COCs Contributing to Risk to the Future Industrial Worker at SWMU 211-A

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For SWMU 211-A, COPECs exceed ESVs. Priority COPECs (i.e., maximum HQ ≥ 10) are the following:

- Aluminum
- Antimony
- Cadmium
- Mercury
- Selenium
- Total PCBs

Goal 4. Support Evaluation of Remedial Alternatives

The representative data set used for SWMU 211-A is sufficient to support decision making and indicates that SWMU 211-A should proceed to the FS. An uncertainty concerning depth of contamination should be considered in the FS. Possible remedial technologies applicable for this unit, as discussed in the Work Plan (DOE 2010a), include excavation, *in situ* treatment, and/or other remedial technologies that will be described in the FS. Remedial actions for groundwater include interim LUCs discussed in the following paragraph. This SWMU is contributing to groundwater contamination in the Southwest Plume. Contamination from SWMU 211-A has migrated beyond the boundaries of the Soils OU.

Subsurface VOC-contaminated soil at SWMU 211-A is being addressed by the VOC Sources for the Southwest Plume project, as defined in the VOC Sources for the Southwest Plumes ROD (DOE 2012). Interim LUCs placed at SWMU 211-A as part of the ROD will consist of the excavation/penetration permit program and placement of warning signs to provide notice and warning of environmental contamination. The interim LUCs will remain in place pending final remedy selection as part of a subsequent OU that will address the relevant media. All non-VOC contaminated soils from 0 to 10 ft bgs at SWMU 211-A will be addressed in the Soils OU FS.

5.7.8 SWMU 211-A Conclusion

The RI defined adequately the nature and extent of contamination in soils at SWMU 211-A; an FS is appropriate for the SWMU due to cancer risk and/or noncancer hazards exceeding the decision rule benchmarks (DOE 2010a) for scenarios including future industrial worker, excavation worker, and hypothetical resident. The reasonably anticipated future land use for this SWMU is industrial land use as shown in the SMP (DOE 2015a).

5.8 SWMU 224, C-340, DMSA OS-13

5.8.1 Background

SWMU 224, the location of the former DMSA OS-13, is located south of C-340 Metals Reduction Complex in the east-central portion of the plant site. SWMU 224 is approximately 800 ft^2. Empty vendor drums used for the C-340 reroofing project were stored here, beginning in 1996. During 1997 or 1998, the drums were removed (DOE 2002b). There is no direct connection between this SWMU and surface water.

5.8.2 Fieldwork Summary

During the first RI for the Soils OU, one grid sample for surface soils only was planned and collected for the unit. Field laboratory results indicated that contingency samples were required to determine the nature and extent of contamination because of elevated concentrations of uranium. Nineteen of 38 contingency samples were collected. Some locations were not sampled because of inaccessibility due to plant operations and utilities. Appendix A contains the sample rectification map.

The unit underwent a gamma radiological walkover survey (Figure 5.8.1) using a FIDLER; the 217 measurements ranged from 6,870 to 15,988 cpm. The ground cover is mostly gravel with some soil and grass. A judgmental grab sample was collected for radiological constituents.

During the March 2014 scoping meetings, the FFA parties determined that SWMU 224 had been characterized adequately. Samples previously collected from the grid containing SWMU 224 (i.e., 224-001M) have been used to define nature and extent and to perform a risk analysis. Existing contamination in the SWMU 224 area was assumed by the FFA parties to be associated with SWMUs 56 and 80 (See Section 5.5).

5.8.3 Nature and Extent of Contamination—Surface Soils

The representative data set presented in Table 5.8.1 provides the nature of the contamination in SWMU 224 surface soils, and Figures 5.8.2–5.8.4 illustrate the horizontal extent. A complete list of sampling results is provided in Appendix F (samples with ending depths of 1 ft bgs or less or null are considered surface soils).

The lateral extent of SWMU 224 surface soil contamination is considered defined adequately for supporting the BRA and FS. SWMU 224 consists of 1 EU.

Metals

Antimony was detected in the surface soil above both the background screening level and the industrial worker NAL. No metals were detected above both the background screening level and the industrial worker ALs.

The following metals were detected in the SWMU 224 surface soil above both the SSLs for the protection of UCRS groundwater and the background screening levels (if available): antimony, barium, cadmium, molybdenum, uranium, and zinc. Additionally, antimony was detected above the SSL for the protection of RGA groundwater and the background screening level.

PCBs

Total PCBs were not detected above the industrial worker NALs or AL in the surface soil in SWMU 224. Total PCBs were not detected in the SWMU 224 surface soil above the SSLs for the protection of UCRS groundwater or for RGA groundwater.

SVOCs

Total PAHs were detected above industrial worker NALs in the surface soil in SWMU 224. No SVOCs were detected in the SWMU 224 surface soil above industrial worker ALs.

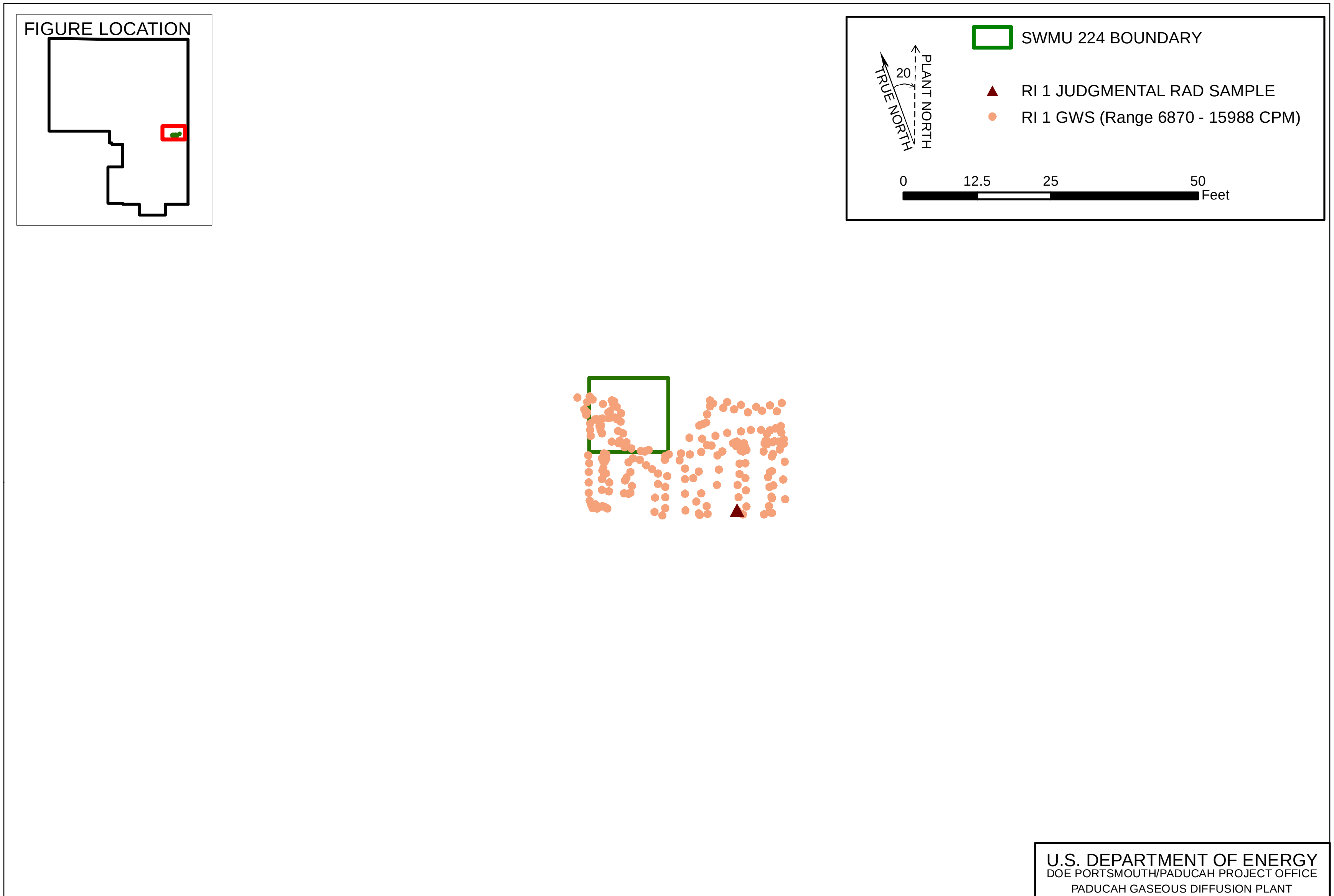

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Figure 5.8.1. SWMU 224 Gamma Walkover Survey

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Table 5.8.1. Surface Soil Data Summary: SWMU 224

Type	Analysis	Unit	Detected Results: Min	Detected Results: Max	Detected Results: Avg	J-qualified FOD	FOD	Provisional Background: FOE	Provisional Background: Bkgd	Industrial Worker: FOE	Industrial Worker: NAL	Industrial Worker: FOE	Industrial Worker: AL	GW Protection Screen: RGA	GW Protection Screen: UCRS	DL Range
METAL	Aluminum	mg/kg	4.91E+03	4.91E+03	4.91E+03	0/1	1/1	0/1	1.30E+04	0/1	1.00E+05	0/1	1.00E+05	0/1	1/1	5–5
METAL	Antimony	mg/kg	1.08E+02	1.08E+02	1.08E+02	0/1	1/1	1/1	2.10E-01	1/1	9.34E+01	0/1	2.80E+03	1/1	1/1	0.5–30
METAL	Arsenic	mg/kg	4.80E+00	4.80E+00	4.80E+00	0/1	1/1	0/1	1.20E+01	1/1	1.41E+00	0/1	1.41E+02	0/1	1/1	1–11
METAL	Barium	mg/kg	4.59E+02	4.59E+02	4.59E+02	0/1	1/1	1/1	2.00E+02	0/1	4.04E+04	0/1	1.00E+05	0/1	1/1	2–100
METAL	Beryllium	mg/kg	3.30E-01	3.30E-01	3.30E-01	0/1	1/1	0/1	6.70E-01	0/1	4.50E+02	0/1	1.35E+04	0/1	0/1	0.1–0.1
METAL	Cadmium	mg/kg	3.80E-01	3.80E-01	3.80E-01	0/1	1/1	1/1	2.10E-01	0/1	6.12E+01	0/1	1.84E+03	0/1	1/1	0.05–12
METAL	Calcium	mg/kg	1.25E+05	1.25E+05	1.25E+05	0/1	1/1	0/1	2.00E+05	0/1	N/A	0/1	N/A	N/A	N/A	252–252
METAL	Chromium	mg/kg	1.21E+01	1.21E+01	1.21E+01	0/1	1/1	0/1	1.60E+01	0/1	1.98E+02	0/1	1.98E+04	0/1	0/1	1–85
METAL	Cobalt	mg/kg	7.10E+00	7.10E+00	7.10E+00	0/1	1/1	0/1	1.40E+01	0/1	6.87E+01	0/1	2.06E+03	1/1	1/1	0.2–0.2
METAL	Copper	mg/kg	9.40E+00	9.40E+00	9.40E+00	0/1	1/1	0/1	1.90E+01	0/1	9.34E+03	0/1	1.00E+05	0/1	0/1	1–35
METAL	Iron	mg/kg	1.44E+04	1.44E+04	1.44E+04	0/1	1/1	0/1	2.80E+04	0/1	1.00E+05	0/1	1.00E+05	1/1	1/1	5–100
METAL	Lead	mg/kg	1.70E+01	1.70E+01	1.70E+01	0/1	1/1	0/1	3.60E+01	0/1	8.00E+02	0/1	8.00E+02	0/1	1/1	0.3–13
METAL	Magnesium	mg/kg	2.30E+03	2.30E+03	2.30E+03	0/1	1/1	0/1	7.70E+03	0/1	N/A	0/1	N/A	N/A	N/A	50.3–50.3
METAL	Manganese	mg/kg	4.29E+02	4.29E+02	4.29E+02	0/1	1/1	0/1	1.50E+03	0/1	4.72E+03	0/1	1.00E+05	1/1	1/1	0.2–85
METAL	Mercury	mg/kg	7.40E-03	7.40E-03	7.40E-03	0/1	1/1	0/1	2.00E-01	0/1	7.01E+01	0/1	2.10E+03	0/1	0/1	0.0335–10
METAL	Molybdenum	mg/kg	5.10E-01	5.10E-01	5.10E-01	0/1	1/1	0/1	N/A	0/1	1.17E+03	0/1	3.51E+04	0/1	1/1	0.5–15
METAL	Nickel	mg/kg	6.70E+00	6.70E+00	6.70E+00	0/1	1/1	0/1	2.10E+01	0/1	4.30E+03	0/1	1.00E+05	0/1	1/1	0.5–65
METAL	Selenium	mg/kg	5.50E-01	5.50E-01	5.50E-01	0/1	1/1	0/1	8.00E-01	0/1	1.17E+03	0/1	3.51E+04	0/1	1/1	0.5–20
METAL	Silver	mg/kg	1.50E-01	1.50E-01	1.50E-01	0/1	1/1	0/1	2.30E+00	0/1	1.17E+03	0/1	3.51E+04	0/1	1/1	0.2–10
METAL	Sodium	mg/kg	1.11E+02	1.11E+02	1.11E+02	0/1	1/1	0/1	3.20E+02	0/1	N/A	0/1	N/A	N/A	N/A	20.1–20.1
METAL	Thallium	mg/kg	1.20E-01	1.20E-01	1.20E-01	0/1	1/1	0/1	2.10E-01	0/1	2.34E+00	0/1	7.02E+01	0/1	0/1	0.2–0.2
METAL	Uranium	mg/kg	3.27E+01	4.15E+01	3.49E+01	0/2	2/2	2/2	4.90E+00	0/2	6.81E+02	0/2	2.04E+04	0/2	2/2	0.07–20
METAL	Vanadium	mg/kg	1.64E+01	1.64E+01	1.64E+01	0/1	1/1	0/1	3.80E+01	0/1	1.15E+03	0/1	3.45E+04	0/1	1/1	1–70
METAL	Zinc	mg/kg	1.09E+02	1.09E+02	1.09E+02	0/1	1/1	1/1	6.50E+01	0/1	7.01E+04	0/1	1.00E+05	0/1	1/1	2–25
PPCB	PCB, Total	mg/kg	4.90E-02	4.90E-02	4.90E-02	0/2	1/2	0/2	N/A	0/2	3.05E-01	0/2	3.05E+01	0/2	0/2	0.033–0.033
SVOA	1,2,4-Trichlorobenzene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	1,2-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	1,3-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	1,4-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	2,4,5-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	2,4,6-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	2,4-Dichlorophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	2,4-Dimethylphenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	2,4-Dinitrophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	1.6–1.6
SVOA	2,4-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	2,6-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	2-Chloronaphthalene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	2-Chlorophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	2-Methyl-4,6-dinitrophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	1.6–1.6
SVOA	2-Methylnaphthalene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	2-Methylphenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	2-Nitrobenzenamine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	2.91E+02	0/1	8.73E+03	0/1	0/1	1.6–1.6
SVOA	2-Nitrophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	3,3'-Dichlorobenzidine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	1.6–1.6
SVOA	3-Nitrobenzenamine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	1.6–1.6
SVOA	4-Bromophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	4-Chloro-3-methylphenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	4-Chlorobenzenamine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	4-Chlorophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	4-Nitrophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	1.6–1.6
SVOA	Acenaphthene	mg/kg	5.30E-02	5.30E-02	5.30E-02	1/1	1/1	0/1	N/A	0/1	1.40E+03	0/1	4.20E+04	0/1	0/1	0.33–0.33
SVOA	Acenaphthylene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	1.40E+03	0/1	4.20E+04	N/A	N/A	0.33–0.33
SVOA	Anthracene	mg/kg	1.10E-01	1.10E-01	1.10E-01	1/1	1/1	0/1	N/A	0/1	6.99E+03	0/1	2.10E+05	0/1	0/1	0.33–0.33

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.8.1. Surface Soil Data Summary: SWMU 224 (Continued)

Type	Analysis	Unit	Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
			Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
SVOA	Benzenemethanol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	Benzo(ghi)perylene	mg/kg	2.80E-01	2.80E-01	2.80E-01	1/1	1/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	Benzoic acid	mg/kg	4.50E-01	4.50E-01	4.50E-01	1/1	1/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	1.6–1.6
SVOA	Bis(2-chloroethoxy)methane	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	Bis(2-chloroethyl) ether	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.0066–0.0066
SVOA	Bis(2-chloroisopropyl) ether	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	Bis(2-ethylhexyl)phthalate	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	5.88E+01	0/1	5.88E+03	0/1	0/1	0.33–0.33
SVOA	Butyl benzyl phthalate	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	Dibenzofuran	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	Diethyl phthalate	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	Dimethyl phthalate	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	Di-n-butyl phthalate	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	Di-n-octylphthalate	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	Fluoranthene	mg/kg	8.90E-01	8.90E-01	8.90E-01	0/1	1/1	0/1	N/A	0/1	9.32E+02	0/1	2.80E+04	0/1	0/1	0.33–0.33
SVOA	Fluorene	mg/kg	5.10E-02	5.10E-02	5.10E-02	1/1	1/1	0/1	N/A	0/1	9.32E+02	0/1	2.80E+04	0/1	0/1	0.33–0.33
SVOA	Hexachlorobenzene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	5.15E-01	0/1	5.15E+01	0/1	0/1	0.33–0.33
SVOA	Hexachlorobutadiene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	Hexachlorocyclopentadiene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	1.6–1.6
SVOA	Hexachloroethane	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	Isophorone	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	m,p-Cresol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.66–0.66
SVOA	Naphthalene	mg/kg	5.90E-02	5.90E-02	5.90E-02	1/1	1/1	0/1	N/A	0/1	1.67E+01	0/1	1.61E+03	1/1	1/1	0.33–0.33
SVOA	Nitrobenzene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	1.6–1.6
SVOA	N-Nitroso-di-n-propylamine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	1.18E-01	0/1	1.18E+01	0/1	0/1	0.0066–0.0066
SVOA	N-Nitrosodiphenylamine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	PAH, Total	mg/kg	5.95E-01	5.95E-01	5.95E-01	0/1	1/1	0/1	N/A	1/1	8.94E-02	0/1	8.94E+00	0/1	1/1	–
SVOA	Pentachlorophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	8.91E-01	0/1	8.91E+01	N/A	N/A	1.6–1.6
SVOA	Phenanthrene	mg/kg	5.00E-01	5.00E-01	5.00E-01	0/1	1/1	0/1	N/A	0/1	1.40E+03	0/1	4.20E+04	0/1	1/1	0.33–0.33
SVOA	Phenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.33–0.33
SVOA	p-Nitroaniline	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	1.6–1.6
SVOA	Pyrene	mg/kg	7.80E-01	7.80E-01	7.80E-01	0/1	1/1	0/1	N/A	0/1	6.99E+02	0/1	2.10E+04	0/1	0/1	0.33–0.33
SVOA	Pyridine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.66–0.66
RADS	Americium-241	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	5.99E+00	0/2	5.99E+02	0/2	0/2	0.018–0.022
RADS	Cesium-137	pCi/g	3.70E-01	3.70E-01	3.70E-01	0/2	1/2	0/2	4.90E-01	1/2	1.02E-01	0/2	1.02E+01	0/2	0/2	0.1–0.12
RADS	Neptunium-237	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	1.00E-01	0/2	2.29E-01	0/2	2.29E+01	0/2	0/2	0.012–0.065
RADS	Plutonium-238	pCi/g	2.60E-02	2.60E-02	2.60E-02	0/2	1/2	0/2	7.30E-02	0/2	2.87E+01	0/2	2.87E+03	0/2	0/2	0.021–0.022
RADS	Plutonium-239/240	pCi/g	3.40E-02	3.40E-02	3.40E-02	0/2	1/2	1/2	2.50E-02	0/2	2.47E+01	0/2	2.47E+03	0/2	0/2	0.015–0.016
RADS	Technetium-99	pCi/g	4.80E-01	4.80E-01	4.80E-01	0/2	1/2	0/2	2.50E+00	0/2	1.20E+03	0/2	1.20E+05	1/2	1/2	0.44–0.48
RADS	Thorium-228	pCi/g	5.05E-01	9.30E-01	7.18E-01	0/2	2/2	0/2	1.60E+00	0/2	N/A	0/2	N/A	N/A	N/A	0.02–0.04
RADS	Thorium-230	pCi/g	6.63E-01	1.15E+00	9.07E-01	0/2	2/2	0/2	1.50E+00	0/2	3.39E+01	0/2	3.39E+03	0/2	0/2	0.02–0.026
RADS	Thorium-232	pCi/g	3.77E-01	9.70E-01	6.74E-01	0/2	2/2	0/2	1.50E+00	0/2	N/A	0/2	N/A	N/A	N/A	0.018–0.02
RADS	Uranium-234	pCi/g	1.31E+00	2.35E+00	1.83E+00	0/2	2/2	2/2	1.20E+00	0/2	5.53E+01	0/2	5.53E+03	0/2	2/2	0.03–0.07
RADS	Uranium-235	pCi/g	1.08E-01	2.50E-01	1.79E-01	0/2	2/2	2/2	6.00E-02	0/2	3.40E-01	0/2	3.40E+01	0/2	2/2	0.01–0.08
RADS	Uranium-238	pCi/g	5.73E+00	1.39E+01	9.82E+00	0/2	2/2	2/2	1.20E+00	2/2	1.60E+00	0/2	1.60E+02	2/2	2/2	0.02–0.06

One or more samples exceed AL value
One or more samples exceed NAL value
One or more samples exceed background value
One or more samples exceed SSLs of RGA and UCRS groundwater protection

Counts of analyses are based on the maximum detected result from a sample (i.e., if a sample has analytical results from two different labs, only the maximum value is counted).
Field replicates, or separate samples are counted independently.

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.8.1. Surface Soil Data Summary: SWMU 224 (Continued)

Type	Analysis	Unit	Detected Results			J-qualified	FOD	Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		DL Range
			Min	Max	Avg	FOD		FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	

The uranium (metal)/uranium (isotopic) may not be from the same sample thus a correlation between uranium (metal)/uranium (isotopic) data may not be possible.
Uranium-238 that was analyzed using method RL-7128NITRIC is compared to a background value of 0.4 pCi/g for surface and subsurface.

Screening values are shown in Appendices C and D.

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

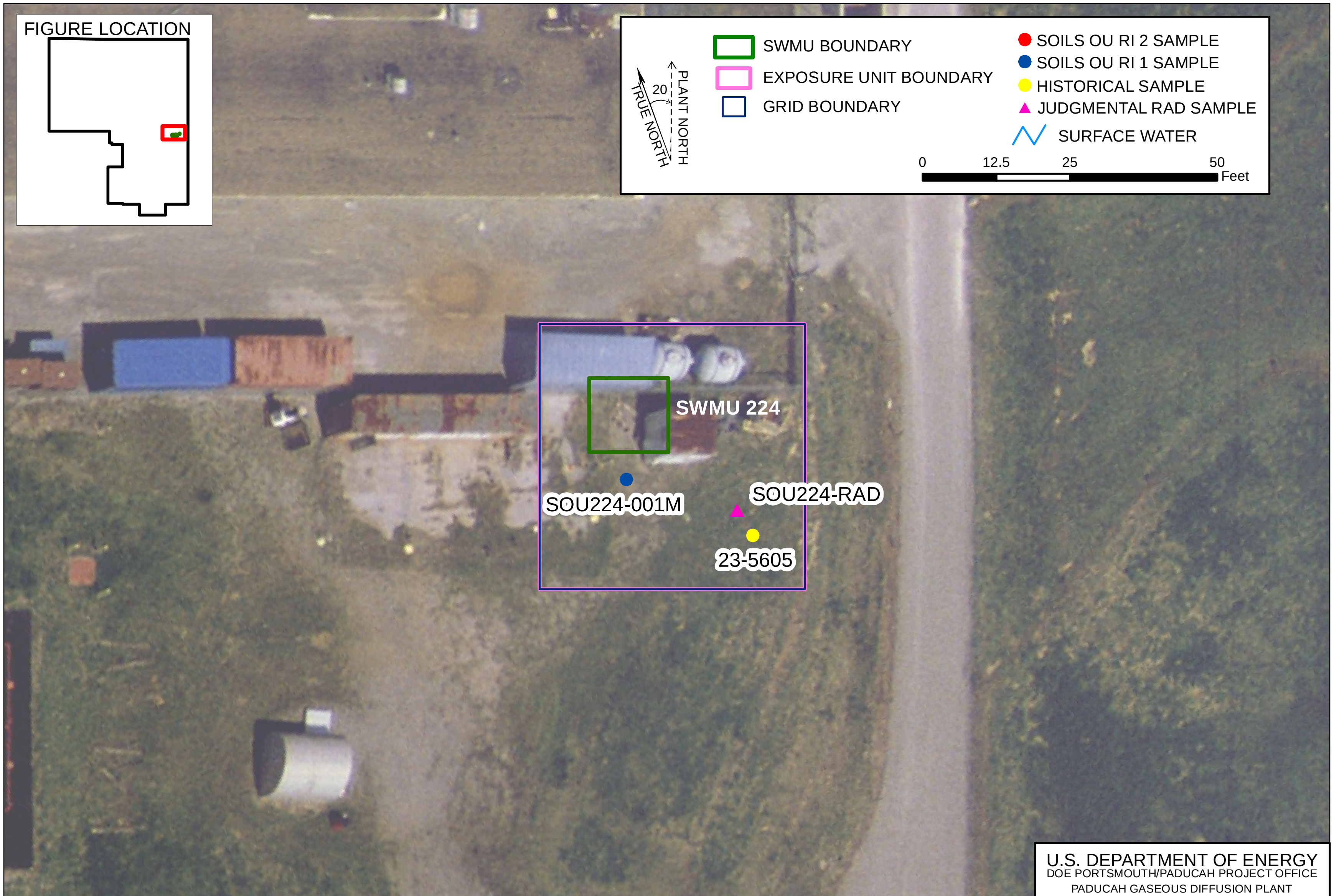

Figure 5.8.2. SWMU 224 Sample Locations—Surface Soil

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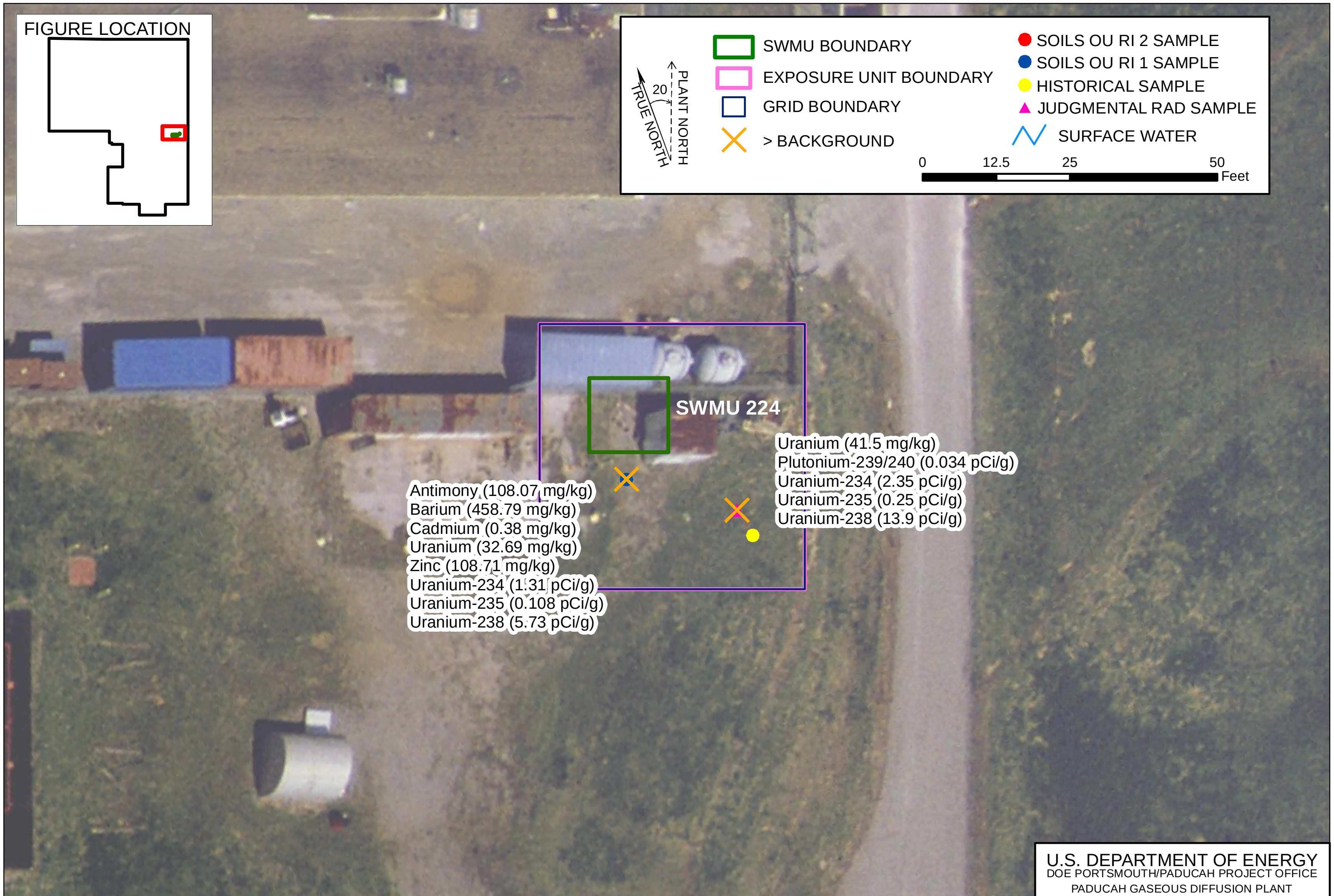
1/8/2015



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PADUCAH GASEOUS DIFFUSION PLANT

Figure 5.8.3. SWMU 224 Background Exceedances—Surface Soil

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3/13/2015

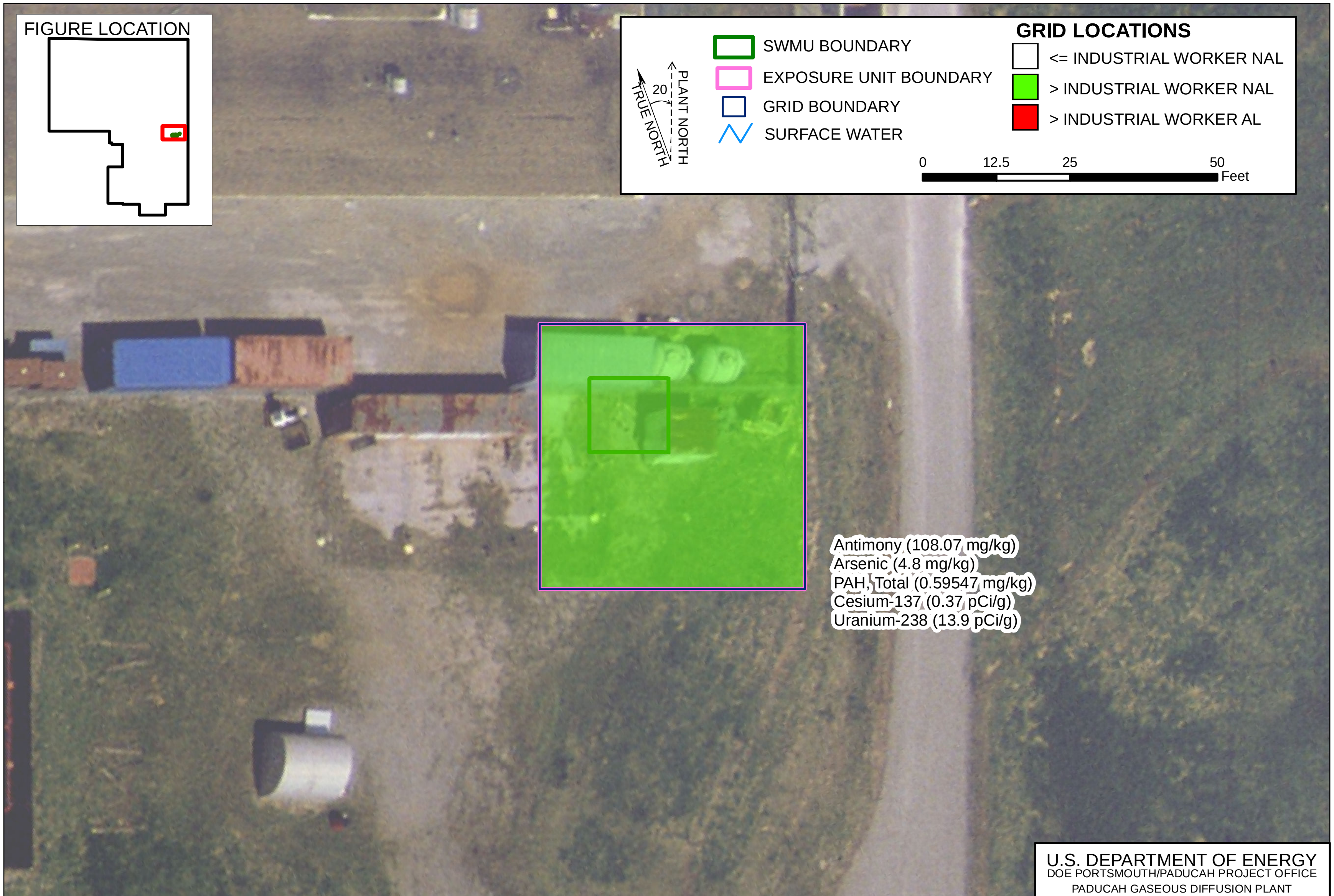

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Figure 5.8.4. SWMU 224 NAL Exceedances—Surface Soil

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Of the SVOCs, naphthalene, phenanthrene, and Total PAHs were detected above the SSLs for the protection of UCRS groundwater. Naphthalene was detected above the SSL for the protection of RGA groundwater.

VOCs

No VOCs were analyzed in the SWMU 224 surface soil.

Radionuclides

Uranium-238 was above both the background screening level and the industrial worker NAL. No radionuclides were detected above industrial worker ALs in the SWMU 224 surface soil.

The following were detected above both the background screening levels and SSLs for the protection of UCRS: uranium-234, uranium-235, and uranium-238. Additionally, uranium-238 was detected above both the background screening levels and the SSL for the protection of RGA groundwater.

5.8.4 Nature and Extent of Contamination—Subsurface Soils

The representative data set presented in Table 5.8.2 provides the nature of contamination in SWMU 224 subsurface soils, and Figures 5.8.5–5.8.7 illustrate the horizontal extent. A complete list of detailed sampling results, including sampling depths, is provided in Appendix F (samples with ending depths greater than 1 ft bgs are considered subsurface soils in this nature and extent section).

The horizontal and vertical extent of SWMU 224 subsurface soil contamination is considered defined adequately for supporting the BRA and FS. There is some uncertainty with vertical extent; however, this will be addressed in the FS.

Metals

Arsenic was detected above both the industrial worker NALs and background screening levels in the SWMU 224 subsurface soil. The metals were detected above industrial worker NALs to a maximum depth of 7 ft bgs. No metals were detected above the industrial worker ALs in the SWMU 224 subsurface soil.

The following metals were detected in the SWMU 224 subsurface soil above both the background screening levels (if available) and the SSLs for the protection of UCRS groundwater: antimony, arsenic, barium, molybdenum, nickel, selenium, and zinc. Additionally, antimony was detected above both its subsurface background screening level and the SSL for the protection of RGA groundwater.

PCBs

Total PCBs were not detected above industrial worker NALs or ALs in the subsurface soil. Total PCBs were not detected above the SSLs for the protection of the UCRS or above the SSLs for the protection of the RGA.

SVOCs

No SVOCs were detected above industrial worker NALs or ALs in the SWMU 224 subsurface soil. SVOCs were not detected above the SSLs for the protection of UCRS groundwater or above the SSLs for the protection of RGA groundwater.

Table 5.8.2. Subsurface Soil Data Summary: SWMU 224

			Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
Type	Analysis	Unit	Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
METAL	Aluminum	mg/kg	8.03E+03	8.03E+03	8.03E+03	0/1	1/1	0/1	1.20E+04	0/1	1.00E+05	0/1	1.00E+05	0/1	1/1	5.4–5.4
METAL	Antimony	mg/kg	6.21E+01	8.03E+01	7.37E+01	0/3	3/3	3/3	2.10E-01	0/3	9.34E+01	0/3	2.80E+03	3/3	3/3	0.54–30
METAL	Arsenic	mg/kg	5.55E+00	1.00E+01	8.42E+00	0/3	3/3	2/3	7.90E+00	3/3	1.41E+00	0/3	1.41E+02	0/3	3/3	1.1–11
METAL	Barium	mg/kg	4.51E+02	5.69E+02	5.38E+02	0/3	3/3	3/3	1.70E+02	0/3	4.04E+04	0/3	1.00E+05	0/3	3/3	2.1–100
METAL	Beryllium	mg/kg	6.30E-01	6.30E-01	6.30E-01	0/1	1/1	0/1	6.90E-01	0/1	4.50E+02	0/1	1.35E+04	0/1	0/1	0.11–0.11
METAL	Cadmium	mg/kg	5.70E-02	5.70E-02	5.70E-02	0/3	1/3	0/3	2.10E-01	0/3	6.12E+01	0/3	1.84E+03	0/3	0/3	0.054–12
METAL	Calcium	mg/kg	2.56E+04	2.56E+04	2.56E+04	0/1	1/1	1/1	6.10E+03	0/1	N/A	0/1	N/A	N/A	N/A	53.7–53.7
METAL	Chromium	mg/kg	5.05E+01	6.50E+01	5.53E+01	0/3	2/3	2/3	4.30E+01	0/3	1.98E+02	0/3	1.98E+04	0/3	0/3	1.1–85
METAL	Cobalt	mg/kg	7.60E+00	7.60E+00	7.60E+00	0/1	1/1	0/1	1.30E+01	0/1	6.87E+01	0/1	2.06E+03	1/1	1/1	0.21–0.21
METAL	Copper	mg/kg	9.60E+00	9.60E+00	9.60E+00	0/3	1/3	0/3	2.50E+01	0/3	9.34E+03	0/3	1.00E+05	0/3	0/3	1.1–35
METAL	Iron	mg/kg	1.20E+04	2.10E+04	1.76E+04	0/3	3/3	0/3	2.80E+04	0/3	1.00E+05	0/3	1.00E+05	3/3	3/3	5.4–100
METAL	Lead	mg/kg	8.31E+00	1.42E+01	1.13E+01	0/3	3/3	0/3	2.30E+01	0/3	8.00E+02	0/3	8.00E+02	0/3	1/3	0.32–13
METAL	Magnesium	mg/kg	1.62E+03	1.62E+03	1.62E+03	0/1	1/1	0/1	2.10E+03	0/1	N/A	0/1	N/A	N/A	N/A	53.7–53.7
METAL	Manganese	mg/kg	1.77E+02	6.26E+02	4.61E+02	0/3	3/3	0/3	8.20E+02	0/3	4.72E+03	0/3	1.00E+05	3/3	3/3	0.21–85
METAL	Mercury	mg/kg	1.00E-02	1.00E-02	1.00E-02	0/3	1/3	0/3	1.30E-01	0/3	7.01E+01	0/3	2.10E+03	0/3	0/3	0.0358–10
METAL	Molybdenum	mg/kg	7.00E-01	7.00E-01	7.00E-01	0/3	1/3	0/3	N/A	0/3	1.17E+03	0/3	3.51E+04	0/3	1/3	0.54–15
METAL	Nickel	mg/kg	1.07E+01	5.84E+01	2.66E+01	0/3	2/3	1/3	2.20E+01	0/3	4.30E+03	0/3	1.00E+05	0/3	2/3	0.54–65
METAL	Selenium	mg/kg	9.80E-01	9.80E-01	9.80E-01	0/3	1/3	1/3	7.00E-01	0/3	1.17E+03	0/3	3.51E+04	0/3	1/3	0.54–20
METAL	Silver	mg/kg	3.40E-02	3.40E-02	3.40E-02	0/3	1/3	0/3	2.70E+00	0/3	1.17E+03	0/3	3.51E+04	0/3	0/3	0.21–10
METAL	Sodium	mg/kg	1.11E+02	1.11E+02	1.11E+02	0/1	1/1	0/1	3.40E+02	0/1	N/A	0/1	N/A	N/A	N/A	21.5–21.5
METAL	Thallium	mg/kg	1.70E-01	1.70E-01	1.70E-01	0/1	1/1	0/1	3.40E-01	0/1	2.34E+00	0/1	7.02E+01	0/1	1/1	0.21–0.21
METAL	Uranium	mg/kg	3.08E+00	3.08E+00	3.08E+00	0/3	1/3	0/3	4.60E+00	0/3	6.81E+02	0/3	2.04E+04	0/3	0/3	0.02–20
METAL	Vanadium	mg/kg	3.05E+01	3.05E+01	3.05E+01	0/3	1/3	0/3	3.70E+01	0/3	1.15E+03	0/3	3.45E+04	0/3	1/3	1.1–70
METAL	Zinc	mg/kg	3.37E+01	6.40E+01	5.35E+01	0/3	3/3	1/3	6.00E+01	0/3	7.01E+04	0/3	1.00E+05	0/3	2/3	2.1–25
PPCB	PCB, Total	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	3.05E-01	0/1	3.05E+01	0/1	0/1	0.32–0.32
SVOA	1,2,4-Trichlorobenzene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	1,2-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	1,3-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	1,4-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	2,4,5-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	2,4,6-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	2,4-Dichlorophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	2,4-Dimethylphenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	2,4-Dinitrophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	1.7–1.7
SVOA	2,4-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	2,6-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	2-Chloronaphthalene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	2-Chlorophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	2-Methyl-4,6-dinitrophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	1.7–1.7
SVOA	2-Methylnaphthalene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	2-Methylphenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	2-Nitrobenzenamine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	2.91E+02	0/1	8.73E+03	0/1	0/1	1.7–1.7
SVOA	2-Nitrophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	3,3'-Dichlorobenzidine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	1.7–1.7
SVOA	3-Nitrobenzenamine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	1.7–1.7
SVOA	4-Bromophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	4-Chloro-3-methylphenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	4-Chlorobenzenamine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	4-Chlorophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	4-Nitrophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	1.7–1.7
SVOA	Acenaphthene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	1.40E+03	0/1	4.20E+04	0/1	0/1	0.35–0.35
SVOA	Acenaphthylene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	1.40E+03	0/1	4.20E+04	N/A	N/A	0.35–0.35
SVOA	Anthracene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	6.99E+03	0/1	2.10E+05	0/1	0/1	0.35–0.35

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.8.2. Subsurface Soil Data Summary: SWMU 224 (Continued)

Type	Analysis	Unit	Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
			Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
SVOA	Benzenemethanol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	Benzo(ghi)perylene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	Benzoic acid	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	1.7–1.7
SVOA	Bis(2-chloroethoxy)methane	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	Bis(2-chloroethyl) ether	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.0071–0.0071
SVOA	Bis(2-chloroisopropyl) ether	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	Bis(2-ethylhexyl)phthalate	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	5.88E+01	0/1	5.88E+03	0/1	0/1	0.35–0.35
SVOA	Butyl benzyl phthalate	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	Dibenzofuran	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	Diethyl phthalate	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	Dimethyl phthalate	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	Di-n-butyl phthalate	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	Di-n-octylphthalate	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	Fluoranthene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	9.32E+02	0/1	2.80E+04	0/1	0/1	0.35–0.35
SVOA	Fluorene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	9.32E+02	0/1	2.80E+04	0/1	0/1	0.35–0.35
SVOA	Hexachlorobenzene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	5.15E-01	0/1	5.15E+01	0/1	0/1	0.35–0.35
SVOA	Hexachlorobutadiene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	Hexachlorocyclopentadiene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	1.7–1.7
SVOA	Hexachloroethane	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	Isophorone	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	m,p-Cresol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.71–0.71
SVOA	Naphthalene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	1.67E+01	0/1	1.61E+03	0/1	0/1	0.35–0.35
SVOA	Nitrobenzene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	1.7–1.7
SVOA	N-Nitroso-di-n-propylamine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	1.18E-01	0/1	1.18E+01	0/1	0/1	0.0071–0.0071
SVOA	N-Nitrosodiphenylamine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	PAH, Total	mg/kg	1.10E-02	1.10E-02	1.10E-02	0/1	1/1	0/1	N/A	0/1	8.94E-02	0/1	8.94E+00	0/1	0/1	–
SVOA	Pentachlorophenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	8.91E-01	0/1	8.91E+01	N/A	N/A	1.7–1.7
SVOA	Phenanthrene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	1.40E+03	0/1	4.20E+04	0/1	0/1	0.35–0.35
SVOA	Phenol	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.35–0.35
SVOA	p-Nitroaniline	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	1.7–1.7
SVOA	Pyrene	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	6.99E+02	0/1	2.10E+04	0/1	0/1	0.35–0.35
SVOA	Pyridine	mg/kg	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	N/A	0/1	N/A	N/A	N/A	0.71–0.71
RADS	Americium-241	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	5.99E+00	0/1	5.99E+02	0/1	0/1	0.024–0.024
RADS	Cesium-137	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	2.80E-01	0/1	1.02E-01	0/1	1.02E+01	0/1	0/1	0.12–0.12
RADS	Neptunium-237	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	2.29E-01	0/1	2.29E+01	0/1	0/1	0.02–0.02
RADS	Plutonium-238	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	2.87E+01	0/1	2.87E+03	0/1	0/1	0.021–0.021
RADS	Plutonium-239/240	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	N/A	0/1	2.47E+01	0/1	2.47E+03	0/1	0/1	0.0065–0.0065
RADS	Technetium-99	pCi/g	N/A	N/A	N/A	0/1	0/1	0/1	2.80E+00	0/1	1.20E+03	0/1	1.20E+05	0/1	0/1	0.44–0.44
RADS	Thorium-228	pCi/g	1.02E+00	1.02E+00	1.02E+00	0/1	1/1	0/1	1.60E+00	0/1	N/A	0/1	N/A	N/A	N/A	0.03–0.03
RADS	Thorium-230	pCi/g	1.05E+00	1.05E+00	1.05E+00	0/1	1/1	0/1	1.40E+00	0/1	3.39E+01	0/1	3.39E+03	0/1	0/1	0.01–0.01
RADS	Thorium-232	pCi/g	1.04E+00	1.04E+00	1.04E+00	0/1	1/1	0/1	1.50E+00	0/1	N/A	0/1	N/A	N/A	N/A	0.007–0.007
RADS	Uranium-234	pCi/g	8.60E-01	8.60E-01	8.60E-01	0/1	1/1	0/1	1.20E+00	0/1	5.53E+01	0/1	5.53E+03	0/1	1/1	0.02–0.02
RADS	Uranium-235	pCi/g	4.80E-02	4.80E-02	4.80E-02	0/1	1/1	0/1	6.00E-02	0/1	3.40E-01	0/1	3.40E+01	0/1	0/1	0.009–0.009
RADS	Uranium-238	pCi/g	1.03E+00	1.03E+00	1.03E+00	0/1	1/1	0/1	1.20E+00	0/1	1.60E+00	0/1	1.60E+02	0/1	1/1	0.007–0.007

One or more samples exceed AL value
One or more samples exceed NAL value
One or more samples exceed background value
One or more samples exceed SSLs of RGA and UCRS groundwater protection

Counts of analyses are based on the maximum detected result from a sample (i.e., if a sample has analytical results from two different labs, only the maximum value is counted).
Field replicates, or separate samples are counted independently.

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.8.2. Subsurface Soil Data Summary: SWMU 224 (Continued)

			Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
Type	Analysis	Unit	Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range

The uranium (metal)/uranium (isotopic) may not be from the same sample thus a correlation between uranium (metal)/uranium (isotopic) data may not be possible.
Uranium-238 that was analyzed using method RL-7128NITRIC is compared to a background value of 0.4 pCi/g for surface and subsurface.

Screening values are shown in Appendices C and D.

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

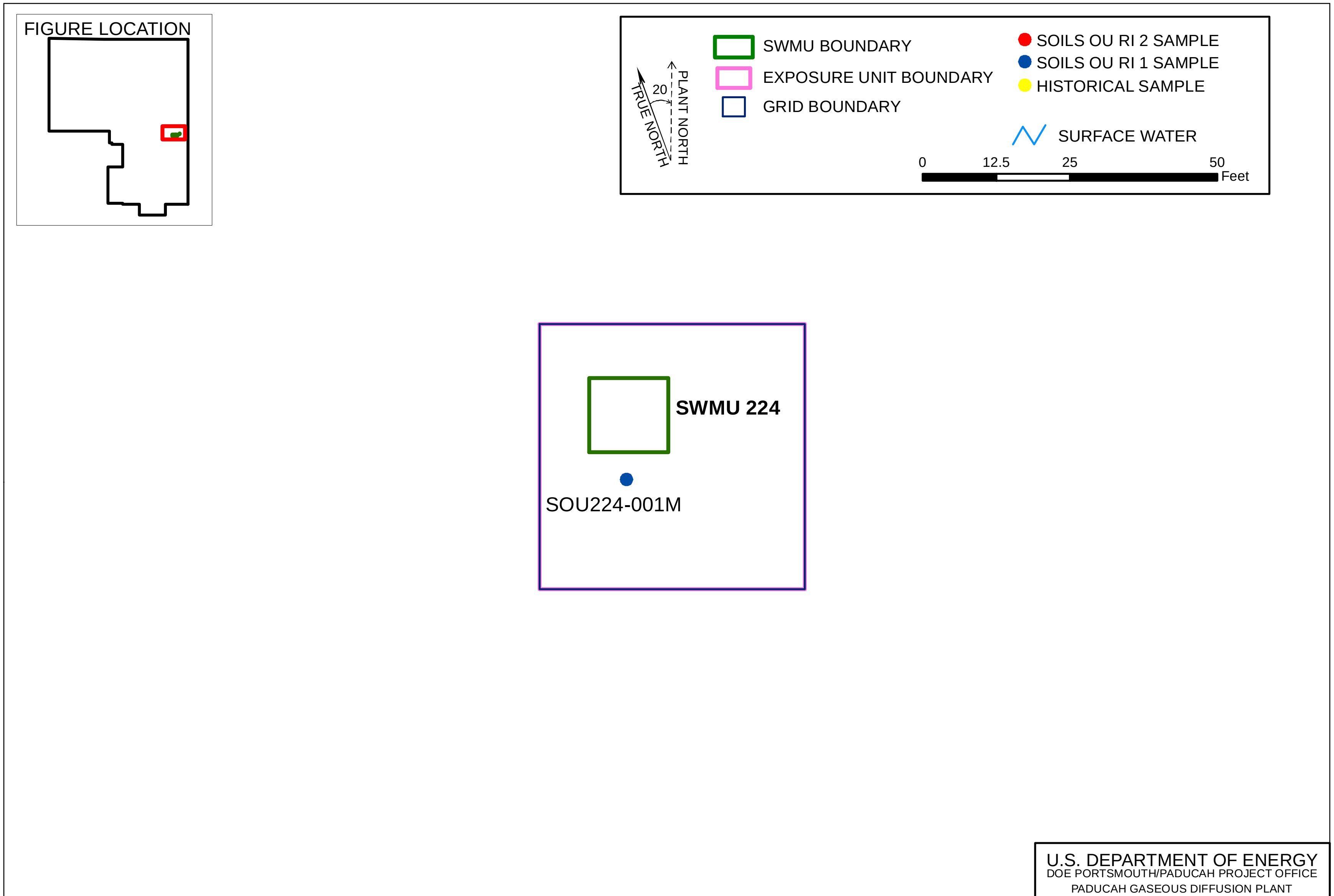

Figure 5.8.5. SWMU 224 Sample Locations—Subsurface Soil

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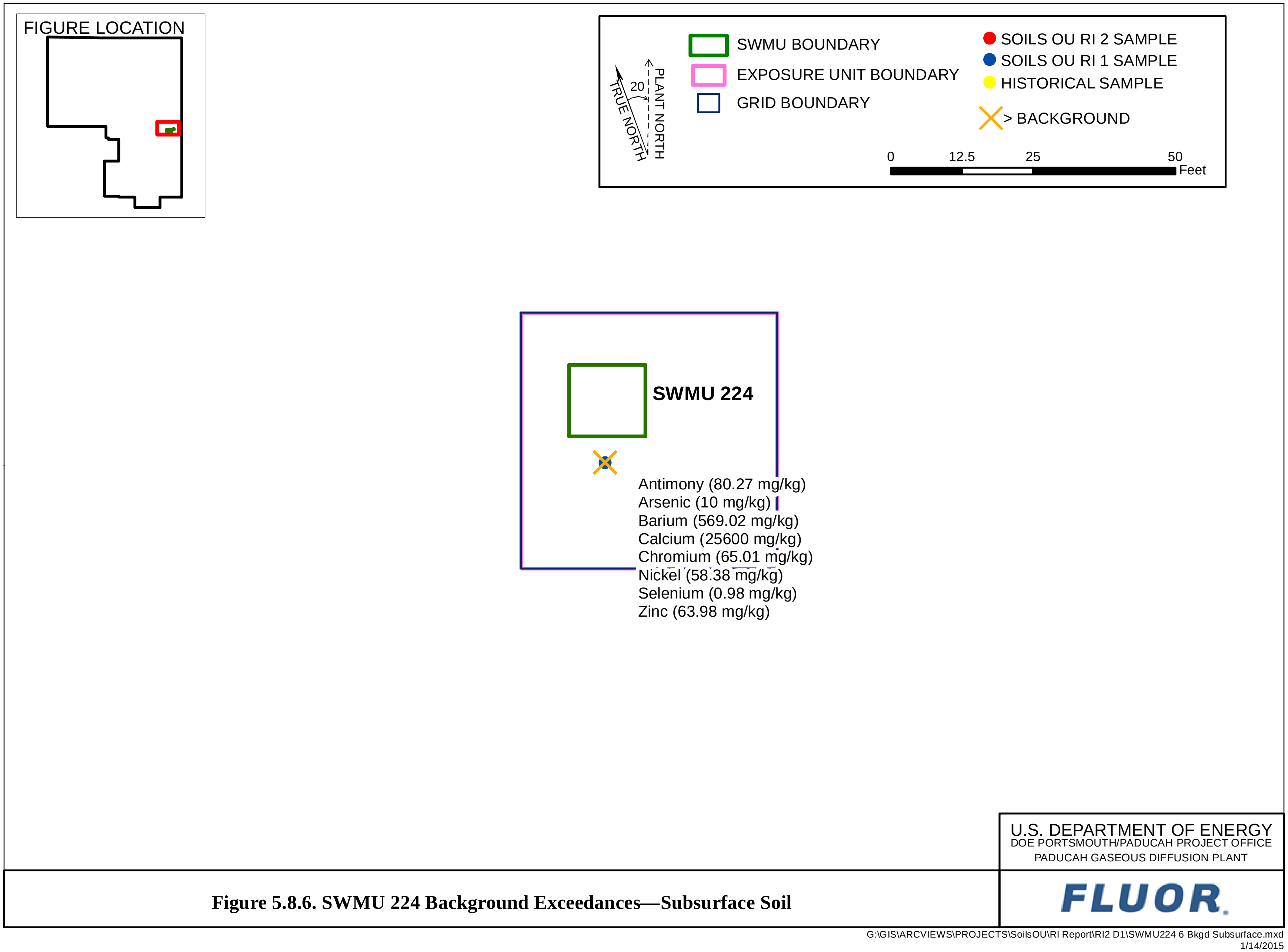

Figure 5.8.6. SWMU 224 Background Exceedances—Subsurface Soil

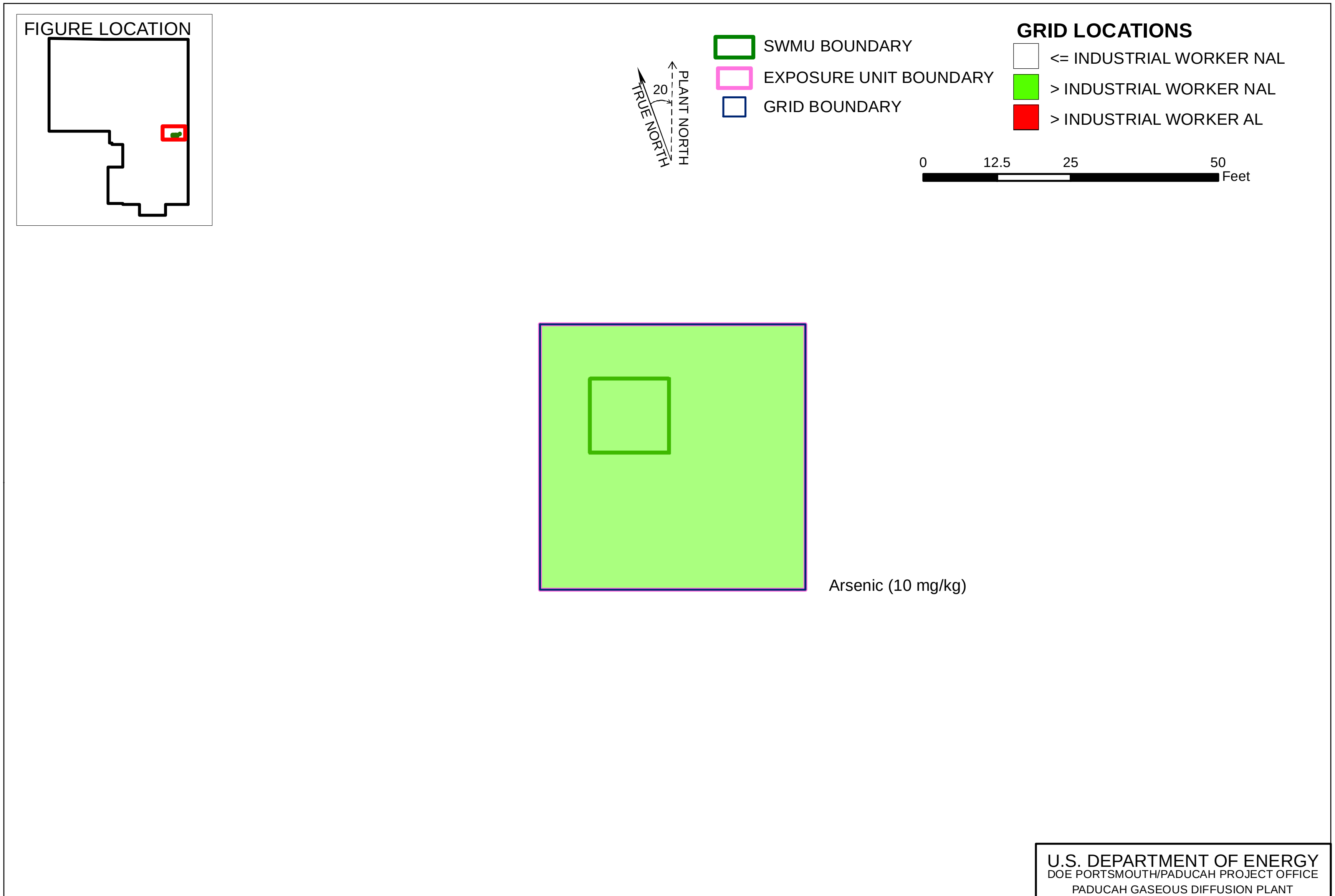

Figure 5.8.7. SWMU 224 NAL Exceedances—Subsurface Soil

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VOCs

No VOCs were analyzed in subsurface soil samples at SWMU 224.

Radionuclides

Radionuclides were not detected above both the background screening levels and the industrial worker NALs or ALs in the SWMU 224 subsurface soil.

No radionuclides were detected in the SWMU 224 subsurface soil above both the background screening levels and the SSLs for the protection of UCRS groundwater. Radionuclides were not detected in the SWMU 224 subsurface soil above the SSLs for the protection of RGA groundwater.

5.8.5 Fate and Transport

No target chemicals were identified for further evaluation under fate and transport (Chapter 4). There is no concern for potential runoff from SWMU 224. Contaminants present at this SWMU are unlikely to migrate due to the physical cover at the SWMU, which limits the potential for particulate transport through sheet flow, and there is no direct connection to surface water from this SWMU. A removal action for the contaminated sediment associated with SWOU (On-Site) (DOE 2011a) was conducted for Outfalls 001, 008, 010, 011, 015, and associated internal ditches. A final response action for internal ditches, outfalls, and creeks will be addressed by the SWOU, as described in the SMP (DOE 2015a).

5.8.6 Baseline Risk Assessment

Human Health. Potential risks and hazards for current/future human health for SWMU 224 were evaluated for direct contact. These results are summarized in Appendix D and in the subsections that follow, including the COCs and relative contributions to the overall ELCR/HI.

The cumulative ELCR and the cumulative HI for SWMU 224 exceed the benchmarks of cumulative ELCR of 1E-06 and cumulative HI greater than 1, respectively, for one or more scenarios; therefore, as stated in the Work Plan, Decision Rule D1a, (DOE 2010a), this SWMU will be evaluated in the FS. As described in the BHHRA (Appendix D), COCs were identified after considering the results of the risk characterization and the uncertainties affecting the results.

COCs were identified as those COPCs considered to contribute at least 1E-06 ELCR or 0.1 HI to a scenario of concern. The basis for COC identification is presented in Appendix D. The identified COCs considered to contribute to the ELCR/HI, the EPC, and the RGOs calculated for a range of ELCR/HI benchmarks are presented in Table 5.8.3 for the future industrial worker, excavation worker, and the hypothetical resident. Table 5.8.3 also compares the EPC to the RGO for each COC under each exposure scenario. Table 5.8.3 summarizes the ELCR/HI posed by the COCs for this SWMU under each exposure scenario by depicting the maximum ELCR/HI contribution per COC.

Ecological Screening. COPECs for SWMU 224 include metals, SVOCs, and PCBs. Potential hazards for ecological receptors and the associated priority COPECs (maximum HQ $\geq$ 10) are summarized in Table 5.8.4.

Table 5.8.3. RGOs for SWMU 224

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3]			HI[4]	RGOs for HI[3]		
					1E-06	1E-05	1E-04		0.1	1	3
Future Industrial Worker											
1	PAH, Total	5.95E-01	mg/kg	6.7E-06	8.94E-02	8.94E-01	8.94E+00	< 0.1	N/A	N/A	N/A
1	Uranium-238	1.39E+01	pCi/g	8.4E-06	1.65E+00	1.65E+01	1.65E+02	N/A	N/A	N/A	N/A
1	**Cumulative**			**1.5E-05**				**< 1**			
Excavation Worker											
1	Arsenic	1.00E+01	mg/kg	4.0E-06	2.52E+00	2.52E+01	2.52E+02	0.1	8.09E+00	8.09E+01	2.43E+02
1	PAH, Total	5.95E-01	mg/kg	1.8E-06	3.25E-01	3.25E+00	3.25E+01	< 0.1	N/A	N/A	N/A
1	Uranium-238	1.39E+01	pCi/g	2.3E-06	5.95E+00	5.95E+01	5.95E+02	N/A	N/A	N/A	N/A
1	**Cumulative**			**8.7E-06**				**< 1**			
Hypothetical Resident[5]											
1	Antimony	1.08E+02	mg/kg	N/A	N/A	N/A	N/A	3.5	3.13E+00	3.13E+01	9.39E+01
1	PAH, Total	5.95E-01	mg/kg	2.6E-05	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
1	Uranium	4.15E+01	mg/kg	N/A	N/A	N/A	N/A	0.2	2.34E+01	2.34E+02	7.01E+02
1	Uranium-238	1.39E+01	pCi/g	2.8E-05	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
1	**Cumulative**			**5.4E-05**				**3.6**			

Grayed cells indicate EPC value is lower than RGO value or an RGO value is not applicable.
N/A = Not applicable because the COC was not applicable (i.e., the COC was of concern for HI, but not ELCR or it was of concern for ELCR by not HI).
[1] See Tables D.6 and D.7 (Appendix D) for EPC values.
[2] See Appendix D, Exhibit D.6, for ELCR.
[3] See Table D.47 for RGOs.
[4] See Appendix D, Exhibit D.6, for HI.
[5] RGOs for residential land use are based on exposure to a resident age 1-27. For carcinogens, the dose method incorporates age-adjusted values for the 26-year exposure duration. Because child soil ingestion rates are higher and body weights are lower, noncancer RGOs are based on the child resident exposure assumptions.

Table 5.8.4. Ecological Screening for SWMU 224

Ground Cover	Near a Surface Water Body?	Total HI[a]	Priority COPECs[b]	Background (mg/kg)[c]	Soil ESV (mg/kg)[d]	Maximum (mg/kg)	HQ (max conc)[a]	EPC (mg/kg)	HQ (EPC)[a]
mostly gravel with some soil/grass	No	688	Aluminum	13,000	50	4,910	98.2	4,910	98.2
			Antimony	0.21	0.27	108.07	400.26	108.07	400.3
			Cadmium	0.21	0.36	6	16.67	6	16.7
			Iron	28,000	200	14,444.19	72.22	14,444.19	72.2
			Mercury	0.2	0.1	5	50	5	50.0
			Selenium	0.8	0.52	10	19.2	10	19.2

Table is from Appendix E, Table E.1.
[a] Total HI includes concentrations from all of the COPECs (listed in Table E4.1); only priority COPECs (i.e., the COPECs with HQs greater than 10, using the EPCs) are shown in this table.
[b] Only priority COPECs are listed. See Appendix E for additional COPECs.
[c] Background value is from DOE 2015b.
[d] ESVs from DOE 2015c and Appendix E of this report.

5.8.7 SWMU 224 Summary

Goal 1. Characterize Nature and Extent of Source Zone

Plant processes that could have contributed to contamination at SWMU 224 are inadvertent releases from the containers of materials stored there in the past.

COPCs for surface and subsurface soils from SWMU 224 are shown on Tables 5.8.1 and 5.8.2 as those analytes with green boxes under the "Industrial Worker/FOE" columns for surface and shallow subsurface soil, and those with blue boxes under the "GW Protection Screen/RGA/UCRS" columns for groundwater. For metals and radioisotopes, an orange box under the "Provisional Background" must accompany the green and blue boxes. The COPCs identified for SWMU 224 surface soil are metals, PAHs, SVOCs, and uranium isotopes; for subsurface soil are metals. Contaminants were detected greater than background and greater than industrial worker NALs to a maximum depth of 7 ft bgs.

Goal 2. Determine Surface and Subsurface Transport Mechanisms and Pathways

The contaminants at SWMU 224 are readily adsorbed to soil particles, so they do not migrate without a direct connection to surface water. The CSM can be found in Appendix D.

Goal 3. Complete a Baseline Risk Assessment for the Soils OU

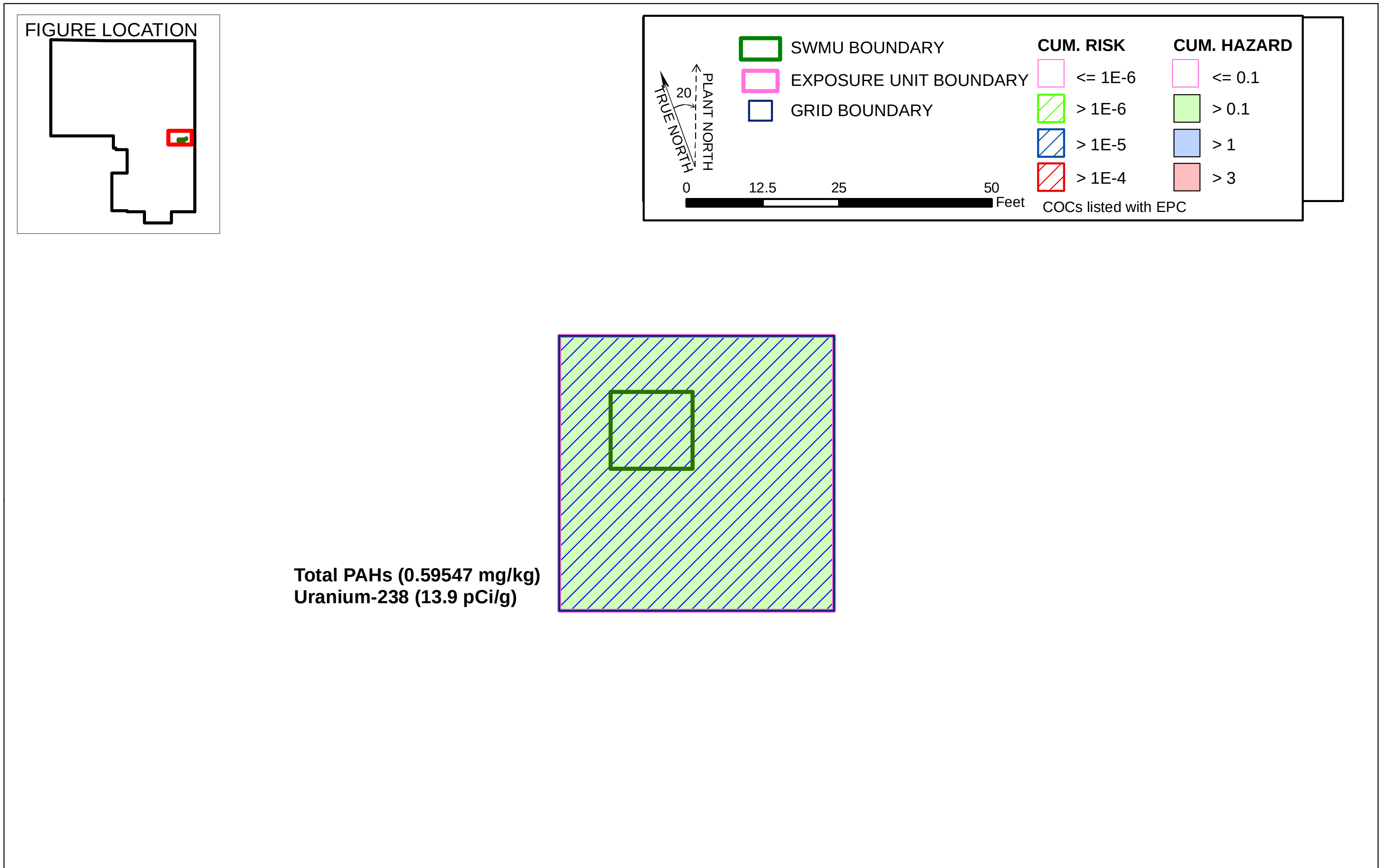
Cumulative ELCRs or HIs exceeded benchmarks of 1E-06 and 1, respectively, for the future industrial worker, excavation worker, and hypothetical residential scenarios. COCs for these scenarios for SWMU 224 are as follows:

- Future Industrial worker
  - Total PAHs
  - Uranium-238
- Excavation worker
  - Arsenic
  - Total PAHs
  - Uranium-238
- Hypothetical Resident (hazards evaluated against the child resident)
  - Antimony
  - Uranium
  - Total PAHs
  - Uranium-238

Figure 5.8.8 shows the COCs exceeding RGOs for the future industrial worker.

One priority COC (i.e., HQ > 1 or chemical-specific ELCR > 1E-04) is located in SWMU 224 for the hypothetical resident: antimony. Priority COCs for other scenarios are described in Appendix D.

No priority COCs were identified for groundwater modeled from soil.



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PADUCAH GASEOUS DIFFUSION PLANT

Figure 5.8.8. Summary of COCs Contributing to Risk to the Future Industrial Worker at SWMU 224

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For SWMU 224, COPECs exceed ESVs. Priority COPECs (i.e., maximum HQ ≥ 10) are the following:

- Aluminum
- Antimony
- Cadmium
- Mercury
- Selenium

Goal 4. Support Evaluation of Remedial Alternatives

The representative data set used for SWMU 224 is sufficient to support decision making and indicates that an FS is appropriate. An uncertainty concerning depth of contamination should be considered in the FS. Possible remedial technologies applicable for this unit, as discussed in the Work Plan (DOE 2010a), are posting, fencing (or other means of limiting access), excavation, and/or other remedial technologies that will be described in the FS.

SWMU 224 is adjacent to SWMUs 56 and 80, discussed within this RI Report. The recently decontaminated and decommissioned C-340 building was located just north of the SWMU. There would be no known physical or cultural impediments to conducting a response action here. A response action at SWMU 224 would not have an impact on groundwater or surface water.

5.8.8 SWMU 224 Conclusion

The RI defined adequately the nature and extent of contamination in soils at SWMU 224; an FS is appropriate for the SWMU due to cancer risk and/or noncancer hazards exceeding the decision rule benchmarks (DOE 2010a) for scenarios including future industrial worker, excavation worker, and hypothetical resident. The reasonably anticipated future land use for this SWMU is industrial land use as shown in the SMP (DOE 2015a).

5.9 SWMU 225, C-533-1, DMSA OS-14, Rail Cars and Contaminated Soil Area near C-533-1 DMSA OS-14

5.9.1 Background

SWMU 225, the location of the former DMSA OS-14 consisted of four tanker cars, three empty flatbeds, and one flatbed with three tanks/containers on it located south of C-533-1 Switch House and west of the C-633 Cooling Towers in the southeast portion of the plant site. The SWMU 225 area is approximately 7,800 ft^2 (390 ft × 20 ft). There is no direct connection between this SWMU and surface water.

Rail tank cars and liquid containers were used as material storage areas. The tanker cars may have been brought on-site containing acid product, lube oil, or Freon®. Some personnel recall the three containers on the flatbed being used to hold water for firefighting purposes (DOE 2001b).

The location of SWMU 225 was mapped incorrectly in the June 2010 RI/FS Work Plan (DOE 2010a); as a result, an area to the west of the original SWMU location was sampled. Sampling results from the area indicate contamination. Based on this, SWMU 225 was divided into SWMU 225-A and SWMU 225-B, where SWMU 225-A is the original SWMU location and SWMU 225-B, Contaminated Soil Area near C-533-1 DMSA OS-14, is the new area located to the west. The SARs were revised in September 2014.

5.9.2 Fieldwork Summary

SWMU 225-A. During RI 2, one grid sample for this unit was planned and collected. The surface soil sample consisted of a 5-point composite collected at the gravel-soil interface next to the railroad from 0 to 6 inches bgs consistent with the sampling protocol for outside DOE Material Storage Areas (DMSAs) in the June 2010 RI/FS Work Plan. A gamma radiological walkover survey was not conducted for this unit because of its close proximity to a cylinder yard.

SWMU 225-B. During the first RI for the Soils OU, one grid sample for this unit was planned and collected from a straight line along the length of the SWMU. No additional sampling was conducted during RI 2. A gamma radiological walkover survey was not conducted for this unit because of its close proximity to a cylinder yard.

5.9.3 Nature and Extent of Contamination—Surface Soils

The representative data set presented in Table 5.9.1 provides the nature of the contamination in SWMU 225 surface soils, and Figures 5.9.1–5.9.3 illustrate the horizontal extent. A complete list of sampling results is provided in Appendix F (samples with ending depths of 1 ft bgs or less or null are considered surface soils).

The lateral extent of SWMU 225 surface soil contamination is considered defined adequately for supporting the BRA and FS. SWMU 225 consists of 1 EU.

Metals

No metals were detected in the surface soil above both the background screening level and the industrial worker NALs and ALs.

The following metals were detected in the SWMU 225 surface soil above both the SSLs for the protection of UCRS groundwater and the background screening levels (if available): antimony, barium, molybdenum, selenium, and thallium from grid 1 and lead, molybdenum, nickel, selenium, vanadium, and zinc from grid 2. Additionally, antimony in grid 1 and molybdenum in grid 2 were detected above the SSL for the protection of RGA groundwater and the background screening level.

PCBs

Total PCBs were not detected above the industrial worker NALs or ALs in the surface soil in SWMU 225. They were not detected above the SSLs for the protection of UCRS groundwater or for RGA groundwater.

SVOCs

No SVOCs were detected above industrial worker NALs or ALs in the surface soil in SWMU 225.

Phenanthrene was detected above the SSLs for the protection of UCRS groundwater. No SVOCs were detected above the SSL for the protection of RGA groundwater.

VOCs

No VOCs were analyzed in the SWMU 225 surface soil.

Table 5.9.1. Surface Soil Data Summary: SWMU 225

			Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
Type	Analysis	Unit	Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
METAL	Aluminum	mg/kg	7.20E+03	8.48E+03	7.84E+03	0/2	2/2	0/2	1.30E+04	0/2	1.00E+05	0/2	1.00E+05	0/2	2/2	4.6–5.6
METAL	Antimony	mg/kg	1.40E-01	5.41E+01	3.61E+01	0/2	2/2	1/2	2.10E-01	0/2	9.34E+01	0/2	2.80E+03	1/2	1/2	0.028–30
METAL	Arsenic	mg/kg	6.30E+00	8.10E+00	7.20E+00	0/3	2/3	0/3	1.20E+01	2/3	1.41E+00	0/3	1.41E+02	0/3	2/3	0.19–11
METAL	Barium	mg/kg	8.40E+01	3.48E+02	2.60E+02	0/2	2/2	1/2	2.00E+02	0/2	4.04E+04	0/2	1.00E+05	0/2	2/2	0.093–100
METAL	Beryllium	mg/kg	4.30E-01	4.80E-01	4.55E-01	0/2	2/2	0/2	6.70E-01	0/2	4.50E+02	0/2	1.35E+04	0/2	0/2	0.046–0.11
METAL	Cadmium	mg/kg	1.20E-01	1.20E-01	1.20E-01	0/2	2/2	0/2	2.10E-01	0/2	6.12E+01	0/2	1.84E+03	0/2	0/2	0.028–12
METAL	Calcium	mg/kg	4.05E+03	2.00E+04	1.20E+04	0/2	2/2	0/2	2.00E+05	0/2	N/A	0/2	N/A	N/A	N/A	56.4–93
METAL	Chromium	mg/kg	1.80E+01	2.55E+01	2.18E+01	0/3	2/3	2/3	1.60E+01	0/3	1.98E+02	0/3	1.98E+04	0/3	0/3	0.93–85
METAL	Cobalt	mg/kg	4.90E+00	7.30E+00	6.10E+00	0/2	2/2	0/2	1.40E+01	0/2	6.87E+01	0/2	2.06E+03	2/2	2/2	0.093–0.23
METAL	Copper	mg/kg	1.23E+01	3.30E+01	2.47E+01	0/3	3/3	2/3	1.90E+01	0/3	9.34E+03	0/3	1.00E+05	0/3	0/3	0.93–35
METAL	Iron	mg/kg	1.57E+04	2.73E+04	2.23E+04	0/3	3/3	0/3	2.80E+04	0/3	1.00E+05	0/3	1.00E+05	3/3	3/3	5.6–100
METAL	Lead	mg/kg	1.10E+01	6.50E+01	2.42E+01	0/3	3/3	1/3	3.60E+01	0/3	8.00E+02	0/3	8.00E+02	0/3	2/3	0.046–13
METAL	Magnesium	mg/kg	1.56E+03	2.10E+03	1.83E+03	0/2	2/2	0/2	7.70E+03	0/2	N/A	0/2	N/A	N/A	N/A	9.3–56.4
METAL	Manganese	mg/kg	4.17E+02	5.62E+02	4.79E+02	0/3	3/3	0/3	1.50E+03	0/3	4.72E+03	0/3	1.00E+05	3/3	3/3	0.19–85
METAL	Mercury	mg/kg	3.10E-02	3.80E-02	3.45E-02	0/3	2/3	0/3	2.00E-01	0/3	7.01E+01	0/3	2.10E+03	0/3	2/3	0.03–40
METAL	Molybdenum	mg/kg	5.20E-01	3.60E+01	7.75E+00	0/3	3/3	0/3	N/A	0/3	1.17E+03	0/3	3.51E+04	1/3	3/3	0.093–15
METAL	Nickel	mg/kg	1.21E+01	2.40E+01	1.64E+01	0/3	3/3	1/3	2.10E+01	0/3	4.30E+03	0/3	1.00E+05	0/3	3/3	0.46–65
METAL	Selenium	mg/kg	9.50E-01	1.50E+00	1.23E+00	0/3	2/3	2/3	8.00E-01	0/3	1.17E+03	0/3	3.51E+04	0/3	2/3	0.093–20
METAL	Silver	mg/kg	2.30E-02	3.30E-02	2.80E-02	0/3	2/3	0/3	2.30E+00	0/3	1.17E+03	0/3	3.51E+04	0/3	0/3	0.0093–50
METAL	Sodium	mg/kg	3.00E+01	3.65E+01	3.33E+01	1/2	2/2	0/2	3.20E+02	0/2	N/A	0/2	N/A	N/A	N/A	22.6–93
METAL	Thallium	mg/kg	1.20E-01	2.80E-01	2.00E-01	0/2	2/2	1/2	2.10E-01	0/2	2.34E+00	0/2	7.02E+01	0/2	1/2	0.019–0.23
METAL	Uranium	mg/kg	1.70E+00	6.10E+00	4.34E+00	0/3	2/3	1/3	4.90E+00	0/3	6.81E+02	0/3	2.04E+04	0/3	0/3	0.0093–20
METAL	Vanadium	mg/kg	2.69E+01	1.09E+02	7.42E+01	0/3	3/3	2/3	3.80E+01	0/3	1.15E+03	0/3	3.45E+04	0/3	3/3	0.093–70
METAL	Zinc	mg/kg	4.74E+01	7.50E+01	5.88E+01	0/3	3/3	1/3	6.50E+01	0/3	7.01E+04	0/3	1.00E+05	0/3	3/3	1–25
PPCB	PCB, Total	mg/kg	N/A	N/A	N/A	0/3	0/3	0/3	N/A	0/3	3.05E-01	0/3	3.05E+01	0/3	0/3	0.05–5
SVOA	1,2,4-Trichlorobenzene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.37
SVOA	1,2-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.37
SVOA	1,3-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.37
SVOA	1,4-Dichlorobenzene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.37
SVOA	2,4,5-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.37
SVOA	2,4,6-Trichlorophenol	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.37
SVOA	2,4-Dichlorophenol	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.37
SVOA	2,4-Dimethylphenol	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.37
SVOA	2,4-Dinitrophenol	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.7–1.8
SVOA	2,4-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.21–0.37
SVOA	2,6-Dinitrotoluene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.21–0.37
SVOA	2-Chloronaphthalene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.37
SVOA	2-Chlorophenol	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.37
SVOA	2-Methyl-4,6-dinitrophenol	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.7–1.8
SVOA	2-Methylnaphthalene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.37
SVOA	2-Methylphenol	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.37
SVOA	2-Nitrobenzenamine	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	2.91E+02	0/2	8.73E+03	0/2	0/2	0.7–1.8
SVOA	2-Nitrophenol	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.37
SVOA	3,3'-Dichlorobenzidine	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.21–1.8
SVOA	3-Nitrobenzenamine	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.7–1.8
SVOA	4-Bromophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.37
SVOA	4-Chloro-3-methylphenol	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.37
SVOA	4-Chlorobenzenamine	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.37
SVOA	4-Chlorophenyl phenyl ether	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.37
SVOA	4-Nitrophenol	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.7–1.8
SVOA	Acenaphthene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	1.40E+03	0/2	4.20E+04	0/2	0/2	0.35–0.37
SVOA	Acenaphthylene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	1.40E+03	0/2	4.20E+04	N/A	N/A	0.35–0.37
SVOA	Anthracene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	6.99E+03	0/2	2.10E+05	0/2	0/2	0.35–0.37

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.9.1. Surface Soil Data Summary: SWMU 225 (Continued)

Type	Analysis	Unit	Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
			Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
SVOA	Benzenemethanol	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.37
SVOA	Benzo(ghi)perylene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.37
SVOA	Benzoic acid	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	1.7–1.8
SVOA	Bis(2-chloroethoxy)methane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.37
SVOA	Bis(2-chloroethyl) ether	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.0074–0.35
SVOA	Bis(2-chloroisopropyl) ether	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.37
SVOA	Bis(2-ethylhexyl)phthalate	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	5.88E+01	0/2	5.88E+03	0/2	0/2	0.35–0.37
SVOA	Butyl benzyl phthalate	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.37
SVOA	Dibenzofuran	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.37
SVOA	Diethyl phthalate	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.37
SVOA	Dimethyl phthalate	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.37
SVOA	Di-n-butyl phthalate	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.37
SVOA	Di-n-octylphthalate	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.37
SVOA	Fluoranthene	mg/kg	1.50E-01	1.50E-01	1.50E-01	1/2	1/2	0/2	N/A	0/2	9.32E+02	0/2	2.80E+04	0/2	0/2	0.35–0.37
SVOA	Fluorene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	9.32E+02	0/2	2.80E+04	0/2	0/2	0.35–0.37
SVOA	Hexachlorobenzene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	5.15E-01	0/2	5.15E+01	0/2	0/2	0.0034–0.37
SVOA	Hexachlorobutadiene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.21–0.37
SVOA	Hexachlorocyclopentadiene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–1.8
SVOA	Hexachloroethane	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.37
SVOA	Isophorone	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.37
SVOA	m,p-Cresol	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.74
SVOA	Naphthalene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	1.67E+01	0/2	1.61E+03	0/2	0/2	0.35–0.37
SVOA	Nitrobenzene	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–1.8
SVOA	N-Nitroso-di-n-propylamine	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	1.18E-01	0/2	1.18E+01	0/2	0/2	0.0074–0.35
SVOA	N-Nitrosodiphenylamine	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.37
SVOA	PAH, Total	mg/kg	7.28E-02	7.79E-02	7.53E-02	0/2	2/2	0/2	N/A	0/2	8.94E-02	0/2	8.94E+00	0/2	0/2	–
SVOA	Pentachlorophenol	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	8.91E-01	0/2	8.91E+01	N/A	N/A	0.63–1.8
SVOA	Phenanthrene	mg/kg	7.50E-02	7.50E-02	7.50E-02	1/2	1/2	0/2	N/A	0/2	1.40E+03	0/2	4.20E+04	0/2	1/2	0.35–0.37
SVOA	Phenol	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.37
SVOA	p-Nitroaniline	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.7–1.8
SVOA	Pyrene	mg/kg	1.00E-01	1.00E-01	1.00E-01	1/2	1/2	0/2	N/A	0/2	6.99E+02	0/2	2.10E+04	0/2	0/2	0.35–0.37
SVOA	Pyridine	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	N/A	0/2	N/A	N/A	N/A	0.35–0.74
RADS	Americium-241	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	5.99E+00	0/2	5.99E+02	0/2	0/2	0.019–0.0352
RADS	Cesium-137	pCi/g	7.97E-02	4.17E-01	2.48E-01	0/2	2/2	0/2	4.90E-01	1/2	1.02E-01	0/2	1.02E+01	0/2	0/2	0.0172–0.066
RADS	Neptunium-237	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	1.00E-01	0/2	2.29E-01	0/2	2.29E+01	0/2	0/2	0.026–0.0404
RADS	Plutonium-238	pCi/g	2.60E-02	2.60E-02	2.60E-02	1/2	1/2	0/2	7.30E-02	0/2	2.87E+01	0/2	2.87E+03	0/2	0/2	0.02–0.0285
RADS	Plutonium-239/240	pCi/g	1.90E-02	2.40E-02	2.15E-02	1/2	2/2	0/2	2.50E-02	0/2	2.47E+01	0/2	2.47E+03	0/2	0/2	0.0093–0.015
RADS	Technetium-99	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	2.50E+00	0/2	1.20E+03	0/2	1.20E+05	0/2	0/2	0.47–0.682
RADS	Thorium-228	pCi/g	5.82E-01	9.00E-01	7.41E-01	0/2	2/2	0/2	1.60E+00	0/2	N/A	0/2	N/A	N/A	N/A	0.02–0.061
RADS	Thorium-230	pCi/g	7.00E-01	1.03E+00	8.65E-01	0/2	2/2	0/2	1.50E+00	0/2	3.39E+01	0/2	3.39E+03	0/2	0/2	0.02–0.0803
RADS	Thorium-232	pCi/g	5.02E-01	9.20E-01	7.11E-01	0/2	2/2	0/2	1.50E+00	0/2	N/A	0/2	N/A	N/A	N/A	0.02–0.0293
RADS	Uranium-234	pCi/g	4.50E-01	1.13E+00	7.90E-01	0/2	2/2	0/2	1.20E+00	0/2	5.53E+01	0/2	5.53E+03	0/2	2/2	0.02–0.0814
RADS	Uranium-235	pCi/g	5.50E-02	5.50E-02	5.50E-02	0/2	1/2	0/2	6.00E-02	0/2	3.40E-01	0/2	3.40E+01	0/2	1/2	0.009–0.054
RADS	Uranium-238	pCi/g	7.17E-01	2.04E+00	1.38E+00	0/2	2/2	1/2	1.20E+00	1/2	1.60E+00	0/2	1.60E+02	0/2	2/2	0.02–0.051

One or more samples exceed AL value
One or more samples exceed NAL value
One or more samples exceed background value
One or more samples exceed SSLs of RGA and UCRS groundwater protection

Counts of analyses are based on the maximum detected result from a sample (i.e., if a sample has analytical results from two different labs, only the maximum value is counted).
Field replicates, or separate samples are counted independently.

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

Table 5.9.1. Surface Soil Data Summary: SWMU 225 (Continued)

			Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
Type	Analysis	Unit	Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range

The uranium (metal)/uranium (isotopic) may not be from the same sample thus a correlation between uranium (metal)/uranium (isotopic) data may not be possible.
Uranium-238 that was analyzed using method RL-7128NITRIC is compared to a background value of 0.4 pCi/g for surface and subsurface.

Screening values are shown in Appendices C and D.

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

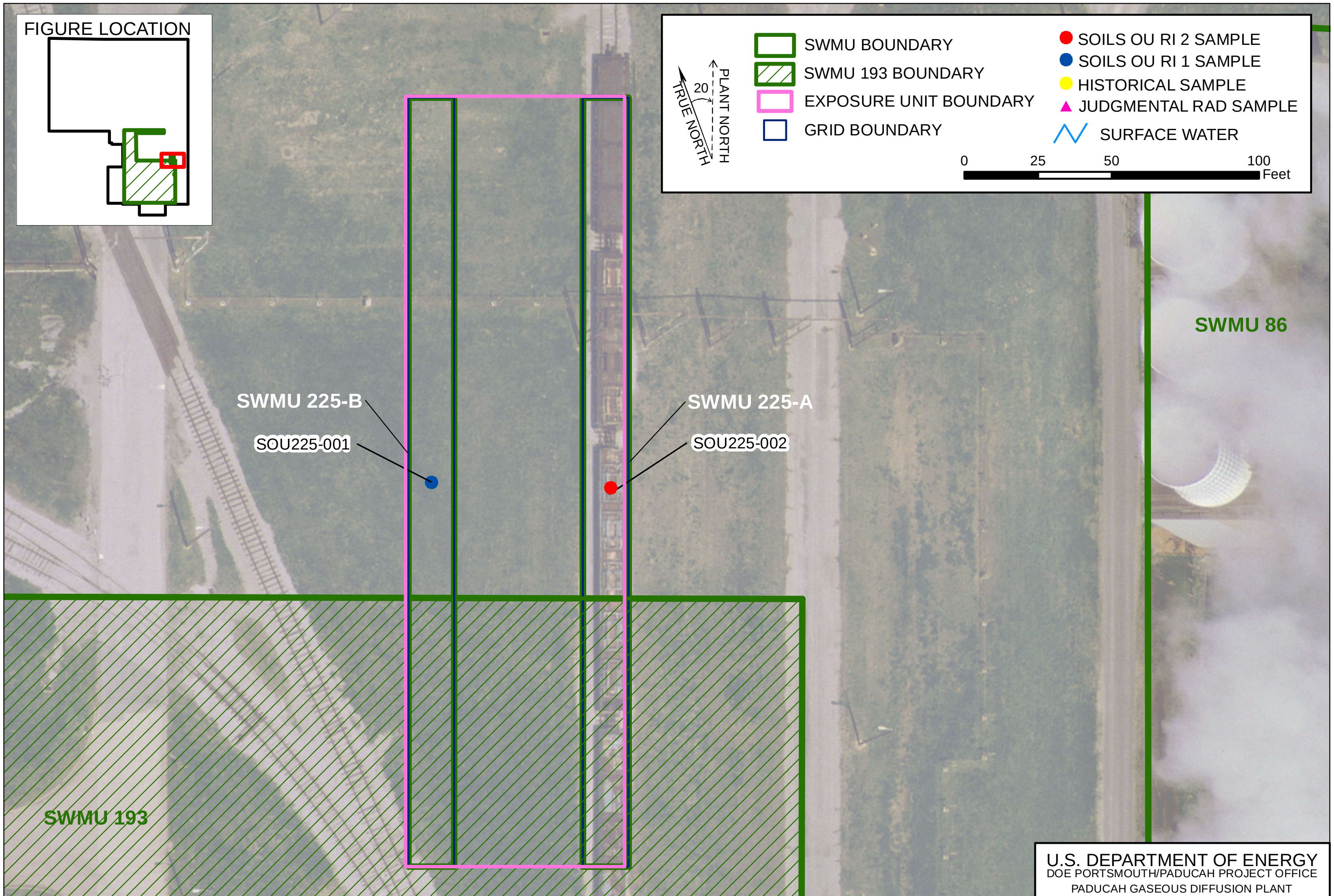

Figure 5.9.1. SWMU 225 Sample Locations—Surface Soil

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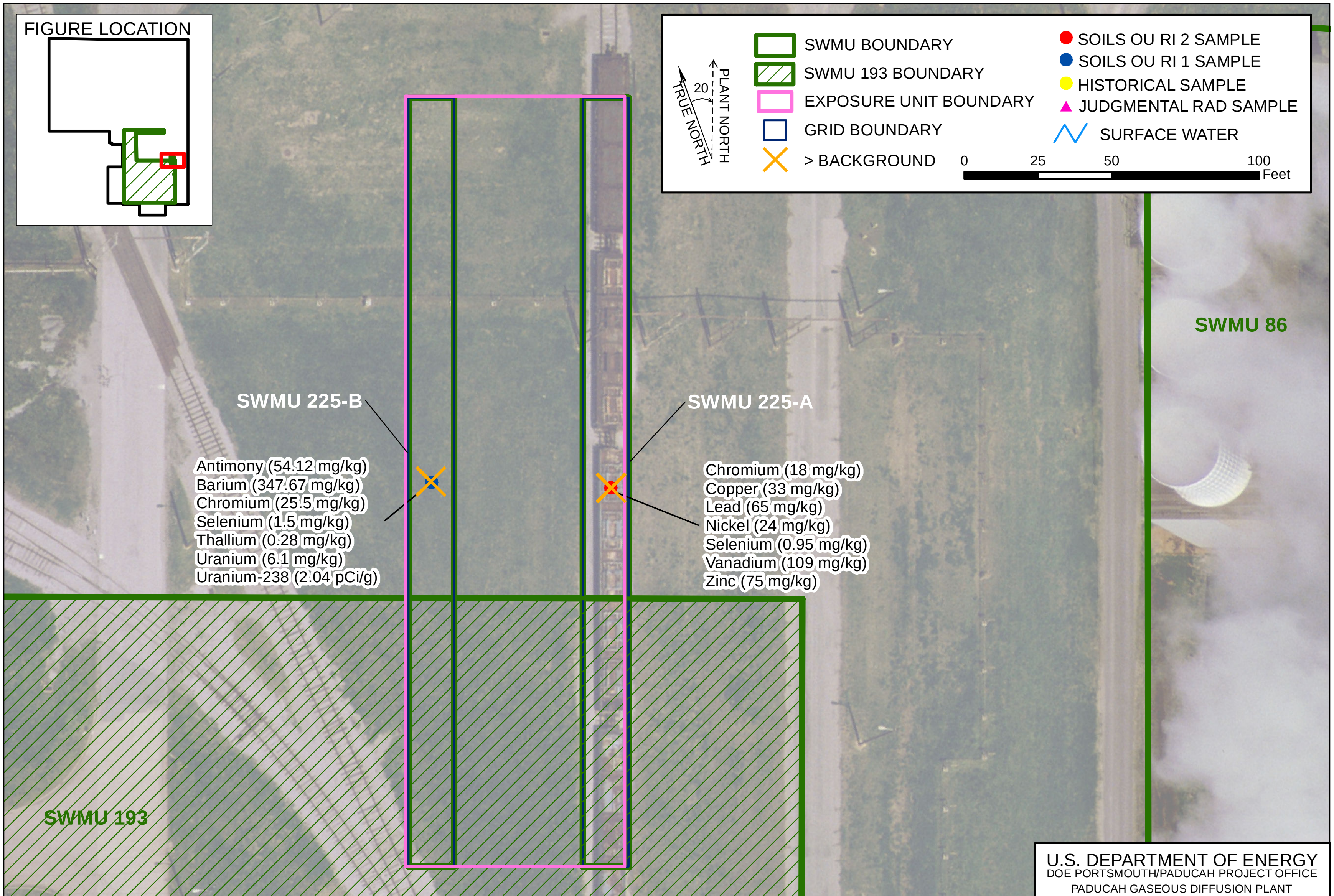

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Figure 5.9.2. SWMU 225 Background Exceedances—Surface Soil

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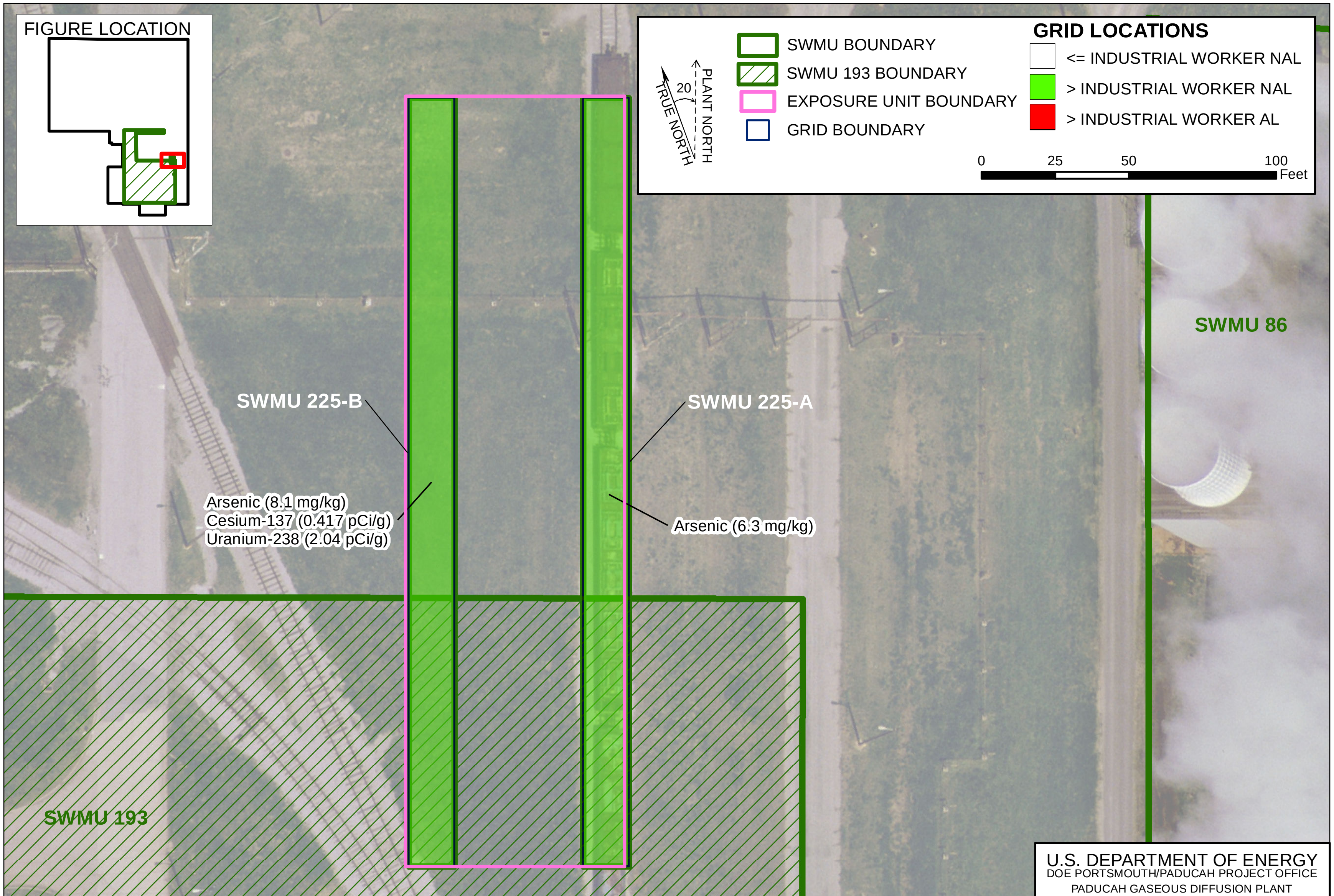

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Figure 5.9.3. SWMU 225 NAL Exceedances—Surface Soil

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Radionuclides

Uranium-238 was above both the background screening level and the industrial worker NAL. No radionuclides were detected above both the background screening level and industrial worker ALs in the SWMU 225 surface soil. Additionally, uranium-238 was detected above both the background screening levels and SSLs for the protection of UCRS. No radionuclides were detected above both the background screening level and the SSL for the protection of RGA groundwater.

5.9.4 Nature and Extent of Contamination—Subsurface Soils

The representative data set presented in Table 5.9.2 provides the nature of contamination in SWMU 225 subsurface soils, and Figures 5.9.4–5.9.6 illustrate the horizontal extent. A complete list of detailed sampling results, including sampling depths, is provided in Appendix F (samples with ending depths greater than 1 ft bgs are considered subsurface soils in this nature and extent section). Subsurface soils were sampled only in grid SOU225-001 due to the presence of underground pipelines.

The horizontal and vertical extent of SWMU 225 subsurface soil contamination is considered defined adequately for supporting the BRA and FS. There is some uncertainty with vertical extent; however, this will be addressed in the FS.

Metals

No metals were detected above both the industrial worker NALs and background screening levels in the SWMU 225 subsurface soil. No metals were detected above the industrial worker ALs in the SWMU 225 subsurface soil.

The following metals were detected in the SWMU 225 subsurface soil above both the background screening levels and the SSLs for the protection of UCRS groundwater: antimony, barium, and manganese. Antimony and manganese also were detected above both the background screening levels and the SSLs for the protection of RGA groundwater.

PCBs

Total PCBs were not detected in the subsurface soil at SWMU 225.

SVOCs

SVOCs were not analyzed in subsurface soil samples at SWMU 225.

VOCs

VOCs were not analyzed in subsurface soil samples at SWMU 225.

Radionuclides

Radionuclides were not analyzed in subsurface soil samples at SWMU 225.

Table 5.9.2. Subsurface Soil Data Summary: SWMU 225

			Detected Results			J-qualified		Provisional Background		Industrial Worker		Industrial Worker		GW Protection Screen		
Type	Analysis	Unit	Min	Max	Avg	FOD	FOD	FOE	Bkgd	FOE	NAL	FOE	AL	RGA	UCRS	DL Range
METAL	Antimony	mg/kg	4.41E+01	4.41E+01	4.41E+01	0/2	1/2	1/2	2.10E-01	0/2	9.34E+01	0/2	2.80E+03	1/2	1/2	30–30
METAL	Arsenic	mg/kg	6.93E+00	6.93E+00	6.93E+00	0/2	1/2	0/2	7.90E+00	1/2	1.41E+00	0/2	1.41E+02	0/2	1/2	11–11
METAL	Barium	mg/kg	2.93E+02	4.01E+02	3.47E+02	0/2	2/2	2/2	1.70E+02	0/2	4.04E+04	0/2	1.00E+05	0/2	2/2	100–100
METAL	Cadmium	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	2.10E-01	0/2	6.12E+01	0/2	1.84E+03	0/2	0/2	12–12
METAL	Chromium	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	4.30E+01	0/2	1.98E+02	0/2	1.98E+04	0/2	0/2	85–85
METAL	Copper	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	2.50E+01	0/2	9.34E+03	0/2	1.00E+05	0/2	0/2	35–35
METAL	Iron	mg/kg	1.01E+04	1.52E+04	1.26E+04	0/2	2/2	0/2	2.80E+04	0/2	1.00E+05	0/2	1.00E+05	2/2	2/2	100–100
METAL	Lead	mg/kg	1.18E+01	1.32E+01	1.25E+01	0/2	2/2	0/2	2.30E+01	0/2	8.00E+02	0/2	8.00E+02	0/2	0/2	13–13
METAL	Manganese	mg/kg	5.15E+02	8.55E+02	6.85E+02	0/2	2/2	1/2	8.20E+02	0/2	4.72E+03	0/2	1.00E+05	2/2	2/2	85–85
METAL	Mercury	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	1.30E-01	0/2	7.01E+01	0/2	2.10E+03	0/2	0/2	10–10
METAL	Molybdenum	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	1.17E+03	0/2	3.51E+04	0/2	0/2	15–15
METAL	Nickel	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	2.20E+01	0/2	4.30E+03	0/2	1.00E+05	0/2	0/2	65–65
METAL	Selenium	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	7.00E-01	0/2	1.17E+03	0/2	3.51E+04	0/2	0/2	20–20
METAL	Silver	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	2.70E+00	0/2	1.17E+03	0/2	3.51E+04	0/2	0/2	10–10
METAL	Uranium	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	4.60E+00	0/2	6.81E+02	0/2	2.04E+04	0/2	0/2	20–20
METAL	Vanadium	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	3.70E+01	0/2	1.15E+03	0/2	3.45E+04	0/2	0/2	70–70
METAL	Zinc	mg/kg	2.91E+01	4.86E+01	3.88E+01	0/2	2/2	0/2	6.00E+01	0/2	7.01E+04	0/2	1.00E+05	0/2	1/2	25–25
PPCB	PCB, Total	mg/kg	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	3.05E-01	0/2	3.05E+01	0/2	0/2	5–5

One or more samples exceed AL value
One or more samples exceed NAL value
One or more samples exceed background value
One or more samples exceed SSLs of RGA and UCRS groundwater protection

Counts of analyses are based on the maximum detected result from a sample (i.e., if a sample has analytical results from two different labs, only the maximum value is counted).
Field replicates, or separate samples are counted independently.

The uranium (metal)/uranium (isotopic) may not be from the same sample thus a correlation between uranium (metal)/uranium (isotopic) data may not be possible.
Uranium-238 that was analyzed using method RL-7128NITRIC is compared to a background value of 0.4 pCi/g for surface and subsurface.

Screening values are shown in Appendices C and D.

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

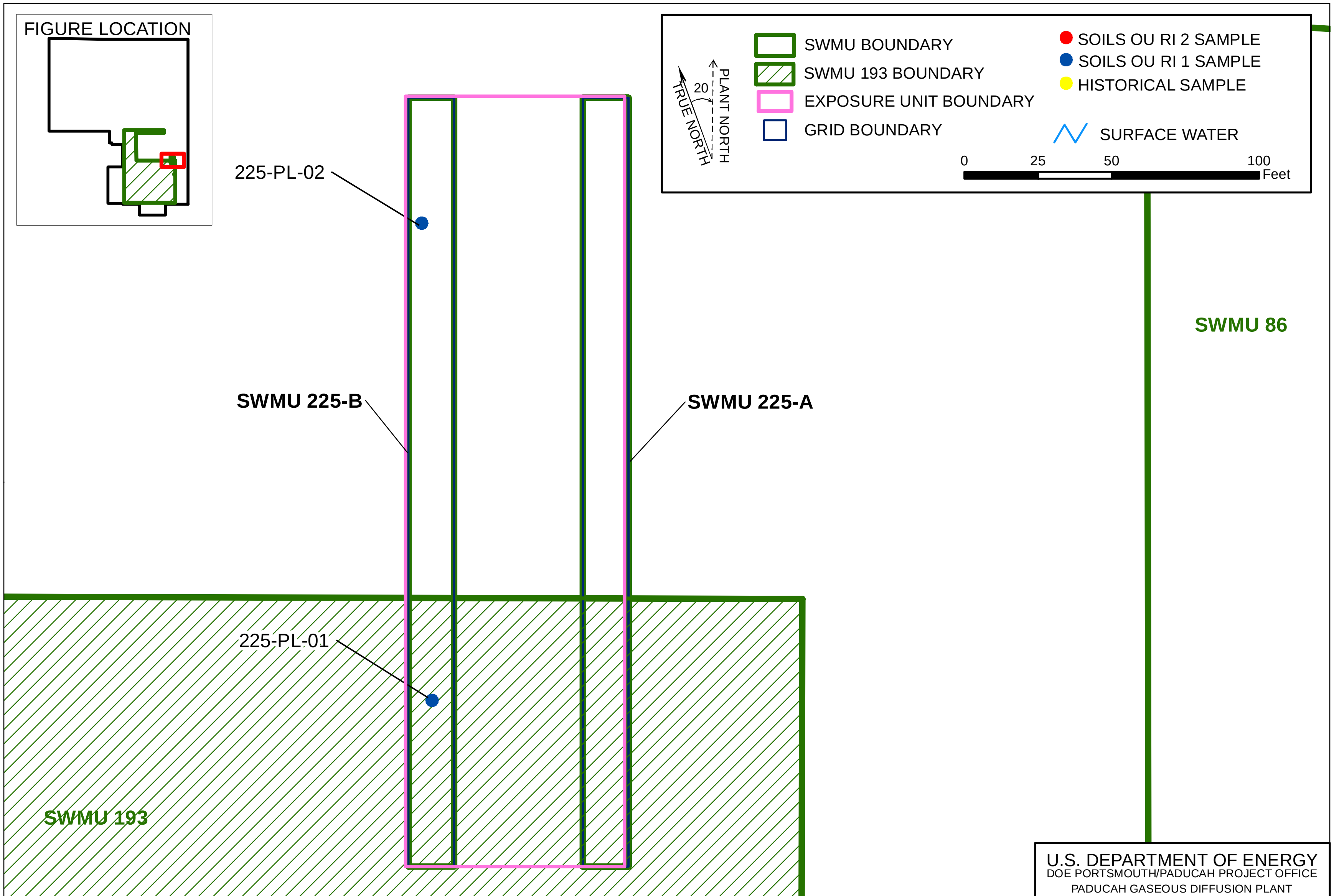

Figure 5.9.4. SWMU 225 Sample Locations—Subsurface Soil

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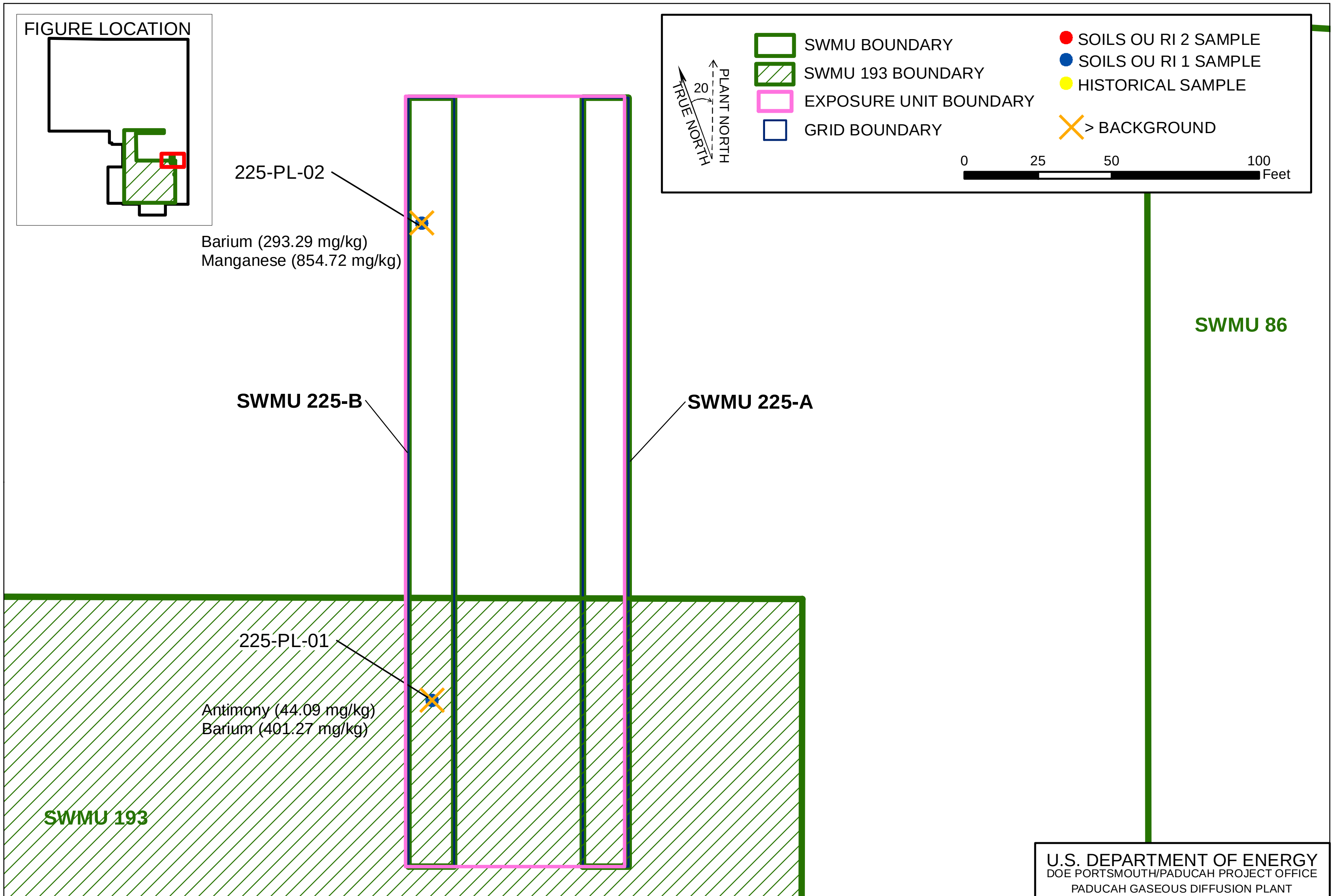

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Figure 5.9.5. SWMU 225 Background Exceedances—Subsurface Soil

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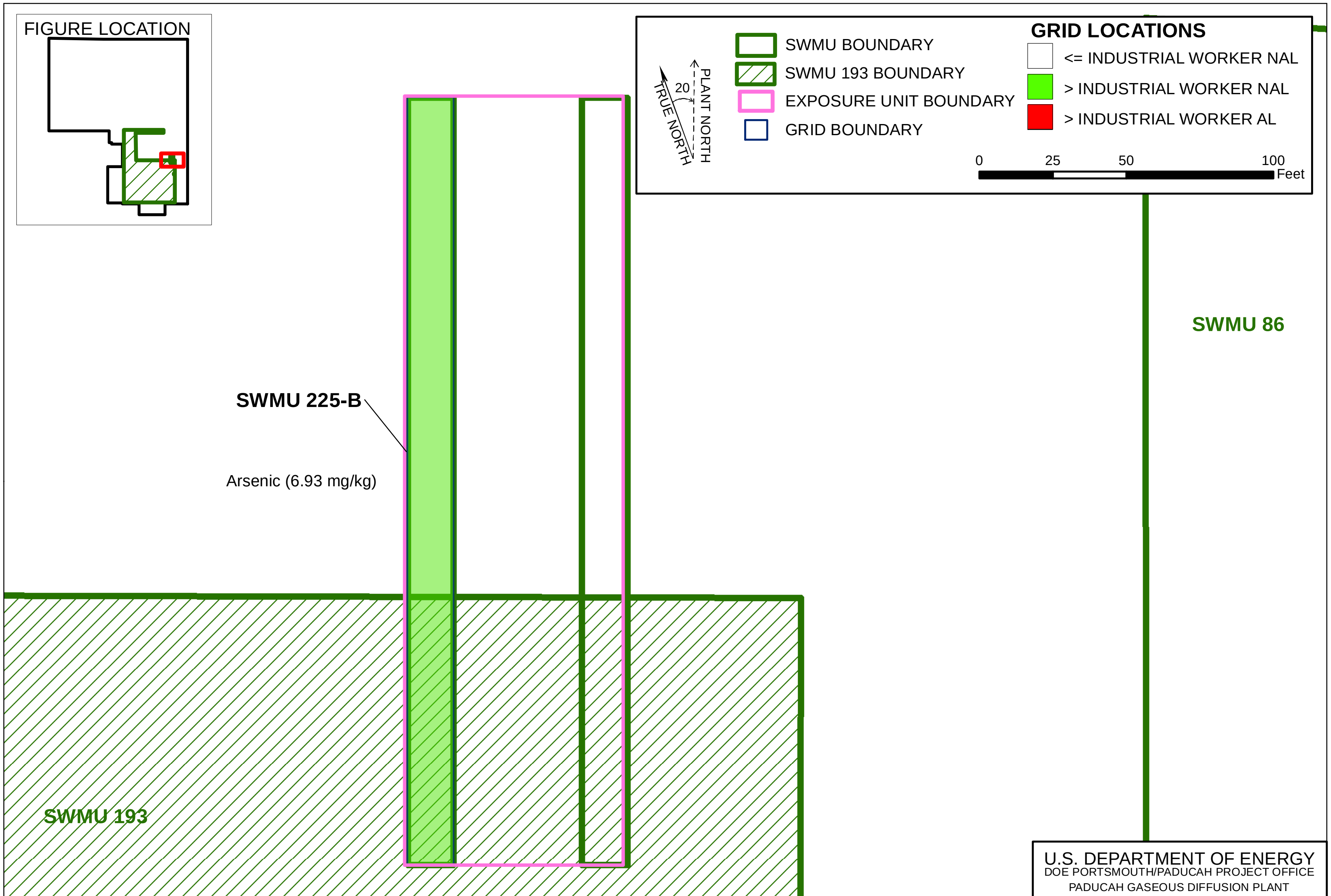

Figure 5.9.6. SWMU 225 NAL Exceedances—Subsurface Soil

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5.9.5 Fate and Transport

No target chemicals were identified for further evaluation of impacts to the RGA (Chapter 4). There is no concern for significant potential runoff for SWMU 225. Contaminants present at this SWMU are unlikely to migrate due to the physical cover at the SWMU, which limits the potential for particulate transport through sheet flow, and there is no direct connection to surface water from this SWMU. A removal action for the contaminated sediment associated with SWOU (On-Site) (DOE 2011a) was conducted for Outfalls 001, 008, 010, 011, 015, and associated internal ditches. A final response action for internal ditches, outfalls, and creeks will be addressed by the SWOU, as described in the SMP (DOE 2015a).

5.9.6 Baseline Risk Assessment

Human Health. Potential risks and hazards for current/future human health for SWMU 225 were evaluated for direct contact. These results are summarized in Appendix D and in the subsections that follow, including the COCs and relative contributions to the overall ELCR/HI.

The cumulative ELCR and the cumulative HI for SWMU 225 exceed the benchmarks of cumulative ELCR of 1E-06 and cumulative HI greater than 1, respectively for one or more scenarios; therefore, as stated in the Work Plan, Decision Rule D1a, (DOE 2010a), this SWMU will be evaluated in the FS. As described in the BHHRA (Appendix D), COCs were identified after considering the results of the risk characterization and the uncertainties affecting the results.

COCs were identified as those COPCs considered to contribute at least 1E-06 ELCR or 0.1 HI to a scenario of concern. The basis for COC identification is presented in Appendix D. The identified COCs considered to contribute to the ELCR/HI, the EPC, and the RGOs calculated for a range of ELCR/HI benchmarks are presented in Table 5.9.3 for the future industrial worker, excavation worker, and the hypothetical resident. Table 5.9.3 also compares the EPC to the RGO for each COC under each exposure scenario. Table 5.9.3 summarizes the ELCR/HI posed by the COCs for this SWMU under each exposure scenario by depicting the maximum ELCR/HI contribution per COC.

Ecological Screening. COPECs for SWMU 225 include metals and SVOCs. Potential hazards for ecological receptors and the associated priority COPECs (maximum HQ $\geq$ 10) are summarized in Table 5.9.4.

5.9.7 SWMU 225 Summary

Goal 1. Characterize Nature and Extent of Source Zone

Plant processes that could have contributed to contamination in the grid at SWMU 225 that encompasses the rail tracks are spills and releases during loading of railcars. Plant processes contributing to the other grid at SWMU 225 are unknown.

COPCs for surface and subsurface soils from SWMU 225 are shown on Tables 6.41 and 6.42 as those analytes with green boxes under the “Industrial Worker/FOE” columns for surface and shallow subsurface soil, and those with blue boxes under the “GW Protection Screen/RGA/UCRS” columns for groundwater. For metals and radioisotopes, an orange box under the “Provisional Background” must accompany the green and blue boxes. The COPCs identified for SWMU 225 surface soil are metals, SVOCs, and uranium isotopes; for subsurface soil it is metals. Contaminants were detected greater than background and greater than industrial worker NALs to a maximum depth of 1 ft bgs.

Table 5.9.3. RGOs for SWMU 225

EU	COC	EPC[1]	Units	ELCR[2]	RGOs for ELCR[3]			HI[4]	RGOs for HI[3]		
					1E-06	1E-05	1E-04		0.1	1	3
Future Industrial Worker											
1	Uranium-238	2.04E+00	pCi/g	1.2E-06	1.65E+00	1.65E+01	1.65E+02	N/A	N/A	N/A	N/A
1	**Cumulative**			**2.1E-06**				**< 1**			
Excavation Worker											
1	Arsenic	8.10E+00	mg/kg	3.2E-06	2.52E+00	2.52E+01	2.52E+02	0.1	8.10E+00	8.10E+01	2.43E+02
1	**Cumulative**			**4.5E-06**				**< 1**			
Hypothetical Resident[5]											
1	Antimony	5.41E+01	mg/kg	N/A	N/A	N/A	N/A	1.7	3.13E+00	3.13E+01	9.39E+01
1	PAH, Total	7.79E-02	mg/kg	3.4E-06	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	N/A
1	Thallium	2.80E-01	mg/kg	N/A	N/A	N/A	N/A	0.4	7.82E-02	7.82E-01	2.35E+00
1	Vanadium	1.09E+02	mg/kg	N/A	N/A	N/A	N/A	0.3	3.93E+01	3.93E+02	1.18E+03
1	Uranium-238	2.04E+00	pCi/g	4.1E-06	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	N/A
1	**Cumulative**			**7.5E-06**				**2.4**			

Grayed cells indicate EPC value is lower than RGO value or an RGO value is not applicable.

N/A = Not applicable because the COC was not applicable (i.e., the COC was of concern for HI, but not ELCR or it was of concern for ELCR by not HI).

[1] See Tables D.6 and D.7 (Appendix D) for EPC values.

[2] See Appendix D, Exhibit D.6, for ELCR.

[3] See Table D.47 for RGOs.

[4] See Appendix D, Exhibit D.6, for HI.

[5] RGOs for residential land use are based on exposure to a resident age 1-27. For carcinogens, the dose method incorporates age-adjusted values for the 26-year exposure duration. Because child soil ingestion rates are higher and body weights are lower, noncancer RGOs are based on the child resident exposure assumptions.

Table 5.9.4. Ecological Screening for SWMU 225

Ground Cover	Near a Surface Water Body?	Total HI[a]	Priority COPECs[b]	Background (mg/kg)[c]	Soil ESV (mg/kg)[d]	Maximum (mg/kg)	HQ (max conc)[a]	EPC (mg/kg)	HQ (EPC)[a]
soil/gravel mix	No	796	Aluminum	13,000	50	8,480	169.6	8,480	169.6
			Antimony	0.21	0.27	54.12	200.44	54.12	200.4
			Cadmium	0.21	0.36	6	16.67	6	16.7
			Iron	28,000	200	27,274	136.37	27,274	136.4
			Mercury	0.2	0.1	20	200	20	200.0
			Molybdenum	N/A	2	36	18	36	18.0
			Selenium	0.8	0.52	10	19.2	10	19.2
			Vanadium	38	7.8	109	13.97	109	14.0

Table is from Appendix E, Table E.1.

[a] Total HI includes concentrations from all of the COPECs (listed in Table E4.1); only priority COPECs (i.e., the COPECs with HQs greater than 10, using the EPCs) are shown in this table.

[b] Only priority COPECs are listed. See Appendix E for additional COPECs.

[c] Background value is from DOE 2015a.

[d] ESVs from DOE 2015c and Appendix E of this report.

Goal 2. Determine Surface and Subsurface Transport Mechanisms and Pathways

The contaminants at SWMU 225 are readily adsorbed to soil particles, so they do not migrate without a direct connection to surface water. Pipelines were sampled at SWMU 225 and results were evaluated within this RI, which do not indicate subsurface transport. The CSM can be found in Appendix D.

Goal 3. Complete a Baseline Risk Assessment for the Soils OU

Cumulative ELCRs or HIs exceeded benchmarks of 1E-06 and 1, respectively, for the future industrial worker, excavation worker, and hypothetical residential scenarios. COCs for these scenarios for SWMU 225 are as follows:

- Future Industrial worker
  - Uranium-238
- Excavation worker
  - Arsenic
- Hypothetical Resident (hazards evaluated against the child resident)
  - Antimony
  - Thallium
  - Vanadium
  - Total PAHs
  - Uranium-238

Figure 5.9.7 shows the COCs exceeding RGOs for the future industrial worker.

One priority COC (i.e., HQ > 1 or chemical-specific ELCR > 1E-04)5- is located in SWMU 225 for the hypothetical resident: antimony. There are no other priority COCs for other scenarios.

No priority COCs were identified for groundwater modeled from soil.

For SWMU 225, COPECs exceed ESVs. Priority COPECs (i.e., maximum HQ ≥ 10) are the following:

- Aluminum
- Antimony
- Cadmium
- Mercury
- Molybdenum
- Selenium
- Vanadium

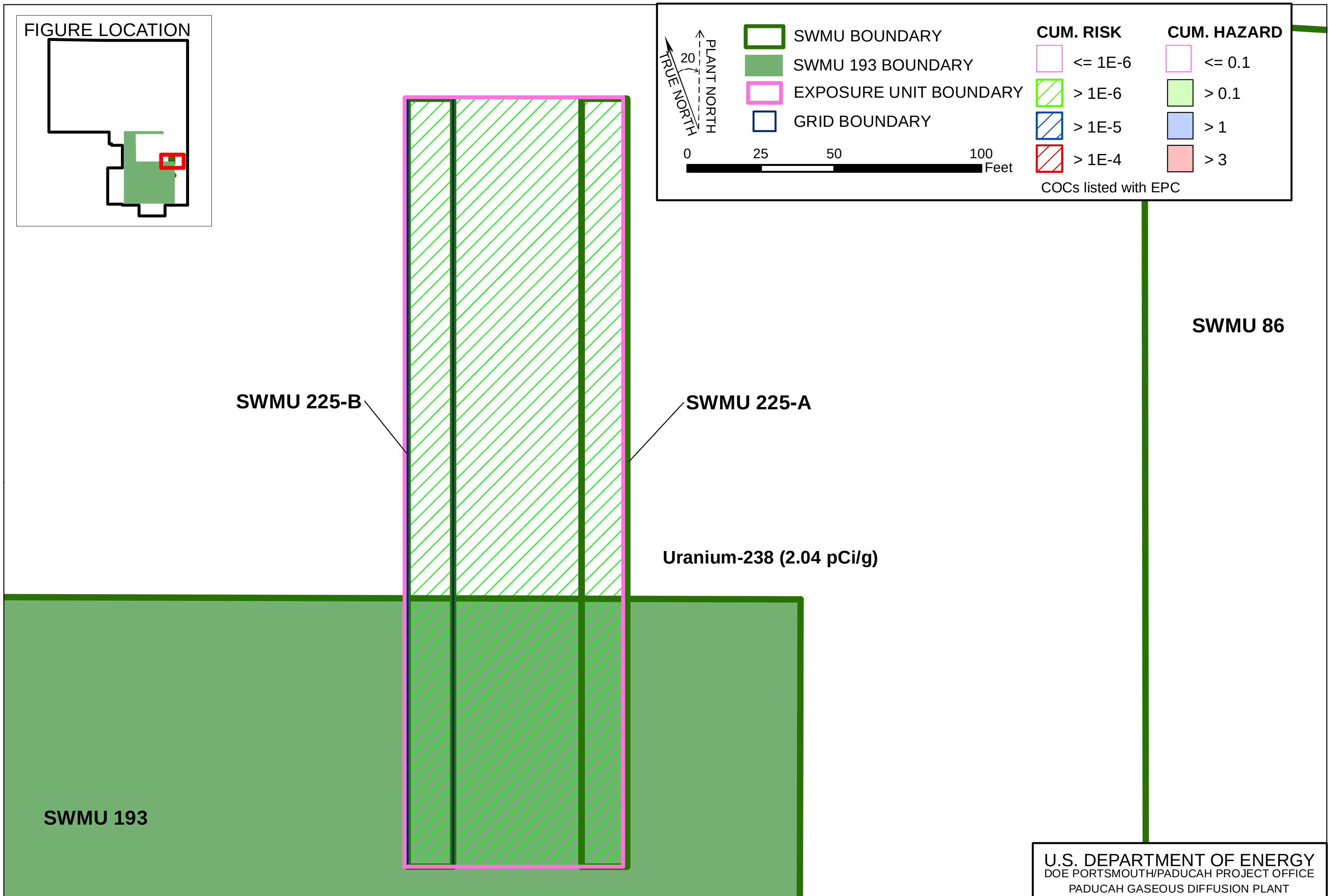

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Figure 5.9.7. Summary of COCs Contributing to Risk to the Future Industrial Worker at SWMU 225

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Goal 4. Support Evaluation of Remedial Alternatives

The representative data set used for SWMU 225 is sufficient to support decision making and indicates that an FS is appropriate. An uncertainty concerning depth of contamination should be considered in the FS. Possible remedial technologies applicable for this unit, as discussed in the Work Plan (DOE 2010a), are posting, fencing (or other means of limiting access), excavation, and/or other remedial technologies that will be described in the FS.

SWMU 225 is adjacent to and partially coincident with SWMU 193, McGraw Construction Facilities (Southside Cylinder Yards), which is scheduled to be addressed by the GDP D&D OU (DUF_6 D&D subproject). There would be no known physical or cultural impediments to conducting a response action here. A response action at SWMU 225 would not have an impact on groundwater or surface water.

5.9.8 SWMU 225 Conclusion

The RI defined adequately the nature and extent of contamination in soils at SWMU 225; an FS is appropriate for the SWMU due to cancer risk and/or noncancer hazards exceeding the decision rule benchmarks (DOE 2010a) for scenarios including future industrial worker, excavation worker, and hypothetical resident. The reasonably anticipated future land use for this SWMU is industrial land use as shown in the SMP (DOE 2015a).

5.10 AOC 565, North of C-611 Water Treatment Plant, Rubble Area K

5.10.1 Background

This rubble area is used for erosion control along the north wall of Bayou Creek, north of the C-611 Water Treatment Plant, and is approximately 60 ft by 30 ft.

This area was discovered in November 2006 during walkover/radiological surveys after soil and rubble areas were found along Little Bayou and Bayou Creeks. This rubble area was designated as Rubble Area KY-19. The readings collected in November 2006 were unfiltered 200 cpm (background is ~ 50 cpm), fixed contamination, and no measurable dose. The area was posted immediately. This area was visited again on February 17, 2009; however, it was inaccessible due to fallen limbs from the January 2009 ice storm that damaged many trees in the western Kentucky area. The area was cleared and revisited on March 25, 2009, at which time only the top of the creek bank was accessible due to high water in the creek.

Investigation results can be found in the SER (DOE 2010b).

5.10.2 Fieldwork Summary

During the first RI for the Soils OU, it had been determined that historical data are representative of the nature and adequately delineate the extent of the contamination; therefore, no samples were collected from this unit (DOE 2010a).

The unit underwent a gamma radiological walkover survey (Figure 5.10.1) using a FIDLER; the 880 measurements ranged from 4,719 to 14,299 cpm. The area consists mostly of soil and grass mix with trees and some rubble. A judgmental grab sample was collected for radiological constituents. As the unit was surveyed, a pile of broken pieces of asphalt-containing rubble was discovered across a steep ravine. Subsequently, that pile was included in the gamma walkover survey. Figure 5.10.1 correctly depicts the original AOC 565 and the totality of the data points collected (including those outside of AOC 565). The highest measurement was on the asphalt pile and is most likely due to the presence of surface contamination.

During RI 2, the unit underwent a gamma radiological walkover survey (Figure 5.10.1) using a FIDLER; the 1,383 measurements ranged from 4,247 to 9,399 cpm. The survey encompassed the area to the north, south, and east of the location exhibiting elevated readings from which a judgmental sample was collected previously. A judgmental grab sample was collected for radiological constituents.

5.10.3 Nature and Extent of Contamination—Surface Soils

The representative data set presented in Table 5.10.1 provides the nature of the contamination in AOC 565 surface soils, and Figures 5.10.2 and 5.10.3 illustrate the horizontal extent. A complete list of sampling results is provided in Appendix F (samples with ending depths of 1 ft bgs or less or null are considered surface soils).

The lateral extent of AOC 565 surface soil contamination is considered defined adequately for supporting the BRA and FS. AOC 565 consists of 1 EU.

Metals

Uranium metal was the only metal analyzed for AOC 565. It was not detected above any screening levels.

PCBs

PCBs were not analyzed in surface soil samples at AOC 565.

SVOCs

SVOCs were not analyzed in surface soil samples at AOC 565.

VOCs

VOCs were not analyzed in surface soil samples at AOC 565.

Radionuclides

No radionuclides were detected above both the background screening level and the teen recreational user NALs and ALs in AOC 565 surface soil. No radionuclides were detected above both the background screening levels and SSLs for the protection of UCRS and RGA groundwater.

5.10.4 Nature and Extent of Contamination—Subsurface Soils

Subsurface soils were not sampled for this AOC.

5.10.5 Fate and Transport

No target chemicals were identified for further evaluation of impacts to the RGA (Chapter 4). AOC 565 is on the banks of Bayou Creek, near the C-611-V recycle lagoon; however, AOC 565 is mostly grass-covered or otherwise stabilized (riprap), and the contaminants are not likely to be transported attached to suspended soil particles. Bayou Creek is scheduled to be investigated as part of the SWOU. A final

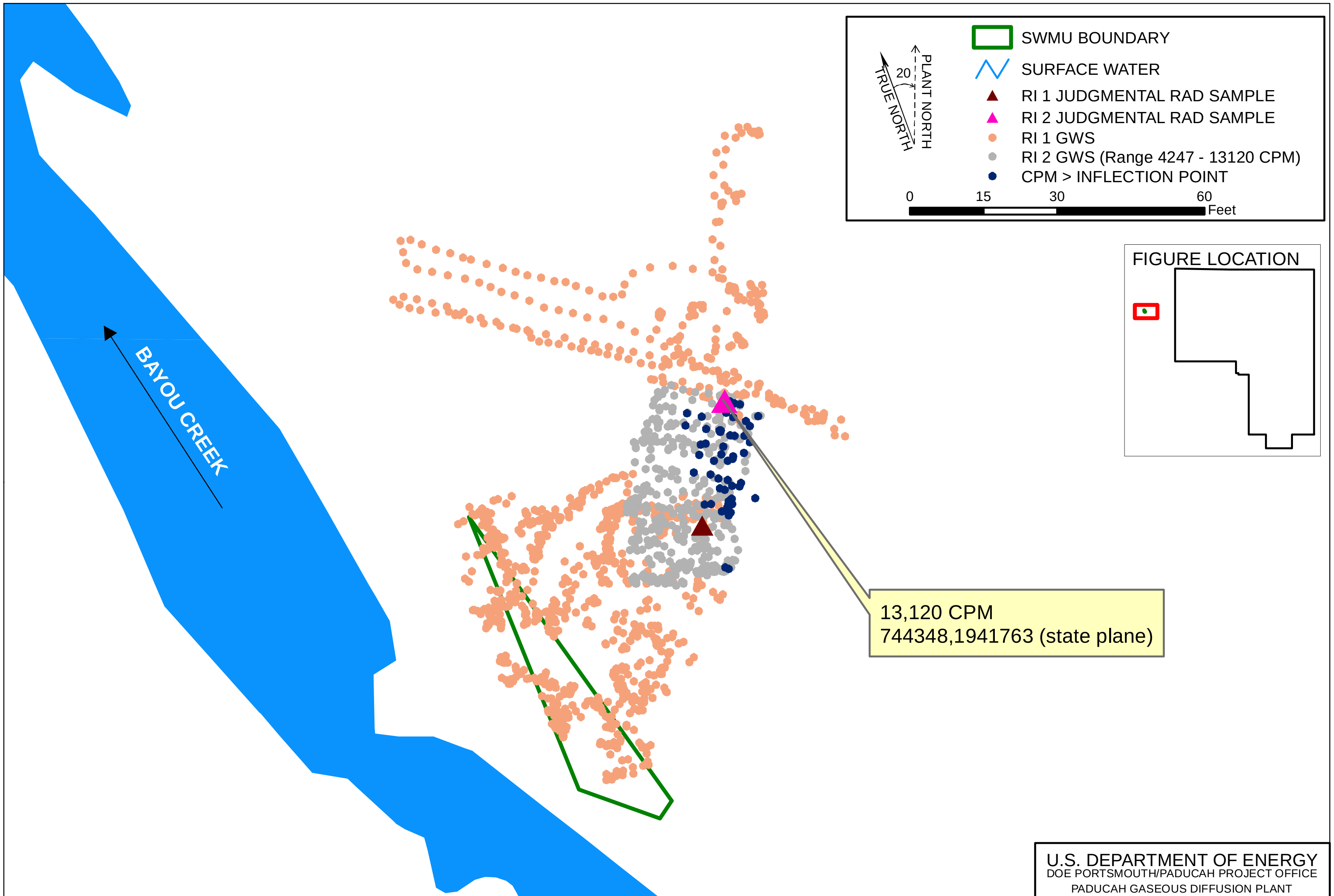

Figure 5.10.1. AOC 565 Gamma Walkover Survey

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Table 5.10.1. Surface Soil Data Summary: AOC 565

			Detected Results			J-qualified		Provisional Background		Teen Recreator		Teen Recreator		GW Protection Screen		
Type	**Analysis**	**Unit**	**Min**	**Max**	**Avg**	**FOD**	**FOD**	**FOE**	**Bkgd**	**FOE**	**NAL**	**FOE**	**AL**	**RGA**	**UCRS**	**DL Range**
METAL	Uranium	mg/kg	3.31E+00	3.31E+00	3.31E+00	0/1	1/1	0/1	4.90E+00	0/1	3.36E+02	0/1	1.01E+04	0/1	0/1	0.02–0.02
RADS	Americium-241	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	N/A	0/2	8.43E+00	0/2	8.43E+02	0/2	0/2	0.029–0.043
RADS	Cesium-137	pCi/g	3.81E-02	4.00E-01	2.19E-01	0/2	2/2	0/2	4.90E-01	1/2	3.23E-01	0/2	3.23E+01	0/2	0/2	0.0358–0.17
RADS	Neptunium-237	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	1.00E-01	0/2	6.68E-01	0/2	6.68E+01	0/2	0/2	0.024–0.0262
RADS	Plutonium-238	pCi/g	1.70E-02	1.70E-02	1.70E-02	0/2	1/2	0/2	7.30E-02	0/2	1.23E+01	0/2	1.23E+03	0/2	0/2	0.015–0.0229
RADS	Plutonium-239/240	pCi/g	1.45E-02	1.45E-02	1.45E-02	0/2	1/2	0/2	2.50E-02	0/2	1.08E+01	0/2	1.08E+03	0/2	0/2	0.00981–0.017
RADS	Technetium-99	pCi/g	N/A	N/A	N/A	0/2	0/2	0/2	2.50E+00	0/2	3.26E+02	0/2	3.26E+04	0/2	0/2	0.45–0.795
RADS	Thorium-228	pCi/g	7.70E-01	1.04E+00	9.05E-01	0/2	2/2	0/2	1.60E+00	0/2	N/A	0/2	N/A	N/A	N/A	0.03–0.0846
RADS	Thorium-230	pCi/g	8.80E-01	1.21E+00	1.05E+00	0/2	2/2	0/2	1.50E+00	0/2	1.45E+01	0/2	1.45E+03	0/2	0/2	0.02–0.083
RADS	Thorium-232	pCi/g	7.40E-01	1.02E+00	8.80E-01	0/2	2/2	0/2	1.50E+00	0/2	N/A	0/2	N/A	N/A	N/A	0.007–0.0377
RADS	Uranium-234	pCi/g	8.48E-01	9.30E-01	8.89E-01	0/2	2/2	0/2	1.20E+00	0/2	1.65E+01	0/2	1.65E+03	0/2	2/2	0.01–0.0479
RADS	Uranium-235	pCi/g	4.70E-02	4.70E-02	4.70E-02	0/2	1/2	0/2	6.00E-02	0/2	9.68E-01	0/2	9.68E+01	0/2	0/2	0.018–0.0374
RADS	Uranium-238	pCi/g	1.02E+00	1.11E+00	1.07E+00	0/2	2/2	0/2	1.20E+00	0/2	3.57E+00	0/2	3.57E+02	0/2	2/2	0.008–0.048

One or more samples exceed AL value
One or more samples exceed NAL value
One or more samples exceed background value
One or more samples exceed SSLs of RGA and UCRS groundwater protection

Counts of analyses are based on the maximum detected result from a sample (i.e., if a sample has analytical results from two different labs, only the maximum value is counted).
Field replicates, or separate samples are counted independently.

The uranium (metal)/uranium (isotopic) may not be from the same sample thus a correlation between uranium (metal)/uranium (isotopic) data may not be possible.
Uranium-238 that was analyzed using method RL-7128NITRIC is compared to a background value of 0.4 pCi/g for surface and subsurface.

Screening values are shown in Appendices C and D.

FOD = frequency of detection
FOE = frequency of exceedance
N/A = not applicable

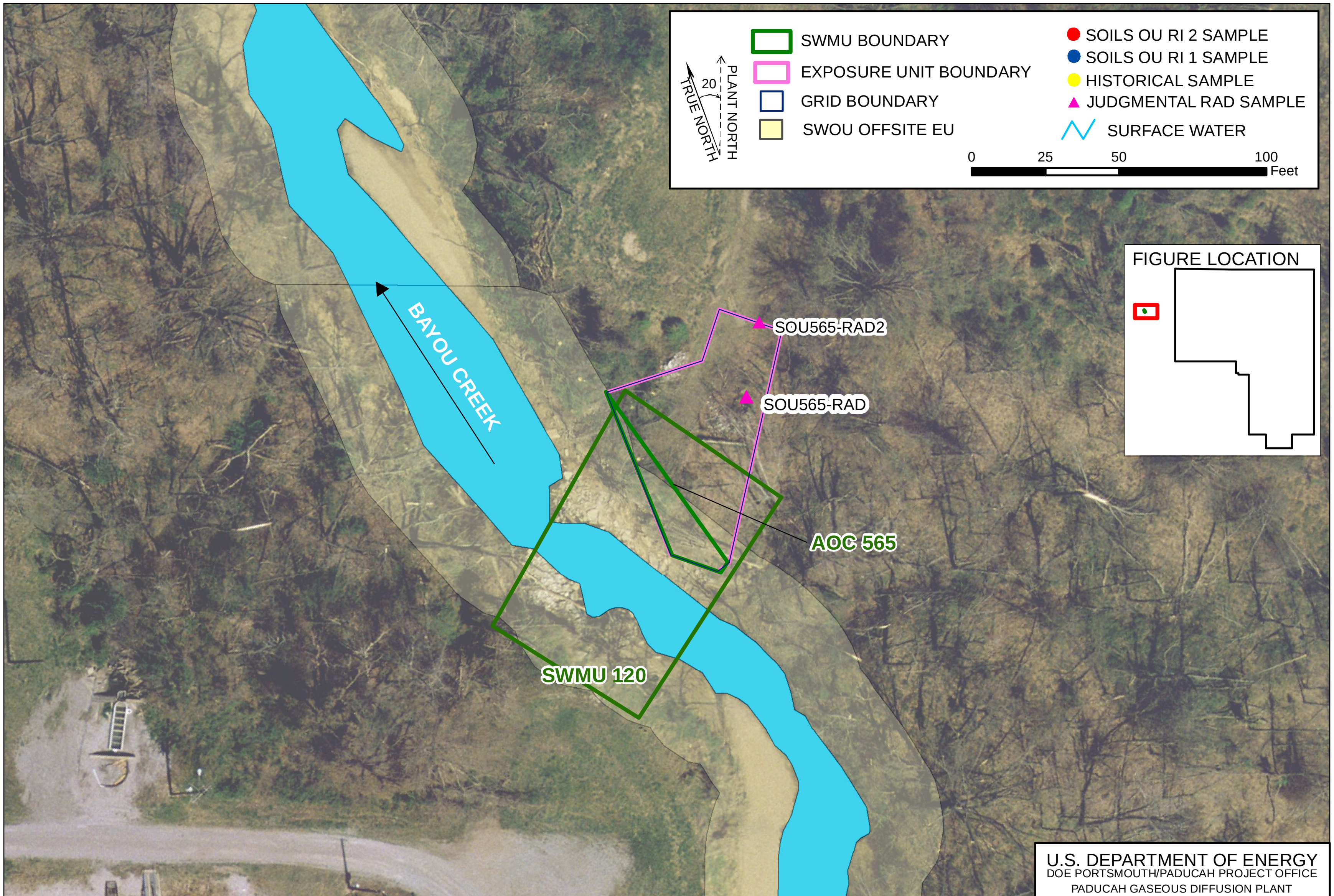

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Figure 5.10.2. AOC 565 Sampling Locations – Surface Soil

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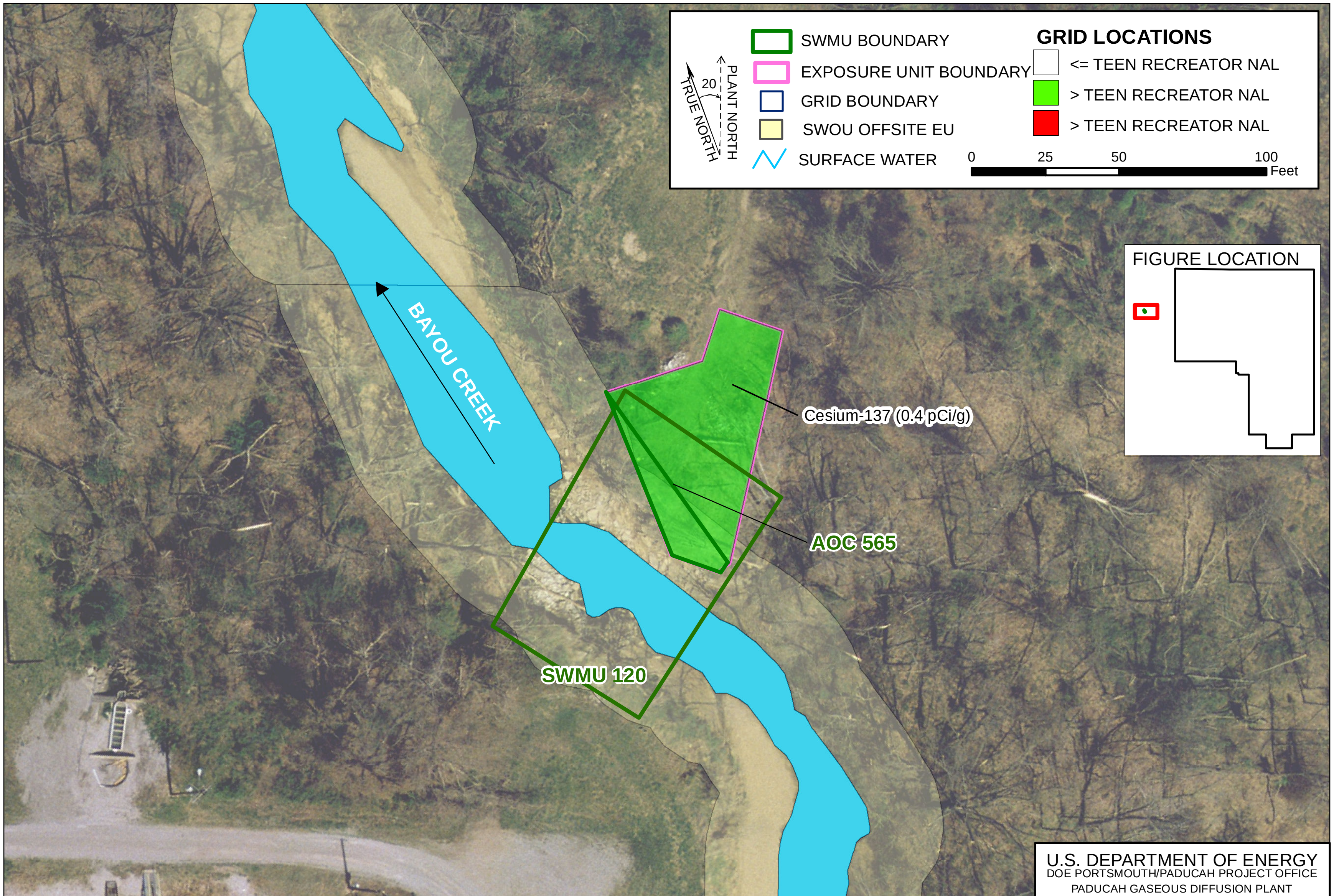

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Figure 5.10.3. AOC 565 NAL Exceedances—Surface Soil

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response action for internal ditches, outfalls, and creeks will be addressed by the SWOU, as described in the SMP (DOE 2015a).

5.10.6 Baseline Risk Assessment

Human Health. Potential risks and hazards for current/future human health for AOC 565 were evaluated for direct contact. These results are summarized in Appendix D and in the subsections that follow, including the COCs and relative contributions to the overall ELCR/HI.

The cumulative ELCR and the cumulative HI for AOC 565 do not exceed the benchmarks of cumulative ELCR of 1E-06 and cumulative HI greater than 1, respectively for any scenario; therefore, as stated in the Work Plan, Decision Rule D1a, (DOE 2010a), this AOC may be considered for no further action. As described in the BHHRA (Appendix D), no COCs were identified after considering the results of the risk characterization and the uncertainties affecting the results.

Ecological Screening. COPECs for AOC 565 were evaluated; however, none were identified.

5.10.7 AOC 565 Summary

Goal 1. Characterize Nature and Extent of Source Zone

The rubble at AOC 565 has not demonstrated any contamination to date. The rubble was placed on the creek bank to control erosion.

COPCs for surface and subsurface soils from AOC 565 are shown on Table 5.10.1 as those analytes with green boxes under the "Industrial Worker/FOE" columns for surface and shallow subsurface soil, and those with blue boxes under the "GW Protection Screen/RGA/UCRS" columns for groundwater. For metals and radioisotopes, an orange box under the "Provisional Background" must accompany the green and blue boxes. No COPCs were identified for AOC 565 in surface soil. Subsurface samples were not collected.

Goal 2. Determine Surface and Subsurface Transport Mechanisms and Pathways

There has been no contamination demonstrated at AOC 565 to date based on the results of gamma radiological walkover surveys and judgmental rad sampling. There are no underground pipelines at AOC 565. The CSM can be found in Appendix D.

Goal 3. Complete a Baseline Risk Assessment for the Soils OU

Neither cumulative ELCRs nor HIs exceeded benchmarks of 1E-06 and 1, respectively, for any scenario, with the exception of subsurface scenarios. There are no COCs for AOC 565. No priority COCs were identified for groundwater modeled from soil.

Goal 4. Support Evaluation of Remedial Alternatives

The representative data set used for AOC 565 is sufficient to support decision making and indicates that this AOC should be considered for a "No Further Action" decision. Possible remedial technologies applicable for this unit, as discussed in the Work Plan, are posting, fencing (or other means of limiting access), and excavation (DOE 2010a). This AOC is adjacent to SWMU 120, which also is a concrete rubble pile categorized as "no further action" in the 2014 SMP (DOE 2015a). A response action at AOC 565 would not affect groundwater or surface water.

5.10.8 AOC 565 Conclusion

The RI defined adequately the nature and extent of contamination in soils at AOC 565; only the subsurface scenarios (i.e., the future outdoor worker (surface and subsurface soil), and the excavation worker), showed an ELCR of at least 1E-06. The sampling indicated the elevated ELCR was a surface sample and was below background.

The reasonably anticipated land use for AOC 565 is recreational, as shown in the SMP (DOE 2015a). This area is outside the Limited Area, away from the plant site, but on the bank of Bayou Creek, which receives PGDP discharges. PGDP workers will be required to perform periodic maintenance of the channel. Because the expected exposure pathway for this AOC has an ELCR/HI lower than EPA's accepted values and because this AOC has no COCs for any scenario, this AOC should be considered for a "no further action" decision.

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6. CONCLUSIONS FOR THE SOILS OU REMEDIAL INVESTIGATION

This Soils OU RI 2 was designed to investigate nature and extent of contamination, contaminant fate and transport, and to characterize potential risks/hazards from current and future exposures[6] as a basis for evaluating remedial alternatives in an FS for 12 SWMUs/AOCs using historical data along with data collected during the Soils OU RI and Soils OU RI 2 to supplement the existing data. The final representative data set includes samples analyzed by laboratory and field methods to join with the historical data. Among the objectives for the sampling and analysis strategy were to provide sufficient delineation of COCs and to provide grid-based sampling that allows better estimates of average concentrations to be used for risk estimates.

The goals of this Soils OU RI 2, consistent with Work Plan (DOE 2010a), are as follows:

(1) Goal 1: Characterize Nature and Extent of Source Zone(s);
(2) Goal 2: Determine Surface and Subsurface Transport Mechanisms and Pathways;
(3) Goal 3: Complete a Baseline Risk Assessment for the Soils OU; and
(4) Goal 4: Support Evaluation of Remedial Alternatives.

The SWMUs/AOCs included in the Soils OU RI 2 (Table 1.1) varied in the nature of the sources/releases, proximity to drainageways, size, cover, and location (within or outside the Limited Area). These SWMUs/AOCs together cover an area of approximately 17 acres and the SWMUs/AOCs range in size from less than 2,000 ft^2 up to nearly 7 acres. Five of these SWMUs/AOCs are less than 0.25 acre.

The goal of this summary is to highlight the observations on an OU-wide basis, recognizing that careful review of each SWMU/AOC individually is needed to make valid risk management decisions.

6.1 GOAL 1: CHARACTERIZE NATURE AND EXTENT OF SOURCE ZONE(S)

The nature and extent of contamination at the 12 SWMUs/AOCs is considered defined adequately. Vertical extent of contamination is uncertain at each of the SWMUs/AOCs (see Section 5), but this uncertainty will be managed in the FS.

To determine nature of contamination in surface soils, results of analyses in SWMUs/AOCs were compared to surface background values, where available. Consistent with the Work Plan (DOE 2010a), which identifies industrial or recreational use as the current and reasonably anticipated future land uses, results of analyses were compared further to future industrial worker NALs for SWMUs/AOCs inside the Limited Area and to the teen recreator NALs for SWMUs/AOCs outside the Limited Area. Table 6.1 indicates the constituent that exceeded this screening in at least one location (shown with a green, italic *X*). Constituents that also exceed ALs are shown in bold, red font.

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[6] The BHHRA in this report considers residential land use consistent with EPA Region 4 Human Health Risk Assessment Supplemental Guidance. As discussed in the Paducah SMP (DOE 2015a), the Paducah Human Health Risk Methods Document (DOE 2015b), and this Soils OU RI 2 Report, industrial and recreational use, and not residential use, are the reasonably anticipated land uses for the SWMU/AOCs assessed. The risk characterization for the residential scenario will be used in subsequent documents to identify unlimited use/unlimited exposure for no further action determinations and any land use controls appropriate for reasonably anticipated land uses.

6.2 GOAL 2: DETERMINE SURFACE AND SUBSURFACE TRANSPORT MECHANISMS AND PATHWAYS

Migration to Groundwater

Screening evaluation, as described in Section 4 and Appendix C, identified SWMUs/AOCs 13, 15, 26, 56 and 80, and 211-A as having potentially problematic soil contamination by leaching to groundwater and impacting the RGA above drinking water standards. Soil constituents at these SWMUs/AOCs included Tc-99, uranium-234, and nickel. Further examination indicated that uranium-234 and nickel did not require modeling. Transport properties for the modeled constituent are listed in Table 6.2.

Table 6.1. Exceedances of NAL Screening

	Surface Soils		Subsurface Soils	
	Future Industrial Worker	**Teen Recreator**	**Future Industrial Worker**	**Teen Recreator**
Metals				
Antimony	*X*		*X*	
Arsenic	**X**	**X**	*X*	*X*
Chromium	*X*			
Cobalt	*X*			
Copper			*X*	
Iron	**X**			
Lead	**X**		**X**	
Manganese				*X*
Nickel			*X*	
Thallium	*X*			
Uranium	*X*	**X**		
Dioxins/Furans				
Total Dioxins/Furans	*X*			
PCBs				
Total PCBs	**X**	**X**	**X**	
SVOCs				
Pentachlorophenol			*X*	
Total PAHs	**X**	*X*	*X*	*X*
Radionuclides				
Americium-241	*X*			
Cesium-137	**X**	*X*	**X**	
Neptunium-237	*X*		**X**	
Tc-99	*X*		*X*	
Thorium-230	*X*			
Uranium-234	*X*	*X*	*X*	
Uranium-235	*X*	*X*	*X*	
Uranium-238	**X**	**X**	*X*	

X constituent that exceeds the NAL in at least one location
X constituent that also exceeds the AL

Table 6.2. Soils OU RI 2 Constituents for the Groundwater Pathway and Properties

Soil Constituents	Mol. Wt. (MW) (g/gmol)	Solubility in water (mg/L)	Diffusion in air (cm^2/s)	Diffusion in water (m^2/hr)	Henry's Constant (atm.m^3/mol)	K_{oc} (L/kg)	$K_d{}^a$ (L/kg)	Degradation Half Life (years)
Tc-99	99	7.18E+03*	N/A	3.60E-07	N/A	N/A	0.2	2.13E+05

Note: Tc-99 solubility is derived from the geochemical database "thermo.com.V8.R6.230," which was prepared by Lawrence Livermore National Laboratory. The exact database used here is 'llnl.dat 4023 2010-02-09 21:02:42Z,' which was converted to PHREEQC format by Greg Anderson and David Parkhurst of the U.S. Geological Survey.

Based on the modeling results, the incremental contributions of Tc-99 currently present in soil at SWMU 13 and SWMU 15 does not have the potential to impact the RGA groundwater at the SWMU boundary at concentrations (510 pCi/L and 680 pCi/L, respectively) that exceed the screening criterion of 900 pCi/L (DOE 2013). Consistent with the Soils OU RI Report (DOE 2013), 900 pCi/L was the criterion used in screening to determine which SWMUs were modeled for Tc-99 transport. Further, a review of the monitoring well and extraction well data does not show incremental impacts to the RGA Tc-99 plume from SWMU 13 or SWMU 15. The RGA Tc-99 plume is from the vicinity of C-400. Further, the RGA Tc-99 plume does not pass under SWMU 13 or SWMU 15.

At SWMU 26, uranium-234 was detected at an activity concentration greater than both the background value and SSL. However, the mass concentration of uranium assumed to be present based upon the assumption that the uranium isotopes were present at natural abundance would be 79 mg/kg. At 79 mg/kg, the average concentration is less than the average uranium concentration at SWMU 81 (2,502 mg/kg) that modeling in the Soils OU RI Report (DOE 2013) found not to migrate to the RGA within 1,000 years. Based on this, uranium was not modeled at SWMUs 15, 26, 56 and 80, or 211-A.

Nickel exceeded both the background value and the SSL at SWMU 26 and exhibited clustering when the results were viewed in 3-dimensions; however, the average concentration of nickel (156 mg/kg) was less than the average concentration for SWMU 14 (401 mg/kg in the 0-5 ft soils) that was modeled in the Soils OU RI Report (DOE 2013) where the results of the modeling showed that nickel did not reach the RGA groundwater in the 1,000-year SESOIL modeling period. Based on this, nickel was not modeled at SWMU 26.

Table 6.3. RGA Groundwater Modeling Results at the SWMU/AOC Boundary and Points of Exposure

SWMU/ AOC	Soil Constituents	Maximum RGA Groundwater Concentration at SWMU/AOC Boundary (Time to Reach Boundary)
13	Tc-99	510 pCi/L (33 years)
15	Tc-99	680 pCi/L (33 years)
26	Tc-99	0*

*Leaching does not result in Tc-99 groundwater concentrations greater than the AT123D minimum reported concentration of 1E-2 µg/L (169 pCi/L) at SWMU 26 boundary.

Runoff

Each of the SWMU/AOC discussions and Table 6.7, included in the summary of the potential ecological risks, identifies the ground cover and whether the SWMU/AOC is located near a drainageway or outfall. Impacts in these receiving areas have been evaluated separately in the SWOU and are not quantified in this assessment for each SWMU/AOC (DOE 2008b). A removal action for the contaminated sediment associated with SWOU (On-Site) (DOE 2011a) was conducted for Outfalls 001, 008, 010, 011, 015, and associated internal ditches. A final response action for internal ditches, outfalls, and creeks will be addressed by the SWOU, as described in the SMP (DOE 2015a).Where elevated surface soil contamination is present in proximity to these drainageways, it is identified as a factor to be considered in the selection of remedial alternatives.

6.3 GOAL 3: COMPLETE A BASELINE RISK ASSESSMENT FOR THE SOILS OU

PGDP is an industrial facility surrounded by a state-maintained wildlife refuge and residential property. The current and reasonably anticipated future use of locations within the Limited Area is industrial, and the reasonably anticipated future use of locations outside the Limited Area is recreational. The risk characterization for these current and reasonably anticipated future uses will be used when making risk management decisions in subsequent documents.

Consistent with the Paducah Human Health Risk Methods Document (DOE 2015b), which incorporates both EPA and Kentucky risk assessment guidance, the BHHRA for the SWMUs/AOCs characterized risk for a range of reasonably anticipated and hypothetical current and future use scenarios. In developing these scenarios, the concept of reasonable maximum exposure was used. Additionally, consistent with the results available, the exposure assessment primarily considered exposure to soil (surface and/or subsurface).

This section summarizes the following:

(1) Priority Contaminants. Identification of the contaminants that most frequently are present and contribute most substantially to the ELCR/HI estimates at many of the SWMUs/AOCs.

(2) Relative Risks (ELCRs)/Hazards (HIs). Relative risks (ELCRs)/hazards (HIs) among SWMUs/AOCs based on contact with contaminants in soil and interpretation of these as priorities for management action.

(3) Ecological risk/hazard considerations of potential ecological receptors.

(4) Other COPECs/Uncertainties.

Priority Contaminants

To determine use scenarios of concern, risk characterization results for Total HI and Total ELCR were compared to benchmarks of 1.0 and 1E-06, respectively. Use scenarios with Total HI or Total ELCR exceeding either of these benchmarks were deemed use scenarios of concern. To determine COCs, potential risk characterization results for chemical-specific HQ and chemical-specific ELCR over all pathways within a use scenario of concern were compared to benchmarks of 0.1 and 1E-06, respectively. COPCs within a use scenario of concern exceeding either of these benchmarks were deemed COCs for the use scenario of concern. The COCs are identified in tables in Chapter 5. In addition, priority COCs have been identified in this report. Priority COCs are those COCs with either a chemical-specific HQ or chemical-specific ELCR over all pathways within a use scenario of concern greater than 1 and 1E-04, respectively. Priority COCs are identified to highlight those COCs contributing most to Total HI and Total ELCR for each SWMU/AOC.

For the Soils OU RI 2 sites, there were three priority COCs (Total PCBs, arsenic, and uranium-238) that had an ELCR > 1E-04 for the future industrial worker scenario or the teen recreational user scenario, as appropriate. There are three priority COCs (arsenic, thallium, and uranium) where the individual metal results in an HI > 1 for the future industrial worker or the teen recreational user scenario, as appropriate. These are summarized in Tables 6.4 and 6.5.

Table 6.4. Soils OU RI 2 Future Industrial Worker Priority COCs (SWMUs inside the Limited Area)

SWMU/EU with Priority COCs	COC	Exposure Point Concentration	HQ	ELCR
15/3	Uranium-238	867.5 pCi/g	N/A	5.3E-04
15/4	Total PCBs	31.31 mg/kg	N/A	1.0E-04
26/2	Thallium	23.77 mg/kg	1.0	N/A
26/4	Uranium-238	849.4 pCi/g	N/A	5.2E-04
80/1	Total PCBs	120 mg/kg	N/A	3.9E-04
80/2	Uranium-238	1921 pCi/g	N/A	1.2E-03
80/3	Total PCBs	566 mg/kg	N/A	1.9E-03

Table 6.5. Soils OU RI 2 Teen Recreational User Priority COCs (AOCs outside the Limited Area)

AOC/EU with Priority COCs	COC	Exposure Point Concentration	HQ	ELCR
204/14	Arsenic	136 mg/kg	1.3	2.2E-04
204/20	Total PCBs	79 mg/kg	N/A	4.6E-04
204/20	Uranium	13070 mg/kg	3.9	N/A
204/20	Uranium-238	4386 pCi/g	N/A	1.3E-03

Although the risk assessment estimates ELCR for radionuclides to be considered in the total risk, a dose assessment for these constituents allows comparison of the detected levels (pCi/g), with an estimate of mrem/yr to consider DOE guidelines for radiation exposure. The results of this analysis indicate in a parallel analysis that these are significant contributors to the risk. The dose assessment performed for the surface soil indicated dose for SWMUs/AOCs inside the Limited Area was as high as 52 mrem/yr for the future industrial worker (SWMUs 56/80). Two SWMU areas inside the Limited Area were estimated higher than the 25 mrem/yr benchmark (SWMUs 26 and 56/80). The dose assessment for surface soil outside the Limited Area estimated dose to the teen recreational user scenario as high as 50 mrem/yr (AOC 204).

<u>Relative Risks (ELCRs)/Hazards (HIs)</u>

The BHHRA process allows a range of scenarios to be considered to help understand the contaminants that pose the greatest hazards. For soil impacted sites, scenarios consistent with reasonably anticipated future use include default assumptions used for future industrial worker (inside the Limited Area) and for the teen recreator (outside of the Limited Area) (DOE 2015b). Similarly, evaluation of ELCRs/HIs provides an upper bounding estimate, if the site were to become residential. Incidental ingestion of contaminated soil, dermal contact with contaminated soil, inhalation of particulates/vapors emitted from contaminated soil, and external exposure to ionizing radiation emitted from contaminated soil were the exposure routes evaluated in the BHHRA. Each of these exposure routes presented a pathway of concern (i.e., HI ≥ 0.1 and/or ELCR ≥ 1E-06) in at least one SWMU/AOC.

Scenarios that assume some future contact with contaminants in the subsurface soil (e.g., the excavation worker) are used to consider contact with the entire soil column (0–16 ft bgs) either during construction or over the longer term as the site soils are mixed and disturbed for alternate uses.

Table 6.6 shows a summary of direct contact risks for each SWMU/AOC, along with the highlighted scenario. The scenarios highlighted are those for the reasonably anticipated future use of the area of the SWMU/AOC, as presented in the SWMU/AOC-specific discussions in Chapter 5. Additionally, for SWMU/AOCs with more than one EU, the highest Total HI, Total ELCR, and Total Dose across all EUs are presented.

Table 6.6. Summary of Maximum Direct Contact Total HI, Total ELCR, and Total Doses for the Soils OU RI 2 SWMUs/AOCs

		Direct Contact*		
SWMU	**Scenario**	**Total HI**	**Total ELCR**	**Total Dose (mrem/yr)**
Former Facilities				
13	Future Industrial Worker	< 1	**7.8E-05**	1.6
15	Future Industrial Worker	< 1	***6.5E-04***	24.1
26	Future Industrial Worker	**1.5**	***7.2E-04***	25.3
77	Future Industrial Worker	< 1	**2.7E-05**	0.5
56 and 80	Future Industrial Worker	< 1	***1.9E-03***	52.1
204	Teen Recreational User	***3.9***	***1.9E-03***	50.2
211-A	Future Industrial Worker	< 1	***1.2E-04***	5.2
224	Future Industrial Worker	< 1	**1.5E-05**	0.3
225	Future Industrial Worker	< 1	**2.1E-06**	< 0.1
565	Teen Recreational User	< 1	< 1.0E-06	N/A

For each SWMU, the total HI, total ELCR, and total Dose from the EU showing the highest result is presented.
Bold indicates total HI > 1 or total ELCR > 1E-06; ***bold italics*** indicates total HI > 3 or total ELCR > 1E-04.
N/A[1] = Total dose was not assessed because there were no radiological COPCs for the SWMU.
*For direct contact, future industrial worker for SWMUs/AOCs inside the Limited Area and the teen recreational user for SWMUs/AOCs outside the industrial area are presented. Total HI and Total ELCR represent the cumulative value across all exposure routes assessed within this BHHRA (i.e., incidental ingestion, dermal contact, inhalation, and external exposure).
Only total dose above 0.1 mrem/year is summarized.

The reasonably anticipated future use of areas containing SWMUs/AOCs outside the Limited Area is recreational. Although some contact with soils would be expected during hunting, the exposure duration, frequency, clothing worn, etc., would limit these intakes. In addition, these activities are unlikely to focus on small areas. The more typical exposure scenario at the Paducah Site would include ingestion of game; this evaluation (consumption of fish and/or game) was not part of this BHHRA. Characterization of risks from this pathway in earlier risk assessments prepared for PGDP shows that potential cancer risks and noncancer hazards from game ingestion are lower than those from direct contact with contaminated soil (DOE 2008b).

Following are the uncertainties affecting the estimation of ELCR and HI in the human health risk assessment for the Soils OU RI 2.

- The range of background was not considered beyond the initial screening against site-specific background.

- Arithmetic average lead concentration is compared to the NAL to determine if additional risk analysis is needed, potentially leading to missed lead exposure.

- Concentration of total cancerous PAHs was used to estimate risk, and the minimum detection limit of the PAHs with toxicity equivalence factors was used when PAHs were not detected.

- Some detection limits for XRF data are above background concentrations and NALs; the COPCs identified using these data are expected to overstate the presence of these metals.

- For those constituents that never were detected within an EU, even if the detection limit is greater than the NAL, the constituent was not considered a COPC.

- UCL concentrations were used as EPCs if there were a sufficient number of samples and distinct results to calculate a UCL. This likely will lead to an overestimation of actual exposure because receptors are assumed to be exposed to the UCL concentration for the entire exposure duration.

- Conservative (i.e., health protective) exposure factors are used when information available is limited in the form of using RME assumptions, per the Risk Methods Document (DOE 2015b). This may result in an overestimation of potential risk.

- Many of the SWMUs/AOCs evaluated in this assessment are very small, and the assumptions used for the levels of exposures (duration, frequency) overstate potential chronic exposures in these units.

- The risk assessment does not consider that concentrations of some COCs may be lower or higher in the future because of processes such as degradation and attenuation.

- Additivity of multiple chemicals is assumed. Whether assuming additivity can lead to an underestimation or overestimation of risk is unknown.

- Most of the assumptions about exposure and toxicity used in the BHHRA are representative of statistical upper-bounds or even maximums for each parameter. The result of combining several such upper-bound assumptions is that the final estimate of potential exposure or potential risk is conservative.

<u>Ecological Risk Considerations</u>

Consistent with the Paducah Ecological Risk Methods Document (DOE 2015c), which incorporates both EPA and Kentucky risk assessment guidance, the SERA was limited to a comparison of maximum concentrations in surface soils at the SWMUs/AOCs against ecological screening levels in order to identify COPECs. The SERA does not consider the limited habitat, SWMU/AOC size, or other factors that also need to be considered to characterize ecological risk. The following observations were made for the SERA as summarized on Tables 6.7 and 6.8.

Table 6.7. Summary of Suite of COPECs Retained in Surface Soil

SWMU/ AOC	Media	Number of Metals	Number of Rads	Number of PCBs	Number of SVOCs	Number of VOCs
13	Soil	19	---	1	1	---
15	Soil	21	---	1	2	---
26	Soil	25	14	1	6	10
77	Soil	16	---	1	---	---
56/80	Soil	18	11	1	17	---
204	Soil	22	13	1	1	1
211-A	Soil	18	---	1	1	---
224	Soil	17	---	1	1	---
225-A and 225-B	Soil	17	---	---	1	---
565	Soil	---	---	---	---	---

---: no COPECs

Table 6.8. Soils OU RI 2 Ecological Risk by SWMU/AOC

Description	SWMU	Area Acres	Ground Cover	Near a Surface Water Body?	Total HI[a]	Priority COPECs	Background (mg/kg)[b]	Maximum Detection or ½ Maximum Detection Limit (mg/kg)	Soil ESV (mg/kg)	EPC (mg/kg)	HQ[a]
Scrap Yards	13	6.83	gravel with a soil/grass mix	No	674	Aluminum	13,000	14,000	50	7,078	141.6
						Antimony	0.21	10	0.27	7.666	28.4
						Iron	28,000	47,830	200	22,491	112.5
						Mercury	0.2	20	0.1	20.49	204.9
						PCB, Total	N/A	2.5	0.02	2.557	127.9
						Vanadium	38	158	7.8	98.61	12.6
Scrap Yard	15	5.29	gravel with a soil/grass mix	Yes	1,326	Aluminum	13,000	9,250	50	8,455	169.1
						Antimony	0.21	283.01	0.27	87.04	322.4
						Cadmium	0.21	24.15	0.36	8.604	23.9
						Copper	19	6,122.47	28	571.9	20.4
						High molecular weight PAHs	N/A	15.99	1.1	12.35	11.2
						Iron	28,000	171,000	200	37,414	187.1
						Lead	36	1,040.18	11	134.7	12.2
						Mercury	0.2	20	0.1	6.116	61.2
						Nickel	21	3,787.15	38	411.8	10.8
						PCB, Total	N/A	55	0.02	8.604	430.2
						Selenium	0.8	26.71	0.52	10.2	19.6
						Uranium	4.9	459	5	91.33	18.3
						Zinc	65	3,168.62	46	474.4	10.3
4-inch Underground Transfer Line	26	0.041	soil/gravel mix	Yes	1,125	Aluminum	13,000	34,600	50	17,359	347.2
						Antimony	0.21	8.95	0.27	6.596	24.4
						High molecular weight PAHs	N/A	29.4	1.1	15.07	13.7
						Iron	28,000	85,100	200	30,020	150.1
						Mercury	0.2	20	0.1	21.16	211.6
						PCB, Total	N/A	2.5	0.02	2.115	105.8
						Uranium	4.9	3,100	5	792.6	158.5
						Vanadium	38	195	7.8	141.6	18.2

Table 6.8. Soils OU RI 2 Ecological Risk by SWMU/AOC (Continued)

Description	SWMU	Area Acres	Ground Cover	Near a Surface Water Body?	Total HI[a]	Priority COPECs	Background (mg/kg)[b]	Maximum Detection or ½ Maximum Detection Limit (mg/kg)	Soil ESV (mg/kg)	EPC (mg/kg)	HQ[a]
Sulfuric Acid Storage Tank	77	0.017	concrete with some gravel	No	765	Iron	28,000	50,329	200	50,329	251.6
						Mercury	0.2	20	0.1	20	200.0
						PCB, Total	N/A	2.5	0.02	2.5	125.0
						Uranium	4.9	666	5	666	133.2
						Vanadium	38	168	7.8	168	21.5
PCB Staging Area and Spill Site	56/80	0.345	gravel/soil/grass with gravel driveways, and concrete pads	Yes	2,865	Aluminum	13,000	9,320	50	9,320	186.4
						Antimony	0.21	58.17	0.27	40.4	149.6
						Cadmium	0.21	6	0.36	6.72	18.7
						Iron	28,000	41,269	200	28,735	143.7
						Mercury	0.2	20	0.1	19.9	198.9
						PCB, Total	N/A	475	0.02	41.8	2,091.5
						Selenium	0.8	10	0.52	5.62	10.8
						Uranium	4.9	5,724	5	77.4	15.5
						Vanadium	38	138	7.8	113	14.5
Historical Staging Area	204	11.3	soil/grass mix	Yes	1,192	Aluminum	13,000	13,700	50	8,971	179.4
						Antimony	0.21	10	0.27	4.35	16.1
						Iron	28,000	33,542	200	24,076	120.4
						Mercury	0.2	20	0.1	20.5	204.8
						PCB, Total	N/A	79	0.02	2.47	123.5
						Trichloroethene	N/A	0.5	0.001	0.5	500.0
						Vanadium	38	151	7.8	113	14.5
Trichloroethene Spill Site Northwest	211-A	0.062	mostly grass, but a gravel patch on the south side of the SWMU; asphalt to the south	No	1,042	Aluminum	13,000	8,800	50	8,800	176.0
						Antimony	0.21	65.23	0.27	59.9	221.7
						Cadmium	0.21	6	0.36	6	16.7
						Iron	28,000	30,465	200	30,465	152.3
						Mercury	0.2	20	0.1	20.9	209.0
						PCB, Total	N/A	2.5	0.02	4.09	204.7
						Selenium	0.8	10	0.52	13.3	25.7
DMSA OS-13, Empty Drum Storage	224	0.149	mostly gravel with some soil/grass	No	688	Aluminum	13,000	4,910	50	4,910	98.2
						Antimony	0.21	108.07	0.27	108.07	400.3
						Cadmium	0.21	6	0.36	6	16.7
						Iron	28,000	14,444.19	200	14,444.19	72.2
						Mercury	0.2	5	0.1	5	50.0
						Selenium	0.8	10	0.52	10	19.2

Table 6.8. Soils OU RI 2 Ecological Risk by SWMU/AOC (Continued)

Description	SWMU	Area Acres	Ground Cover	Near a Surface Water Body?	Total HI[a]	Priority COPECs	Background (mg/kg)[b]	Maximum Detection or ½ Maximum Detection Limit (mg/kg)	Soil ESV (mg/kg)	EPC (mg/kg)	HQ[a]
DMSA OS-14, Rail Cars	225	0.186	soil/gravel mix	No	796	Aluminum	13,000	8,480	50	8,480	169.6
						Antimony	0.21	54.12	0.27	54.12	200.4
						Cadmium	0.21	6	0.36	6	16.7
						Iron	28,000	27,274	200	27,274	136.4
						Mercury	0.2	20	0.1	20	200.0
						Molybdenum	N/A	36	2	36	18.0
						Selenium	0.8	10	0.52	10	19.2
						Vanadium	38	109	7.8	109	14.0
Rubble Area K, North of C-611 Water Treatment Plant	565	0.012	concrete rubble with soil/grass	Yes	0	None					

[a] Total HI includes concentrations from all of the COPECs (listed in Table E4.1); only priority COPECs (i.e., the COPECs with HQs greater than 10 using the EPCs) are shown in this table.
[b] Background values are for surface soil taken from DOE 2015b; ESVs are taken from DOE 2015c and Appendix E of this report.

The two primary risk drivers when comparing maximum detection to ecological risk are the same as those for human health.

- **Total PCBs.** The maximum PCB concentration was greater than 10 times the ESVs of 0.02 mg/kg at 8 of the 12 SWMUs/AOCs (13, 15, 26, 56, 77, 80, 204, and 211-A), with a combined area of about 24 acres. The largest of these was AOC 204 (11.3 acres). Runoff from this SWMU discharges to Outfall 011. The maximum concentration for these 8 SWMUs/AOCs was 475 mg/kg at SWMUs 56 and 80. However, there may be some bias when using field data because PCBs were not detected in some areas. The ESV is 0.02 mg/kg and is well below the detection limit for field screening; therefore, the risk may be overstated, since one-half the detection limit is used for nondetected constituents.

- **Uranium.** The maximum uranium concentration was above 10 times the ESV of 5 mg/kg (background is 4.9 mg/kg) at 8 SWMUs/AOCs (13, 15, 26, 56, 77, 80, 204, and 229), representing a combined area of 24 acres. The highest concentration was 13,070 mg/kg at AOC 204 (11.3 acres).

Other COPECs/Uncertainties

Metals. As indicated in Appendix B, there may be uncertainties when using XRF data to estimate risks. Three metals (aluminum, antimony, and mercury) show significant exceedances of the ESVs at all of the SWMUs/AOCs with the exception of AOC 565.

6.4 GOAL 4: SUPPORT EVALUATION OF REMEDIAL ALTERNATIVES

The representative data set used for the SWMUs/AOCs is sufficient to support decision making and indicates that an FS is appropriate for 11 SWMUs/AOCs including 13, 15, 26, 56, 77, 80, 204, 211-A, 224, 225-A, 225-B. Other information was gathered in support of the evaluation of remedial alternatives to include infrastructure issues, extent of contamination, and verification of site descriptions. Possible remedial technologies applicable for these units are, as discussed in the Work Plan (DOE 2010a), posting, fencing (or other means of limiting access), excavation, and/or other remedial technologies that will be described in the FS. Chapter 5 contains the SWMU/AOC specific details.

Remedial Goal Options

All SWMUs/AOCs, with the exception of AOC 565, require further review in the FS to evaluate the appropriate options to address current or potential future risks/hazards. The BHHRA in this RI characterized the cancer risks and noncancer hazards (i.e., Total ELCR and Total HI, respectively) potentially resulting from exposure to contaminants in soil.

RGOs were calculated for each COC as determined by the conclusions of the BHHRA. These RGOs should not be interpreted as being cleanup goals, but as risk-based values that may be used by risk managers to revise preliminary remediation goals to be consistent with the RAOs in the FS and to develop cleanup goals from these revised preliminary remediation goals in the Record of Decision. The COCs and RGOs consistent with the current and reasonably anticipated future use scenarios (i.e., industrial use, including both the industrial and excavation worker, and the teen recreator) are shown in Table 6.9. This table also includes, for use by risk managers, the RGOs for the other hypothetical scenarios, included in the BHHRA.

Table 6.9. Consolidated RGOs for the Soils OU RI 2 SWMUs/AOCs

COC	RGO at ELCR=1E-6	RGO at ELCR=1E-5	RGO at ELCR=1E-4	RGO at HI=0.1	RGO at HI=1	RGO at HI=3	Units
Future Industrial Worker (Exposed to Surface Soils)							
Arsenic	1.41E+00	1.41E+01	1.41E+02	2.26E+01	2.26E+02	6.78E+02	mg/kg
Cobalt	N/A	N/A	N/A	9.82E+00	9.82E+01	2.95E+02	mg/kg
Dioxins/Furans, Total	1.63E-05	1.63E-04	1.63E-03	N/A	N/A	N/A	mg/kg
PAH, Total	8.94E-02	8.94E-01	8.94E+00	N/A	N/A	N/A	mg/kg
PCB, Total	3.05E-01	3.05E+00	3.05E+01	N/A	N/A	N/A	mg/kg
Thallium	N/A	N/A	N/A	2.34E+00	2.34E+01	7.01E+01	mg/kg
Uranium	N/A	N/A	N/A	6.58E+02	6.58E+03	1.97E+04	mg/kg
Americium-241	5.45E+00	5.45E+01	5.45E+02	N/A	N/A	N/A	pCi/g
Cesium-137	1.14E-01	1.14E+00	1.14E+01	N/A	N/A	N/A	pCi/g
Neptunium-237	2.53E-01	2.53E+00	2.53E+01	N/A	N/A	N/A	pCi/g
Plutonium-239/240	1.30E+01	1.30E+02	1.30E+03	N/A	N/A	N/A	pCi/g
Protactinium-231	1.47E+00	1.47E+01	1.47E+02	N/A	N/A	N/A	pCi/g
Radium-228	1.67E-01	1.67E+00	1.67E+01	N/A	N/A	N/A	pCi/g
Tc-99	3.78E+02	3.78E+03	3.78E+04	N/A	N/A	N/A	pCi/g
Thorium-230	1.71E+01	1.71E+02	1.71E+03	N/A	N/A	N/A	pCi/g
Uranium-234	2.01E+01	2.01E+02	2.01E+03	N/A	N/A	N/A	pCi/g
Uranium-235	3.73E-01	3.73E+00	3.73E+01	N/A	N/A	N/A	pCi/g
Outdoor Worker (Exposed to Surface Soils)							
Antimony	N/A	N/A	N/A	1.32E+01	1.32E+02	3.95E+02	mg/kg
Arsenic	5.04E-01	5.04E+00	5.04E+01	8.09E+00	8.09E+01	2.43E+02	mg/kg
Cobalt	N/A	N/A	N/A	9.82E+00	9.82E+01	2.95E+02	mg/kg
Copper	N/A	N/A	N/A	1.32E+03	1.32E+04	3.95E+04	mg/kg
Iron	N/A	N/A	N/A	2.30E+04	2.30E+05	6.91E+05	mg/kg
Manganese	N/A	N/A	N/A	7.57E+02	7.57E+03	2.27E+04	mg/kg
Mercury	N/A	N/A	N/A	9.86E+00	9.86E+01	2.96E+02	mg/kg
Nickel	N/A	N/A	N/A	6.45E+02	6.45E+03	1.93E+04	mg/kg
Thallium	N/A	N/A	N/A	3.29E-01	3.29E+00	9.86E+00	mg/kg
Uranium	N/A	N/A	N/A	9.80E+01	9.80E+02	2.94E+03	mg/kg
Vanadium	N/A	N/A	N/A	1.65E+02	1.65E+03	4.95E+03	mg/kg
Dioxins/Furans, Total	5.82E-06	5.82E-05	5.82E-04	2.30E-05	2.30E-04	6.91E-04	mg/kg
PAH, Total	6.50E-02	6.50E-01	6.50E+00	N/A	N/A	N/A	mg/kg
PCB, Total	2.29E-01	2.29E+00	2.29E+01	N/A	N/A	N/A	mg/kg
Americium-241	2.02E+00	2.02E+01	2.02E+02	N/A	N/A	N/A	pCi/g
Cesium-137	1.52E-01	1.52E+00	1.52E+01	N/A	N/A	N/A	pCi/g
Neptunium-237	3.12E-01	3.12E+00	3.12E+01	N/A	N/A	N/A	pCi/g
Plutonium-239/240	1.96E+00	1.96E+01	1.96E+02	N/A	N/A	N/A	pCi/g
Protactinium-231	9.13E-01	9.13E+00	9.13E+01	N/A	N/A	N/A	pCi/g
Radium-228	1.76E-01	1.76E+00	1.76E+01	N/A	N/A	N/A	pCi/g
Tc-99	6.11E+01	6.11E+02	6.11E+03	N/A	N/A	N/A	pCi/g
Thorium-230	2.68E+00	2.68E+01	2.68E+02	N/A	N/A	N/A	pCi/g
Uranium-234	3.02E+00	3.02E+01	3.02E+02	N/A	N/A	N/A	pCi/g
Uranium-235	4.37E-01	4.37E+00	4.37E+01	N/A	N/A	N/A	pCi/g
Uranium-238	1.19E+00	1.19E+01	1.19E+02	N/A	N/A	N/A	pCi/g

Table 6.9. Consolidated RGOs for the Soils OU RI 2 SWMUs/AOCs (Continued)

COC	RGO at ELCR=1E-6	RGO at ELCR=1E-5	RGO at ELCR=1E-4	RGO at HI=0.1	RGO at HI=1	RGO at HI=3	Units
Teen Recreational User (Exposed to Surface Soils)[1]							
Antimony	N/A	N/A	N/A	4.48E+01	4.48E+02	1.35E+03	mg/kg
Arsenic	6.14E-01	6.14E+00	6.14E+01	1.03E+01	1.03E+02	3.10E+02	mg/kg
Cobalt	N/A	N/A	N/A	3.35E+01	3.35E+02	1.00E+03	mg/kg
Dioxins/Furans, Total	7.09E-06	7.09E-05	7.09E-04	N/A	N/A	N/A	mg/kg
Iron	N/A	N/A	N/A	7.85E+04	7.85E+05	2.35E+06	mg/kg
Mercury	N/A	N/A	N/A	3.36E+01	3.36E+02	1.01E+03	mg/kg
PAH, Total	5.03E-02	5.03E-01	5.03E+00	N/A	N/A	N/A	mg/kg
PCB, Total	1.73E-01	1.73E+00	1.73E+01	N/A	N/A	N/A	mg/kg
Thallium	N/A	N/A	N/A	1.12E+00	1.12E+01	3.36E+01	mg/kg
Uranium	N/A	N/A	N/A	3.34E+02	3.34E+03	1.00E+04	mg/kg
Cesium-137	2.79E-01	2.79E+00	2.79E+01	N/A	N/A	N/A	pCi/g
Neptunium-237	6.03E-01	6.03E+00	6.03E+01	N/A	N/A	N/A	pCi/g
Plutonium-239/240	1.05E+01	1.05E+02	1.05E+03	N/A	N/A	N/A	pCi/g
Protactinium-231	2.76E+00	2.76E+01	2.76E+02	N/A	N/A	N/A	pCi/g
Radium-228	3.60E-01	3.60E+00	3.60E+01	N/A	N/A	N/A	pCi/g
Tc-99	3.18E+02	3.18E+03	3.18E+04	N/A	N/A	N/A	pCi/g
Thorium-230	1.42E+01	1.42E+02	1.42E+03	N/A	N/A	N/A	pCi/g
Uranium-234	1.61E+01	1.61E+02	1.61E+03	N/A	N/A	N/A	pCi/g
Uranium-235	8.75E-01	8.75E+00	8.75E+01	N/A	N/A	N/A	pCi/g
Uranium-238	3.29E+00	3.29E+01	3.29E+02	N/A	N/A	N/A	pCi/g
Excavation Worker (Exposed to Surface and Subsurface Soils)							
Antimony	N/A	N/A	N/A	1.32E+01	1.32E+02	3.95E+02	mg/kg
Arsenic	2.52E+00	2.52E+01	2.52E+02	8.09E+00	8.09E+01	2.43E+02	mg/kg
Cadmium	N/A	N/A	N/A	2.53E+01	2.53E+02	7.60E+02	mg/kg
Cobalt	N/A	N/A	N/A	9.82E+00	9.82E+01	2.95E+02	mg/kg
Copper	N/A	N/A	N/A	1.32E+03	1.32E+04	3.95E+04	mg/kg
Iron	N/A	N/A	N/A	2.30E+04	2.30E+05	6.91E+05	mg/kg
Manganese	N/A	N/A	N/A	7.57E+02	7.57E+03	2.27E+04	mg/kg
Mercury	N/A	N/A	N/A	9.86E+00	9.86E+01	2.96E+02	mg/kg
Nickel	N/A	N/A	N/A	1.64E+02	1.64E+03	4.91E+03	mg/kg
PAH, Total	3.25E-01	3.25E+00	3.25E+01	N/A	N/A	N/A	mg/kg
PCB, Total	1.14E+00	1.14E+01	1.14E+02	N/A	N/A	N/A	mg/kg
Thallium	N/A	N/A	N/A	3.29E-01	3.29E+00	9.86E+00	mg/kg
Uranium	N/A	N/A	N/A	9.80E+01	9.80E+02	2.94E+03	mg/kg
Vanadium	N/A	N/A	N/A	1.65E+02	1.65E+03	4.95E+03	mg/kg
Cesium-137	6.12E-01	6.12E+00	6.12E+01	N/A	N/A	N/A	pCi/g
Neptunium-237	1.56E+00	1.56E+01	1.56E+02	N/A	N/A	N/A	pCi/g
Plutonium-239/240	9.80E+00	9.80E+01	9.80E+02	N/A	N/A	N/A	pCi/g
Protactinium-231	4.57E+00	4.57E+01	4.57E+02	N/A	N/A	N/A	pCi/g
Radium-228	3.69E-01	3.69E+00	3.69E+01	N/A	N/A	N/A	pCi/g
Tc-99	3.05E+02	3.05E+03	3.05E+04	N/A	N/A	N/A	pCi/g
Thorium-230	1.34E+01	1.34E+02	1.34E+03	N/A	N/A	N/A	pCi/g
Uranium-234	1.51E+01	1.51E+02	1.51E+03	N/A	N/A	N/A	pCi/g
Uranium-235	2.18E+00	2.18E+01	2.18E+02	N/A	N/A	N/A	pCi/g
Uranium-238	5.95E+00	5.95E+01	5.95E+02	N/A	N/A	N/A	pCi/g

Table 6.9. Consolidated RGOs for the Soils OU RI 2 SWMUs/AOCs (Continued)

COC	RGO at ELCR=1E-6	RGO at ELCR=1E-5	RGO at ELCR=1E-4	RGO at HI=0.1	RGO at HI=1	RGO at HI=3	Units
Future Hypothetical Resident (Exposed to Surface Soils) [2]							
Aluminum	N/A	N/A	N/A	7.73E+03	7.73E+04	2.32E+05	mg/kg
Antimony	N/A	N/A	N/A	3.13E+00	3.13E+01	9.39E+01	mg/kg
Arsenic	2.67E-01	2.67E+00	2.67E+01	1.67E+00	1.67E+01	5.01E+01	mg/kg
Cadmium	N/A	N/A	N/A	5.07E+00	5.07E+01	1.52E+02	mg/kg
Cobalt	N/A	N/A	N/A	2.34E+00	2.34E+01	7.02E+01	mg/kg
Copper	N/A	N/A	N/A	3.13E+02	3.13E+03	9.39E+03	mg/kg
Dioxins/Furans, Total	3.08E-06	3.08E-05	3.08E-04	5.47E-06	5.47E-05	1.64E-04	mg/kg
Iron	N/A	N/A	N/A	5.47E+03	5.48E+04	1.64E+05	mg/kg
Iron	N/A	N/A	N/A	5.48E+03	5.48E+04	1.64E+05	mg/kg
Manganese	N/A	N/A	N/A	1.82E+02	1.82E+03	5.47E+03	mg/kg
Mercury	N/A	N/A	N/A	2.35E+00	2.35E+01	7.04E+01	mg/kg
Molybdenum	N/A	N/A	N/A	3.91E+01	3.91E+02	1.17E+03	mg/kg
Nickel	N/A	N/A	N/A	3.90E+01	3.90E+02	1.17E+03	mg/kg
PAH, Total	2.27E-02	2.27E-01	2.27E+00	N/A	N/A	N/A	mg/kg
PCB, Total	7.82E-02	7.82E-01	7.82E+00	N/A	N/A	N/A	mg/kg
Silver	N/A	N/A	N/A	3.91E+01	3.91E+02	1.17E+03	mg/kg
Thallium	N/A	N/A	N/A	7.82E-02	7.82E-01	2.35E+00	mg/kg
Uranium	N/A	N/A	N/A	2.34E+01	2.34E+02	7.01E+02	mg/kg
Vanadium	N/A	N/A	N/A	3.93E+01	3.93E+02	1.18E+03	mg/kg
Americium-241	1.63E+00	1.63E+01	1.63E+02	N/A	N/A	N/A	pCi/g
Cesium-137	3.51E-02	3.51E-01	3.51E+00	N/A	N/A	N/A	pCi/g
Neptunium-237	7.72E-02	7.72E-01	7.72E+00	N/A	N/A	N/A	pCi/g
Plutonium-239/240	3.73E+00	3.73E+01	3.73E+02	N/A	N/A	N/A	pCi/g
Protactinium-231	4.45E-01	4.45E+00	4.45E+01	N/A	N/A	N/A	pCi/g
Radium-228	5.25E-02	5.25E-01	5.25E+00	N/A	N/A	N/A	pCi/g
Tc-99	1.07E+02	1.07E+03	1.07E+04	N/A	N/A	N/A	pCi/g
Thorium-230	4.89E+00	4.89E+01	4.89E+02	N/A	N/A	N/A	pCi/g
Uranium-234	5.73E+00	5.73E+01	5.73E+02	N/A	N/A	N/A	pCi/g
Uranium-235	1.14E-01	1.14E+00	1.14E+01	N/A	N/A	N/A	pCi/g
Uranium-238	4.99E-01	4.99E+00	4.99E+01	N/A	N/A	N/A	pCi/g

N/A = not applicable

RGOs for the current industrial worker were not calculated because RGOs for the current industrial worker are not needed to develop preliminary remediation goals used to screen remedial alternatives in the FS.

[1] RGOs for the teen recreational user dose method incorporate age-adjusted values for the 26-year exposure duration for carcinogens.

[2] RGOs for residential land use are based on exposure to a resident age 1-27. For carcinogens, the dose method incorporates age-adjusted values for the 26-year exposure duration. Because child soil ingestion rates are higher and body weights are lower, noncancer RGOs are based on the child resident exposure assumptions.

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APPENDIX A

TECHNICAL MEMORANDUM FOR FIELD ACTIVITIES

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CONTENTS

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TABLES

FIGURES

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ACRONYMS

AOC	area of concern
bgs	below ground surface
BHHRA	baseline human health risk assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
DOE	U.S. Department of Energy
DPT	direct push technology
EPA	U.S. Environmental Protection Agency
ES&H	environment, safety, and health
FS	feasibility study
KPDES	Kentucky Pollutant Discharge Elimination System
OU	operable unit
PGDP	Paducah Gaseous Diffusion Plant
PPE	personal protective equipment
QC	quality control
RCRA	Resource Conservation and Recovery Act
RCT	radiological control technician
RI	remedial investigation
SERA	screening-level ecological risk assessment
SWMU	solid waste management unit
VOC	volatile organic compound

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A.1. INTRODUCTION

The purpose of this memorandum is to provide certain technical details regarding field activities pertaining to the Soils Operable Unit (OU) Remedial Investigation (RI) 2. A brief summary of project objectives is provided below; a more thorough discussion is contained in the main text of the report.

The Soils OU is one of the OUs located within the Paducah Gaseous Diffusion Plant (PGDP). This OU consists of contamination associated with PGDP's soils, which are listed in Tables ES.1 and 1.1 in the main text of the RI Report.

The primary focus of this RI was to collect field and fixed-base analytical data necessary to determine the nature and extent of any soil contamination. The data will be used to support the completion of a baseline human health risk assessment (BHHRA) and a screening-level ecological risk assessment (SERA). The data also will be used in conjunction with other data that may be necessary to evaluate appropriate remedial alternatives, as necessary, at each of the solid waste management units (SWMUs)/areas of concern (AOCs).

Table A.1 presents procedures and work instructions that were used to complete the fieldwork conducted as part of the Soils OU RI.

Table A.1. Examples of Procedures Used in the RI of the Soils OU

Work Instructions or Procedures Required for Fieldwork and Sampling Activities
Archival of Environmental Data Within the Environmental Restoration Program
Chain-of-Custody
Cleaning and Decontaminating Sample Containers and Sampling Equipment
Data Entry
Data Management Coordination
Data Validation
Environmental Radiological Screening
Equipment Decontamination
Field Quality Control
Identification and Management of Waste not from a Radioactive Material Management Area
Labeling, Packaging, and Shipping of Environmental Field Samples
On-Site Handling and Disposal of Waste Materials
Opening Containerized Waste
Paducah Contractor Records Management Program
Quality Assured Data
Sampling of Soil
Composite Sampling
Use of Field Logbooks

Sixteen SWMUs/AOCs were determined to require additional characterization subsequent to the Soils OU RI to delineate the nature and extent of contamination. On April 13, 2012, the Federal Facility Agreement (FFA) parties agreed that the Soils OU RI would be bifurcated into two investigations based on the results of the 2010 field investigation (DOE 2012). Subsequent to the Soils OU RI (DOE 2010), SWMU 225 was divided into SWMUs 225-A and 225-B (DOE 2014). A work plan addendum was developed and approved to describe how additional sampling would be performed (DOE 2014). This work plan addendum supplemented the approved Soils OU RI/Feasibility Study (FS) Work Plan (Work Plan) (DOE 2010), which was completed in June 2010. The work performed in this phase of the project is referred to as the Soils OU RI 2 within this document. The work plan addendum (DOE 2014) documents

March and April 2014 walk downs and scoping meetings where the FFA parties identified SWMUs that were recommended for deferral to another OU (i.e., the Soils and Slabs OU) or SWMUs that did not require additional sampling (i.e., SWMU 224). During the course of the Soils OU RI 2 field work, SWMU 229 consistently contained standing water. As stated in the survey plan of the work plan addendum (DOE 2014), gamma radiological surveys would not be performed in areas of standing water; therefore, the planned activities (i.e., radiological walkover survey and a judgmental grab sample) for this unit could not be completed. After discussion among the FFA parties on December 2, 2014, it was concluded that the activities for SWMU 229 will need to be conducted at a later time when the unit is free of standing water (e.g., July, August). SWMU 229 has not been evaluated within this report. The remaining 12 SWMUs/AOCs are addressed by this RI Report. The SWMUs/AOCs were investigated per the Work Plan (DOE 2010) and addendum (DOE 2014), as described in the following sections in this appendix.

A.2. SOIL SAMPLING STRATEGY

The field sampling strategy used for the RI consisted of intrusive media sampling (surface and subsurface soil). The investigation activities used standard industry practices that were consistent with U.S. Environmental Protection Agency (EPA) procedures and protocols. Sampling activities at the Soils OU RI 2 SWMUs/AOCs focused on the soils from 0–10 ft below ground surface (bgs) and down to a depth of 16 ft bgs at the invert of a pipeline.

Soil samples generally were taken by hand using a hand-auger for the 0–1 ft bgs and in 3 ft increments (1–4, 4–7, 7–10) with a track-mounted rig capable of direct push technology (DPT) drilling. The depths of 4–7, and 7–10 ft bgs were taken only when field laboratory results indicated the need for contingency (i.e., step-out and step down) sampling, as described in the Work Plan (DOE 2010) and addendum (DOE 2014). This track-mounted drill rig utilized push rods to advance a soil sample tube with an acetate liner to collect undisturbed soil samples. If refusal was met using the push rods, the sample was offset 10 ft and attempted again up to two times. Samples consisted of a five-point composite in each 45 ft by 45 ft grid and for each depth interval, as described in the Work Plan (DOE 2010).

The field crew sampled the soil borings in accordance with U.S. Department of Energy (DOE) Prime Contractor-approved procedures, consistent with *Environmental Investigation Standard Operating Procedures and Quality Assurance Manual* (EPA 2001). As soon as the drill crew recovered the acetate liner containing the soil sample, the soil core was placed in the sample preparation area. A health and safety specialist and radiological control technician (RCT) scanned the acetate sleeve and the ends of the soil core for volatile organic compounds (VOCs) and radiation before releasing the core to the sample crew. Once the soil core in acetate sleeve was cleared, the sample crew opened the acetate sleeve with a utility knife and, once again, a health and safety officer and radiation control officer scanned the sample for contamination. When contamination was found, the health and safety officer and radiation control officer directed the field crew in any additional personal protective equipment (PPE) requirements and appropriate handling precautions.

Immediately upon approval from the health and safety specialist and RCT for the field crew to sample the soil core, the field crew collected the samples by placing the soil in a clean bowl and mixed thoroughly. Samplers placed the resulting soil mixture in the appropriate sample jars for analysis.

The contingency grids were composite sampled, as explained above. The contingency grids were determined by preliminary results from field analysis of grid sampling at the surface and/or 1 ft to 4 ft bgs depth. Project action levels were set as the benchmarks to determine whether contingency grid sampling was necessary and if additional depth samples (4–7 ft and 7–10 ft bgs) were necessary. The project action levels are shown in Chapter 2, Table 2.2, and further discussed in Chapter 4. If a project action level was exceeded (i.e., surface migration pathways) an additional grid (up to two) was placed until a boundary was reached (e.g., road, another SWMU, ditch). If the exceedance was for the 1–4 ft bgs sample, then collection of depth samples (4–7 ft and 7–10 ft bgs) also were performed in the original grid.

A.3. SURVEYING

As the field crew performed the Soils OU RI 2 sampling, they marked the boring locations using flagging and/or paint. Global Positioning System units with submeter accuracy documented the sample locations. The Soils OU RI 2 included surveying of sampling center grid locations prior to sampling activities. This survey work was performed by or under responsible charge of a Professional Land Surveyor registered in the Commonwealth of Kentucky, locating each sample point with its horizontal and vertical position using the PGDP coordinate system for horizontal control. Additionally, the survey identified the State Plane Coordinates for each sample location using the U.S. Coast and Geodetic Survey North American Datum of 1983. The datum for vertical control was the U.S. Coast and Geodetic Survey North American Vertical Datum of 1988. Accuracy for this work was that of a Class 1 First Order survey.

Project personnel entered the coordinates into the Paducah Project Environmental Measurements System and the coordinate locations were transferred with the station's ready-to-load file to the Paducah Oak Ridge Environmental Information System.

The Soils OU RI 2 also performed nonintrusive data collection (gamma radiological walkover surveys) for SWMUs/AOCs 13, 56 and 80, 204, and 565. Biased, 0–6 inch samples were taken from a location selected by inflection point analysis in SWMU/AOC 13, 15, 56 and 80, 211-A, 204, 565 and submitted to the fixed-base laboratory for radionuclide analysis.

A.4. SAMPLING PROCEDURES

During the sampling event, two types of samples—soil and field quality control (QC)—were collected and submitted for analysis. Prior to initiation of field sampling, all sample team members completed all required training.

The sampling team collected, stored, and shipped the samples according to preestablished QC protocols and approved project procedures, which were consistent with EPA Region 4 sampling methodologies. Sample container, preservation, and holding time requirements were in accordance with the EPA Engineering Support Branch Standard Operating Procedures.

Samples collected for this project were assigned unique sample identifiers that were recorded on the sample labels and chain-of-custody forms.

An example of the sample numbering scheme used for the Soils OU RI 2 project, as discussed in the Work Plan (DOE 2010), is provided below.

SOUssseeeMA000

where	SOU	Identifies the project (i.e., Soils OU)

sss	Identifies the SWMU/AOC being investigated
eee	Identifies the grid
M	Identifies the media type (W identifies the sample as water, S identifies the sample as soil)
A	Identifies the sequential sample (usually "A" for a primary sample and "B" for a secondary sample) If additional rounds of sampling are required, the sequential letter designations will continue.
000	Identifies the planned depth of the sample in ft bgs

Sample team crew members directly affixed labels to the sample containers that included the following information:

- Station name
- Sample identification number
- Sample matrix
- Sample type
- Type or types of analysis required
- Date and time of collection
- Sampler name
- Sample preservation (if required)
- Destination laboratory

The sampling team wore proper PPE during sampling. PPE consisted of, in part, company-issued clothing, safety glasses, and latex gloves. Sampling in radiological contamination areas sometimes necessitated modifications of the PPE requirements (as prescribed in work permits and directed by the project's health physics technician).

A.4.1 SOIL SAMPLES

Samples were collected in accordance with the Work Plan (DOE 2010) and addendum (DOE 2014). The field crew sampled the soil borings in accordance with DOE Prime Contractor-approved procedures, consistent with EPA guidance (EPA 2014), collecting soil for VOC analysis (if required), followed by the remaining soil was placed in a clean stainless steel bowl and mixed thoroughly using a stainless steel spoon to homogenize the soil taken from the sample interval before sampling for other analyses.

Sample team members filled the sample containers and ensured that each lid was tightened securely. The sample container then was placed in a cooler with an ice pack to maintain a preservation temperature of 4°C. Crew members recorded all required information in the sampling logbook.

A.4.2 FIELD QC SAMPLES

To ensure reliability of the analytical data and to meet the data quality objectives for the project, the following QC sample types were obtained during sample collection.

- Trip Blanks—Analysis of trip blanks documented the occurrence of cross-contamination by VOCs during sample handling and shipping. The sample crew prepared trip blanks by filling VOC vials with deionized water before collection of the field samples. These trip blanks accompanied the filled sample bottles in ice chests in the field and during shipment and through interim storage in secured refrigerators until laboratory analysis. The trip blanks were analyzed for VOCs only.

- Field Blanks—Field blanks served as a check for potential airborne environmental contamination at the sample site. For the field blanks, the sample crew typically filled sample bottles with deionized water for samples required for fixed-base laboratory analysis and with clean soil for samples required for field laboratory analysis in the project’s sample staging area and transported the bottles to the field sample station where they were opened during the sampling process. Field blanks also were used as a reagent blank, as needed. The Soils OU RI 2 required field blanks at a frequency of 1 in 20 samples (5%) for each sample matrix.

- Field Duplicate Samples—Field duplicate samples determined the sampling variance. The sampling crew collected 1 duplicate for every 20 samples (5%), per matrix. The field duplicate was analyzed for the same set of analytical parameters as the sample it duplicated.

- Equipment Blanks or Rinseate Samples—Equipment blanks provided a measure of the decontamination process effectiveness and were used as reagent blanks, as needed. These equipment blanks were required only when nondisposable equipment was being used. The equipment blanks consisted of deionized water passed through or over decontaminated sampling equipment and analyzed for the same parameters as the samples collected with the equipment. Equipment blanks were collected at a frequency of 1 for every 20 samples (5%).

A.5. FIELD DECONTAMINATION

The field decontamination procedure, *Decontamination of Sampling Equipment and Devices* (PAD-ENM-2702), determined the decontamination activities for the stainless steel spoons and bowls used in soil sampling. This procedure, as applied during the RI, is summarized as follows:

- Equipment first was cleaned with tap water and nonphosphate detergent, using a brush if necessary, to remove particulate matter and surface films.

- The equipment then was rinsed thoroughly with tap water, followed by an analyte-free water rinse, and then wiped with an isopropyl alcohol towelette.

- Cleaned sample equipment was allowed to air dry.

- Cleaned equipment was handled only by personnel wearing clean latex gloves to prevent recontamination.

- If cleaned sampling equipment was not reused immediately, it was wrapped in aluminum foil.

Large Equipment Decontamination (PAD-DD-2701) governed the cleaning of other sampling equipment such as the drill rigs and associated tooling. This procedure provides for the use of high-pressure steam as the primary cleaning agent. The on-site decontamination facility, C-752, supported cleaning activities for the drill rig and associated tooling during sampling at all Soils OU RI 2 locations.

A.6. WASTE MANAGEMENT

The Work Plan (DOE 2010) included a project-specific waste management plan to provide instruction regarding waste storage and disposition. A variety of wastes were generated during the field investigation, including sample residuals and associated waste derived from sample collection. The waste generated was stored in Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) waste storage areas within the CERCLA AOC during the characterization period and prior to disposal. Consistent with EPA Policy, the storage of waste within the CERCLA AOC does not trigger Resource Conservation and Recovery Act (RCRA) storage requirements (similarly, movement of waste within a CERCLA AOC does not trigger RCRA disposal requirements). As a best management practice, waste storage areas within the CERCLA AOC were managed in accordance with the substantive requirements of RCRA. Because this is a CERCLA project, the administrative requirements do not apply.

PPE was considered to fall into the same waste classification as the environmental media with which it came into contact. PPE, plastic, and paper were segregated by classification, collected in plastic bags, and labeled appropriately. These items then were handled as solid waste and dispositioned based on the waste classification of the residual soil samples.

Decontamination water that included small quantities of soil/mud was generated from cleaning the equipment. The water was collected and stored in a polyethylene tank and discharged to the Kentucky Pollutant Discharge Elimination System (KPDES) Outfall 001 after final characterization documented that the stored water met release criteria in the KPDES permit for Outfall 001.

Solid waste was containerized in 55-gal drums, or approved equivalent, that were lined with a thick plastic liner and placed in CERCLA waste storage areas. The amount of free liquid was minimized. Any substantial amount of free liquid was decanted and placed in an approved container. Drummed soils and other solid wastes were being disposed of at Energy*Solutions*.

All clean trash (i.e., trash that was not chemically or radiologically contaminated) was segregated according to established guidelines and then collected and disposed of. Examples of clean trash are office paper, aluminum cans, packaging materials, glass bottles not used to store potentially hazardous chemicals, aluminum foil, and food items.

Based on sample analyses, existing data, or process knowledge, the waste was classified into one of the following categories:

- RCRA-listed hazardous waste
- RCRA-characteristic hazardous waste
- Polychlorinated biphenyl waste
- Low-level waste
- Mixed waste
- Nonhazardous waste

Waste minimization was implemented in accordance with Hazardous and Solid Waste Amendments of RCRA of 1984 as well as other requirements. Requirements specified in the waste management plan regarding waste generation, waste tracking, waste reduction techniques, and the waste reduction program, in general, also were implemented.

To support DOE's commitment to waste reduction, an effort was made during field activities to minimize waste generation as much as possible, largely through ensuring that potentially contaminated wastes were localized and did not come into contact with any clean media (which could create more contaminated waste). Waste minimization also was accomplished through waste segregation, selection of PPE, waste handling (spill control), and the use of alternative treatment standards.

A.7. ENVIRONMENT, SAFETY, AND HEALTH

A project-specific environment, safety, and health (ES&H) plan was included as Chapter 10 in the approved Work Plan (DOE 2010) and was used to provide instruction regarding safety and health of workers, the public, and the environment. The ES&H plan established the specific applicable standards and practices to be used during execution of the RI to protect the safety and health of workers, the public, and the environment. The document contained information about the sites, potential contaminants and hazards that may be encountered on-site, and hazards inherent in routine procedures. The list of contaminants was site-specific and based on previous investigations. The plan also outlined directly, or by reference, federal and state standards, pertinent consensus standards, and applicable contract requirements. The ES&H plan was implemented in accordance with 29 *CFR* § 1910.120, "Hazardous Waste Operations and Emergency Response." Additional health and safety requirements were incorporated into the ES&H plan for the various field activities through preparation of project-specific activity hazard analyses.

The project team held daily safety and plan of the day meetings at the beginning of each shift. This approach ensured that the planned daily activities were reviewed prior to execution and the potential hazards were identified and discussed with the entire field team. These meetings are documented in the project work package and in the field logbooks.

A.8. FIELDWORK DOCUMENTATION

Field documentation was maintained throughout the Soils OU RI 2 in various types of documents and formats, including the field logbooks, sample labels, sample tags, chain-of-custody forms, and field data sheets. The following general guidelines for maintaining field documentation were implemented. Documentation requirements are listed below. Entries were written clearly and legibly using indelible ink.

- Corrections were made by striking through the error with a single line that did not obliterate the original entry. Corrections were dated and initialed.
- Dates and times were recorded using the format "mm/dd/yy" for the date and the military clock (i.e., 24-hour) for the time.
- Zeroes were recorded with a slash (/) to distinguish them from the letter O.
- Blank lines were prohibited. Information was recorded on each line or a blank line was lined out, initialed, and dated.
- No documents were altered, destroyed, or discarded, even if they were illegible or contained inaccuracies that required correction.
- Information blocks on field data forms were completed or a line was drawn through the unused section, and the area was dated and initialed.

- Unused logbook pages were marked with a diagonal line drawn from corner to corner and a signature and date was placed on the line.

- Photocopies of logbooks, field data sheets, and chain-of-custody forms were made and stored in the project file.

- The following information was recorded on the outside of the front cover of each logbook using indelible ink:

  — Project name
  — Unique logbook name and number
  — Client and contract number
  — Task and document control number
  — Activity or site name
  — Start and completion date of the logbook

Quality assurance personnel conducted periodic reviews of the data forms and logbooks (including data forms placed in the logbooks) prepared by field personnel to verify the following:

- Accuracy of entries;
- Legibility and clarity of entries;
- Completeness, to ensure that at least the minimum required information was recorded;
- Consistency of information recorded; and
- Signature and date of entries by the designated team member.

A.9. RECTIFICATION OF PLANNED SAMPLE LOCATIONS

A.9.1 INTRODUCTION

A Geographic Information System provided sample coordinates from maps of the intended sample locations in the Soils OU RI/FS Work Plan addendum (DOE 2014). Conventional survey methods were used to locate the center point sample coordinates at each grid within each SWMU/AOC.

A.9.2 DISCUSSION OF PLANNED SAMPLE LOCATIONS

During the survey and location of the sample boreholes, there were some boreholes that could not be located at the planned coordinates due to steep topography and surface structures (i.e., roads, concrete slabs, etc.). When obstructions or conditions prevented location/collection of a sample at the planned location, the samples locations were offset by 10 ft up to two times. This section presents a summary of the sampling effort.

Table A.2 is a summary of the number of samples planned and the number of samples collected during both the 2010 and 2014 field investigations. Figures A.1–A.6 show the locations of samples not obtained.

SWMU 13 was not investigated during the 2010 field effort. During the 2014 field effort, all 158 of the planned grid samples were collected. Contingency samples were not required.

SWMU 15 was investigated during the 2010 field effort. Of the 234 planned grid samples, 232 were collected. Samples from 0–1 ft bgs and 1–4 ft bgs could not be collected from grid 114 due to utilities.

Table A.2. Samples Collected

SWMU/ AOC	Planned Grid Samples	Collected Grid Samples	Contingency/ Step-out Samples Anticipated	Contingency/ Step-out Samples Collected	Planned Pipeline Samples	Collected Pipeline Samples
13	158	158	0	0	0	0
15	236	234	32	32	25	25
26	35	35	7	7	64	51
77	2	2	6	6	0	0
56/80	30	28	16	16	0	0
204	372	370	0	0	0	0
211-A	27	27	38	16	2	1
224	1	1	38	19	2	1
225-A	1	1	0	0	0	0
225-B	1	1	0	0	2	2

Note: Sample totals include quantities from both the 2010 and 2014 field investigations.

There were 24 out of 24 contingency samples collected. Of the planned pipeline samples, 25 out of 25 were collected. During the 2014 field effort, each of the 2 planned grid samples and 8 contingency samples were collected.

SWMU 26 was investigated during the 2010 field effort. Of the 64 planned pipeline samples, 51 were collected. Sampling was limited or prohibited due to asphalt road, utilities, and the boundary and cap of SWMU 3 located at the west end of SWMU 26. During the 2014 field effort, all 35 of the planned grid samples and 7 contingency samples were collected.

SWMU 77 was not investigated during the 2010 field effort. During the 2014 field effort, each of the two planned grid samples and all six of the contingency samples were collected.

SWMUs 56 and 80 was investigated during the 2010 field effort. Of the 4 planned grid samples, 2 were collected. Samples from 0–1 ft bgs and 1–4 ft bgs were not collected from grid 1 due to utilities. No pipeline samples were planned. During the 2014 field effort, all 26 of the planned grid samples and 16 contingency samples were collected.

AOC 204 was not investigated during the 2010 field effort. During the 2014 field effort, of the 372 planned grid samples, 370 were collected. Samples from 0–1 ft bgs were not collected from grids 182 and 183 due to gravel. These grids are located adjacent to the remediated area of Outfall 011. Contingency samples were not required.

SWMU 211-A was investigated during the 2010 field effort. All 4 of the planned grid samples were collected. There were 16 out of 38 contingency samples collected; samples from 4–7 ft bgs and 7–10 ft bgs could not be collected from grid 1C; samples from 0–1 ft bgs and 1–4 ft bgs could not be collected from grids 1D, 1E, 2B, 2C, 2D, and 2E; and samples from all sample intervals could not be collected from grids 1F and 1H. Sampling in these locations was limited due to utilities, asphalt, concrete, and a storage trailer. Of the planned pipeline samples, 1 out of 2 was collected. During the 2014 field effort, all 23 of the planned grid samples were collected. Contingency samples were not required.

SWMU 224 was investigated during the 2010 field effort. All samples were collected from the 1 planned grid sample. There were 19 out of 38 contingency samples collected: samples for 0–1 ft bgs and 1–ft bgs could not be collected from grids 1A, 1B, 1C, 1F, 1G, and 1H; and samples from all sample intervals could not be collected from grid 1K. Sampling in these locations was limited due to utilities and ongoing operations preventing accessibility. Of the planned pipeline samples, 1 out of 2 was collected. SWMU 224 was not investigated during the 2014 field effort.

SWMU 225-A was not investigated during the 2010 field effort. During the 2014 field effort, the one planned grid sample was collected. Contingency samples were not required.

SWMU 225-B was investigated during the 2010 field effort. All samples were collected from the one planned grid sample and two planned pipeline samples. Contingency samples were not required. SWMU 225-B was not investigated during the 2014 field effort.

A.10. REFERENCES

DOE (U.S. Department of Energy) 2010. *Work Plan for the Soils Operable Unit Remedial Investigation/Feasibility Study at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-0120&D2/R2, U.S. Department of Energy, Paducah, KY, June.

DOE 2014. *Addendum to tile Work Plan for the Soils Operable Unit Remedial Investigation/Feasibility Study at the* Paducah Gaseous Diffusion Plant, Paducah, Kentucky, Remedial Investigation 2, Sampling and Analysis Plan, DOE/LX/07-0120&D2/R2/A1/R1, U.S. Department of Energy, Paducah, KY, August.

EPA (U.S. Environmental Protection Agency) 2001. *Environmental Investigation Standard Operating Procedures and Quality Assurance Manual*, U.S. Environmental Protection Agency, Region 4, Atlanta, GA, November.

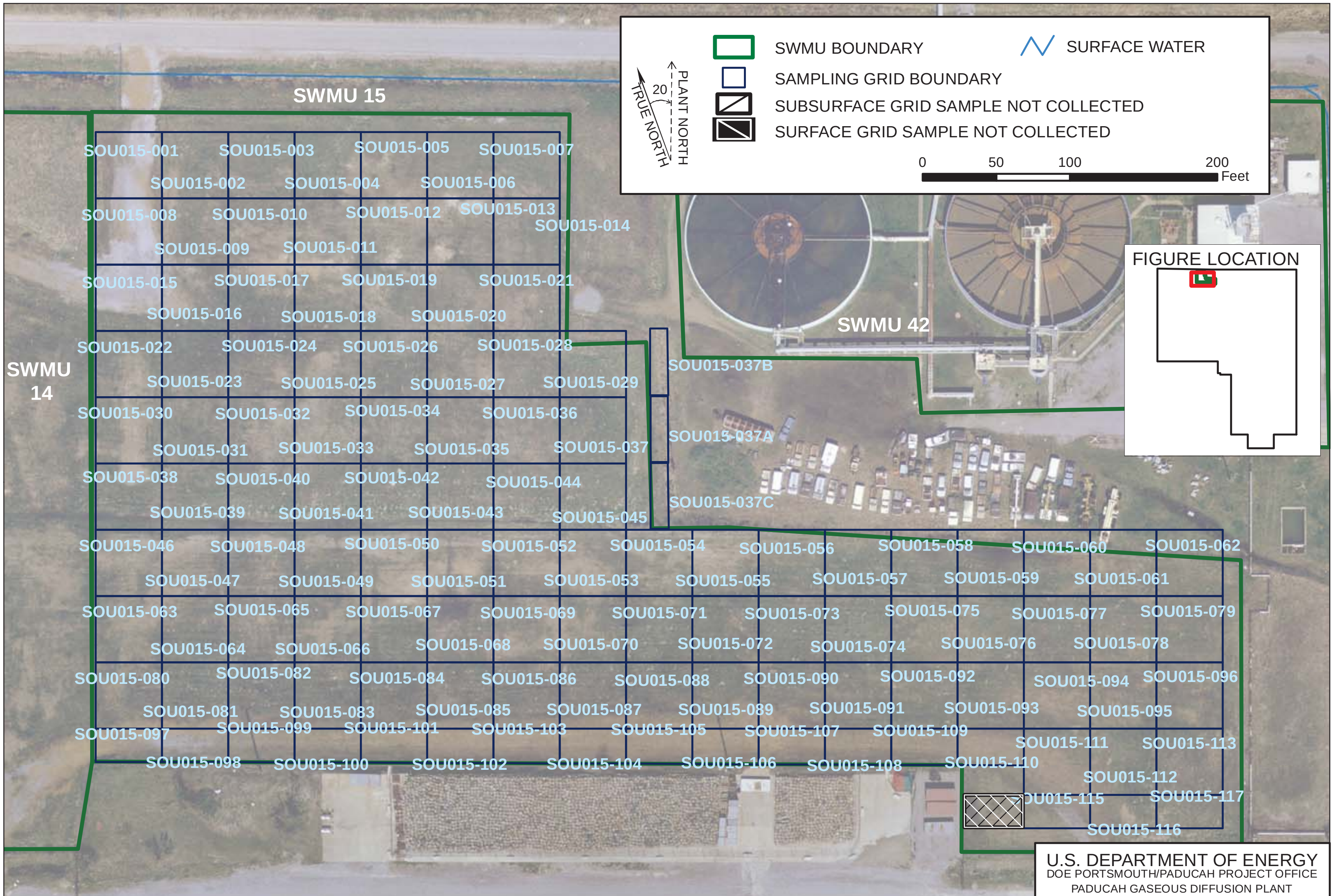

Figure A.1. SWMU 15 Sampling Rectification Map

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3/13/2015

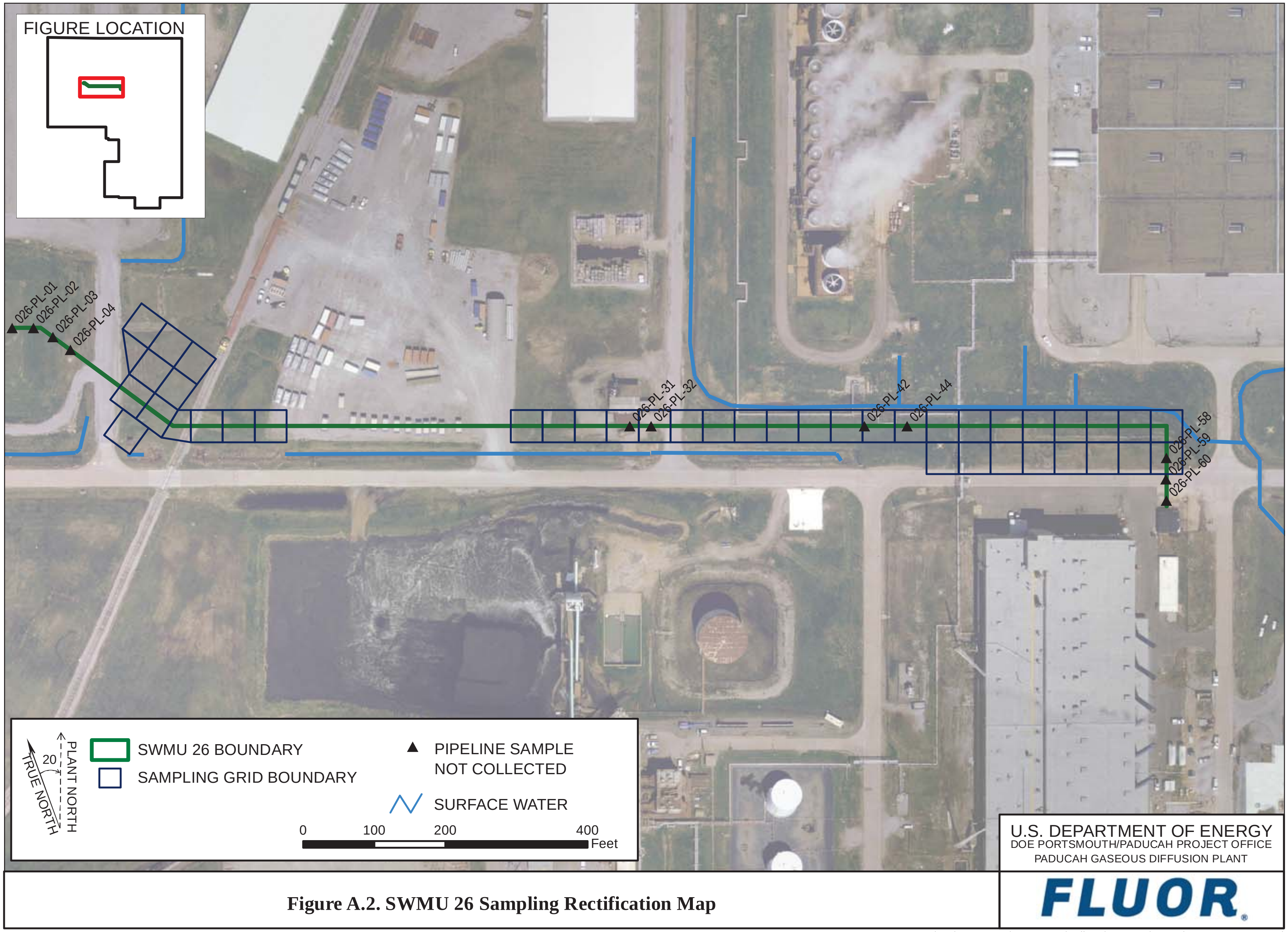

Figure A.2. SWMU 26 Sampling Rectification Map

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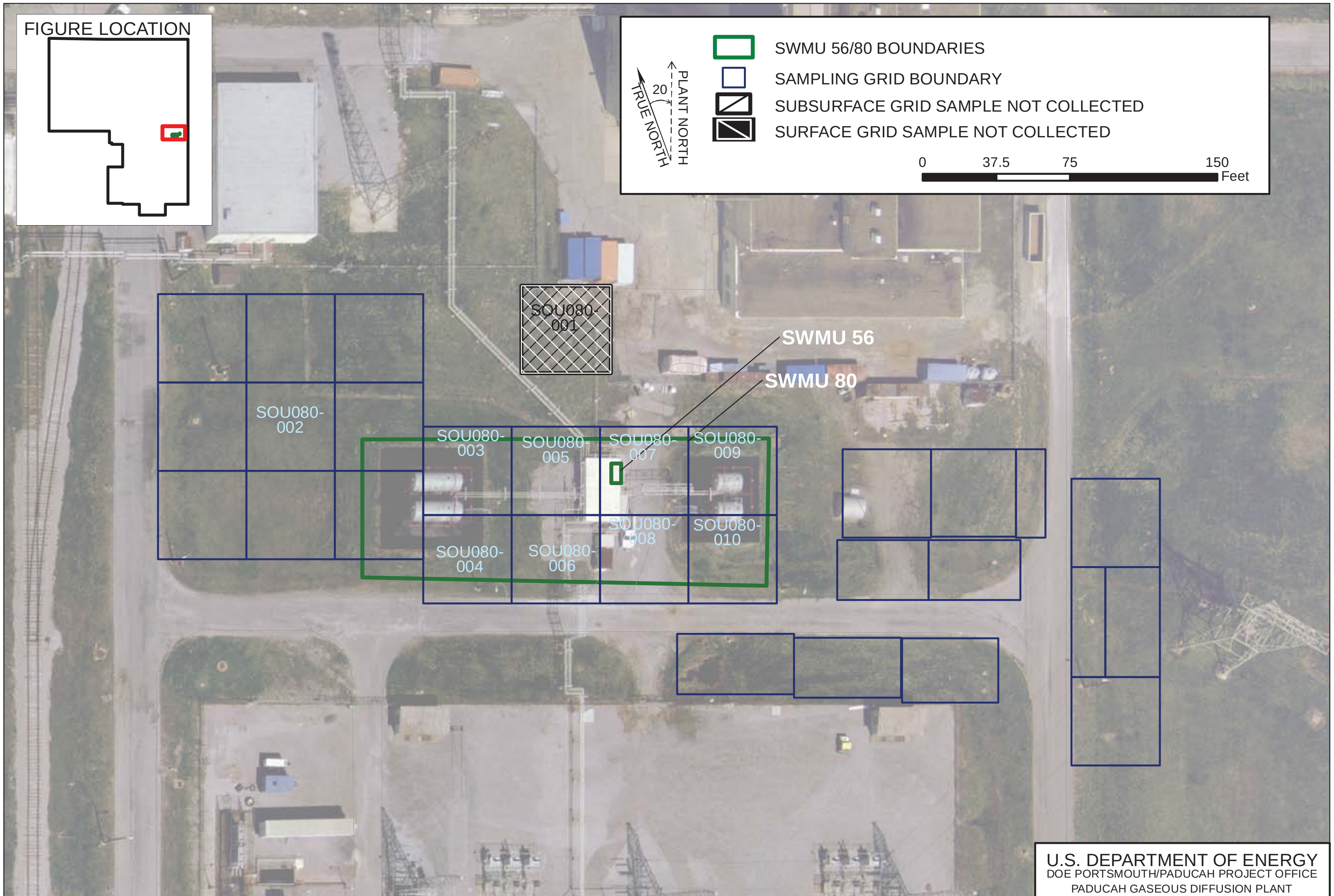
3/13/2015



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DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

FLUOR

Figure A.3. SWMUs 56 and 80 Sampling Rectification Map

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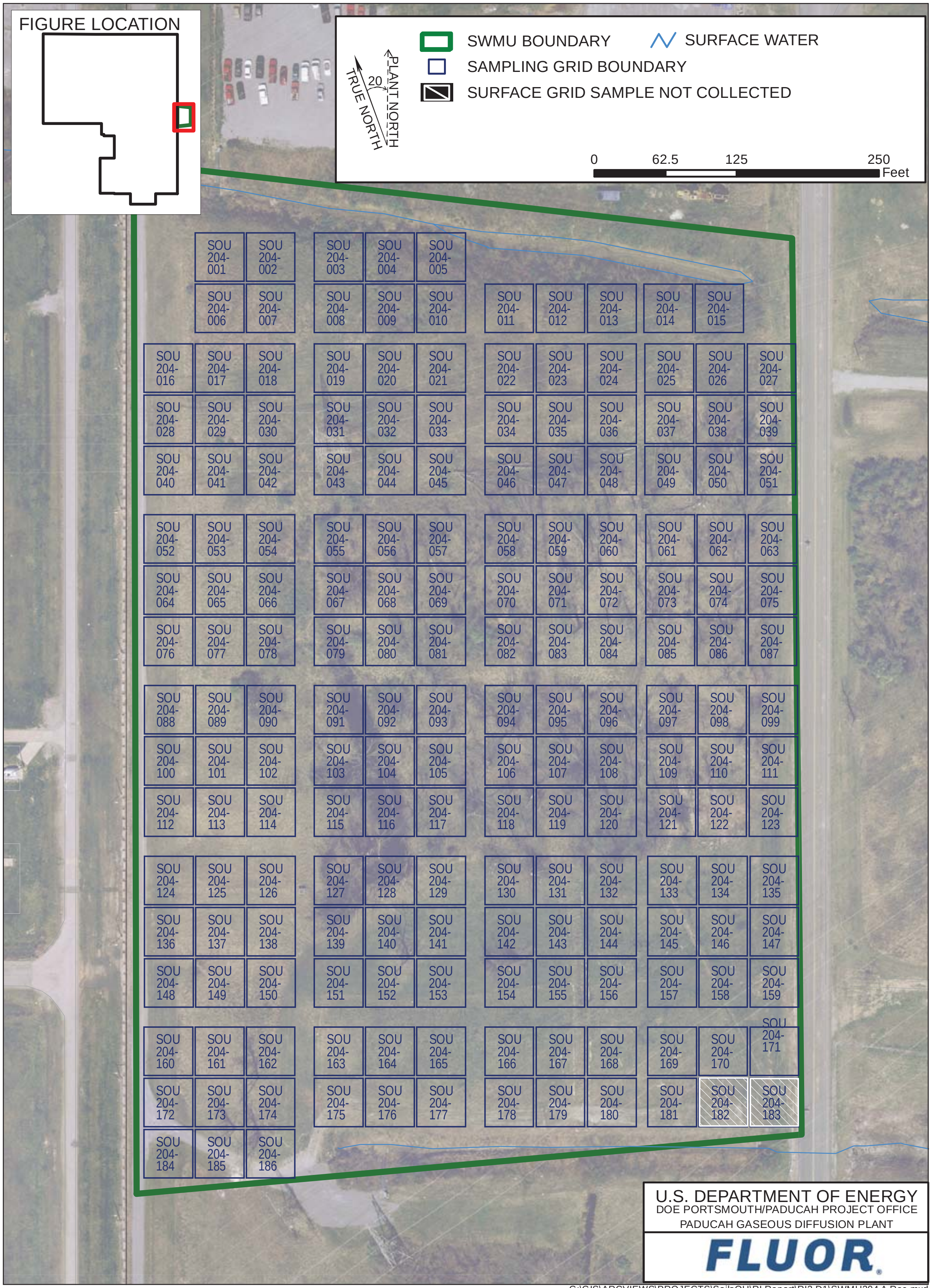
3/13/2015



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3/13/2015

Figure A.4. AOC 204 Sampling Rectification Map

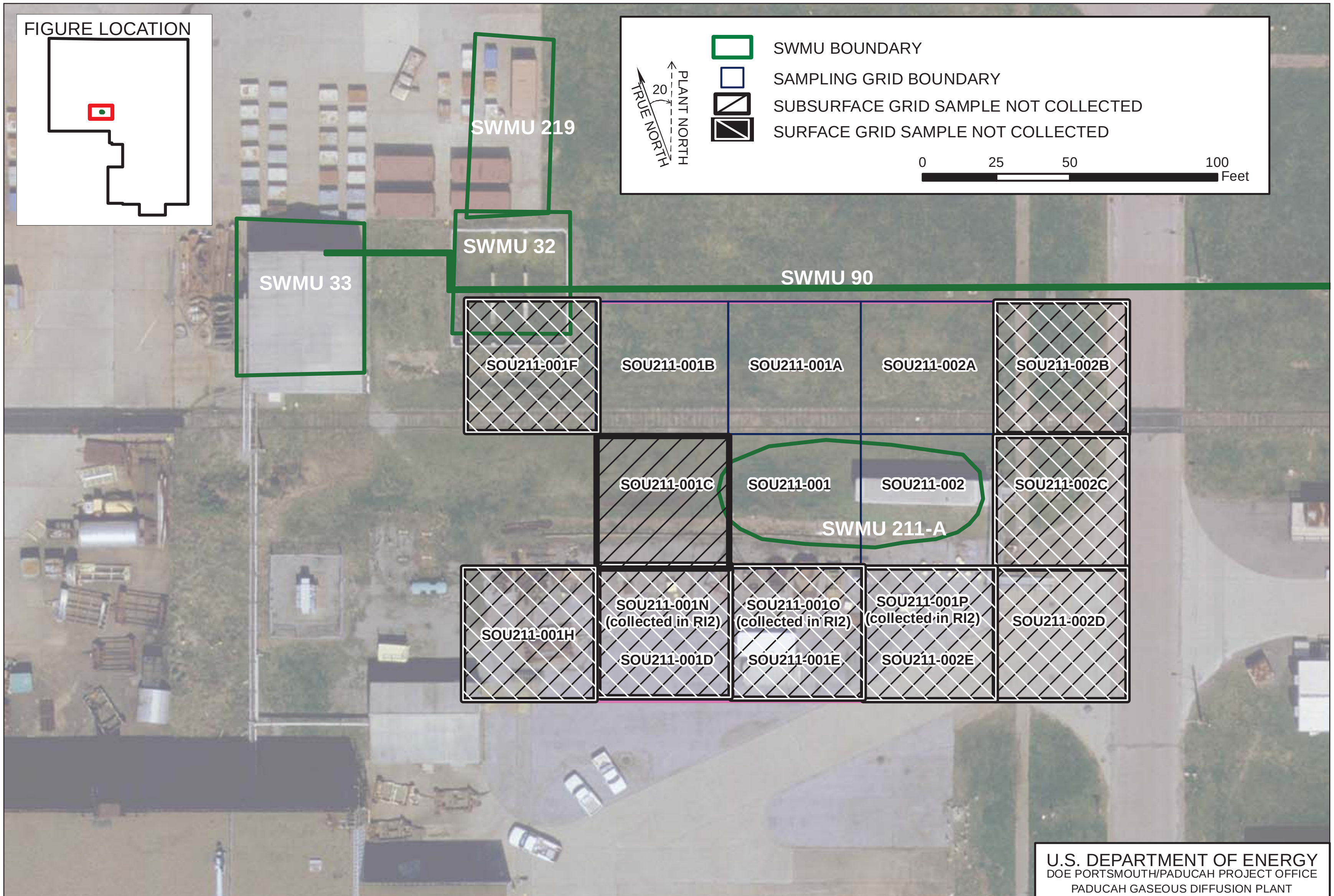

Figure A.5. SWMU 211-A Sampling Rectification Map

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3/13/2015

Figure A.6. SWMU 224 Sampling Rectification Map

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APPENDIX B

DATA QUALITY ANALYSIS

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CONTENTS

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TABLES

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ACRONYMS

AOC	area of concern
COPC	chemical of potential concern
DQO	data quality objective
DQA	data quality Analysis
EU	exposure unit
FS	feasibility study
GWS	gamma walkover survey
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
RI	remedial investigation
SWMU	solid waste management unit
VOC	volatile organic compound
XRF	X-ray fluorescence

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Numerous investigations have been conducted over the past 20 years that have provided soil data that may be considered in drawing conclusions for the Soils Operable Unit (OU) Remedial Investigation (RI) 2. The most recent sampling and analysis strategy was implemented according to the agreed upon protocols to support characterization and risk-based decisions at the OU. These data were collected to supplement the historical information, providing a robust data set representative of the soils at these sites.

The goals, as stated in the work plan (DOE 2010) and addendum (DOE 2014), include providing data for characterization of source zones, defining extent of contamination in soil, risk characterization, and evaluation of remedial alternatives. This section provides a review of the overall data set to determine potential data quality issues that limit the uses of some of these data to support decisions at these sites.

The data to support the RI 2 includes historical data that were evaluated during development of the work plan (DOE 2010) relative to the data quality objectives (DQOs). The work plan then identified a sampling strategy to address data gaps for each solid waste management unit (SWMU)/area of concern (AOC) that included supplementing collection of laboratory analytical data with field data that included results from X-ray fluorescence (XRF) and polychlorinated biphenyl (PCB) field test kits.

In some cases, the historical data were determined to delineate adequately the nature and extent, requiring only limited additional data to be collected. Table B.1 provides a general overview of the data set whose results may be used in one or more of the decision units.

Table B.1. Summary of Sampling

	Surface Fixed-base Laboratory	Surface Field Laboratory	Subsurface/ Shallow Fixed-base Laboratory	Subsurface/ Shallow Field Laboratory	Surface Historical Data	Subsurface/ Shallow Historical Data
Total:	47	435	26	230	332	550

Sampling Location/ ID Number	Depth	Analytical Group	Number of RI 2 Samples	Number of Historical Samples
Total	Surface*	VOCs	0	29
		SVOCs	47	39
		PCBs	47	219
		Metals	47	198
		Radionuclides	53	56
		Metals by XRF	435	153
		PCBs by test kit	435	167
	Subsurface*	VOCs	23	216
		SVOCs	26	134
		PCBs	26	368
		Metals	26	129
		Radionuclides	26	121
		Metals by XRF	230	263
		PCBs by test kit	230	256

*For the Soils OU RI 2, Surface is defined as 0–1 ft bgs and Subsurface is defined as 1–16 ft bgs. For SWMU 13, however, samples collected during the fall of 2014 RI were "surface soil" samples at first contact of soil beneath overlying rock. These samples, despite the depth collected, are considered surface samples for purposes of this RI.

The field sampling strategy for the RI included elements of stratified sampling, grid sampling, adaptive cluster sampling, composite sampling, and random sampling. These data, as described in detail for each exposure unit (EU), were collected consistent with the protocols documented in the work plan.

B.1. HISTORICAL DATA

The historical data set which the data quality analysis (DQA) evaluates primarily is defined in the Soils OU RI/Feasibility Study (FS) Work Plan (DOE 2010) and in the Soils OU RI Report (DOE 2013). This evaluation will look only at whether the location from which the data were collected is representative of the SWMU/AOC area (i.e., was the sample collected within the area of the influence of the SWMU) and whether the data itself was analyzed to a quality adequate for decision making for this Soils OU RI 2.

Some of the decision rules that will be used in the DQA when determining the usability of historical data were established in the RI/FS Work Plan. Those rules are the following:

- Historical data that have been qualified as rejected by data validation or by data assessment will not be included in the historical data set.
- Historical data that contain units inconsistent with the sampled media or with the analysis will not be included in the historical data set (e.g., a soil sample with analytical units reported in mg/L or a radiological result with units reported in mg/kg).
- Historical data for radionuclide results with no minimum detectable concentration recorded will not be included in the historical data set.
- Historical data for nonradionuclide results with no reported result and no detection limit recorded will not be included in the historical data set.
- Historical data for radionuclide results with a null or zero recorded as a counting error will not be included in the historical data set.
- Data assessment qualifiers previously placed on the data will be noted and applied as appropriate.
- A result will be considered a nondetect if it is qualified by the reporting laboratory with the following:
    - A “U” qualifier or a “<” qualifier or
    - An “A” qualifier if the result is a radiological result analyzed by a laboratory with codes “PGDP” or “PARGN.”
- A result will be considered a nondetect if it has a “U” validation code or a “U” data assessment code.
- A radiological result may be considered a nondetect if the reported total propagated uncertainty is greater than the reported result.

Any exceptions to these rules will be documented in this DQA.

Historical data that no longer are representative of current site conditions are excluded. Use of historical data for constituents like polycyclic aromatic hydrocarbons (PAHs), whose concentrations may decrease over time due to weathering, may overestimate current conditions. Similarly, volatile organic compound (VOC) data from historical samples have been included in the data set, but should be used with caution as they will not accurately estimate current conditions.

Individual evaluations of SWMU/AOC-specific historical data can be found in Attachment B1. All figures referred to in B1 are found in the main text of the Soils OU RI Report.

B.2. RI LABORATORY ANALYTICAL DATA

Consistent with the work plan, the following analytical data that are not considered usable for the RI:

- Data qualified as rejected by data validation.
- Data qualified as rejected by data assessment.

Validation showed some results for acrolein, ethyl methacrylate, and vinyl acetate were rejected based on matrix spike and/or matrix spike duplicate recovery below lower control limit. These data will not be used in the RI.

B.3. FIELD RESULTS

For many sites, field laboratory data, such as XRF data and results from PCB field test kits, are available in addition to the laboratory analytical data. The primary use of such data is for site characterization, but these survey-type data also can play a role in risk-based decision making. Survey-type data assist in determining the distribution of chemicals of potential concern (COPCs) and can be used to identify which sets of laboratory data should be combined to develop site average contaminant concentrations. As stated in the work plan, survey-type data also could be combined with laboratory data in a risk assessment to determine the average concentrations for contaminants, but this would require demonstrating that the laboratory and survey-type data possess similar detection limits and analytical uncertainty, and data sets are comparable and representative of the site conditions. This is the one focus of the considerations in determining the usability of these results.

Per U.S. Environmental Protection Agency data usability guidance (EPA 1992), the analytical data objective for baseline risk assessment is that uncertainty is known and acceptable, not that uncertainty be reduced to a particular level. In addition, because sampling variability typically contributes much more to total error than analytical variability, the use of a larger number of field method results to characterize the site may provide a better estimate of the average concentration, provided these data are defensible.

The following discussions consider whether the detection limits are sufficiently low to distinguish from background or risk-based concentrations, detected concentration ranges and ability to use to identify “hot spots” (values above action levels), potential for false negatives that could result in underestimating risks, and comparison of field results with confirmatory samples.

B.3.1 XRF

XRF data were evaluated in multiple stages. The initial comparison of XRF and fixed-base laboratory data include correlation and graphical comparison between paired data (i.e., composite split samples with both XRF and fixed-base results). The second stage of comparison includes false negative/false positive comparison (assuming fixed-base laboratory data represents the soil sample concentration).

A summary of the XRF data collected for this RI is presented in Table B.2.

Table B.2. Ranges of XRF Results

		ALL XRF DATA		PAIRED XRF DATA	
Analysis	**Units**	**Min**	**Max**	**Min**	**Max**
Arsenic	mg/kg	10	160	10	136
Chromium	mg/kg	12	113	12	12
Copper	mg/kg	4	201	4	100
Iron	mg/kg	1,370	50,329	16,088	35,477
Lead	mg/kg	3	657	3	293
Manganese	mg/kg	24	3,114	227	989
Mercury	mg/kg	40	40	40	40
Molybdenum	mg/kg	3	78	3	34
Nickel	mg/kg	4	203	4	104
Selenium	mg/kg	3	5	3	3
Silver	mg/kg	0	146	47	124
Uranium	mg/kg	10	1,551	10	409
Vanadium	mg/kg	5	195	69	195
Zinc	mg/kg	1	1,043	27	185

B.3.1.1 Initial Comparison

Data collected from the Soils OU RI 2 to evaluate the nature and extent of metals in surface and subsurface soils yielded approximately 75 laboratory analyses that were supplemented with approximately 665 field analyses using XRF. As expected, the XRF data correlated better with the laboratory data for many constituents, but not all constituents (Johnson 2008). This discrepancy provides an uncertainty that is documented in this DQA and will be addressed in the Soils OU RI 2 baseline risk assessment(s) sections of the RI to support remedial decision making. Attachment B2 of this DQA provides additional statistics for the XRF data.

B.3.1.2 Graphical Comparison of Paired Samples Based Upon Analytical Method

The results for approximately 75 soil samples analyzed by cup XRF and laboratory methods were assessed graphically. These pairs were sorted graphically by increasing XRF and laboratory result and by sample number. In general, it appears that XRF results have higher detection limits and higher reported values than the laboratory results. There are exceptions to this generalization and other factors, such as laboratory dissolution methods, may contribute to the higher reported values for the XRF. Thus, using the higher value (typically the XRF value) in a risk assessment typically will overstate the risk/hazard (hereafter referred to as risk) associated with a given EU. Table B.3 lists observations from the initial review of the data.

Table B.3. Summary of Initial Observations by Analyte

Analyte	Correlation*	Notes
Arsenic	-5.48E-03	Few XRF detections; laboratory results near XRF reporting limit
Chromium	not defined	No XRF detections; laboratory results near XRF reporting limit
Copper	5.59E-01	Somewhat good correlation
Iron	3.86E-01	Somewhat good correlation
Lead	3.18E-01	Most results below background for both methods
Manganese	2.16E-01	Most results below background for both methods
Mercury	not defined	No XRF detections; laboratory results < XRF reporting limit
Molybdenum	7.96E-03	Few XRF detections; no laboratory detection > XRF reporting limit
Nickel	7.96E-01	Good correlation
Selenium	not defined	No XRF detections; laboratory results near XRF reporting limit
Silver	-2.20E-02	Few XRF detections; no laboratory detection > background
Uranium	3.26E-01	Few XRF detections
Vanadium	5.29E-02	Most XRF above background; laboratory results mostly below background
Zinc	8.32E-01	Good correlation

*Pearson correlation coefficient for sample pairs.
Note: Additional information regarding XRF performance by analyte at Paducah Gaseous Diffusion Plant (PGDP) can be found in Johnson 2008.

B.3.1.2.1 Differences between XRF results and fixed-base laboratory results

Some differences between XRF results and fixed-base laboratory results are expected due to the differences in how the constituents were measured [i.e., the XRF measures the secondary (fluorescent) X-rays emitted by elements after they have been stimulated by (primary) X-rays]. Thus, this technique tends to measure the concentrations of elements located near the surface of the sample while the fixed-base laboratory method theoretically measures the concentration of an element located throughout the entire sample volume (assuming homogeneity and complete dissolution).

The XRF and the fixed-base laboratory results are expected to correlate generally (because they are expected to correlate generally, higher XRF results would be expected to be found when the laboratory result is higher). Many of the data collected with the XRF are consistent with the laboratory results; however, the degree to which these data correlate varies by analyte.

B.3.1.2.2 Graphical presentation

The graphs for comparison are presented in Attachment B3. The graphs illustrate the differences in results for the samples in which both a XRF and a fixed-base laboratory result were obtained. Three graphs are shown for each constituent. The initial graph illustrates the results obtained by the two different methods (on the same sample), sorted by increasing XRF result; the second graph for each metal illustrates the results obtained by the two different methods sorted by increasing fixed-base laboratory results; the third graph illustrates the results sorted by increasing sample number in order to determine clustered values. The same evaluation was conducted on both surface and subsurface samples. Each graph also shows the XRF reporting limits, the background values, and the industrial worker action/no action levels (DOE 2015).

B.3.1.3 Summary of Frequencies of Detection of Analytes and False Positive/Negative Results

A summary of frequencies of false positive and false negative results in field data are compiled in Table B.4. A result was designated as a false positive if the XRF result was detected greater than the fixed-base laboratory result and as a false negative if the XRF was not detected or was detected less than a fixed-base laboratory result that was greater than the XRF detection limit.

The graphs and Table B.4 indicate that all metals except arsenic, chromium, lead, manganese, and uranium have a greater tendency toward a false positive XRF result. Thus, using these XRF data will overstate the risk from these constituents.

Table B.4. Summary of Frequencies of False Positive and False Negative Results in Field Data

Analyte	Frequency of Detection for Field Data	Surface Background mg/kg	Subsurface Background mg/kg	Frequency of False Positive Results	Frequency of False Negative Results
Arsenic	4/695	12	7.9	1/75	6/75
Chromium	6/695	16	43	0/75	46/75
Copper	635/695	19	25	64/75	11/75
Iron	695/695	28,000	28,000	72/75	3/75
Lead	59/695	36	23	6/75	69/75
Manganese	694/695	1,500	820	37/75	38/75
Mercury	0/695	0.2	0.13	0/75	0/75
Molybdenum	53/695	N/A	N/A	4/75	0/75
Nickel	540/695	21	22	50/75	23/75
Selenium	2/695	0.8	0.7	0/75	1/75
Silver	18/695	2.3	2.7	4/75	0/75
Uranium	42/695	4.9	4.6	6/75	8/75
Vanadium	688/695	38	37	75/75	0/75
Zinc	694/695	65	60	68/75	5/75

N/A—not applicable; no background value available.

B.3.1.4 Summary

Evaluation of the XRF data with laboratory data indicates the use of results for copper, iron, nickel, and zinc present the strongest case. Arsenic, chromium, mercury, molybdenum, selenium, silver, and uranium can be used for risk, as these results are generally below the reporting limits and will not lead to incorrect decisions in the risk assessment. For vanadium, comparison with the laboratory data indicate risks derived from XRF data will be overstated for detects.

In general, because of differences in detection limits, XRF detections near or below their detection limits may suggest incorrectly the presence of the metal is present above background levels.

Table B.5 summarizes the findings based on this DQA.

Table B.5. DQA Findings for Use of XRF Data

Analysis	Correlation	Use for Nature and Extent/Hot Spots?	Use for Risk Assessment?	Comments
Arsenic	Potentially	Yes	Yes	Few XRF detections; laboratory results near XRF reporting limit
Chromium	No	Yes	Yes	No correlation because no XRF detections; laboratory results near XRF reporting limit
Copper	Yes	Yes	Yes	More false positive than false negative results; in general XRF data higher than laboratory
Iron	Yes	Yes	Yes	Few false negative results
Lead	Potentially	Yes	Yes	Most results are below background for both methods
Manganese	Marginal	Yes	Yes	Although correlation is marginal, most results are below background for both methods
Mercury	No	Yes	Yes	No correlation because no XRF detections; laboratory results near XRF reporting limit
Molybdenum	Potentially	Yes	Yes	Few XRF detections; no laboratory detection > XRF reporting limit
Nickel	Yes	Yes	Yes	Somewhat good correlation
Selenium	No	Yes	Yes	No correlation because no XRF detections; laboratory results near XRF reporting limit
Silver	Marginal	Yes	Yes	Few XRF detections; no laboratory detection > background
Uranium	Potentially	Yes	Yes	Few XRF detections
Vanadium	Marginal	Yes	Yes, with uncertainties	XRF data higher than laboratory; risk derived from XRF data may be overstated
Zinc	Yes	Yes	Yes	Good correlation; however, XRF data slightly higher than laboratory; risk derived from XRF data may be overstated

B.3.2 PCBs

Consistent with the work plan and addendum, 665 samples were analyzed for PCBs using field test kits, and approximately 10% of these were split with the analytical laboratory to evaluate potential uncertainties or biases in the results.

Table B.6 is an overview of the results from the field tests.

Table B.6. Ranges of PCB Test Kit Results

		ALL PCB DATA			PAIRED PCB DATA		
Analysis	**Units**	**FOD**	**Min**	**Max**	**FOD**	**Min**	**Max**
Total PCBs	mg/kg	8/665	5	50	4/73	5	50

FOD = frequency of detection

The detection limit for the field test kits was 5 mg/kg, as compared to 0.05 mg/kg for the laboratory results. For sites with detectable PCBs, the exposure point concentration may overestimate the exposure concentration when incorporating the field results that were below detection limits, an issue to be discussed in the uncertainty section.

The 73 confirmatory samples were collected to evaluate the results of the field data. Of these results, 69 of the field results reported below 5 mg/kg, and all were confirmed with the laboratory results. The four detected PCB concentrations reported in the field samples split with the laboratory results reporting two higher than the laboratory and two lower than the laboratory. Those reported by the field laboratory as higher than the fixed-base laboratory were significantly higher, and those reported by the field laboratory as less than the fixed-base laboratory were comparable. This comparison suggests field results are not expected to significantly underestimate the levels of PCBs.

The PCB field results are usable both for identification of hot spots and can support the risk assessment recognizing risks may be overestimated.

B.3.3 GAMMA WALKOVER SURVEYS

The gamma walkover survey (GWS) and the XRF field laboratory analysis were not implemented in a manner that permitted a direct comparison between the two data sets. The XRF was a composite sample that was composed of five single grab samples. The XRF composite sample was collected over a 45 ft × 45 ft area. The composite sample was homogenized and a subsample analyzed by XRF. The GWS provides measurements for an area of approximately a 1 m^2. In order to compare the XRF to the GWS data, discrete gamma measurements would need to have been taken at each location where a sample was to be collected. The sample collected for XRF analysis would need to be representative of the 1 m^2 area of the gamma measurement. Because the major contaminant being measured during a GWS at PGDP is uranium-238, the *in situ* gamma measurement most likely would represent an activity to an approximate depth of 4 inches below ground surface (bgs). In contrast to the GWS, the XRF sample was collected at a depth of 0 to 1 ft bgs.

Differences between the GWS and the biased fixed-base laboratory sample prevented an accurate comparison. Noted differences are the following:

1. The biased sample was a homogenized 0 to 6-inch single grab sample verses the GWS that provides measurements for an area of approximately a 1 m^2 area. In addition, the GWS measurement most likely would represent an activity to a depth of approximately 4 inches bgs.

2. The GWS measures an area for only approximately two seconds. As indicated above, discrete gamma measurements would need to be conducted, and XRF measurements would need to be representative of the 1 m^2.

3. Because shielding was not used for the gamma detector, the GWS potentially could be impacted by shine from the cylinder yards, as demonstrated by the 1992 and the 2009 Aerial Radiation Surveys. Soil samples collected in the same areas as the GWS are not impacted by shine from the cylinder yards.

B.4. REFERENCES

DOE (U.S. Department of Energy) 2010. *Work Plan for the Soils Operable Unit Remedial Investigation/Feasibility Study at the Paducah Gaseous Diffusion Plant Paducah, Kentucky*, LATA Environmental Services of Kentucky, DOE/LX/07-0120&D2/R2, June.

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EPA (U.S. Environmental Protection Agency) 1992. *Guidance for Data Usability in Risk Assessment (Part A)*, Publication 9285.7-09A, U. S. Environmental Protection Agency, April.

Johnson, R. L. 2008. *Real Time Demonstration Project XRF Performance Evaluation Report for Paducah Gaseous Diffusion Plant AOC 492*. Kentucky Research Consortium for Energy and Environment, Lexington, KY, April 3.

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ATTACHMENT B1

HISTORICAL DATA REVIEW

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HISTORICAL DATA REVIEW FOR EACH SWMU/AOC

The historical data review for each solid waste management unit (SWMU)/area of concern (AOC) for those units in the Soils Operable Unit (OU) Remediation Investigation (RI) 2 follows a similar format as that for the first Soils OU RI.

Comparisons are made to the child resident no action levels (NALs), as shown in Appendix D of this RI Work Plan. Comparisons made to background values are those values reported in the Risk Methods Document (DOE 2015). Calculated values were added for total polycyclic aromatic hydrocarbons (PAHs), total polychlorinated biphenyls (PCBs), and total dioxins/furans, if necessary, according to the methodology described in the Risk Methods Document.

B1.1. SWMU 13

Data Evaluation and Screening

Historical data for surface soils from this SWMU include metals, pesticides/polychlorinated biphenyls (PCBs), radionuclides, semivolatile organic compounds (SVOCs), and volatile organic compounds (VOCs). The historic data from the shallow subsurface soils include metals, pesticides/PCBs, radionuclides, SVOCs, and VOCs. These data were collected from the following project(s):

- Scrap Metal Site Characterization for C-746-P Yard
- Scrap Yard Profile of Soil—C-746-P
- Scrap Yard Profile of Soil—C-746-P1
- Waste Area Group (WAG) 22 (SWMUs 7 and 30) RI
- Soils OU RI/Feasibility Study (FS)—Former Facility Sites
- SWMU 13 Burial Grounds OU (BGOU) RI/FS

Sampling Representative of the SWMU/AOC Area?

Figures in Section 5 illustrate the location of the historical data points associated with this SWMU. The grids and exposure units (EUs) for SWMU 13 were in the approved Sampling and Analysis Plan (SAP), and all soil and sediment data within those grids were selected and assigned to SWMU 13.

Indicator chemicals were removed from the data set [i.e., alpha activity, beta activity, uranium-235 (wt.%), mass of uranium-235 (µg/g), total uranium (reported in pCi/g with no isotopes), and moisture]. Additionally, soils analyses with units that were inconsistent with the sampled media were removed from the data set.

In order to more comprehensively address the data set for all SWMUs, plutonium-239 data was evaluated as plutonium-239/240 and uranium-235/236 was evaluated as uranium-235.

Usability of Historical Data

Validation: Validation was performed for 10% of the WAG 22 (SWMUs 7 and 30) RI, the Scrap Yard Profile of Soil—C-746-P1, Soils OU RI/FS, and SWMU 13 BGOU RI/F. Validation qualifiers applied to these data were "=," "J," and "U."

Data Assessment: Data assessment qualifiers that have been applied to the data for this SWMU are shown in Table B1.1.

Table B1.1. Assessment Qualifiers Applied to SWMU 13 Historic Data

Assessment Qualifier	Definition
BH-FB	Result may be biased high; chemical detected in associated field blank.
BH-LAB	Result may be biased high; compound is a known or probable laboratory contaminant.
BL-HS	Biased low due to headspace in sample container.
KYRHTAB-50	Kentucky Radiation Health Branch, formerly known as the Kentucky Radiation Health and Toxic Agents Branch (KYRHTAB), has performed an independent data evaluation (not to be confused with data verification and validation) and the rad error accounts for greater than 50% of the results.
KYRHTAB-ER*	KYRHTAB has performed an independent data evaluation (not to be confused with data verification and validation) and the data presents error problems (i.e., no counting uncertainty or zero counting uncertainty).
KYRHTAB-OK	KYRHTAB has performed an independent data evaluation (not to be confused with data verification and validation) and the data is acceptable for use.
U-RAD	Result considered a nondetect; instrument measurement error is equal to or greater than the reported result.
USECNITRIC-CF	During the period from May 2004 to September 2009, the United States Enrichment Corporation (USEC)-Paducah Gaseous Diffusion Plant (PGDP) laboratory used method RL-7128-NITRIC for isotopic uranium analysis by alpha spec. Method RL-7128-NITRIC utilizes only nitric acid for dissolution rather than hydrofluoric/nitric acid. The use of nitric acid only is a less aggressive dissolution for isotopic uranium analysis by alpha spec. It has been demonstrated that Method RL-7128-NITRIC can be utilized only for isotopic uranium analysis of soil with activity greater than 10 pCi/g due to low recoveries below that level. If the data from Method RL-7128-NITRIC will be screened against the background values reported in *Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the PGDP* (1997), the following adjusted background values must be used: U-234: 1.73 pCi/g surface and 1.63 pCi/g subsurface; U-235: 0.10 pCi/g; and U-238: 0.40 pCi/g [*Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant*, Appendix E (2009)]. Risk assessors may use data from this time period for comparison against other thresholds below 10 pCi/g without adjusting the values as long as the level of uncertainty and its impact on the risk assessment/evaluation are adequately discussed. No additional action is required for comparisons to thresholds above 10 pCi/g.

*The result to which this assessment qualifier was applied was for uranium analyzed by SW846-6010. Therefore, the assessment does not affect the usability of the data.

Units of Results

Reported units within the data set are appropriate for the analytical types. Total uranium reported in µg/g has been revised from classification as a radiological analytical type to a metal.

Detection Limits/Minimum Detectable Concentration

All of the historical data records that had no reported results and no reported detection limits or minimum detectable concentrations (MDCs) were removed from the data set.

There are 15 chemicals that are nondetects and have their sample quantitation limit (SQL)/MDCs greater than background or the child resident NAL. Those chemicals and referenced values are shown in Table B1.2.

Table B1.2. Analytes with SQL or MDC Greater that Background or Child Resident NAL for SWMU 13

Chemical	Unit	Maximum SQL/MDC for Nondetects	NAL*	Background*	
				Surface	Subsurface
Inorganics					
Antimony	mg/kg	2.00E+01	5.71E-01	2.10E-01	2.10E-01
Arsenic	mg/kg	1.98E+01	2.67E-01	1.20E+01	7.90E+00
Cadmium	mg/kg	2.00E+00	5.07E+00	2.10E-01	2.10E-01
Selenium	mg/kg	1.98E+01	2.34E+01	8.00E-01	7.00E-01
Silver	mg/kg	2.50E+00	2.71E+00	2.30E+00	2.70E+00
Thallium	mg/kg	2.00E+01	4.68E-02	2.10E-01	3.40E-01
Uranium	mg/kg	1.00E+02	1.40E+01	4.90E+00	4.60E+00
Organics					
Benz(a)anthracene	mg/kg	5.00E-01	6.19E-02		
Benzo(a)pyrene	mg/kg	5.00E-01	6.19E-03		
Benzo(b)fluoranthene	mg/kg	5.00E-01	6.19E-02		
Dibenz(a,h)anthracene	mg/kg	5.00E-01	6.19E-03		
Hexachlorobenzene	mg/kg	5.00E-01	1.26E-01		
Indeno(1,2,3-cd)pyrene	mg/kg	5.00E-01	6.19E-02		
N-Nitroso-di-n-propylamine	mg/kg	5.00E-01	2.87E-02		
PCB, Total	mg/kg	1.30E-01	7.82E-02		
PCB-1221	mg/kg	1.30E-01	6.59E-02		
PCB-1232	mg/kg	1.00E-01	6.59E-02		
PCB-1248	mg/kg	1.00E-01	7.82E-02		
PCB-1254	mg/kg	9.00E-02	5.43E-02		
PCB-1260	mg/kg	1.00E-01	7.82E-02		
Pentachlorophenol	mg/kg	5.00E-01	2.43E-01		
Radionuclides					
Plutonium-238	pCi/g	2.12E-01	4.42E+00	7.30E-02	
Plutonium-239/240	pCi/g	9.26E-02	3.87E+00	2.50E-02	
Technetium-99	pCi/g	3.38E+00	1.17E+02	2.50E+00	2.80E+00
Uranium-234	pCi/g	2.48E+00	5.93E+00	1.20E+00	1.20E+00
Uranium-235	pCi/g	4.64E-01	3.47E-01	6.00E-02	6.00E-02

*NAL is the Child Resident NAL, as shown in Appendix D. Background values are reported in the Risk Methods Document (DOE 2015).

Radionuclide Counting Errors

There are no radionuclide historical data records that have both no MDCs and no counting errors reported.

Nondetect Result Qualifiers

All usable data records that were considered nondetect were considered so due to laboratory qualification or validation qualification.

Assignment of Historical Data to RI Sampling Grids

The historic data has been assigned to grids as discussed. The assignments are listed in Table B1.3.

Table B1.3. Stations and Grids for Historical Data from SWMU 13

Station Name	Grid No.
C746PGR104	SOU013-007
DD-07	SOU013-007
013-007	SOU013-009
013-009	SOU013-013
013-001	SOU013-017
C746P1GR58	SOU013-021
C746P1GR60	SOU013-024
013-003	SOU013-024
013-004	SOU013-026
013-006	SOU013-030
C746PGR106	SOU013-034
C746P1GR41	SOU013-040
C746P1GR45	SOU013-043
013-002	SOU013-043
C746P1GR37	SOU013-044
C746PGR83	SOU013-051
013-005	SOU013-052
SYP007	SOU013-053
SYP001	SOU013-055
SYP002	SOU013-057
C746PGR58	SOU013-058
013-008	SOU013-058
C746PGR91	SOU013-059
SYP003	SOU013-059
C746PGR78	SOU013-061
C746P1GR31	SOU013-063
C746P1GR33	SOU013-065

Station Name	Grid No.
013-012	SOU013-071
C746PGR65	SOU013-073
C746PGR38	SOU013-078
C746PGR41	SOU013-080
013-010	SOU013-088
013-013	SOU013-098
013-015	SOU013-105
013-016	SOU013-107
013-017	SOU013-109
C746P1GR13	SOU013-113
C746P1GR14	SOU013-114
C746P1GR15	SOU013-115
C746P1GR5	SOU013-115
013-011	SOU013-117
C746P1GR18	SOU013-118
C746P1GR20	SOU013-120
C746PGR1	SOU013-122
SYP004	SOU013-123
SYP005	SOU013-125
013-014	SOU013-126
SYP006	SOU013-127
C746PGR27	SOU013-130
C746PGR29	SOU013-132
C746PGR31	SOU013-134
C746P1GR1	SOU013-135
SOU013-RAD	SOU013-141
C746PGR7	SOU013-151

Summary of Detected Chemicals

A summary of detected chemicals is presented in Table B1.4.

Table B1.4. Summary of SWMU 13 Detected Chemicals

Chemical	FOD	Minimum Detected Result	Average Detected Result	Maximum Detected Result	FOD above NAL[a]	FOD above Bkgd[a]
Inorganics (mg/kg)						
Aluminum	75/75	2.82E+03	6.41E+03	1.40E+04	57/75	1/75
Antimony	1/75	8.20E-01	8.20E-01	8.20E-01	1/75	1/75
Arsenic	21/75	8.88E-01	2.02E+00	4.20E+00	21/75	0/75
Barium	39/39	4.94E+01	9.20E+01	1.78E+02	2/39	1/39
Beryllium	15/75	4.58E-01	6.03E-01	9.40E-01	0/75	4/75
Cadmium	9/75	1.20E+00	2.87E+00	6.78E+00	1/75	9/75
Calcium	74/75	4.28E+02	6.98E+03	9.14E+04	0/75	17/75
Chromium	75/75	2.94E+00	1.22E+01	1.64E+02	7/75	2/75
Cobalt	9/9	3.10E+00	4.65E+00	8.75E+00	9/9	0/9
Copper	62/75	2.43E+00	9.51E+00	4.60E+01	0/75	4/75
Iron	45/45	2.17E+03	6.91E+03	1.40E+04	40/45	0/45
Lead	4/39	2.04E+01	3.56E+01	4.99E+01	0/39	2/39
Lithium	6/8	5.13E+00	6.49E+00	8.59E+00	N/A	N/A

Table B1.4. Summary of SWMU 13 Detected Chemicals (Continued)

Chemical	FOD	Minimum Detected Result	Average Detected Result	Maximum Detected Result	FOD above NAL[a]	FOD above Bkgd[a]
Magnesium	9/9	4.92E+02	8.10E+02	1.60E+03	N/A	0/9
Manganese	45/45	1.53E+01	1.56E+02	1.12E+03	45/45	0/45
Mercury	9/75	1.20E-02	1.88E-02	4.80E-02	0/75	0/75
Nickel	50/75	4.47E+00	1.05E+01	1.40E+02	7/75	1/75
Silver	1/75	2.81E+00	2.81E+00	2.81E+00	1/75	1/75
Uranium	3/46	9.29E-01	4.97E+01	1.30E+02	2/46	2/46
Vanadium	75/75	3.59E+00	1.59E+01	3.93E+01	75/75	2/75
Zinc	35/75	1.71E+01	4.45E+01	2.40E+02	0/75	6/75
Organics (mg/kg)						
2-Butanone	22/74	6.20E-03	1.57E-02	4.20E-02	N/A	N/A
Acetone	25/74	5.45E-03	3.78E-02	9.80E-02	N/A	N/A
Anthracene	1/75	1.50E-02	1.50E-02	1.50E-02	0/75	N/A
Benz(a)anthracene	2/75	5.60E-02	5.78E-01	1.10E+00	1/75	N/A
Benzo(a)pyrene	2/75	5.10E-02	4.81E-01	9.10E-01	2/75	N/A
Benzo(b)fluoranthene	3/75	9.60E-02	7.02E-01	1.50E+00	3/75	N/A
Benzo(k)fluoranthene	3/67	2.10E-02	7.84E-01	1.70E+00	2/67	N/A
Bis(2-ethylhexyl)phthalate	1/39	2.30E-01	2.30E-01	2.30E-01	0/39	N/A
Carbon disulfide	29/74	6.80E-03	6.99E-03	7.60E-03	N/A	N/A
Chrysene	3/75	6.00E-02	7.43E-01	1.60E+00	0/75	N/A
Dichlorodifluoromethane	1/36	5.86E-03	5.86E-03	5.86E-03	0/36	N/A
Di-n-butyl phthalate	17/67	4.90E-01	1.53E+00	6.80E+00	N/A	N/A
Fluoranthene	6/67	1.40E-01	8.17E-01	1.40E+00	0/67	N/A
Indeno(1,2,3-cd)pyrene	1/75	5.80E-01	5.80E-01	5.80E-01	1/75	N/A
PAH, Total	3/75	5.79E-02	4.57E-01	1.25E+00	3/75	N/A
PCB, Total	12/75	1.20E-01	5.08E-01	1.25E+00	12/75	N/A
PCB-1016	1/75	5.10E-02	5.10E-02	5.10E-02	0/75	N/A
PCB-1248	1/75	3.80E-01	3.80E-01	3.80E-01	1/75	N/A
PCB-1254	8/75	1.20E-01	3.39E-01	9.90E-01	8/75	N/A
PCB-1260	6/75	1.00E-01	4.30E-01	1.20E+00	6/75	N/A
PCB-1268	1/74	3.80E-01	3.80E-01	3.80E-01	N/A	N/A
Phenanthrene	3/75	8.40E-02	3.91E-01	5.50E-01	0/75	N/A
Pyrene	6/75	1.10E-01	7.72E-01	1.70E+00	0/75	N/A
Radionuclides (pCi/g)						
Americium-241	1/75	2.50E-02	2.50E-02	2.50E-02	0/75	0/75
Cesium-137	11/75	3.24E-02	1.79E-01	5.62E-01	5/75	2/75
Cobalt-60	1/38	9.70E-02	9.70E-02	9.70E-02	N/A	N/A
Neptunium-237	6/76	5.70E-02	3.04E-01	8.90E-01	2/76	2/76
Plutonium-238	1/75	1.70E-02	1.70E-02	1.70E-02	0/75	0/75
Plutonium-239/240	5/76	3.00E-02	9.57E-02	1.31E-01	0/76	2/76
Potassium-40	30/30	6.05E+00	9.89E+00	1.16E+01	N/A	0/30
Radium-226	2/30	3.79E-01	4.34E-01	4.89E-01	N/A	0/30
Technetium-99	12/76	1.84E+00	1.77E+01	1.50E+02	1/76	9/76
Thorium-228	45/75	3.23E-01	8.96E-01	1.36E+00	N/A	0/75
Thorium-230	57/76	3.46E-01	7.64E-01	1.30E+00	0/76	0/76
Thorium-232	75/75	2.26E-01	6.72E-01	1.35E+00	N/A	0/75
Uranium-234	53/75	2.48E-01	1.39E+00	3.57E+01	1/75	8/75
Uranium-235	21/76	2.35E-02	2.64E-01	4.12E+00	1/76	6/76
Uranium-238[b]	60/75	2.45E-01	2.22E+00	6.41E+01	15/75	21/75

[a] NAL is the Child Resident NAL as shown in Appendix D. Background values are reported in the Risk Methods Document (DOE 2015).
[b] Uranium-238 assessed with the "USECNITRIC-CF" is compared to 0.40 pCi/g. For additional information, see assessment qualifier codes.
"N/A" indicates a value is not available.

B1.2. SWMU 15

Data Evaluation and Screening

Historical data for surface soils from this SWMU include metals, pesticides/PCBs, radionuclides, and SVOCs. The historic data from the shallow subsurface soils include metals, pesticides/PCBs, radionuclides, SVOCs, and VOCs. These data were collected from the following project(s):

- RCRA Characterization/Waste Characterization (RCWC) Data
- Scrap Yard Profile of Soil—C-746-C
- Soils OU PCB Group 3
- Soils OU RI/FS—Scrap Yard
- Soils OU X-ray Fluorescence (XRF) Group 3

Sampling Representative of the SWMU/AOC Area?

Figures in Section 5 illustrate the location of the historical data points associated with this SWMU. The grids and EUs for SWMU 15 were in the approved SAP, and all soil and sediment data within those grids were selected and assigned to SWMU 15. Additionally, grids sampled during the first Soils OU RI for SWMU 15 were included.

Indicator chemicals were removed from the data set [i.e., alpha activity, beta activity, uranium-235 (wt.%), mass of uranium-235 (µg/g) and moisture]. Additionally, soils analyses with units that were inconsistent with the sampled media were removed from the data set.

In order to more comprehensively address the data set for all SWMUs, uranium-235/236 was evaluated as uranium-235.

Usability of Historical Data

Validation: Validation was performed for 10% of the Soils OU RI/FS; however, there was no validation performed for this historic data set.

Data Assessment: The data assessment qualifiers that have been applied to the data for this SWMU are shown in Table B1.5. Data with the assessment code R-C (result questionable, credibility at issue) have been removed from the data set.

Units of Results

Total uranium reported in µg/g has been revised from classification as a radiological analytical type to a metal.

Detection Limits/Minimum Detectable Concentration

All of the nonradionuclide historical data records with neither results nor detection limits have been removed from the data set. There are 31 chemicals that are nondetects and have their SQL/MDCs greater than background or the child resident NAL. Those chemicals and referenced values are shown in Table B1.6.

Table B1.5. Assessment Qualifiers Applied to SWMU 15 Historic Data

Assessment Qualifier	Definition
BH-FB	Result may be biased high; chemical detected in associated field blank.
BH-LAB	Result may be biased high; compound is a known or probable laboratory contaminant.
U-RAD	Result considered a nondetect; instrument measurement error is equal to or greater than the reported result.
USECNITRIC-CF	During the period from May 2004 to September 2009, the USEC-(PGDP laboratory used method RL-7128-NITRIC for isotopic uranium analysis by alpha spec. Method RL-7128-NITRIC utilizes only nitric acid for dissolution rather than hydrofluoric/nitric acid. The use of nitric acid only is a less aggressive dissolution for isotopic uranium analysis by alpha spec. It has been demonstrated that Method RL-7128-NITRIC can be utilized only for isotopic uranium analysis of soil with activity greater than 10 pCi/g due to low recoveries below that level. If the data from Method RL-7128-NITRIC will be screened against the background values reported in *Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the PGDP* (1997), the following adjusted background values must be used: U-234: 1.73 pCi/g surface and 1.63 pCi/g subsurface; U-235: 0.10 pCi/g; and U-238: 0.40 pCi/g [*Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant*, Appendix E (2009)]. Risk assessors may use data from this time period for comparison against other thresholds below 10 pCi/g without adjusting the values as long as the level of uncertainty and its impact on the risk assessment/evaluation are adequately discussed. No additional action is required for comparisons to thresholds above 10 pCi/g.

Table B1.6. Analytes with SQL or MDC Greater that Background or Child Resident NAL for SWMU 15

Chemical	Unit	Maximum SQL/MDC for Nondetects	NAL[1]	Background[1]	
				Surface	Subsurface
Inorganics					
Antimony	mg/kg	3.00E+01	5.71E-01	2.10E-01	2.10E-01
Arsenic	mg/kg	1.75E+01	2.67E-01	1.20E+01	7.90E+00
Cadmium	mg/kg	1.20E+01	5.07E+00	2.10E-01	2.10E-01
Chromium	mg/kg	8.50E+01	1.64E+01	1.60E+01	4.30E+01
Copper	mg/kg	3.50E+01	1.87E+02	1.90E+01	2.50E+01
Manganese	mg/kg	8.50E+01	1.30E+01	1.50E+03	8.20E+02
Mercury	mg/kg	1.00E+01	2.21E-01	2.00E-01	1.30E-01
Nickel	mg/kg	6.50E+01	1.08E+01	2.10E+01	2.20E+01
Selenium	mg/kg	2.00E+01	2.34E+01	8.00E-01	7.00E-01
Silver	mg/kg	1.00E+01	2.71E+00	2.30E+00	2.70E+00
Thallium	mg/kg	1.75E+01	4.68E-02	2.10E-01	3.40E-01
Uranium	mg/kg	2.00E+01	1.40E+01	4.90E+00	4.60E+00
Vanadium	mg/kg	7.00E+01	2.73E+00	3.80E+01	3.70E+01
Organics					
Benz(a)anthracene	mg/kg	5.00E-01	6.19E-02		
Benzo(a)pyrene	mg/kg	5.00E-01	6.19E-03		
Benzo(b)fluoranthene	mg/kg	5.00E-01	6.19E-02		
Dibenz(a,h)anthracene	mg/kg	5.00E-01	6.19E-03		
Hexachlorobenzene	mg/kg	5.00E-01	1.26E-01		
Indeno(1,2,3-cd)pyrene	mg/kg	5.00E-01	6.19E-02		
N-Nitroso-di-n-propylamine	mg/kg	5.00E-01	2.87E-02		
PCB, Total	mg/kg	5.00E+00	7.82E-02		

Table B1.6. Analytes with SQL or MDC Greater that Background or Child Resident NAL for SWMU 15 (Continued)

Chemical	Unit	Maximum SQL/MDC for Nondetects	NAL[1]	Background[1]	
				Surface	Subsurface
PCB-1221	mg/kg	1.30E-01	6.59E-02		
PCB-1232	mg/kg	1.00E-01	6.59E-02		
PCB-1248	mg/kg	1.00E-01	7.82E-02		
PCB-1254	mg/kg	9.00E-02	5.43E-02		
PCB-1260	mg/kg	1.00E-01	7.82E-02		
Pentachlorophenol	mg/kg	1.90E+00	2.43E-01		
Radionuclides					
Cesium-137	pCi/g	1.30E-01	1.16E-01	4.90E-01	2.80E-01
Neptunium-237	pCi/g	1.01E-01	2.39E-01	1.00E-01	
Plutonium-238	pCi/g	1.56E-01	4.42E+00	7.30E-02	
Plutonium-239/240	pCi/g	8.98E-02	3.87E+00	2.50E-02	

[1] NAL is the Child Resident NAL as shown in Appendix D. Background values are reported in the Risk Methods Document (DOE 2015).

Radionuclide Counting Errors

Radionuclide historical data records that have no MDCs and no counting errors reported have been removed from the data set.

Nondetect Result Qualifiers

All usable data records that were considered nondetect were considered so due to laboratory qualification.

Assignment of Historical Data to RI Sampling Grids

The historic data has been assigned to grids as discussed. The assignments are listed in Table B1.7.

Table B1.7. Stations and Grids for Historical Data from SWMU 15

Station Name	Grid No.
SOU015-001	SOU015-001
SOU015-002	SOU015-002
SOU015-003	SOU015-003
SOU015-004	SOU015-004
SOU015-005	SOU015-005
SOU015-006	SOU015-006
SOU015-007	SOU015-007
C746CGR55	SOU015-007
SOU015-008	SOU015-008
SOU015-009	SOU015-009
SOU015-010	SOU015-010
SOU015-011	SOU015-011
C746CGR52	SOU015-011
SOU015-012	SOU015-012
SOU015-013	SOU015-013
SOU015-RAD	SOU015-013
SOU015-014	SOU015-014
C746CGR47	SOU015-014
SOU015-015	SOU015-015
SOU015-016	SOU015-016
SOU015-017	SOU015-017
SOU015-018	SOU015-018
C746CGR7	SOU015-018

Station Name	Grid No.
SOU015-039	SOU015-039
SOU015-040	SOU015-040
C746CGR5	SOU015-040
SOU015-041	SOU015-041
SOU015-042	SOU015-042
SOU015-043	SOU015-043
SOU015-044	SOU015-044
SOU015-045	SOU015-045
SOU015-046	SOU015-046
SOU015-047	SOU015-047
SOU015-048	SOU015-048
SOU015-049	SOU015-049
SOU015-050	SOU015-050
SOU015-051	SOU015-051
SOU015-052	SOU015-052
SOU015-053	SOU015-053
SOU015-054	SOU015-054
SOU015-055	SOU015-055
SOU015-056	SOU015-056
SOU015-057	SOU015-057
SOU015-058	SOU015-058
SOU015-059	SOU015-059
SOU015-060	SOU015-060

Station Name	Grid No.
SOU015-090	SOU015-090
SOU015-091	SOU015-091
SOU015-092	SOU015-092
SOU015-093	SOU015-093
SOU015-094	SOU015-094
SOU015-095	SOU015-095
SOU015-096	SOU015-096
015-PL-01	SOU015-097
SOU015-097	SOU015-097
015-PL-02	SOU015-098
SOU015-098	SOU015-098
015-PL-03	SOU015-099
015-PL-04	SOU015-099
SOU015-099	SOU015-099
015-PL-05	SOU015-100
SOU015-100	SOU015-100
015-PL-06	SOU015-101
015-PL-07	SOU015-101
SOU015-101	SOU015-101
015-PL-08	SOU015-102
SOU015-102	SOU015-102
015-PL-09	SOU015-103
015-PL-10	SOU015-103

Table B1.7. Stations and Grids for Historical Data from SWMU 15 (Continued)

Station Name	Grid No.	Station Name	Grid No.	Station Name	Grid No.
SOU015-019	SOU015-019	SOU015-061	SOU015-061	SOU015-103	SOU015-103
C746CGR45	SOU015-019	SOU015-062	SOU015-062	015-PL-11	SOU015-104
SOU015-020	SOU015-020	SOU015-063	SOU015-063	SOU015-104	SOU015-104
SOU015-021	SOU015-021	SOU015-064	SOU015-064	015-PL-12	SOU015-105
C746CGR39	SOU015-021	SOU015-065	SOU015-065	015-PL-13	SOU015-105
SOU015-022	SOU015-022	SOU015-066	SOU015-066	SOU015-105	SOU015-105
C746CGR13	SOU015-022	SOU015-067	SOU015-067	015-PL-14	SOU015-106
SOU015-023	SOU015-023	SOU015-068	SOU015-068	SOU015-106	SOU015-106
C746CGR24	SOU015-023	SOU015-069	SOU015-069	015-PL-15	SOU015-107
SOU015-024	SOU015-024	SOU015-070	SOU015-070	015-PL-16	SOU015-107
SOU015-025	SOU015-025	SOU015-071	SOU015-071	SOU015-107	SOU015-107
SOU015-026	SOU015-026	SOU015-072	SOU015-072	015-PL-17	SOU015-108
SOU015-027	SOU015-027	SOU015-073	SOU015-073	SOU015-108	SOU015-108
SOU015-028	SOU015-028	SOU015-074	SOU015-074	015-PL-18	SOU015-109
SOU015-029	SOU015-029	SOU015-075	SOU015-075	015-PL-19	SOU015-109
C746CGR29	SOU015-029	SOU015-076	SOU015-076	SOU015-109	SOU015-109
SOU015-030	SOU015-030	SOU015-077	SOU015-077	015-PL-20	SOU015-110
SOU015-031	SOU015-031	SOU015-078	SOU015-078	SOU015-110	SOU015-110
SOU015-032	SOU015-032	SOU015-079	SOU015-079	015-PL-21	SOU015-111
SOU015-033	SOU015-033	SOU015-080	SOU015-080	015-PL-22	SOU015-111
SOU015-034	SOU015-034	SOU015-081	SOU015-081	SOU015-111	SOU015-111
C746CGR16	SOU015-034	SOU015-082	SOU015-082	015-PL-23	SOU015-112
SOU015-035	SOU015-035	SOU015-083	SOU015-083	SOU015-112	SOU015-112
C746CGR18	SOU015-035	SOU015-084	SOU015-084	015-PL-24	SOU015-113
SOU015-036	SOU015-036	SOU015-085	SOU015-085	015-PL-25	SOU015-113
SOU015-037	SOU015-037	SOU015-086	SOU015-086	SOU015-113	SOU015-113
C746CGR20	SOU015-037	SOU015-087	SOU015-087	SOU015-115	SOU015-115
RC-4908	SOU015-037	SOU015-088	SOU015-088	SOU015-116	SOU015-116
SOU015-038	SOU015-038	SOU015-089	SOU015-089	SOU015-117	SOU015-117

Summary of Detected Chemicals

A summary of detected chemicals is presented in Table B1.8.

Table B1.8. Summary of SWMU 15 Detected Chemicals

Chemical	FOD	Minimum Detected Result	Average Detected Result	Maximum Detected Result	FOD above NAL[a]	FOD above Bkgd[a]
Inorganics (mg/kg)						
Aluminum	39/39	4.16E+03	7.50E+03	1.68E+04	36/39	3/39
Antimony	274/333	1.80E-01	7.43E+01	2.83E+02	262/333	273/333
Arsenic	178/333	3.80E+00	1.19E+01	1.11E+02	178/333	73/333
Barium	330/333	3.57E+01	3.39E+02	6.78E+02	284/333	273/333
Beryllium	34/39	3.73E-01	5.03E-01	7.60E-01	0/39	2/39
Cadmium	69/333	1.80E-02	1.00E+01	2.42E+01	40/333	53/333
Calcium	39/39	8.52E+02	1.85E+04	1.56E+05	N/A	2/39
Chromium	142/333	6.06E+00	4.40E+01	1.51E+02	118/333	78/333
Cobalt	25/25	3.60E+00	9.04E+00	3.41E+01	25/25	2/25
Copper	188/333	4.70E+00	2.21E+02	6.12E+03	55/333	145/333
Iron	319/319	4.44E+03	1.95E+04	1.71E+05	319/319	52/319
Lead	308/333	6.53E+00	6.00E+01	1.80E+03	9/333	91/333
Magnesium	25/25	4.31E+02	2.10E+03	6.73E+03	N/A	3/25
Manganese	313/319	5.48E+01	4.32E+02	2.90E+03	313/319	10/319

Table B1.8. Summary of SWMU 15 Detected Chemicals (Continued)

Chemical	FOD	Minimum Detected Result	Average Detected Result	Maximum Detected Result	FOD above NAL[a]	FOD above Bkgd[a]
Mercury	41/333	8.10E-03	3.71E+00	1.53E+01	22/333	22/333
Molybdenum	30/319	2.20E-01	3.83E+00	2.36E+01	1/319	N/A
Nickel	181/333	3.87E+00	1.99E+02	3.79E+03	160/333	153/333
Selenium	30/333	6.10E-01	2.55E+00	2.67E+01	1/333	27/333
Silver	63/333	1.90E-02	7.21E+00	1.80E+01	39/333	39/333
Sodium	25/25	3.40E+01	9.94E+01	2.66E+02	N/A	0/25
Thallium	24/39	6.50E-02	2.44E-01	6.10E-01	24/39	8/39
Uranium	183/340	1.10E+00	5.12E+01	4.59E+02	122/340	158/340
Vanadium	47/333	1.13E+01	3.41E+01	1.32E+02	47/333	9/333
Zinc	332/333	1.15E+01	1.48E+02	3.17E+03	4/333	122/333
Organics (mg/kg)						
1,1-Dichloroethane	1/14	6.10E-03	6.10E-03	6.10E-03	0/14	N/A
2-Butanone	5/14	5.90E-03	1.34E-02	3.60E-02	N/A	N/A
2-Hexanone	1/14	6.40E-03	6.40E-03	6.40E-03	N/A	N/A
2-Methylnaphthalene	1/36	5.20E-02	5.20E-02	5.20E-02	N/A	N/A
Acenaphthene	6/36	3.60E-02	1.88E-01	4.60E-01	0/36	N/A
Acenaphthylene	2/36	4.20E-02	8.60E-02	1.30E-01	0/36	N/A
Acetone	8/14	7.10E-03	1.37E-02	3.60E-02	N/A	N/A
Anthracene	7/36	6.40E-02	3.21E-01	7.70E-01	0/36	N/A
Benz(a)anthracene	11/36	3.70E-02	5.80E-01	1.60E+00	9/36	N/A
Benzo(a)pyrene	14/36	1.80E-02	5.46E-01	1.60E+00	14/36	N/A
Benzo(b)fluoranthene	12/36	4.20E-02	4.93E-01	1.60E+00	10/36	N/A
Benzo(ghi)perylene	10/36	5.40E-02	3.19E-01	8.90E-01	N/A	N/A
Benzo(k)fluoranthene	11/36	4.50E-02	5.00E-01	1.40E+00	5/36	N/A
Benzoic acid	5/22	3.70E-01	3.90E-01	4.00E-01	N/A	N/A
Bis(2-ethylhexyl)phthalate	8/36	4.80E-02	1.58E-01	3.90E-01	0/36	N/A
Butyl benzyl phthalate	1/36	3.90E-02	3.90E-02	3.90E-02	N/A	N/A
Carbon disulfide	14/14	6.60E-03	6.75E-03	6.90E-03	N/A	N/A
Chrysene	12/36	4.20E-02	6.62E-01	1.90E+00	0/36	N/A
Dibenz(a,h)anthracene	12/36	6.30E-03	1.38E-01	4.60E-01	12/36	N/A
Dibenzofuran	5/22	4.40E-02	9.46E-02	2.00E-01	N/A	N/A
Dibromochloromethane	1/14	8.30E-03	8.30E-03	8.30E-03	N/A	N/A
Di-n-butyl phthalate	10/36	6.30E-02	1.15E+00	4.10E+00	N/A	N/A
Fluoranthene	13/36	4.50E-02	1.10E+00	3.60E+00	0/36	N/A
Fluorene	5/36	8.60E-02	1.87E-01	3.90E-01	0/36	N/A
Indeno(1,2,3-cd)pyrene	9/36	4.80E-02	3.14E-01	8.30E-01	8/36	N/A
Naphthalene	1/36	1.20E-01	1.20E-01	1.20E-01	0/36	N/A
PAH, Total	14/37	1.80E-02	7.77E-01	2.44E+00	14/37	N/A
PCB, Total	47/334	1.10E-02	8.46E+00	5.00E+01	41/334	N/A
PCB-1248	1/39	3.10E+00	3.10E+00	3.10E+00	1/39	N/A
PCB-1254	19/39	1.10E-02	1.49E+00	6.40E+00	14/39	N/A
PCB-1260	2/39	1.40E-01	2.52E+00	4.90E+00	2/39	N/A
Phenanthrene	9/36	1.10E-01	1.02E+00	2.90E+00	0/36	N/A
Pyrene	12/36	4.70E-02	9.33E-01	3.00E+00	0/36	N/A
Radionuclides (pCi/g)						
Americium-241	6/35	2.00E-02	1.13E-01	4.37E-01	0/35	N/A
Cesium-137	3/35	9.30E-02	1.44E-01	2.00E-01	2/35	0/35
Neptunium-237	13/35	1.30E-02	6.61E-01	4.10E+00	7/35	8/35
Plutonium-238	8/35	1.80E-02	4.34E-02	1.20E-01	0/35	1/35
Plutonium-239/240	14/35	8.50E-03	3.46E-01	2.78E+00	0/35	8/35

Table B1.8. Summary of SWMU 15 Detected Chemicals (Continued)

Chemical	FOD	Minimum Detected Result	Average Detected Result	Maximum Detected Result	FOD above NAL[a]	FOD above Bkgd[a]
Potassium-40	14/14	8.70E+00	9.96E+00	1.13E+01	N/A	0/14
Radium-226	4/14	6.93E-01	7.19E-01	7.49E-01	N/A	0/14
Technetium-99	26/35	6.50E-01	3.63E+01	3.67E+02	2/35	19/35
Thorium-228	21/35	4.29E-01	7.77E-01	1.13E+00	N/A	0/35
Thorium-230	24/35	5.39E-01	1.40E+00	7.23E+00	1/35	5/35
Thorium-232	35/35	3.05E-01	6.40E-01	1.10E+00	N/A	0/35
Uranium-234	35/35	3.00E-01	4.46E+00	6.96E+01	6/35	14/35
Uranium-235	30/35	3.37E-02	3.17E-01	4.21E+00	7/35	17/35
Uranium-238[b]	35/35	3.57E-01	6.44E+00	9.67E+01	17/35	25/35

[a] NAL is the Child Resident NAL as shown in Appendix D. Background values are reported in the Risk Methods Document (DOE 2015).
[b] Uranium-238 assessed with the "USECNITRIC-CF" are compared to 0.40 pCi/g. For additional information see assessment qualifier codes.
"N/A" indicates a value is not available.

B1.3. SWMU 26

Data Evaluation and Screening

Historical data for surface soils from this SWMU include metals, pesticides/PCBs, radionuclides, and SVOCs. The historic data from the shallow subsurface soils include metals, pesticides/PCBs, radionuclides, SVOCs, and VOCs. These data were collected from the following project(s):

- 745-C Road Repair Sampling EF04-02
- AIP Sediment Remediation Unit (RU) Split March 2004
- AIP Soil CH October 2005 01
- False Claims Investigation—Department of Justice—Soils/Sediment
- Historical data from Analytical Laboratory Information System (AnaLIS) for WAGs 9 and 11 Data Quality Objectives (DQOs)
- *In situ* Waste Characterization—Section 1
- North-South Diversion Ditch (NSDD) Characterization of Section 1
- RCWC Data
- Remedial Action SI—Phase 1
- Remedial Action SI—Phase 2
- Soils OU RI/FS—Chromium Areas, Soil/Rubble Pile, and Underground Storage Tank
- Soils OU RI/FS—Underground Storage Tank
- Surface Water OU—Outfall 015 Activity 2 EU03 and EU04

- Verification Sampling—Post Excavation Sampling (Activity II)—Section 1
- Verification Sampling—Remedial Action Support Survey (Activity 1)—Section 1
- WAG 6—A

Sampling Representative of the SWMU/AOC Area?

Figures in Section 5 illustrate the location of the historical data points associated with this SWMU. The grids and EUs for SWMU 26 were in the approved SAP, and all soil and sediment data within those grids were selected and assigned to SWMU 26. Additionally, areas along the pipeline that were not designated for sampling were included.

Indicator chemicals were removed from the data set [i.e., alpha activity, beta activity, uranium-235 (wt.%), uranium-235 (%), mass of uranium-235 (µg/g), total uranium (reported in pCi/g with no isotopes), moisture, percent solids, ignitability, reactivity, corrosivity, cation exchange capacity, total organic carbon, extractable organic halides, and pH]. Additionally, soils analyses with units that were inconsistent with the sampled media were removed from the data set.

In order to more comprehensively address the data set for all SWMUs, plutonium-239 data was evaluated as plutonium-239/240 and uranium-235/236 was evaluated as uranium-235.

Usability of Historical Data

Laboratory Qualification: Laboratory qualifiers of R (Rejected) were placed on two historical records for plutonium-239/240 and thorium-230 from the sample "CH213268-00000." These records have been removed from the data set.

Validation: Validation was performed for data from the following projects:

- AIP Sediment RU Split March 2004
- AIP Soil CH October 2005 01
- Remedial Action SI—Phase 1
- Remedial Action SI—Phase 2
- Soils OU RI/FS—Underground Storage Tank
- Verification Sampling—Post Excavation Sampling (Activity II)—SECTION 1
- WAG 6—A

Rejected data have been removed from the data set.

Validation qualifiers applied to the data include "=," "E," "J," "N," and "U."

Data Assessment: Data assessed with the code R-C (result questionable, credibility at issue) have been removed from the data set. Additionally, data assessed with the code KYRHTAB-ER [indicating the KYRHTAB performed an independent data evaluation (not to be confused with data verification and validation), and the data presents error problems (i.e., no counting uncertainty or zero counting uncertainty)] were removed from the data set. Other data assessment qualifiers that have been applied to the data for this SWMU are shown in Table B1.9.

Table B1.9. Assessment Qualifiers Applied to SWMU 26 Historic Data

Assessment Qualifier	Definition
BH-SS	Result may be biased high; sample may contain particles of the acetate sampling sleeve.
IN-LAB	Result should be considered information only. Compound is a known or probable laboratory contaminant.
J	Result estimated.
KYRHTAB-50	KYRHTAB has performed an independent data evaluation (not to be confused with data verification and validation) and the rad error accounts for greater than 50% of the results.
KYRHTAB-ER*	KYRHTAB has performed an independent data evaluation (not to be confused with data verification and validation) and the data presents error problems (i.e., no counting uncertainty or zero counting uncertainty).
KYRHTAB-OK	KYRHTAB has performed an independent data evaluation (not to be confused with data verification and validation) and the data is acceptable for use.
U	Not detected.
U-RAD	Result considered a nondetect; instrument measurement error is equal to or greater than the reported result.
USECNITRIC-CF	During the period from May 2004 to September 2009, the USEC-PGDP laboratory used method RL-7128-NITRIC for isotopic uranium analysis by alpha spec. Method RL-7128-NITRIC utilizes only nitric acid for dissolution rather than hydrofluoric/nitric acid. The use of nitric acid only is a less aggressive dissolution for isotopic uranium analysis by alpha spec. It has been demonstrated that Method RL-7128-NITRIC can be utilized only for isotopic uranium analysis of soil with activity greater than 10 pCi/g due to low recoveries below that level. If the data from Method RL-7128-NITRIC will be screened against the background values reported in *Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the PGDP* (1997), the following adjusted background values must be used: U-234: 1.73 pCi/g surface and 1.63 pCi/g subsurface; U-235: 0.10 pCi/g; and U-238: 0.40 pCi/g [*Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant*, Appendix E (2009)]. Risk assessors may use data from this time period for comparison against other thresholds below 10 pCi/g without adjusting the values as long as the level of uncertainty and its impact on the risk assessment/evaluation are adequately discussed. No additional action is required for comparisons to thresholds above 10 pCi/g.

*One result to which this assessment qualifier was applied was for uranium in units of mg/kg. Therefore, the assessment does not affect the usability of the data.

Units of Results

Data records with reported units inappropriate for the analytical types have been removed from the data set (i.e., radioisotopes reported in ng/g). Total uranium reported in µg/g has been revised from classification as a radiological analytical type to a metal.

Detection Limits/Minimum Detectable Concentration

Nonradionuclide historical data records for which there are no reported results or reported result of 0 and no detection limit recorded were removed from the data set for SWMU 26. Radionuclide historical data with no reported MDC and no reported counting error were removed.

There are 36 chemicals that are nondetects and have their SQL/MDCs greater than background or the child resident NAL. Those chemicals and referenced values are shown in Table B1.10.

Table B1.10. Analytes with SQL or MDC Greater than Background or Child Resident NAL for SWMU 26

Chemical	Unit	Maximum SQL/MDC for Nondetects	NAL*	Background*	
				Surface	Subsurface
Inorganics					
Antimony	mg/kg	3.00E+01	5.71E-01	2.10E-01	2.10E-01
Arsenic	mg/kg	2.00E+01	2.67E-01	1.20E+01	7.90E+00
Cadmium	mg/kg	1.20E+01	5.07E+00	2.10E-01	2.10E-01
Chromium	mg/kg	8.50E+01	1.64E+01	1.60E+01	4.30E+01
Copper	mg/kg	3.50E+01	1.87E+02	1.90E+01	2.50E+01
Manganese	mg/kg	8.50E+01	1.30E+01	1.50E+03	8.20E+02
Mercury	mg/kg	1.00E+01	2.21E-01	2.00E-01	1.30E-01
Nickel	mg/kg	6.50E+01	1.08E+01	2.10E+01	2.20E+01
Potassium	mg/kg	8.92E+03		1.30E+03	9.50E+02
Selenium	mg/kg	2.00E+01	2.34E+01	8.00E-01	7.00E-01
Silver	mg/kg	1.79E+01	2.71E+00	2.30E+00	2.70E+00
Thallium	mg/kg	1.92E+01	4.68E-02	2.10E-01	3.40E-01
Uranium	mg/kg	1.00E+02	1.40E+01	4.90E+00	4.60E+00
Vanadium	mg/kg	7.00E+01	2.73E+00	3.80E+01	3.70E+01
Organics					
Acrylonitrile	mg/kg	9.00E-01	2.55E-01		
Benz(a)anthracene	mg/kg	9.16E-01	6.19E-02		
Benzo(a)pyrene	mg/kg	9.16E-01	6.19E-03		
Benzo(b)fluoranthene	mg/kg	9.16E-01	6.19E-02		
Benzo(k)fluoranthene	mg/kg	9.16E-01	6.19E-01		
Dibenz(a,h)anthracene	mg/kg	9.16E-01	6.19E-03		
Dieldrin	mg/kg	2.10E-02	1.26E-02		
Hexachlorobenzene	mg/kg	9.16E-01	1.26E-01		
Indeno(1,2,3-cd)pyrene	mg/kg	9.16E-01	6.19E-02		
N-Nitroso-di-n-propylamine	mg/kg	9.16E-01	2.87E-02		
PCB, Total	mg/kg	5.00E+00	7.82E-02		
PCB-1221	mg/kg	2.40E-01	6.59E-02		
PCB-1232	mg/kg	1.00E-01	6.59E-02		
PCB-1242	mg/kg	1.00E-01	7.82E-02		
PCB-1248	mg/kg	1.00E-01	7.82E-02		
PCB-1254	mg/kg	2.10E-01	5.43E-02		
PCB-1260	mg/kg	2.10E-01	7.82E-02		
Pentachlorophenol	mg/kg	4.40E+00	2.43E-01		
Trichloroethene	mg/kg	5.00E+00	4.12E-01		
Vinyl chloride	mg/kg	1.00E+00	5.92E-02		
Radionuclides					
Plutonium-238	pCi/g	2.14E-01	4.42E+00	7.30E-02	
Plutonium-239/240	pCi/g	5.05E-02	3.87E+00	2.50E-02	

*NAL is the Child Resident NAL as shown in Appendix D. Background values are reported in the Risk Methods Document (DOE 2015).

Radionuclide Counting Errors

Radionuclide historical data records that have no MDCs and no counting errors reported have been removed from the data set.

Nondetect Result Qualifiers

Usable data records that were considered nondetect were considered so due to laboratory or validator qualification. Additionally, data records that were qualified through data assessment with the code "U-RAD" were considered nondetect.

Additionally, three records for protactinium-231 will be considered a nondetect because the radiological counting error and total propagated uncertainty (TPU) were greater than the reported results, as shown in Table B1.11.

Table B1.11. SWMU 26 Historic Protactinium-231 Data with Results Less than Counting Errors

Sample ID	Chemical	Results	Detection Limit	Radiological Error	TPU	Units
DOJ1-99-DUP1	Protactinium-231	29.51	1.265	59.01	59.01	pCi/g
DOJ1-99-0152	Protactinium-231	29.92	1.203	59.84	59.84	pCi/g
DOJ1-99-0157	Protactinium-231	2.46	0.7811	4.92	4.92	pCi/g

According to the Risk Assessment Guidance for Superfund (RAGS) Part A, acetone, 2-butanone (or methyl ethyl ketone), methylene chloride, toluene, and the phthalate esters are considered by EPA to be common laboratory contaminants "if the blank contains detectable levels of common laboratory contaminants, then the sample results should be considered as positive results only if the concentrations in the sample exceed ten times the maximum amount detected in any blank" (EPA 1989). For data records qualified through data assessment with the code "IN-LAB," whose results were less than ten times the detection limit, the DETECT field was set to "No." Those data records are listed in Table B1.12.

Table B1.12. SWMU 26 Historic Data with IN-LAB Assessment Qualifier

Sample ID	Analytical Method	Chemical	Results	Detection Limit	Laboratory Qualifier	Units
026005SA007	SW846-8270	Di-n-butyl phthalate	1.591	0.801	B	mg/kg
026005SA007	SW846-8270	Di-n-butyl phthalate	1.591	0.801	B	mg/kg
026005SA007	SW846-8240	Methylene chloride	0.017	0.04	J	mg/kg
026005SA007	SW846-8240	Acetone	0.89	0.8		mg/kg
026005SA007	SW846-8270	Bis(2-ethylhexyl)phthalate	0.05	0.8	J	mg/kg
026005SA007	SW846-8270	Di-n-butyl phthalate	0.28	0.8	J	mg/kg
026005SA007	SW846-8240	Methylene chloride	0.017	0.04	J	mg/kg
026005SA007	SW846-8240	Acetone	0.89	0.8		mg/kg
026005SA007	SW846-8270	Bis(2-ethylhexyl)phthalate	0.05	0.8	J	mg/kg
026005SA007	SW846-8270	Di-n-butyl phthalate	0.28	0.8	J	mg/kg
026006SA007	SW846-8270	Di-n-butyl phthalate	1.637	0.793	B	mg/kg
026006SA007	SW846-8270	Bis(2-ethylhexyl)phthalate	0.04	0.82	J	mg/kg
026007SA007	SW846-8270	Di-n-butyl phthalate	1.67	0.823	B	mg/kg
026007SA007	SW846-8240	Methylene chloride	0.012	0.04	J	mg/kg
026007SA007	SW846-8240	Acetone	1.1	0.9		mg/kg
026007SA007	SW846-8270	Bis(2-ethylhexyl)phthalate	0.05	0.81	J	mg/kg
026007SA007	SW846-8270	Di-n-butyl phthalate	0.1	0.81	J	mg/kg
026008SA007	SW846-8270	Di-n-butyl phthalate	1.855	0.916	B	mg/kg
026009SA007	SW846-8240	Methylene chloride	0.0014	0.006	J	mg/kg
026020SA003	SW846-8270	Bis(2-ethylhexyl)phthalate	0.12	0.81	J	mg/kg
026020SA003	SW846-8270	Di-n-butyl phthalate	0.15	0.81	J	mg/kg
026025SA015	SW846-8240	Methylene chloride	0.0033	0.006	J	mg/kg

Table B1.12. SWMU 26 Historic Data with IN-LAB Assessment Qualifier (Continued)

Sample ID	Analytical Method	Chemical	Results	Detection Limit	Laboratory Qualifier	Units
026025SA015	SW846-8270	Bis(2-ethylhexyl)phthalate	0.09	0.82	J	mg/kg
400034SA001	SW846-8270	Di-n-butyl phthalate	0.04	0.73	J	mg/kg
400034SA001	SW846-8270	Bis(2-ethylhexyl)phthalate	0.08	0.73	J	mg/kg

Assignment of Historical Data to RI Sampling Grids

The historic data have been assigned to grids as discussed. The assignments are listed in Table B1.13.

Table B1.13. Stations and Grids for Historical Data from SWMU 26

Station Name	Grid No.	Station Name	Grid No.	Station Name	Grid No.
026-004	SOU026-002	026-PL-36	SOU026-014	JP-0152	SOU026-035
026-005	SOU026-006c	026-PL-37	SOU026-014	JP-0157	SOU026-032
026-006	SOU026-009	026-PL-38	SOU026-015	OF15B-04-01	SOU026-006f
026-007	SOU026-015	026-PL-39	SOU026-016	OF15B-04-02	SOU026-006d
026-008	SOU026-021	026-PL-40	SOU026-016	RC-3762	SOU026-013
026-009	SOU026-027	026-PL-41	SOU026-017	RC-4509	SOU026-014
026-020	SOU026-027	026-PL-43	SOU026-018	RC-4899	SOU026-013
026-025	SOU026-027	026-PL-45	SOU026-020	RU10	SOU026-021
026-PL-07	SOU026-001	026-PL-46	SOU026-020	RU11S	SOU026-021
026-PL-08	SOU026-001	026-PL-47	SOU026-021	RU12	SOU026-020
026-PL-09	SOU026-002	026-PL-48	SOU026-022	RU12S	SOU026-020
026-PL-10	SOU026-003	026-PL-49	SOU026-022	RU13S	SOU026-019
026-PL-11	SOU026-004	026-PL-50	SOU026-023	RU14C	SOU026-018
026-PL-12	SOU026-005	026-PL-51	SOU026-023	RU14S	SOU026-018
026-PL-13	SOU026-005	026-PL-52	SOU026-024	RU15C	SOU026-017
026-PL-14	SOU026-006	026-PL-53	SOU026-025	RU15S	SOU026-018
026-PL-15	SOU026-006a	026-PL-54	SOU026-025	RU16S	SOU026-017
026-PL-16	SOU026-006a	026-PL-55	SOU026-026	RU17S	SOU026-016
026-PL-17	SOU026-006b	026-PL-56	SOU026-027	RU18S	SOU026-015
026-PL-18	SOU026-006c	026-PL-57	SOU026-027	RU19	SOU026-015
026-PL-19	SOU026-006c	040-005	SOU026-122	RU19S	SOU026-014
026-PL-20	SOU026-006d	040-006	SOU026-117	RU20S	SOU026-014
026-PL-21	SOU026-006e	400-034	SOU026-021	RU21S	SOU026-013
026-PL-22	SOU026-006e	400-043	SOU026-019	RU2C	SOU026-027
026-PL-23	SOU026-006f	400-056	SOU026-122	RU2W	SOU026-027
026-PL-24	SOU026-006g	400-095	SOU026-121	RU3	SOU026-026
026-PL-25	SOU026-006g	400-208	SOU026-035	RU3S	SOU026-027
026-PL-26	SOU026-007	C745C SA1	SOU026-001G	RU4S	SOU026-026
026-PL-27	SOU026-008	C745C SA2	SOU026-001A	RU5S	SOU026-025
026-PL-28	SOU026-008	H068	SOU026-032	RU6S	SOU026-025
026-PL-29	SOU026-009	H069	SOU026-012	RU7S	SOU026-024
026-PL-30	SOU026-010	H224	SOU026-008	RU8S	SOU026-023
026-PL-33	SOU026-012	H380	SOU026-001	RU9S	SOU026-022
026-PL-34	SOU026-012	H381	SOU026-009	SOU026-RAD	SOU026-025
026-PL-35	SOU026-013				

Summary of Detected Chemicals

A summary of detected chemicals is presented in Table B1.14.

Table B1.14. Summary of SWMU 26 Detected Chemicals

Chemical	FOD	Minimum Detected Result	Average Detected Result	Maximum Detected Result	FOD above NAL[a]	FOD above Bkgd[a]
Inorganics (mg/kg)						
Aluminum	37/37	2.94E+03	9.99E+03	3.46E+04	30/37	15/37
Antimony	58/91	1.90E-01	5.96E+01	1.57E+02	50/91	54/91
Arsenic	54/102	4.90E-01	1.40E+01	1.30E+02	54/102	17/102
Barium	100/102	3.13E+01	2.51E+02	8.15E+02	0/102	54/102
Beryllium	36/40	2.00E-01	2.09E+00	2.49E+01	3/40	9/40
Cadmium	35/102	2.80E-02	5.90E+00	2.83E+01	11/102	24/102
Calcium	31/31	7.51E+02	4.57E+04	2.30E+05	N/A	16/31
Chromium	55/105	2.00E+00	3.70E+01	2.31E+02	38/105	18/105
Cobalt	31/31	3.00E+00	1.04E+01	9.05E+01	31/31	5/31
Copper	42/91	2.20E+00	2.57E+02	9.52E+03	3/91	9/91
Iron	91/91	5.09E+03	1.41E+04	8.51E+04	91/91	4/91
Lead	84/102	5.30E+00	1.48E+01	8.75E+01	0/102	7/102
Magnesium	31/31	6.19E+02	2.63E+03	8.05E+03	N/A	8/31
Manganese	90/91	8.09E+01	3.94E+02	1.80E+03	90/91	6/91
Mercury	30/105	1.68E-02	1.78E+00	1.40E+01	5/105	13/105
Molybdenum	10/66	5.30E-01	9.89E+00	2.01E+01	0/66	N/A
Nickel	47/97	2.70E+00	4.18E+02	1.76E+04	32/97	20/97
Potassium	22/23	1.82E+02	4.50E+02	1.19E+03	N/A	2/23
Selenium	21/102	3.00E-01	3.72E+00	1.36E+01	0/102	14/102
Silicon	1/1	2.42E+03	2.42E+03	2.42E+03	N/A	N/A
Silver	21/102	3.70E-02	3.46E+00	1.06E+01	0/102	7/102
Sodium	31/31	2.45E+01	2.68E+02	1.17E+03	N/A	5/31
Sulfur	1/1	4.00E-01	4.00E-01	4.00E-01	N/A	N/A
Thallium	12/41	1.20E-01	1.38E+00	1.39E+01	12/41	3/41
Uranium	49/89	1.00E+00	1.56E+02	3.10E+03	21/89	37/89
Vanadium	37/91	8.60E+00	2.41E+01	7.26E+01	37/91	2/91
Zinc	85/85	4.70E+00	5.13E+01	8.00E+02	0/85	12/85
Organics (mg/kg)						
(1,1-Dimethylethyl)benzene	1/2	1.00E-03	1.00E-03	1.00E-03	N/A	N/A
(1-Methylpropyl)benzene	1/2	1.40E-03	1.40E-03	1.40E-03	N/A	N/A
1,1,1-Trichloroethane	1/30	1.20E-03	1.20E-03	1.20E-03	0/30	N/A
1,2,4-Trichlorobenzene	1/44	3.90E-03	3.90E-03	3.90E-03	N/A	N/A
1,2,4-Trimethylbenzene	1/2	2.30E-03	2.30E-03	2.30E-03	N/A	N/A
1,2-Dichlorobenzene	1/44	2.60E-03	2.60E-03	2.60E-03	N/A	N/A
1,2-Dimethylbenzene	1/2	8.60E-04	8.60E-04	8.60E-04	0/2	N/A
1,3,5-Trimethylbenzene	1/2	1.80E-03	1.80E-03	1.80E-03	N/A	N/A
1,3-Dichlorobenzene	1/44	2.80E-03	2.80E-03	2.80E-03	N/A	N/A
1,4-Cineole	1/1	3.30E-02	3.30E-02	3.30E-02	N/A	N/A
1,4-Dichlorobenzene	1/44	3.70E-03	3.70E-03	3.70E-03	N/A	N/A
1-Methyl-4-(1-methylethyl)benzene	1/2	1.90E-03	1.90E-03	1.90E-03	N/A	N/A
2,4-Dinitrotoluene	1/42	4.57E-01	4.57E-01	4.57E-01	N/A	N/A
Acenaphthene	2/51	4.10E-02	4.55E-02	5.00E-02	0/51	N/A
Acetone	7/27	5.50E-03	5.42E-02	1.40E-01	N/A	N/A
Anthracene	2/52	1.40E-01	1.50E-01	1.60E-01	0/52	N/A
Benz(a)anthracene	5/52	8.00E-02	2.06E-01	3.40E-01	5/52	N/A
Benzene	1/27	6.30E-04	6.30E-04	6.30E-04	0/27	N/A
Benzo(a)pyrene	10/52	1.40E-02	1.03E-01	3.00E-01	10/52	N/A

Table B1.14. Summary of SWMU 26 Detected Chemicals (Continued)

Chemical	FOD	Minimum Detected Result	Average Detected Result	Maximum Detected Result	FOD above NAL[a]	FOD above Bkgd[a]
Benzo(b)fluoranthene	6/52	7.60E-02	1.44E-01	2.60E-01	6/52	N/A
Benzo(ghi)perylene	5/51	4.70E-02	9.08E-02	1.30E-01	N/A	N/A
Benzo(k)fluoranthene	5/52	7.00E-02	1.57E-01	2.90E-01	0/52	N/A
Bis(2-ethylhexyl)phthalate	6/42	4.30E-02	1.40E+00	5.70E+00	0/42	N/A
Butylbenzene	1/2	2.10E-03	2.10E-03	2.10E-03	N/A	N/A
Carbon disulfide	3/23	9.80E-04	9.93E-04	1.00E-03	N/A	N/A
Chloroform	1/27	1.10E-02	1.10E-02	1.10E-02	0/27	N/A
Chrysene	5/52	9.00E-02	2.30E-01	3.50E-01	0/52	N/A
Cineole	1/1	2.40E-02	2.40E-02	2.40E-02	N/A	N/A
cis-1,2-Dichloroethene	2/23	3.10E-04	2.36E-03	4.40E-03	0/23	N/A
Dibenz(a,h)anthracene	3/52	6.60E-03	2.82E-02	5.20E-02	3/52	N/A
Diethyl ether	2/3	1.00E-02	1.50E-02	2.00E-02	N/A	N/A
Dimethyl phthalate	1/42	4.30E-01	4.30E-01	4.30E-01	N/A	N/A
Di-n-butyl phthalate	1/42	1.10E-01	1.10E-01	1.10E-01	N/A	N/A
Ethylbenzene	1/27	1.00E-03	1.00E-03	1.00E-03	0/27	N/A
Fluoranthene	7/52	4.00E-02	3.45E-01	8.40E-01	0/52	N/A
Fluorene	2/52	4.90E-02	4.95E-02	5.00E-02	0/52	N/A
Indeno(1,2,3-cd)pyrene	4/52	5.00E-02	9.18E-02	1.40E-01	3/52	N/A
m,p-Xylene	1/2	1.90E-03	1.90E-03	1.90E-03	0/2	N/A
Methylene chloride	5/27	3.90E-02	5.52E-02	7.90E-02	N/A	N/A
Naphthalene	1/54	4.80E-03	4.80E-03	4.80E-03	0/54	N/A
N-Nitrosodiphenylamine	1/42	8.23E-01	8.23E-01	8.23E-01	N/A	N/A
PAH, Total	9/45	7.60E-03	1.44E-01	4.15E-01	9/45	N/A
PCB, Total	23/139	1.50E-02	4.93E-01	1.90E+00	19/139	N/A
PCB-1248	3/65	3.10E-01	3.80E-01	4.90E-01	3/65	N/A
PCB-1254	12/65	2.20E-02	2.83E-01	5.30E-01	10/65	N/A
PCB-1260	12/65	1.50E-02	4.01E-01	1.60E+00	9/65	N/A
Pentachlorophenol	1/42	2.10E+00	2.10E+00	2.10E+00	1/42	N/A
Phenanthrene	7/52	6.40E-02	3.93E-01	7.00E-01	0/52	N/A
Propylbenzene	1/2	2.00E-03	2.00E-03	2.00E-03	N/A	N/A
Pyrene	6/52	6.90E-02	3.30E-01	7.10E-01	0/52	N/A
Styrene	1/23	9.90E-04	9.90E-04	9.90E-04	N/A	N/A
Toluene	5/27	3.10E-01	3.18E-01	3.20E-01	0/27	N/A
Trichloroethene	7/46	5.00E-04	3.11E-03	1.00E-02	0/46	N/A
Radionuclides (pCi/g)						
Actinium-228	4/4	2.62E-01	7.44E-01	1.69E+00	N/A	N/A
Americium-241	9/35	1.71E-01	1.07E+00	2.93E+00	0/35	N/A
Bismuth-211	3/3	2.18E+00	2.41E+00	2.58E+00	N/A	N/A
Bismuth-212	1/3	1.00E+00	1.00E+00	1.00E+00	N/A	N/A
Bismuth-214	3/3	6.87E-01	7.78E-01	9.51E-01	N/A	N/A
Cesium-137	25/35	2.94E-02	1.83E+00	1.12E+01	17/35	10/35
Lead-211	3/3	4.25E-01	1.73E+00	2.58E+00	N/A	N/A
Lead-212	4/4	1.85E-01	7.54E-01	1.88E+00	N/A	N/A
Lead-214	4/4	7.31E-01	1.28E+00	2.60E+00	N/A	N/A
Neptunium-237	19/30	5.20E-02	3.92E+00	5.26E+01	12/30	12/30
Plutonium-238	5/22	4.30E-02	2.39E-01	3.90E-01	0/22	3/22
Plutonium-239/240	23/38	4.10E-02	2.53E+00	1.59E+01	4/38	13/38
Potassium-40	4/4	2.11E+00	6.68E+00	1.37E+01	N/A	0/4
Protactinium-233	3/3	4.76E-01	7.00E-01	1.06E+00	N/A	N/A
Protactinium-234m	4/4	7.90E+01	1.33E+02	1.82E+02	N/A	N/A

Table B1.14. Summary of SWMU 26 Detected Chemicals (Continued)

Chemical	FOD	Minimum Detected Result	Average Detected Result	Maximum Detected Result	FOD above NAL[a]	FOD above Bkgd[a]
Radium-223	3/3	3.17E-01	4.98E-01	6.29E-01	N/A	N/A
Radium-226	3/3	8.44E-01	8.69E-01	8.98E-01	N/A	0/3
Radium-228	4/4	1.48E-01	7.68E-01	1.69E+00	N/A	N/A
Radon-219	3/3	3.37E-01	5.60E-01	7.54E-01	N/A	N/A
Strontium-90	2/3	3.60E+00	5.30E+00	7.00E+00	N/A	1/3
Technetium-99	26/35	3.00E-01	3.51E+02	4.84E+03	5/35	19/35
Thallium-208	4/4	7.64E-02	3.35E-01	8.20E-01	N/A	N/A
Thorium-227	2/3	2.89E-01	3.70E-01	4.51E-01	N/A	N/A
Thorium-228	18/22	2.30E-01	5.84E-01	1.81E+00	0/22	1/22
Thorium-230	33/35	3.89E-01	7.63E+00	1.11E+02	6/35	16/35
Thorium-232	21/23	9.14E-02	5.98E-01	2.03E+00	0/23	2/23
Thorium-234	7/7	7.48E+00	1.19E+02	3.14E+02	N/A	N/A
Uranium-234	36/39	2.00E-01	3.10E+01	4.37E+02	11/39	19/39
Uranium-235	30/37	2.00E-02	2.10E+00	3.19E+01	9/37	24/37
Uranium-238[b]	40/40	7.00E-01	6.67E+01	1.04E+03	26/40	26/40

[a] NAL is the Child Resident NAL as shown in Appendix D. Background values are reported in the Risk Methods Document (DOE 2015).
[b] Uranium-238 assessed with the "USECNITRIC-CF" are compared to 0.40 pCi/g. For additional information see assessment qualifier codes.
"N/A" indicates a value is not available.

B1.4. SWMU 77

Data Evaluation and Screening

Historical data for this SWMU include PCBs and radionuclides in the surface soils. There are no data for the shallow subsurface for this SWMU. These data were collected from the following projects:

- RCWC Data
- RCWC Data 92-82A

Sampling Representative of the SWMU/AOC Area?

Figures in Section 5 illustrate the location of the historical data points associated with this SWMU. The grid for SWMU 77 was in the approved SAP, and all soil and sediment data within that grid was selected and assigned to SWMU 77. Data collected from the project RCWC Data (LMES96-40) were removed from the data set; these data actually were collected from the C-409 concrete sump and not near SWMU 77. The coordinates for these sample locations were reversed.

Indicator chemicals were removed from the data set [i.e., uranium-235 (wt.%)].

Usability of Historical Data

Validation: Validation was not performed for the data set.

Data Assessment: No data assessment qualifiers have been applied to this data set.

Units of Results

Reported units within the data set are appropriate for the analytical types.

Detection Limits/Minimum Detectable Concentration

All of the nonradionuclide historical data for which there are no reported results and no detection limit have been removed from the data set for SWMU 77. For radionuclide historical data, MDCs are not reported for the data set.

Radionuclide Counting Errors

Radionuclide historical data records that have no MDCs and no counting errors reported have been removed from the data set.

Nondetect Result Qualifiers

Usable data records that were considered nondetect were considered so due to laboratory qualification.

Assignment of Historical Data to RI Sampling Grids

The historic data has been assigned to grids as discussed. The assignments are listed in Table B1.15.

Table B1.15. Stations and Grids for Historical Data from SWMU 77

Station Name	Grid No.
WC-787	SOU077-001

Summary of Detected Chemicals

A summary of detected chemicals is presented in Table B1.16.

Table B1.16. Summary of SWMU 77 Detected Chemicals

Chemical	FOD	Minimum Detected Result	Average Detected Result	Maximum Detected Result	FOD above NAL*	FOD above Bkgd*
Organics (mg/kg)						
PCB, Total	1/1	4.00E+00	4.00E+00	4.00E+00	1/1	N/A
PCB-1254	1/1	4.00E+00	4.00E+00	4.00E+00	1/1	N/A

*NAL is the Child Resident NAL as shown in Appendix D. Background values are reported in the Risk Methods Document (DOE 2015).
"N/A" indicates a value is not available.

B1.5. SWMUS 56 AND 80

Data Evaluation and Screening

Historical samples collected from surface soil at these SWMUs were analyzed for metals, radionuclides, dioxins/furans, pesticides/PCBs, herbicides, SVOCs, and VOCs. The analytical types for the shallow subsurface soil are metals, radionuclides, pesticides/PCB, SVOCs, and VOCs. These data were collected from the following project(s):

- False Claims Investigation—Department of Justice—Soils/Sediment
- Historical data from AnaLIS for WAG 28 DQO
- Outfalls 011/012 Time Critical Removal

- RCWC Data
- Remedial Action SI—Phase 1
- Remedial Action SI—Phase 2
- Soils OU PCB Group 1
- Soils OU PCB Group 3
- Soils OU RI/FS—PCB Areas
- Soils OU RI/FS—PCB Evaluation
- Soils OU RI/FS—Storage Areas
- Soils OU XRF Group 1
- Soils OU XRF Group 3
- WAG 23 Excavation Sampling
- WAG 23 Phase 1
- WAG 23 Phase 2

<u>Sampling Representative of the SWMU/AOC Area?</u>

Figures in Section 5 illustrate the location of the historical data points associated with these SWMUs. The grids and EUs for SWMUs 56/80 were in the approved SAP, and all soil and sediment data within those grids were selected and assigned to SWMUs 56/80. The sampling locations/sample numbers presented in Table B1.17 are not representative of the SWMU/AOC area because they were removed as part of the WAG 23 removal action in 1998.

Table B1.17. Sample Locations within SWMUs 56 and 80 That Are Not Representative

Station	Sample ID	Sample Depth (ft)
RC-2002	RC-2002 (SO) RC-2002 (NA)	0–0
RC-2003	RC-2003 (SO) RC-2003 (NA)	0–0
23-5627	23A5627	0–0.5
23-5609	23A5609	0–0
H037	CH205127-00000	0–1
23-5608	23A5608	0–0.5
23-5607	23A5607	0–0.5

Additionally, sample 056008SA002 from location 056-008 and samples 056006SA002 and 056006SB002 from location 056-006 have been revised from the data set in OREIS so that their sample depths are 2 ft. These samples were collected from the bottom of the removal excavation prior to backfill.

Indicator chemicals were removed from the data set [i.e., alpha activity, beta activity, uranium-235 (wt.%), total uranium reported in pCi/g (with no isotopes), and moisture].

In order to more comprehensively address the data set for all SWMUs, uranium-235/236 was evaluated as uranium-235.

Usability of Historical Data

Validation: Validation was performed on 10% of the data collected during the Phase 1, Phase 2, and WAG 23 projects. Rejected data has been removed from the data set. Validation qualifiers applied to the SWMUs 56/80 data set include "=," "E," "J," "N," and "U."

Data Assessment: Data assessed with the code R-RERUN (result unusable, results from re-analysis should be used) have been removed from the data set. Additionally, those data whose assessment qualifiers indicate incorrectly reported errors (i.e., KYRHTAB-ER) were removed from the data set. Other data assessment qualifiers that have been applied to the data for this SWMU are shown in Table B1.18.

Table B1.18. Assessment Qualifiers Applied to SWMUs 56 and 80 Historic Data

Assessment Qualifier	Definition
KYRHTAB-50	KYRHTAB has performed an independent data evaluation (not to be confused with data verification and validation) and the rad error accounts for greater than 50% of the results.
KYRHTAB-LT	KYRHTAB has performed an independent data evaluation (not to be confused with data verification and validation) and the results are less than the minimum detectable activity (MDA) or detection limit and should not be plotted.
KYRHTAB-OK	KYRHTAB has performed an independent data evaluation (not to be confused with data verification and validation) and the data is acceptable for use.

Units of Results

Data records with reported units inappropriate for the medial type (i.e., soil data reported with units of mg/L) and for the analytical types (i.e., radioisotopes reported in ng/g) have been removed from the data set. Total uranium reported in µg/g has been revised from classification as a radiological analytical type to a metal.

Detection Limits/Minimum Detectable Concentration

All of the nonradionuclide historical data records without either results or detection limits have been removed from the data set.

There are 35 chemicals that are nondetects and have their SQL/MDCs greater than background or the child resident NAL. Those chemicals and referenced values are shown in Table B1.19.

Table B1.19. Analytes with SQL or MDC Greater that Background or Child Resident NAL for SWMUs 56 and 80

Chemical	Unit	Maximum SQL/MDC for Nondetects	NAL*	Background*	
				Surface	Subsurface
Inorganics					
Antimony	mg/kg	3.00E+01	5.71E-01	2.10E-01	2.10E-01
Arsenic	mg/kg	1.10E+01	2.67E-01	1.20E+01	7.90E+00
Cadmium	mg/kg	1.20E+01	5.07E+00	2.10E-01	2.10E-01
Chromium	mg/kg	8.50E+01	1.64E+01	1.60E+01	4.30E+01
Copper	mg/kg	3.50E+01	1.87E+02	1.90E+01	2.50E+01
Mercury	mg/kg	1.00E+01	2.21E-01	2.00E-01	1.30E-01

Table B1.19. Analytes with SQL or MDC Greater that Background or Child Resident NAL for SWMUs 56 and 80 (Continued)

Chemical	Unit	Maximum SQL/MDC for Nondetects	NAL*	Background*	
				Surface	Subsurface
Nickel	mg/kg	6.50E+01	1.08E+01	2.10E+01	2.20E+01
Selenium	mg/kg	2.00E+01	2.34E+01	8.00E-01	7.00E-01
Silver	mg/kg	1.00E+01	2.71E+00	2.30E+00	2.70E+00
Uranium	mg/kg	2.00E+01	1.40E+01	4.90E+00	4.60E+00
Vanadium	mg/kg	7.00E+01	2.73E+00	3.80E+01	3.70E+01
Organics					
2,3,7,8-Tetrachlorodibenzofuran	mg/kg	4.00E-05	3.08E-05		
2,3,7,8-Tetrachlorodibenzo-p-dioxin	mg/kg	5.00E-05	3.08E-06		
Benz(a)anthracene	mg/kg	4.00E-01	6.19E-02		
Benzo(a)pyrene	mg/kg	4.00E-01	6.19E-03		
Benzo(b)fluoranthene	mg/kg	4.00E-01	6.19E-02		
Dibenz(a,h)anthracene	mg/kg	4.00E-01	6.19E-03		
Dieldrin	mg/kg	7.80E-01	1.26E-02		
Hexachlorobenzene	mg/kg	4.00E-01	1.26E-01		
Hexachloro-dibenzo[b,e][1,4]dioxin	mg/kg	1.10E-04	3.08E-05		
Hexachlorodibenzofuran	mg/kg	9.00E-05	3.08E-05		
Indeno(1,2,3-cd)pyrene	mg/kg	4.00E-01	6.19E-02		
N-Nitroso-di-n-propylamine	mg/kg	4.00E-01	2.87E-02		
PCB, Total	mg/kg	5.00E+00	7.82E-02		
PCB-1016	mg/kg	1.90E+01	1.90E-01		
PCB-1221	mg/kg	4.80E+01	6.59E-02		
PCB-1232	mg/kg	4.80E+01	6.59E-02		
PCB-1242	mg/kg	1.90E+01	7.82E-02		
PCB-1248	mg/kg	9.60E+00	7.82E-02		
PCB-1254	mg/kg	9.60E+00	5.43E-02		
PCB-1260	mg/kg	3.70E+00	7.82E-02		
Pentachloro-dibenzo[b,e][1,4]dioxin	mg/kg	1.30E-04	3.08E-06		
Pentachlorophenol	mg/kg	1.90E+00	2.43E-01		
Radionuclides					
Cesium-137	pCi/g	1.20E-01	1.16E-01	4.90E-01	2.80E-01
Plutonium-238	pCi/g	1.70E-01	4.42E+00	7.30E-02	

*NAL is the Child Resident NAL as shown in Appendix D. Background values are reported in the Risk Methods Document (DOE 2015).

Radionuclide Counting Errors

Radionuclide historical data records that have no MDCs and no counting errors reported have been removed from the data set.

Nondetect Result Qualifiers

All usable data records that were considered nondetect were considered so due to laboratory or validator qualification.

Additionally, one record for protactinium-231 and one for thorium-229 will be considered a nondetect because the radiological counting error and/or TPU were greater than the reported results, as shown in Table B1.20.

Table B1.20. SWMUs 56 and 80 Historic Protactinium-231 and Thorium -229 Data with Results Less than Counting Errors

Sample ID	Chemical	Results	Detection Limit	Radiological Error	TPU	Units
DOJ1-99-0153	Protactinium-231	291.4	3.199	582.9	582.9	pCi/g
DOJ1-99-0153	Thorium-229	0.9301	0.4038	1.86	1.86	pCi/g

Assignment of Historical Data to RI Sampling Grids

The historic data has been assigned to grids as discussed. The assignments are listed in Table B1.21.

Table B1.21. Stations and Grids for Historical Data from SWMUs 56 and 80

Station Name	Grid No.
204-26	SOU080-001A
SOUED1-001	SOU080-001B
SOUED1-002	SOU080-001B
SOUED1-003	SOU080-001B
H346	SOU080-001C
SOUED1-004	SOU080-001C
SOUED1-005	SOU080-001C
SOUED1-006	SOU080-001C
SOUED1-007	SOU080-001C
SOUED1-008	SOU080-001C
SOUED1-009	SOU080-001C
23-5601	SOU080-001D
23-5601-1	SOU080-001D
23-5601-2	SOU080-001D
23-5601-3	SOU080-001D
23-5602	SOU080-001D
23-5602-1	SOU080-001D
23-5602-2	SOU080-001D
23-5602-3	SOU080-001D
H330	SOU080-001D
23-5630	SOU080-001E
23-5630-1	SOU080-001E
23-5630-2	SOU080-001E
23-5630-3	SOU080-001E
23-5603	SOU080-001L
23-5604	SOU080-001L
SOU224-001L	SOU080-001L
SOUED2-001	SOU080-001O
SOUED2-002	SOU080-001O
SOUED2-003	SOU080-001O
SOUED2-004	SOU080-001O
23-5606	SOU080-001Q
23-5606-1	SOU080-001Q
23-5606-2	SOU080-001Q
23-5606-3	SOU080-001Q
H329	SOU080-001Q
JP-0153	SOU080-002
SOU080-002	SOU080-002
SOU224-001	SOU080-002
23-5618	SOU080-002B

Station Name	Grid No.
23-5617	SOU080-002C
23-5616	SOU080-002D
H328	SOU080-002D
WC6-377	SOU080-002E
WC6-378	SOU080-002E
WC6-379	SOU080-002E
WC6-407	SOU080-002E
WC6-408	SOU080-002E
WC6-409	SOU080-002E
23-5620	SOU080-003
23-5624	SOU080-003
23-5624-1	SOU080-003
23-5624-2	SOU080-003
23-5624-3	SOU080-003
RC-4601	SOU080-003
RC-4602	SOU080-003
23-5613	SOU080-004
23-5613-1	SOU080-004
23-5613-2	SOU080-004
23-5613-3	SOU080-004
23-5614	SOU080-004
23-5614-1	SOU080-004
23-5614-2	SOU080-004
23-5614-3	SOU080-004
23-5615	SOU080-004
23-5615-1	SOU080-004
23-5615-2	SOU080-004
23-5615-3	SOU080-004
23-5625	SOU080-004
23-5625-1	SOU080-004
23-5625-2	SOU080-004
23-5625-3	SOU080-004
080-001	SOU080-005
080-002	SOU080-005
080-003	SOU080-005
080-004	SOU080-005
23-5627-1	SOU080-005
23-5627-2	SOU080-005
23-5627-3	SOU080-005
23-5627-4	SOU080-005

Station Name	Grid No.
23-5628	SOU080-005
23-5628-1	SOU080-005
23-5628-2	SOU080-005
23-5628-3	SOU080-005
RC-2001	SOU080-005
23-5612	SOU080-006
23-5612-1	SOU080-006
23-5612-2	SOU080-006
23-5612-3	SOU080-006
23-5626	SOU080-006
23-5626-1	SOU080-006
23-5626-2	SOU080-006
23-5626-3	SOU080-006
23-5635-1	SOU080-006
H034	SOU080-006
H035	SOU080-006
RC-2004	SOU080-006
23-5633-1	SOU080-007
23-5634-1	SOU080-008
23-5610	SOU080-009
RC-4603	SOU080-009
RC-4604	SOU080-009
056-001	SOU080-010
056-002	SOU080-010
056-006	SOU080-010
056-007	SOU080-010
056-008	SOU080-010
23-5608-1	SOU080-010
23-5608-2	SOU080-010
23-5608-3	SOU080-010
23-5608-4	SOU080-010
23-5609-1	SOU080-010
23-5609-2	SOU080-010
23-5609-3	SOU080-010
H037	SOU080-010

Summary of Detected Chemicals

A summary of detected chemicals is presented in Table B1.22.

Table B1.22. Summary of SWMUs 56 and 80 Detected Chemicals

Chemical	FOD	Minimum Detected Result	Average Detected Result	Maximum Detected Result	FOD above NAL*	FOD above Bkgd*
Inorganics (mg/kg)						
Aluminum	2/2	7.40E+03	8.36E+03	9.32E+03	2/2	0/2
Antimony	8/11	3.90E-01	5.05E+01	9.60E+01	7/11	8/11
Arsenic	9/11	5.80E+00	8.08E+00	1.20E+01	9/11	1/11
Barium	11/11	8.85E+01	3.20E+02	5.23E+02	9/11	9/11
Beryllium	3/3	4.30E-01	5.53E-01	7.80E-01	0/3	1/3
Cadmium	3/11	1.00E-01	5.99E+00	1.77E+01	1/11	1/11
Calcium	2/2	2.13E+04	3.52E+04	4.91E+04	N/A	0/2
Chromium	7/12	1.33E+01	5.11E+01	1.65E+02	5/12	3/12
Cobalt	2/2	7.50E+00	7.60E+00	7.70E+00	2/2	0/2
Copper	3/11	9.00E+00	1.54E+01	2.41E+01	0/11	0/11
Iron	11/11	8.66E+03	1.35E+04	1.73E+04	11/11	0/11
Lead	10/11	6.95E+00	1.26E+01	1.89E+01	0/11	0/11
Magnesium	2/2	2.01E+03	2.73E+03	3.45E+03	N/A	0/2
Manganese	11/11	8.63E+01	3.21E+02	8.15E+02	11/11	0/11
Mercury	4/12	2.52E-02	1.85E+00	6.88E+00	2/12	2/12
Molybdenum	2/11	7.70E-01	7.80E-01	7.90E-01	0/11	N/A
Nickel	3/11	9.40E+00	3.10E+01	7.11E+01	2/11	1/11
Selenium	2/11	1.10E+00	1.15E+00	1.20E+00	0/11	2/11
Silver	2/11	3.10E-02	3.80E-02	4.50E-02	0/11	0/11
Sodium	2/2	4.09E+01	4.40E+01	4.71E+01	N/A	0/2
Thallium	2/2	1.20E-01	1.40E-01	1.60E-01	2/2	0/2
Uranium	15/18	9.66E+00	4.21E+02	5.72E+03	12/18	15/18
Vanadium	2/11	2.59E+01	2.71E+01	2.82E+01	2/11	0/11
Zinc	11/11	2.39E+01	3.93E+01	6.17E+01	0/11	0/11
Organics (mg/kg)						
1,1,2-Trichloro-1,2,2-trifluoroethane	1/1	1.10E-02	1.10E-02	1.10E-02	0/1	N/A
1,2,3,4,6,7,8-Heptachlorodibenzofuran	3/3	6.00E-05	6.67E-05	8.00E-05	N/A	N/A
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	3/3	9.00E-05	1.23E-04	1.70E-04	N/A	N/A
1,2,3,4,7,8,9-Heptachlorodibenzofuran	3/3	2.00E-05	2.33E-05	3.00E-05	N/A	N/A
1,2,3,4,7,8-Hexachlorodibenzofuran	3/3	4.00E-05	6.00E-05	8.00E-05	N/A	N/A
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	3/3	4.87E-06	7.91E-06	9.82E-06	N/A	N/A
1,2,3,6,7,8-Hexachlorodibenzofuran	3/3	9.71E-06	9.90E-06	1.00E-05	N/A	N/A
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	3/3	1.00E-05	2.00E-05	3.00E-05	N/A	N/A

Table B1.22. Summary of SWMUs 56 and 80 Detected Chemicals (Continued)

Chemical	FOD	Minimum Detected Result	Average Detected Result	Maximum Detected Result	FOD above NAL*	FOD above Bkgd*
1,2,3,7,8,9-Hexachlorodibenzofuran	3/3	7.77E-06	9.26E-06	1.00E-05	N/A	N/A
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	3/3	9.15E-06	9.72E-06	1.00E-05	N/A	N/A
1,2,3,7,8-Pentachlorodibenzofuran	3/3	5.77E-06	7.81E-06	9.65E-06	0/3	N/A
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	3/3	2.50E-06	4.35E-06	6.19E-06	N/A	N/A
2,3,4,6,7,8-Hexachlorodibenzofuran	3/3	1.26E-06	3.26E-06	5.52E-06	N/A	N/A
2,3,4,7,8-Pentachlorodibenzofuran	3/3	3.00E-05	3.00E-05	3.00E-05	3/3	N/A
2,3,7,8-Tetrachlorodibenzofuran	3/4	2.00E-05	2.00E-05	2.00E-05	0/4	N/A
2,3,7,8-Tetrachlorodibenzo-p-dioxin	3/4	1.38E-06	2.10E-05	6.00E-05	1/4	N/A
Acenaphthene	1/4	9.40E-02	9.40E-02	9.40E-02	0/4	N/A
Acetone	1/5	1.10E-01	1.10E-01	1.10E-01	N/A	N/A
Anthracene	1/4	1.70E-01	1.70E-01	1.70E-01	0/4	N/A
Benz(a)anthracene	2/4	1.00E-01	3.55E-01	6.10E-01	2/4	N/A
Benzo(a)pyrene	2/4	9.00E-02	2.75E-01	4.60E-01	2/4	N/A
Benzo(b)fluoranthene	2/4	1.10E-01	3.15E-01	5.20E-01	2/4	N/A
Benzo(ghi)perylene	2/4	8.70E-02	2.24E-01	3.60E-01	N/A	N/A
Benzo(k)fluoranthene	2/4	8.20E-02	2.76E-01	4.70E-01	0/4	N/A
Chrysene	2/4	1.30E-01	4.30E-01	7.30E-01	0/4	N/A
Dibenz(a,h)anthracene	2/4	2.20E-02	6.60E-02	1.10E-01	2/4	N/A
Dibenzofuran	1/4	4.90E-02	4.90E-02	4.90E-02	N/A	N/A
Dioxins/Furans, Total	4/4	2.95E-05	4.68E-05	8.82E-05	4/4	N/A
Fluoranthene	2/4	2.00E-01	7.00E-01	1.20E+00	0/4	N/A
Fluorene	1/4	9.20E-02	9.20E-02	9.20E-02	0/4	N/A
Indeno(1,2,3-cd)pyrene	2/4	7.70E-02	2.04E-01	3.30E-01	2/4	N/A
Naphthalene	1/4	7.40E-02	7.40E-02	7.40E-02	0/4	N/A
Octachloro-dibenzo[b,e][1,4]dioxin	4/4	2.71E-03	6.40E-03	1.18E-02	1/4	N/A
Octachlorodibenzofuran	3/4	1.70E-04	2.13E-04	2.50E-04	0/4	N/A
PAH, Total	2/4	1.42E-01	4.32E-01	7.21E-01	2/4	N/A
PCB, Total	64/164	5.00E-03	1.45E+01	4.75E+02	54/164	N/A
PCB-1242	3/41	1.40E+00	1.77E+00	2.40E+00	3/41	N/A
PCB-1248	4/106	4.00E+00	6.00E+00	8.40E+00	4/106	N/A
PCB-1254	6/111	4.70E-02	2.77E+00	6.30E+00	5/111	N/A
PCB-1260	54/120	5.00E-03	1.35E+01	4.75E+02	40/120	N/A
Phenanthrene	2/4	1.10E-01	4.45E-01	7.80E-01	0/4	N/A
Pyrene	2/4	1.70E-01	5.85E-01	1.00E+00	0/4	N/A
Radionuclides (pCi/g)						
Actinium-228	1/1	2.98E-01	2.98E-01	2.98E-01	N/A	N/A
Americium-241	1/3	6.40E+00	6.40E+00	6.40E+00	1/3	N/A
Bismuth-211	1/1	1.07E+00	1.07E+00	1.07E+00	N/A	N/A

Table B1.22. Summary of SWMUs 56 and 80 Detected Chemicals (Continued)

Chemical	FOD	Minimum Detected Result	Average Detected Result	Maximum Detected Result	FOD above NAL*	FOD above Bkgd*
Bismuth-214	1/1	6.33E-01	6.33E-01	6.33E-01	N/A	N/A
Cesium-137	2/3	1.32E-01	2.02E-01	2.71E-01	2/3	0/3
Lead-211	1/1	1.07E+00	1.07E+00	1.07E+00	N/A	N/A
Lead-212	1/1	2.00E-01	2.00E-01	2.00E-01	N/A	N/A
Lead-214	1/1	4.11E-01	4.11E-01	4.11E-01	N/A	N/A
Neptunium-237	2/4	1.80E-01	3.43E-01	5.05E-01	1/4	2/4
Plutonium-239/240	4/4	6.50E-03	2.11E-01	4.38E-01	0/4	2/4
Potassium-40	1/1	3.98E+00	3.98E+00	3.98E+00	N/A	0/1
Protactinium-233	1/1	3.00E-01	3.00E-01	3.00E-01	N/A	N/A
Protactinium-234m	1/1	1.33E+03	1.33E+03	1.33E+03	N/A	N/A
Radium-226	1/1	3.19E-01	3.19E-01	3.19E-01	N/A	0/1
Radium-228	1/1	3.38E-01	3.38E-01	3.38E-01	N/A	N/A
Strontium-90	1/1	6.70E+00	6.70E+00	6.70E+00	N/A	1/1
Technetium-99	1/4	2.95E+01	2.95E+01	2.95E+01	0/4	1/4
Thallium-208	1/1	1.66E-01	1.66E-01	1.66E-01	N/A	N/A
Thorium-228	4/4	1.87E-01	5.29E-01	9.70E-01	N/A	0/4
Thorium-230	3/3	8.50E-01	2.12E+00	4.40E+00	0/3	1/3
Thorium-232	4/4	1.52E-01	4.78E-01	8.70E-01	N/A	0/4
Thorium-234	1/1	1.33E+03	1.33E+03	1.33E+03	N/A	N/A
Uranium-234	4/4	1.14E+00	1.12E+02	2.29E+02	2/4	3/4
Uranium-235	3/3	1.13E-01	1.01E+01	3.00E+01	1/3	3/3
Uranium-238	4/4	3.95E+00	8.51E+02	1.92E+03	4/4	4/4

*NAL is the Child Resident NAL as shown in Appendix D. Background values are reported in the Risk Methods Document (DOE 2015).
"N/A" indicates a value is not available.

B1.6. AOC 204

Data Evaluation and Screening

Historical data for this SWMU include metals, pesticides/PCBs, radionuclides, SVOCs, and VOCs in the surface and pesticides/PCBs, radionuclides, and VOCs in shallow subsurface soils. These data were collected from the following projects:

- AIP Limited Sampling of Outfall 008, 010, and Section 3A of North-South Diversion Ditch
- AIP Sediment & Soil CH Split December 2000
- Contingency WAG 28—SWMU 204
- False Claims Investigation—Dept. of Justice—Soils/Sediment
- KYRAD Limited Sampling of Outfall 008, 010, and Section 3A of N/S Ditch
- Limited Sampling of Outfall 008, 010, and Section 3A of N/S Ditch
- Outfalls 011/012 Time Critical Removal
- Surface Water OU—Activity 1 ISOCS data SWOU05-ISOCS
- Surface Water OU—Outfall 010 Activity 1 EU01
- Surface Water OU—Outfall 010 Activity 1 EU02
- Surface Water OU—Outfall 010 Activity 2 EU01 and EU02
- WAG 28—SWMU 204

Sampling Representative of the SWMU/AOC Area?

Figures in Section 5 illustrate the location of the historical data points associated with this AOC. The grids and EUs for AOC 204 were in the approved SAP, and all soil and sediment data within those grids were selected and assigned to AOC 204.

Indicator chemicals were removed from the data set [i.e., alpha activity, beta activity, uranium-235 (wt.%), total uranium (reported in pCi/g with no isotopes), and moisture].

In order to more comprehensively address the data set for all SWMUs, uranium-235/236 was evaluated as uranium-235.

Usability of Historical Data

Validation: Data validation was performed on 10% of the limited sampling of Outfalls 008 and 010, Section 3A of NSDD, and Surface Water OU fixed-base laboratory project data, and 100% of the Agreement in Principle sampling projects. Rejected data have been removed from the data set. Qualifiers of "=," "J," and "U" were applied to the data.

Data Assessment: Data assessed with the code KYRHTAB-ER [indicating the KYRHTAB performed an independent data evaluation (not to be confused with data verification and validation) and the data presents error problems (i.e., no counting uncertainty or zero counting uncertainty)] were removed from the data set. Other data assessment qualifiers that have been applied to the data for this SWMU are shown in Table B1.23.

Table B1.23. Assessment Qualifiers Applied to AOC 204 Historic Data

Assessment Qualifier	Definition
J	Result estimated.
KYRHTAB-50	KYRHTAB has performed an independent data evaluation (not to be confused with data verification and validation) and the rad error accounts for greater than 50% of the results.
KYRHTAB-OK	KYRHTAB has performed an independent data evaluation (not to be confused with data verification and validation) and the data is acceptable for use.
U	Not detected.
USECNITRIC-CF	During the period from May 2004 to September 2009, the USEC-PGDP laboratory used method RL-7128-NITRIC for isotopic uranium analysis by alpha spec. Method RL-7128-NITRIC utilizes only nitric acid for dissolution rather than hydrofluoric/nitric acid. The use of nitric acid only is a less aggressive dissolution for isotopic uranium analysis by alpha spec. It has been demonstrated that Method RL-7128-NITRIC can be utilized only for isotopic uranium analysis of soil with activity greater than 10 pCi/g due to low recoveries below that level. If the data from Method RL-7128-NITRIC will be screened against the background values reported in *Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the PGDP* (1997), the following adjusted background values must be used: U-234: 1.73 pCi/g surface and 1.63 pCi/g subsurface; U-235: 0.10 pCi/g; and U-238: 0.40 pCi/g [*Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant*, Appendix E (2009)]. Risk assessors may use data from this time period for comparison against other thresholds below 10 pCi/g without adjusting the values as long as the level of uncertainty and its impact on the risk assessment/evaluation are adequately discussed. No additional action is required for comparisons to thresholds above 10 pCi/g.

It was noted in the Surface Water Operable Unit (SWOU) SI/Baseline Risk Assessment (BRA) that data for cesium-137 and uranium-238 were produced using an *In Situ* Object Counting System (ISOCS) unit, as opposed to a fixed-base laboratory. The data are considered screening level only (its intended purpose) and did not meet data evaluation methods; therefore, they could not be used in the risk assessment (DOE 2008). These data subsequently were removed from the Soils OU data set.

Units of Results

Total uranium reported in µg/g has been revised from classification as a radiological analytical type to a metal.

Detection Limits/Minimum Detectable Concentration

All of the historical data records that had no reported results and no reported detection limits were removed from the data set.

For radionuclide historical data, records with no MDCs and counting errors reported have been removed from the data set.

There are 28 chemicals that are nondetects and have their SQL/MDCs greater than background or the child resident NAL. The chemical and referenced values are shown in Table B1.24.

Table B1.24. Analytes with SQL or MDC Greater that Background or Child Resident NAL for AOC 204

Chemical	Unit	Maximum SQL/MDC for Nondetects	NAL*	Background	
				Surface	Subsurface
Inorganics					
Antimony	mg/kg	2.00E+01	5.71E-01	2.10E-01	2.10E-01
Arsenic	mg/kg	5.00E+00	2.67E-01	1.20E+01	7.90E+00
Cadmium	mg/kg	2.00E+00	5.07E+00	2.10E-01	2.10E-01
Cobalt	mg/kg	2.50E+00	1.40E+00	1.40E+01	1.30E+01
Selenium	mg/kg	1.94E+01	2.34E+01	8.00E-01	7.00E-01
Silver	mg/kg	4.00E+00	2.71E+00	2.30E+00	2.70E+00
Thallium	mg/kg	2.00E+01	4.68E-02	2.10E-01	3.40E-01
Organics					
Benz(a)anthracene	mg/kg	4.90E-01	6.19E-02		
Benzo(a)pyrene	mg/kg	4.90E-01	6.19E-03		
Benzo(b)fluoranthene	mg/kg	4.90E-01	6.19E-02		
Dibenz(a,h)anthracene	mg/kg	4.90E-01	6.19E-03		
Indeno(1,2,3-cd)pyrene	mg/kg	4.90E-01	6.19E-02		
PCB, Total	mg/kg	1.30E-01	7.82E-02		
PCB-1221	mg/kg	1.30E-01	6.59E-02		
PCB-1232	mg/kg	1.00E-01	6.59E-02		
PCB-1242	mg/kg	1.00E-01	7.82E-02		
PCB-1248	mg/kg	1.00E-01	7.82E-02		
PCB-1254	mg/kg	1.00E-01	5.43E-02		
PCB-1260	mg/kg	1.00E-01	7.82E-02		
Trichloroethene	mg/kg	4.27E-01	4.12E-01		
Vinyl chloride	mg/kg	1.00E+01	5.92E-02		

Table B1.24. Analytes with SQL or MDC Greater that Background or Child Resident NAL for AOC 204

Chemical	Unit	Maximum SQL/MDC for Nondetects	NAL*	Background	
				Surface	Subsurface
Radionuclides					
Americium-241	pCi/g	9.20E+00	3.03E+00		
Cesium-137	pCi/g	2.90E+00	1.16E-01	4.90E-01	2.80E-01
Neptunium-237	pCi/g	2.64E-01	2.39E-01	1.00E-01	
Plutonium-238	pCi/g	2.22E-01	4.42E+00	7.30E-02	
Plutonium-239/240	pCi/g	6.49E-02	3.87E+00	2.50E-02	
Technetium-99	pCi/g	4.25E+00	1.17E+02	2.50E+00	2.80E+00
Uranium-235	pCi/g	9.00E+00	3.47E-01	6.00E-02	6.00E-02

*NAL is the Child Resident NAL, as shown in Appendix D. Background values are reported in the Risk Methods Document (DOE 2015).

Radionuclide Counting Errors

There are no radionuclide historical data records that have both no MDCs and no counting errors reported.

Nondetect Result Qualifiers

All usable data records that were considered nondetect were considered so due to laboratory qualification.

Additionally, one record each for protactinium-231, radium-228, and thorium-229 will be considered a nondetect because the radiological counting error and/or TPU were greater than the reported results, as shown in Table B1.25.

Table B1.25. AOC 204 Historic Selected Radionuclide Data with Results Less than Counting Errors

Sample ID	Chemical	Results	Detection Limit	Radiological Error	TPU	Units
DOJ1-99-0090	Protactinium-231	0.8278	0.3748	1.656	1.656	pCi/g
DOJ1-99-0090	Radium-228	0.848	0.2848	1.696	1.696	pCi/g
DOJ1-99-0092	Thorium-229	0.637	0.5981	1.274	1.274	pCi/g

Assignment of Historical Data to RI Sampling Grids

The historic data has been assigned to grids as discussed. The assignments are listed in Table B1.26.

Table B1.26. Stations and Grids for Historical Data from AOC 204

Station Name	Grid No.
204-01	SOU204-001
OF10A-060	SOU204-001
OF10A-050	SOU204-003
OF10A-053	SOU204-003
OF10B-02-03	SOU204-003
OF10A-046	SOU204-004
OF10A-048	SOU204-004
OF10A-043	SOU204-005
OF10A-044	SOU204-005
OF10B-02-04	SOU204-005
204-030	SOU204-007

Station Name	Grid No.
OF-11-04	SOU204-012
OF10A-026	SOU204-014
K010-2SE	SOU204-015
K010-2SO	SOU204-015
OF10A-023	SOU204-015
OF10A-073	SOU204-016
204-02	SOU204-052
204-028	SOU204-072
204-22	SOU204-085
204-20	SOU204-091

Station Name	Grid No.
204-19	SOU204-107
204-16	SOU204-109
204-03	SOU204-124
204-17	SOU204-139
SOU204-RAD	SOU204-151
204-18	SOU204-157
JP-0092	SOU204-168
204-15	SOU204-178
OF-11-05	SOU204-179
JP-0090	SOU204-180

Summary of Detected Chemicals

A summary of detected chemicals is presented in Table B1.27.

Table B1.27. Summary of AOC 204 Detected Chemicals

Chemical	FOD	Minimum Detected Result	Average Detected Result	Maximum Detected Result	FOD above NAL[a]	FOD above Bkgd[a]
Inorganics (mg/kg)						
Aluminum	6/6	4.39E+03	8.12E+03	1.37E+04	5/6	1/6
Antimony	2/6	1.10E+00	1.10E+00	1.10E+00	2/6	2/6
Arsenic	3/6	3.00E+00	4.24E+00	6.72E+00	3/6	0/6
Barium	6/6	2.99E+01	6.70E+01	1.01E+02	0/6	0/6
Beryllium	5/8	3.30E-01	6.37E-01	1.33E+00	1/8	2/8
Cadmium	2/6	6.10E-01	6.10E-01	6.10E-01	0/6	2/6
Calcium	6/6	9.20E+02	1.90E+03	4.02E+03	N/A	0/6
Chromium	8/8	1.41E+01	3.94E+01	1.75E+02	5/8	6/8
Cobalt	5/6	3.89E+00	4.62E+00	5.00E+00	5/6	0/6
Copper	6/6	6.55E+00	1.62E+01	2.69E+01	0/6	2/6
Iron	6/6	5.43E+03	1.13E+04	1.63E+04	6/6	0/6
Lead	2/6	9.60E+00	9.60E+00	9.60E+00	0/6	0/6
Magnesium	6/6	7.31E+02	1.28E+03	1.75E+03	N/A	0/6
Manganese	6/6	8.27E+01	2.14E+02	3.19E+02	6/6	0/6
Mercury	2/8	1.20E-01	1.20E-01	1.20E-01	0/8	0/8
Molybdenum	2/6	8.60E-01	8.60E-01	8.60E-01	0/6	N/A
Nickel	6/6	6.08E+00	8.32E+00	9.32E+00	0/6	0/6
Potassium	6/6	3.26E+02	7.61E+02	1.19E+03	N/A	0/6
Silicon	2/2	4.98E+02	4.98E+02	4.98E+02	N/A	N/A
Sodium	4/6	1.08E+02	1.35E+02	1.83E+02	N/A	0/6
Uranium	4/7	1.51E+00	3.29E+03	1.31E+04	3/7	3/7
Vanadium	6/6	8.11E+00	1.85E+01	2.99E+01	6/6	0/6
Zinc	6/6	2.78E+01	8.81E+01	1.66E+02	0/6	3/6
Organics (mg/kg)						
1,1,1-Trichloroethane	5/50	1.30E-02	1.82E-02	2.40E-02	0/50	N/A
PCB, Total	2/62	1.00E-01	3.96E+01	7.90E+01	2/62	N/A
PCB-1242	1/18	2.80E+01	2.80E+01	2.80E+01	1/18	N/A
PCB-1254	1/62	2.40E+01	2.40E+01	2.40E+01	1/62	N/A
PCB-1260	2/62	1.00E-01	1.36E+01	2.70E+01	2/62	N/A
Trichloroethene	4/61	1.50E-02	5.15E-02	7.30E-02	0/61	N/A
Radionuclides (pCi/g)						
Actinium-228	2/2	8.42E-01	9.66E-01	1.09E+00	N/A	N/A
Americium-241	1/16	3.71E+00	3.71E+00	3.71E+00	1/16	N/A
Bismuth-211	2/2	2.20E+00	2.21E+00	2.22E+00	N/A	N/A
Bismuth-212	1/2	8.13E-01	8.13E-01	8.13E-01	N/A	N/A
Bismuth-214	2/2	7.39E-01	8.88E-01	1.04E+00	N/A	N/A
Cesium-137	3/14	1.04E-01	6.35E-01	1.17E+00	2/14	2/14
Lead-211	2/2	2.20E+00	2.21E+00	2.22E+00	N/A	N/A
Lead-212	2/2	7.16E-01	7.25E-01	7.35E-01	N/A	N/A
Lead-214	2/2	8.32E-01	8.80E-01	9.28E-01	N/A	N/A
Neptunium-237	1/7	6.10E-02	6.10E-02	6.10E-02	0/7	0/7
Plutonium-239/240	3/9	1.05E-02	5.60E-02	9.80E-02	0/9	2/9
Potassium-40	2/2	1.01E+01	1.07E+01	1.13E+01	N/A	0/2

Table B1.27. Summary of AOC 204 Detected Chemicals (Continued)

Chemical	FOD	Minimum Detected Result	Average Detected Result	Maximum Detected Result	FOD above NAL[a]	FOD above Bkgd[a]
Protactinium-231	1/2	3.65E+01	3.65E+01	3.65E+01	N/A	N/A
Protactinium-234m	4/13	8.13E+00	1.11E+03	4.38E+03	N/A	N/A
Radium-223	1/2	2.02E-01	2.02E-01	2.02E-01	N/A	N/A
Radium-226	2/2	7.67E-01	7.70E-01	7.74E-01	N/A	0/2
Radium-228	1/2	9.62E-01	9.62E-01	9.62E-01	N/A	N/A
Radon-219	1/2	1.14E+00	1.14E+00	1.14E+00	N/A	N/A
Strontium-90	1/2	4.70E+00	4.70E+00	4.70E+00	N/A	0/2
Technetium-99	3/13	8.20E-01	4.21E+00	7.64E+00	0/13	2/13
Thallium-208	2/2	2.22E-01	2.34E-01	2.45E-01	N/A	N/A
Thorium-228	7/7	2.67E-01	5.82E-01	1.05E+00	N/A	0/7
Thorium-230	4/5	2.83E-01	7.31E-01	1.15E+00	0/5	0/5
Thorium-232	7/7	9.49E-02	4.46E-01	1.06E+00	N/A	0/7
Thorium-234	4/13	3.03E+00	8.24E+02	3.26E+03	N/A	N/A
Uranium-234	8/9	2.20E-01	9.03E+01	4.45E+02	2/9	6/9
Uranium-235	6/17	6.62E-02	9.67E+00	5.70E+01	2/17	6/17
Uranium-238[b]	9/9	1.68E-01	8.68E+02	4.39E+03	7/9	7/9

[a] NAL is the Child Resident NAL as shown in Appendix D. Background values are reported in the Risk Methods Document (DOE 2015).
[b] Uranium-238 assessed with the "USECNITRIC-CF" are compared to 0.40 pCi/g. For additional information see assessment qualifier codes.
"N/A" indicates a value is not available.

B1.7. SWMU 211-A

Data Evaluation and Screening

Historical data for this SWMU from the surface soils include metals, radionuclides, pesticides/PCBs, dioxins/furans, SVOCs, and VOCs. The data from the shallow subsurface include metals, radionuclides, pesticides/PCBs, SVOCs, and VOCs. These data were collected from the following projects:

- Remedial Action SI—Phase 1
- Remedial Action SI—Phase 2
- Soils OU PCB Group 1
- Soils OU RI/FS—Former Facility Sites
- Soils OU XRF Group 1
- Southwest Plume Remedial Design Site Investigation (SWMU 211-A)
- Southwest Plume Remedial Design Site Investigation (SWMU 211-A) Additional
- Southwest Plume Site Investigation—C-720
- Southwest Plume Site Investigation C-720—Head Space 2 Day Turn
- WAG 23 Phase 1
- WAG 27 RI Sampling

Sampling Representative of the SWMU/AOC Area?

Figures in Section 5 illustrate the location of the historical data points associated with this SWMU. The grids and EUs for SWMU 211-A were in the approved SAP, and all soil and sediment data within those grids were selected and assigned to SWMU 211-A. Additionally, grids sampled during the first Soils OU RI for SWMU 211-A were included.

Indicator chemicals were removed from the data set [i.e., alpha activity, beta activity, uranium-235 (wt.%), total uranium (reported in pCi/g with no isotopes), total organic carbon, and moisture].

In order to more comprehensively address the data set for all SWMUs, uranium-235/236 was evaluated as uranium-235.

Usability of Historical Data

Validation: Validation was performed for 10% of the Phase 1, Phase 2, and Southwest Plume projects. Rejected data were removed from the data set. The validation qualifiers that have been applied to this data are "=," "E," "J," "N," and "U."

Data Assessment: Data assessed with the code KYRHTAB-ER [indicating KYRHTAB performed an independent data evaluation (not to be confused with data verification and validation) and the data presents error problems (i.e., no counting uncertainty or zero counting uncertainty)] were removed from the data set. Other data assessment qualifiers that have been applied to the data for this SWMU are shown in Table B1.28.

Table B1.28. Assessment Qualifiers Applied to SWMU 211-A Historic Data

Assessment Qualifier	Definition
KYRHTAB-LT	KYRHTAB has performed an independent data evaluation (not to be confused with data verification and validation) and the results are less than the MDA or detection limit and should not be plotted.
USECNITRIC-CF	During the period from May 2004 to September 2009, the United USEC-PGDP laboratory used method RL-7128-NITRIC for isotopic uranium analysis by alpha spec. Method RL-7128-NITRIC utilizes only nitric acid for dissolution rather than hydrofluoric/nitric acid. The use of nitric acid only is a less aggressive dissolution for isotopic uranium analysis by alpha spec. It has been demonstrated that Method RL-7128-NITRIC can be utilized only for isotopic uranium analysis of soil with activity greater than 10 pCi/g due to low recoveries below that level. If the data from Method RL-7128-NITRIC will be screened against the background values reported in *Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the PGDP* (1997), the following adjusted background values must be used: U-234: 1.73 pCi/g surface and 1.63 pCi/g subsurface; U-235: 0.10 pCi/g; and U-238: 0.40 pCi/g [*Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant*, Appendix E (2009)]. Risk assessors may use data from this time period for comparison against other thresholds below 10 pCi/g without adjusting the values as long as the level of uncertainty and its impact on the risk assessment/evaluation are adequately discussed. No additional action is required for comparisons to thresholds above 10 pCi/g.

Units of Results

Total uranium reported in µg/g has been revised from classification as a radiological analytical type to a metal.

Detection Limits/Minimum Detectable Concentration

All of the nonradionuclide historical data that had no reported result and no detection limit have been removed from the data set.

There are 34 chemicals that are nondetects and have their SQL/MDCs greater than background or the child resident NAL. The chemical and referenced values are shown in Table B1.29.

Table B1.29. Analytes with SQL or MDC Greater that Background or Child Resident NAL for SWMU 211-A

Chemical	Unit	Maximum SQL/MDC for Nondetects	NAL*	Background*	
				Surface	Subsurface
Inorganics					
Antimony	mg/kg	3.00E+01	5.71E-01	2.10E-01	2.10E-01
Arsenic	mg/kg	1.10E+01	2.67E-01	1.20E+01	7.90E+00
Cadmium	mg/kg	1.20E+01	5.07E+00	2.10E-01	2.10E-01
Chromium	mg/kg	8.50E+01	1.64E+01	1.60E+01	4.30E+01
Cobalt	mg/kg	1.00E+01	1.40E+00	1.40E+01	1.30E+01
Copper	mg/kg	3.50E+01	1.87E+02	1.90E+01	2.50E+01
Manganese	mg/kg	8.50E+01	1.30E+01	1.50E+03	8.20E+02
Mercury	mg/kg	1.00E+01	2.21E-01	2.00E-01	1.30E-01
Nickel	mg/kg	6.50E+01	1.08E+01	2.10E+01	2.20E+01
Selenium	mg/kg	2.00E+01	2.34E+01	8.00E-01	7.00E-01
Silver	mg/kg	1.00E+01	2.71E+00	2.30E+00	2.70E+00
Thallium	mg/kg	2.00E+00	4.68E-02	2.10E-01	3.40E-01
Uranium	mg/kg	2.00E+01	1.40E+01	4.90E+00	4.60E+00
Vanadium	mg/kg	7.00E+01	2.73E+00	3.80E+01	3.70E+01
Organics					
Benz(a)anthracene	mg/kg	4.20E-01	6.19E-02		
Benzo(a)pyrene	mg/kg	4.20E-01	6.19E-03		
Benzo(b)fluoranthene	mg/kg	4.20E-01	6.19E-02		
Dibenz(a,h)anthracene	mg/kg	4.20E-01	6.19E-03		
Hexachlorobenzene	mg/kg	4.20E-01	1.26E-01		
Indeno(1,2,3-cd)pyrene	mg/kg	4.20E-01	6.19E-02		
N-Nitroso-di-n-propylamine	mg/kg	4.20E-01	2.87E-02		
PCB, Total	mg/kg	5.00E+00	7.82E-02		
PCB-1016	mg/kg	3.60E-01	1.90E-01		
PCB-1221	mg/kg	3.60E-01	6.59E-02		
PCB-1232	mg/kg	3.60E-01	6.59E-02		
PCB-1242	mg/kg	3.60E-01	7.82E-02		
PCB-1248	mg/kg	3.60E-01	7.82E-02		
PCB-1254	mg/kg	2.00E-01	5.43E-02		
PCB-1260	mg/kg	2.00E-01	7.82E-02		
Pentachlorophenol	mg/kg	2.00E+00	2.43E-01		
Trichloroethene	mg/kg	5.00E+00	4.12E-01		
Vinyl chloride	mg/kg	9.00E-01	5.92E-02		
Radionuclides					
Cesium-137	pCi/g	1.40E-01	1.16E-01	4.90E-01	2.80E-01
Technetium-99	pCi/g	2.88E+00	1.17E+02	2.50E+00	2.80E+00

*NAL is the Child Resident NAL as shown in Appendix D. Background values are reported in the Risk Methods Document (DOE 2015).

Radionuclide Counting Errors

Radionuclide historical data records that have no MDCs and no counting errors reported have been removed from the data set.

Nondetect Result Qualifiers

All usable data records that were considered nondetect were considered so due to laboratory qualification.

Assignment of Historical Data to RI Sampling Grids

The historic data has been assigned to grids as discussed. The assignments are listed in Table B1.30.

Table B1.30. Stations and Grids for Historical Data from SWMU 211-A

Station Name	Grid No.
23-3222	SOU211-001
211-PL-01	SOU211-001
SOU211-001	SOU211-001
211-A-008	SOU211-001
211-A-009	SOU211-001
211-A-001	SOU211-001
211-A-016	SOU211-001
211-A-015	SOU211-001
23-3203	SOU211-001A
23-3204	SOU211-001A
SOU211-001A	SOU211-001A
23-3205	SOU211-001B

Station Name	Grid No.
23-3206	SOU211-001B
H301	SOU211-001B
H305	SOU211-001B
SOU211-001B	SOU211-001B
SOU211-001C	SOU211-001C
211-A-014	SOU211-001C
720-101	SOU211-001N
211-A-021	SOU211-001O
211-A-022	SOU211-001O
211-A-020	SOU211-001P
720-106	SOU211-001P
23-3223	SOU211-002

Station Name	Grid No.
720-027	SOU211-002
211-PL-02	SOU211-002
SOU211-002	SOU211-002
211-A-002	SOU211-002
211-A-010	SOU211-002
211-A-017	SOU211-002
23-3201	SOU211-002A
23-3202	SOU211-002A
H306	SOU211-002A
SOU211-002A	SOU211-002A
211-A-032	SOU211-002A

Summary of Detected Chemicals

A summary of detected chemicals is presented in Table B1.31.

Table B1.31. Summary of SWMU 211-A Detected Chemicals

Chemical	FOD	Minimum Detected Result	Average Detected Result	Maximum Detected Result	FOD above NAL[a]	FOD above Bkgd[a]
Inorganics (mg/kg)						
Aluminum	9/9	3.97E+03	7.10E+03	1.11E+04	8/9	0/9
Antimony	16/28	2.30E-01	4.63E+01	9.74E+01	11/28	16/28
Arsenic	14/28	9.64E-01	5.76E+00	1.00E+01	14/28	1/28
Barium	27/28	2.88E+01	2.44E+02	5.13E+02	16/28	14/28
Beryllium	9/9	3.00E-01	5.52E-01	8.50E-01	0/9	3/9
Cadmium	5/28	2.40E-02	2.93E+00	1.42E+01	1/28	1/28
Calcium	9/9	8.00E+02	5.05E+03	3.00E+04	N/A	0/9
Chromium	22/28	8.40E+00	2.88E+01	4.84E+01	15/28	8/28
Cobalt	8/9	1.83E+00	1.13E+01	4.95E+01	8/9	1/9
Copper	10/28	2.88E+00	1.00E+01	2.15E+01	0/28	0/28
Iron	28/28	2.29E+03	1.06E+04	2.37E+04	27/28	0/28
Lead	27/28	5.33E+00	1.24E+01	2.41E+01	0/28	0/28
Magnesium	9/9	4.21E+02	1.24E+03	3.32E+03	N/A	0/9
Manganese	27/28	2.07E+01	2.12E+02	6.41E+02	27/28	0/28
Mercury	6/28	2.32E-02	2.11E-01	9.61E-01	1/28	1/28
Molybdenum	4/23	2.60E-01	6.35E-01	1.10E+00	0/23	N/A
Nickel	10/28	4.09E+00	2.98E+01	8.87E+01	6/28	3/28
Potassium	5/5	1.37E+02	2.45E+02	4.94E+02	N/A	0/5

Table B1.31. Summary of SWMU 211-A Detected Chemicals (Continued)

Chemical	FOD	Minimum Detected Result	Average Detected Result	Maximum Detected Result	FOD above NAL[a]	FOD above Bkgd[a]
Selenium	5/28	1.76E-01	1.16E+00	2.00E+00	0/28	4/28
Silver	4/28	2.60E-02	4.08E-02	5.20E-02	0/28	0/28
Sodium	7/9	4.34E+01	1.47E+02	2.84E+02	N/A	0/9
Thallium	5/9	1.00E-01	2.92E-01	6.02E-01	5/9	2/9
Uranium	11/30	2.20E+00	2.09E+01	4.85E+01	7/30	9/30
Vanadium	9/28	1.18E+01	1.97E+01	2.69E+01	9/28	0/28
Zinc	26/28	1.09E+01	3.34E+01	9.19E+01	0/28	1/28
Organics (mg/kg)						
1,1-Dichloroethene	2/69	6.10E-03	1.51E-02	2.40E-02	0/69	N/A
Benz(a)anthracene	3/11	4.50E-02	5.60E-02	6.50E-02	1/11	N/A
Benzo(a)pyrene	3/11	4.40E-02	5.77E-02	7.00E-02	3/11	N/A
Benzo(b)fluoranthene	3/11	4.30E-02	6.17E-02	7.90E-02	2/11	N/A
Benzo(ghi)perylene	1/11	4.60E-02	4.60E-02	4.60E-02	N/A	N/A
Benzo(k)fluoranthene	3/11	5.00E-02	6.63E-02	8.10E-02	0/11	N/A
Chrysene	3/11	5.90E-02	7.97E-02	9.60E-02	0/11	N/A
cis-1,2-Dichloroethene	17/65	5.40E-04	4.43E-03	2.10E-02	0/65	N/A
Dibenz(a,h)anthracene	3/11	8.90E-03	1.16E-02	1.40E-02	3/11	N/A
Fluoranthene	3/11	8.20E-02	9.73E-02	1.10E-01	0/11	N/A
Indeno(1,2,3-cd)pyrene	1/11	4.50E-02	4.50E-02	4.50E-02	0/11	N/A
Methylene chloride	3/11	3.70E-03	5.63E-03	9.20E-03	N/A	N/A
PAH, Total	3/11	6.23E-02	8.33E-02	1.04E-01	3/11	N/A
PCB, Total	8/34	1.30E-02	2.34E+00	1.00E+01	4/34	N/A
PCB-1254	4/15	1.30E-02	5.82E-01	2.10E+00	2/15	N/A
PCB-1260	4/15	2.00E-02	3.56E-01	1.20E+00	2/15	N/A
Phenanthrene	3/11	4.60E-02	6.27E-02	7.60E-02	0/11	N/A
Pyrene	3/11	7.70E-02	1.02E-01	1.30E-01	0/11	N/A
Toluene	1/11	8.30E-04	8.30E-04	8.30E-04	0/11	N/A
Trichloroethene	22/71	4.60E-04	1.21E-02	7.90E-02	0/71	N/A
Vinyl chloride	1/69	5.90E-04	5.90E-04	5.90E-04	0/69	N/A
Radionuclides (pCi/g)						
Cesium-137	1/3	1.36E-01	1.36E-01	1.36E-01	1/3	0/3
Neptunium-237	3/5	1.29E-01	1.44E-01	1.56E-01	0/5	2/5
Plutonium-239/240	2/5	1.50E-02	1.65E-02	1.80E-02	0/5	0/5
Technetium-99	3/5	2.06E+00	3.28E+00	5.58E+00	0/5	1/5
Thorium-228	3/3	8.30E-01	1.03E+00	1.42E+00	N/A	0/3
Thorium-230	3/3	8.40E-01	1.06E+00	1.46E+00	0/3	1/3
Thorium-232	3/3	7.90E-01	9.50E-01	1.18E+00	N/A	0/3
Uranium-234	3/5	2.77E+00	4.70E+00	8.06E+00	1/5	3/5
Uranium-235	3/5	2.01E-01	3.31E-01	5.80E-01	1/5	3/5
Uranium-238[b]	3/5	5.34E+00	9.03E+00	1.59E+01	3/5	3/5

[a] NAL is the Child Resident NAL as shown in Appendix D. Background values are reported in the Risk Methods Document (DOE 2015).
[b] Uranium-238 assessed with the "USECNITRIC-CF" are compared to 0.40 pCi/g. For additional information see assessment qualifier codes.
"N/A" indicates a value is not available.

B1.8. SWMU 224

Data Evaluation and Screening

Historical data for this SWMU from the surface and shallow subsurface soils include metals, PCBs, radionuclides, and SVOCs. The data are from the following projects:

- Soils OU RI/FS—Storage Areas
- Soils OU XRF Group 1
- WAG 23 Phase 1

Sampling Representative of the SWMU/AOC Area?

Figures in Section 5 illustrate the location of the historical data points associated with this SWMU. The grids and EUs for SWMU 224 were in the approved SAP, and all soil and sediment data within those grids were selected and assigned to SWMU 224.

Indicator chemicals were removed from the data set [i.e., alpha activity, beta activity, uranium-235 (wt.%), total uranium (reported in pCi/g with no isotopes), and moisture].

In order to more comprehensively address the data set for all SWMUs, uranium-235/236 was evaluated as uranium-235.

Usability of Historical Data

Validation: Validation was performed for 10% of the Soils OU RI/FS; however, there was no validation performed for this historic data set.

Data Assessment: Data assessed with the code R-C (result questionable, credibility at issue) have been removed from the data set. No other data assessment qualifiers were applied.

Units of Results

Total uranium reported in µg/g has been revised from classification as a radiological analytical type to a metal.

Detection Limits/Minimum Detectable Concentration

All of the nonradionuclide historical data that had no reported result and no detection limit have been removed from the data set.

There are 18 chemicals that are nondetects and have their SQL/MDCs greater than background or the child resident NAL. The chemical and referenced values are shown in Table B1.32.

Table B1.32. Analytes with SQL or MDC Greater that Background or Child Resident NAL for SWMU 224

Chemical	Unit	Maximum SQL/MDC for Nondetects	NAL*	Background*	
				Surface	Subsurface
Inorganics					
Arsenic	mg/kg	1.10E+01	2.67E-01	1.20E+01	7.90E+00

Table B1.32. Analytes with SQL or MDC Greater that Background or Child Resident NAL for SWMU 224 (Continued)

Chemical	Unit	Maximum SQL/MDC for Nondetects	NAL*	Background*	
				Surface	Subsurface
Cadmium	mg/kg	1.20E+01	5.07E+00	2.10E-01	2.10E-01
Chromium	mg/kg	8.50E+01	1.64E+01	1.60E+01	4.30E+01
Copper	mg/kg	3.50E+01	1.87E+02	1.90E+01	2.50E+01
Mercury	mg/kg	1.00E+01	2.21E-01	2.00E-01	1.30E-01
Nickel	mg/kg	6.50E+01	1.08E+01	2.10E+01	2.20E+01
Selenium	mg/kg	2.00E+01	2.34E+01	8.00E-01	7.00E-01
Silver	mg/kg	1.00E+01	2.71E+00	2.30E+00	2.70E+00
Uranium	mg/kg	2.00E+01	1.40E+01	4.90E+00	4.60E+00
Vanadium	mg/kg	7.00E+01	2.73E+00	3.80E+01	3.70E+01
Organics					
Benz(a)anthracene	mg/kg	3.50E-01	6.19E-02		
Benzo(b)fluoranthene	mg/kg	3.50E-01	6.19E-02		
Dibenz(a,h)anthracene	mg/kg	7.10E-03	6.19E-03		
Hexachlorobenzene	mg/kg	3.50E-01	1.26E-01		
Indeno(1,2,3-cd)pyrene	mg/kg	3.50E-01	6.19E-02		
PCB, Total	mg/kg	3.20E-01	7.82E-02		
Pentachlorophenol	mg/kg	1.70E+00	2.43E-01		
Radionuclides					
Cesium-137	pCi/g	1.20E-01	1.16E-01	4.90E-01	2.80E-01

*NAL is the Child Resident NAL as shown in Appendix D. Background values are reported in the Risk Methods Document (DOE 2015).

Radionuclide Counting Errors

There are no radionuclide historical data records that have both no MDCs and no counting errors reported.

Nondetect Result Qualifiers

All usable data records that were considered nondetect were considered so due to laboratory qualification.

Assignment of Historical Data to RI Sampling Grids

The historic data has been assigned to grids as discussed. The assignments are listed in Table B1.33.

Table B1.33. Stations and Grids for Historical Data from SWMU 224

Station Name	Grid No.
23-5605	SOU224-001
SOU224-001M	SOU224-001
SOU224-RAD	SOU224-001

Summary of Detected Chemicals

A summary of detected chemicals is presented in Table B1.34.

Table B1.34. Summary of SWMU 224 Detected Chemicals

Chemical	FOD	Minimum Detected Result	Average Detected Result	Maximum Detected Result	FOD above NAL*	FOD above Bkgd*
Inorganics (mg/kg)						
Aluminum	2/2	4.91E+03	6.47E+03	8.03E+03	2/2	0/2
Antimony	6/6	1.90E-01	5.38E+01	1.08E+02	4/6	5/6
Arsenic	5/6	4.80E+00	7.57E+00	1.00E+01	5/6	3/6
Barium	6/6	8.76E+01	3.72E+02	5.69E+02	4/6	4/6
Beryllium	2/2	3.30E-01	4.80E-01	6.30E-01	0/2	0/2
Cadmium	2/6	5.70E-02	2.19E-01	3.80E-01	0/6	1/6
Calcium	2/2	2.56E+04	7.53E+04	1.25E+05	N/A	1/2
Chromium	4/6	1.21E+01	3.69E+01	6.50E+01	3/6	2/6
Cobalt	2/2	7.10E+00	7.35E+00	7.60E+00	2/2	0/2
Copper	2/6	9.40E+00	9.50E+00	9.60E+00	0/6	0/6
Iron	6/6	1.18E+04	1.58E+04	2.10E+04	6/6	0/6
Lead	6/6	6.58E+00	1.09E+01	1.70E+01	0/6	0/6
Magnesium	2/2	1.62E+03	1.96E+03	2.30E+03	N/A	0/2
Manganese	6/6	1.77E+02	3.99E+02	6.26E+02	6/6	0/6
Mercury	2/6	7.40E-03	8.70E-03	1.00E-02	0/6	0/6
Molybdenum	2/6	5.10E-01	6.05E-01	7.00E-01	0/6	N/A
Nickel	3/6	6.70E+00	2.53E+01	5.84E+01	1/6	1/6
Selenium	2/6	5.50E-01	7.65E-01	9.80E-01	0/6	1/6
Silver	2/6	3.40E-02	9.20E-02	1.50E-01	0/6	0/6
Sodium	2/2	1.11E+02	1.11E+02	1.11E+02	N/A	0/2
Thallium	2/2	1.20E-01	1.45E-01	1.70E-01	2/2	0/2
Uranium	6/9	1.80E+00	1.74E+01	4.15E+01	3/9	4/9
Vanadium	2/6	1.64E+01	2.35E+01	3.05E+01	2/6	0/6
Zinc	6/6	3.12E+01	5.47E+01	1.09E+02	0/6	2/6
Organics (mg/kg)						
Acenaphthene	1/2	5.30E-02	5.30E-02	5.30E-02	0/2	N/A
Anthracene	1/2	1.10E-01	1.10E-01	1.10E-01	0/2	N/A
Benz(a)anthracene	1/2	4.40E-01	4.40E-01	4.40E-01	1/2	N/A
Benzo(a)pyrene	2/2	1.10E-02	2.11E-01	4.10E-01	2/2	N/A
Benzo(b)fluoranthene	1/2	3.40E-01	3.40E-01	3.40E-01	1/2	N/A
Benzo(ghi)perylene	1/2	2.80E-01	2.80E-01	2.80E-01	N/A	N/A
Benzo(k)fluoranthene	1/2	4.00E-01	4.00E-01	4.00E-01	0/2	N/A
Benzoic acid	1/2	4.50E-01	4.50E-01	4.50E-01	N/A	N/A
Chrysene	1/2	4.70E-01	4.70E-01	4.70E-01	0/2	N/A
Dibenz(a,h)anthracene	1/2	6.90E-02	6.90E-02	6.90E-02	1/2	N/A
Fluoranthene	1/2	8.90E-01	8.90E-01	8.90E-01	0/2	N/A
Fluorene	1/2	5.10E-02	5.10E-02	5.10E-02	0/2	N/A
Indeno(1,2,3-cd)pyrene	1/2	3.40E-01	3.40E-01	3.40E-01	1/2	N/A
Naphthalene	1/2	5.90E-02	5.90E-02	5.90E-02	0/2	N/A
PAH, Total	2/2	1.10E-02	3.03E-01	5.95E-01	2/2	N/A
PCB, Total	1/3	4.90E-02	4.90E-02	4.90E-02	0/3	N/A
PCB-1260	1/3	4.90E-02	4.90E-02	4.90E-02	0/3	N/A
Phenanthrene	1/2	5.00E-01	5.00E-01	5.00E-01	0/2	N/A
Pyrene	1/2	7.80E-01	7.80E-01	7.80E-01	0/2	N/A
Radionuclides (pCi/g)						
Cesium-137	1/3	3.70E-01	3.70E-01	3.70E-01	1/3	0/3
Plutonium-238	1/3	2.60E-02	2.60E-02	2.60E-02	0/3	0/3
Plutonium-239/240	1/3	3.40E-02	3.40E-02	3.40E-02	0/3	1/3
Technetium-99	1/3	4.80E-01	4.80E-01	4.80E-01	0/3	0/3
Thorium-228	3/3	5.05E-01	8.18E-01	1.02E+00	N/A	0/3

Table B1.34. Summary of SWMU 224 Detected Chemicals (Continued)

Chemical	FOD	Minimum Detected Result	Average Detected Result	Maximum Detected Result	FOD above NAL*	FOD above Bkgd*
Thorium-230	3/3	6.63E-01	9.54E-01	1.15E+00	0/3	0/3
Thorium-232	3/3	3.77E-01	7.96E-01	1.04E+00	N/A	0/3
Uranium-234	3/3	8.60E-01	1.51E+00	2.35E+00	0/3	2/3
Uranium-235	3/3	4.80E-02	1.35E-01	2.50E-01	0/3	2/3
Uranium-238	3/3	1.03E+00	6.89E+00	1.39E+01	2/3	2/3

*NAL is the Child Resident NAL as shown in Appendix D. Background values are reported in the Risk Methods Document (DOE 2015).
"N/A" indicates a value is not available.

B1.9. SWMU 225

Data Evaluation and Screening

Historical data for this SWMU from the surface soils include metals, PCBs, radionuclides, and SVOCs. Shallow subsurface soils include historical data for metals and PCBs. The data are from the following projects:

- Soils OU PCB Group 1
- Soils OU RI/FS—Storage Areas
- Soils OU XRF Group 1

Sampling Representative of the SWMU/AOC Area?

Figures in Section 5 illustrate the location of the historical data points associated with this SWMU. The grids and EUs for SWMU 225 were in the approved SAP, and all soil and sediment data within those grids were selected and assigned to SWMU 255. Additionally, grids sampled during the first Soils OU RI for SWMU 255 were included.

Indicator chemicals were removed from the data set [i.e., alpha activity, beta activity, uranium-235 (wt.%), and moisture].

In order to more comprehensively address the data set for all SWMUs, uranium-235/236 was evaluated as uranium-235.

Usability of Historical Data

Validation: Validation was performed for 10% of the Soils OU RI/FS; however, there was no validation performed for this historic data set.

Data Assessment: No assessment qualifiers have been applied to this data set.

Units of Results

Total uranium reported in µg/g has been revised from classification as a radiological analytical type to a metal.

Detection Limits/Minimum Detectable Concentration

All of the nonradionuclide historical data that had no reported result and no detection limit have been removed from the data set.

There are 15 chemicals that are nondetects and have their SQL/MDCs greater than background or the child resident NAL. The chemical and referenced values are shown in Table B1.35.

Table B1.35. Analytes with SQL or MDC Greater that Background or Child Resident NAL for SWMU 225

Chemical	Unit	Maximum SQL/MDC for Nondetects	NAL*	Background*	
				Surface	Subsurface
Inorganics					
Antimony	mg/kg	3.00E+01	5.71E-01	2.10E-01	2.10E-01
Arsenic	mg/kg	1.10E+01	2.67E-01	1.20E+01	7.90E+00
Cadmium	mg/kg	1.20E+01	5.07E+00	2.10E-01	2.10E-01
Chromium	mg/kg	8.50E+01	1.64E+01	1.60E+01	4.30E+01
Copper	mg/kg	3.50E+01	1.87E+02	1.90E+01	2.50E+01
Mercury	mg/kg	1.00E+01	2.21E-01	2.00E-01	1.30E-01
Nickel	mg/kg	6.50E+01	1.08E+01	2.10E+01	2.20E+01
Selenium	mg/kg	2.00E+01	2.34E+01	8.00E-01	7.00E-01
Silver	mg/kg	1.00E+01	2.71E+00	2.30E+00	2.70E+00
Uranium	mg/kg	2.00E+01	1.40E+01	4.90E+00	4.60E+00
Vanadium	mg/kg	7.00E+01	2.73E+00	3.80E+01	3.70E+01
Organics					
Hexachlorobenzene	mg/kg	3.70E-01	1.26E-01		
Indeno(1,2,3-cd)pyrene	mg/kg	3.70E-01	6.19E-02		
PCB, Total	mg/kg	5.00E+00	7.82E-02		
Pentachlorophenol	mg/kg	1.80E+00	2.43E-01		

*NAL is the Child Resident NAL as shown in Appendix D. Background values are reported in the Risk Methods Document (DOE 2015).

Radionuclide Counting Errors

There are no radionuclide historical data records that have both no MDCs and no counting errors reported.

Nondetect Result Qualifiers

All usable data records that were considered nondetect were considered so due to laboratory qualification.

Assignment of Historical Data to RI Sampling Grids

The historic data has been assigned to grids as discussed. The assignments are listed in Table B1.36.

Table B1.36. Stations and Grids for Historical Data from SWMU 225

Station Name	Grid No.
225-PL-01	SOU225-001
225-PL-02	SOU225-001
SOU225-001	SOU225-001

Summary of Detected Chemicals

A summary of detected chemicals is presented in Table B1. 37.

Table B1.37. Summary of SWMU 225 Detected Chemicals

Chemical	FOD	Minimum Detected Result	Average Detected Result	Maximum Detected Result	FOD above NAL*	FOD above Bkgd*
Inorganics (mg/kg)						
Aluminum	1/1	8.48E+03	8.48E+03	8.48E+03	1/1	0/1
Antimony	3/4	5.40E-01	3.29E+01	5.41E+01	2/4	3/4
Arsenic	3/4	6.93E+00	7.54E+00	8.10E+00	3/4	0/4
Barium	4/4	8.90E+01	2.83E+02	4.01E+02	3/4	3/4
Beryllium	1/1	4.80E-01	4.80E-01	4.80E-01	0/1	0/1
Cadmium	1/4	1.20E-01	1.20E-01	1.20E-01	0/4	0/4
Calcium	1/1	4.05E+03	4.05E+03	4.05E+03	N/A	0/1
Chromium	1/4	2.55E+01	2.55E+01	2.55E+01	1/4	1/4
Cobalt	1/1	7.30E+00	7.30E+00	7.30E+00	1/1	0/1
Copper	1/4	1.23E+01	1.23E+01	1.23E+01	0/4	0/4
Iron	4/4	1.01E+04	1.37E+04	1.57E+04	4/4	0/4
Lead	4/4	1.18E+01	1.41E+01	1.69E+01	0/4	0/4
Magnesium	1/1	1.56E+03	1.56E+03	1.56E+03	N/A	0/1
Manganese	4/4	2.38E+02	5.09E+02	8.55E+02	4/4	1/4
Mercury	1/4	3.10E-02	3.10E-02	3.10E-02	0/4	0/4
Molybdenum	1/4	8.50E-01	8.50E-01	8.50E-01	0/4	N/A
Nickel	1/4	1.21E+01	1.21E+01	1.21E+01	1/4	0/4
Selenium	1/4	1.50E+00	1.50E+00	1.50E+00	0/4	1/4
Silver	1/4	3.30E-02	3.30E-02	3.30E-02	0/4	0/4
Sodium	1/1	3.65E+01	3.65E+01	3.65E+01	N/A	0/1
Thallium	1/1	2.80E-01	2.80E-01	2.80E-01	1/1	1/1
Uranium	2/5	5.60E+00	5.85E+00	6.10E+00	0/5	2/5
Vanadium	1/4	2.69E+01	2.69E+01	2.69E+01	1/4	0/4
Zinc	4/4	2.91E+01	4.25E+01	4.86E+01	0/4	0/4
Organics (mg/kg)						
Benz(a)anthracene	1/1	6.40E-02	6.40E-02	6.40E-02	1/1	N/A
Benzo(a)pyrene	1/1	5.20E-02	5.20E-02	5.20E-02	1/1	N/A
Benzo(b)fluoranthene	1/1	6.80E-02	6.80E-02	6.80E-02	1/1	N/A
Benzo(k)fluoranthene	1/1	5.80E-02	5.80E-02	5.80E-02	0/1	N/A
Chrysene	1/1	7.10E-02	7.10E-02	7.10E-02	0/1	N/A
Dibenz(a,h)anthracene	1/1	1.20E-02	1.20E-02	1.20E-02	1/1	N/A
Fluoranthene	1/1	1.50E-01	1.50E-01	1.50E-01	0/1	N/A
PAH, Total	1/1	7.79E-02	7.79E-02	7.79E-02	1/1	N/A
Phenanthrene	1/1	7.50E-02	7.50E-02	7.50E-02	0/1	N/A
Pyrene	1/1	1.00E-01	1.00E-01	1.00E-01	0/1	N/A
Radionuclides (pCi/g)						
Cesium-137	1/1	4.17E-01	4.17E-01	4.17E-01	1/1	0/1
Plutonium-238	1/1	2.60E-02	2.60E-02	2.60E-02	0/1	0/1
Plutonium-239/240	1/1	1.90E-02	1.90E-02	1.90E-02	0/1	0/1
Thorium-228	1/1	9.00E-01	9.00E-01	9.00E-01	N/A	0/1
Thorium-230	1/1	1.03E+00	1.03E+00	1.03E+00	0/1	0/1
Thorium-232	1/1	9.20E-01	9.20E-01	9.20E-01	N/A	0/1
Uranium-234	1/1	1.13E+00	1.13E+00	1.13E+00	0/1	0/1

Table B1.37. Summary of SWMU 225 Detected Chemicals (Continued)

Chemical	FOD	Minimum Detected Result	Average Detected Result	Maximum Detected Result	FOD above NAL*	FOD above Bkgd*
Uranium-235	1/1	5.50E-02	5.50E-02	5.50E-02	0/1	0/1
Uranium-238	1/1	2.04E+00	2.04E+00	2.04E+00	1/1	1/1

*NAL is the Child Resident NAL as shown in Appendix D. Background values are reported in the Risk Methods Document (DOE 2015).
"N/A" indicates a value is not available.

B1.10. AOC 565

Data Evaluation and Screening

Historical data for this AOC include only radionuclide data in the surface soils. These data were collected from the following project:

- Soils OU RI/FS—Former Facility Sites

Sampling Representative of the SWMU/AOC Area?

Figures in Section 5 illustrate the location of the historical data points associated with this AOC. Only one sample is representative of the AOC 565 area. One indicator chemical was removed from the data set [i.e., alpha activity, beta activity, and uranium-235 (wt.%)].

In order to more comprehensively address the data set for all SWMUs, uranium-235/236 was evaluated as uranium-235.

Usability of Historical Data

Validation: Validation was performed for 10% of the Soils OU RI/FS; however, there was no validation performed for this historic data set.

Data Assessment: No assessment qualifiers have been applied to this data set.

Units of Results

Total uranium reported in µg/g has been revised from classification as a radiological analytical type to a metal.

Detection Limits/Minimum Detectable Concentration

All of the nonradionuclide historical data that had no reported result and no detection limit have been removed from the data set.

There are no chemicals that are nondetects and have their SQL/MDCs greater than background or the child resident NAL.

Radionuclide Counting Errors

There are no radionuclide historical data records that have both no MDCs and no counting errors reported.

Nondetect Result Qualifiers

All usable data records that were considered nondetect were considered so due to laboratory qualification.

Assignment of Historical Data to RI Sampling Grids

The historic data has been assigned to grids as discussed. The assignments are listed in Table B1.38.

Table B1.38. Stations and Grids for Historical Data from AOC 565

Station Name	Grid No.
SOU565-RAD	SOU565-001

Summary of Detected Chemicals

A summary of detected chemicals is presented in Table B1.39.

Table B1.39. Summary of AOC 565 Detected Chemicals

Chemical	FOD	Minimum Detected Result	Average Detected Result	Maximum Detected Result	FOD above NAL*	FOD above Bkgd*
Inorganics (mg/kg)						
Uranium	1/1	3.31E+00	3.31E+00	3.31E+00	0/1	0/1
Radionuclides (pCi/g)						
Cesium-137	1/1	4.00E-01	4.00E-01	4.00E-01	1/1	0/1
Plutonium-238	1/1	1.70E-02	1.70E-02	1.70E-02	0/1	0/1
Thorium-228	1/1	7.70E-01	7.70E-01	7.70E-01	N/A	0/1
Thorium-230	1/1	8.80E-01	8.80E-01	8.80E-01	0/1	0/1
Thorium-232	1/1	7.40E-01	7.40E-01	7.40E-01	N/A	0/1
Uranium-234	1/1	9.30E-01	9.30E-01	9.30E-01	0/1	0/1
Uranium-235	1/1	4.70E-02	4.70E-02	4.70E-02	0/1	0/1
Uranium-238	1/1	1.11E+00	1.11E+00	1.11E+00	0/1	0/1

*NAL is the Child Resident NAL as shown in Appendix D. Background values are reported in the Risk Methods Document (DOE 2015).
"N/A" indicates a value is not available.

REFERENCES

DOE 2008. *Surface Water Operable Unit (On-Site) Site Investigation and Baseline Risk Assessment Report at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-0001&D2/R1, U.S. Department of Energy, Paducah, KY.

DOE 2015. DRAFT *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-0107&D2/R5, U.S. Department of Energy, Paducah, KY.

ATTACHMENT B2

XRF STATISTICS

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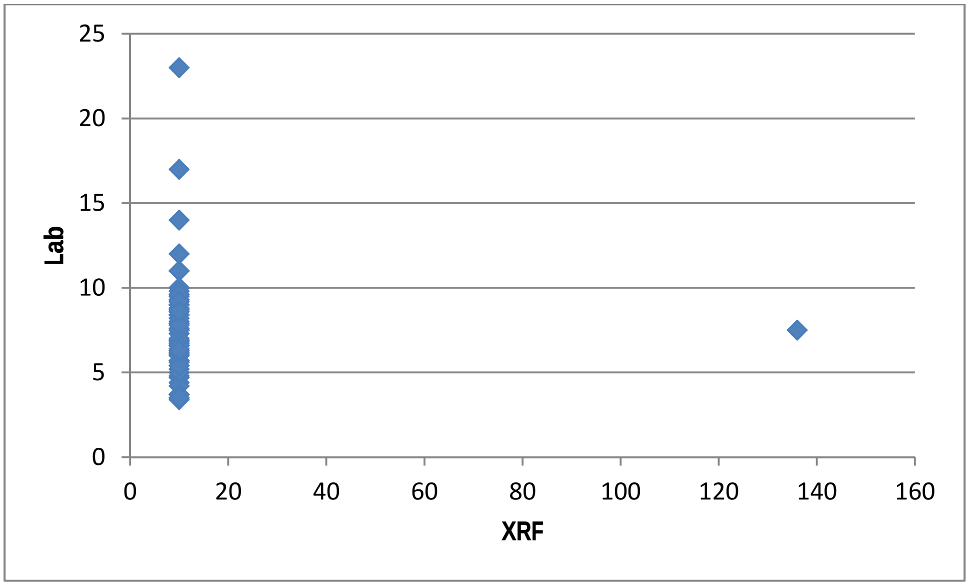
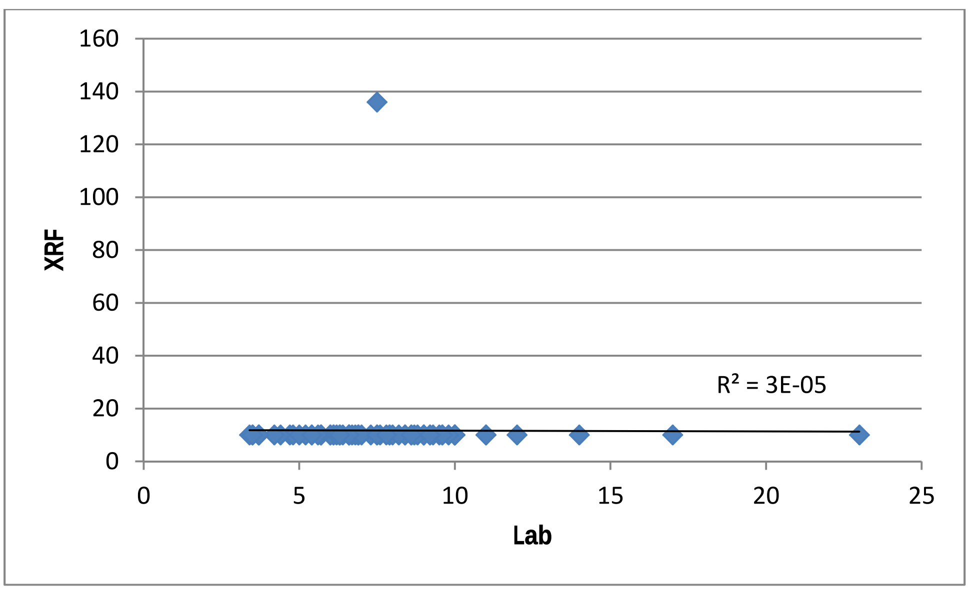
The XRF data correlated better with the laboratory data for many constituents, but not all constituents (Johnson 2008). This discrepancy provides an uncertainty that is documented in this DQA and will be addressed in the Soils OU Baseline Risk Assessment(s) sections of the RI to support remedial decision making. This attachment provides additional statistics for the XRF data to support Section B.3.1.1, Initial Comparison.

Arsenic

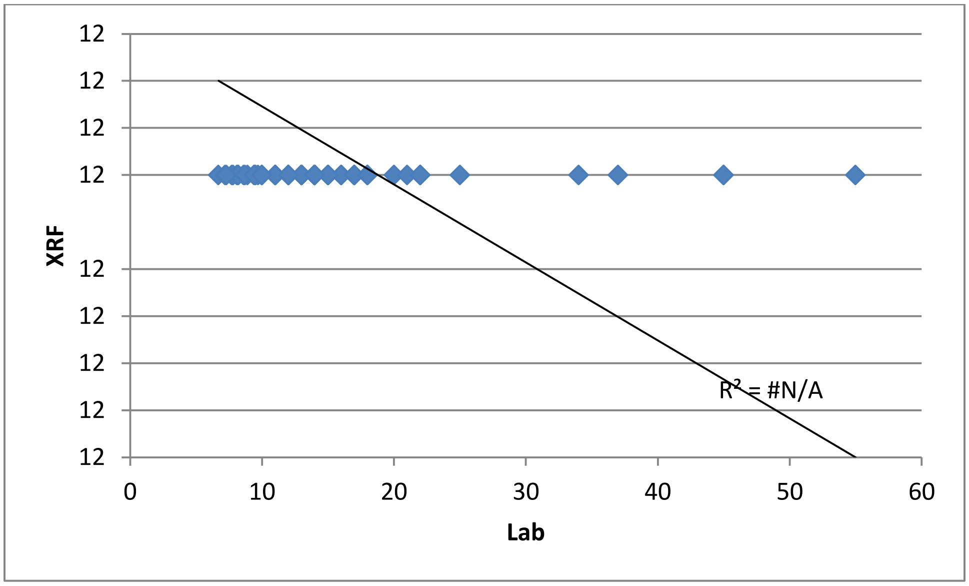
Pearson's Correlation Coefficient	-0.00548	Bkg	12/7.9
		IW NAL	1.41

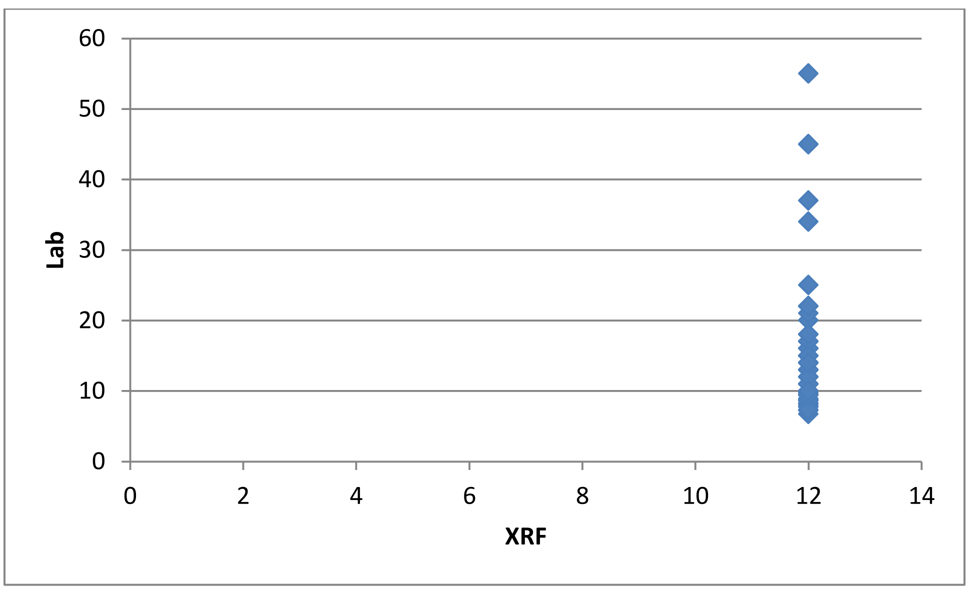




Chromium

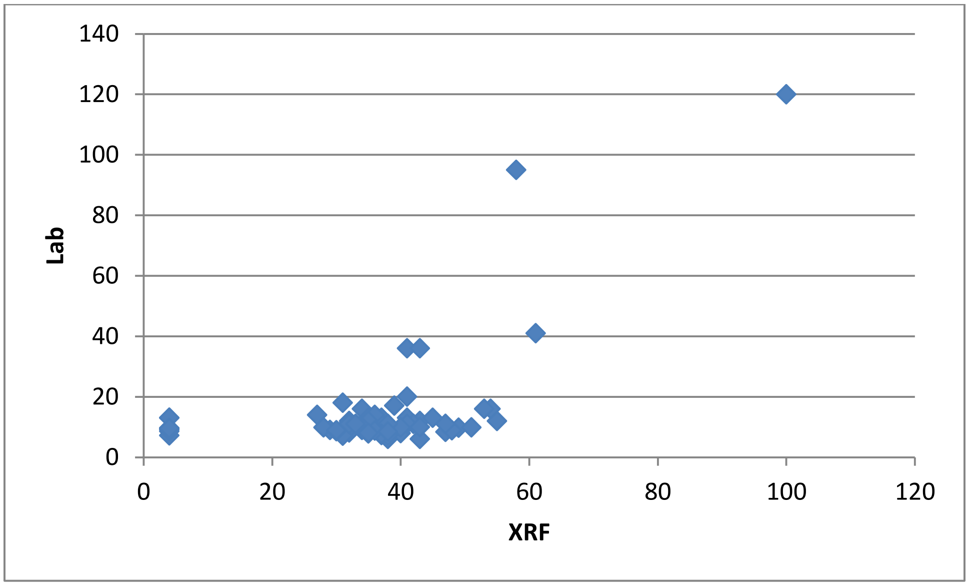
Pearson's Correlation Coefficient	N/A	Bkg	16/43
		NAL	198

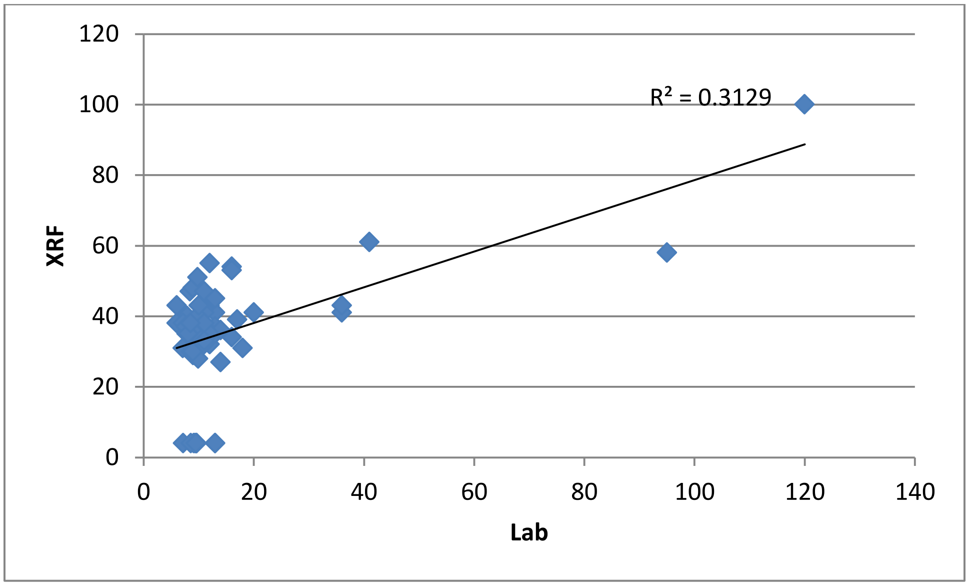




Copper

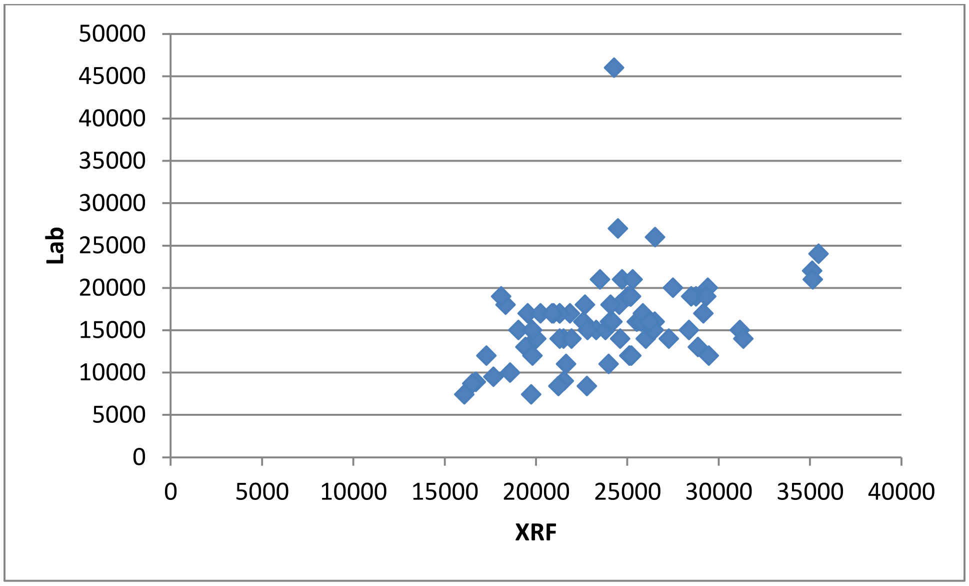
Pearson's Correlation Coefficient	0.559343638	Bkg	19/25
		NAL	9,340

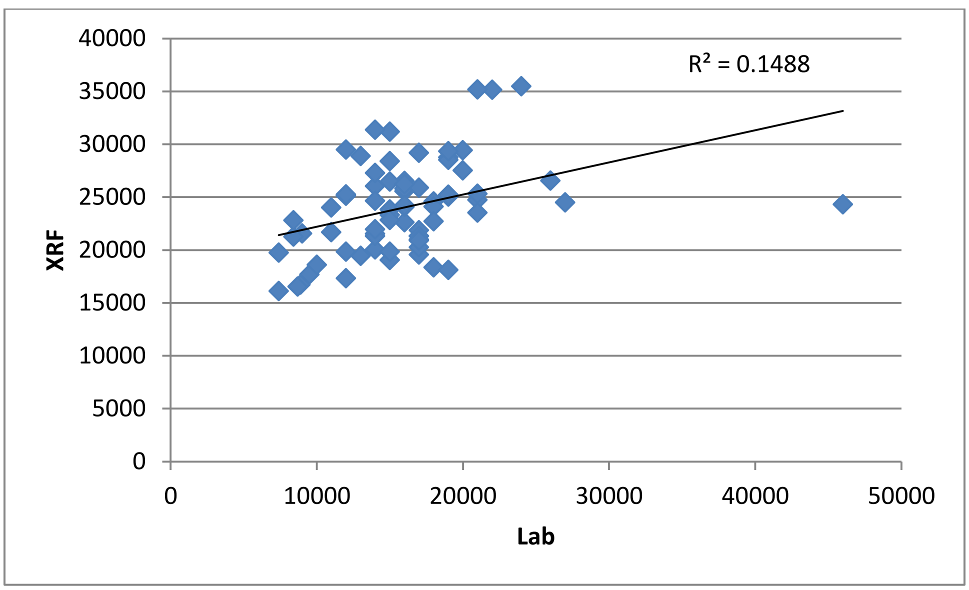




Iron

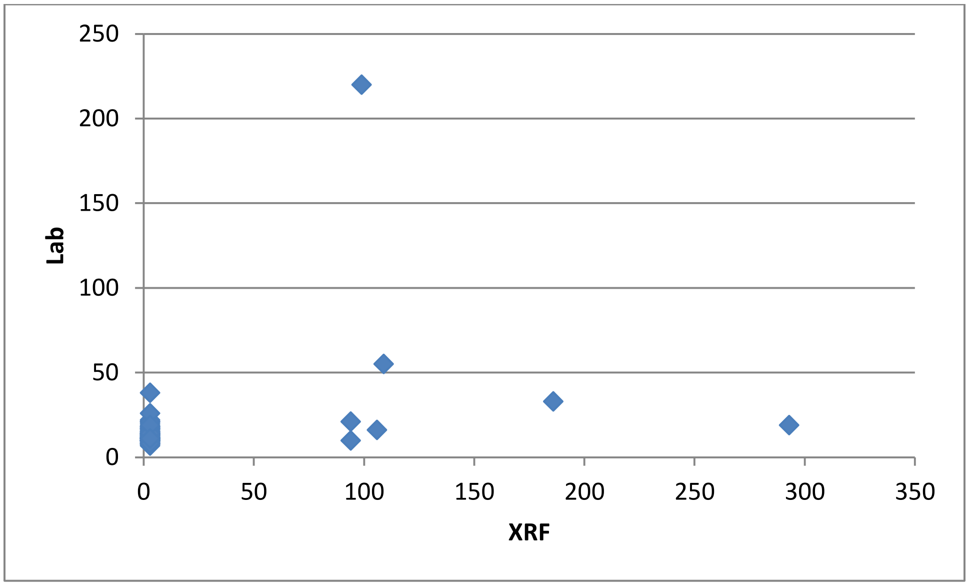
Pearson's Correlation Coefficient	0.385780447	Bkg	28,000/28,000
		NAL	100,000

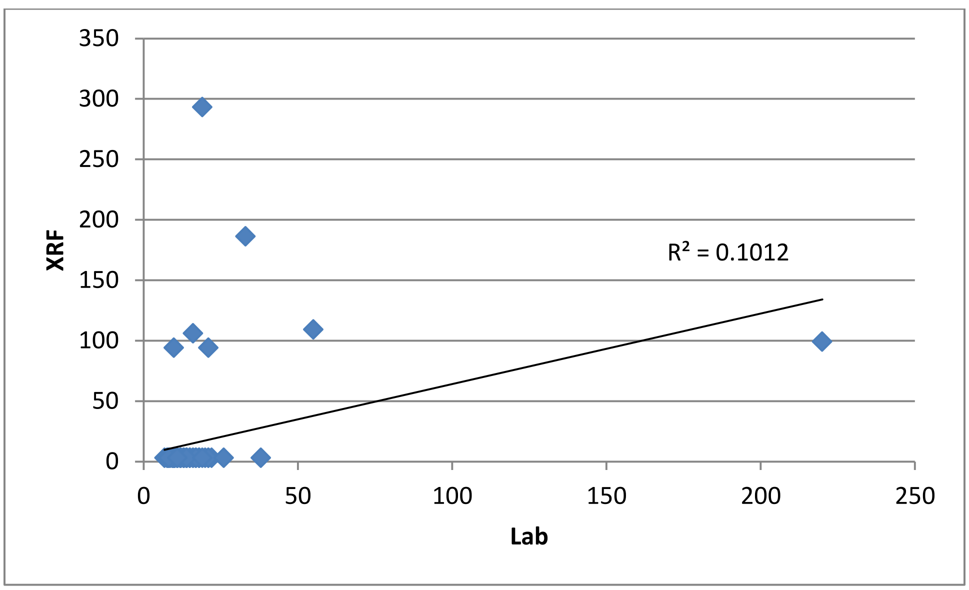




Lead

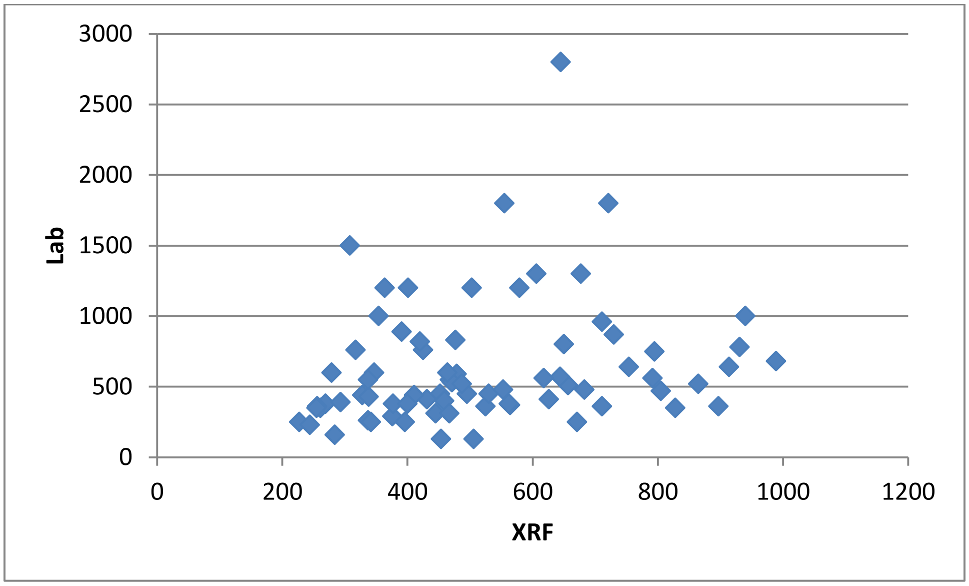
Pearson's Correlation Coefficient	0.318168131	Bkg	36/23
		NAL	800

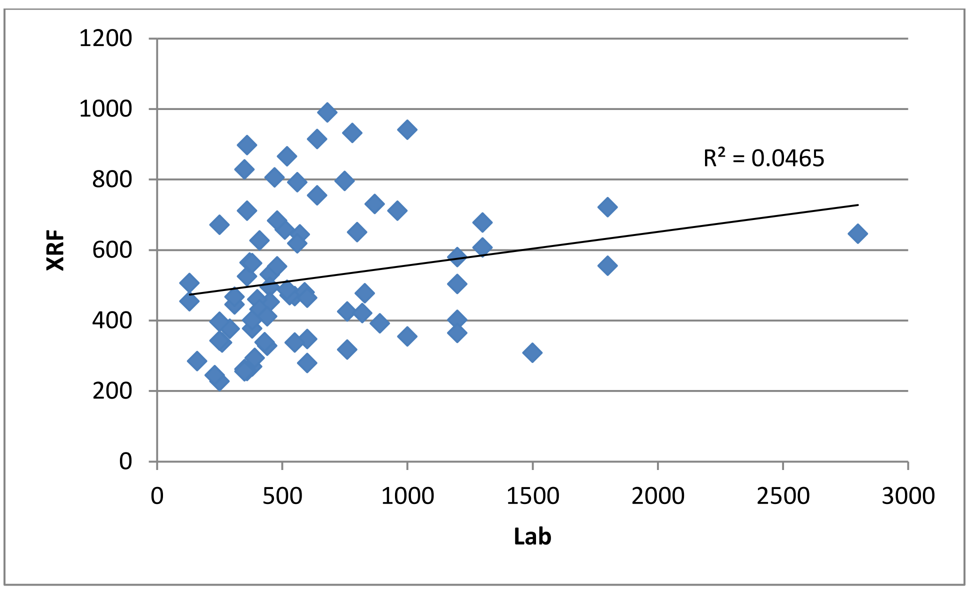




Manganese

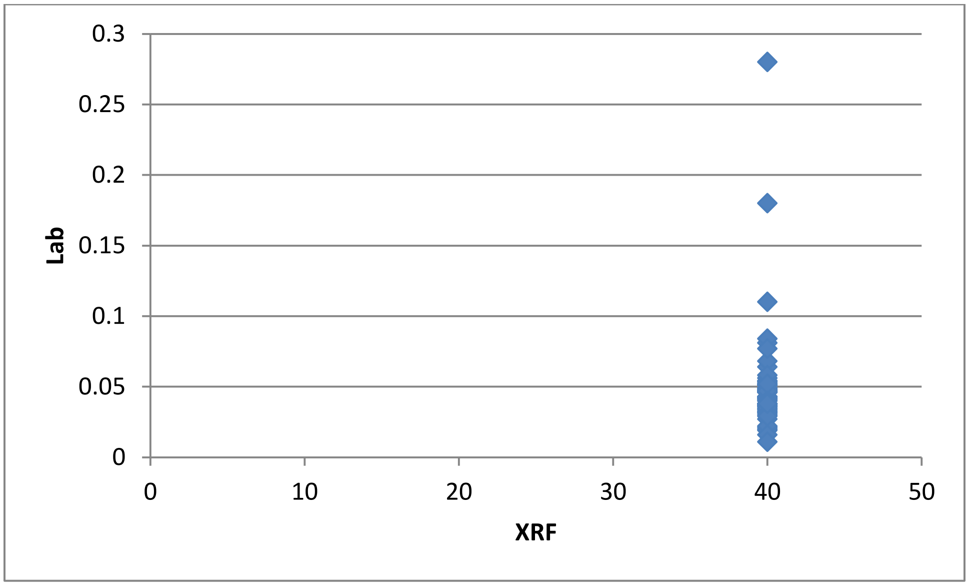
Pearson's Correlation Coefficient	0.215566162	Bkg	1,500/820
		NAL	4,720

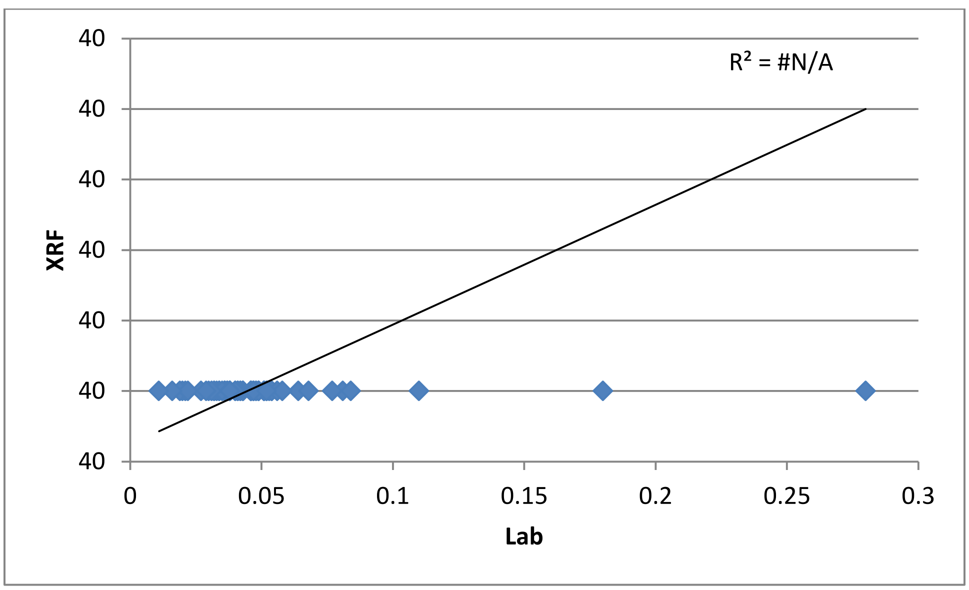




Mercury

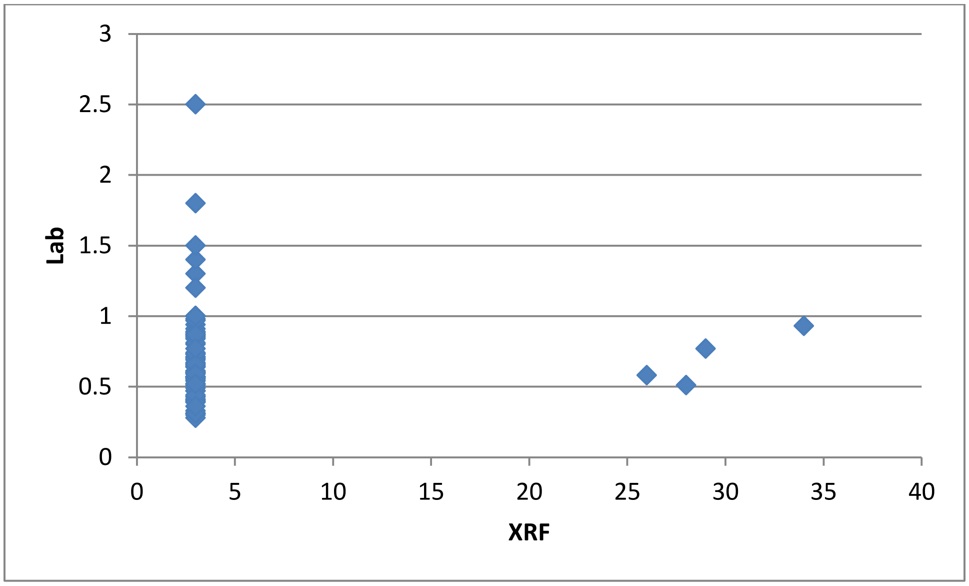
Pearson's Correlation Coefficient	N/A	Bkg	0.2/0.13
		NAL	70.1

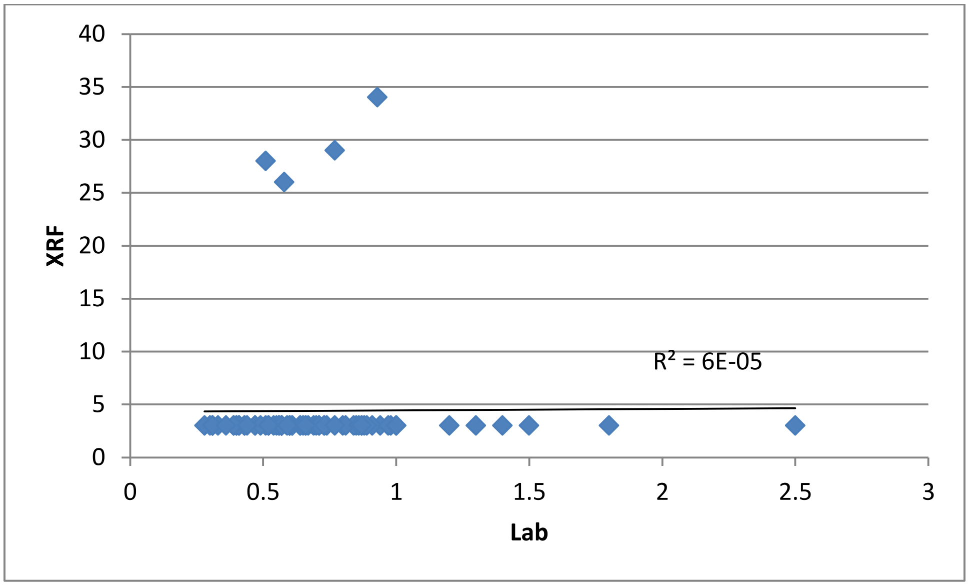




Molybdenum

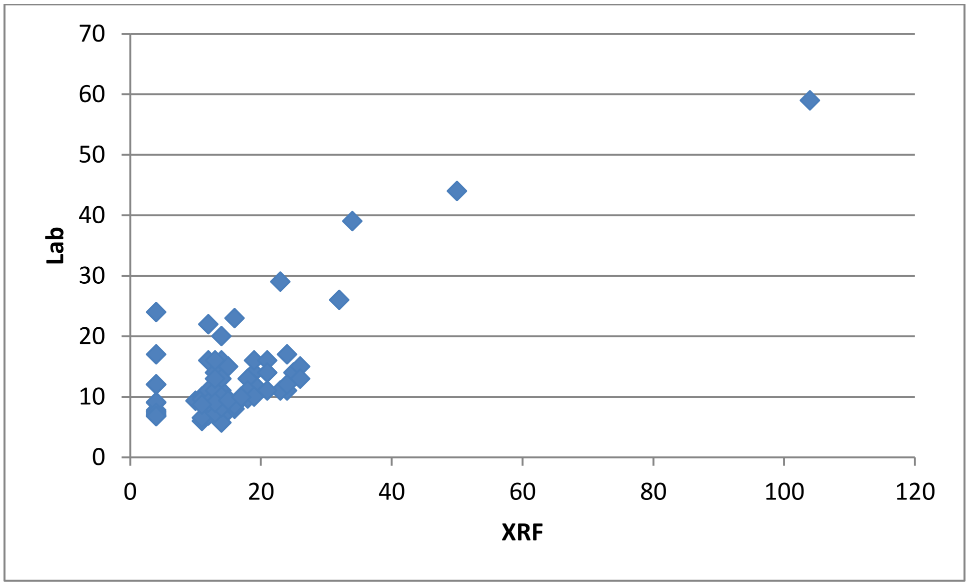
Pearson's Correlation Coefficient	0.007962127	Bkg	Not available
		NAL	1,170

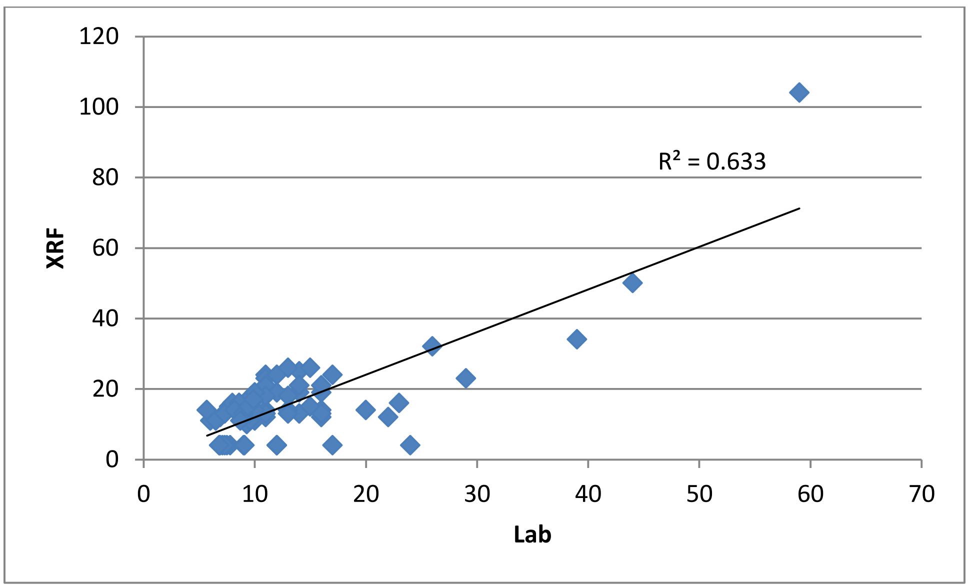




Nickel

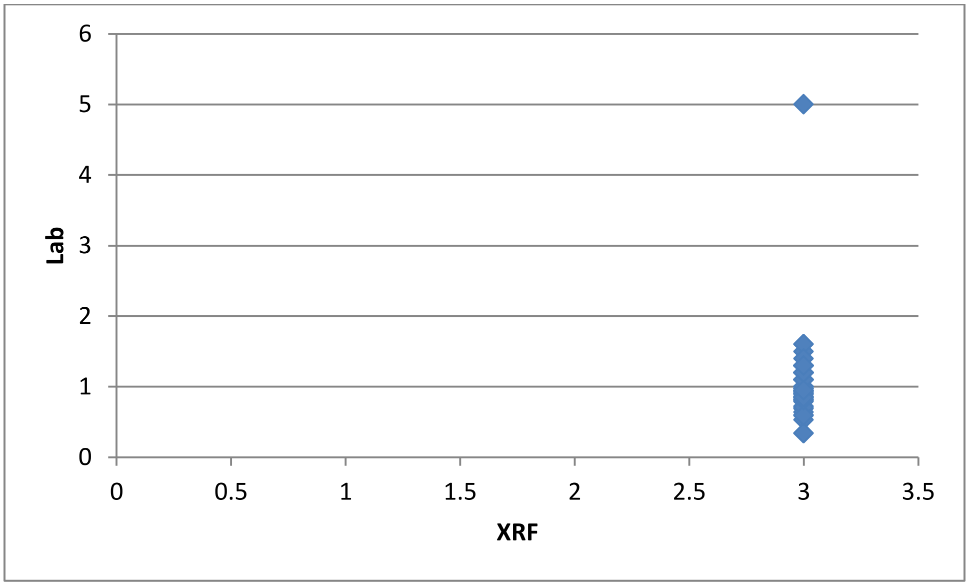
Pearson's Correlation Coefficient	0.795627142	Bkg	21/22
		NAL	4,300

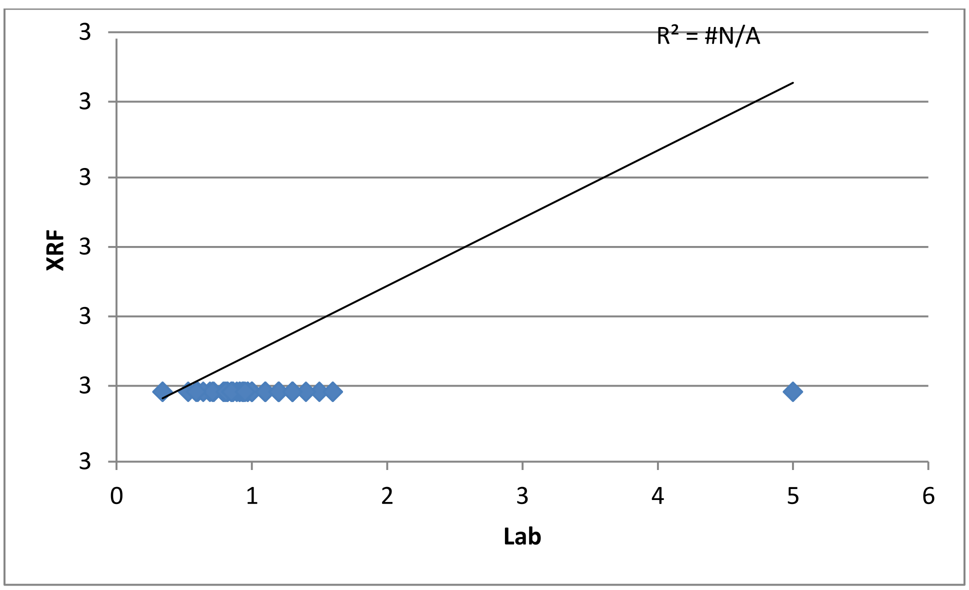




Selenium

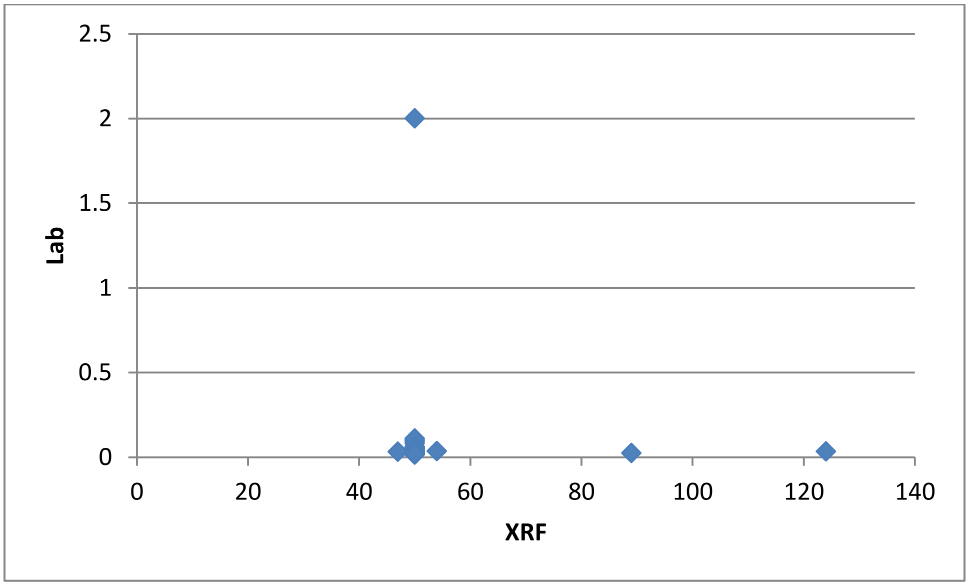
Pearson's Correlation Coefficient	N/A	Bkg	0.8/0.7
		NAL	1,170

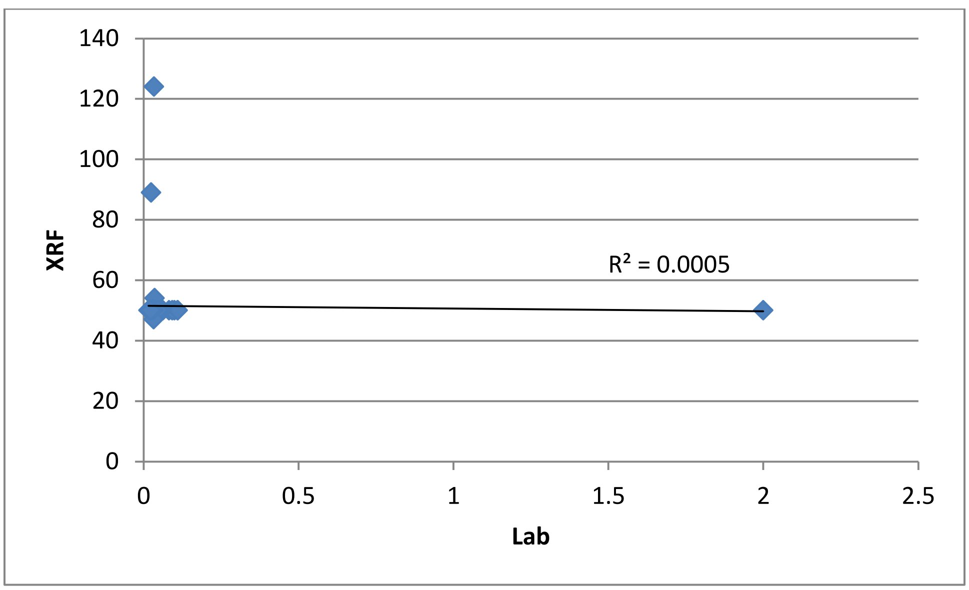




Silver

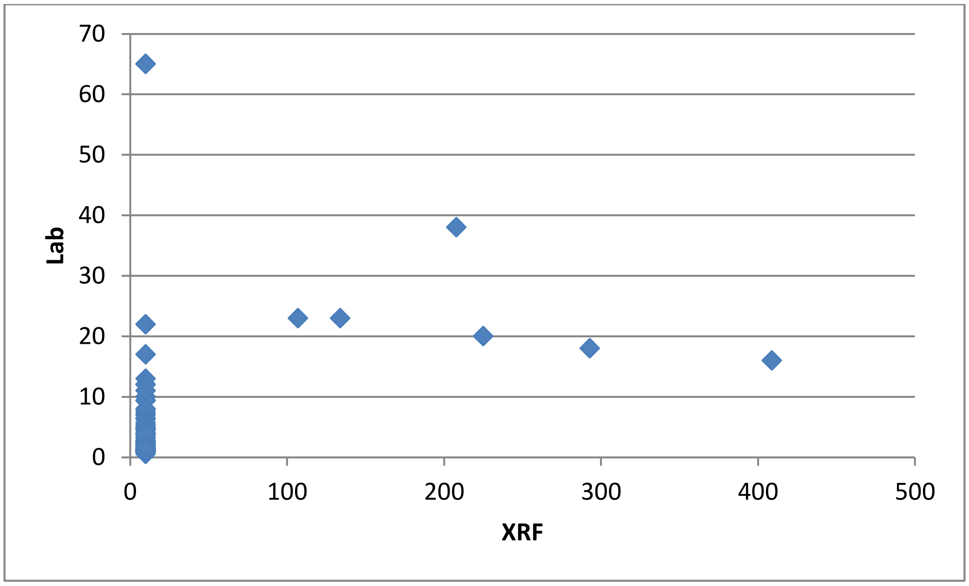
Pearson's Correlation Coefficient	-0.02202	Bkg	2.3/2.7
		NAL	1,170

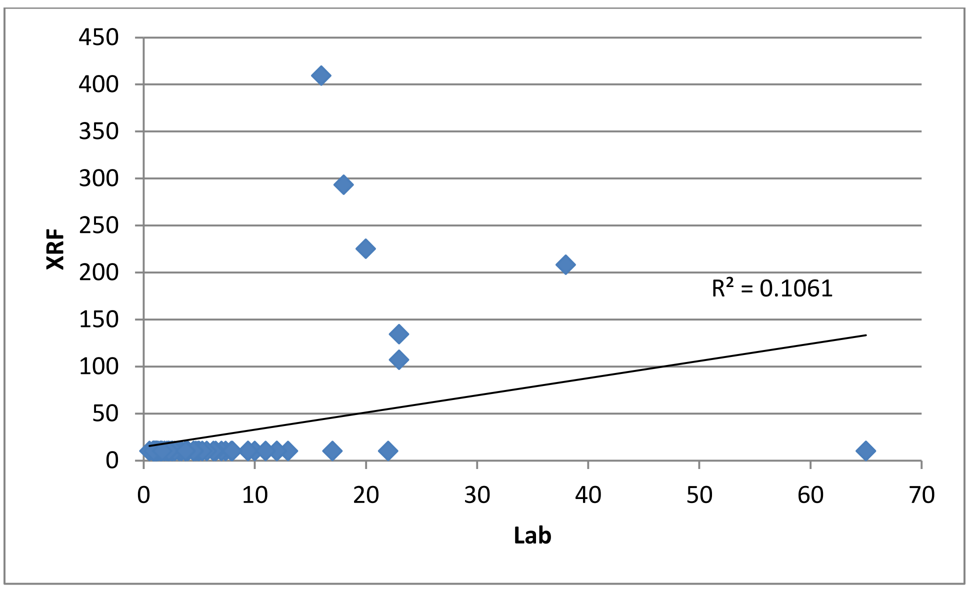




Uranium

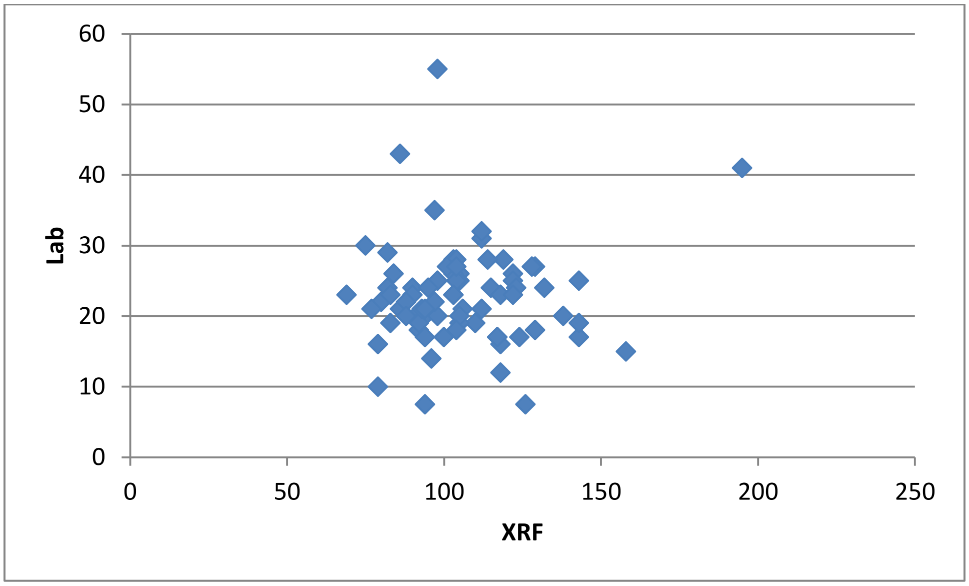
Pearson's Correlation Coefficient	0.325653353	Bkg	4.9/4.6
		NAL	681

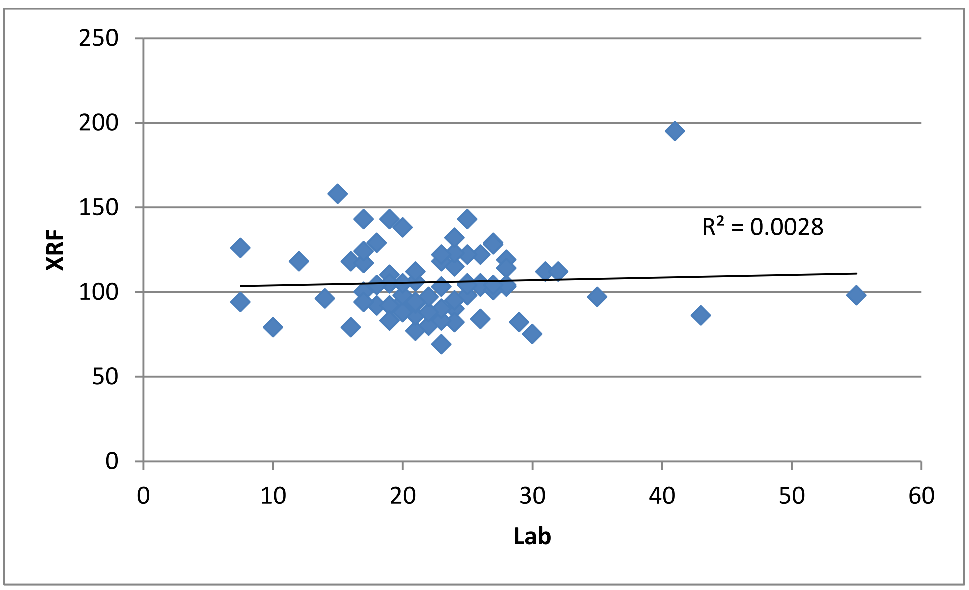




Vanadium

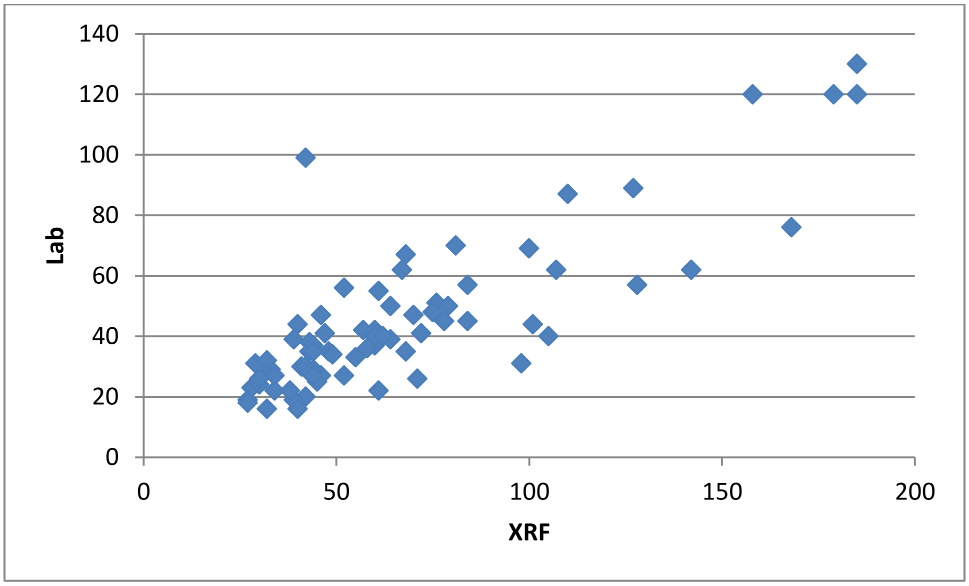
Pearson's Correlation Coefficient	0.052866355	Bkg	38/37
		NAL	1,150

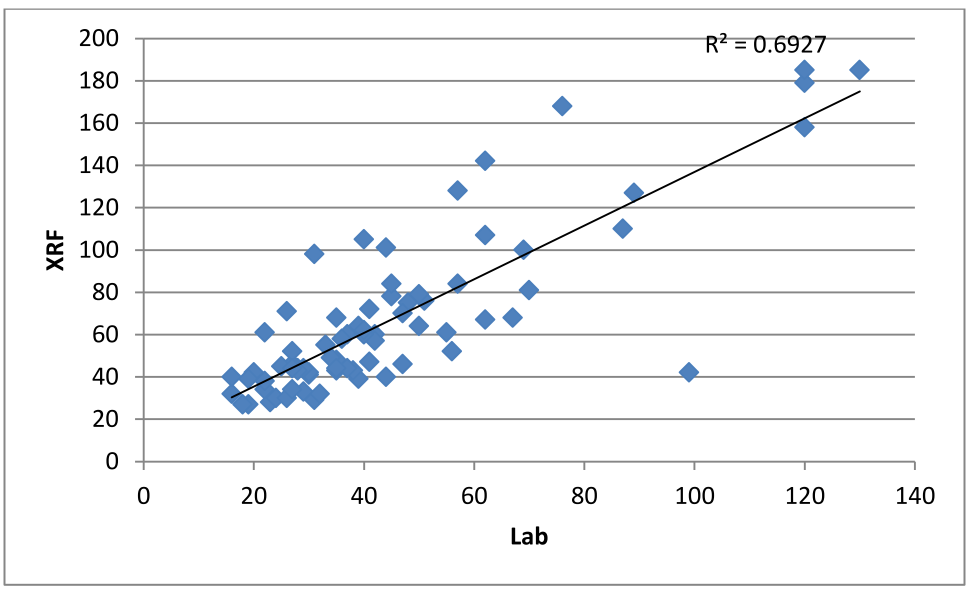




Zinc

Pearson's Correlation Coefficient	0.832274896	Bkg	65/60
		NAL	70,100





ATTACHMENT B3

GRAPHICAL COMPARISON

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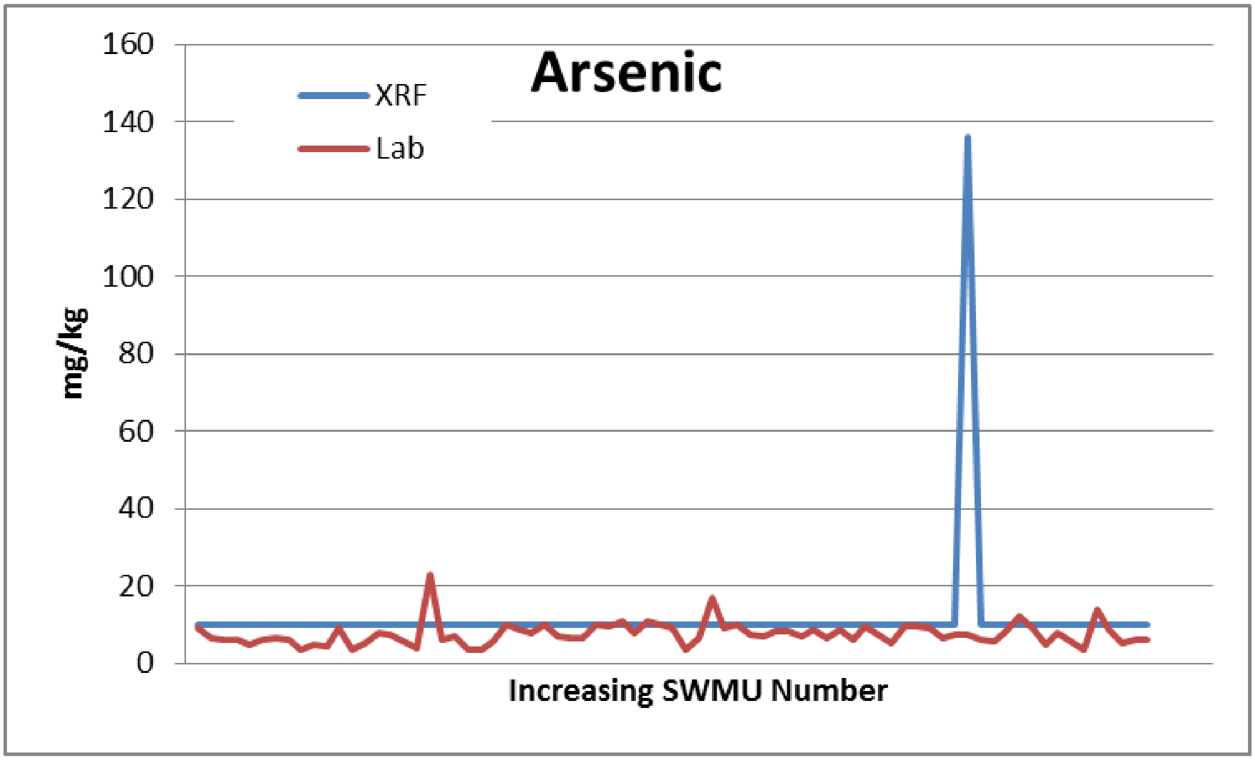
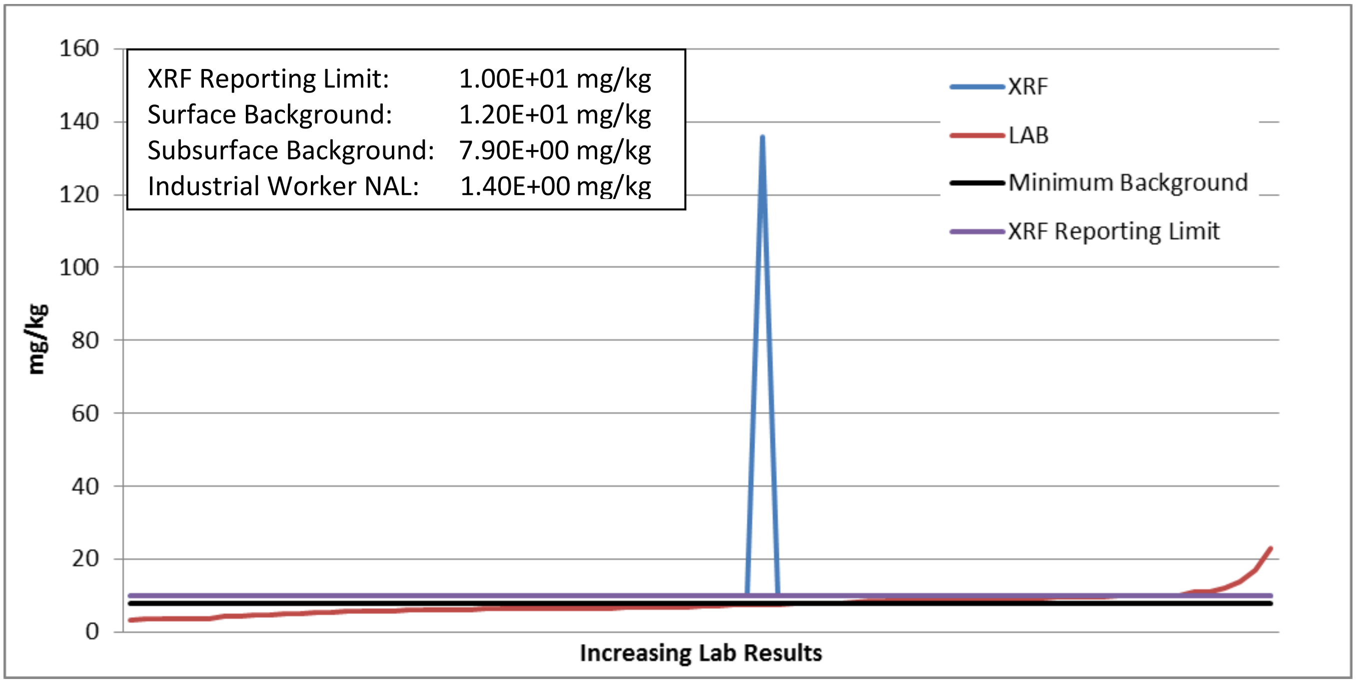
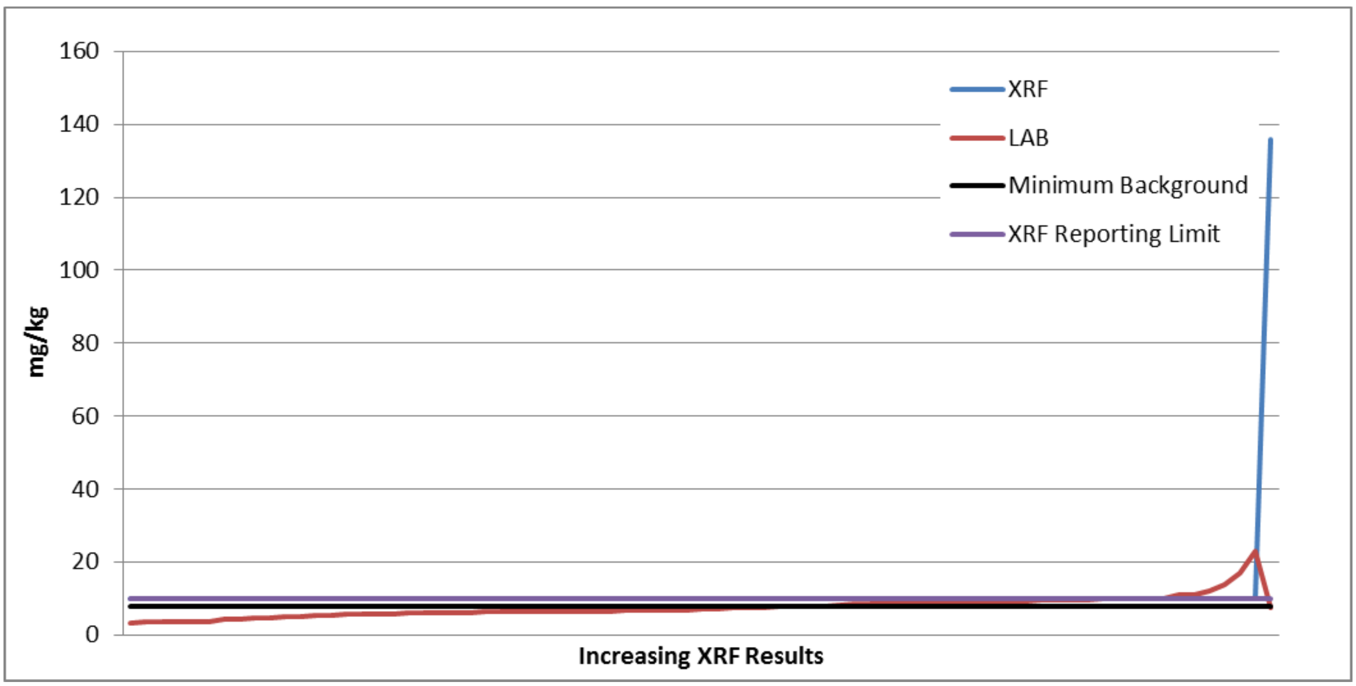
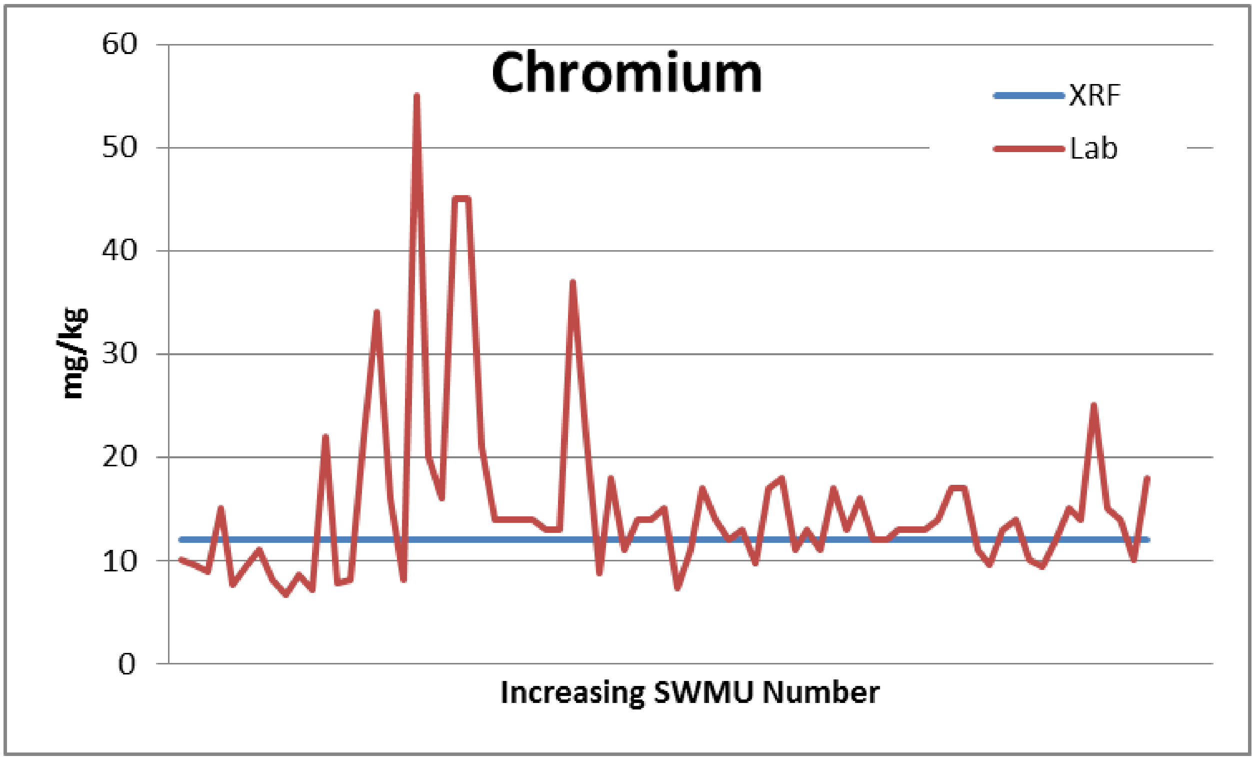

Arsenic
XRF
Lab
mg/kg
160
140
120
100
80
60
40
20
0
Increasing SWMU Number

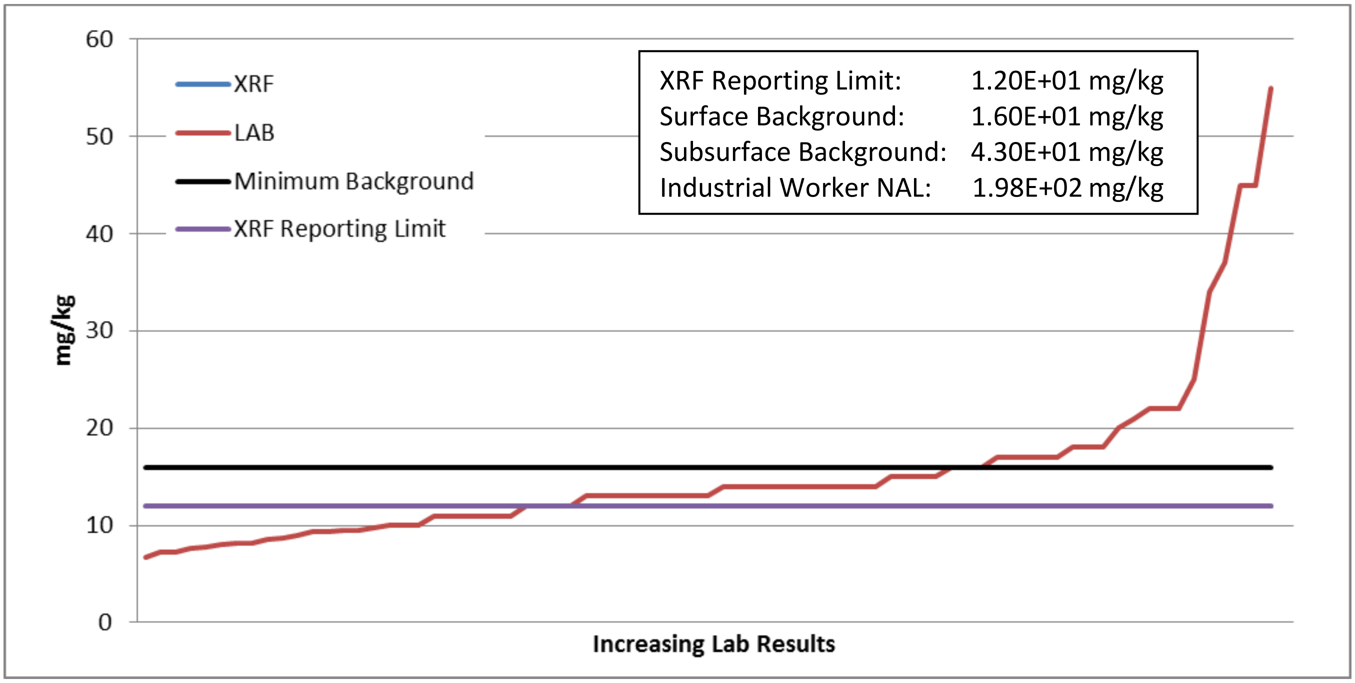
The Pearson correlation coefficient for arsenic is -5.48E-03.

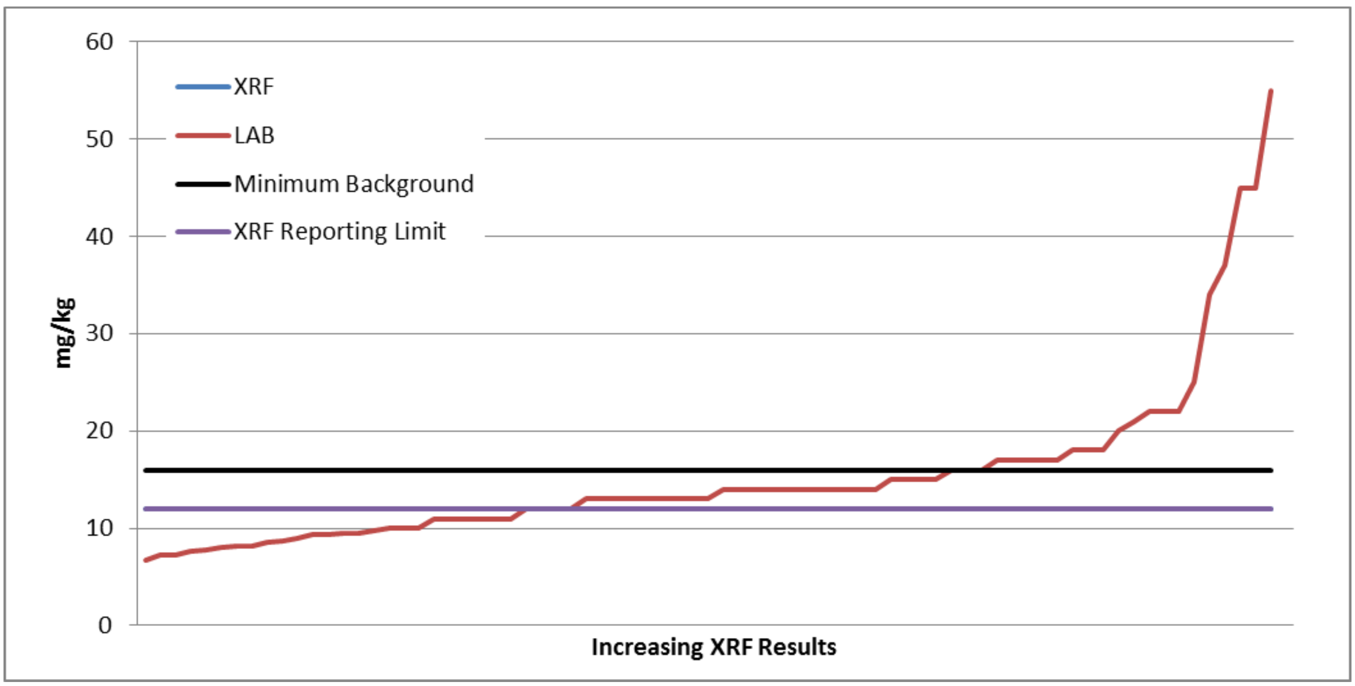


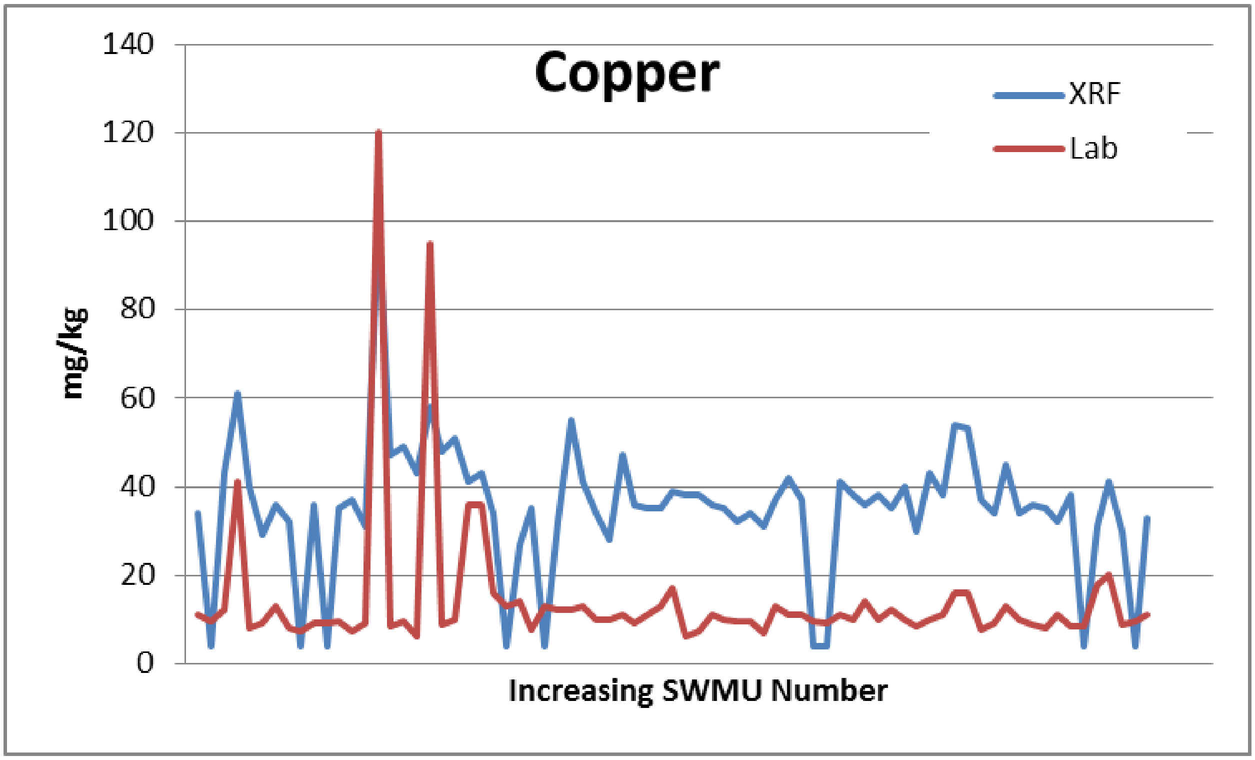



Chromium
mg/kg
60
50
40
30
20
10
0
XRF
Lab
Increasing SWMU Number

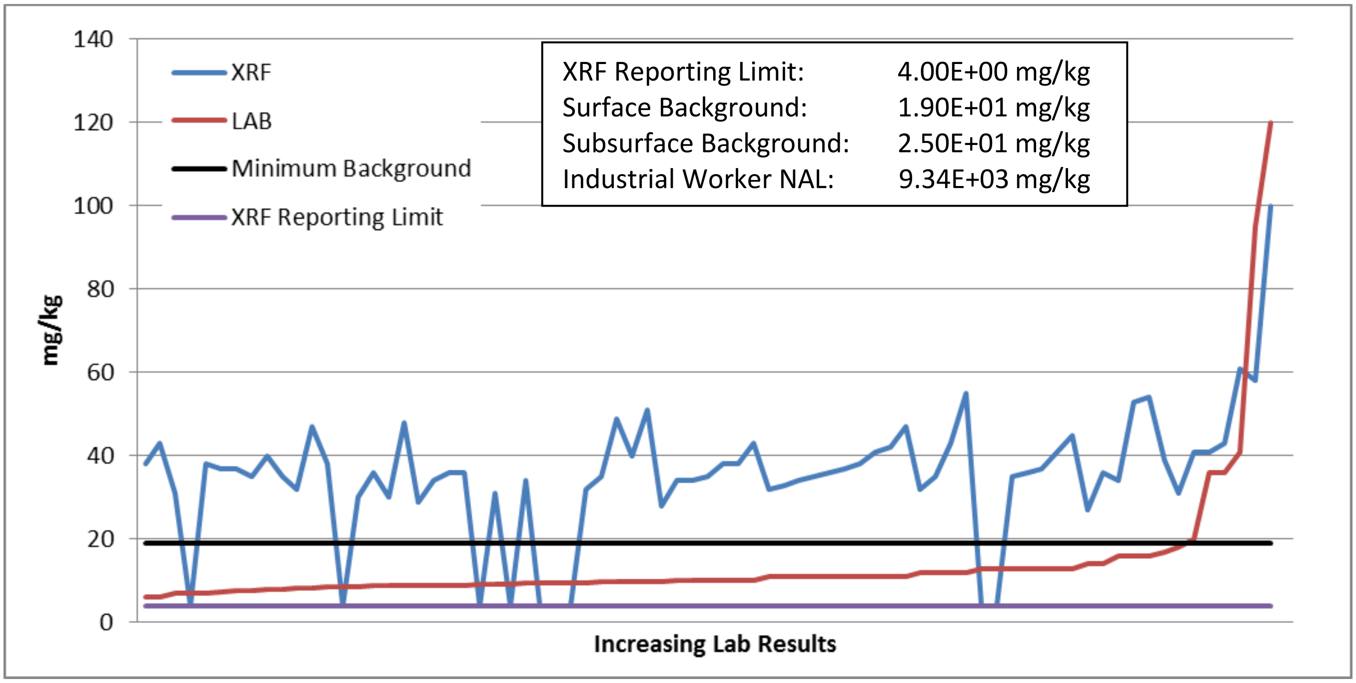
The Pearson correlation coefficient for chromium is not defined.

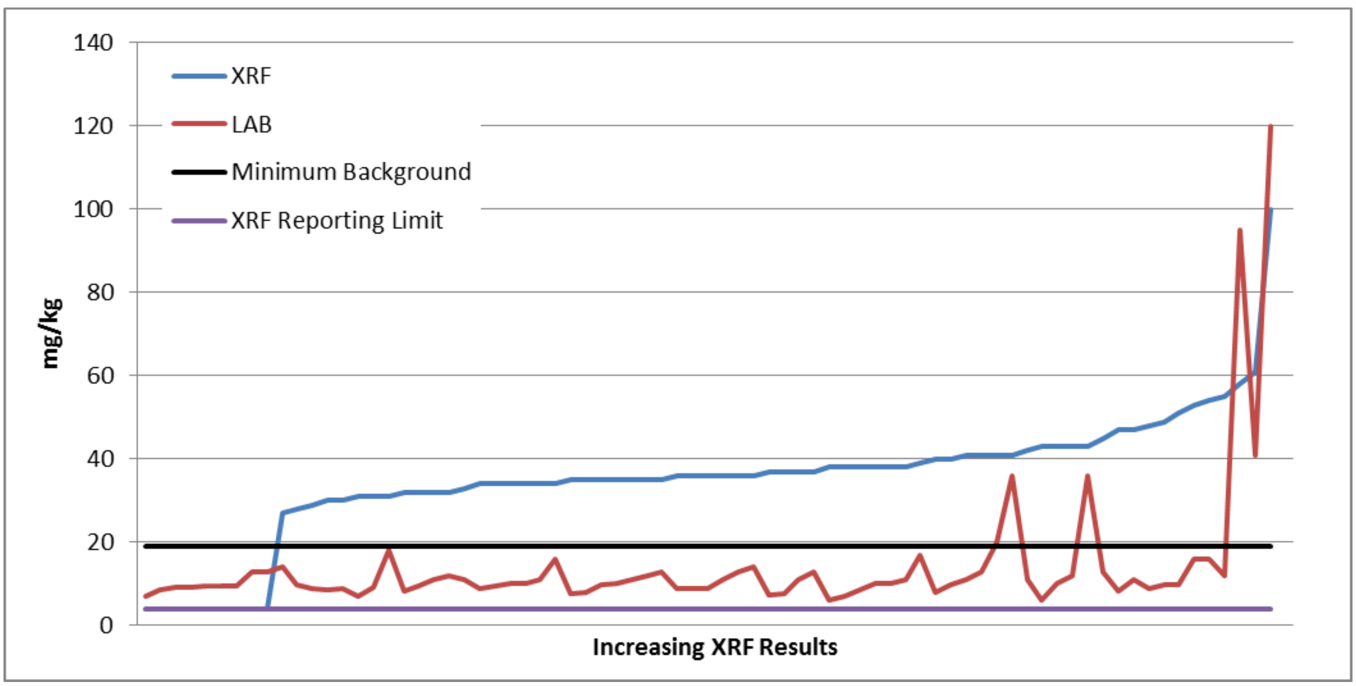


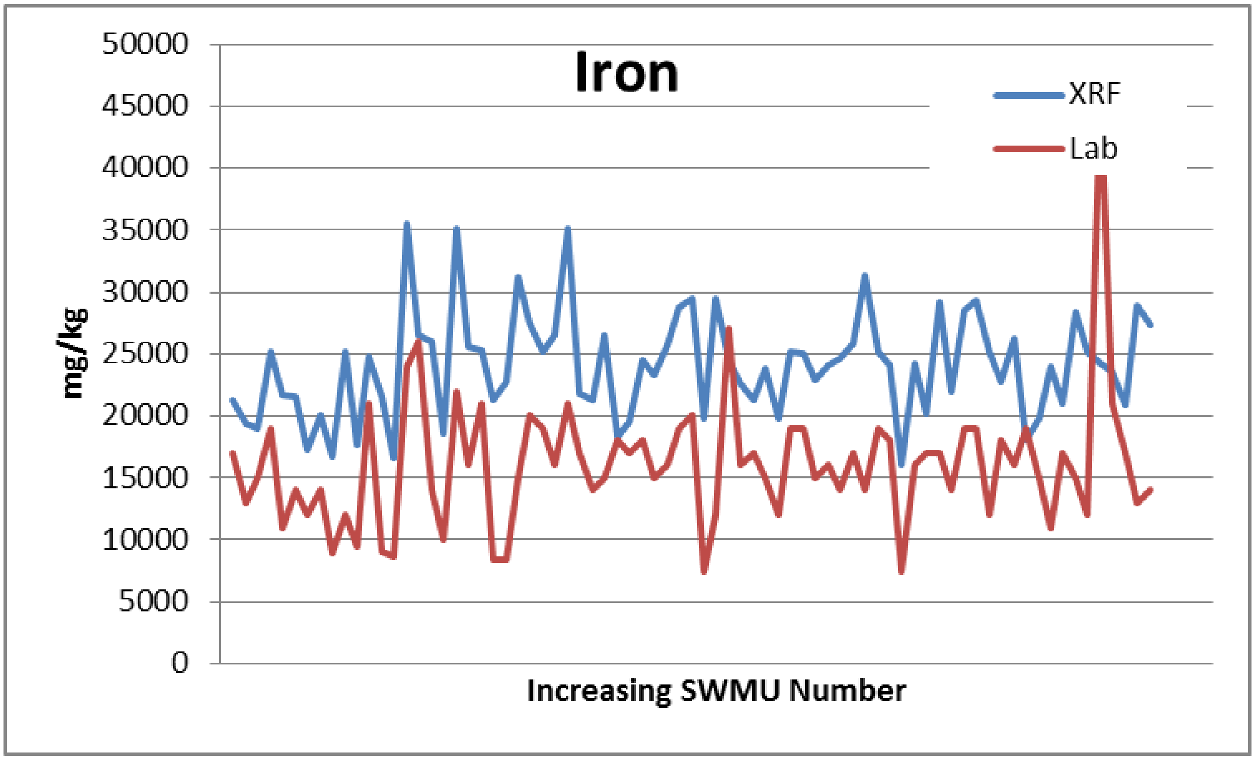



Copper
XRF
Lab
140
120
100
80
60
40
20
0
mg/kg
Increasing SWMU Number

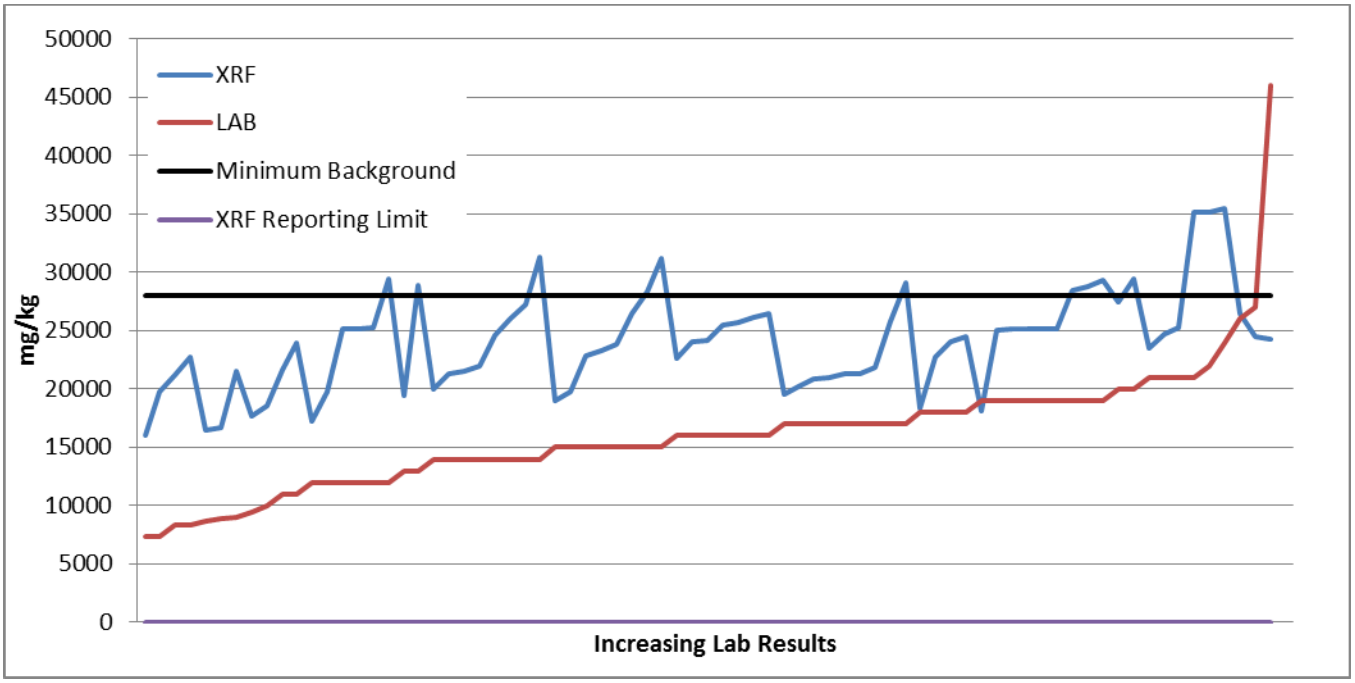
The Pearson correlation coefficient for copper is 5.59E-01.

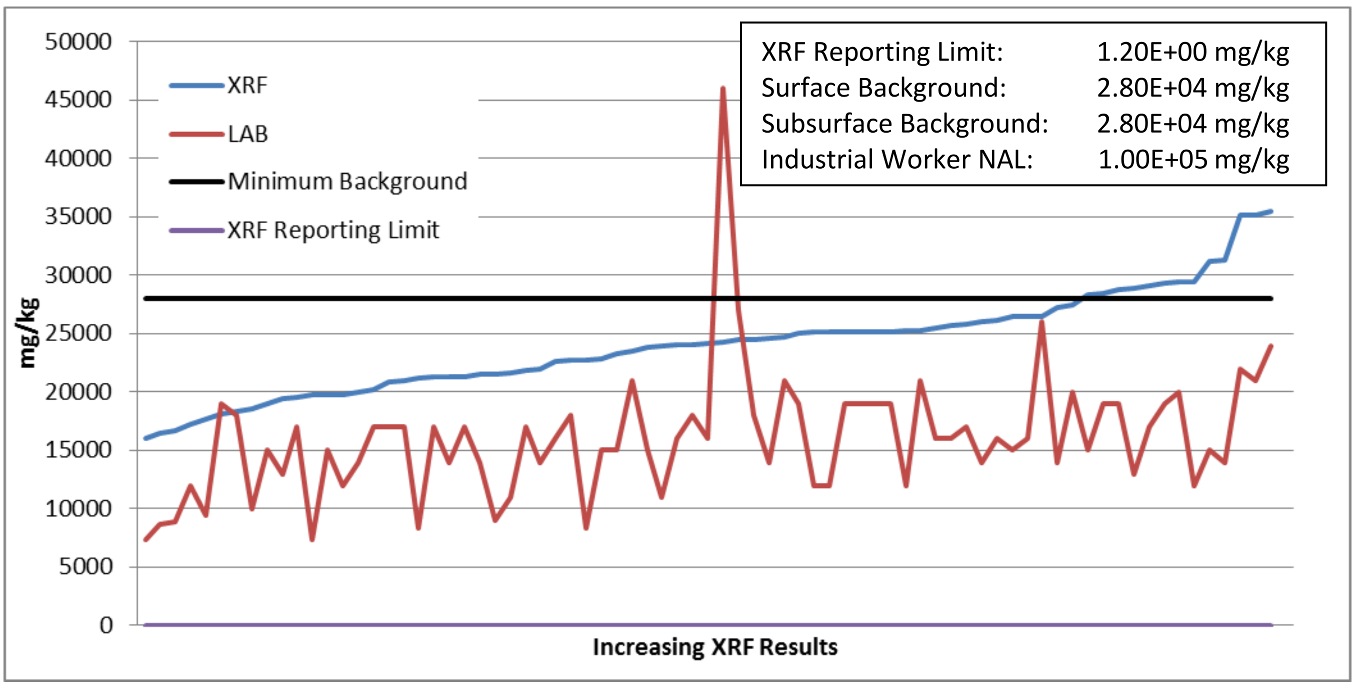


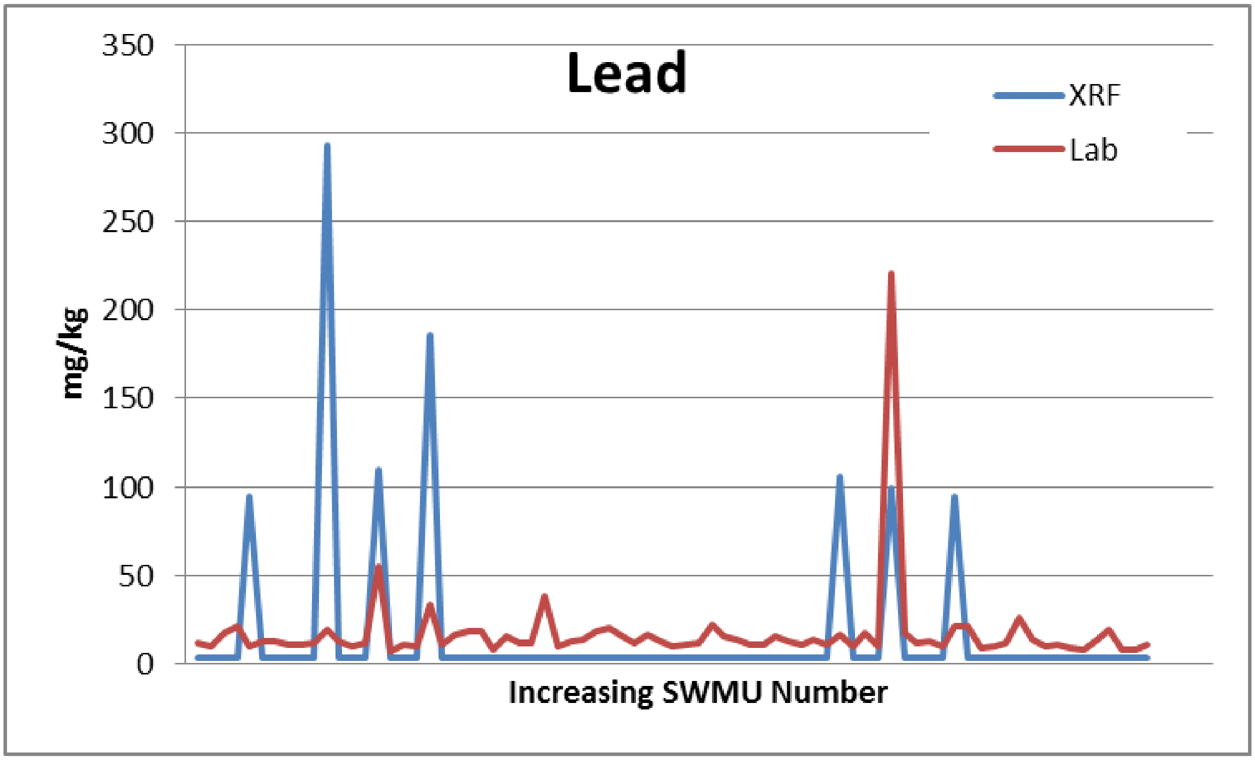



Iron
XRF
Lab
mg/kg
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
Increasing SWMU Number

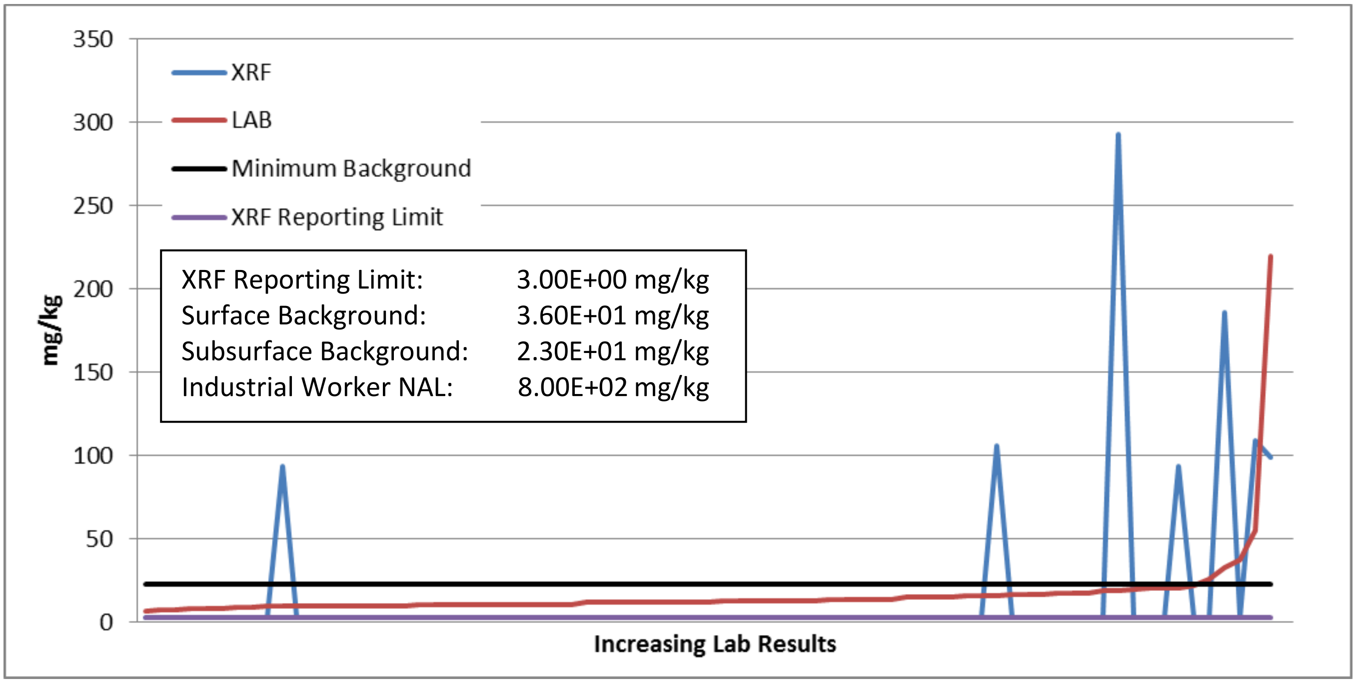
The Pearson correlation coefficient for iron is 3.86E-01.

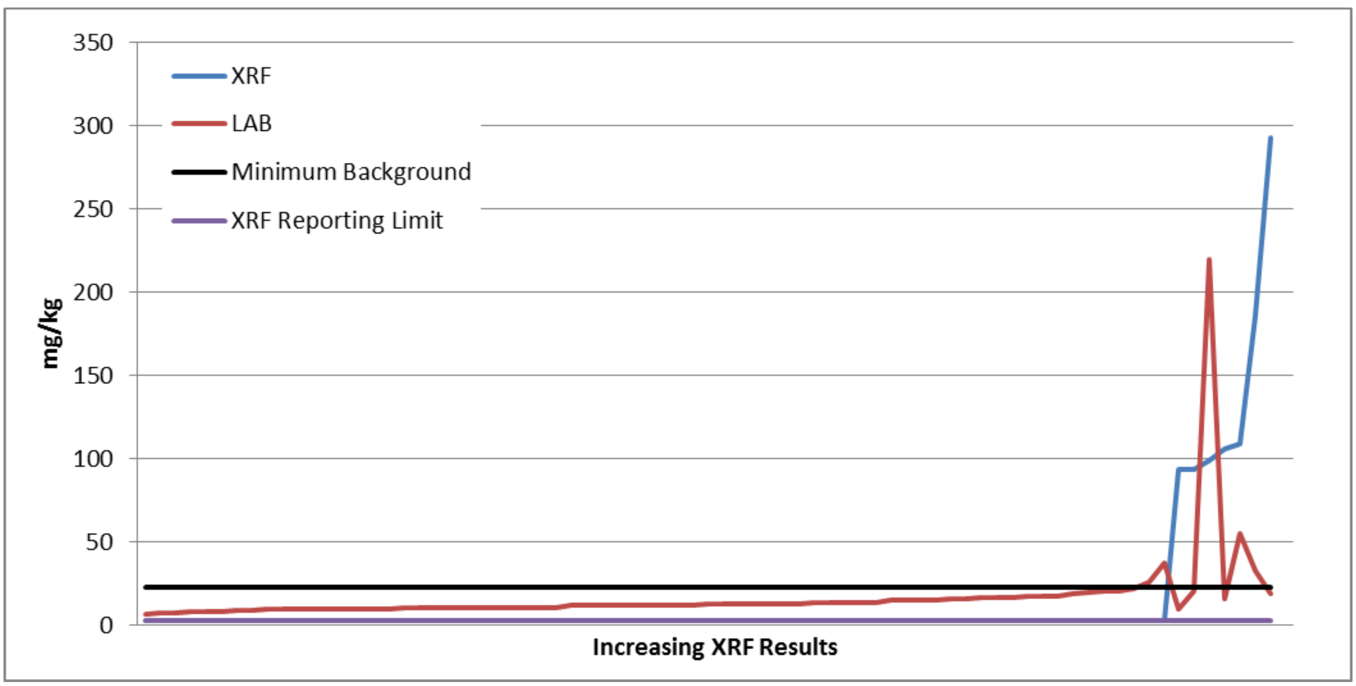


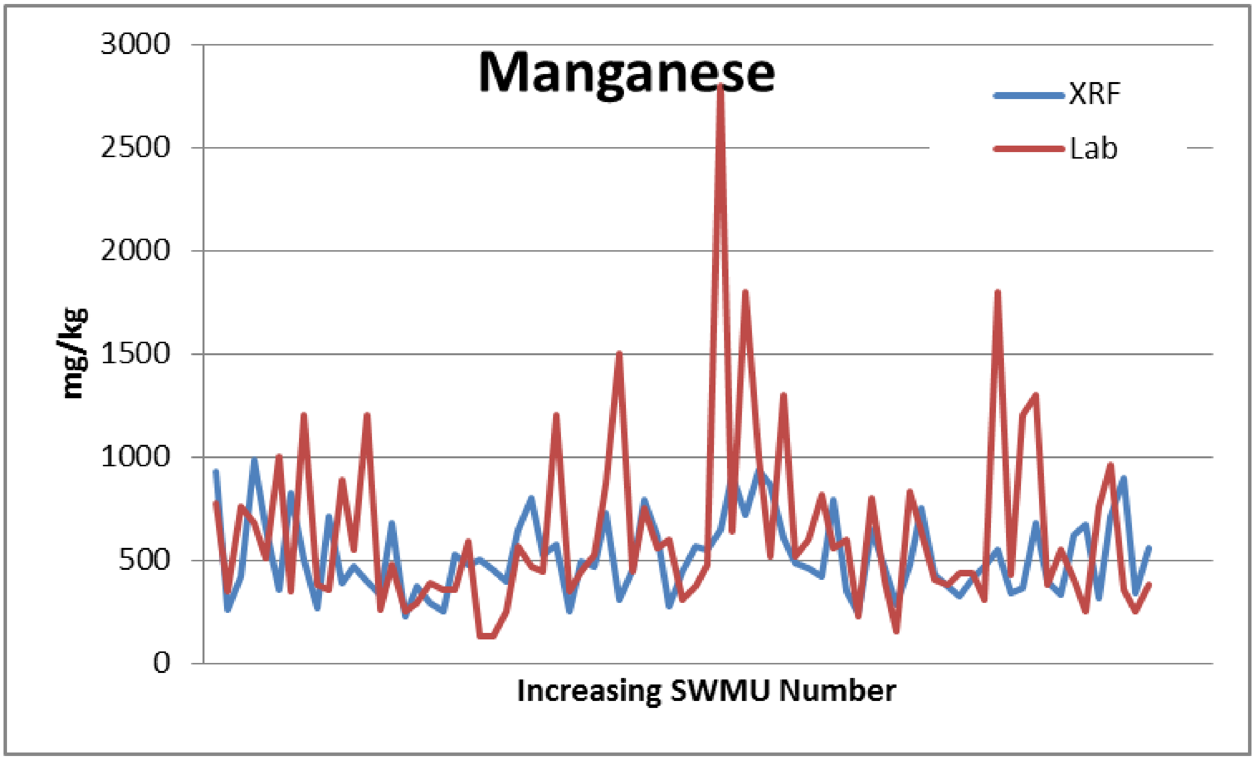



Lead
350
300
250
200
150
100
50
0
mg/kg
Increasing SWMU Number
XRF
Lab

The Pearson correlation coefficient for lead is 3.18E-01.

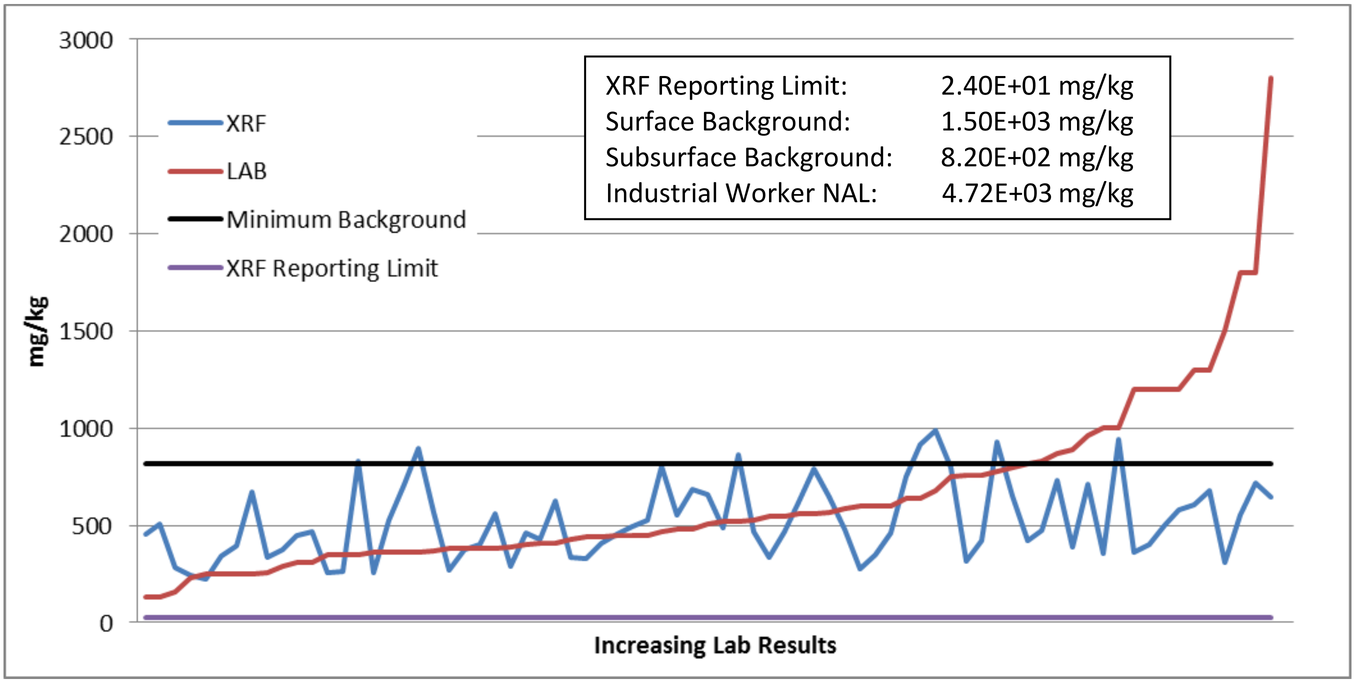


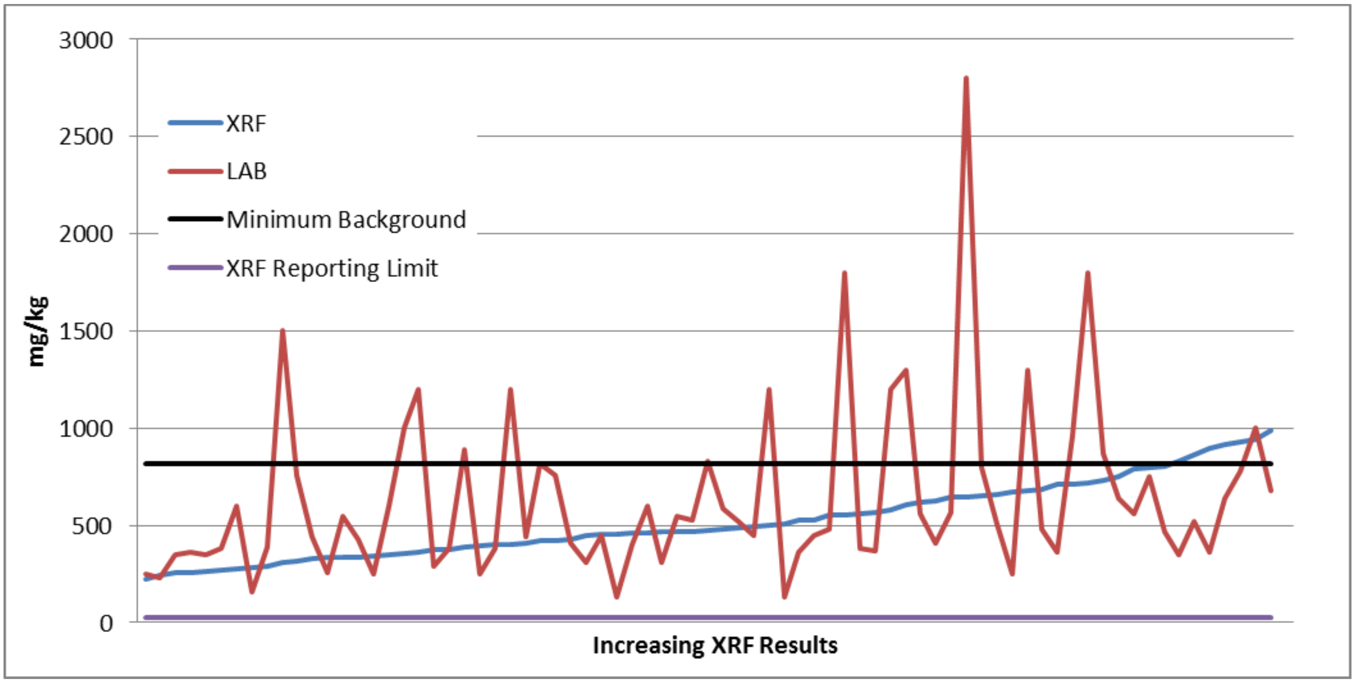


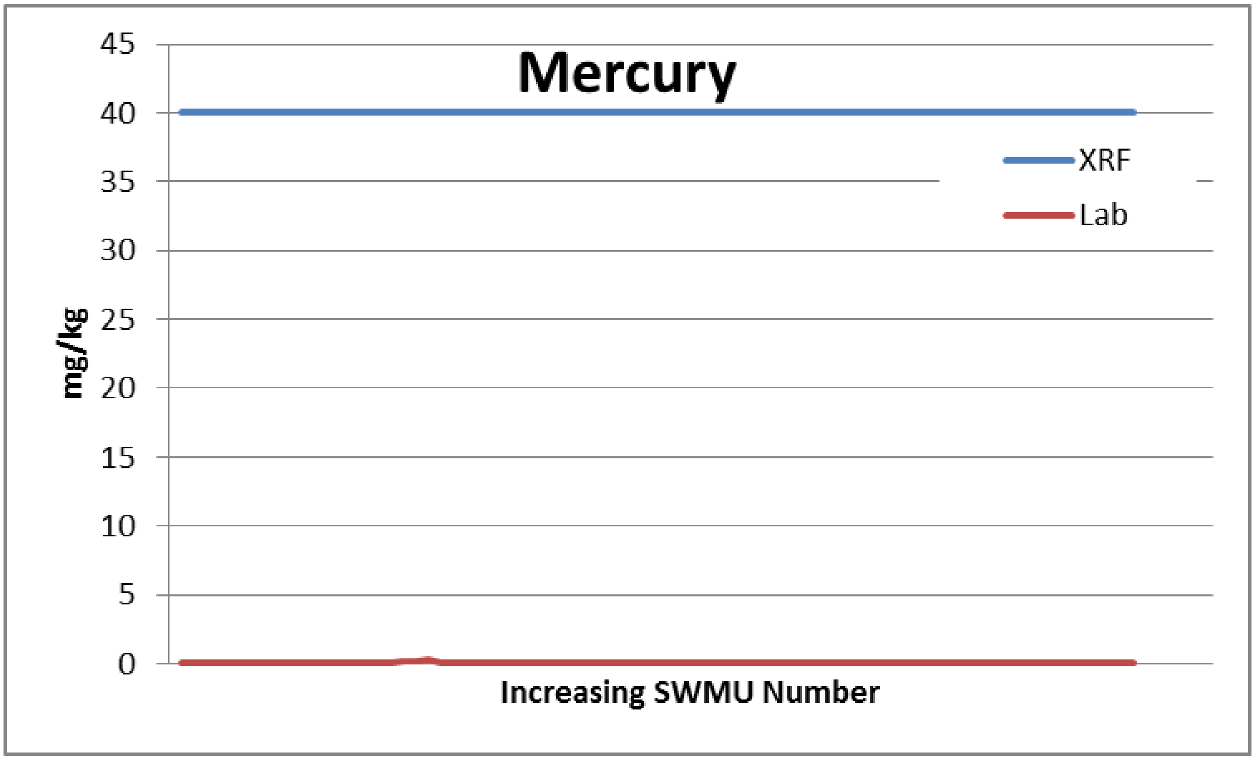


Manganese
XRF
Lab
3000
2500
2000
1500
1000
500
0
mg/kg
Increasing SWMU Number

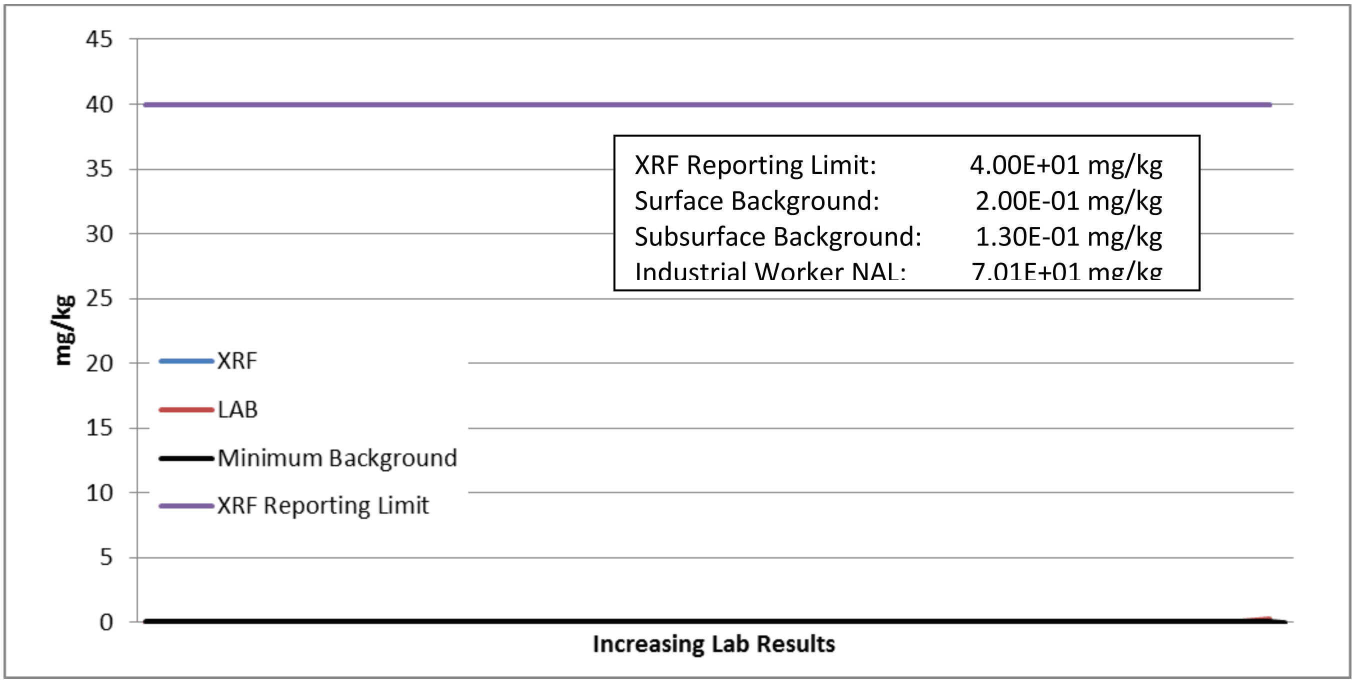
The Pearson correlation coefficient for manganese is 2.16E-01.

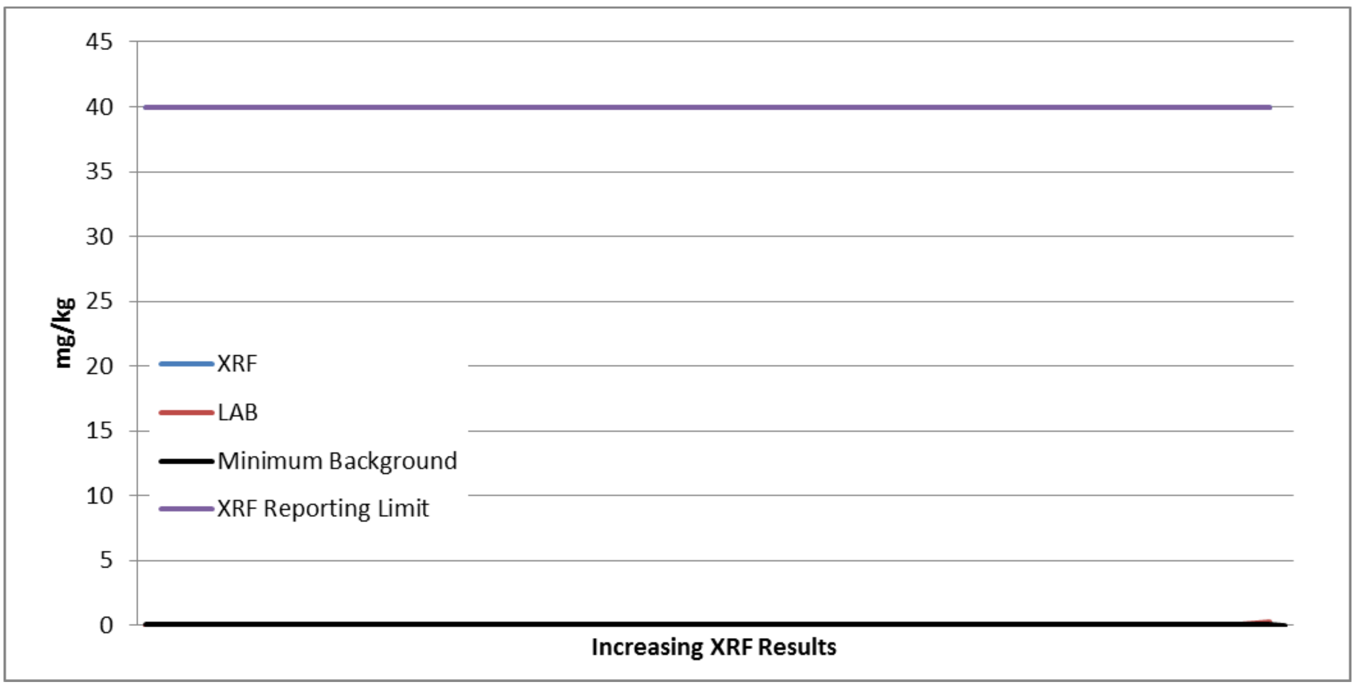


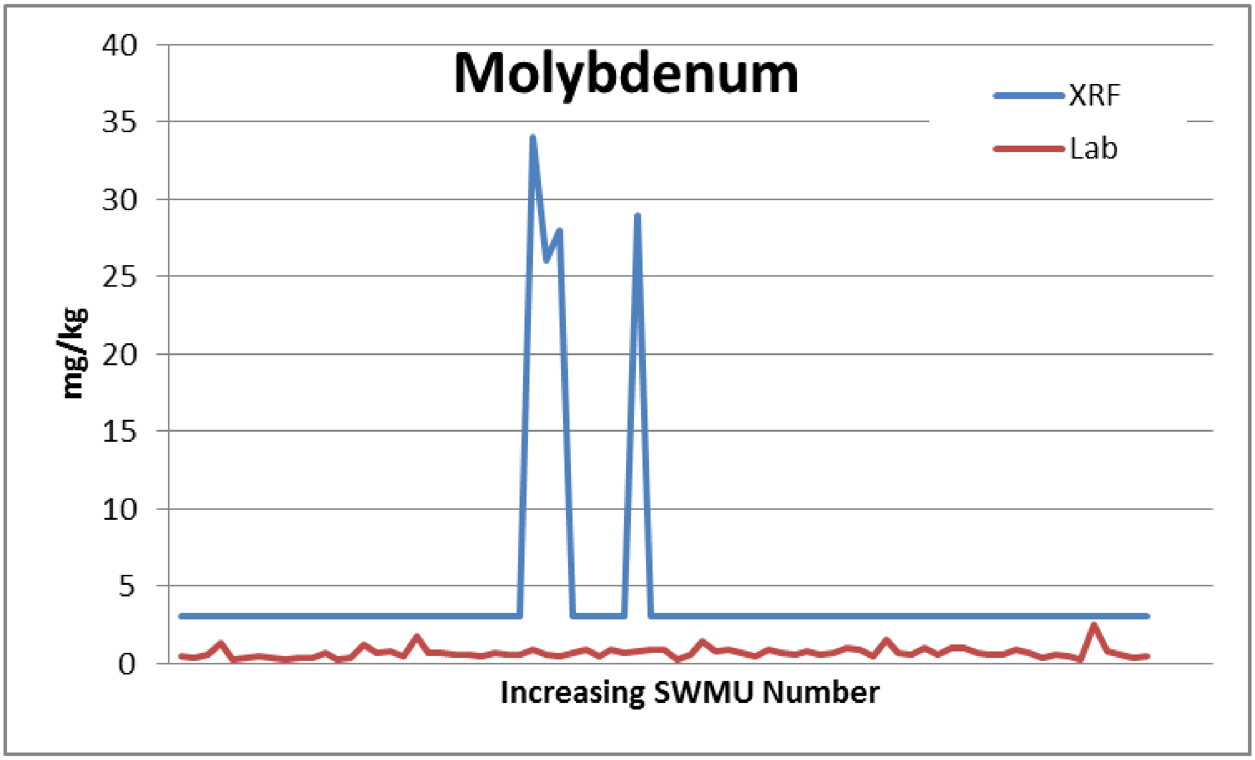



Mercury
45
40
35
30
25
20
15
10
5
0
mg/kg
XRF
Lab
Increasing SWMU Number

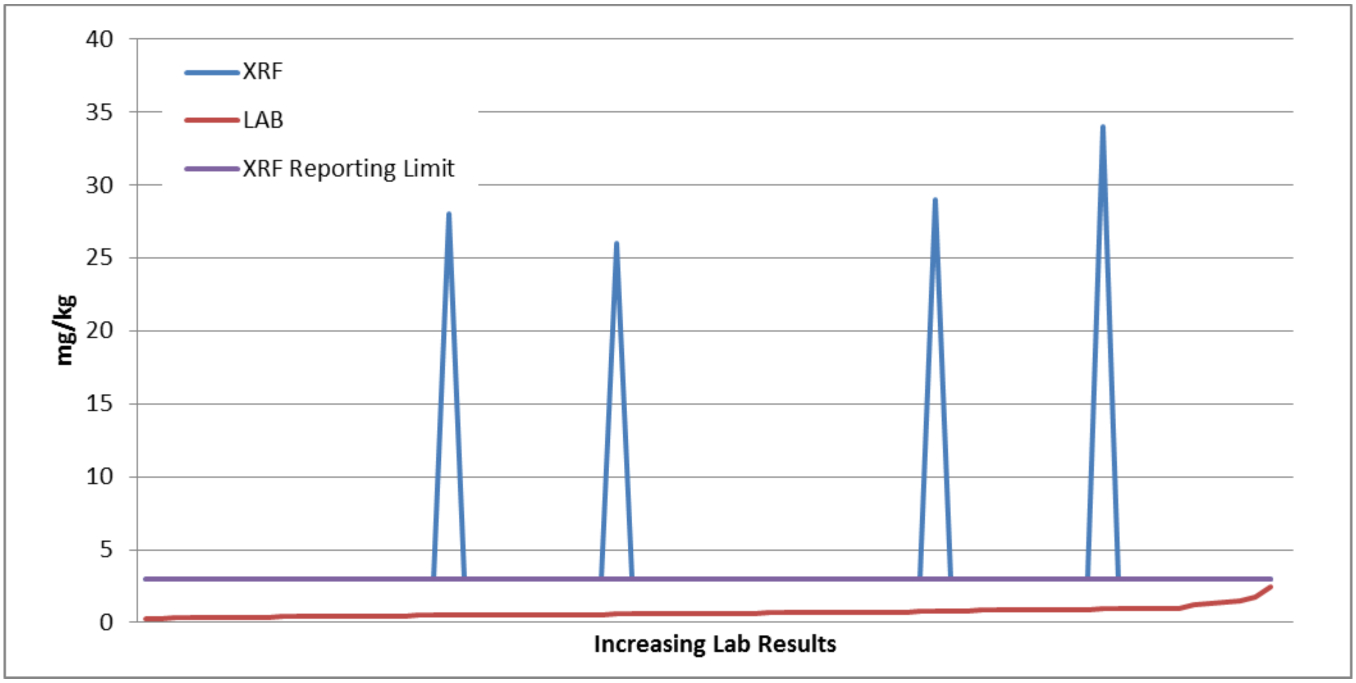
The Pearson correlation coefficient for mercury is not defined.

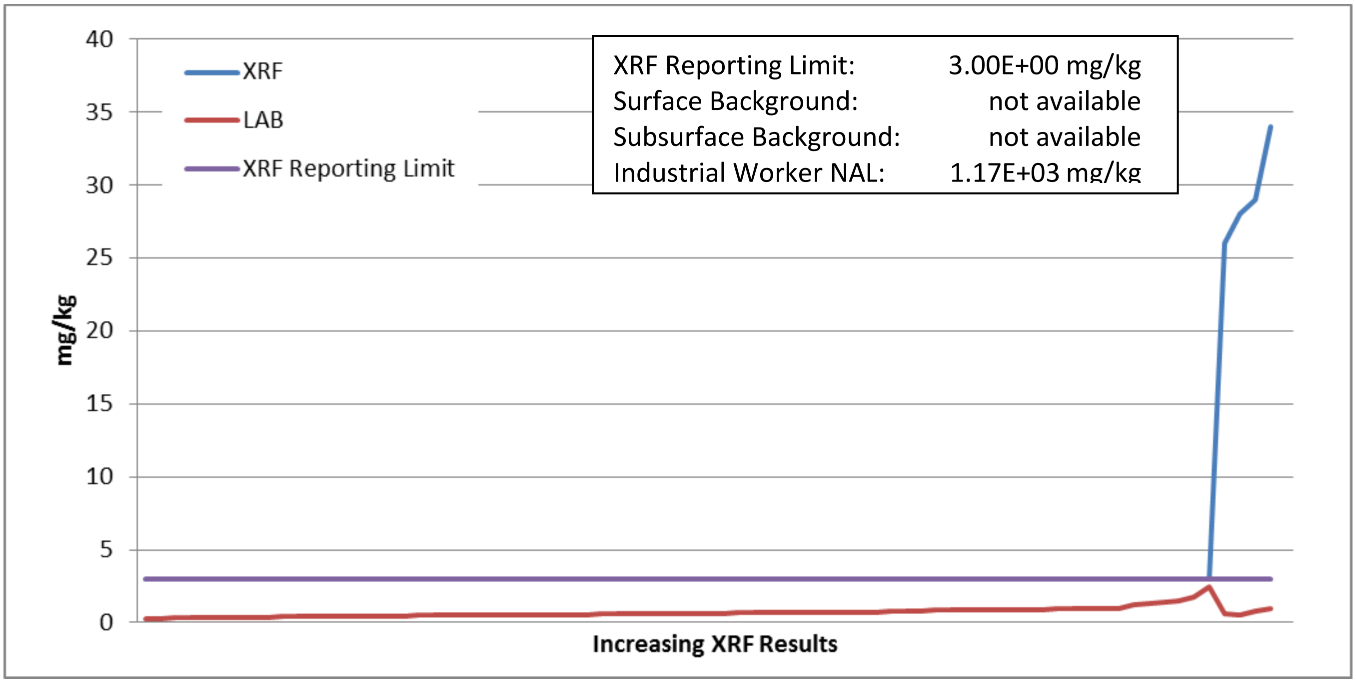


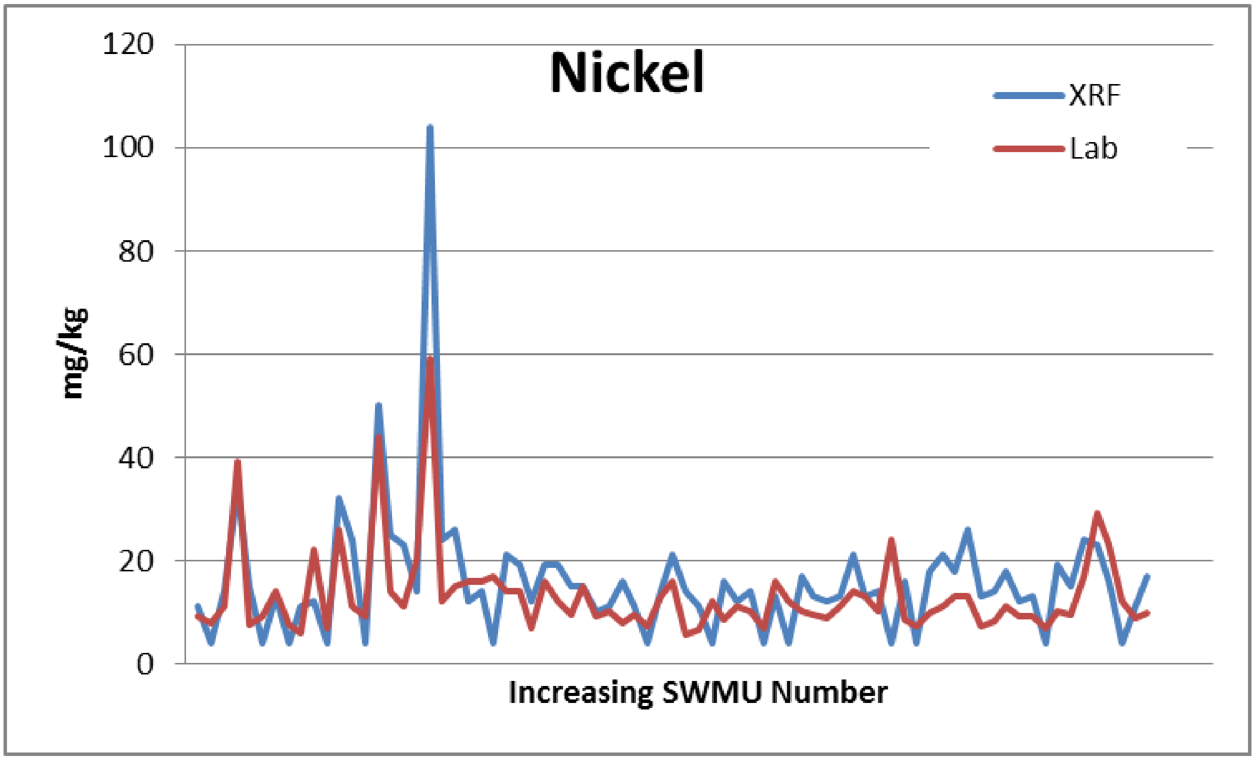



Molybdenum
mg/kg
0
5
10
15
20
25
30
35
40
XRF
Lab
Increasing SWMU Number

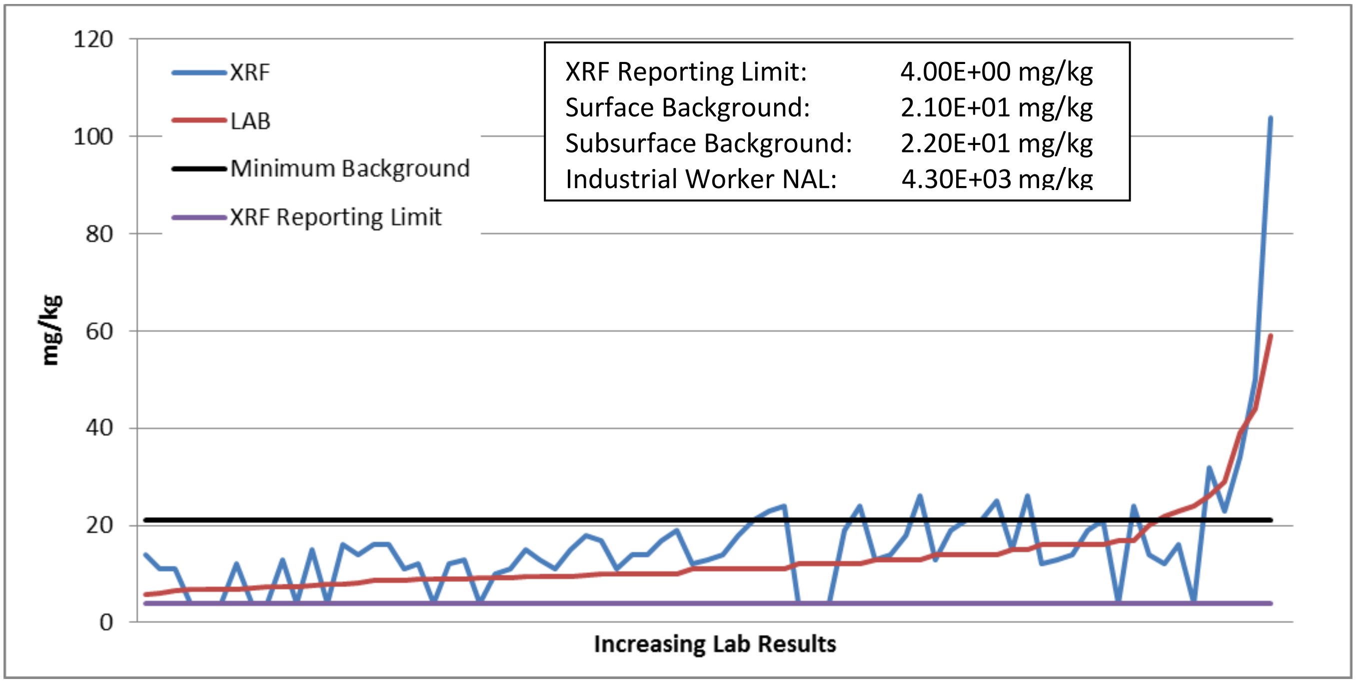
The Pearson correlation coefficient for molybdenum is 7.96E-03.

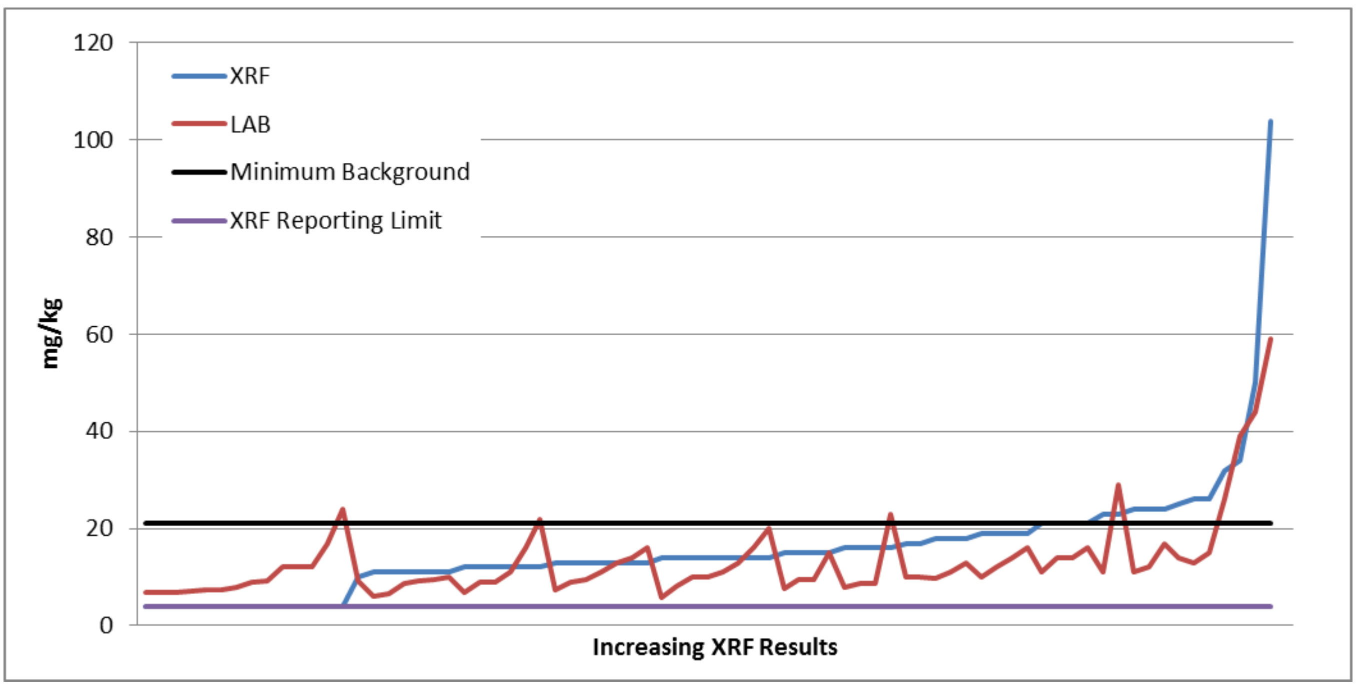


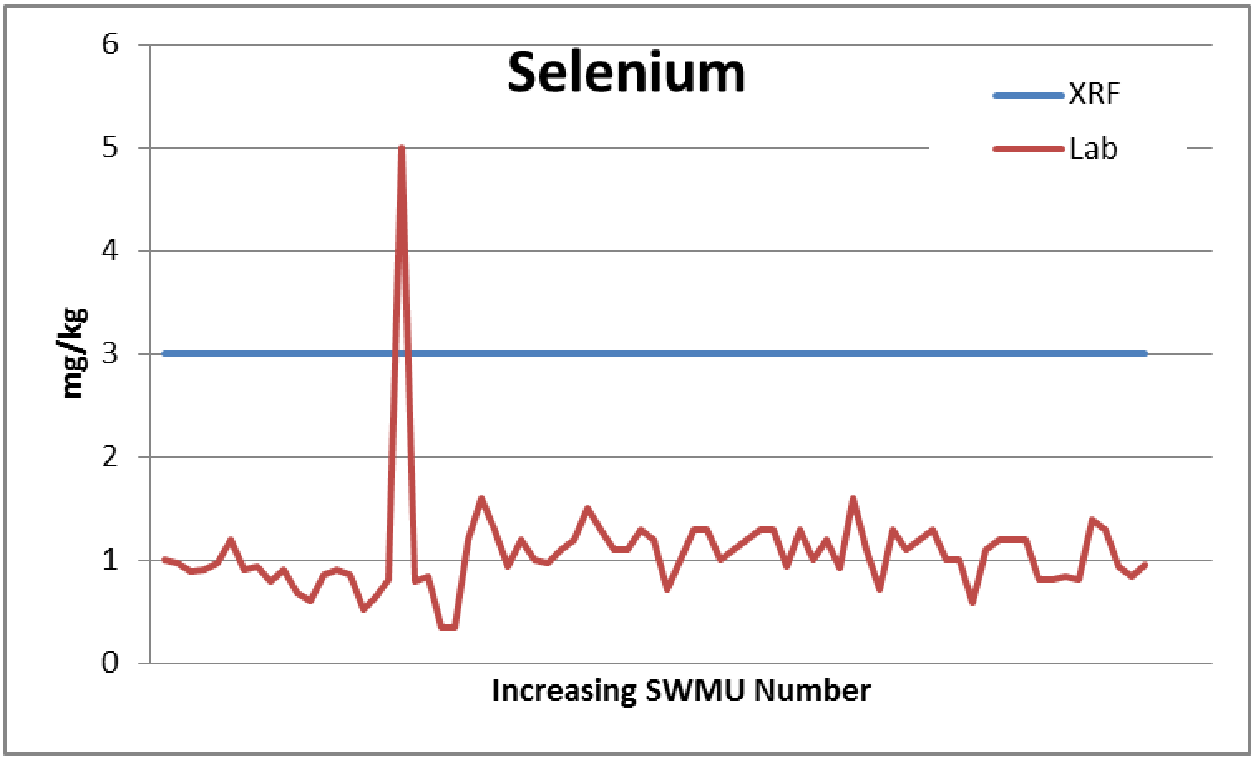



Nickel
XRF
Lab
mg/kg
120
100
80
60
40
20
0
Increasing SWMU Number

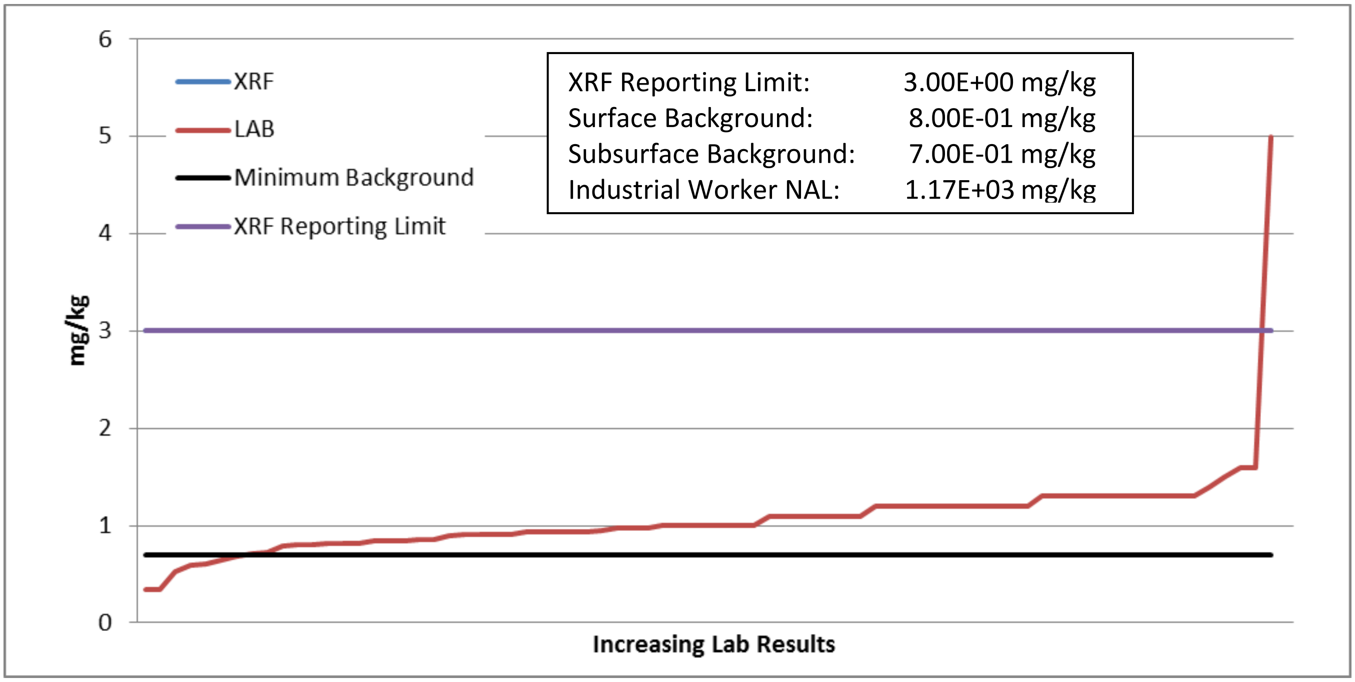
The Pearson correlation coefficient for nickel is 7.96E-01.

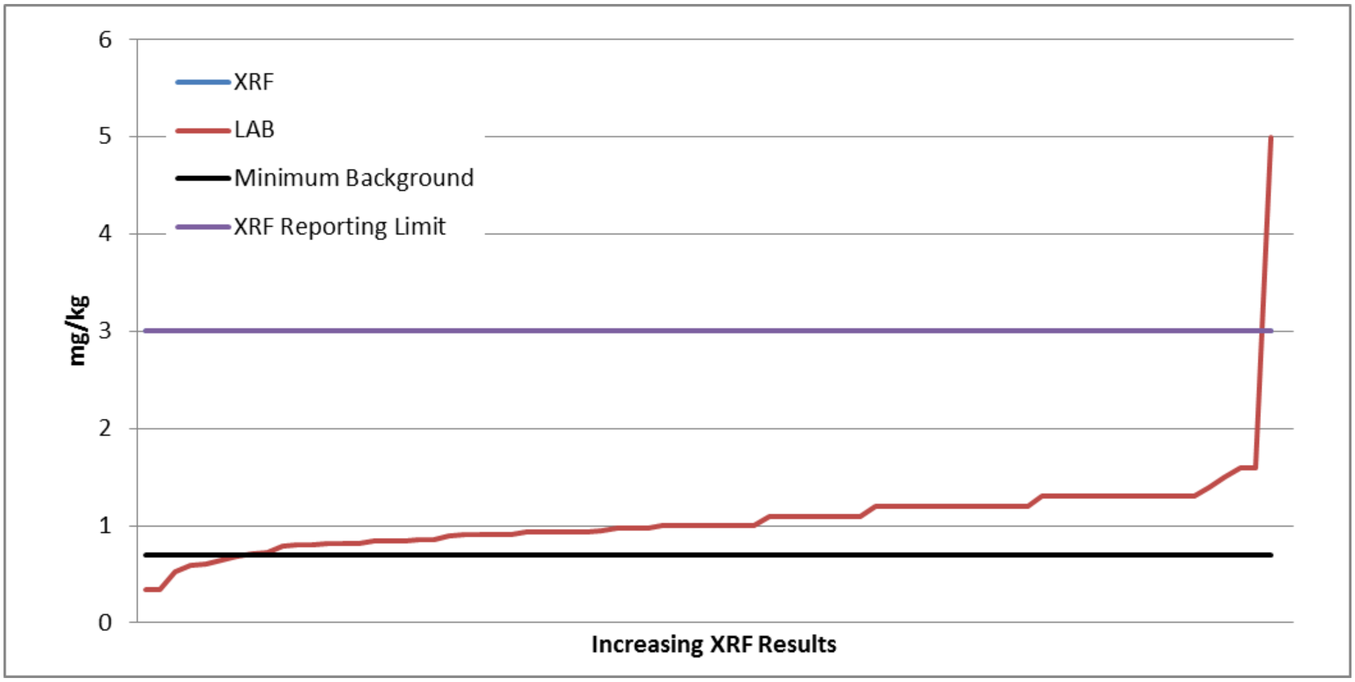


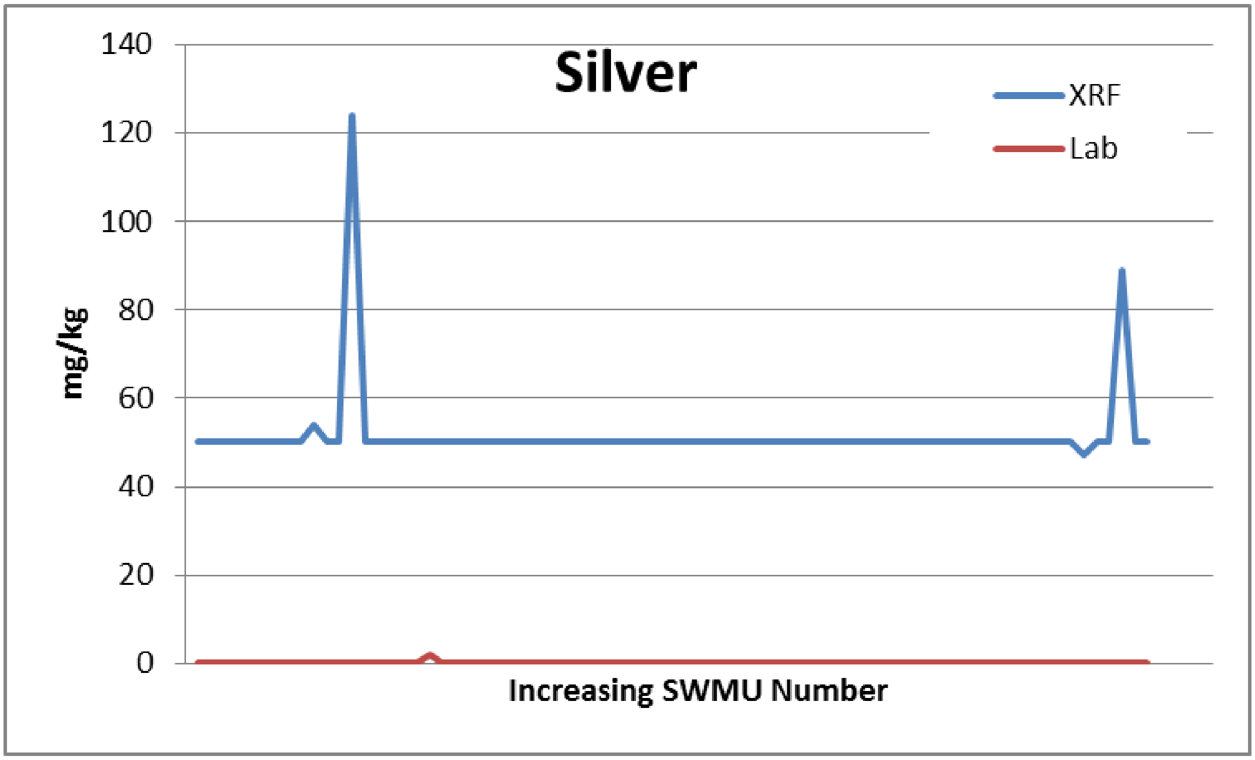



Selenium
XRF
Lab
mg/kg
6
5
4
3
2
1
0
Increasing SWMU Number

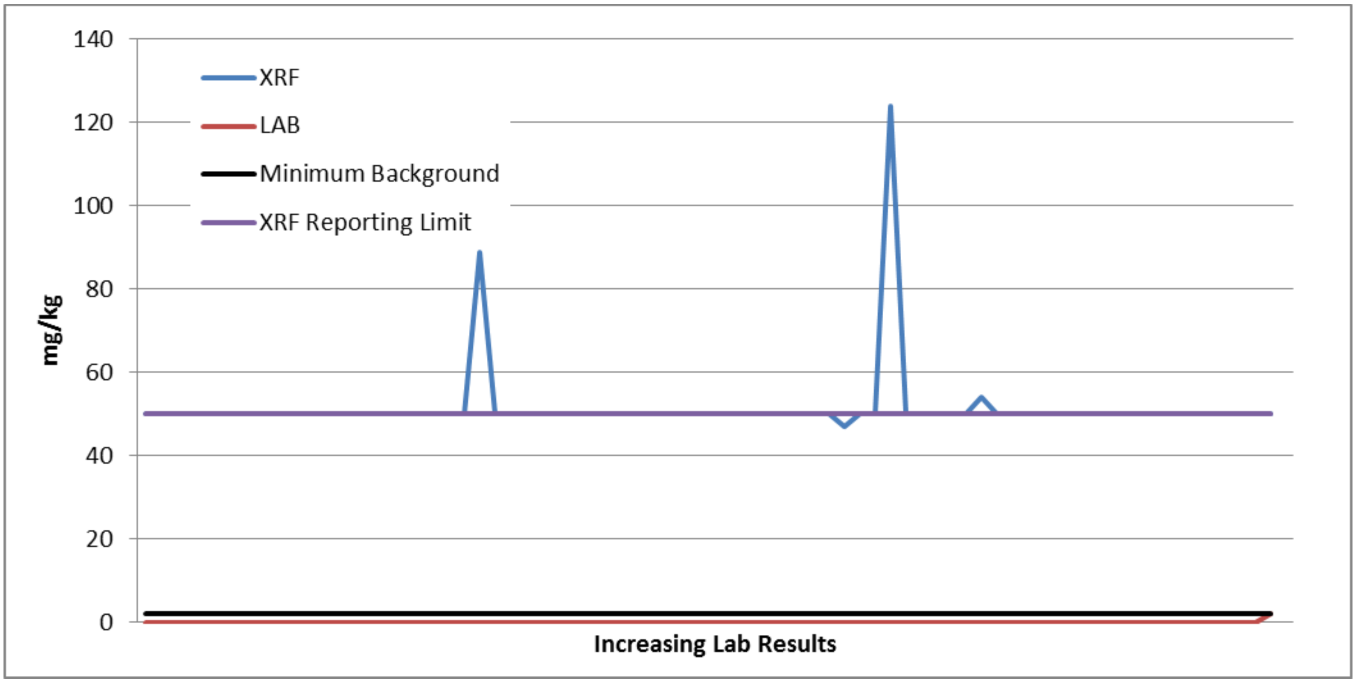
The Pearson correlation coefficient for selenium is not defined.

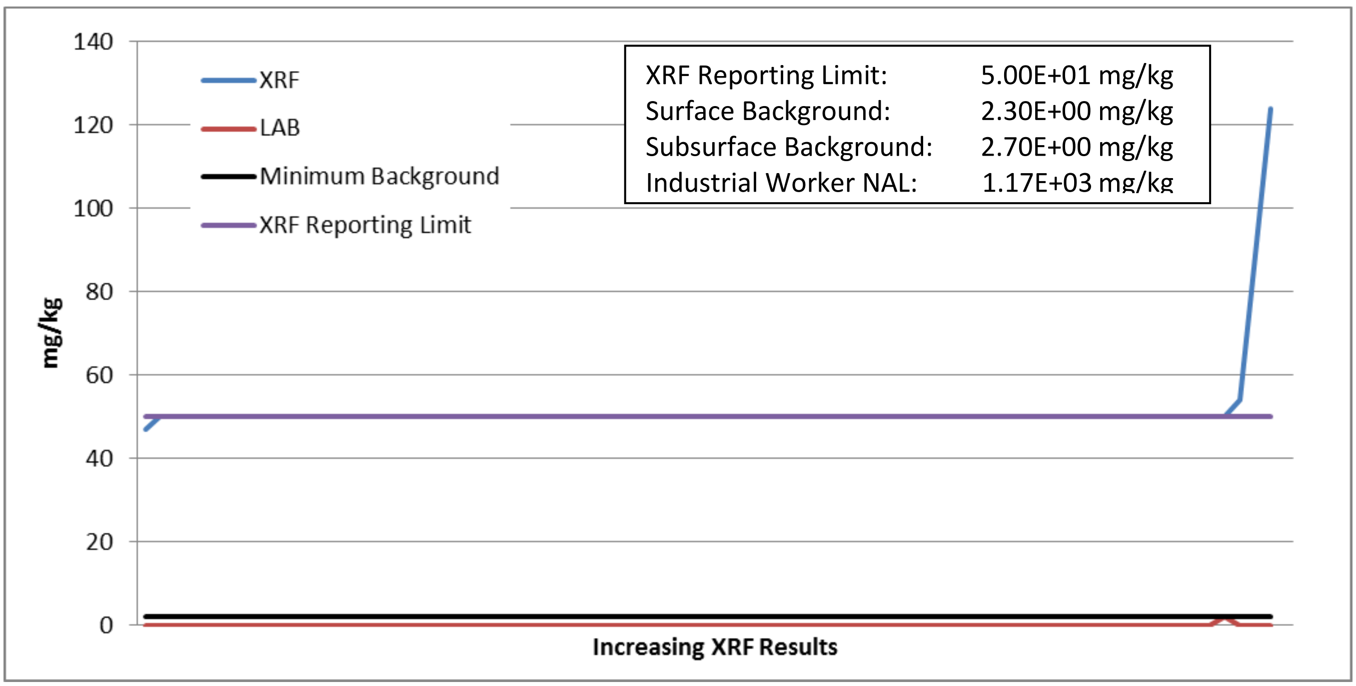


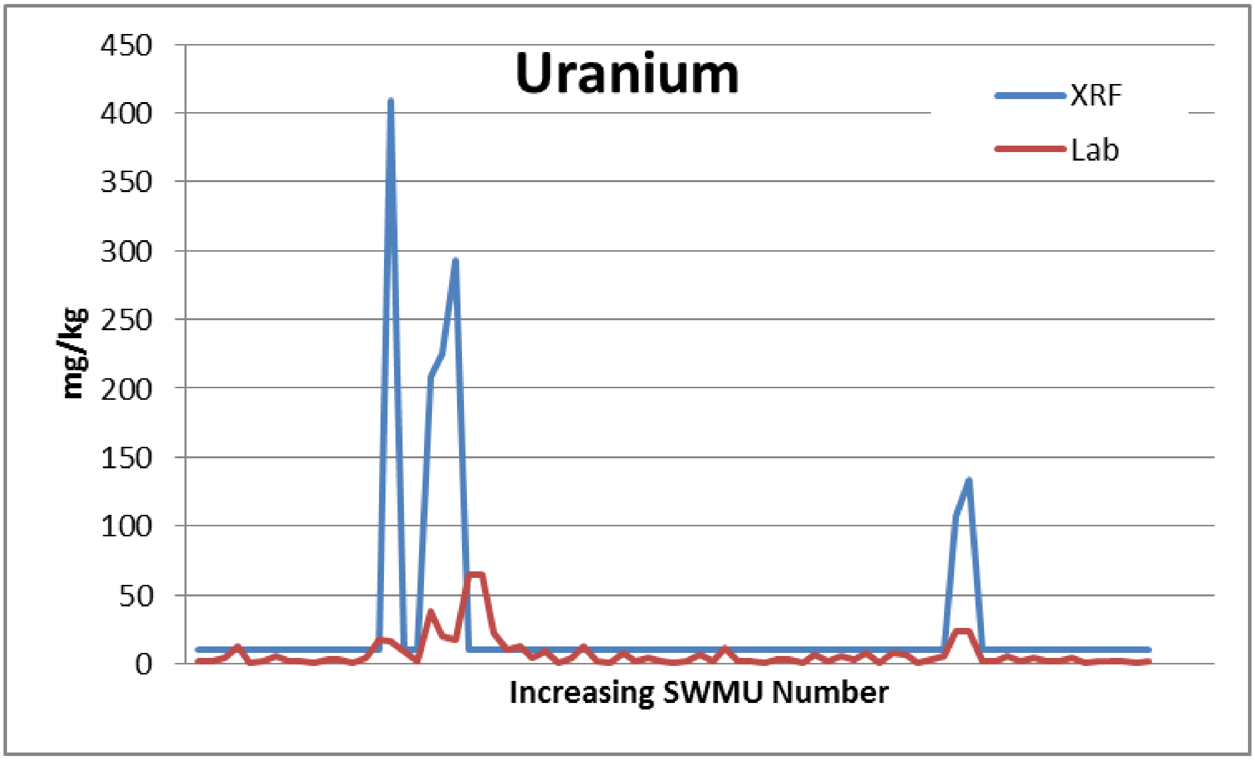



Silver
XRF
Lab
140
120
100
80
60
40
20
0
mg/kg
Increasing SWMU Number

The Pearson correlation coefficient for silver is -2.20E-02.

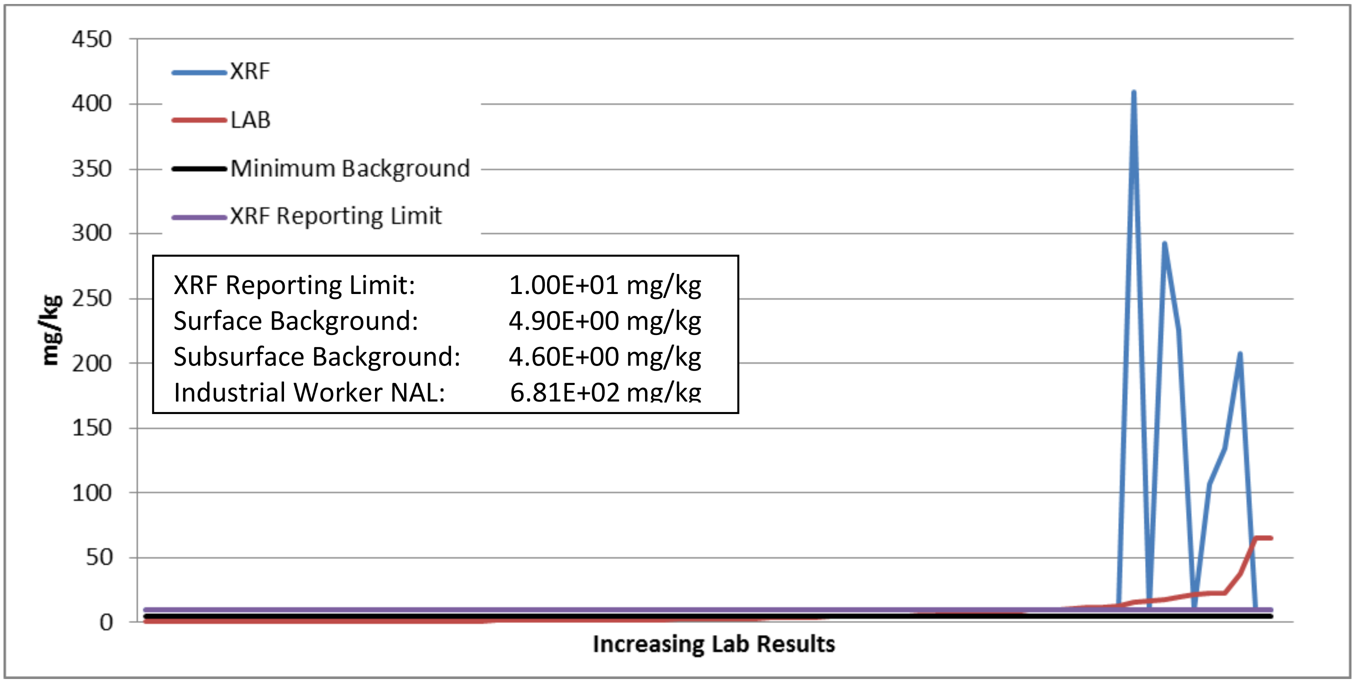


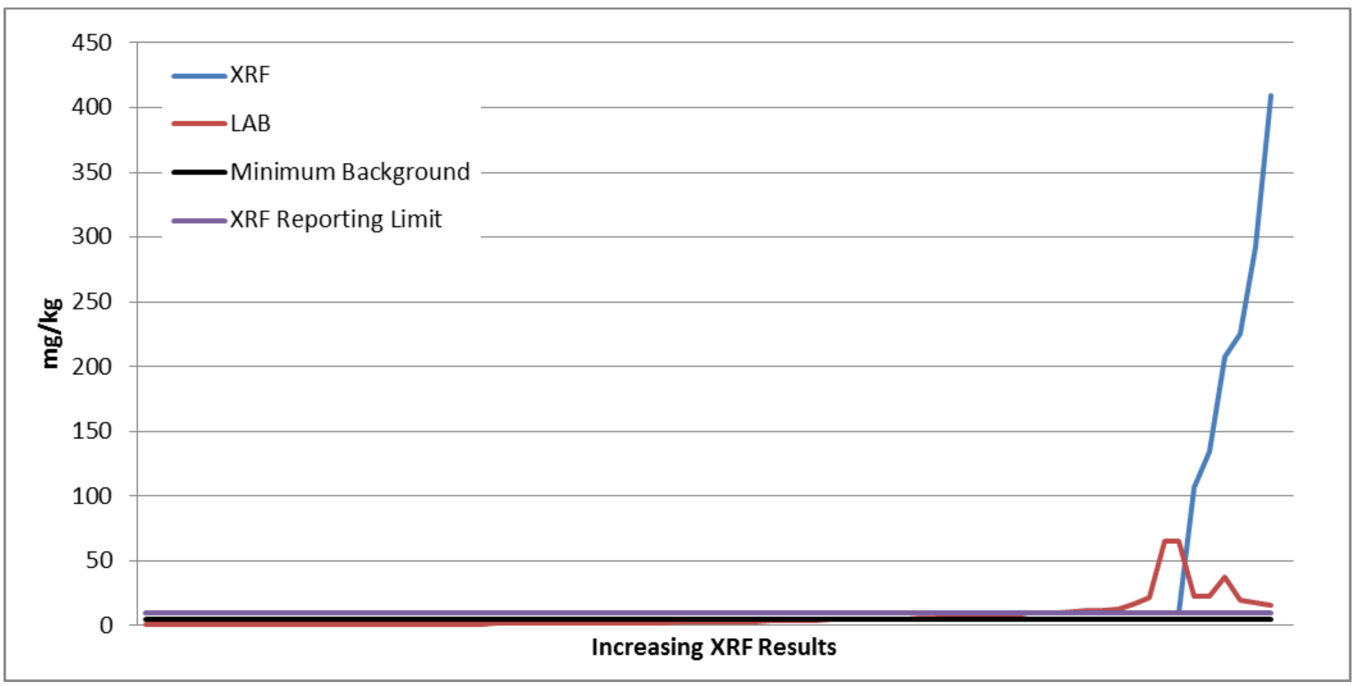


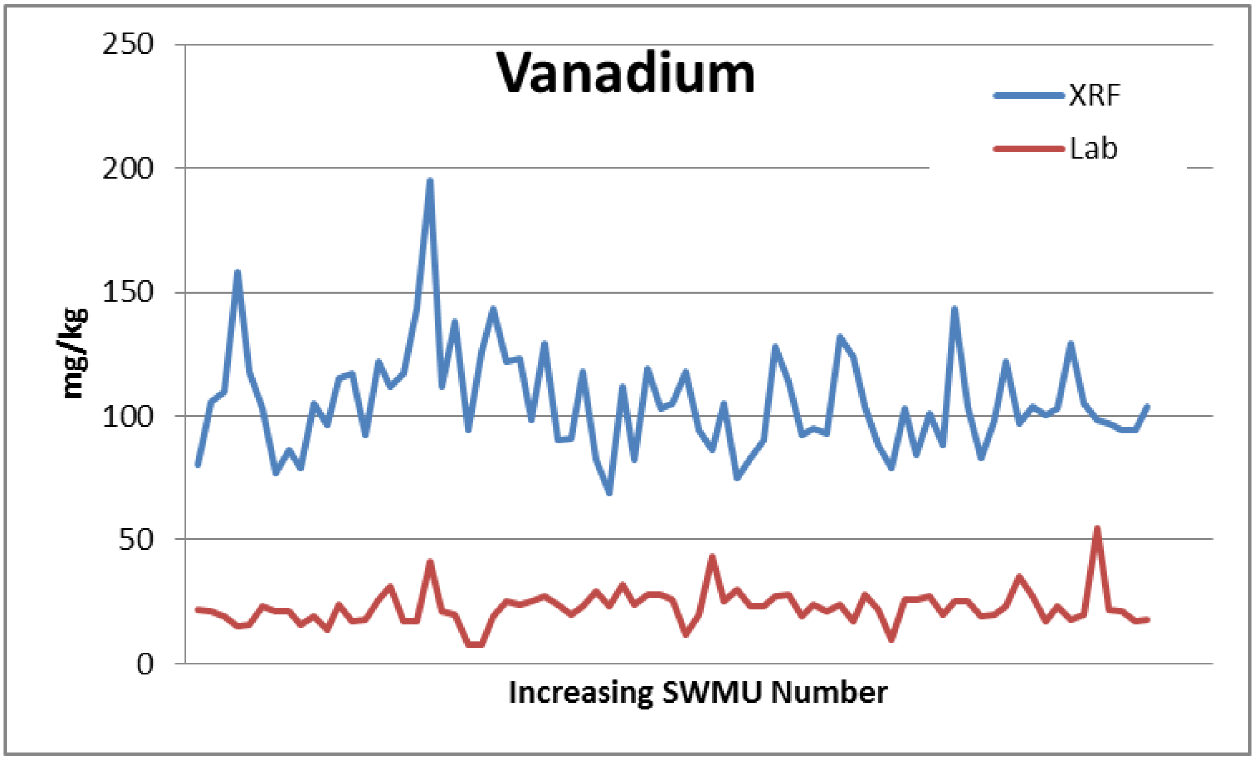


Uranium
XRF
Lab
mg/kg
450
400
350
300
250
200
150
100
50
0
Increasing SWMU Number

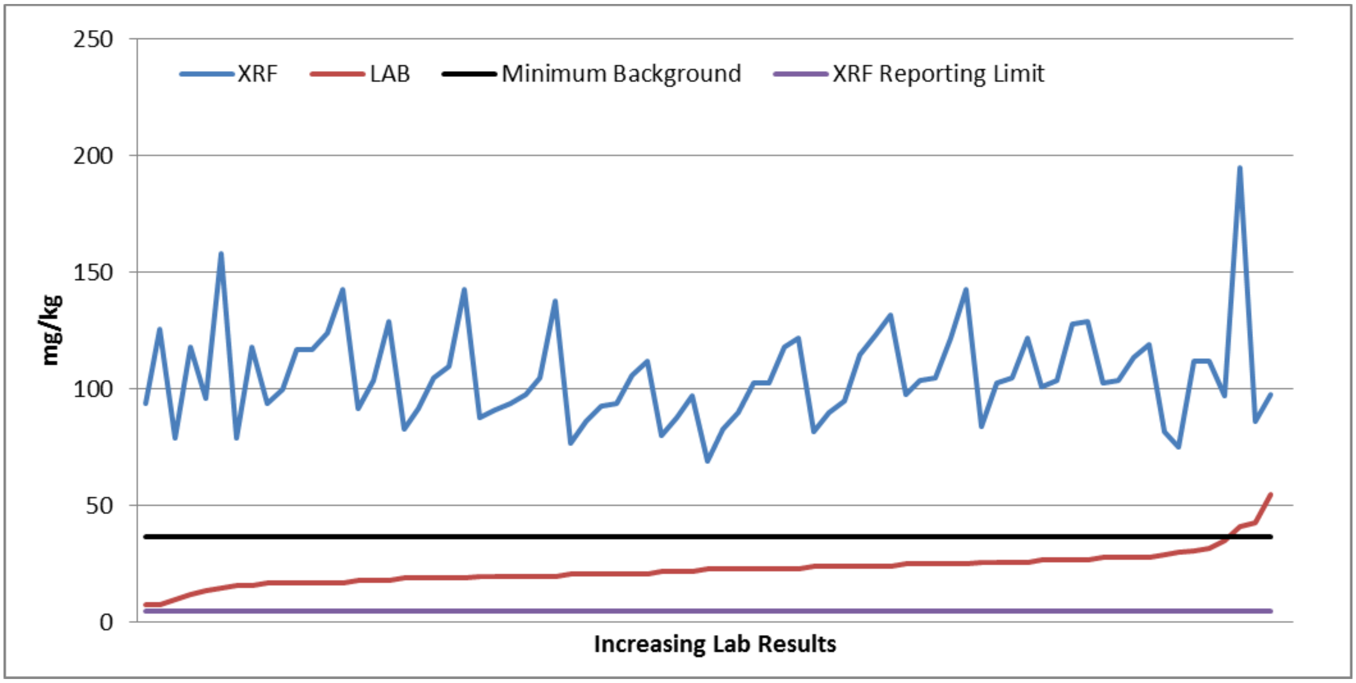
The Pearson correlation coefficient for uranium is 3.26E-01.

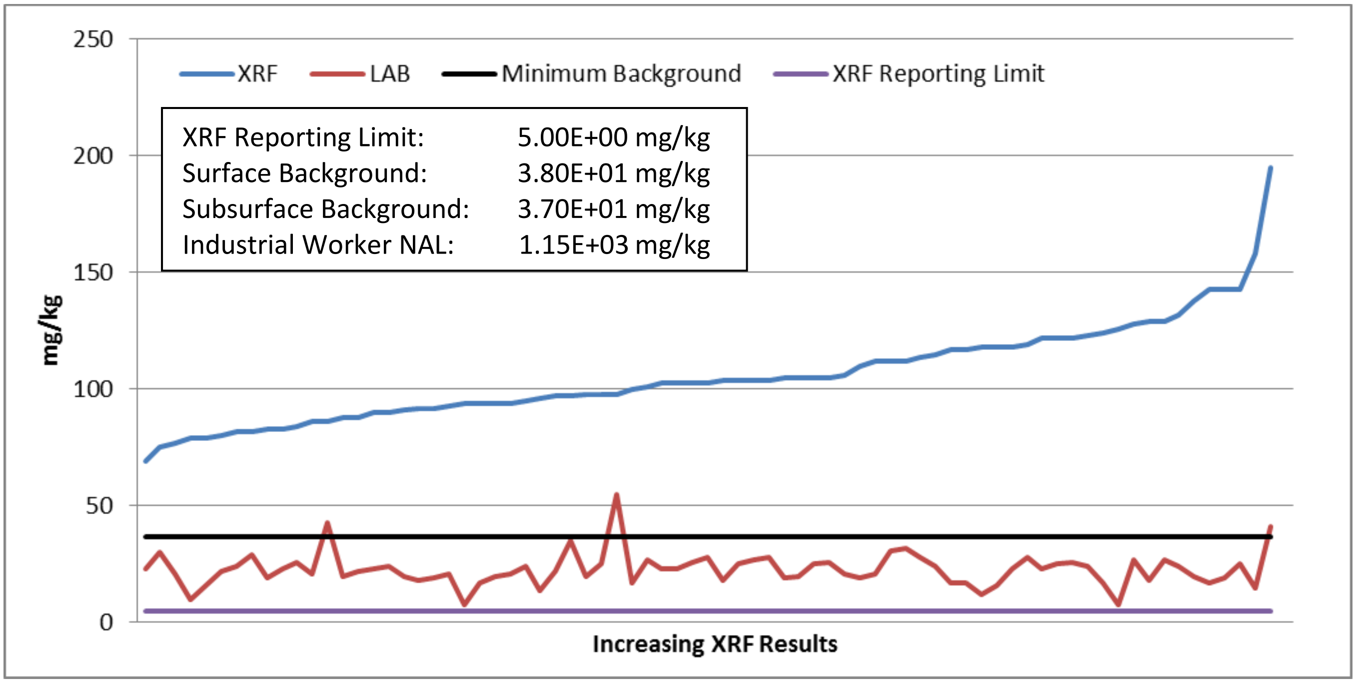


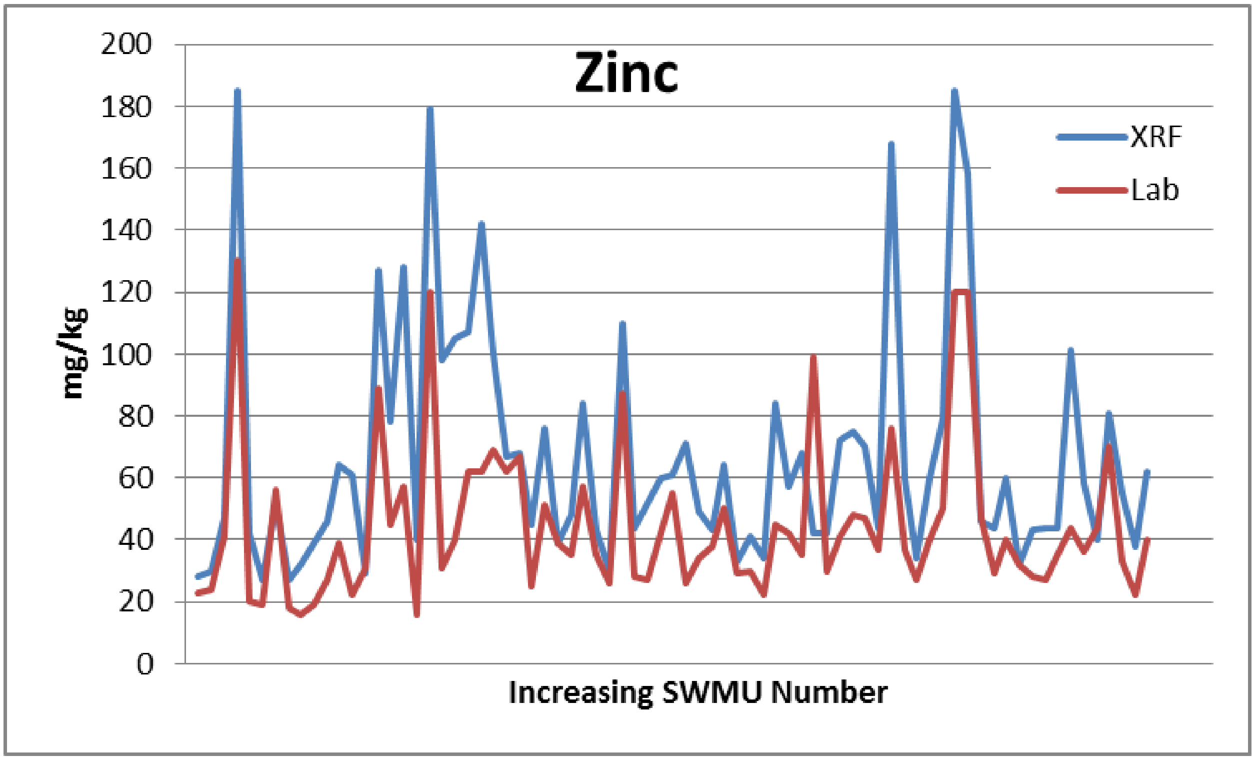



Vanadium
XRF
Lab
250
200
150
100
50
0
mg/kg
Increasing SWMU Number

The Pearson correlation coefficient for vanadium is 5.29E-02.

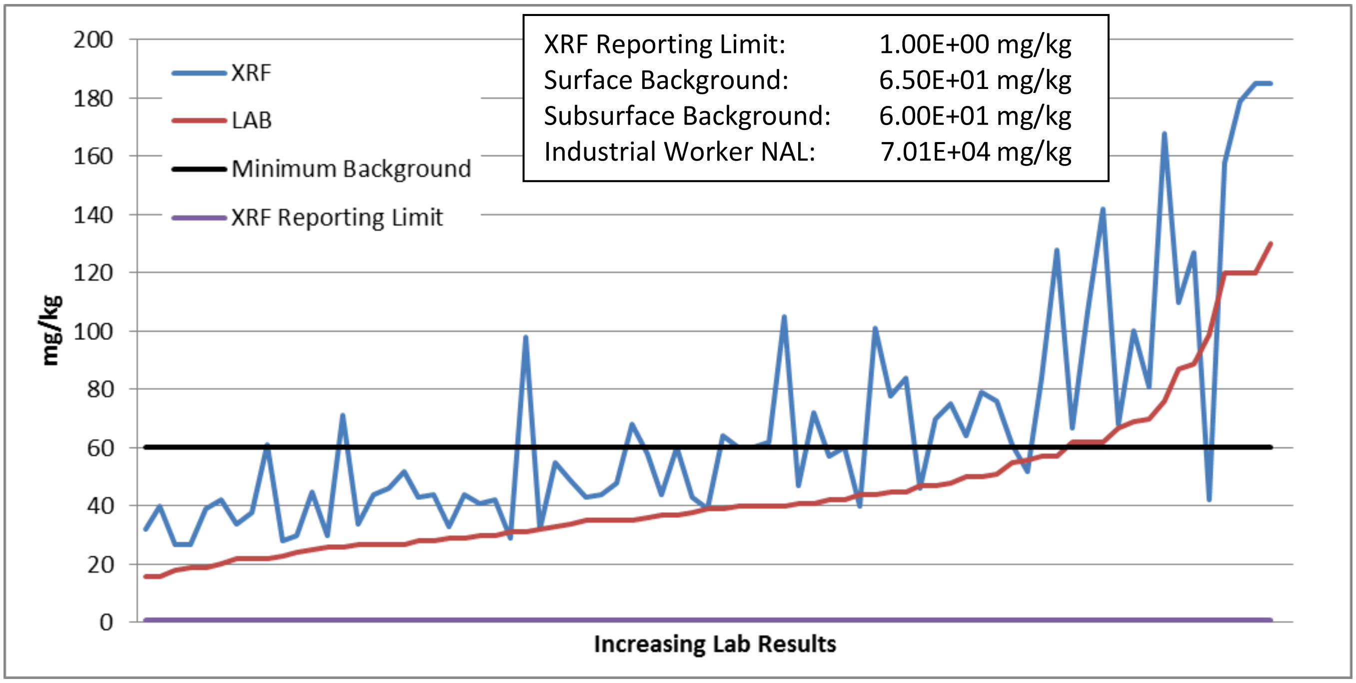


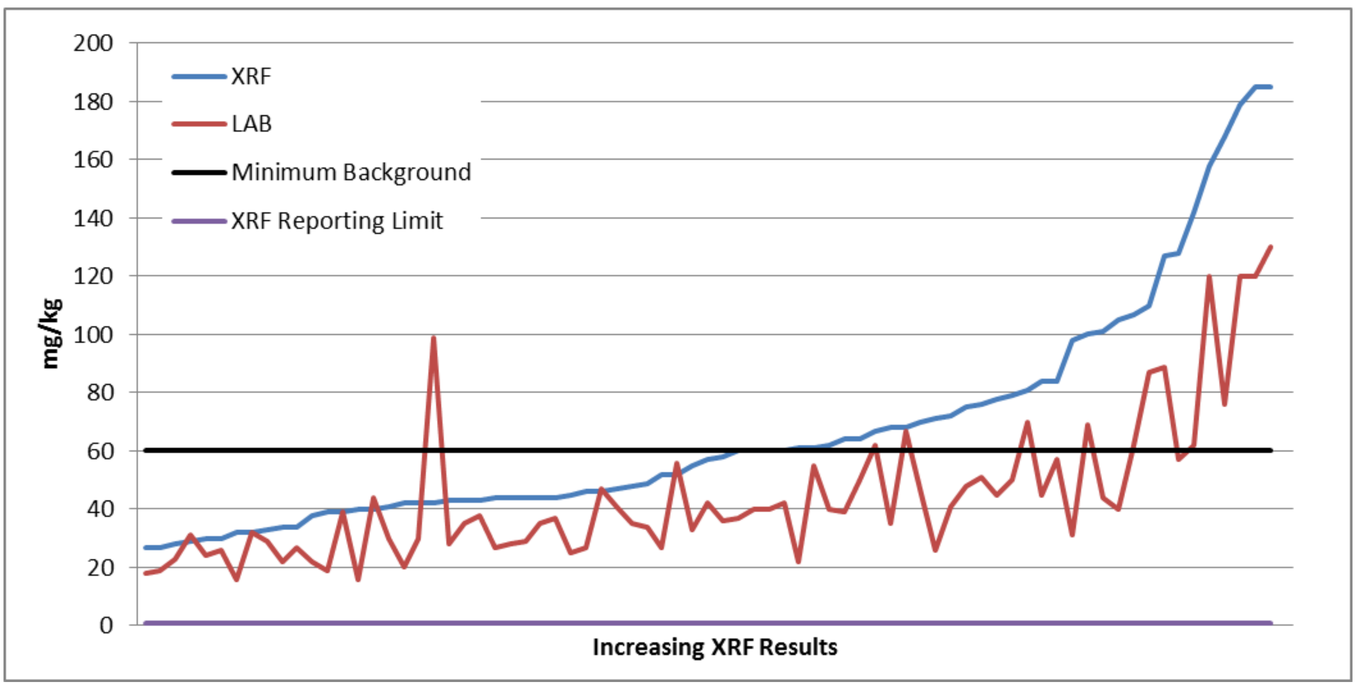




Zinc
200
180
160
140
120
100
80
60
40
20
0
mg/kg
Increasing SWMU Number
XRF
Lab

The Pearson correlation coefficient for zinc is 8.32E-01.





APPENDIX C

FATE AND TRANSPORT MODELING

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CONTENTS

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FIGURE

TABLES

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ACRONYMS

AOC	area of concern
AT123D	Analytical Transient 1-, 2-, 3-Dimensional Model
OU	operable unit
PGDP	Paducah Gaseous Diffusion Plant
RGA	Regional Gravel Aquifer
RI	remedial investigation
SESOIL	Seasonal Soil Compartment Model
SWMU	solid waste management unit
UCRS	Upper Continental Recharge System

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C.1. INTRODUCTION

Seasonal Soil Compartment Model (SESOIL) and Analytical Transient 1-, 2-, 3-Dimensional Model (AT123D) groundwater and transport modeling were conducted as part of the Soils Operable Unit (OU) Remedial Investigation (RI) to evaluate the potential Regional Gravel Aquifer (RGA) groundwater impacts from residual soil contamination at the solid waste management units (SWMUs)/areas of concern (AOCs) boundaries. This modeling effort evaluated the potential migration of technetium-99 (Tc-99). Figure C.1 illustrates the relationship of the RGA and the Upper Continental Recharge System (UCRS) at the Paducah Gaseous Diffusion Plant (PGDP).

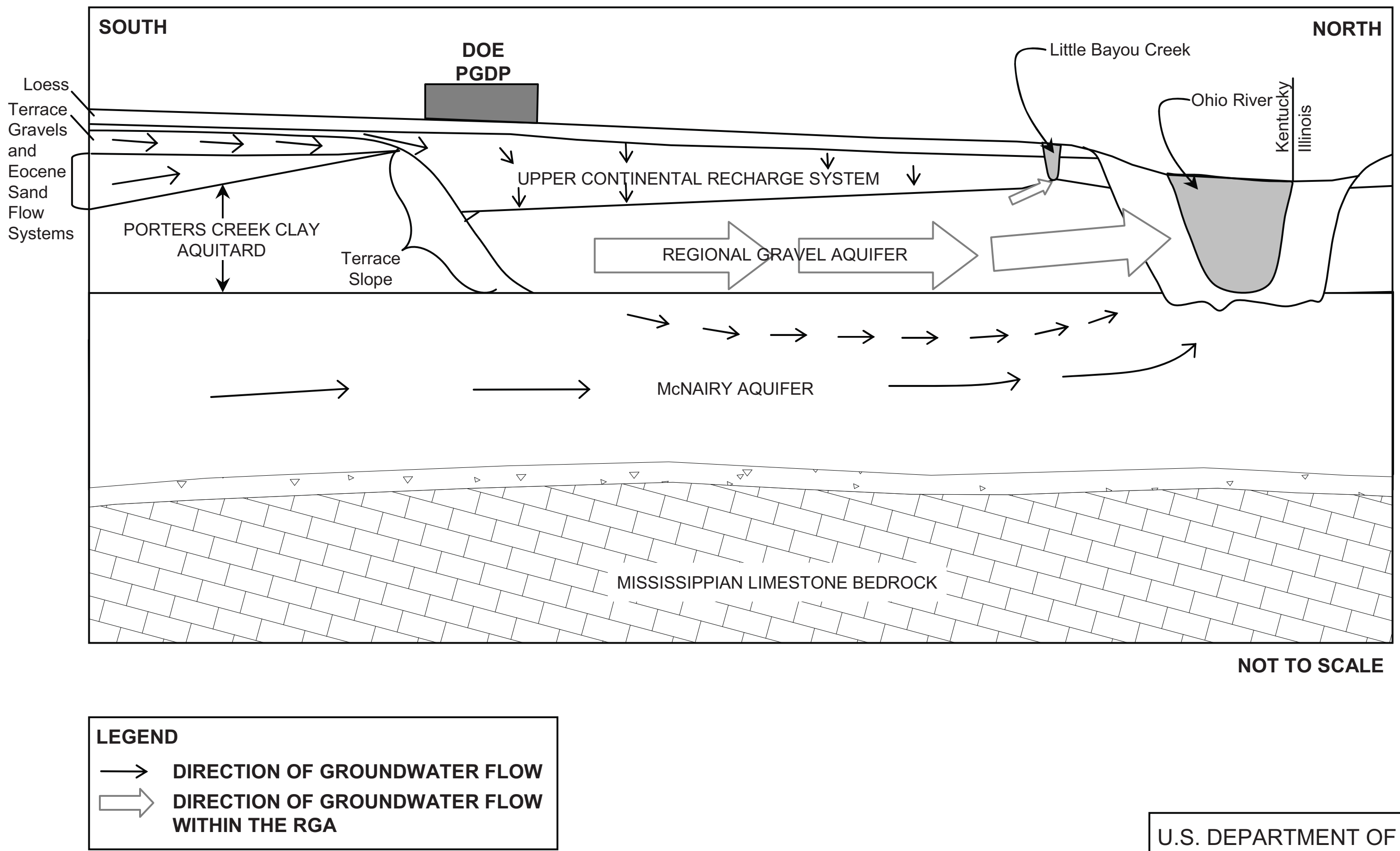
The contents of this report are as follows:

- Section C.2 discusses the technical approach used for determining the impacts of soil constituent concentrations on RGA groundwater.
- Section C.3 compiles and presents Soils OU SWMU/AOC-specific soil sample results and soil and groundwater flow and contaminant transport parameters. SESOIL and AT123D model input data are also presented.
- Section C.4 presents SESOIL and AT123D modeling results.
- Section C.5 provides references used in the report.
- Attachment C1 to Appendix C provides a discussion of the screening used to identify which SWMU/AOCs soil constituent combinations were subjected to modeling.
- Attachment C2 of Appendix C provides a three-dimensional analysis of the concentration data.
- Attachment C3 of Appendix C consists of the calculation package for the fate and transport modeling.

C.2. TECHNICAL APPROACH

The first step in this modeling effort was to evaluate SWMU/AOC-specific soil constituent concentration data and determine which SWMUs/AOCs and soil constituents posed a potential threat to RGA groundwater quality. The screening process followed Risk Methods Document (DOE 2015) procedures and is documented in the Fate and Transport Section of this report, as supplemented by Attachments C1, C2, and C3.

Next, the individual SWMU/AOC average soil constituent concentration was determined for 0-ft–5-ft, 5-ft–10-ft, and 10-ft–15 ft-depths, and these concentrations were used as input values for the SESOIL modeling. SESOIL-predicted UCRS temporal groundwater contaminant concentrations were then used as input to AT123D to predict downgradient RGA contaminant concentrations at the SWMU/AOC boundary.



Source: PRS 2009

U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

Figure C.1. Water-Bearing Zones near PGDP

C.3. DATA EVALUATION AND COMPILATION

This section compiles and presents Soils OU SWMU/AOC-specific soil sample results and soil and groundwater flow and contaminant transport parameters. SESOIL and AT123D model input data also are presented.

C.3.1 SOIL CONTAMINANT SCREENING

Soil contaminant screening (described in Attachment C1) was used to assess the SWMUs/AOCs and soil contaminants that potentially could impact RGA groundwater quality (see list in Table C.3.1). These SWMUs/AOCs and constituents were subjected to groundwater modeling to bound the potential for impacts to RGA groundwater.

Table C.3.1. SWMUs/AOCs and Associated Soil Constituents Subjected to Modeling

SWMU/AOC	Contaminant
13	Tc-99
15	Tc-99
26	Tc-99

C.3.2 AVERAGE UCRS SOIL CONTAMINANT CONCENTRATIONS AND DISTRIBUTIONS

The PGDP soils database was evaluated to determine how many samples (Table C.3.2) had been collected at each SWMU/AOC previously identified as potentially problematic (Table C.3.1). Field duplicate samples were collected at some locations as per the project SAP or QAPP (DOE 2010b and DOE 2014). Where field duplicate samples were collected, one result was selected for each location and depth interval using the following selection criteria: the maximum detected result was selected for locations and depths where both results were detected, the minimum reporting limit was selected for locations and depths where both samples were not detected, and the detected result was selected for locations and samples where one sample was reported as detected and the other a nondetect.

As per the Risk Methods Document (DOE 2015), the higher-concentration sample of the duplicate was retained in the data set and used in modeling. Given the small sample sizes, geostatistical evaluation was not used. Rather, soil concentration averages for the detections were calculated for 0-ft–5-ft, 5-ft–10-ft, and 10-ft–15-ft depths bgs (Table C.3.3).

The area affected by soil contamination was determined by assuming that the area impacted was proportional to the ratio of the number of detects verses the total number of samples collected in a depth interval at the SWMU/AOC. The ratio then was converted to a proportion, and the SWMU/AOC area was multiplied by the proportion to determine the impacted area (Table C.3.4). For example, at SWMU 13, at a depth interval of between 0 and 5 ft bgs, 35 of 52 soil samples had a detectable level of Tc-99 in soil. Based on the ratio, equal to a proportion of 0.673 (i.e., 35/52), the area affected by Tc-99 contamination was assumed to be 4.60 acres of the total SWMU size of 6.83 acres.

Table C.3.2. Soil Sample Summary[1]

SWMU/AOC	Size (acres)	Contaminant	Depth [ft below ground surface (bgs)]	Number of Samples	Number of Analytical Detects
13	6.83	Tc-99	0–5	53	17
			5–10	0	NA
			10–15	17	0
15	5.29	Tc-99	0–5	37	28
			5–10	0	NA
			10–15	0	NA
26	0.041	Tc-99	0–5	32	25
			5–10	6	5
			10–15	1	1

[1] Table C.3.2 counts only one soil sample result selected based on the selection criteria: the maximum detected result was selected for locations and depths where both results were detected, the minimum reporting limit was selected for locations and depths where both samples were not detected, and the detected result was selected for locations and samples where one sample was reported as detected and the other a nondetect..
NA = Not Applicable; no samples exist at specified interval.

Table C.3.3. Average Soil Constituent Concentrations

SWMU/AOC	Contaminant	0 ft–5 ft bgs Average Concentration (μg/g)	5 ft–10 ft bgs Average Concentration (μg/g)	10 ft–15 ft bgs Average Concentration (μg/g)
13	Tc-99	1.32E-3 (22.5 pCi/g)	NA	0
15	Tc-99	2.08E-3 (35.4 pCi/g)	NA	NA
26	Tc-99	2.09E-2 (355.4 pCi/g)	5.76E-5 (0.980 pCi/g)	2.35E-4 (4.00 pCi/g)

NA = Not applicable, no samples exist at specified interval.

Table C.3.4. Area of Soil Contamination

SWMU/AOC	SWMU/AOC Area (acres)	0 ft–5 ft bgs Contaminated Area (acres)	5 ft–10 ft bgs Contaminated Area (acres)	10 ft–15 ft bgs Contaminated Area (acres)
13 (Tc-99)	6.83	2.19	NA	0
15 (Tc-99)	5.29	4.00	NA	NA
26 (Tc-99)	0.041	0.032	0.034	0.041

NA = Not applicable, no samples exist at specified interval.

C.3.3 SESOIL AND AT123D INPUTS

The following section summarizes the input parameters used with the SESOIL and AT123D models. The units presented with the input data are those used with SESOIL and AT123D.

Table C.3.5 presents the UCRS properties used in the SESOIL model for 15 ft bgs or less. It previously was agreed upon in the Soils OU Work Plan that the Soils OU would limit the soil depths used in the modeling to 15 ft bgs or less. Thus, Soils OU SWMU-specific input at depths greater than 15 ft were not available for the SESOIL and AT123D simulations. For this reason, input parameters were developed in the Soils OU RI Report (DOE 2013). These same parameters, with the exception of the percolation rate, which was obtained from SESOIL climate data, were used in this addendum. For depths below 15 ft bgs, the constituent concentrations were assumed to be 0. Selection of this concentration for this interval is supported by the results shown in Table C.3.3 where soil concentrations of even mobile and soluble constituents like Tc-99 decrease by orders of magnitude below 5 ft of depth.

Table C.3.5. General SESOIL Input Parameters[1]

Input Parameter	Value	Source
Soil type	Silty clay	PGDP site-specific
Bulk density (g/cm^3)	1.46	Laboratory analysis
Annual Percolation rate (cm/year)	10.5	SESOIL Climate Data
Intrinsic permeability (cm^2)	1.65E-10	Calibrated
Disconnectedness index	10	Calibrated
Porosity	0.45	Laboratory analysis
Depth to RGA potentiometric surface (m)	16.76	Typical based on field observation
Organic carbon content ($f_{oc)}$ (%)	0.08	Laboratory analysis
Freundlich equation exponent	1	SESOIL default value

[1] Remedial Investigation Report for the Burial Grounds Operable Unit (DOE 2010a)

Chemical-specific parameters for Tc-99 (the soil constituent) are listed in Table C.3.6.

SESOIL uses the same contaminated soil area as an input parameter for all depth intervals in a given SWMU; however, as shown in Table C.3.4, the contaminated soil area in the Soils OU SWMUs varies with depth. To adjust the evaluation to allow the modeling to meet the SESOIL requirement of constant contaminated soil areas, the estimated soil concentrations were adjusted by multiplying the concentrations by the ratio of the depth-specific soil contamination area to the largest soil contamination area for that SWMU. Doing so yields a result that adjusts the contaminant mass loading used in the uniform SESOIL areas to match the actual contaminant mass loading. Table C.3.7 lists the area-adjusted soil contaminant concentrations used in the SESOIL modeling.

Table C.3.6. Chemical-Specific Parameters of the Site-Related Soil Constituents Used in SESOIL Modeling

Soil Constituent	Mol. Wt. (MW) (g/gmol)	Solubility in water (mg/L)	Diffusion in air (cm^2/s)	Diffusion in water (m^2/hr)	Henry's Constant ($atm.m^3/mol$)	K_{oc} (L/kg)	K_d (L/kg)	Degradation Half Life (years)
Tc-99	99	7.18E+03*	NA	3.60E-07	NA	NA	0.2	2.13E+05

Note:
*Tc-99 solubility is derived from the geochemical database "thermo.com.V8.R6.230," which was prepared by Lawrence Livermore National Laboratory. The exact database used here is "llnl.dat 4023 2010-02-09 21:02:42Z," which was converted to PHREEQC format by Greg Anderson and David Parkhurst of the U.S. Geological Survey.

Table C.3.7. Adjusted SESOIL Areas and Soil Constituent Concentrations

SWMU/ AOC	Soil Constituent	Contaminated Area (cm^2)	0 to 152.4 cm bgs Average Concentration (µg/g)	152.4 to 304.8 cm bgs Average Concentration (µg/g)	308.4 to 457.2 cm bgs Average Concentration (µg/g)
13	Tc-99	8.87E+07	1.32E-03 (22.5 pCi/g)	0	0
15	Tc-99	1.62E+08	2.08E-03 (35.4 pCi/g)	0	0
26	Tc-99	1.66E+06	1.63E-02 (277 pCi/g)	4.80E-05 (0.820 pCi/g)	2.35E-04 (4.00 pCi/g)

Note: The contaminated area presented is the maximum area of the three soil intervals at each contaminated site (see Table C.3.4).

General AT123D input parameters are listed in Table C.3.8.

Table C.3.8. General AT123D Input Parameters[1]

Input Parameter	Value	Source
Bulk density (kg/m^3)	1,670	Laboratory analysis
Effective porosity (unitless)	0.3	PGDP sitewide model calibrated value
Trichloroethene biological half-life (years)	10	RGA Biodegradation study (KCREE 2008)
Hydraulic conductivity (m/hour)	22.263	Historical sitewide model
Hydraulic gradient	0.0015	ArcGIS particle tracking shapefiles
RGA aquifer thickness (m)	9.14	Site average
Longitudinal dispersivity (m)	1.5	Template input files
Density of water (kg/m^3)	1,000	Default
Fraction of organic carbon (%)	0.02	Laboratory analysis
Well screen length (m)	3	Assumed a 10 ft well screen mixing zone

[1] Remedial Investigation Report for the Burial Grounds Operable Unit (DOE 2010a)

C.4. SESOIL AND AT123D RESULTS

SESOIL and AT123D simulation results are summarized in Table C.4.1. Based on the modeling results, the incremental contributions of Tc-99 currently present in soil at SWMUs 13, 15, and 26 do not have the potential to impact the RGA groundwater at the respective SWMU boundaries as the modeled-predicted concentrations in the RGA groundwater are less than the screening criterion of 900 pCi/L (DOE 2013). Consistent with the Soils OU RI Report (DOE 2013), 900 pCi/L was the criterion used in screening to determine which SWMUs were modeled for Tc-99 transport. Although the model predicts that the Tc-99 associated with the vadose zone at SWMUs 13, 15, and 26 will leach to the RGA, the mass flux of Tc-99 from the vadose zone to the RGA is insufficient to cause RGA groundwater concentrations to exceed the 900 pCi/L screening criterion.

Model predictions indicate that for SWMU-13, dissolved Tc-99 reaches the underlying saturated zone and SWMU boundary at 33 years. The peak predicted Tc-99 concentration occurs at 37 years. For SWMU-15, Tc-99 is predicted to reach the underlying saturated zone at 33 years and the SWMU boundary at 38 years. At SWMU-26, model results indicate that Tc-99 first arrives in the saturated zone after 29 years; however, AT123D modeling does not predict groundwater concentrations of Tc-99 greater than the modeling program's minimum concentration of 1E-02 µg/L (169 pCi/L).

Table C.4.1. SESOIL and AT123D Maximum Predicted Groundwater Concentrations

SWMU/ AOC	Groundwater Constituent	Maximum RGA Groundwater Concentration at SWMU/AOC Boundary (µg/L)	Predicted Time to Reach SWMU/AOC Boundary (years)
13	Tc-99	3.0E-2 (510 pCi/L)	33
15	Tc-99	4.0E-2 (680 pCi/L)	33
26	Tc-99	0[a]	N/A

Notes:
[a] Leaching does not result in Tc-99 groundwater concentrations greater than the AT123D minimum reported concentration of 1E-2 µg/L (169 pCi/L) at SWMU 26 boundary.

C.5. REFERENCES

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ATTACHMENT C1

DATA SCREENING

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C1.1. SCREENING FOR GROUNDWATER MODELING

Attachment C1 to Appendix C presents a summary of the multistage decision process established to identify which soil constituents were selected for evaluation using fate and transport modeling (hereafter referred to as "modeling") to estimate the potential for impacts to the Regional Gravel Aquifer (RGA) groundwater from contaminants in the Soils Operable Unit (OU) solid waste management units (SWMUs)/areas of concern (AOCs). The decision process is described further in the Methodology section (Section C.1.1) and involves the following:

1. Screening of Soils OU SWMU/AOC-specific soil sampling results against the Paducah project-specific remedial guide soil screening levels (RG SSLs); and

2. Review of the site-related soil constituents that are not screened from further modeling to identify which SWMU/AOC soil constituent combinations were subjected to modeling.

An identification of certain process-related soil constituents to ensure an appropriate dilution attenuation factor (DAF) is used in the detailed vadose zone/groundwater modeling was performed for the Soils OU Remedial Investigation Report at the Paducah Gasous Diffusion Plant (Soils OU RI Report) (DOE 2013). The RG SSLs were back-calculated from maximum contaminant levels (MCLs) (or risk-based values, if an MCL was not available) using the DAF. The DAF for the Soils OU SWMUs/AOCs was identified from a deterministic calculation and set at 58 (see Attachment C2 to Appendix C, Soils Operable Unit Dilution Attenuation Factor of the Soils OU RI Report).

C1.1.1 METHODOLOGY

C1.1.1.1 Screening Process

Analytical results for the Soils OU SWMUs/AOCs were first screened against SSL values to identify which SWMU/AOC soil constituent combinations may need modeling. The screening steps are listed below.

1. Soils OU RG SSLs were calculated based on the MCL or residential groundwater-use no action level (NAL) as adjusted by multiplying by a DAF of 58.

2. The average concentration of each soil constituent at each SWMU/AOC was compared to the SSL and background. That comparison was used for the following:

    a. If the average concentration of each soil constituent at each SWMU/AOC did not exceed the SSL and background values, the screening did not indicate the need for modeling due to the *overall* potential for impacts.

    b. If the average soil constituent concentration did exceed both the SSL and background, the need for modeling was further evaluated if that soil constituent is included in the list of contaminants of concern (COCs) identified for groundwater (Table C1.1).

Table C1.1. Chemicals Identified in the GWOU FS as Contaminants of Concern for the RGA Residential Use of Groundwater (DOE 2001)

Aluminum	1,1,1-Trichloroethane	Americium-241
Antimony	1,1,2-Trichloroethane	Cesium-137
Arsenic	1,1-Dichloroethene	Neptunium-237
Beryllium	1,2-Dichloroethane	Radium-226
Boron	*cis*-1,2-Dichloroethene	Radon-222
Cadmium	*trans*-1,2-Dichloroethene	Tc-99
Chromium	2-Butanone	Uranium-234
Fluoride	4-Methyl-2-pentanone	Uranium-235
Iron	Acetone	Uranium-238
Lead	Acrylonitrile	
Lithium	Benzene	
Manganese	Bis(2-ethylhexyl)phthalate	
Molybdenum	Bromomethane	
Nickel	Carbazole	
Silver	Carbon tetrachloride	
Vanadium	Chlorobenzene	
	Chloroform	
	Chloromethane	
	Ethylbenzene	
	Methylene chloride	
	Aroclor-1254	
	Polychlorinated biphenyls	
	Tetrachloroethene	
	Trichloroethene	
	Vinyl chloride	
	Xylenes	

3. Information on the presence of a contaminant in RGA groundwater and whether the results of prior modeling indicated RGA groundwater concentrations of the contaminant consistent with background were considered when determining if detailed modeling of the residual soil contaminant was performed.

4. The individual soil constituent concentrations were compared to the SSL/background values; if at least three sample results from one SWMU/AOC exceeded the SSL/background concentrations, modeling of the SWMU/AOC soil constituent combination was considered. Some of these SWMU/AOC soil constituent combinations were evaluated further using Mining Visualization Software (MVS) (Version 9.85) (CTech Software 2014) to identify if the exceedances are indicative of hot spots and whether any of these SWMU/AOC soil constituent combinations needed to be subjected to modeling.

For those SWMU/AOC soil constituent combinations whose average concentration at that SWMU/AOC exceeded the screening levels listed above, the next step was to review those combinations against the groundwater COC list (Table C1.1), the groundwater data, and the other site-specific considerations (e.g., location of the SWMU/AOC relative to the groundwater data) to support a determination of those constituents that then were subjected to modeling. The determination of which soil constituent SWMU/AOC combinations to subject to modeling considered the nature of the soil constituents (e.g., are they naturally occurring compounds?) and whether there was an identified groundwater impact of that soil constituent in the vicinity of the SWMU/AOC in question. Information provided in the assessment performed in the Soils OU RI Report also was incorporated into the screening process.

After following the above process, the decision was made to model technetium-99 at SWMUs 13, 15, and 26. Tc-99 was modeled in accordance with the RMD, Section 3.3.4.3 (DOE 2015), though the screening process did not necessarily identify a groundwater impact attributable to any Soils OU SWMU/AOC.

C1.1.2 RG SSL DETERMINATION

The RG SSLs were determined using the U.S. Environmental Protection Agency (EPA)-established formulas listed below. These formulas and inputs are consistent with those used in the Risk Methods Document (DOE 2015). If an MCL has been established for the chemical constituent, then the RG SSLs are based on the MCL; if not, then they are based on the residential NAL for groundwater use.

For inorganic compounds,

$$C_t = C_w\left(K_d + \frac{\theta_w + \theta_a H'}{\rho_b}\right)$$

Where:
C_t = screening level in soil (mg/kg)
C_w = target soil leachate concentration (mg/L) (MCL or residential NAL × 58 DAF)
K_d = soil-water partition coefficient (L/kg) (chemical-specific, see Table C1.1)
θ_w = water-filled soil porosity (L_{water}/L_{soil}) (0.3) (EPA 1996)
θ_a = air-filled soil porosity (L_{air}/L_{soil}) (0.13) (EPA 1996)
ρ_b = dry soil bulk density (kg/L) (1.5) (EPA 1996)
H' = dimensionless Henry's law constant [chemical-specific × 41 (conversion factor)] (value taken from EPA Web site http://www.epa.gov/safewater/consumer/pdf/mcl.pdf)

For organic compounds,

$$C_t = C_w\left((K_{oc}\, f_{oc}) + \frac{\theta_w + \theta_a H'}{\rho_b}\right)$$

Where:
C_t = screening level in soil (mg/kg)
C_w = target soil leachate concentration (mg/L) (MCL or residential NAL × 58 DAF)
K_{oc} = soil organic carbon-water partition coefficient (L/kg) (chemical-specific, taken from EPA Web site)
f_{oc} = organic carbon content of soil (kg/kg) (0.002) (EPA 1996)
θ_w = water-filled soil porosity (L_{water}/L_{soil}) (0.3) (EPA 1996)
θ_a = air-filled soil porosity (L_{air}/L_{soil}) (0.13) (EPA 1996)
ρ_b = dry soil bulk density (kg/L) (1.5) (EPA 1996)
H' = dimensionless Henry's law constant [chemical-specific × 41 (conversion factor)] (value taken from EPA Web site http://www.epa.gov/safewater/consumer/pdf/mcl.pdf)

C1.2. SCREENING, EVALUATION, AND RESULTS

C1.2.1 INITIAL SCREENING

Initial screening of the maximum detected value (only laboratory and validation qualifiers were considered in determining whether a result was detected) of soil constituents from each SWMU/AOC included determining if any of the results from that SWMU/AOC included a detected value greater than the RG SSL or subsurface background value. Only laboratory and validation qualifiers were considered in determining whether a result was detected. Chapter 4 and Appendix B of this Remedial Investigation Report give additional information regarding data quality and the use of data qualifiers for this project. A list of screening values is presented in Table C1.2.

Table C1.2. Soils OU Soil Screening Levels for Groundwater Modeling

Chemical	Target Conc. (mg/L or pCi/L)[a]	Target Ref.[b]	Subsurface Background Conc.[a]	K_d[c] (L/kg)	RG SSL (DAF 58)	UNITS
Metals						
Aluminum	1.04E+00	NAL	1.20E+04	1.50E+03	1.73E+05	mg/kg
Antimony	6.00E-03	MCL	2.10E-01	4.50E+01	1.57E+01	mg/kg
Arsenic	1.00E-02	MCL	7.90E+00	2.90E+01	1.69E+01	mg/kg
Barium	2.00E+00	MCL	1.70E+02	4.10E+01	4.78E+03	mg/kg
Beryllium	4.00E-03	MCL	6.90E-01	7.90E+02	1.83E+02	mg/kg
Boron	2.08E-01	NAL	N/A	3.00E+00	7.40E+01	mg/kg
Cadmium	5.00E-03	MCL	2.10E-01	7.50E+01	2.18E+01	mg/kg
Chromium	1.00E-01	MCL	4.30E+01	1.80E+06	1.04E+07	mg/kg
Cobalt	3.13E-04	NAL	1.30E+01	4.50E+01	1.57E+00	mg/kg
Copper	1.30E+00	MCL	2.50E+01	3.50E+01	2.65E+03	mg/kg
Iron	7.29E-01	NAL	2.80E+04	2.50E+01	2.04E+03	mg/kg
Lead	1.50E-02	MCL	2.30E+01	9.00E+02	7.83E+02	mg/kg
Manganese	2.45E-02	NAL	8.20E+02	6.50E+01	1.59E+02	mg/kg
Mercury	2.00E-03	NAL	1.30E-01	5.20E+01	1.68E+00	mg/kg
Molybdenum	5.21E-03	NAL	N/A	2.00E+01	1.17E+01	mg/kg
Nickel	2.08E-02	NAL	2.20E+01	6.50E+01	1.47E+02	mg/kg
Selenium	5.00E-02	MCL	7.00E-01	5.00E+00	1.51E+01	mg/kg
Silver	5.15E-03	NAL	2.70E+00	8.30E+00	4.55E+00	mg/kg
Thallium	2.00E-03	MCL	3.40E-01	7.10E+01	8.26E+00	mg/kg
Uranium[e]	3.00E-02	MCL	4.60E+00	4.50E+02	7.83E+02	mg/kg
Vanadium	7.06E-05	NAL	3.70E+01	1.00E+03	4.79E+02	mg/kg
Zinc	3.13E-01	NAL	6.00E+01	6.20E+01	2.16E+03	mg/kg

Table C1.2. Soils OU Soil Screening Levels for Groundwater Modeling (Continued)

Chemical	Target Conc. (mg/L or pCi/L)[a]	Target Ref.[b]	Subsurface Background Conc.[a]	K_d[c] (L/kg)	RG SSL (DAF 58)	UNITS
Radionuclides[e]						
Americium-241	5.04E-01	NAL	N/A	8.20E+00	5.55E+01	pCi/g
Cesium-137	1.71E+00	NAL	2.80E-01	1.00E+01	2.78E+01	pCi/g
Neptunium-237	7.63E-01	NAL	N/A	1.00E-01	3.11E+00	pCi/g
Plutonium-238	3.98E-01	NAL	N/A	5.00E+00	1.27E+01	pCi/g
Plutonium-239	3.87E-01	NAL	N/A	5.00E+00	1.23E+01	pCi/g
Tc-99	1.90E+01	NAL	2.80E+00	2.00E-01	4.41E-01	pCi/g
Thorium-230	5.72E-01	NAL	1.40E+00	2.00E+01	1.06E+02	pCi/g
Uranium-234	7.39E-01	NAL	1.20E+00	4.50E+02	2.87E+00	pCi/g
Uranium-235	7.28E-01	NAL	6.00E-02	4.50E+02	2.83E+00	pCi/g
Uranium-238	6.01E-01	NAL	1.20E+00	4.50E+02	2.34E+00	pCi/g
Organics (PCBs)						
PCB, Total	5.00E-04	MCL	N/A	1.56E+02	4.54E+00	mg/kg
Organics (Semivolatile)						
Acenaphthene	1.38E-02	NAL	N/A	1.01E+01	2.94E+01	mg/kg
Anthracene	6.39E-02	NAL	N/A	3.27E+01	3.05E+02	mg/kg
Bis(2-ethylhexyl) phthalate	6.00E-03	MCL	N/A	2.39E+02	8.33E+01	mg/kg
Fluoranthene	1.44E-02	NAL	N/A	1.11E+02	5.17E+02	mg/kg
Fluorene	8.91E-03	NAL	N/A	1.83E+01	2.89E+01	mg/kg
Hexachlorobenzene	1.00E-03	MCL	N/A	1.24E+01	7.31E-01	mg/kg
Naphthalene	1.76E-04	NAL	N/A	3.09E+00	3.15E-02	mg/kg
Nitroaniline, 2-	1.02E-02	NAL	N/A	5.51E-01	4.61E-01	mg/kg
Nitroso-di-N-propylamine, N-	8.03E-06	NAL	N/A	5.26E+00	4.69E-04	mg/kg
Pentachlorophenol	1.00E-03	MCL	N/A	9.92E+00	5.87E-01	mg/kg
Pyrene	5.81E-03	NAL	N/A	1.09E+02	6.82E+01	mg/kg
Total PAH [Benz(a)pyrene][d]	1.22E-05	NAL	N/A	3.54E+02	7.05E-01	mg/kg
Organics (Volatile)						
Benzene	5.00E-03	MCL	N/A	2.92E-01	1.48E-01	mg/kg
Carbon Tetrachloride	5.00E-03	MCL	N/A	8.78E-02	1.13E-01	mg/kg
Chloroform	8.00E-02	MCL	N/A	6.36E-02	1.29E+00	mg/kg
Dibromochloromethane	8.00E-02	MCL	N/A	6.36E-02	1.26E+00	mg/kg
Dichloroethane, 1,2-	5.00E-03	MCL	N/A	7.92E-02	8.22E-02	mg/kg
Dichloroethene, 1,1-	7.00E-03	MCL	N/A	6.36E-02	1.46E-01	mg/kg
Dichloroethene, 1,2-	2.24E-03	NAL	N/A	7.92E-02	2.73E-01	mg/kg
Dichloroethene, 1,2-*cis*-	7.00E-02	MCL	N/A	7.92E-02	1.19E+00	mg/kg
Dichloroethene, 1,2-*trans*-	1.00E-01	MCL	N/A	7.92E-02	1.71E+00	mg/kg
Ethylbenzene	7.00E-01	MCL	N/A	8.92E-01	4.55E+01	mg/kg
Tetrachloroethene	5.00E-03	MCL	N/A	1.90E-01	1.31E-01	mg/kg
Toluene	1.00E+00	MCL	N/A	4.68E-01	4.01E+01	mg/kg

Table C1.2. Soils OU Soil Screening Levels for Groundwater Modeling

Chemical	Target Conc. (mg/L or pCi/L)[a]	Target Ref.[b]	Subsurface Background Conc.[a]	K_d[c] (L/kg)	RG SSL (DAF 58)	UNITS
Trichloroethane, 1,1,1-	2.00E-01	NAL	N/A	8.78E-02	4.07E+00	mg/kg
Trichloroethane, 1,1,2-	5.00E-03	MCL	N/A	1.21E-01	9.41E-02	mg/kg
Trichloroethene	5.00E-03	MCL	N/A	1.21E-01	1.04E-01	mg/kg
Vinyl Chloride	2.00E-03	MCL	N/A	4.35E-02	4.00E-02	mg/kg
Xylene, Mixture	1.00E+01	MCL	N/A	7.66E-01	5.71E+02	mg/kg
Xylene, m,p-	1.00E+01	NAL	N/A	7.51E-01	1.09E+00	mg/kg
Xylene, o-	4.85E-02	NAL	N/A	7.66E-01	1.10E+00	mg/kg

N/A = not available or not applicable; not used in this screening.
Conc. = Concentration. Concentration units as noted in the units column.
Ref. = Reference
Bckgd. = Background
[a] Target concentrations for soil constituents without an MCL and subsurface background values are taken from the Risk Methods Document (DOE 2015).
[b] MCLs are taken from the EPA Web site: http://www.epa.gov/safewater/consumer/pdf/mcl.pdf.
[c] K_d values are taken from the EPA Web site http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search, consistent with the Risk Methods Document, except for Tc-99 and uranium. The Tc-99 and uranium Kd values are set at levels consistent with the Burial Grounds Operable Unit to reflect the PGDP site. The model input parameters are found in Table B.2 and Table B.3 of the *Remedial Investigation for the Burial Grounds Operable unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-0030&D2/R1, February 2010.
[d] RG SSL (DAF 58) are taken from Table A.7a of the Risk Methods Document (DOE 2015).
[e] RG SSL (DAF 58) for radionuclides are taken from Table A.7b of the Risk Methods Document (DOE 2015) at 10^{-6} risk.

The overall average value of the soil constituent for each SWMU/AOC was calculated using both detected values and nondetected values (nondetected values at one-half the reported value). These values were used as reported and not segregated into grid values. If the overall average value of the soil constituent for the SWMU/AOC was below the background value or the RG SSL, then the soil constituent was screened out from consideration for modeling for general fate and transport. The fate and transport modeling utilizes a weighted average value of the concentration of the chemical as the source term value (see Appendix C, Attachment C3); thus, the modeled value for the RGA concentration at the SWMU/AOC boundary is expected to be below the target (MCL or risk-based) concentration if the average soil concentration is below the SSL.

If the average soil constituent concentration was found to be above both the background value and the RG SSL, then the soil constituent subsequently was evaluated against the groundwater COCs (Table C1.1) and against the information available about RGA groundwater impacts (see Section C1.3). For example, this evaluation resulted in screening out those constituents that are not RGA groundwater COCs (e.g., cobalt) or those soil constituents that are not typically detected in RGA groundwater (e.g., silver). Additionally, if there were three or more exceedances of both the background value and the RG SSL, and the constituent is an RGA groundwater COC, and the constituent is typically detected in RGA groundwater, the soils results were evaluated against any patterns of detection in RGA groundwater to identify whether a given SWMU/AOC might have been a source of the RGA exceedances. The additional information for this screening and the results of this screening are presented in the following sections.

C1.2.2 HOT SPOT SCREENING

To determine if hot spots exist within the SWMU/AOC that might pose a localized threat to groundwater, the constituents for a given SWMU/AOC where the average concentration exceeded the RG SSL and the background concentration, where the constituent is considered to be an RGA groundwater COC (as presented in C1.2), where the constituent is typically detected in RGA groundwater (see discussion in Section C1.3.3 of the Soils OU RI Report), and where there were three or more individual result exceedances of the RG SSL and the background concentration, the results were evaluated and soil constituents and SWMUs/AOCs were selected for further evaluation.

For the selected soil constituents, the results of this evaluation were summarized graphically. These graphs are presented in Attachment C2 to Appendix C. The selected SWMU/AOC soil constituent combinations were evaluated using MVS and plotted by depth and spatially to support an evaluation of whether a hot spot exists and whether it may present a potential risk to RGA groundwater.

C1.2.3 SCREENING SUMMARY, OVERALL AVERAGE

Table C1.3 provides the results of the screening where the overall average concentration of a soil constituent exceeds both the respective SSL and the background concentration.

The results of the screening are summarized in Table C1.3 to find a total of 109 SWMU/AOC soil constituent combinations that exceeded screening values, as follows:

- 6 exceeded for antimony;
- 1 exceeded for iron;
- 3 exceeded for mercury;
- 4 exceeded for naphthalene;
- 1 exceeded for neptunium-237;
- 1 exceeded for nickel;
- 2 exceeded for PCB, Total;
- 5 exceeded for silver;
- 6 exceeded for Tc-99;
- 5 exceeded for uranium-234;
- 1 exceeded for uranium-235; and
- 8 exceeded for uranium-238.

Each of the 9 SWMUs considered in this assessment had at least one exceedance. Although widely distributed, the frequency of exceedance for each soil constituent and the distribution of the exceedances do not indicate impacts to the RGA from soils in these SWMUs for the reasons discussed below. Nevertheless, each of the soil constituents was evaluated further against the RGA groundwater data (see Section C1.3) to identify which SWMU/AOC soil constituent combinations were subjected to fate and transport modeling.

Table C1.3. SWMU/AOC Soil Constituent Combinations That Survive Screening and Are Considered for Modeling Based on Overall Average Concentration

#	SWMU/ AOC	Analyte	Units	No. Samples	Average Concentration[a]	Maximum Concentration[a]	Subsurface Background Concentration[b]	RG SSL Concentration (DAF 58)[c]	Screening Value (Higher of RG SSL or Background)
1	13	Cobalt	mg/kg	24	6.16E+00	1.20E+01	1.30E+01	1.57E+00	1.30E+01
2	13	Iron	mg/kg	226	1.85E+04	4.78E+04	2.80E+04	2.04E+03	2.80E+04
3	13	Manganese	mg/kg	226	5.38E+02	3.11E+03	8.20E+02	1.59E+02	8.20E+02
4	13	Molybdenum	mg/kg	218	3.19E+00	4.30E+01		1.17E+01	1.17E+01
5	13	Silver	mg/kg	256	1.79E+01	1.46E+02	2.70E+00	4.55E+00	4.55E+00
6	13	Tc-99	pCi/g	92	4.92E+00	1.50E+02	2.80E+00	4.41E-01	2.80E+00
7	13	Uranium-234	pCi/g	91	1.58E+00	3.57E+01	1.20E+00	2.87E+00	2.87E+00
8	13	Uranium-235	pCi/g	92	1.43E-01	4.12E+00	6.00E-02	2.83E+00	2.83E+00
9	13	Uranium-238	pCi/g	91	2.50E+00	6.41E+01	1.20E+00	2.34E+00	2.34E+00
10	15	Antimony	mg/kg	334	6.32E+01	2.83E+02	2.10E-01	1.57E+01	1.57E+01
11	15	Arsenic	mg/kg	346	8.85E+00	1.11E+02	7.90E+00	1.69E+01	1.69E+01
12	15	Cadmium	mg/kg	334	6.68E+00	2.42E+01	2.10E-01	2.18E+01	2.18E+01
13	15	Cobalt	mg/kg	26	8.98E+00	3.41E+01	1.30E+01	1.57E+00	1.30E+01
14	15	Copper	mg/kg	346	1.30E+02	6.12E+03	2.50E+01	2.65E+03	2.65E+03
15	15	Iron	mg/kg	332	1.98E+04	1.71E+05	2.80E+04	2.04E+03	2.80E+04
16	15	Lead	mg/kg	346	5.59E+01	1.80E+03	2.30E+01	7.83E+02	7.83E+02
17	15	Manganese	mg/kg	332	4.20E+02	2.90E+03	8.20E+02	1.59E+02	8.20E+02
18	15	Mercury	mg/kg	345	5.17E+00	1.53E+01	1.30E-01	1.68E+00	1.68E+00
19	15	Molybdenum	mg/kg	332	6.93E+00	2.36E+01		1.17E+01	1.17E+01
20	15	Naphthalene	mg/kg	37	2.07E-01	1.20E-01		3.15E-02	3.15E-02
21	15	Neptunium-237	pCi/g	37	2.68E-01	4.10E+00		3.11E+00	3.11E+00
22	15	Nickel	mg/kg	346	1.19E+02	3.79E+03	2.20E+01	1.47E+02	1.47E+02
23	15	PCB, Total	mg/kg	345	3.63E+00	5.50E+01		4.54E+00	4.54E+00
24	15	Phenanthrene	mg/kg	37	4.14E-01	2.90E+00		5.87E-01	5.87E-01
25	15	Selenium	mg/kg	346	8.94E+00	2.67E+01	7.00E-01	1.51E+01	1.51E+01
26	15	Silver	mg/kg	346	5.92E+00	1.80E+01	2.70E+00	4.55E+00	4.55E+00
27	15	Tc-99	pCi/g	37	2.69E+01	3.67E+02	2.80E+00	4.41E-01	2.80E+00
28	15	Uranium-234	pCi/g	37	9.33E+00	1.85E+02	1.20E+00	2.87E+00	2.87E+00
29	15	Uranium-235	pCi/g	37	8.53E-01	2.17E+01	6.00E-02	2.83E+00	2.83E+00

Table C1.3. SWMU/AOC Soil Constituent Combinations That Survive Screening and Are Considered for Modeling Based on Overall Average Concentration (Continued)

#	SWMU/ AOC	Analyte	Units	No. Samples	Average Concentration[a]	Maximum Concentration[a]	Subsurface Background Concentration[b]	RG SSL Concentration (DAF 58)[c]	Screening Value (Higher of RG SSL or Background)
30	15	Uranium-238	pCi/g	37	3.60E+01	1.10E+03	1.20E+00	2.34E+00	2.34E+00
31	15	Zinc	mg/kg	346	1.45E+02	3.17E+03	6.00E+01	2.16E+03	2.16E+03
32	26	Antimony	mg/kg	105	3.61E+01	1.74E+02	2.10E-01	1.57E+01	1.57E+01
33	26	Arsenic	mg/kg	157	9.35E+00	1.60E+02	7.90E+00	1.69E+01	1.69E+01
34	26	Cadmium	mg/kg	112	4.36E+00	2.83E+01	2.10E-01	2.18E+01	2.18E+01
35	26	Cobalt	mg/kg	44	9.66E+00	9.05E+01	1.30E+01	1.57E+00	1.30E+01
36	26	Copper	mg/kg	150	1.07E+02	9.52E+03	2.50E+01	2.65E+03	2.65E+03
37	26	Iron	mg/kg	150	1.82E+04	8.51E+04	2.80E+04	2.04E+03	2.80E+04
38	26	Manganese	mg/kg	150	4.03E+02	1.80E+03	8.20E+02	1.59E+02	8.20E+02
39	26	Mercury	mg/kg	160	7.57E+00	1.40E+01	1.30E-01	1.68E+00	1.68E+00
40	26	Molybdenum	mg/kg	115	6.69E+00	7.80E+01		1.17E+01	1.17E+01
41	26	Naphthalene	mg/kg	74	2.85E-01	7.20E-01		3.15E-02	3.15E-02
42	26	Neptunium-237	pCi/g	44	4.40E+00	5.50E+01		3.11E+00	3.11E+00
43	26	Nickel	mg/kg	154	1.56E+02	1.76E+04	2.20E+01	1.47E+02	1.47E+02
44	26	Phenanthrene	mg/kg	71	3.19E-01	8.70E-01		5.87E-01	5.87E-01
45	26	Plutonium-239/240	pCi/g	50	1.31E+00	1.59E+01		1.23E+01	1.23E+01
46	26	Silver	mg/kg	157	9.46E+00	1.26E+01	2.70E+00	4.55E+00	4.55E+00
47	26	Tc-99	pCi/g	47	2.38E+02	4.84E+03	2.80E+00	4.41E-01	2.80E+00
48	26	Thallium	mg/kg	53	2.15E+00	1.39E+01	3.40E-01	8.26E+00	8.26E+00
49	26	Thorium-230	pCi/g	47	6.45E+00	1.11E+02	1.40E+00	1.06E+02	1.06E+02
50	26	Uranium	mg/kg	142	1.41E+02	3.10E+03	4.60E+00	7.83E+02	7.83E+02
51	26	Uranium-234	pCi/g	51	2.64E+01	4.37E+02	1.20E+00	2.87E+00	2.87E+00
52	26	Uranium-235	pCi/g	49	1.59E+00	3.19E+01	6.00E-02	2.83E+00	2.83E+00
53	26	Uranium-238	pCi/g	52	5.94E+01	1.04E+03	1.20E+00	2.34E+00	2.34E+00
54	77	Cobalt	mg/kg	2	5.15E+00	7.80E+00	1.30E+01	1.57E+00	1.30E+01
55	77	Iron	mg/kg	15	2.84E+04	5.03E+04	2.80E+04	2.04E+03	2.80E+04
56	77	Manganese	mg/kg	15	2.70E+02	6.50E+02	8.20E+02	1.59E+02	8.20E+02
57	77	PCB, Total	mg/kg	13	2.55E+00	5.00E+00		4.54E+00	4.54E+00
58	77	Tc-99	pCi/g	3	3.55E+00	1.85E+00	2.80E+00	4.41E-01	2.80E+00
59	77	Uranium-234	pCi/g	2	2.83E+00	4.18E+00	1.20E+00	2.87E+00	2.87E+00
60	77	Uranium-238	pCi/g	2	1.06E+01	1.53E+01	1.20E+00	2.34E+00	2.34E+00
61	80	Antimony	mg/kg	15	3.00E+01	9.60E+01	2.10E-01	1.57E+01	1.57E+01

Table C1.3. SWMU/AOC Soil Constituent Combinations That Survive Screening and Are Considered for Modeling Based on Overall Average Concentration (Continued)

#	SWMU/ AOC	Analyte	Units	No. Samples	Average Concentration[a]	Maximum Concentration[a]	Subsurface Background Concentration[b]	RG SSL Concentration (DAF 58)[c]	Screening Value (Higher of RG SSL or Background)
62	80	Cobalt	mg/kg	6	9.32E+00	1.90E+01	1.30E+01	1.57E+00	1.30E+01
63	80	Iron	mg/kg	65	2.47E+04	4.13E+04	2.80E+04	2.04E+03	2.80E+04
64	80	Manganese	mg/kg	65	4.48E+02	2.07E+03	8.20E+02	1.59E+02	8.20E+02
65	80	Mercury	mg/kg	66	1.59E+01	6.88E+00	1.30E-01	1.68E+00	1.68E+00
66	80	Molybdenum	mg/kg	65	4.87E+00	4.60E+01		1.17E+01	1.17E+01
67	80	Naphthalene	mg/kg	8	1.81E-01	7.40E-02		3.15E-02	3.15E-02
68	80	PCB, Total	mg/kg	214	6.13E+00	4.75E+02		4.54E+00	4.54E+00
69	80	Phenanthrene	mg/kg	8	2.62E-01	7.80E-01		5.87E-01	5.87E-01
70	80	Tc-99	pCi/g	9	3.72E+00	2.95E+01	2.80E+00	4.41E-01	2.80E+00
71	80	Uranium	mg/kg	72	1.04E+02	5.72E+03	4.60E+00	7.83E+02	7.83E+02
72	80	Uranium-234	pCi/g	9	5.07E+01	2.29E+02	1.20E+00	2.87E+00	2.87E+00
73	80	Uranium-235	pCi/g	8	3.90E+00	3.00E+01	6.00E-02	2.83E+00	2.83E+00
74	80	Uranium-238	pCi/g	9	3.82E+02	1.92E+03	1.20E+00	2.34E+00	2.34E+00
75	204	Arsenic	mg/kg	432	6.02E+00	1.36E+02	7.90E+00	1.69E+01	1.69E+01
76	204	Cobalt	mg/kg	50	7.12E+00	1.80E+01	1.30E+01	1.57E+00	1.30E+01
77	204	Iron	mg/kg	432	2.28E+04	4.60E+04	2.80E+04	2.04E+03	2.80E+04
78	204	Manganese	mg/kg	432	5.84E+02	2.80E+03	8.20E+02	1.59E+02	8.20E+02
79	204	Molybdenum	mg/kg	432	3.33E+00	4.10E+01		1.17E+01	1.17E+01
80	204	PCB, Total	mg/kg	486	2.12E+00	7.90E+01		4.54E+00	4.54E+00
81	204	Silver	mg/kg	432	2.26E+01	8.90E+01	2.70E+00	4.55E+00	4.55E+00
82	204	Tc-99	pCi/g	58	9.41E-01	7.64E+00	2.80E+00	4.41E-01	2.80E+00
83	204	Uranium	mg/kg	433	3.63E+01	1.31E+04	4.60E+00	7.83E+02	7.83E+02
84	204	Uranium-234	pCi/g	54	1.43E+01	4.45E+02	1.20E+00	2.87E+00	2.87E+00
85	204	Uranium-235	pCi/g	62	1.37E+00	5.70E+01	6.00E-02	2.83E+00	2.83E+00
86	204	Uranium-238	pCi/g	54	1.46E+02	4.39E+03	1.20E+00	2.34E+00	2.34E+00
87	211	Antimony	mg/kg	34	3.41E+01	9.74E+01	2.10E-01	1.57E+01	1.57E+01
88	211	Cobalt	mg/kg	11	9.94E+00	4.95E+01	1.30E+01	1.57E+00	1.30E+01
89	211	Iron	mg/kg	60	1.68E+04	4.71E+04	2.80E+04	2.04E+03	2.80E+04
90	211	Manganese	mg/kg	60	2.39E+02	7.01E+02	8.20E+02	1.59E+02	8.20E+02
91	211	Neptunium-237	pCi/g	10	7.15E-01	5.93E+00		3.11E+00	3.11E+00
92	211	PCB, Total	mg/kg	75	9.16E+00	1.40E+02		4.54E+00	4.54E+00
93	211	Silver	mg/kg	60	1.43E+01	1.27E+02	2.70E+00	4.55E+00	4.55E+00

Table C1.3. SWMU/AOC Soil Constituent Combinations That Survive Screening and Are Considered for Modeling Based on Overall Average Concentration (Continued)

#	SWMU/ AOC	Analyte	Units	No. Samples	Average Concentration[a]	Maximum Concentration[a]	Subsurface Background Concentration[b]	RG SSL Concentration (DAF 58)[c]	Screening Value (Higher of RG SSL or Background)
94	211	Tc-99	pCi/g	7	1.70E+01	1.06E+02	2.80E+00	4.41E-01	2.80E+00
95	211	Uranium-234	pCi/g	10	8.66E+00	6.69E+01	1.20E+00	2.87E+00	2.87E+00
96	211	Uranium-235	pCi/g	7	7.08E-01	3.86E+00	6.00E-02	2.83E+00	2.83E+00
97	211	Uranium-238	pCi/g	9	1.68E+01	1.19E+02	1.20E+00	2.34E+00	2.34E+00
98	224	Antimony	mg/kg	6	5.38E+01	1.08E+02	2.10E-01	1.57E+01	1.57E+01
99	224	Cobalt	mg/kg	2	7.35E+00	7.60E+00	1.30E+01	1.57E+00	1.30E+01
100	224	Iron	mg/kg	6	1.58E+04	2.10E+04	2.80E+04	2.04E+03	2.80E+04
101	224	Manganese	mg/kg	6	3.99E+02	6.26E+02	8.20E+02	1.59E+02	8.20E+02
102	224	Naphthalene	mg/kg	2	1.17E-01	5.90E-02		3.15E-02	3.15E-02
103	224	Tc-99	pCi/g	3	3.13E-01	4.80E-01	2.80E+00	4.41E-01	2.80E+00
104	224	Uranium-238	pCi/g	3	6.89E+00	1.39E+01	1.20E+00	2.34E+00	2.34E+00
105	225	Antimony	mg/kg	5	2.28E+01	5.41E+01	2.10E-01	1.57E+01	1.57E+01
106	225	Cobalt	mg/kg	2	6.10E+00	7.30E+00	1.30E+01	1.57E+00	1.30E+01
107	225	Iron	mg/kg	7	1.74E+04	2.73E+04	2.80E+04	2.04E+03	2.80E+04
108	225	Manganese	mg/kg	7	4.85E+02	8.55E+02	8.20E+02	1.59E+02	8.20E+02
109	225	Molybdenum	mg/kg	7	8.77E+00	3.60E+01		1.17E+01	1.17E+01

RG SSL= Remedial Guide Soil Screening Level
[a] Concentration units as noted in the units column.
[b] Subsurface background concentration values are taken from the Risk Methods Document (DOE 2015).
[c] Subsurface RG SSL (DAF 58) as shown in Table C1.2.

C1.2.4 ADDITIONAL SCREENING

The screenings were extended by reviewing the soil constituents and site-specific information, including an evaluation based in part upon the presence of these soil constituents in PGDP RGA groundwater as COCs (see Table C1.1). The discussion of this screening is presented below. Based on this screening, detailed modeling was completed for Tc-99, at SWMU 26 (the SWMU/AOC with the greatest average concentration). This modeling was performed to bound the potential for Tc-99 to migrate to the RGA groundwater from the Soil OU SWMUs/AOCs. Detailed modeling also was completed for Tc-99 at SWMUs 13 and 15 due to their having an average Tc-99 concentration above the RGA groundwater SSL combined with their proximity to the Tc-99 RGA groundwater plume.

No modeling was conducted for antimony, iron, mercury, naphthalene, neptunium-237, silver, Total PCBs, or uranium-238 because the soil constituent did not fail screening, the soil constituent is not a problem for PGDP groundwater, or the concentration of the soil constituent in groundwater is controlled by other factors as discussed in Section C1.3.

Uranium-234 exceeded both the SSL and background concentrations at SWMU 26 and exhibited clustering when the results were viewed in 3-dimensions; however, the average concentration of uranium-234 (26.5 pCi/g) when converted to uranium (78 μg/g) was less than the average concentration for SWMU 81 (2,502 μg/g), which was modeled in the Soils OU RI Report (DOE 2013) where the results of the modeling showed that uranium did not reach the RGA groundwater in the 1,000-year SESOIL modeling period. Based on this, uranium was not modeled at SWMUs 15, 26, 80, or 211-A.

Nickel exceeded both the SSL and background concentrations at SWMU 26 and exhibited clustering when the results were viewed in 3-dimensions; however, the average concentration of nickel (156 mg/kg) was less than the average concentration for SWMU 14 (401 mg/kg in the 0–5 ft soils), which was modeled in the Soils OU RI Report (DOE 2013) where the results of the modeling showed that nickel did not reach the RGA groundwater in the 1,000-year SESOIL modeling period. Based on this, nickel was not modeled at SWMU 26.

The results of the modeling are presented in Appendix C. Additional evaluation of hot spot candidates is discussed below and presented in Appendix C, Attachment C2.

C1.3. REVIEW OF SOIL CONSTITUENTS AGAINST RGA GROUNDWATER DATA

Naturally-occurring metals and other soil constituents exceed screening criteria at one or more SWMUs. This section of the document summarizes the evaluation of these soil constituents against the RGA groundwater data to determine whether the Soils OU SWMUs are apparent sources of RGA contamination or whether the measured RGA concentrations are consistent with groundwater background concentrations (see the Soils OU RI Report for additional information).

As detailed in the Soils OU RI Report (DOE 2013), the following dissolved-phase constituents are not subject to modeling:

- Antimony
- Arsenic
- Beryllium
- Cadmium
- Chromium
- Cobalt/Cobalt-60
- Iron
- Lead
- Manganese
- Mercury
- Molybdenum
- Neptunium-237
- Nickel
- Plutonium-239/240
- Silver
- Total PCBs
- Uranium
- Uranium-238
- Vanadium
- Zinc

A review of the Tc-99 groundwater plume (see Figure 3.6 of the main text) indicates Tc-99 groundwater concentrations greater than MCLs in RGA groundwater are sourced from the vicinity of C-400; however, SWMUs 13, 15, 26, 77, 80, and 211-A have average soil concentrations that exceed the RG SSL and soil background concentration. Additionally, SWMUs 13, 15, and 26 are located (at least in part) near the RGA Tc-99 plume. Thus, it is possible that these SWMUs could be a secondary source of Tc-99. SWMUs 77, 80, and 211-A also had average concentrations that exceed the RG SSL and soil background, but these SWMUs are not located near an above-MCL RGA plume of Tc-99, and the soil concentrations at these SWMUs are less than those at SWMU 26. Based on these observations, SWMU 26 was subjected to modeling to bound any impacts of Tc-99 migration to RGA groundwater; SWMUs 13 and 15 also were modeled due to their proximity to the Tc-99 plume.

C1.4. SUMMARY OF EVALUATION THAT IDENTIFIED SWMU/AOC SOIL CONSTITUENTS TO BE SUBJECTED TO MODELING

Based upon the performed screening evaluation:

- The SWMU/AOC soil constituent combination whose average most exceeded the Tc-99 screening values (SWMU 26) was subjected to modeling; and

- SWMUs 13 and 15 were modeled for Tc-99 due to their proximity to the Tc-99 RGA groundwater plume.

No modeling was conducted for antimony, iron, mercury, naphthalene, neptunium-237, nickel, silver, Total PCBs, or uranium-238 because the soil constituent did not fail screening, the soil constituent is not a problem for PGDP groundwater, or the concentration of the soil constituent in groundwater is controlled by other factors.

C1.5. SCREENING SUMMARY, HOT SPOT IDENTIFICATION

The soil constituents subjected to further hot spot analysis are identified in Table C1.4 and are summarized in Appendix C, Attachment C2.

Table C1.4. SWMU/AOC Soil Constituent Combinations Subjected to Further Analysis

#	SWMU/AOC	Soil Constituent	Location
1	13	Tc-99	NW corner of PGDP; lithology consistent with DAF of 58
2	15	Tc-99	NW corner of PGDP; lithology consistent with DAF of 58
3	15	Uranium-234	NW corner of PGDP; lithology consistent with DAF of 58
4	26	Tc-99	Central portion of PGDP; lithology consistent w/DAF of 58
5	26	Uranium-234	Central portion of PGDP; lithology consistent w/DAF of 58
6	26	Nickel	Central portion of PGDP; lithology consistent w/DAF of 58
7	80	Uranium-234	Eastern portion of PGDP; lithology consistent w/DAF of 58
8	211	Uranium-234	Central portion of PGDP; lithology consistent w/DAF of 58

Table C1.5 provides the results of the screening process that identifies SWMU/AOC soil constituent combinations that have at least three results that exceed both the respective RG SSL and background concentration, where the constituent is considered to be an RGA groundwater COC (as presented in C1.2), where the constituent is typically detected in RGA groundwater (see the 2013 Soils OU RI Report), where there were three or more individual result exceedances of the RG SSL and the background concentration. This screening was performed to identify hot spots that may pose a threat to groundwater and was supported by graphical or MVS evaluation, presented in Attachment C2.

C1.6. REFERENCES

CTech Software 2014. Mining Visualization System Version 9.93, C Tech Development Corporation.

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EPA (U.S. Environmental Protection Agency) 1996. *Soil Screening Guidance: Technical Background Document*, EPA/540/R-95/128, Office of Emergency and Remedial Response, Washington, DC, May.

Table C1.5. PGDP Soils OU RI 2—Groundwater Screening (Potential Hot Spots)

#	SWMU/ AOC	Analysis	Unit	No. of Detects	No. of Samples	Average[a,b] (Avg.)	Maximum[a,c] (Max.)	Subsurface Bckgrnd. Conc.[a,d]	RG SSL (DAF 57)[a,e]	Ave.> Screen[f]?	Max.> Screen[g]?	How Many?[h]	Included in the list of COCs?[i]	Potential RGA Groundwater Impact?[j]
10	15	Antimony	mg/kg	275	334	6.32E+01	2.83E+02	2.10E-01	1.57E+01	YES	YES	250	Yes	No
32	26	Antimony	mg/kg	66	105	3.61E+01	1.74E+02	2.10E-01	1.57E+01	YES	YES	42	Yes	No
61	80	Antimony	mg/kg	12	15	3.00E+01	9.60E+01	2.10E-01	1.57E+01	YES	YES	6	Yes	No
87	211	Antimony	mg/kg	16	34	3.41E+01	9.74E+01	2.10E-01	1.57E+01	YES	YES	11	Yes	No
98	224	Antimony	mg/kg	6	6	5.38E+01	1.08E+02	2.10E-01	1.57E+01	YES	YES	4	Yes	No
105	225	Antimony	mg/kg	4	5	2.28E+01	5.41E+01	2.10E-01	1.57E+01	YES	YES	2	Yes	No
11	15	Arsenic	mg/kg	179	346	8.85E+00	1.11E+02	7.90E+00	1.69E+01	NO	YES	22	Yes	No
33	26	Arsenic	mg/kg	61	157	9.35E+00	1.60E+02	7.90E+00	1.69E+01	NO	YES	9	Yes	No
75	204	Arsenic	mg/kg	50	432	6.02E+00	1.36E+02	7.90E+00	1.69E+01	NO	YES	4	Yes	No
12	15	Cadmium	mg/kg	70	334	6.68E+00	2.42E+01	2.10E-01	2.18E+01	NO	YES	4	Yes	No
34	26	Cadmium	mg/kg	41	112	4.45E+00	2.83E+01	2.10E-01	2.18E+01	NO	YES	1	Yes	No
1	13	Cobalt	mg/kg	24	24	6.16E+00	1.20E+01	1.30E+01	1.57E+00	NO	YES	0	Yes	No
13	15	Cobalt	mg/kg	26	26	8.98E+00	3.41E+01	1.30E+01	1.57E+00	NO	YES	2	Yes	No
35	26	Cobalt	mg/kg	37	44	9.66E+00	9.05E+01	1.30E+01	1.57E+00	NO	YES	5	Yes	No
54	77	Cobalt	mg/kg	2	2	5.15E+00	7.80E+00	1.30E+01	1.57E+00	NO	YES	0	Yes	No
62	80	Cobalt	mg/kg	6	6	9.32E+00	1.90E+01	1.30E+01	1.57E+00	NO	YES	1	Yes	No
76	204	Cobalt	mg/kg	49	50	7.12E+00	1.80E+01	1.30E+01	1.57E+00	NO	YES	4	Yes	No
88	211	Cobalt	mg/kg	8	11	9.94E+00	4.95E+01	1.30E+01	1.57E+00	NO	YES	1	Yes	No
99	224	Cobalt	mg/kg	2	2	7.35E+00	7.60E+00	1.30E+01	1.57E+00	NO	YES	0	Yes	No
106	225	Cobalt	mg/kg	2	2	6.10E+00	7.30E+00	1.30E+01	1.57E+00	NO	YES	0	Yes	No
14	15	Copper	mg/kg	199	346	1.30E+02	6.12E+03	2.50E+01	2.65E+03	NO	YES	2	No	NA
36	26	Copper	mg/kg	92	150	1.07E+02	9.52E+03	2.50E+01	2.65E+03	NO	YES	1	No	NA
2	13	Iron	mg/kg	226	226	1.85E+04	4.78E+04	2.80E+04	2.04E+03	NO	YES	17	Yes	No
15	15	Iron	mg/kg	332	332	1.98E+04	1.71E+05	2.80E+04	2.04E+03	NO	YES	56	Yes	No
37	26	Iron	mg/kg	144	150	1.82E+04	8.51E+04	2.80E+04	2.04E+03	NO	YES	18	Yes	No
63	80	Iron	mg/kg	65	65	2.47E+04	4.13E+04	2.80E+04	2.04E+03	NO	YES	20	Yes	No
77	204	Iron	mg/kg	432	432	2.28E+04	4.60E+04	2.80E+04	2.04E+03	NO	YES	45	Yes	No
89	211	Iron	mg/kg	34	60	1.68E+04	4.71E+04	2.80E+04	2.04E+03	NO	YES	4	Yes	No
100	224	Iron	mg/kg	6	6	1.58E+04	2.10E+04	2.80E+04	2.04E+03	NO	YES	0	Yes	No
107	225	Iron	mg/kg	7	7	1.74E+04	2.73E+04	2.80E+04	2.04E+03	NO	YES	0	Yes	No
55	77	Iron	mg/kg	15	15	2.84E+04	5.03E+04	2.80E+04	2.04E+03	YES	YES	8	Yes	No
16	15	Lead	mg/kg	312	346	5.59E+01	1.80E+03	2.30E+01	7.83E+02	NO	YES	3	Yes	No
3	13	Manganese	mg/kg	226	226	5.38E+02	3.11E+03	8.20E+02	1.59E+02	NO	YES	34	Yes	No
17	15	Manganese	mg/kg	326	332	4.20E+02	2.90E+03	8.20E+02	1.59E+02	NO	YES	25	Yes	No
38	26	Manganese	mg/kg	143	150	4.03E+02	1.80E+03	8.20E+02	1.59E+02	NO	YES	9	Yes	No
56	77	Manganese	mg/kg	15	15	2.70E+02	6.50E+02	8.20E+02	1.59E+02	NO	YES	0	Yes	No

Table C1.5. PGDP Soils OU RI 2—Groundwater Screening (Potential Hot Spots) (Continued)

#	SWMU/ AOC	Analysis	Unit	No. of Detects	No. of Samples	Average[a,b] (Avg.)	Maximum[a,c] (Max.)	Subsurface Bckgrnd. Conc.[a,d]	RG SSL (DAF 57)[a,e]	Ave.> Screen[f]?	Max.> Screen[g]?	How Many?[h]	Included in the list of COCs?[i]	Potential RGA Groundwater Impact?[j]
64	80	Manganese	mg/kg	64	65	4.48E+02	2.07E+03	8.20E+02	1.59E+02	NO	YES	4	Yes	No
78	204	Manganese	mg/kg	432	432	5.84E+02	2.80E+03	8.20E+02	1.59E+02	NO	YES	66	Yes	No
90	211	Manganese	mg/kg	33	60	2.39E+02	7.01E+02	8.20E+02	1.59E+02	NO	YES	0	Yes	No
101	224	Manganese	mg/kg	6	6	3.99E+02	6.26E+02	8.20E+02	1.59E+02	NO	YES	0	Yes	No
108	225	Manganese	mg/kg	7	7	4.85E+02	8.55E+02	8.20E+02	1.59E+02	NO	YES	1	Yes	No
18	15	Mercury	mg/kg	41	345	5.17E+00	1.53E+01	1.30E-01	1.68E+00	YES	YES	17	Yes	No
39	26	Mercury	mg/kg	36	160	7.57E+00	1.40E+01	1.30E-01	1.68E+00	YES	YES	5	Yes	No
65	80	Mercury	mg/kg	5	66	1.59E+01	6.88E+00	1.30E-01	1.68E+00	YES	YES	1	Yes	No
4	13	Molybdenum	mg/kg	28	218	3.19E+00	4.30E+01		1.17E+01	NO	YES	13	Yes	No
19	15	Molybdenum	mg/kg	31	332	6.93E+00	2.36E+01		1.17E+01	NO	YES	3	Yes	No
40	26	Molybdenum	mg/kg	20	115	6.69E+00	7.80E+01		1.17E+01	NO	YES	8	Yes	No
66	80	Molybdenum	mg/kg	11	65	4.87E+00	4.60E+01		1.17E+01	NO	YES	5	Yes	No
79	204	Molybdenum	mg/kg	75	432	3.33E+00	4.10E+01		1.17E+01	NO	YES	29	Yes	No
109	225	Molybdenum	mg/kg	3	7	8.77E+00	3.60E+01		1.17E+01	NO	YES	1	Yes	No
20	15	Naphthalene	mg/kg	1	37	2.07E-01	1.20E-01		3.15E-02	YES	YES	1	Yes	No
41	26	Naphthalene	mg/kg	2	74	2.85E-01	7.20E-01		3.15E-02	YES	YES	1	Yes	No
67	80	Naphthalene	mg/kg	1	8	1.81E-01	7.40E-02		3.15E-02	YES	YES	1	Yes	No
102	224	Naphthalene	mg/kg	1	2	1.17E-01	5.90E-02		3.15E-02	YES	YES	1	Yes	No
21	15	Neptunium-237	pCi/g	15	37	2.68E-01	4.10E+00		3.11E+00	NO	YES	1	Yes	No
91	211	Neptunium-237	pCi/g	4	10	7.15E-01	5.93E+00		3.11E+00	NO	YES	1	Yes	No
42	26	Neptunium-237	pCi/g	22	44	4.40E+00	5.50E+01		3.11E+00	YES	YES	3	Yes	No
22	15	Nickel	mg/kg	192	346	1.19E+02	3.79E+03	2.20E+01	1.47E+02	NO	YES	69	Yes	Yes
43	26	Nickel	mg/kg	97	154	1.56E+02	1.76E+04	2.20E+01	1.47E+02	YES	YES	5	Yes	Yes
23	15	PCB, Total	mg/kg	51	345	3.68E+00	5.50E+01		4.54E+00	NO	YES	35	Yes	No
57	77	PCB, Total	mg/kg	4	13	4.28E+00	5.00E+00		4.54E+00	NO	YES	1	Yes	No
80	204	PCB, Total	mg/kg	4	486	4.08E+00	7.90E+01		4.54E+00	NO	YES	1	Yes	No
68	80	PCB, Total	mg/kg	78	214	6.75E+00	4.75E+02		4.54E+00	YES	YES	29	Yes	No
92	211	PCB, Total	mg/kg	8	75	9.66E+00	1.40E+02		4.54E+00	YES	YES	2	Yes	No
24	15	Phenanthrene	mg/kg	9	37	4.14E-01	2.90E+00		5.87E-01	NO	YES	5	No	NA
44	26	Phenanthrene	mg/kg	11	71	3.19E-01	8.70E-01		5.87E-01	NO	YES	3	No	NA
69	80	Phenanthrene	mg/kg	4	8	2.62E-01	7.80E-01		5.87E-01	NO	YES	1	No	NA
45	26	Plutonium-239/240	pCi/g	26	50	1.32E+00	1.59E+01		1.23E+01	NO	YES	1	Yes	No
25	15	Selenium	mg/kg	31	346	8.94E+00	2.67E+01	7.00E-01	1.51E+01	NO	YES	1	No	NA
5	13	Silver	mg/kg	22	256	1.79E+01	1.46E+02	2.70E+00	4.55E+00	YES	YES	6	Yes	No
26	15	Silver	mg/kg	64	346	5.92E+00	1.80E+01	2.70E+00	4.55E+00	YES	YES	38	Yes	No
46	26	Silver	mg/kg	27	157	9.50E+00	1.26E+01	2.70E+00	4.55E+00	YES	YES	6	Yes	No
81	204	Silver	mg/kg	53	432	2.26E+01	8.90E+01	2.70E+00	4.55E+00	YES	YES	9	Yes	No

Table C1.5. PGDP Soils OU RI 2—Groundwater Screening (Potential Hot Spots) (Continued)

#	SWMU/ AOC	Analysis	Unit	No. of Detects	No. of Samples	Average[a,b] (Avg.)	Maximum[a,c] (Max.)	Subsurface Bckgrnd. Conc.[a,d]	RG SSL (DAF 57)[a,e]	Ave.> Screen[f]?	Max.> Screen[g]?	How Many?[h]	Included in the list of COCs?[i]	Potential RGA Groundwater Impact?[j]
93	211	Silver	mg/kg	5	60	1.43E+01	1.27E+02	2.70E+00	4.55E+00	YES	YES	1	Yes	No
82	204	Tc-99	pCi/g	8	58	9.41E-01	7.64E+00	2.80E+00	4.41E-01	NO	YES	2	Yes	Yes
103	224	Tc-99	pCi/g	1	3	3.13E-01	4.80E-01	2.80E+00	4.41E-01	NO	YES	0	Yes	Yes
6	13	Tc-99	pCi/g	19	92	4.92E+00	1.50E+02	2.80E+00	4.41E-01	YES	YES	13	Yes	Yes
27	15	Tc-99	pCi/g	28	37	2.69E+01	3.67E+02	2.80E+00	4.41E-01	YES	YES	21	Yes	Yes
47	26	Tc-99	pCi/g	30	47	2.38E+02	4.84E+03	2.80E+00	4.41E-01	YES	YES	22	Yes	Yes
58	77	Tc-99	pCi/g	1	3	6.38E+00	1.85E+00	2.80E+00	4.41E-01	YES	YES	0	Yes	Yes
70	80	Tc-99	pCi/g	2	9	3.72E+00	2.95E+01	2.80E+00	4.41E-01	YES	YES	1	Yes	Yes
94	211	Tc-99	pCi/g	4	7	1.70E+01	1.06E+02	2.80E+00	4.41E-01	YES	YES	2	Yes	Yes
48	26	Thallium	mg/kg	18	53	2.24E+00	1.39E+01	3.40E-01	8.26E+00	NO	YES	1	No	NA
49	26	Thorium-230	pCi/g	39	47	6.45E+00	1.11E+02	1.40E+00	1.06E+02	NO	YES	1	No	NA
50	26	Uranium	mg/kg	76	142	1.41E+02	3.10E+03	4.60E+00	7.83E+02	NO	YES	8	Yes	No
71	80	Uranium	mg/kg	27	72	1.04E+02	5.72E+03	4.60E+00	7.83E+02	NO	YES	1	Yes	No
83	204	Uranium	mg/kg	53	433	3.63E+01	1.31E+04	4.60E+00	7.83E+02	NO	YES	1	Yes	No
7	13	Uranium-234	pCi/g	69	91	1.58E+00	3.57E+01	1.20E+00	2.87E+00	NO	YES	4	Yes	Yes
59	77	Uranium-234	pCi/g	2	2	2.83E+00	4.18E+00	1.20E+00	2.87E+00	NO	YES	1	Yes	Yes
28	15	Uranium-234	pCi/g	37	37	9.33E+00	1.85E+02	1.20E+00	2.87E+00	YES	YES	12	Yes	Yes
51	26	Uranium-234	pCi/g	42	51	2.64E+01	4.37E+02	1.20E+00	2.87E+00	YES	YES	17	Yes	Yes
72	80	Uranium-234	pCi/g	9	9	5.07E+01	2.29E+02	1.20E+00	2.87E+00	YES	YES	3	Yes	Yes
84	204	Uranium-234	pCi/g	53	54	1.43E+01	4.45E+02	1.20E+00	2.87E+00	YES	YES	2	Yes	Yes
95	211	Uranium-234	pCi/g	4	10	8.66E+00	6.69E+01	1.20E+00	2.87E+00	YES	YES	3	Yes	Yes
8	13	Uranium-235	pCi/g	35	92	1.43E-01	4.12E+00	6.00E-02	2.83E+00	NO	YES	1	Yes	Yes
29	15	Uranium-235	pCi/g	32	37	8.53E-01	2.17E+01	6.00E-02	2.83E+00	NO	YES	2	Yes	Yes
52	26	Uranium-235	pCi/g	36	49	1.60E+00	3.19E+01	6.00E-02	2.83E+00	NO	YES	5	Yes	Yes
85	204	Uranium-235	pCi/g	42	62	1.37E+00	5.70E+01	6.00E-02	2.83E+00	NO	YES	1	Yes	Yes
96	211	Uranium-235	pCi/g	4	7	7.08E-01	3.86E+00	6.00E-02	2.83E+00	NO	YES	1	Yes	Yes
73	80	Uranium-235	pCi/g	8	8	3.90E+00	3.00E+01	6.00E-02	2.83E+00	YES	YES	1	Yes	Yes
9	13	Uranium-238	pCi/g	76	91	2.50E+00	6.41E+01	1.20E+00	2.34E+00	YES	YES	12	Yes	No
30	15	Uranium-238	pCi/g	37	37	3.60E+01	1.10E+03	1.20E+00	2.34E+00	YES	YES	12	Yes	No
53	26	Uranium-238	pCi/g	46	52	5.94E+01	1.04E+03	1.20E+00	2.34E+00	YES	YES	24	Yes	No
60	77	Uranium-238	pCi/g	2	2	1.06E+01	1.53E+01	1.20E+00	2.34E+00	YES	YES	2	Yes	No
74	80	Uranium-238	pCi/g	9	9	3.82E+02	1.92E+03	1.20E+00	2.34E+00	YES	YES	8	Yes	No
86	204	Uranium-238	pCi/g	54	54	1.46E+02	4.39E+03	1.20E+00	2.34E+00	YES	YES	17	Yes	No
97	211	Uranium-238	pCi/g	4	9	1.68E+01	1.19E+02	1.20E+00	2.34E+00	YES	YES	4	Yes	No
104	224	Uranium-238	pCi/g	3	3	6.89E+00	1.39E+01	1.20E+00	2.34E+00	YES	YES	2	Yes	No
31	15	Zinc	mg/kg	345	346	1.45E+02	3.17E+03	6.00E+01	2.16E+03	NO	YES	2	Yes	No

RG SSL= Remedial Guide Soil Screening Level
[a] Concentration units as noted in the units column.
[b] Average concentration using half the detection limit for non-detected samples.

Table C1.5. PGDP Soils OU RI 2—Groundwater Screening (Potential Hot Spots) (Continued)

#	SWMU/ AOC	Analysis	Unit	No. of Detects	No. of Samples	Average[a,b] (Avg.)	Maximum[a,c] (Max.)	Subsurface Bckgrnd. Conc.[a,d]	RG SSL (DAF 57)[a,e]	Ave.> Screen[f]?	Max.> Screen[g]?	How Many?[h]	Included in the list of COCs?[i]	Potential RGA Groundwater Impact?[j]

[c] Maximum detected concentration.
[d] Subsurface background concentration values are taken from the Risk Methods Document (DOE 2011).
[e] Subsurface RG SSL (DAF 58) calculated as noted above, consistent with EPA Web site: http://www.epa.gov/safewater/consumer/pdf/mcl.pdf. RG SSL for uranium and Tc-99 calculated in similar manner but based on Kd value of 450 for uranium and 0.2 for Tc-99 to be consistent with the BGOU RI modeling, DOE/LX/07-0030&D2/R1.
[f] Average concentration exceeds both the subsurface background concentration and the subsurface RG SSL.
[g] Maximum concentration exceeds both the subsurface background concentration and the subsurface RG SSL.
[h] Number of detected samples that exceed both the subsurface background concentration and the subsurface RG SSL.
[i] Soil constituent is included in the list of contaminants of concern (COCs) identified for groundwater (Table C1.1)
[j] As determined in the Soils RI Report (DOE 2013).

ATTACHMENT C2

DATA SUMMARY AND EVALUATION

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C.2. DATA SUMMARY AND EVALUATION

In this attachment to Appendix C, the solid waste management unit (SWMU)/area of concern (AOC)-specific results are discussed for those soil constituents with exceedances of the Remedial Guide (RG) Soil Screening Level (SSL) or background concentrations to identify whether they should be subjected to fate and transport modeling. Although few SWMU/AOC soil constituent combinations were subjected to modeling because they did not exceed the screening criteria (see Attachment C1), the information presented in this attachment has been developed to support the feasibility study (FS).

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C.2.1 SWMU 13, C-746-P&P1 SCRAPYARDS

Data for SWMU 13 consist of both historical data and Remedial Investigation (RI)-collected data. SWMU 13 exceedances of the RG SSL include the following soil constituents: cobalt, iron, manganese, molybdenum, silver, Tc-99, uranium-234, uranium-235, and uranium-238.

Cobalt was detected in all of the 24 samples. Detections are shown in Figure C2.1.1. The average concentration[1] over SWMU 13 for cobalt is greater than the RG SSL, but less than the subsurface background concentration; therefore, cobalt does not meet the screening criteria for groundwater fate and transport modeling at SWMU 13.

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[1] As discussed in Appendix C Attachment C1, the overall average value of the soil constituent for each SWMU/AOC was calculated using both detected values and nondetected values (nondetected values at one-half the reported value).

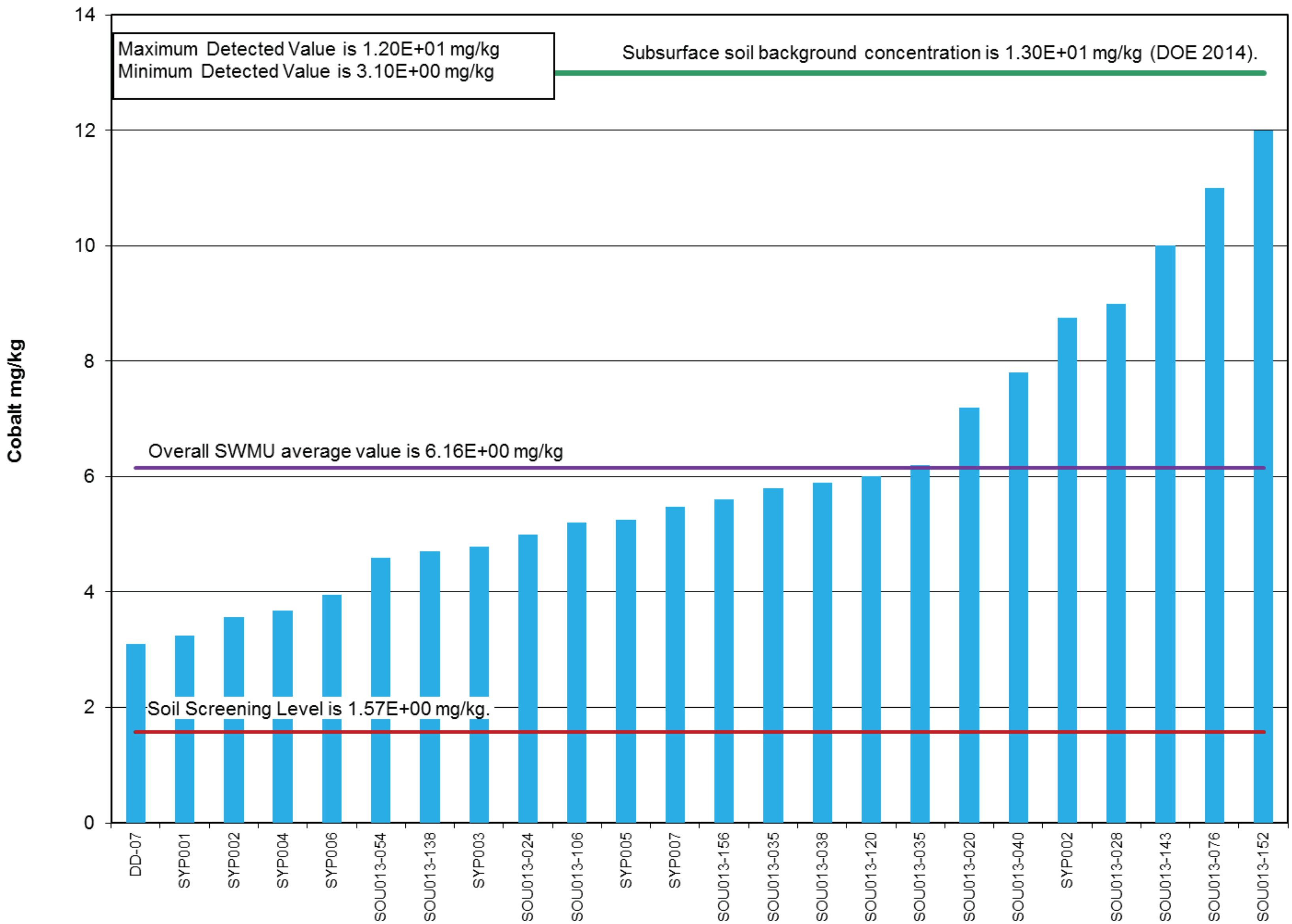

Figure C2.1.1. Cobalt Detections at SWMU 13

Iron was detected in all 226 samples. Detections are shown in Figure C2.1.2. The average concentration over SWMU 13 for iron is greater than the RG SSL, but less than the subsurface background concentration; therefore, iron does not meet the screening criteria for groundwater fate and transport modeling at SWMU 13.

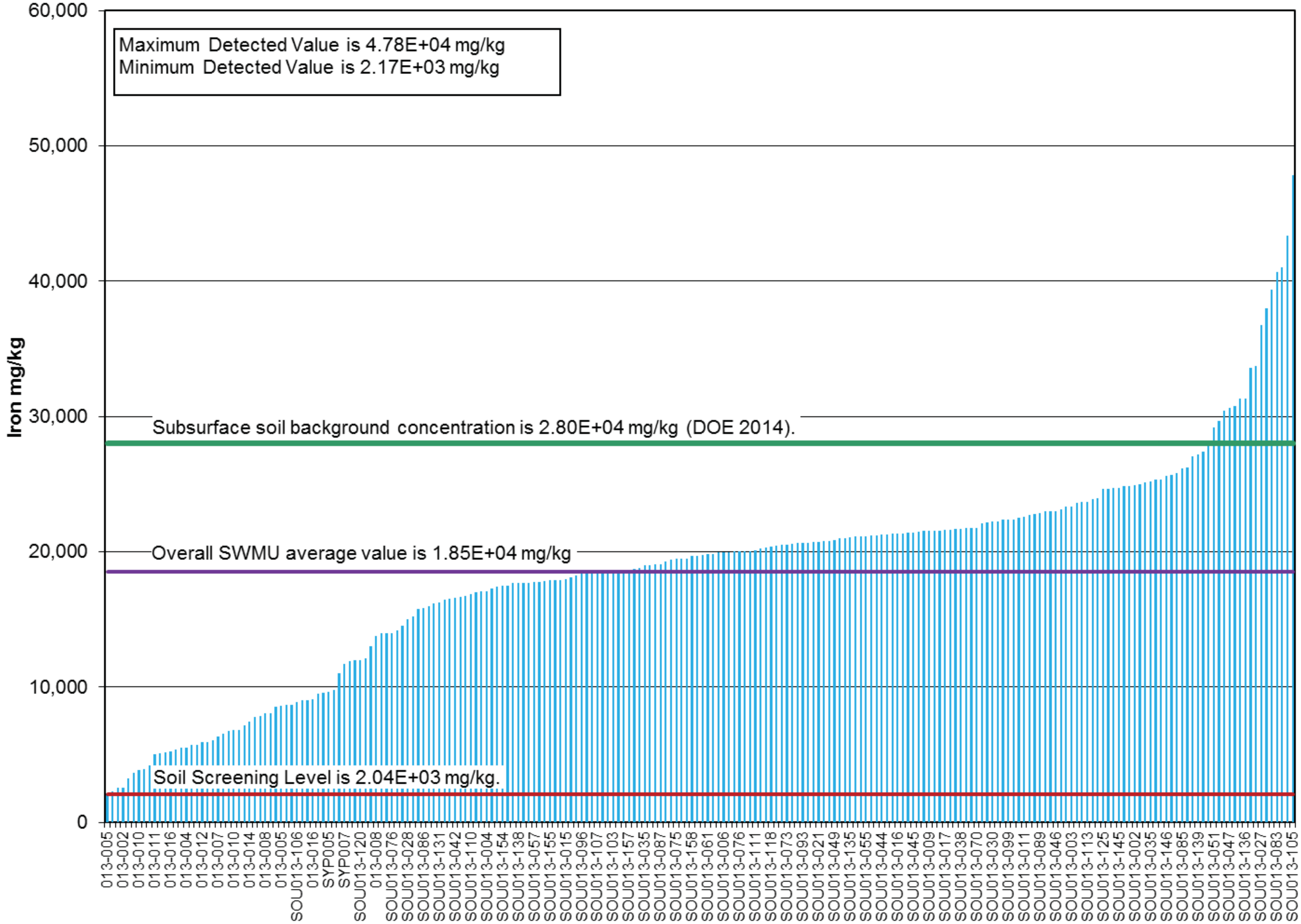

Figure C2.1.2. Iron Detections at SWMU 13

Manganese was detected in all 226 samples. Detections are shown in Figure C2.1.3. The average concentration over SWMU 13 for manganese is greater than the RG SSL, but less than the subsurface background concentration; therefore, manganese does not meet the screening criteria for groundwater fate and transport modeling at SWMU 13.

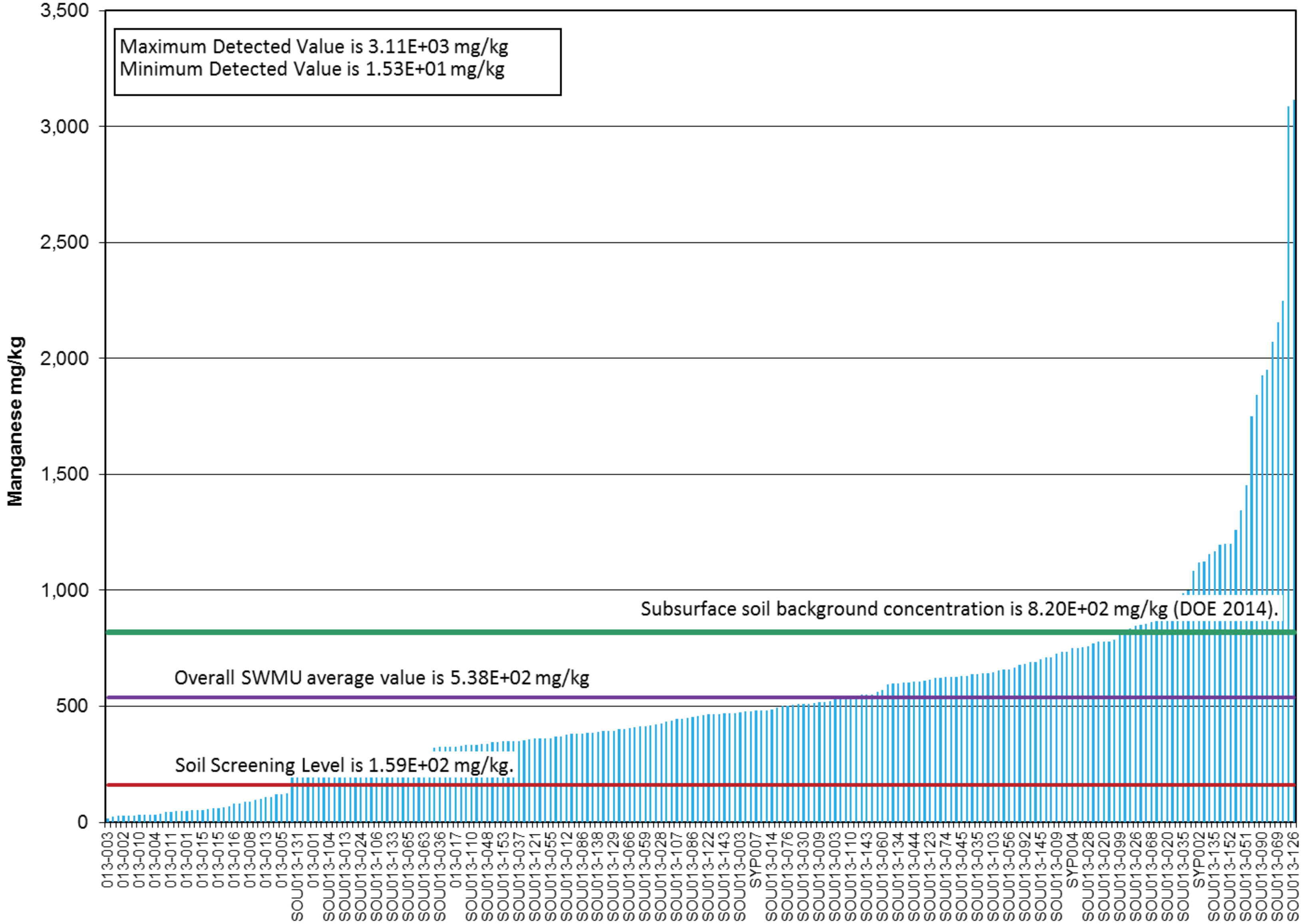

Figure C2.1.3. Manganese Detections at SWMU 13

Molybdenum was detected in 28 of the 218 samples. The detections are show in Figure C2.1.4. The average concentration over SWMU 13 for molybdenum is less than the RG SSL; therefore, molybdenum does not meet the screening criteria for groundwater fate and transport modeling at SWMU 13.

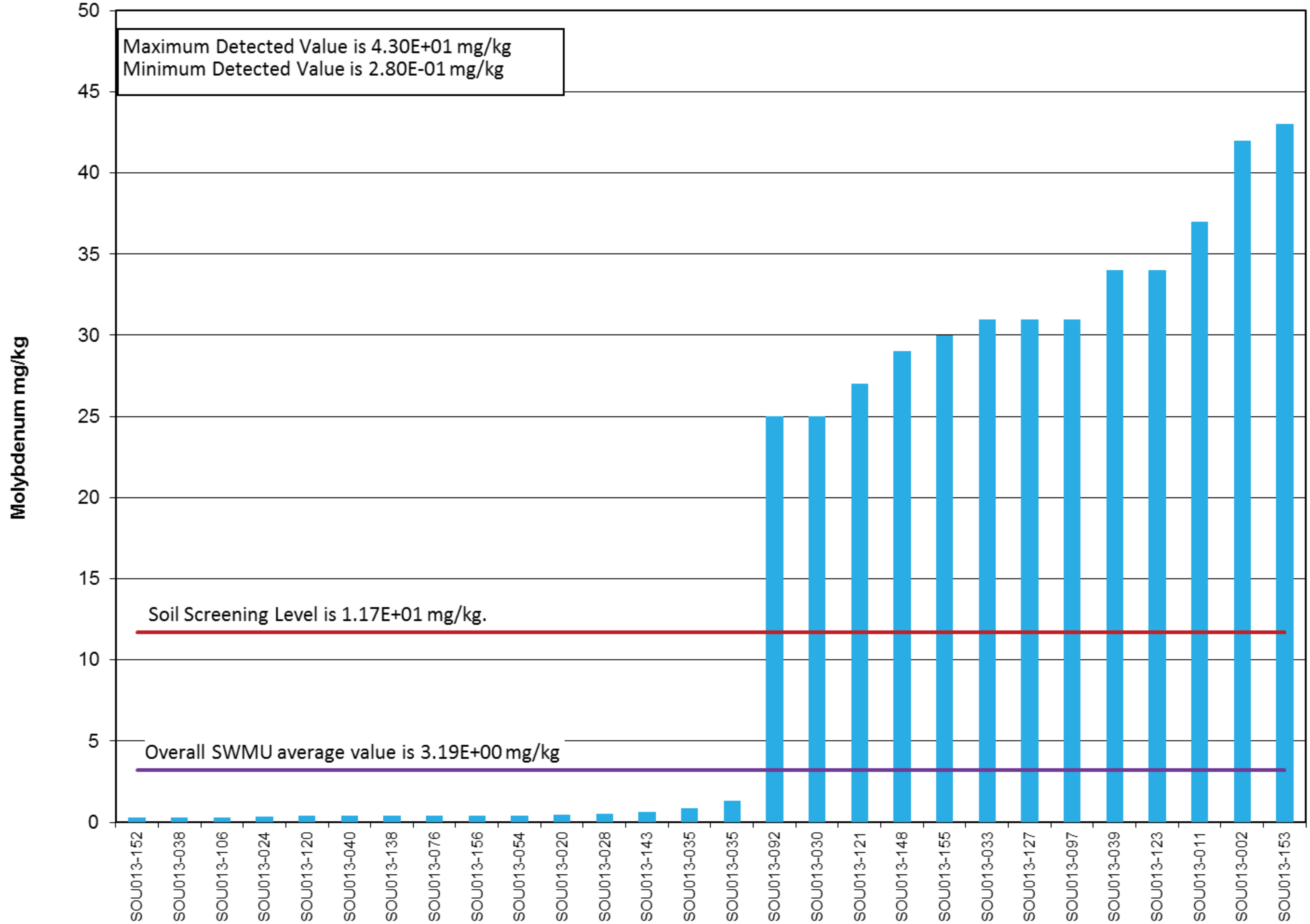

Figure C2.1.4. Molybdenum Detections at SWMU 13

Silver was detected in 22 of the 256 samples. The chart illustrating the detections is shown in Figure C2.1.5. The average concentration over SWMU 13 for silver is greater than both the RG SSL and the background concentration. Silver was evaluated as part of the Groundwater Operable Unit (GWOU) FS and identified as a contaminant of concern (COC) in the groundwater plumes associated with PGDP (DOE 2001). The evaluation presented in Attachment C1 to Appendix C of the Soils Operable Unit Remedial Investigation Report at the Paducah Gaseous Diffusion Plant (Soils OU RI Report) (DOE 2013) did not identify any impacts due to silver in the Regional Gravel Aquifer (RGA) groundwater; therefore, silver does not meet the screening criteria for groundwater fate and transport modeling at SWMU 13.

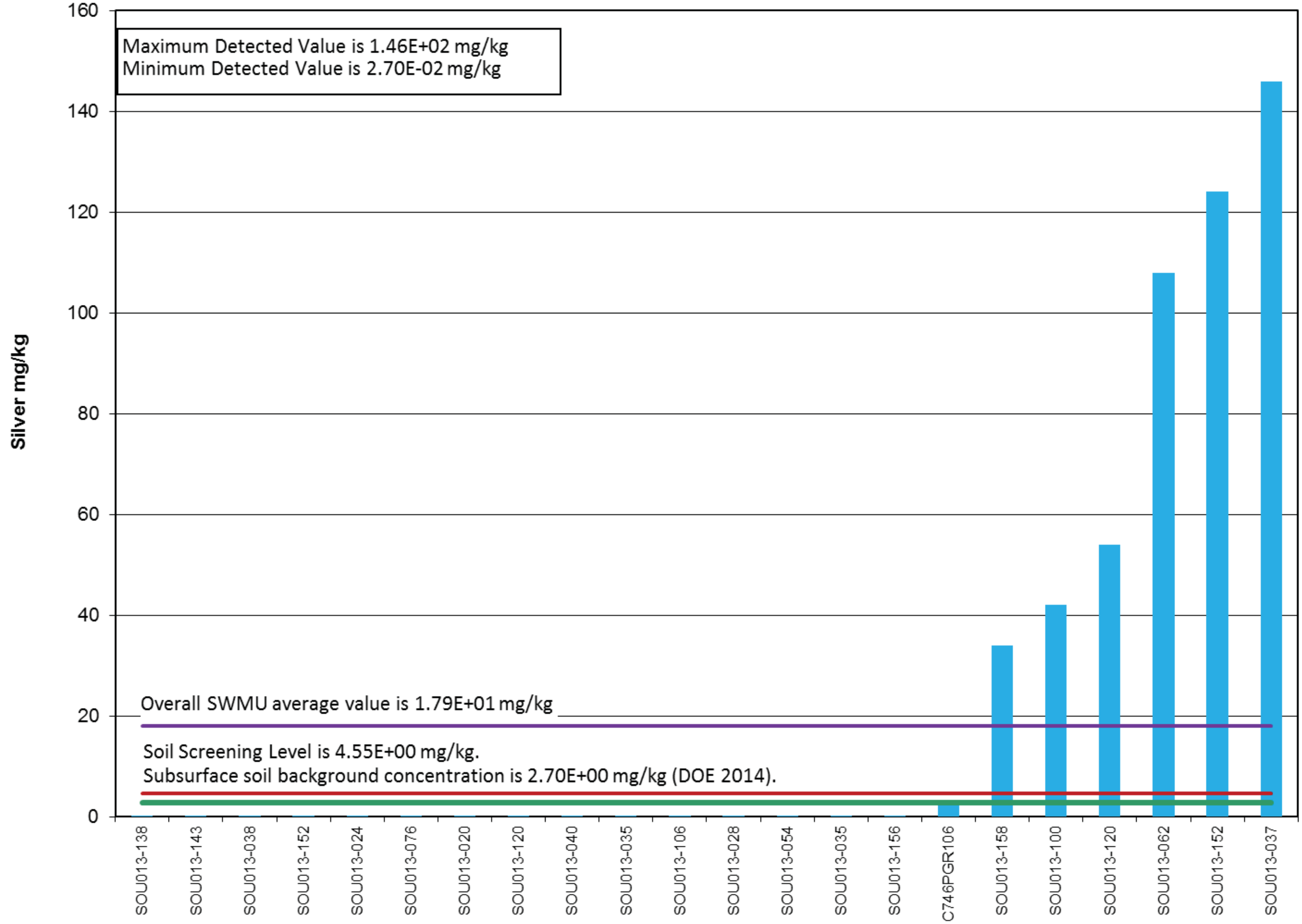

Figure C2.1.5. Silver Detections at SWMU 13

Tc-99 was detected in 19 of the 92 samples. The detections are shown in Figure C2.1.6. The average activity concentration over SWMU 13 for Tc-99 is greater than both the RG SSL and the background activity concentration. Tc-99 was evaluated as part of the GWOU FS and identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). Because of the presence of Tc-99 in RGA groundwater and the close proximity of SWMU 13 to the Tc-99 plume, SWMU 13 may be a secondary source of Tc-99. Thirteen of the samples were detected above both the RG SSL and the background activity concentration; therefore, a hot spot evaluation was performed.

Mining Visualization Software (MVS) (Version 9.85) (CTech Software 2014) was used to evaluate the distribution of Tc-99 across SWMU 13. Figure C2.1.7 shows the distribution of detections in three depth intervals: 0–5 ft below ground surface (ft bgs), 5–10 ft bgs, and 10–15 ft bgs. A hot spot appears to be present.

Tc-99 in SWMU 13 appears to meet the screening criteria for fate and transport modeling.

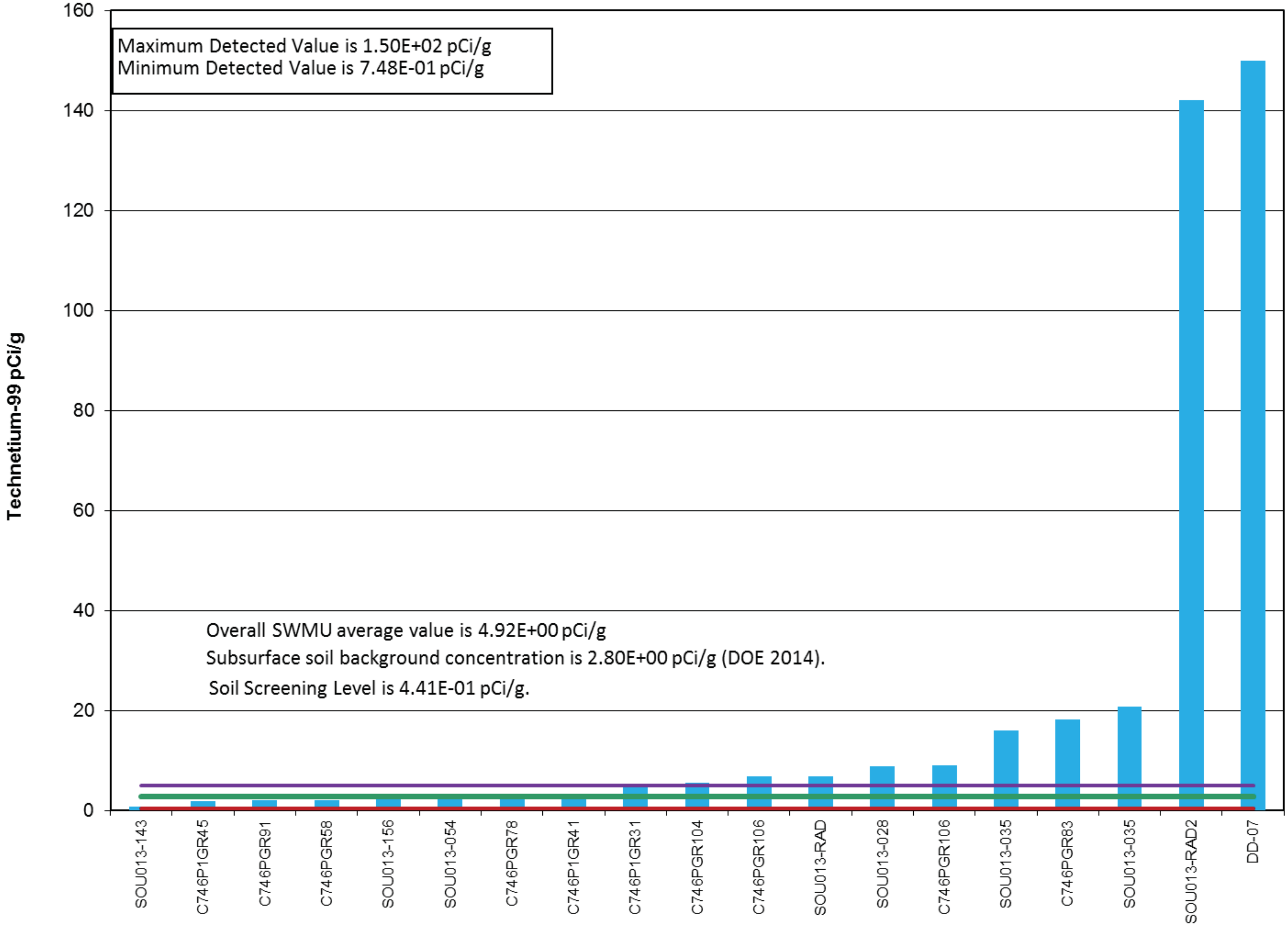

Figure C2.1.6. Tc-99 Detections at SWMU 13

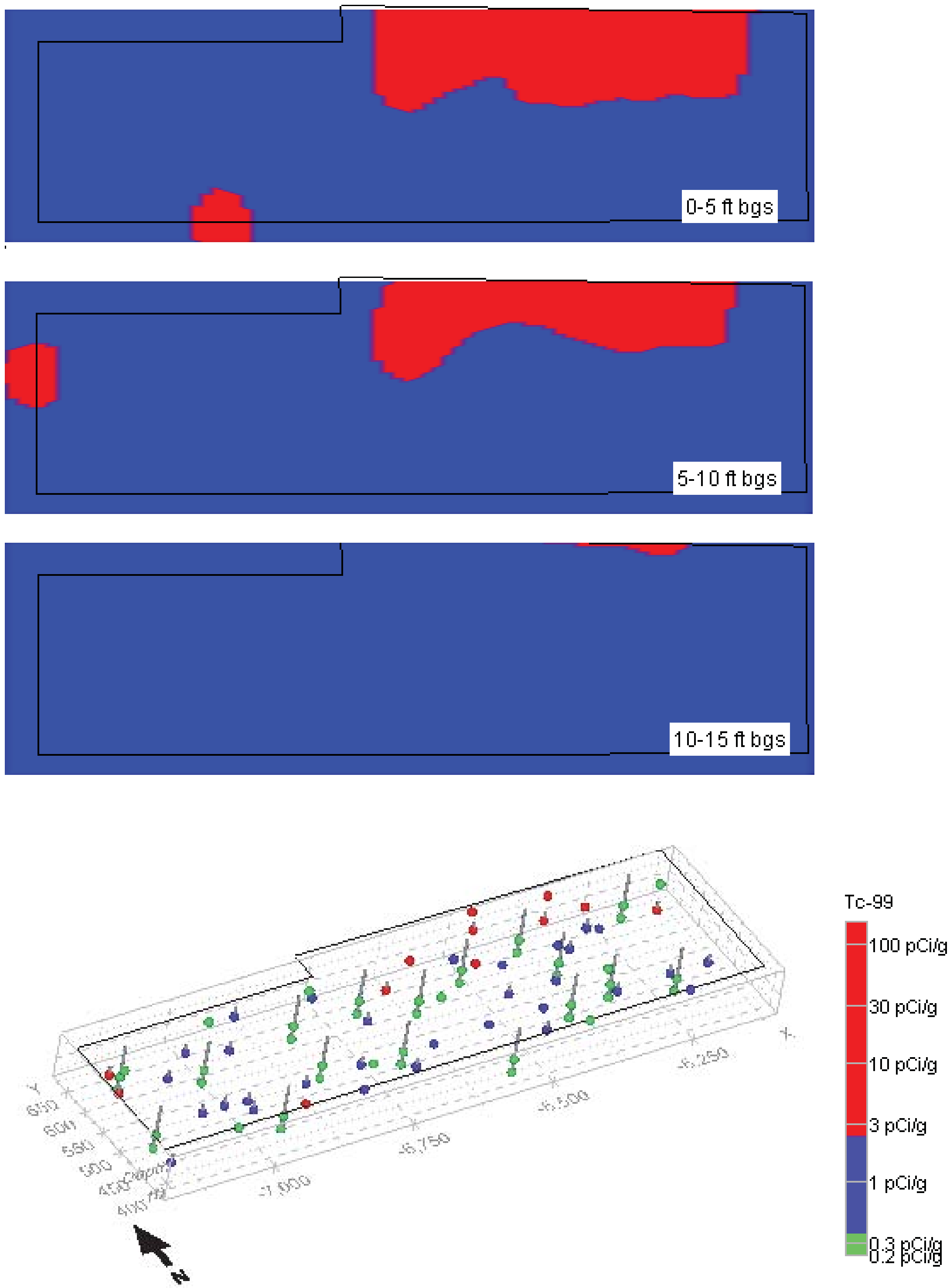

Figure C2.1.7. Distribution of Tc-99 at SWMU 13

Uranium-234 was detected in 69 of the 91 samples. The detections are shown in Figure C2.1.8. The average activity concentration over SWMU 13 for uranium-234 is less than the RG SSL, but greater than the background activity concentration; therefore, uranium-234 does not meet the screening criteria for fate and transport modeling at SWMU 13.

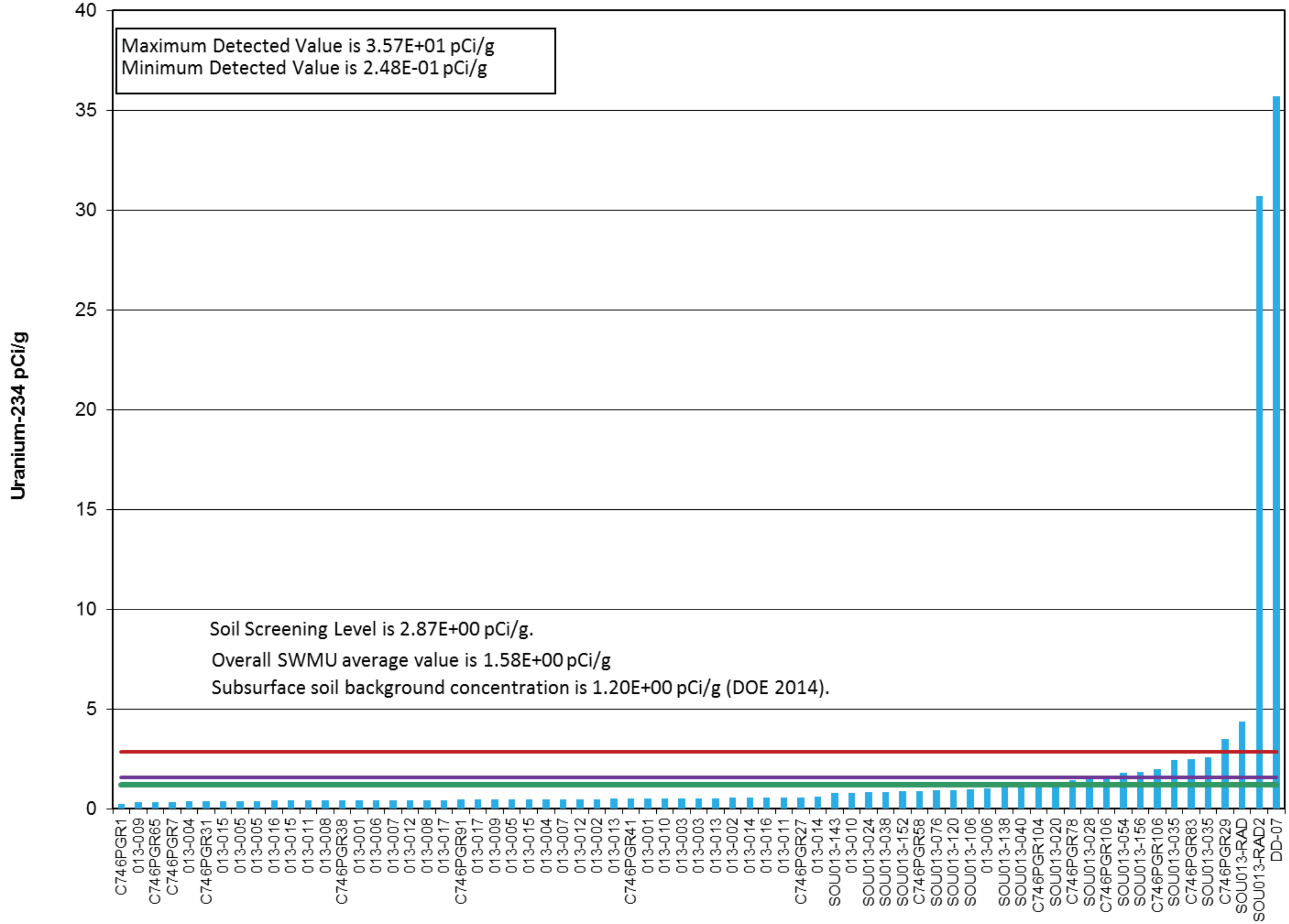

Figure C2.1.8. Uranium-234 Detections at SWMU 13

Uranium-235 was detected in 35 of the 92 samples. The detections are shown in Figure C2.1.9. The average activity concentration over SWMU 13 for uranium-235 is less than the RG SSL and greater than the background activity concentration; therefore, uranium-235 does not meet the screening criteria for fate and transport modeling.

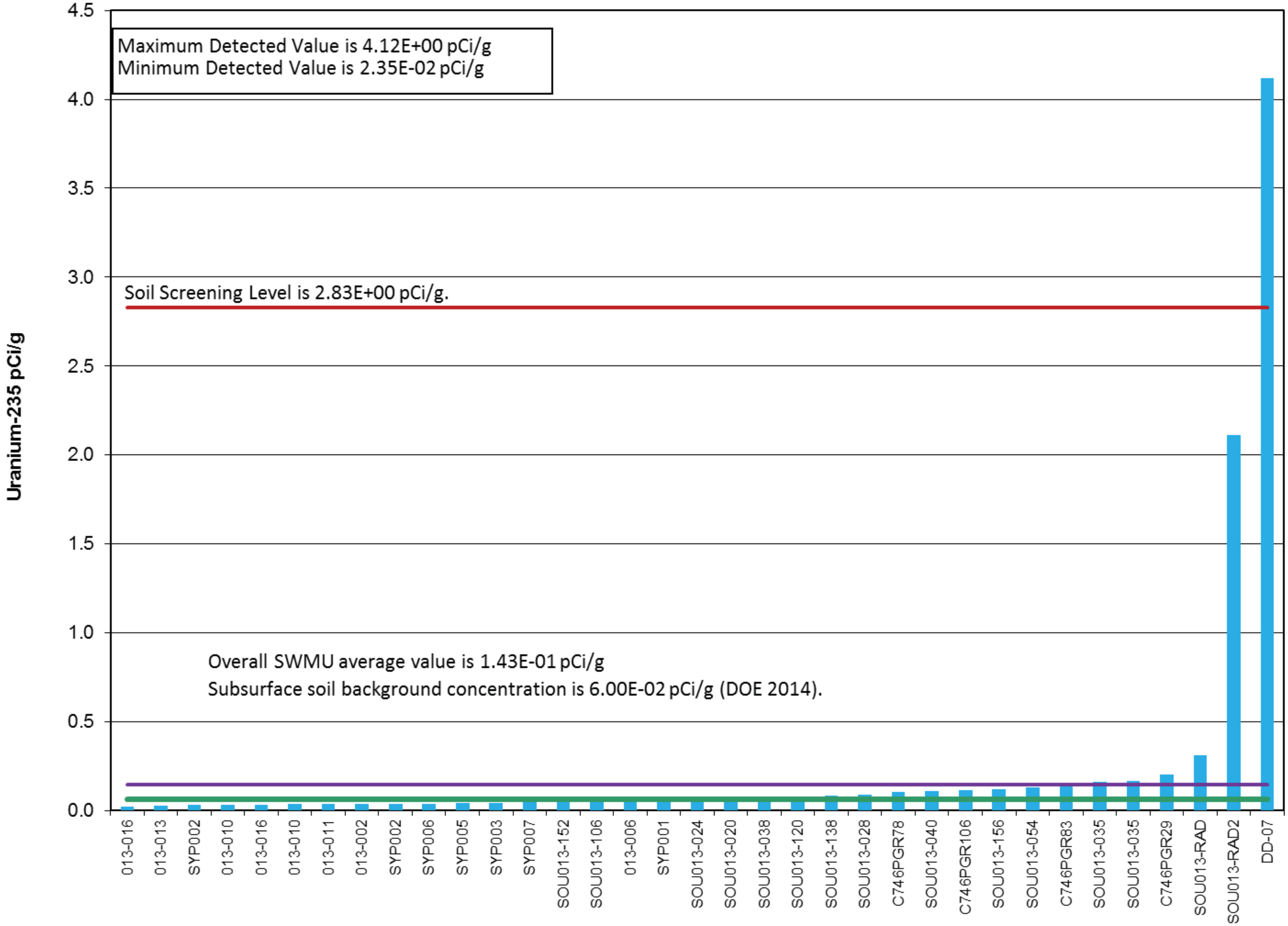

Figure C2.1.9. Uranium-235 Detections at SWMU 13

Uranium-238 was detected in 76 of the 91 samples. The detections are shown in Figure C2.1.10. The average activity concentration over SWMU 13 for uranium-238 is greater than both the RG SSL and the background activity concentration. Uranium-238 was evaluated as part of the GWOU FS and identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). The evaluation presented in Attachment C1 to Appendix C of the Soils OU RI Report (DOE 2013) did not identify any uranium-238 impacts to RGA groundwater; therefore, uranium-238 does not meet the screening criteria for fate and transport modeling.

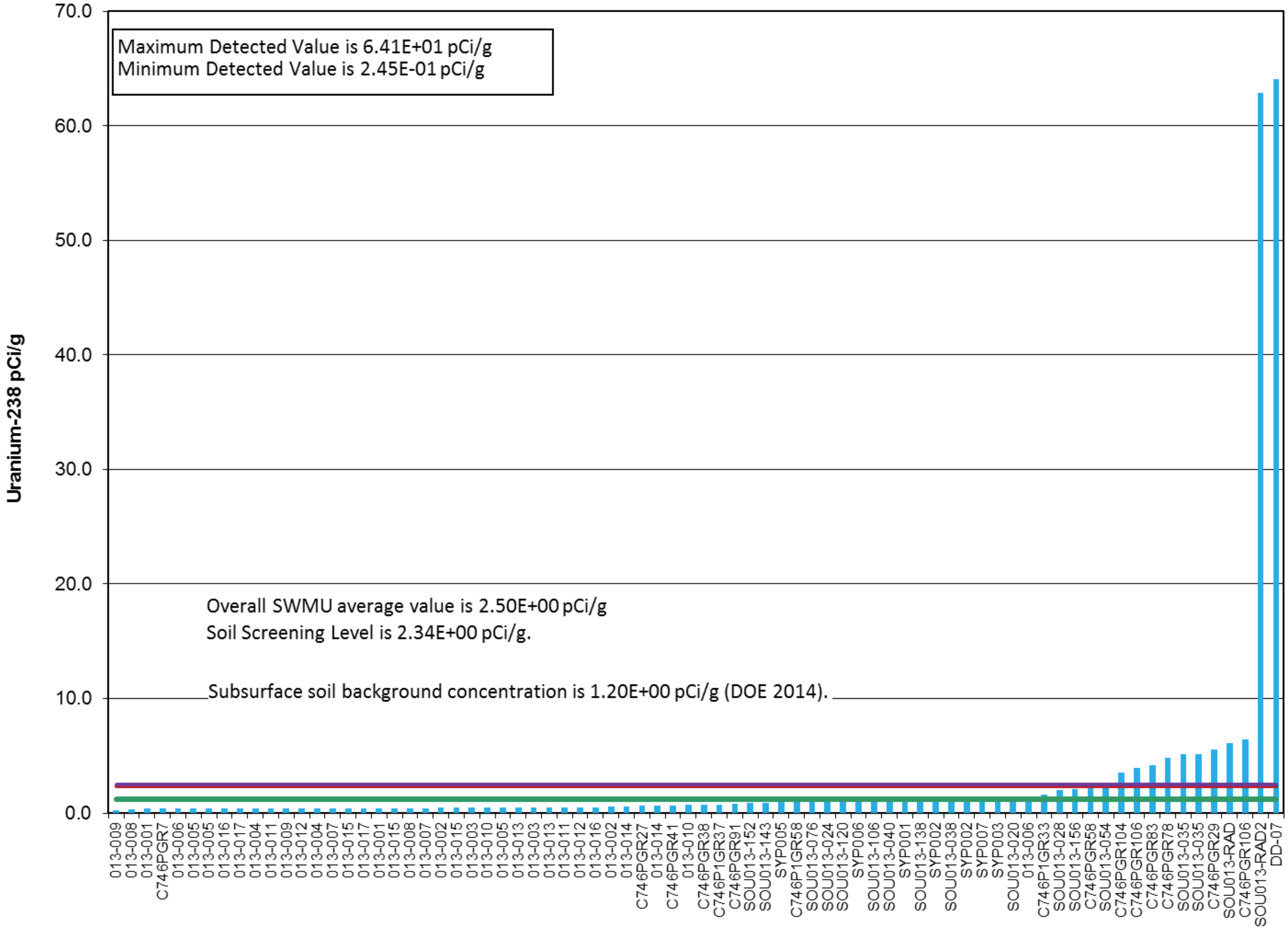

Figure C2.1.10. Uranium-238 Detections at SWMU 13

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C.2.2 SWMU 15

Data for SWMU 15 consists of both historical data and RI-collected data. SWMU 15 exceedances of the RG SSL include the following soil constituents: antimony, arsenic, cadmium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, naphthalene, neptunium-237, nickel, Total PCBs, phenanthrene, selenium, silver, Tc-99, uranium-234, uranium-235, uranium-238, and zinc.

Antimony was detected in 275 of the 334 samples. The detections are shown in Figure C2.2.1. The average concentration over SWMU 15 for antimony is greater than both the RG SSL and the background concentration. Antimony was evaluated as part of the GWOU FS and identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). The evaluation presented in Attachment C1 to Appendix C of the Soils OU RI Report (DOE 2013) did not identify any antimony impacts to RGA groundwater; therefore, antimony does not meet the screening criteria for fate and transport modeling for SWMU 15.

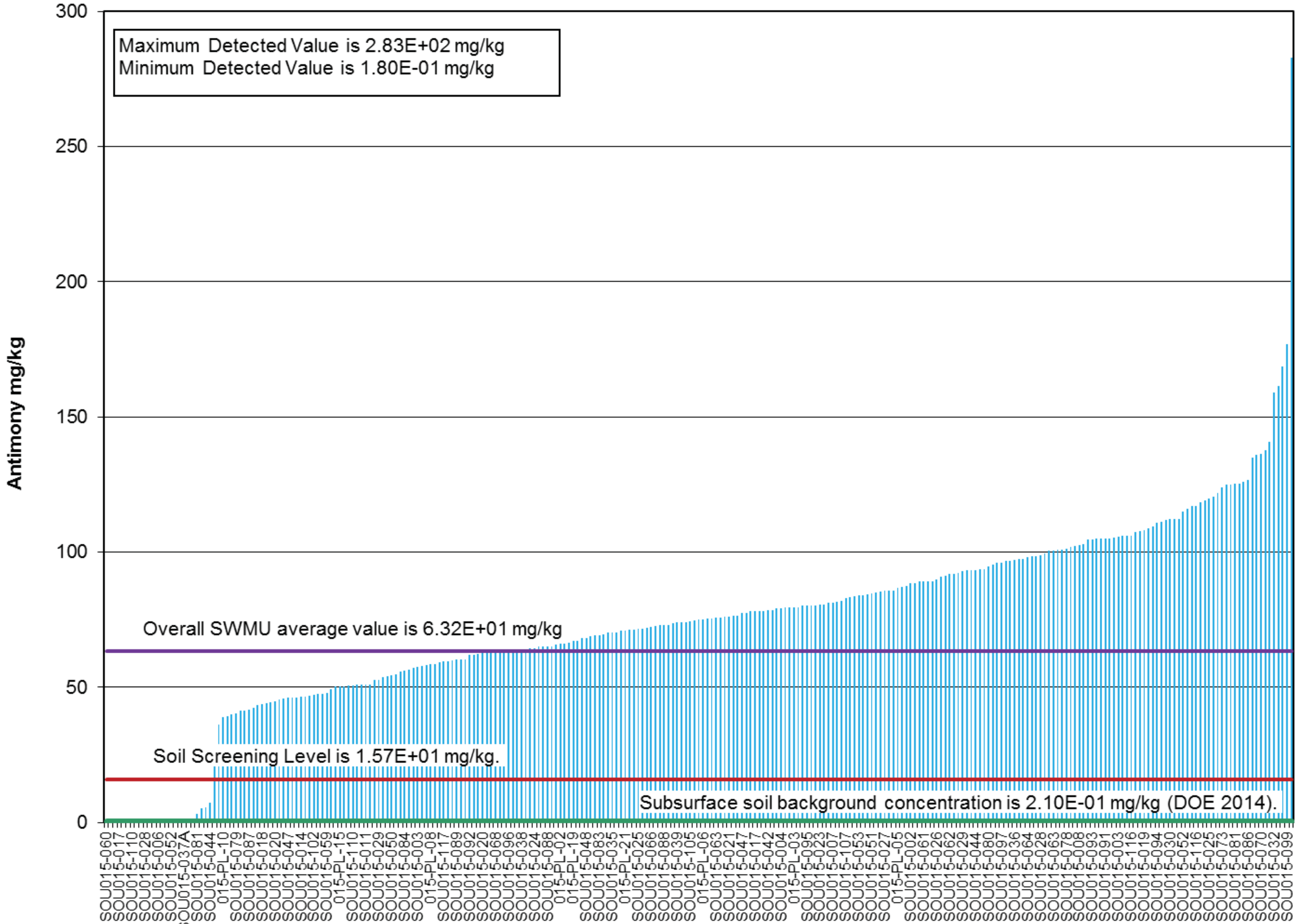

Figure C2.2.1. Antimony Detections at SWMU 15

Arsenic was detected in 179 of the 346 samples. The detections are shown in Figure C2.2.2. The average concentration over SWMU 15 for arsenic is greater than the background concentration, but less than the RG SSL; therefore, arsenic does not meet the screening criteria for fate and transport modeling for SWMU 15.

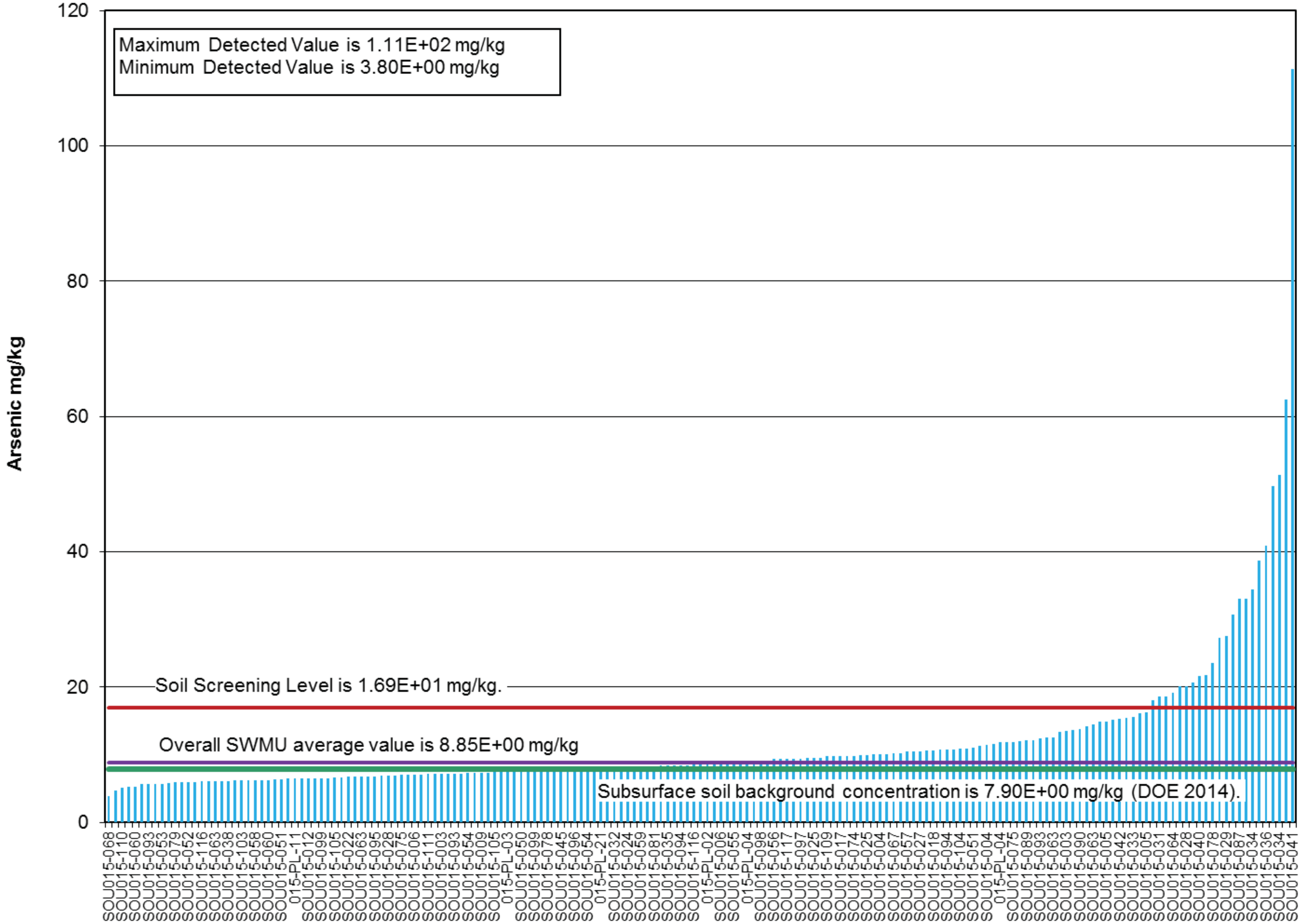

Figure C2.2.2. Arsenic Detections at SWMU 15

Cadmium was detected in 70 of the 334 samples. The detections are shown in Figure C2.2.3. The average concentration over SWMU 15 for cadmium is greater than the background concentration, but less than the RG SSL; therefore, cadmium does not meet the screening criteria for fate and transport modeling for SWMU 15.

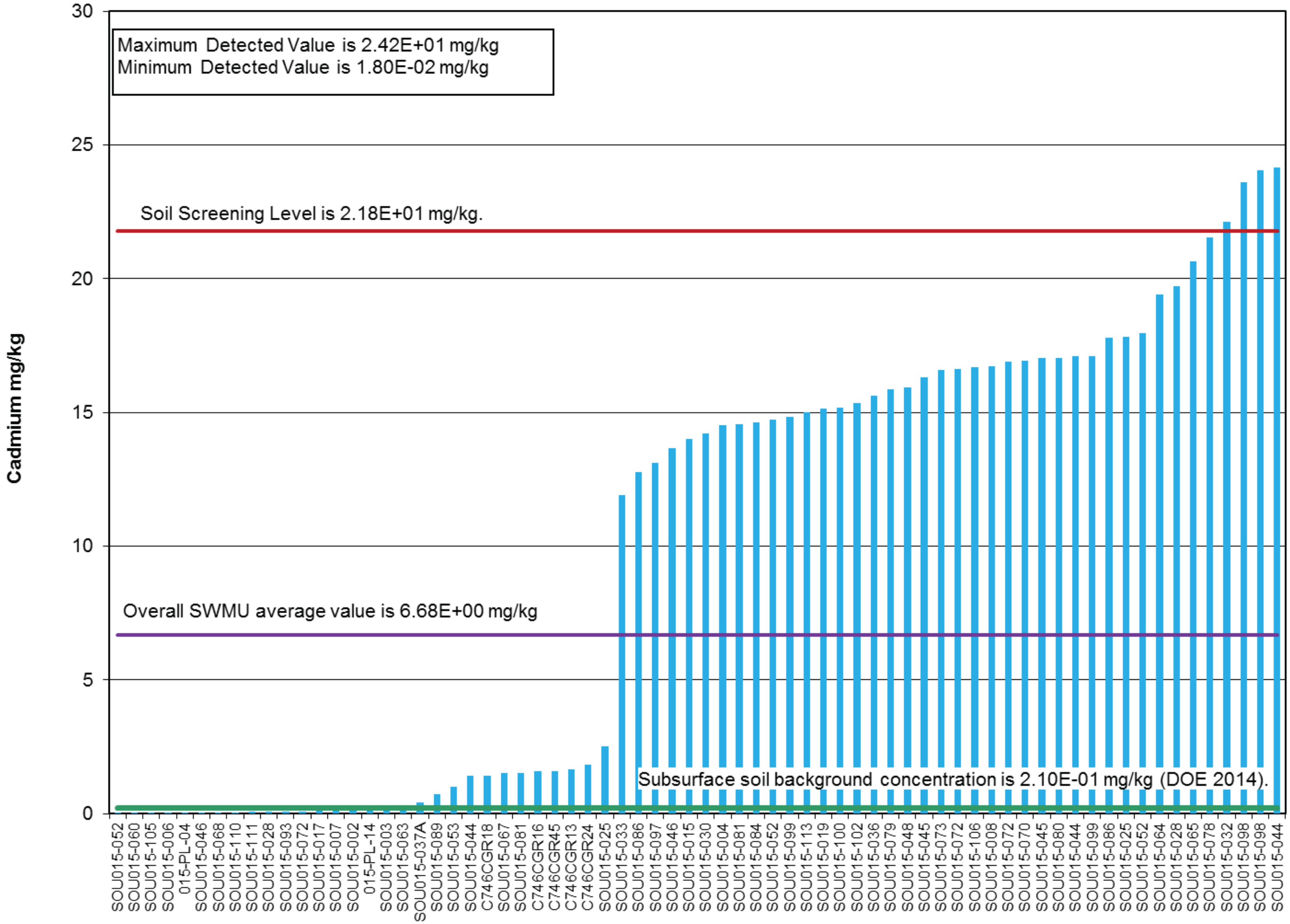

Figure C2.2.3. Cadmium Detections at SWMU 15

Cobalt was detected in 26 of the 26 samples. The detections are shown in Figure C2.2.4. The average concentration over SWMU 15 for cobalt is greater than the RG SSL, but less than the background concentration; therefore, cobalt does not meet the screening criteria for fate and transport modeling for SWMU 15.

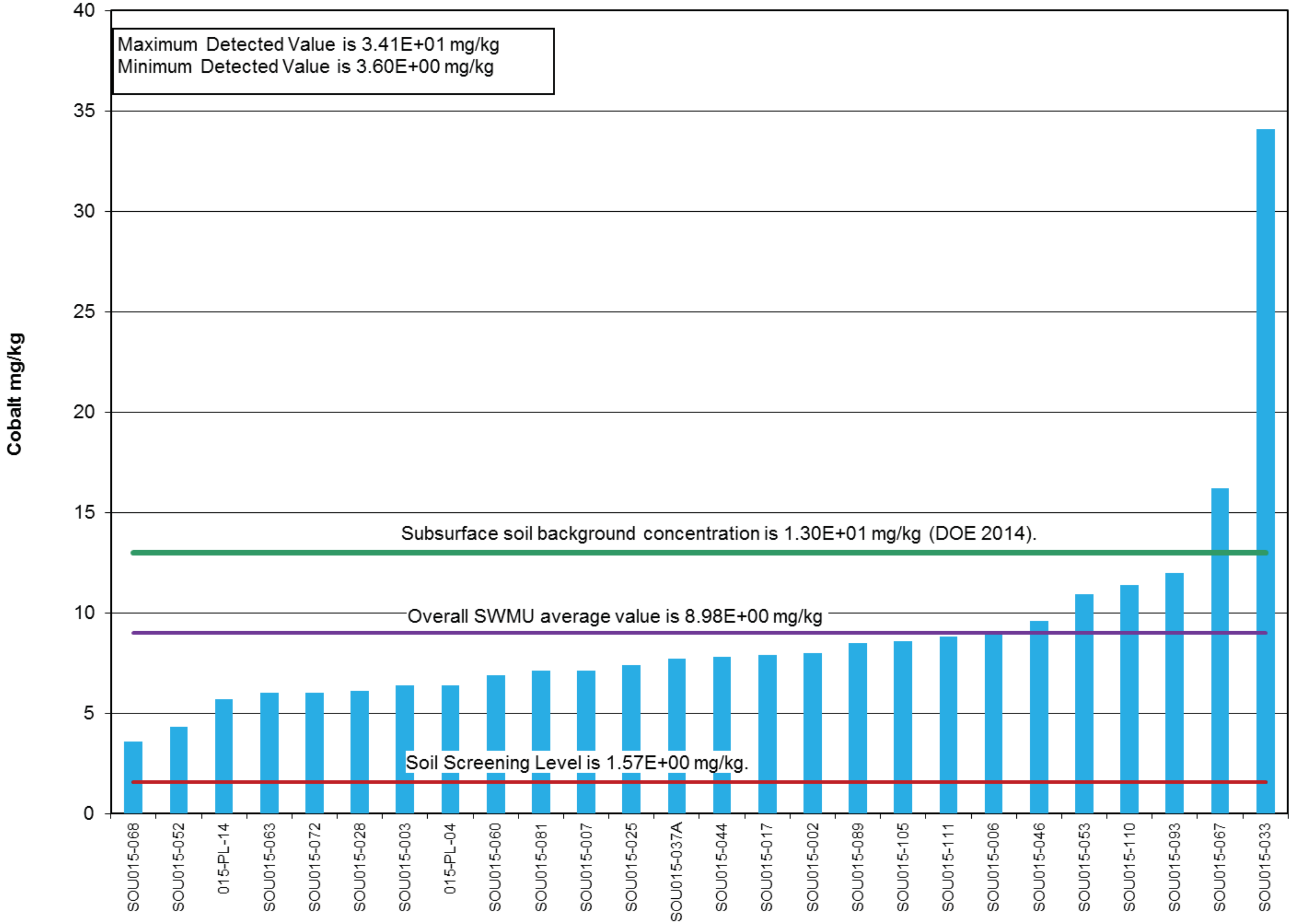

Figure C2.2.4. Cobalt Detections at SWMU 15

Copper was detected in 199 of the 346 samples. The detections are shown in Figure C2.2.5. The average concentration over SWMU 15 for copper is greater than the background concentration, but less than the RG SSL; therefore, copper does not meet the screening criteria for fate and transport modeling for SWMU 15.

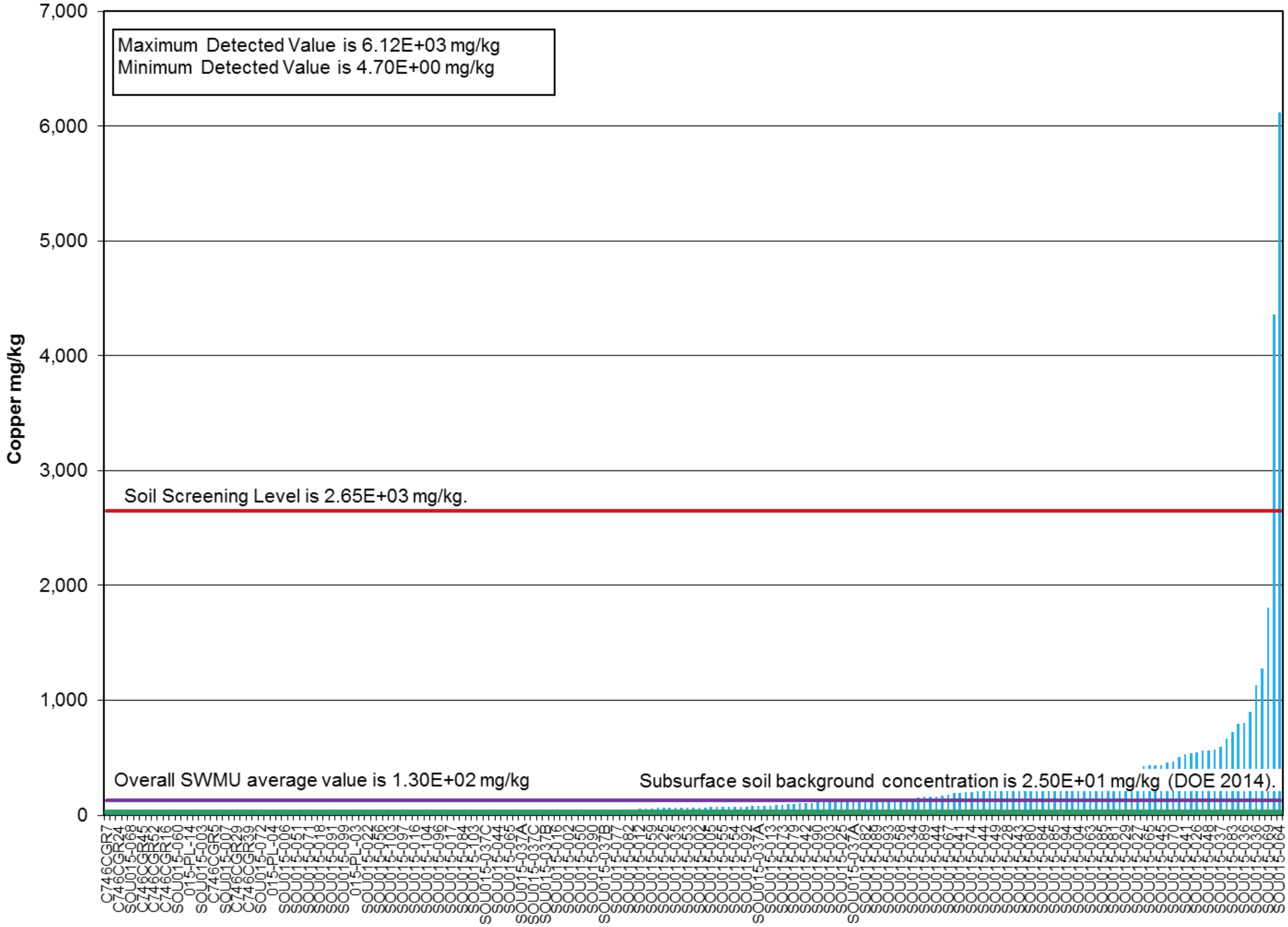

Figure C2.2.5. Copper Detections at SWMU 15

Iron was detected in 332 of the 332 samples. The detections are shown in Figure C2.2.6. The average concentration over SWMU 15 for iron is greater than the RG SSL, but less than the background concentration; therefore, iron does not meet the screening criteria for fate and transport modeling for SWMU 15.

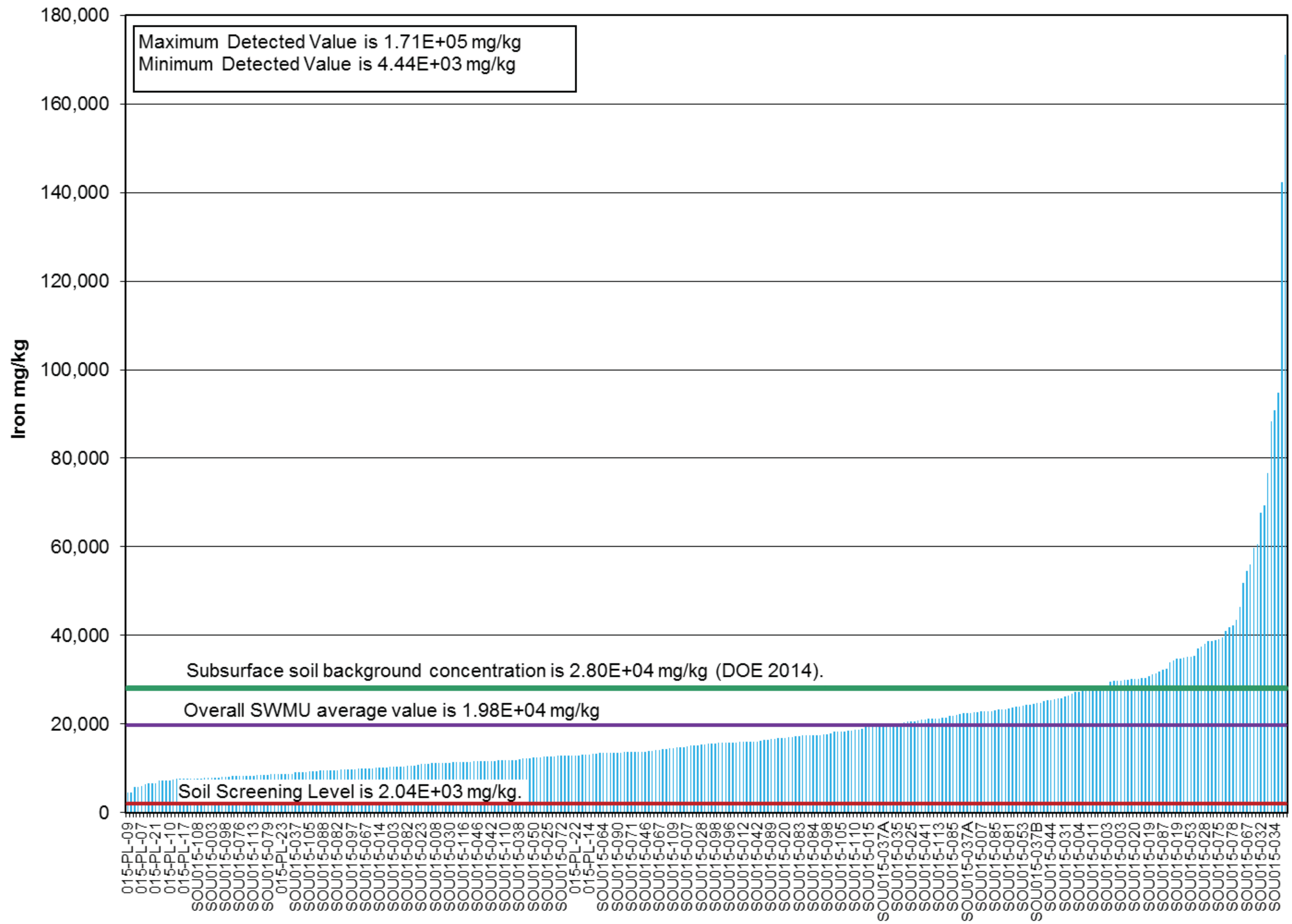

Figure C2.2.6. Iron Detections at SWMU 15

Lead was detected in 312 of the 346 samples. The detections are shown in Figure C2.2.7. The average concentration over SWMU 15 for lead is greater than the background concentration, but less than the RG SSL; therefore, lead does not meet the screening criteria for fate and transport modeling for SWMU 15.

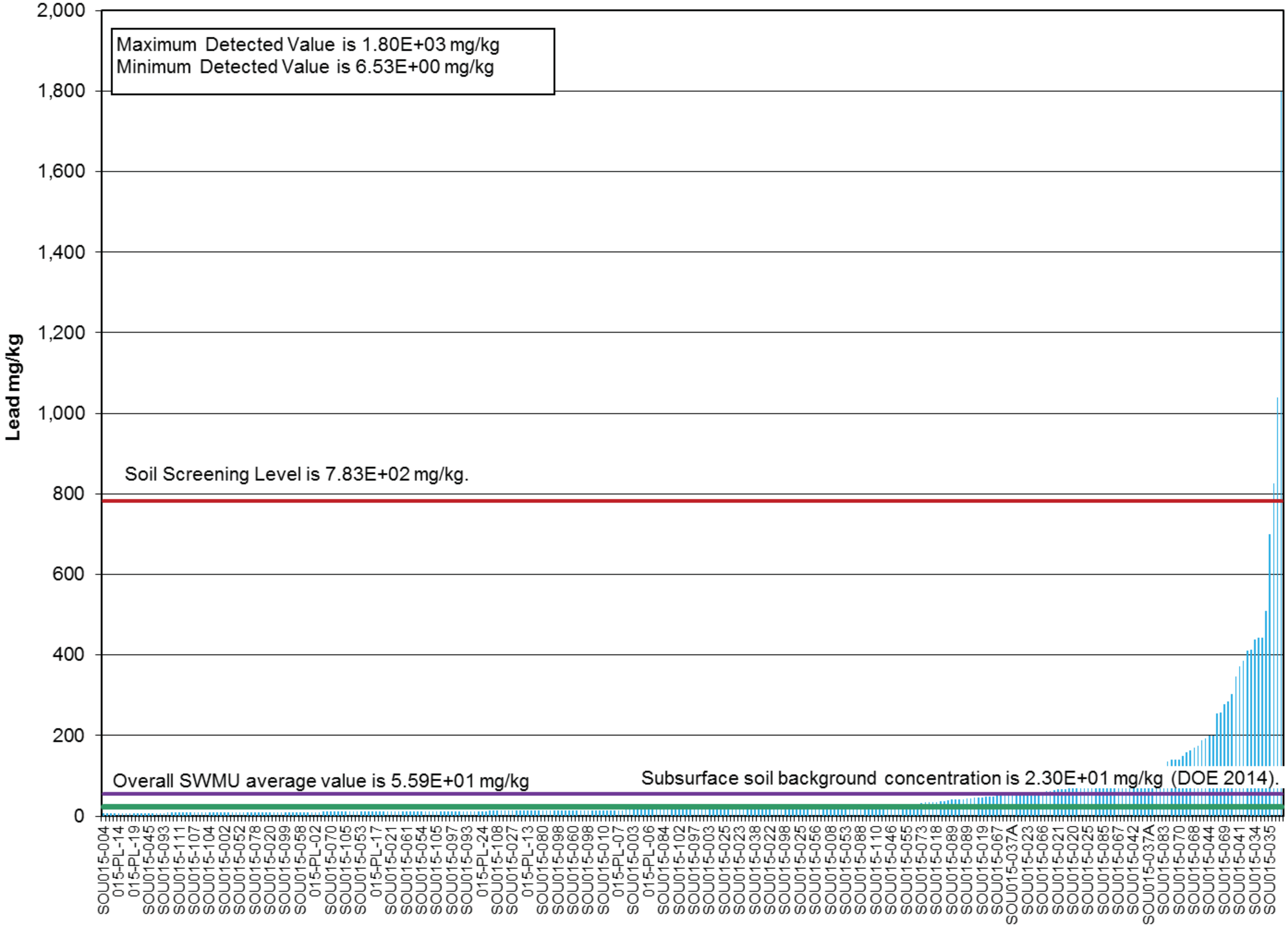

Figure C2.2.7. Lead Detections at SWMU 15

Manganese was detected in 326 of the 332 samples. The detections are shown in Figure C2.2.8. The average concentration over SWMU 15 for manganese is greater than the RG SSL, but less than the background concentration; therefore, manganese does not meet the screening criteria for fate and transport modeling for SWMU 15.

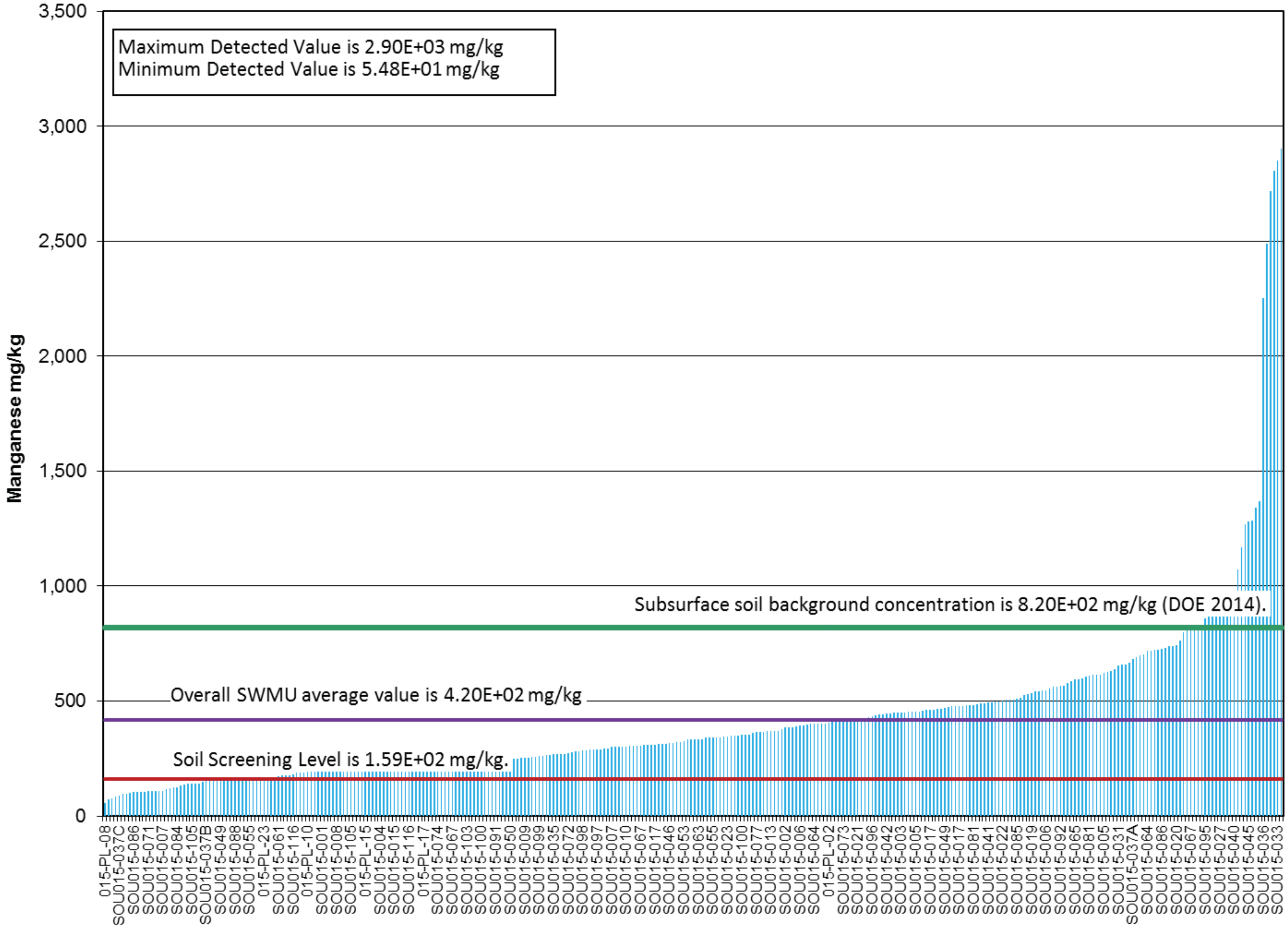

Figure C2.2.8. Manganese Detections at SWMU 15

Mercury was detected in 41 of the 345 samples. The detections are shown in Figure C2.2.9. The average concentration over SWMU 15 for mercury is greater than both the RG SSL and the background concentration. Mercury was not identified as a COC in the groundwater plumes associated with PGDP (DOE 2001); therefore, mercury does not meet the screening criteria for fate and transport modeling for SWMU 15.

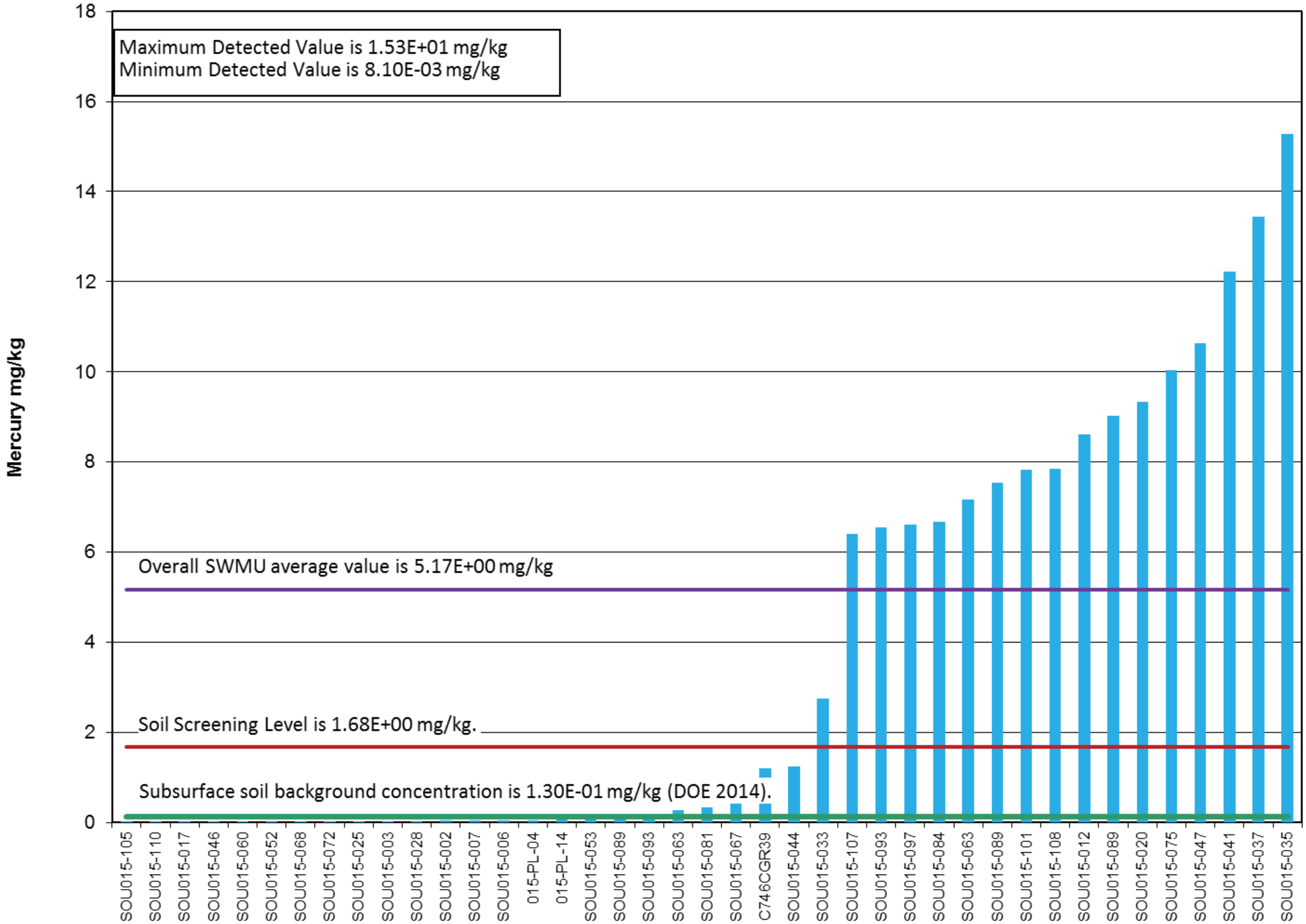

Figure C2.2.9. Mercury Detections at SWMU 15

Molybdenum was detected in 31 of the 332 samples. The detections are shown in Figure C2.2.10. The average concentration over SWMU 15 for molybdenum is less than the RG SSL; therefore, molybdenum does not meet the screening criteria for fate and transport modeling for SWMU 15.

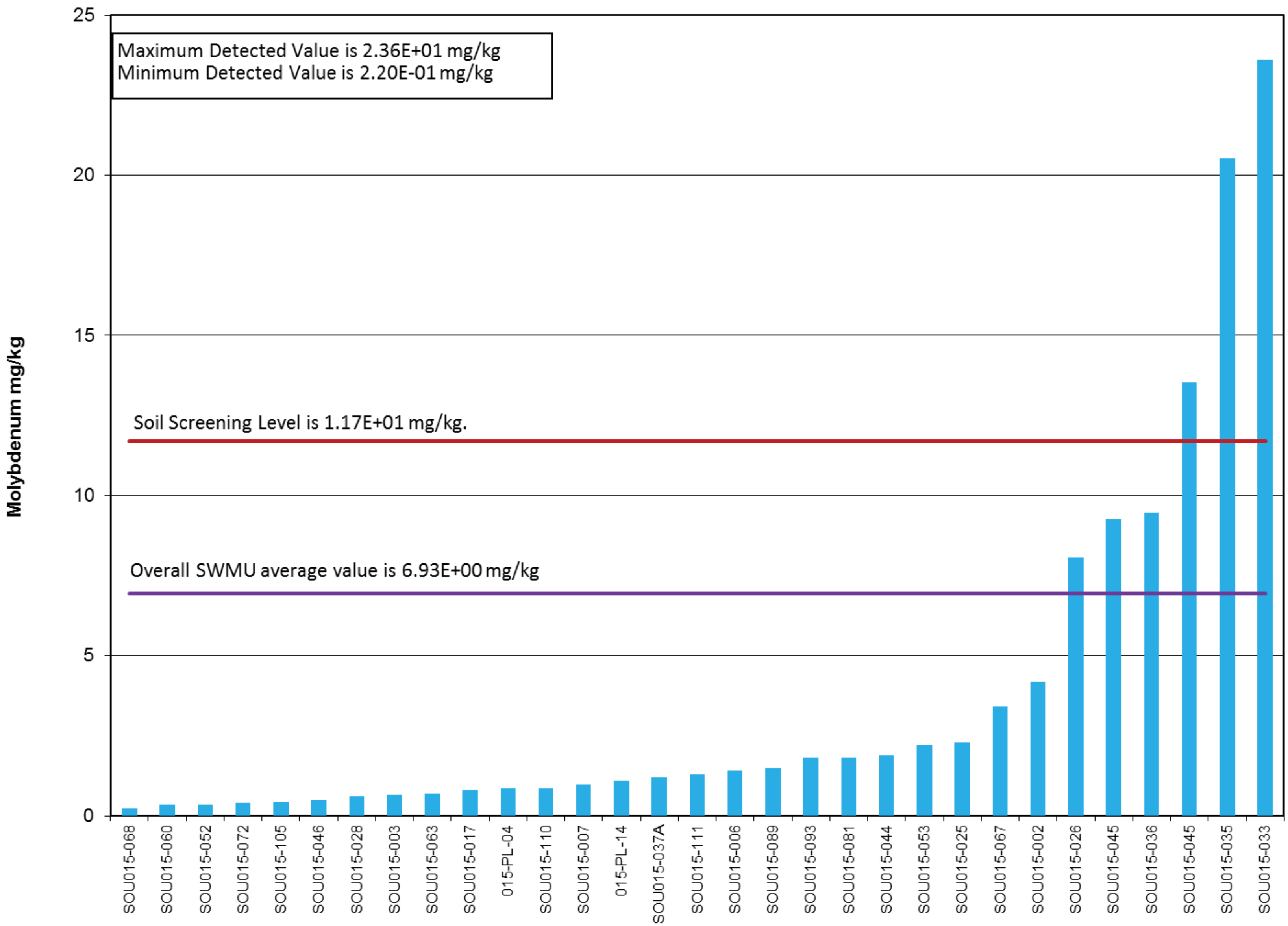

Figure C2.2.10. Molybdenum Detections at SWMU 15

Naphthalene was detected in 1 of the 37 samples. The detection is shown in Figure C2.2.11. The average concentration over SWMU 15 for naphthalene is greater than the RG SSL. Naphthalene was not identified as a COC in the groundwater plumes associated with PGDP (DOE 2001); therefore, naphthalene does not meet the screening criteria for fate and transport modeling for SWMU 15.

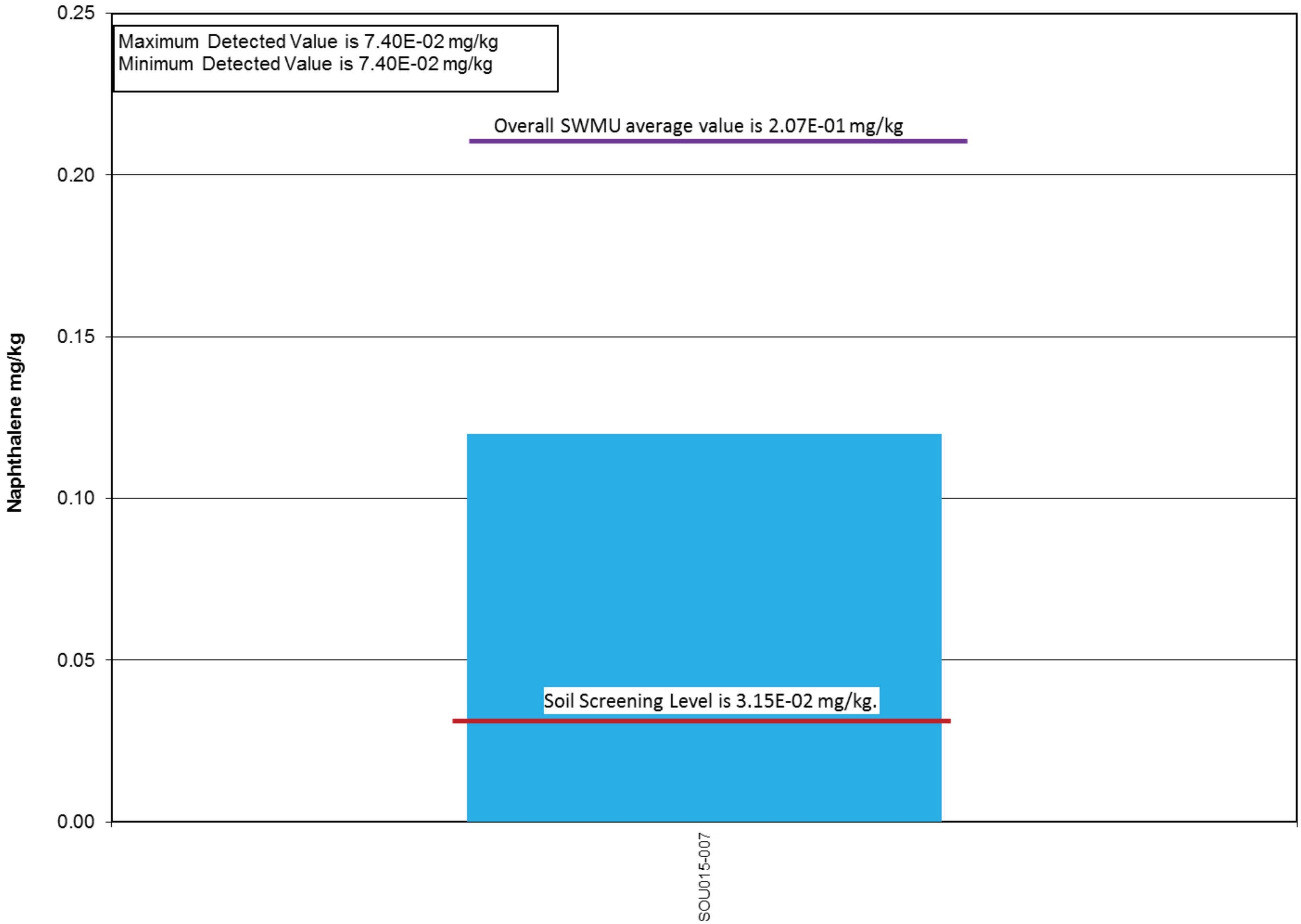

Figure C2.2.11. Naphthalene Detections at SWMU 15

Neptunium-237 was detected in 15 of the 37 samples. The detections are shown in Figure C2.2.12. The average activity concentration over SWMU 15 for neptunium-237 is less than the RG SSL; therefore, neptunium-237 does not meet the screening criteria for fate and transport modeling for SWMU 15.

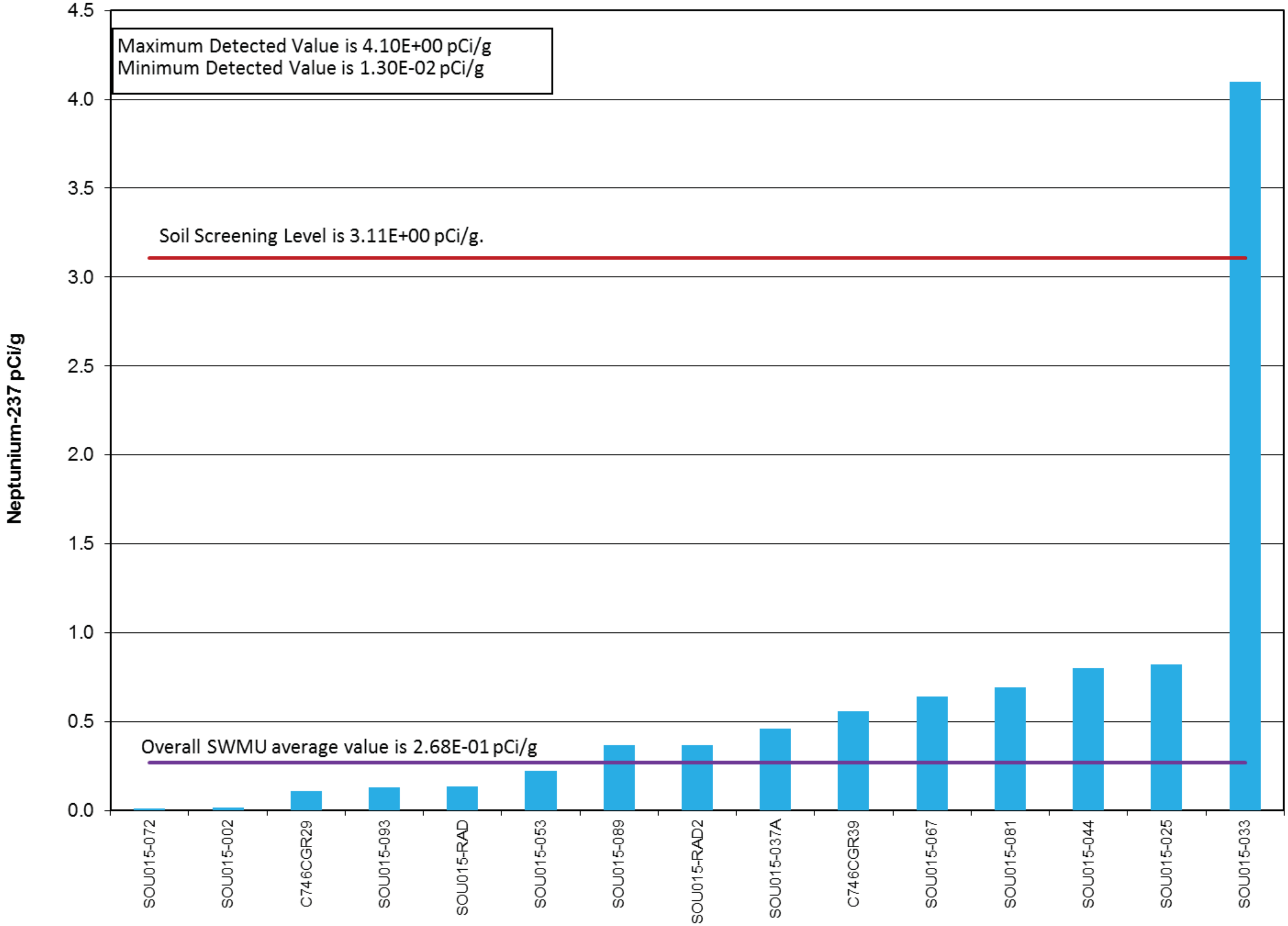

Figure C2.2.12. Neptunium-237 Detections at SWMU 15

Nickel was detected in 192 of the 346 samples. The detections are shown in Figure C2.2.13. The average concentration over SWMU 15 for nickel is greater than the background concentration, but less than the RG SSL; therefore, nickel does not meet the screening criteria for fate and transport modeling for SWMU 15.

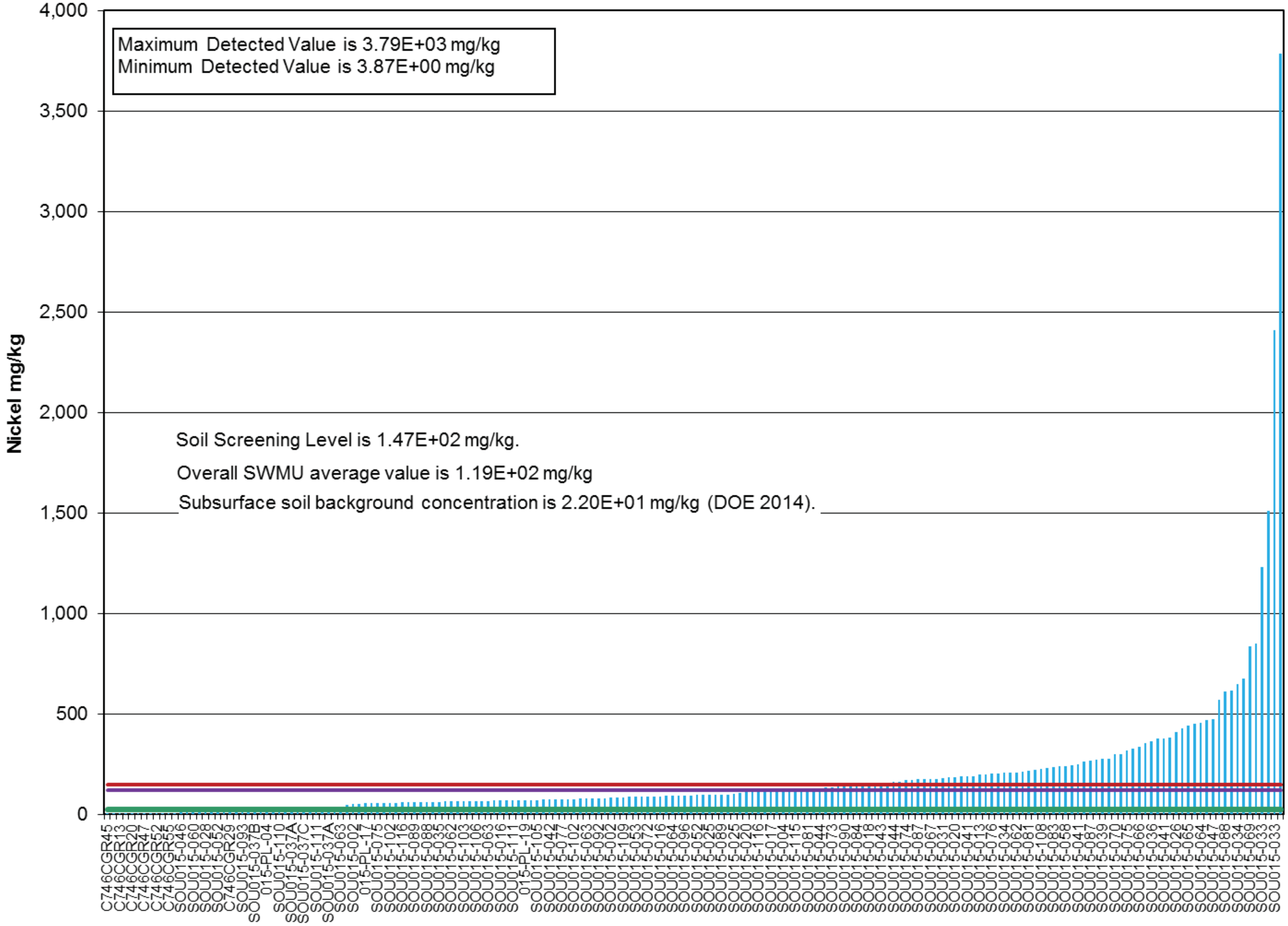

Figure C2.2.13. Nickel Detections at SWMU 15

Total PCBs was detected in 51 of the 345 samples. The detections are shown in Figure C2.2.14. The average concentration over SWMU 15 for Total PCBs is less than the RG SSL; therefore, Total PCBs does not meet the screening criteria for fate and transport modeling for SWMU 15.

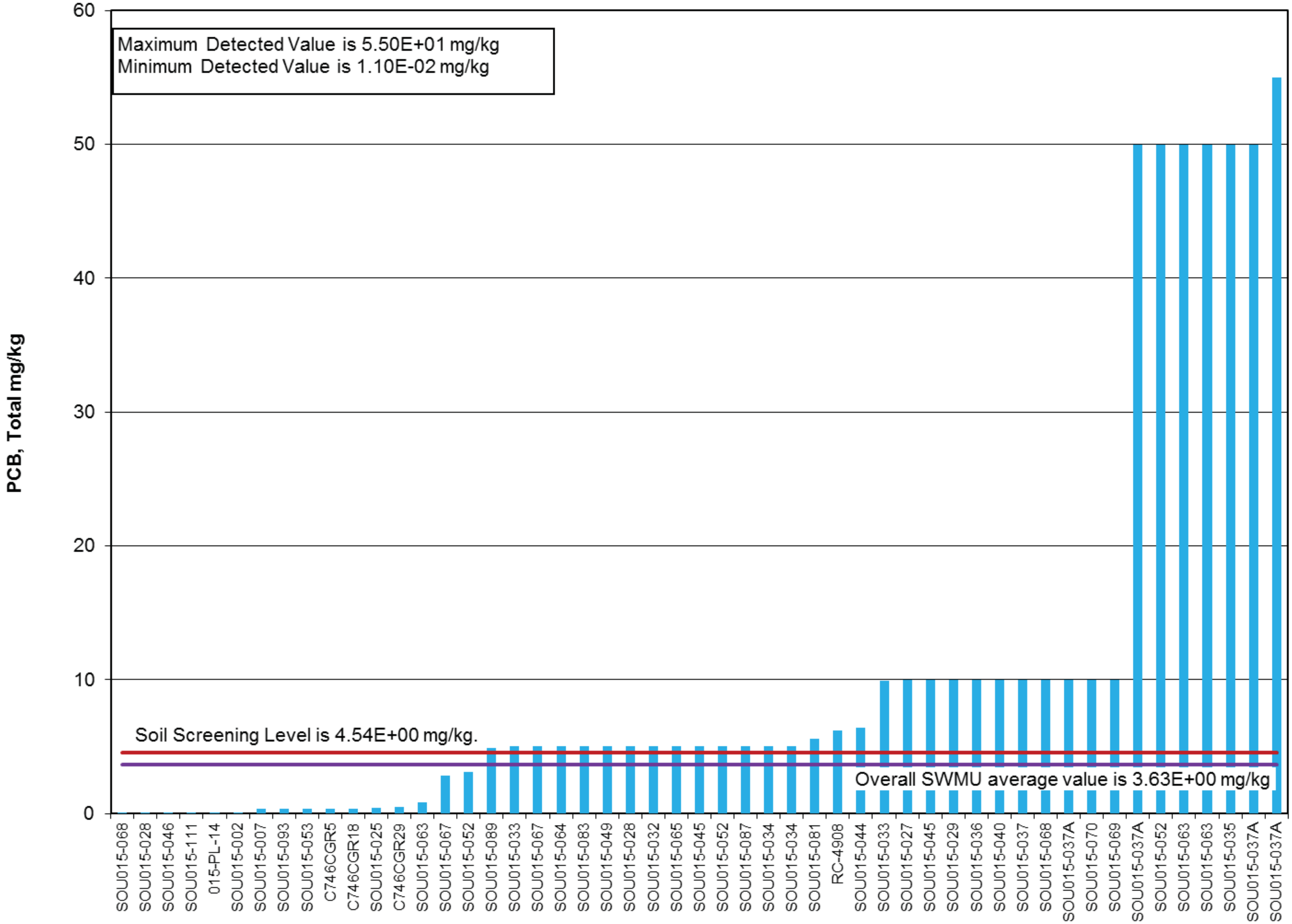

Figure C2.2.14. Total PCBs Detections at SWMU 15

Phenanthrene was detected in 9 of the 37 samples. The detections are shown in Figure C2.2.15. The average concentration over SWMU 15 for phenanthrene is less than the RG SSL; therefore, phenanthrene does not meet the screening criteria for fate and transport modeling for SWMU 15. Additionally phenanthrene was not identified as a COC in the groundwater plumes associated with PGDP (DOE 2001).

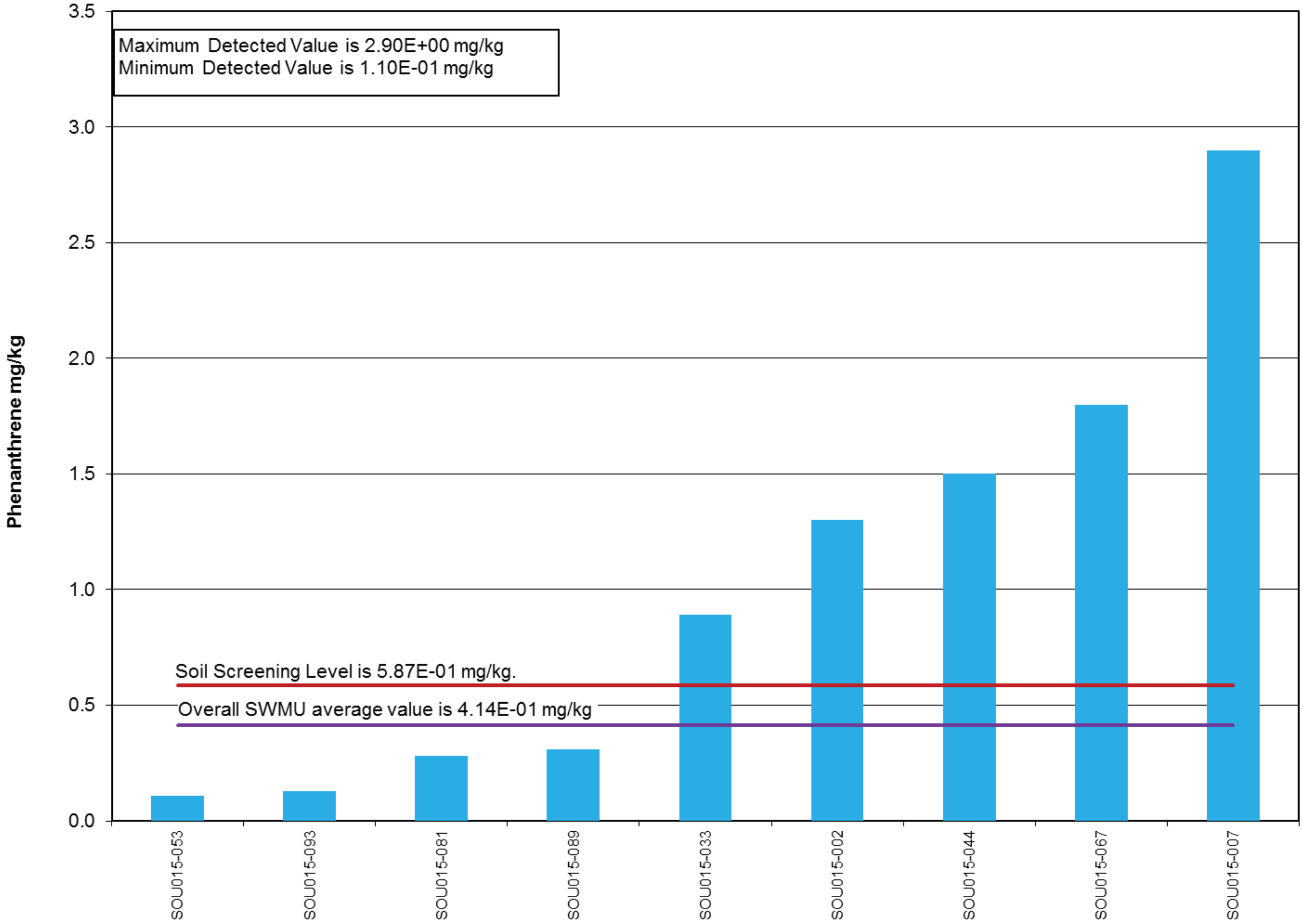

Figure C2.2.15. Phenanthrene Detections at SWMU 15

Selenium was detected in 31 of the 346 samples. The detections are shown in Figure C2.2.16. The average concentration over SWMU 15 for selenium is greater than the background concentration, but less than the RG SSL; therefore, selenium does not meet the screening criteria for fate and transport modeling for SWMU 15. Additionally, selenium was not identified as a COC in the groundwater plumes associated with PGDP (DOE 2001).

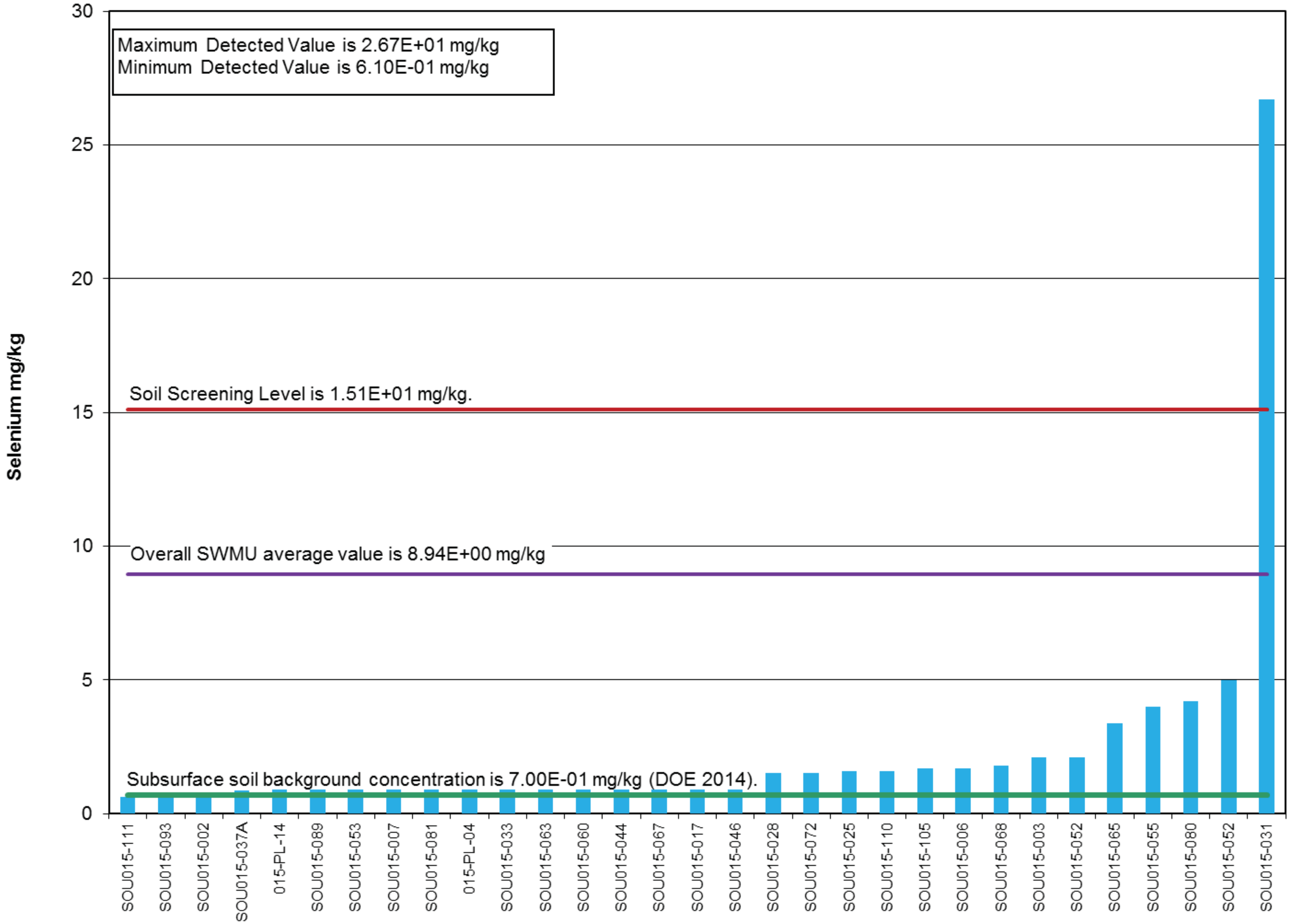

Figure C2.2.16. Selenium Detections at SWMU 15

Silver was detected in 64 of the 346 samples. The detections are shown in Figure C2.2.17. The average concentration over SWMU 15 for silver is greater than both the background and the RG SSL. Silver was evaluated as part of the GWOU FS and identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). The evaluation presented in Attachment C1 to Appendix C of the Soils OU RI Report (DOE 2013) did not identify any silver impacts RGA to groundwater; therefore, silver does not meet the screening criteria for groundwater fate and transport modeling for SWMU 15.

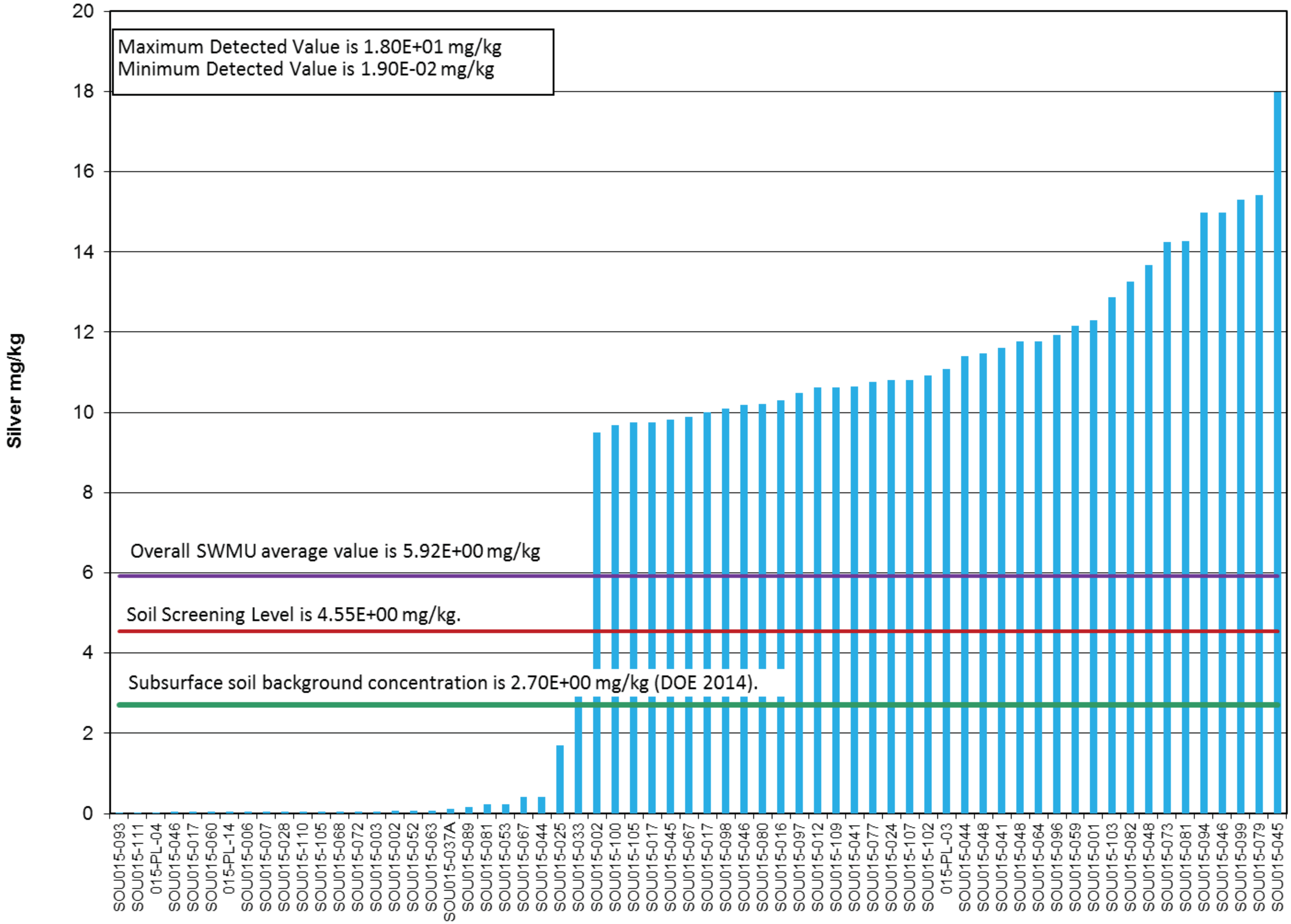

Figure C2.2.17. Silver Detections at SWMU 15

Tc-99 was detected in 28 of the 37 samples. The detections are shown in Figure C2.2.18. The average activity concentration over SWMU 15 for Tc-99 is greater than both the RG SSL and the background activity concentration. Tc-99 was evaluated as part of the GWOU FS and identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). Because of the presence of Tc-99 in RGA groundwater and the close proximity of SWMU 15 to the Tc-99 plume, SWMU 15 may be a secondary source of Tc-99. Twenty-one of the samples were detected above both the RG SSL and the background concentration; therefore, a hot spot evaluation was performed.

MVS was used to evaluate the distribution of Tc-99 across SWMU 15. Figure C2.2.19 shows the distribution of Tc-99 at 0–5 ft bgs. A hot spot does appear to be present.

Tc-99 in SWMU 15 appears to meet the screening criteria for fate and transport modeling.

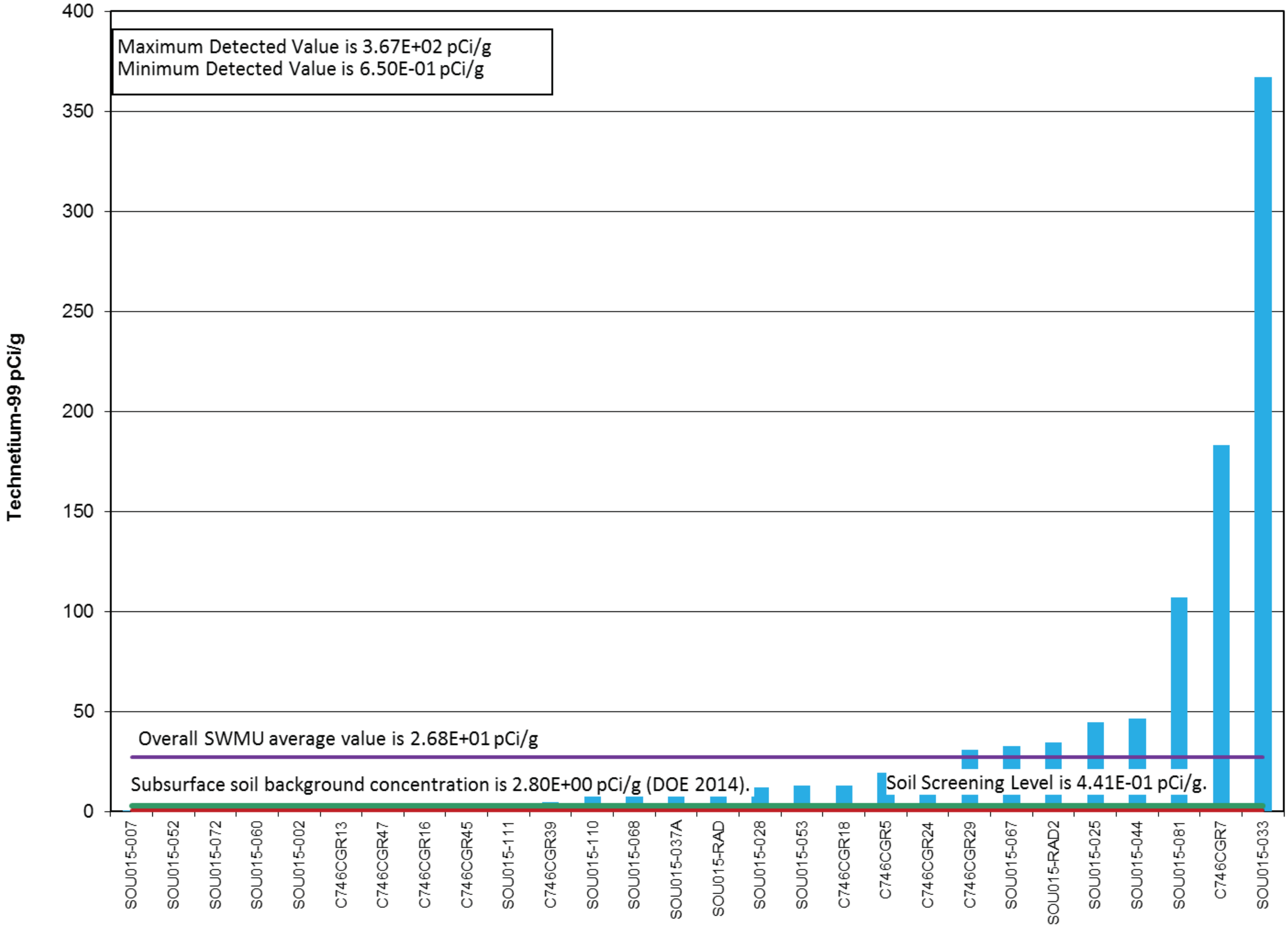

Figure C2.2.18. Tc-99 Detections at SWMU 15

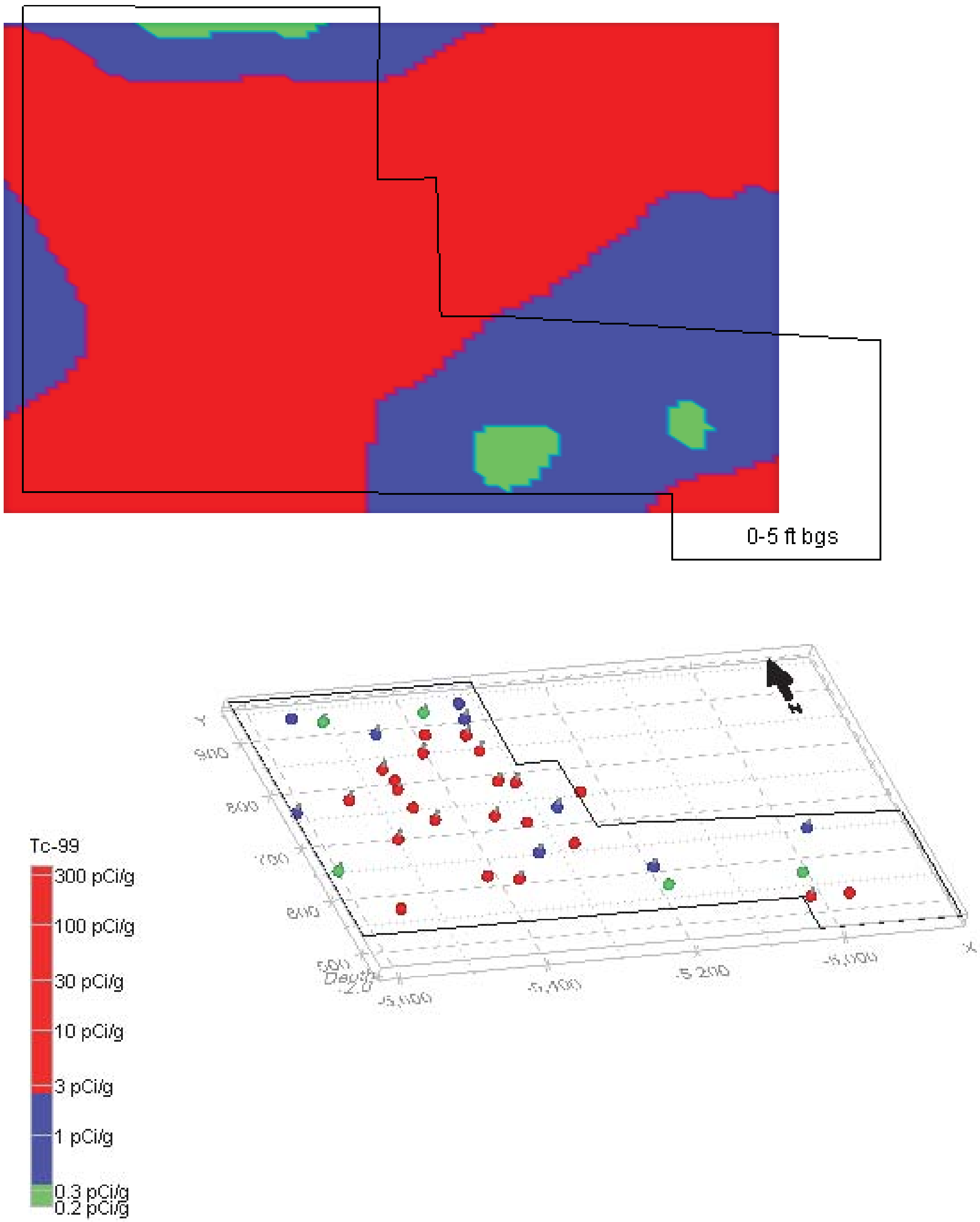

Figure C2.2.19. Tc-99 Distribution at SWMU 15

Uranium-234 was detected in 37 of 37 samples. The detections are shown in Figure C2.2.20. The average activity concentration over SWMU 15 for uranium-234 is greater than both the background and the RG SSL. Uranium-234 was evaluated as part of the GWOU FS and identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). Twelve samples exceed both the background and the RG SSL; therefore, a hot spot evaluation was performed.

MVS was used to evaluate the distribution of uranium-234 across SWMU 15. Figure C2.2.21 shows the distribution of uranium-234 at 0 to 5 ft bgs. Uranium-234 meets the requirement for fate and transport modeling for SWMU 15; however, hot spot analysis shows the distribution is not clustered and, therefore, not indicative of a source location. Additionally, uranium was modeled at SWMU 81 [presented in the Soils OU RI Report (DOE 2013)] did not identify any uranium-234 impacts to RGA groundwater; therefore, uranium-234 fate and transport modeling was not performed for SWMU 15 (see Attachment C1 to Appendix C).

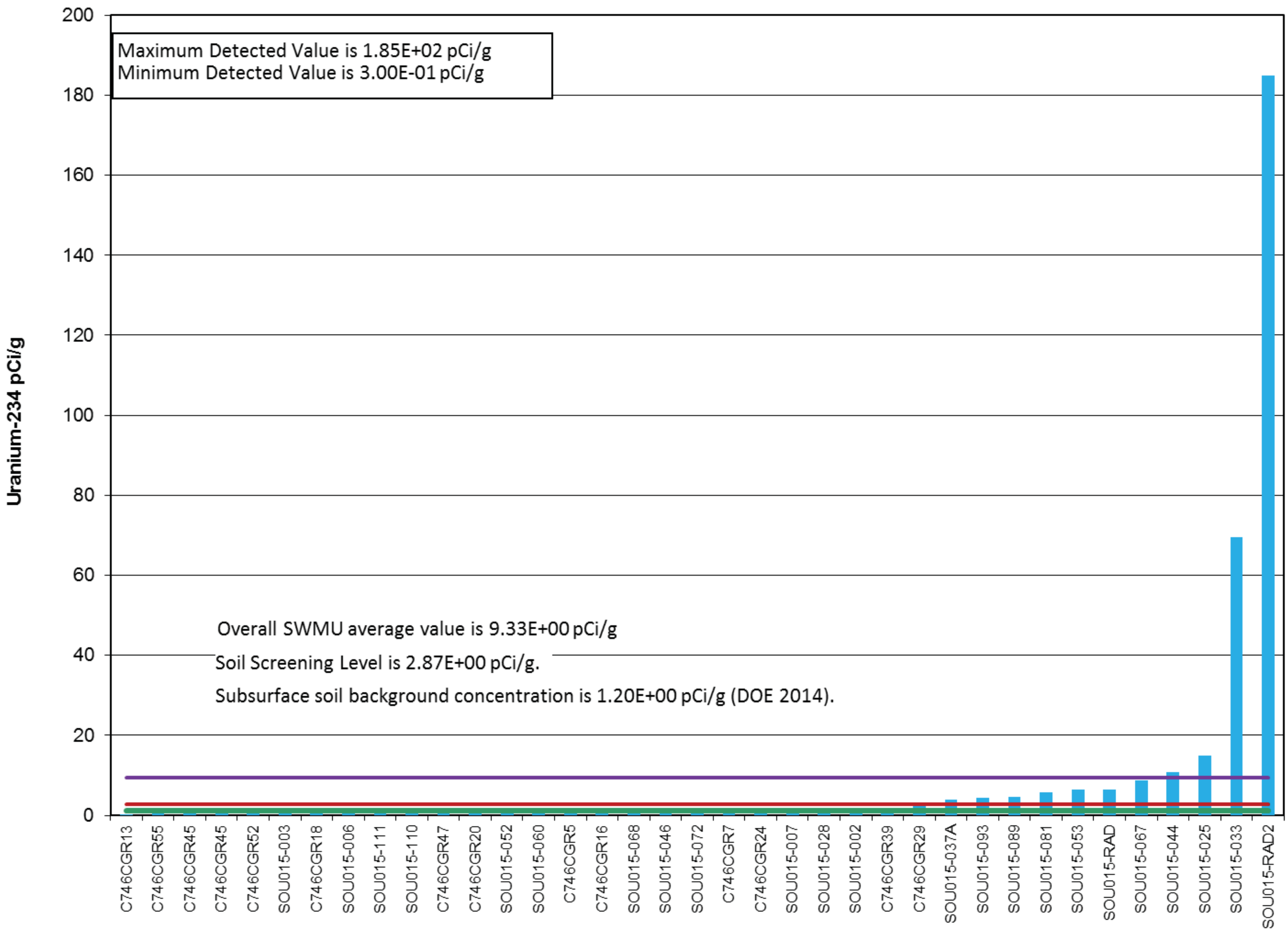

Figure C2.2.20. Uranium-234 Detections at SWMU 15

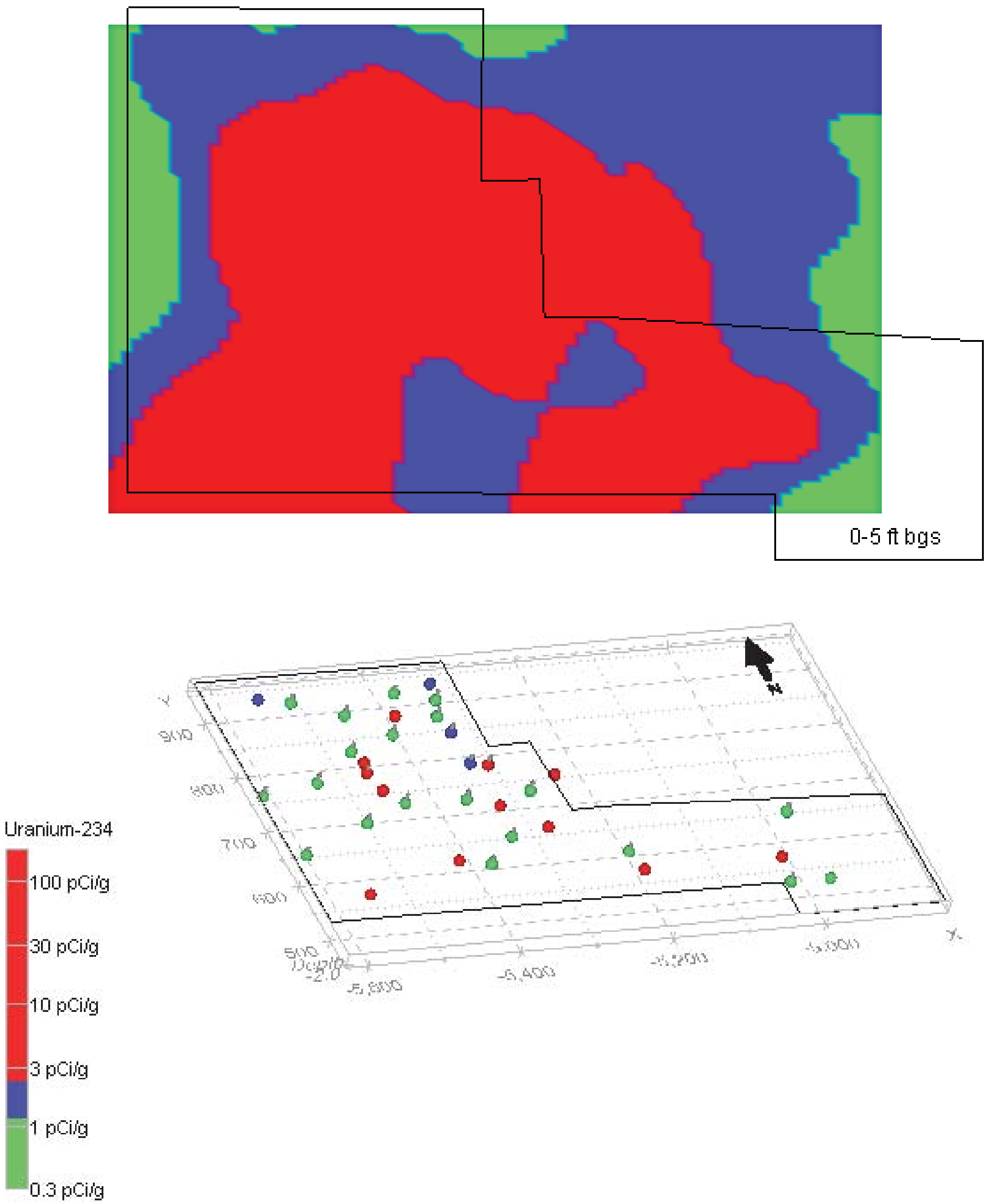

Figure C2.2.21. U-234 Distribution at SWMU 15

Uranium-235 was detected in 32 of the 37 samples. The detections are shown in Figure C2.2.22. The average activity concentration over SWMU 15 for uranium-235 is greater than the background activity concentration but less than the RG SSL; therefore, uranium-235 does not meet the screening criteria for fate and transport modeling for SWMU 15.

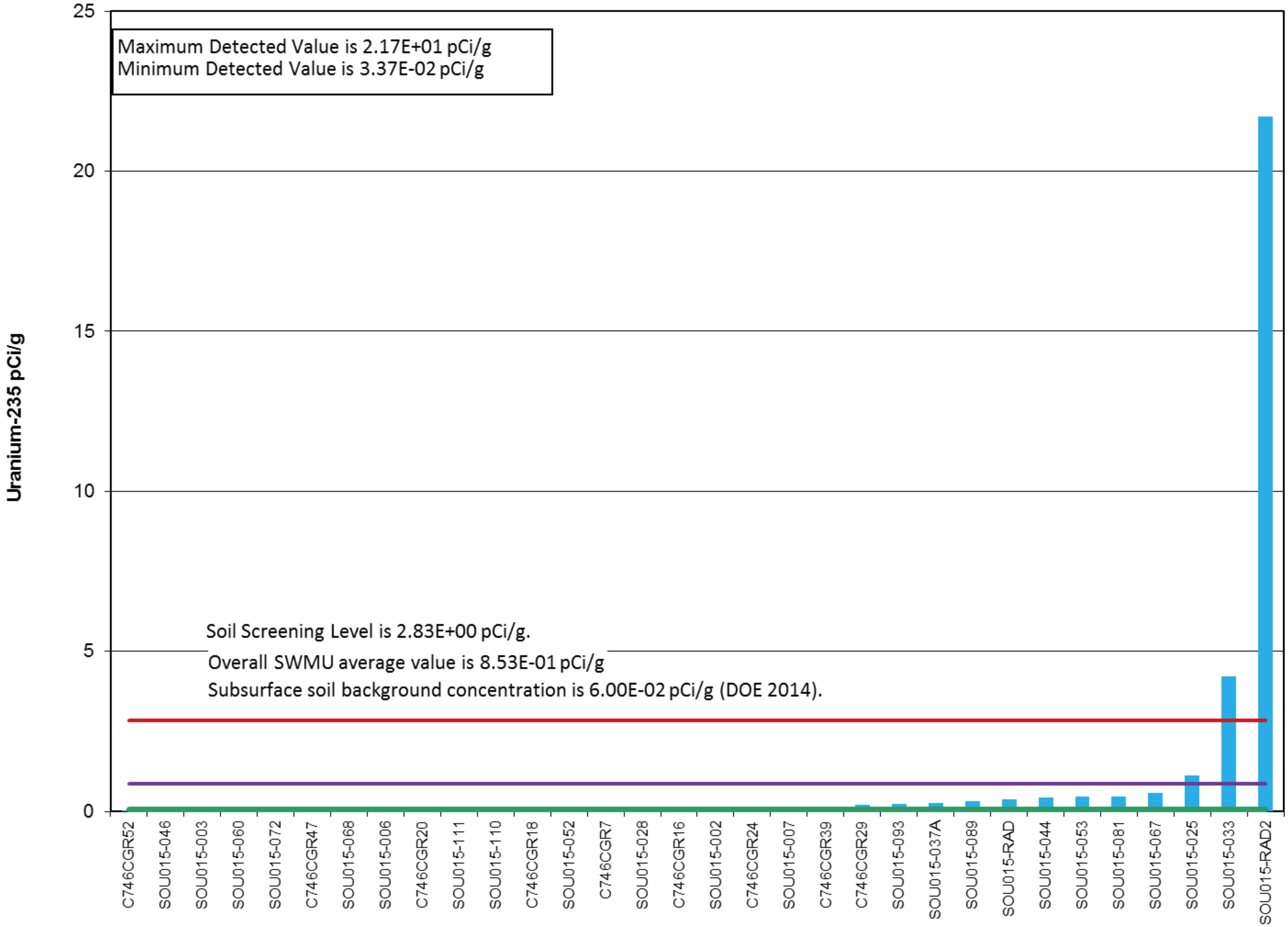

Figure C2.2.22. Uranium-235 Detections at SWMU 15

Uranium-238 was detected in 37 of 37 samples. The detections are shown in Figure C2.2.23. The average activity concentration over SWMU 15 for uranium-238 is greater than both the background activity concentration and the RG SSL. Uranium-238 was evaluated as part of the GWOU FS and identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). The evaluation presented in Attachment C1 to Appendix C of the Soils OU RI Report (DOE 2013) did not identify any uranium-238 impacts to RGA groundwater; therefore, uranium-238 does not meet the screening criteria for fate and transport modeling for SWMU 15.

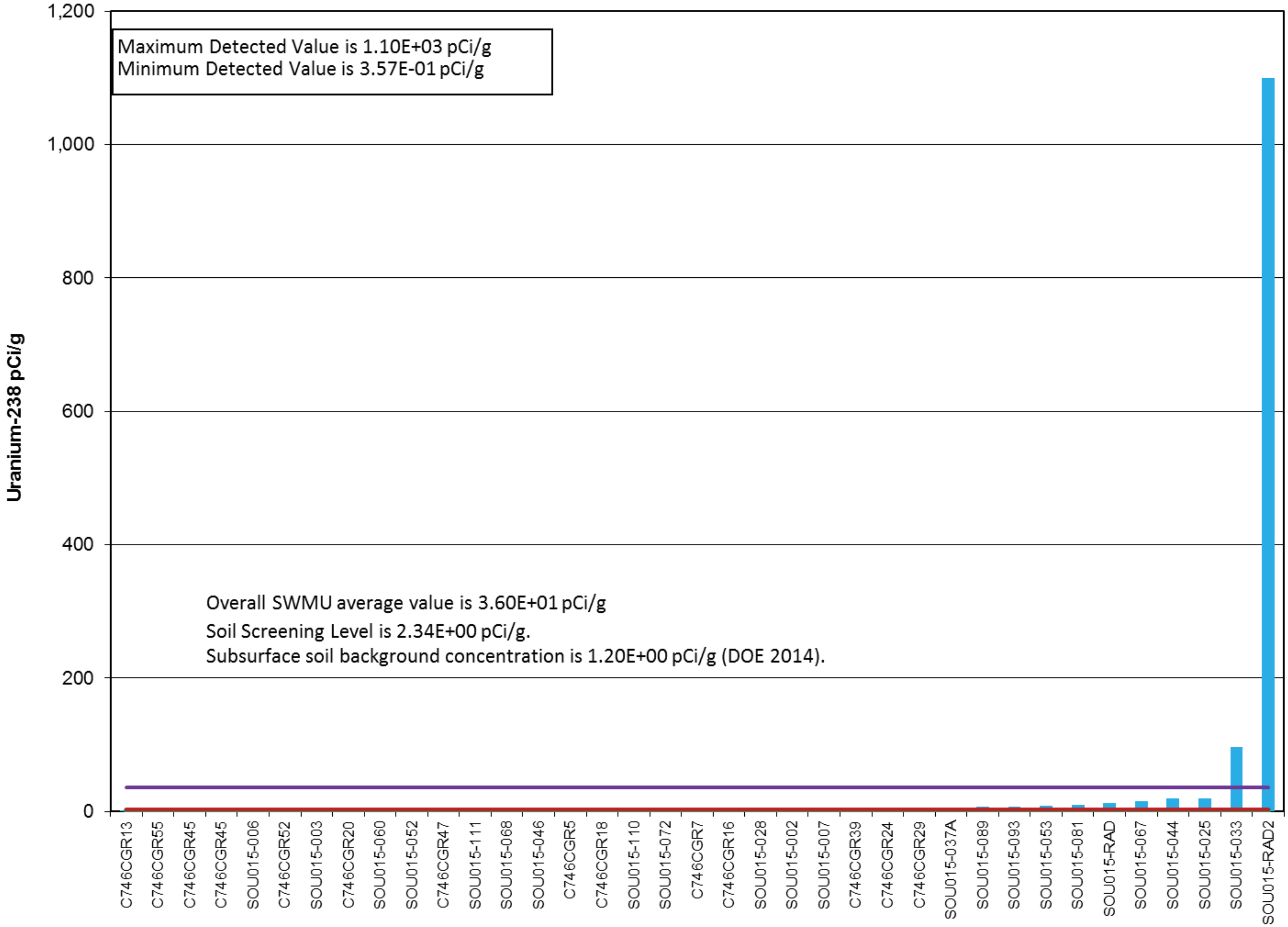

Figure C2.2.23. Uranium-238 Detections at SWMU 15

Zinc was detected in 345 of the 346 samples. The detections are shown in Figure C2.2.24. The average concentration at SWMU 15 for zinc is greater than the background concentration, but less than the RG SSL. Additionally, zinc was not identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). Zinc does not meet the screening criteria for fate and transport modeling for SWMU 15.

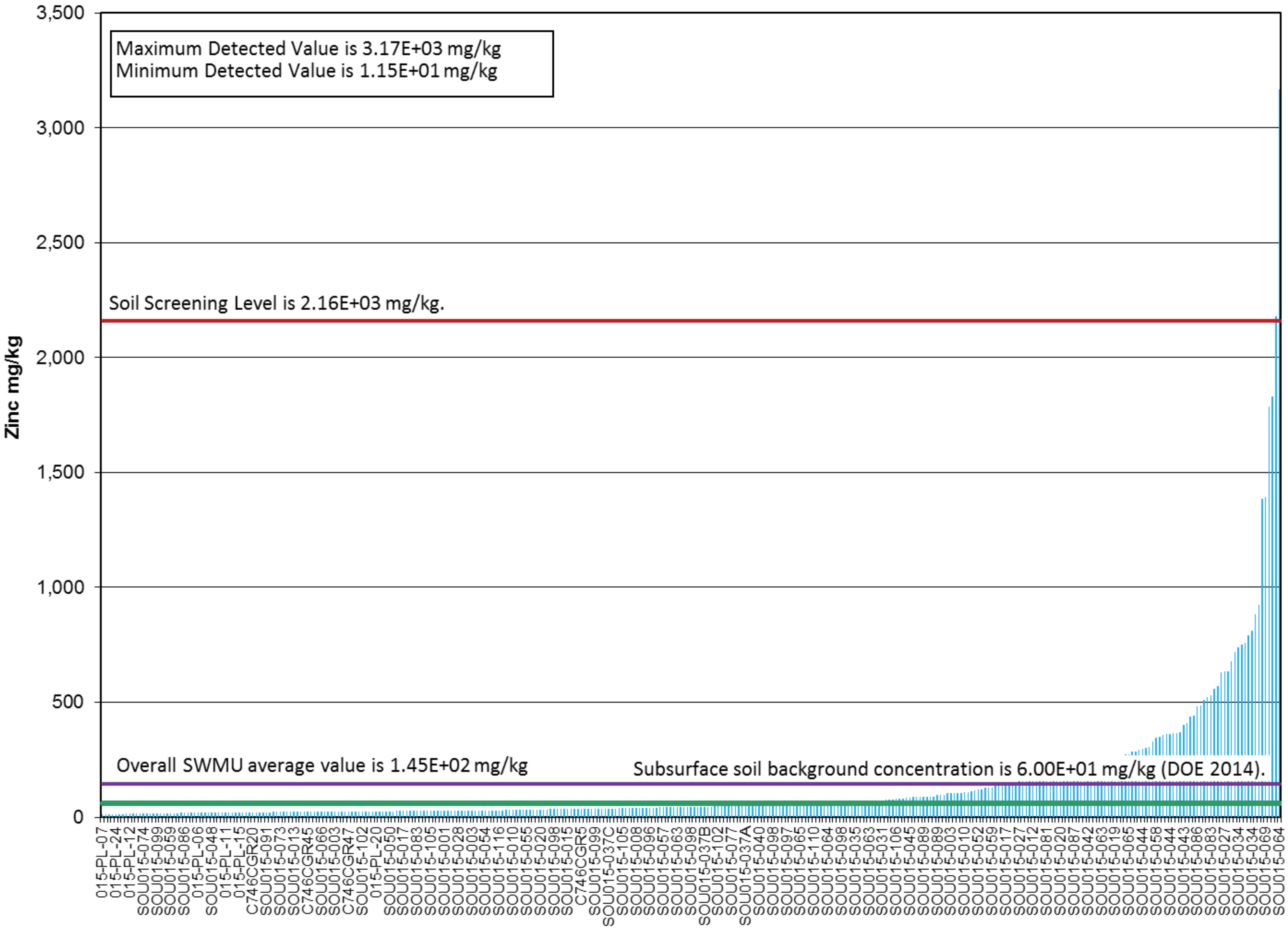

Figure C2.2.24. Zinc Detections at SWMU 15

C.2.3 SWMU 26

Data for SWMU 26 consists of both historical data and RI-collected data. SWMU 26 exceedances of the RG SSL include the following soil constituents: antimony, arsenic, cadmium, cobalt, copper, iron, manganese, mercury, molybdenum, naphthalene, neptunium-237, nickel, phenanthrene, plutonium-239/240, silver, Tc-99, thallium, thorium-230, uranium, uranium-234, uranium-235, and uranium-238. The average concentration of soil constituents at SWMU 26 (see Attachment C1) included the following locations due to their proximity to the SWMU, but were not included in the charts or nature and extent summaries because they fall outside of an RI 2 grid: 026-003, 026-PL-05, 026-PL-06, 040-005, 040-006, 400-056, 400-095, NSD002, RU1, RU1C, RU1E, RU1W, RU21C, and RU2E.

Antimony was detected in 66 of 105 samples. The detections are shown in Figure C2.3.1. The average concentration at SWMU 26 for antimony is greater than both the background concentration and the RG SSL. Antimony is a groundwater COC, but groundwater information suggests there are no antimony impacts to RGA groundwater [as discussed in the Soils OU RI Report (DOE 2013)]; therefore, antimony does not meet the screening criteria for fate and transport modeling for SWMU 26.

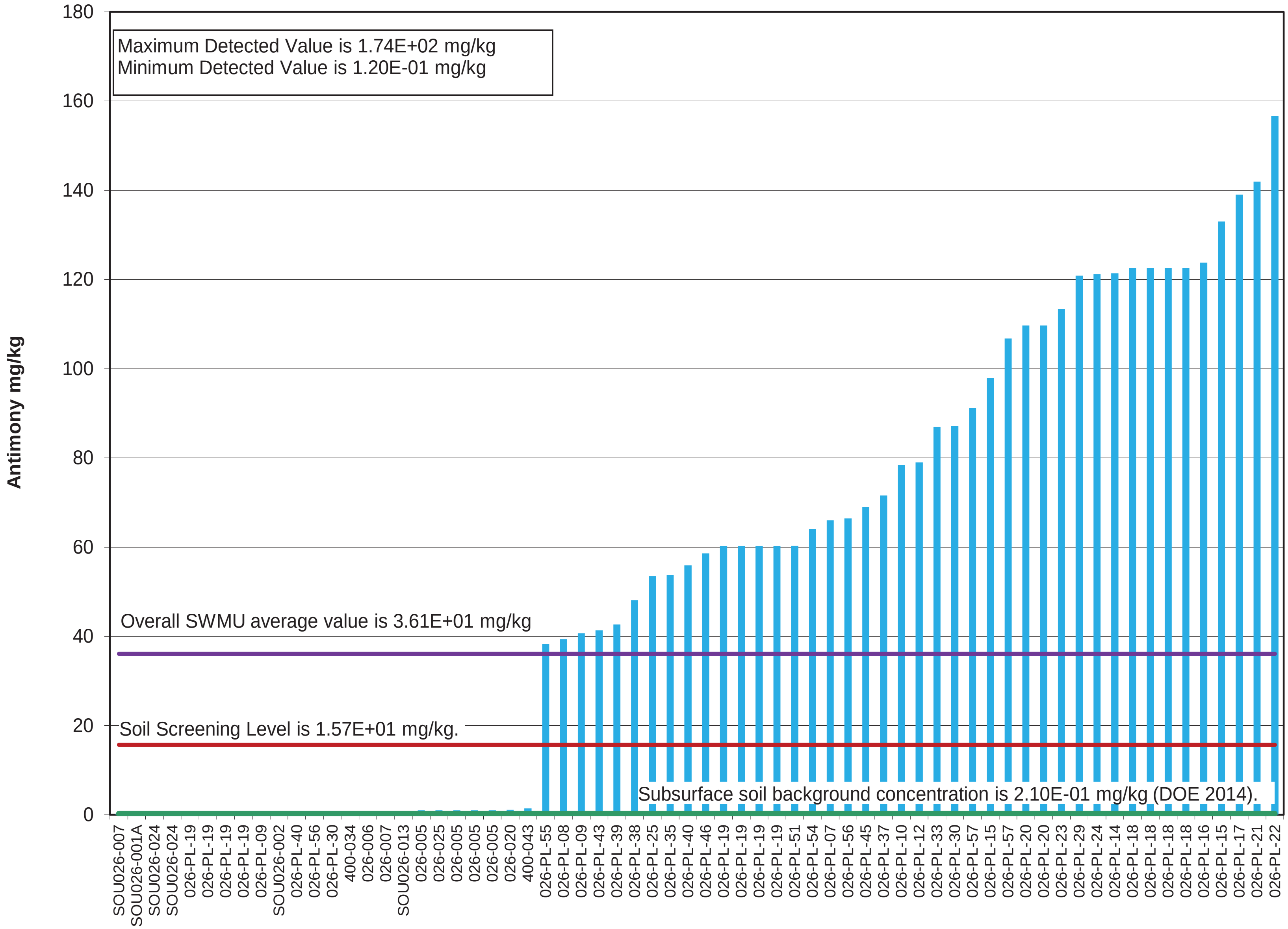

Figure C2.3.1. Antimony Detections at SWMU 26

Arsenic was detected in 61 of 157 samples. The detections are shown in Figure C2.3.2. The average concentration over SWMU 26 for arsenic is greater than the background, but less than the RG SSL; therefore, arsenic does not meet the screening criteria for fate and transport modeling for SWMU 26.

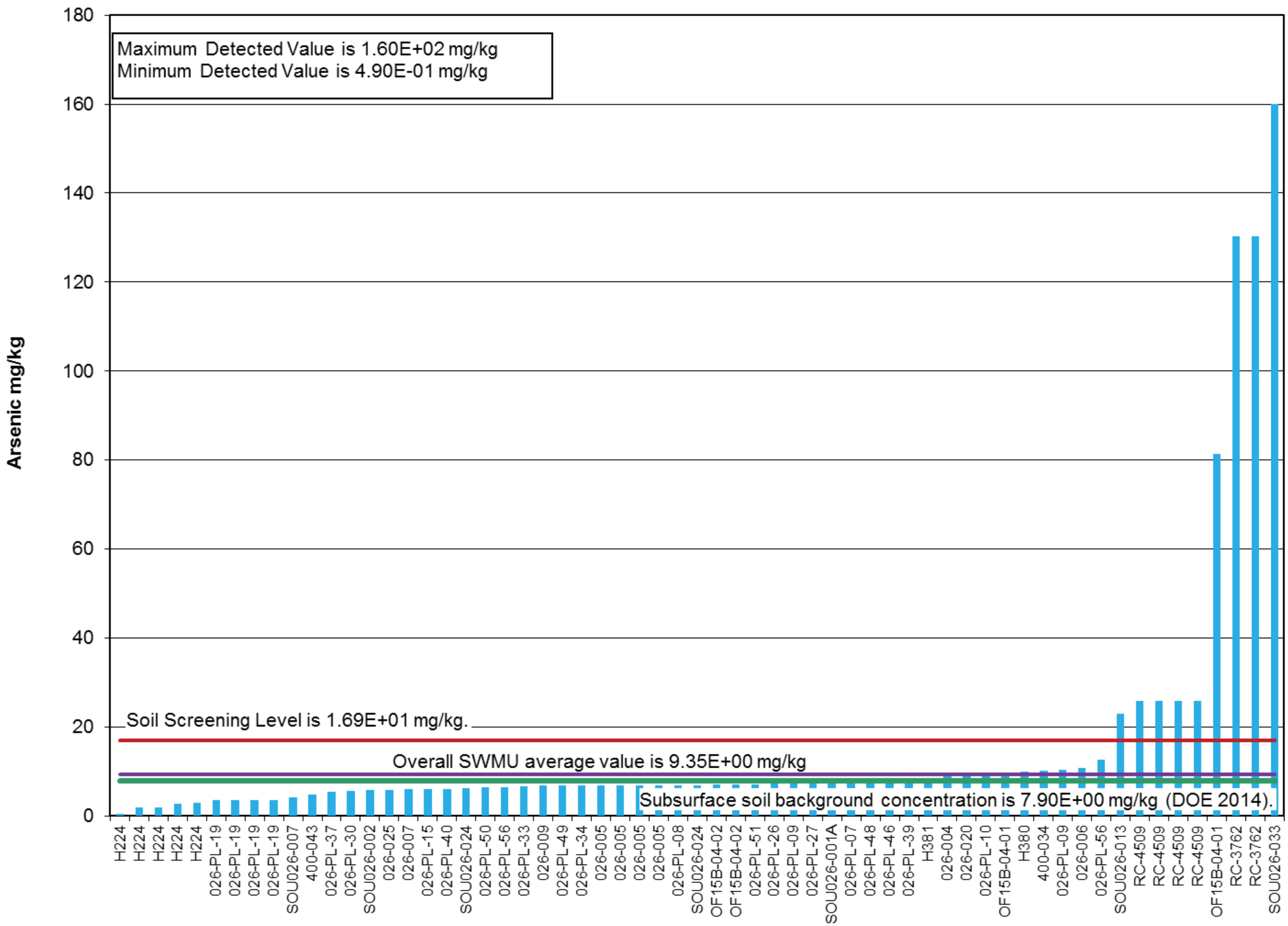

Figure C2.3.2. Arsenic Detections at SWMU 26

Cadmium was detected in 41 of 112 samples. The detections are shown in Figure C2.3.3. The average concentration over SWMU 26 for cadmium is greater than the background concentration, but less than the RG SSL; therefore, cadmium does not meet the screening criteria for fate and transport modeling for SWMU 26.

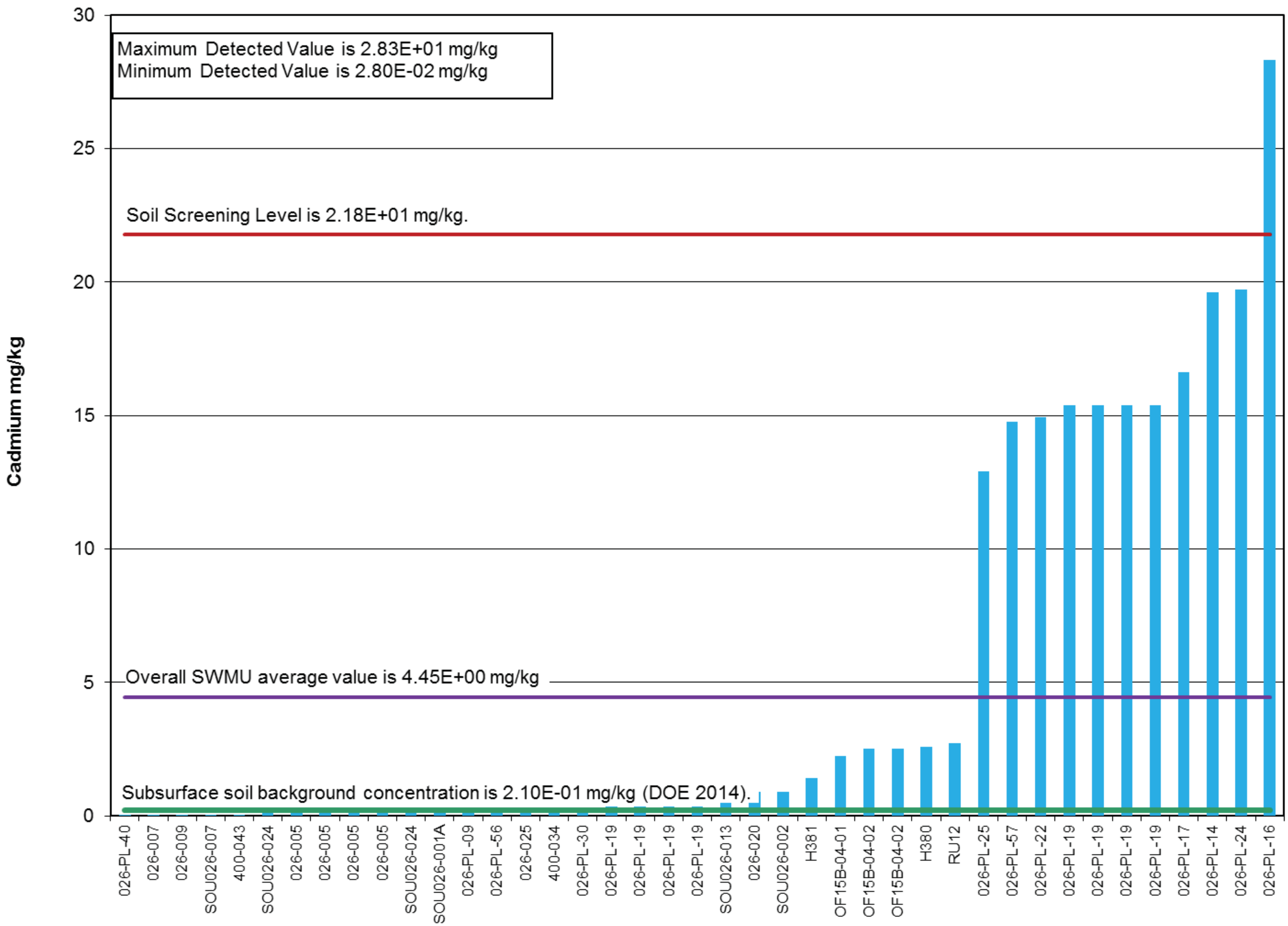

Figure C2.3.3. Cadmium detections at SWMU 26

Cobalt was detected in 37 of 44 samples. The detections are shown in Figure C2.3.4. The average concentration at SWMU 26 for cobalt is greater than the RG SSL, but less than the background concentration; therefore, cobalt does not meet the screening criteria for fate and transport modeling for SWMU 26.

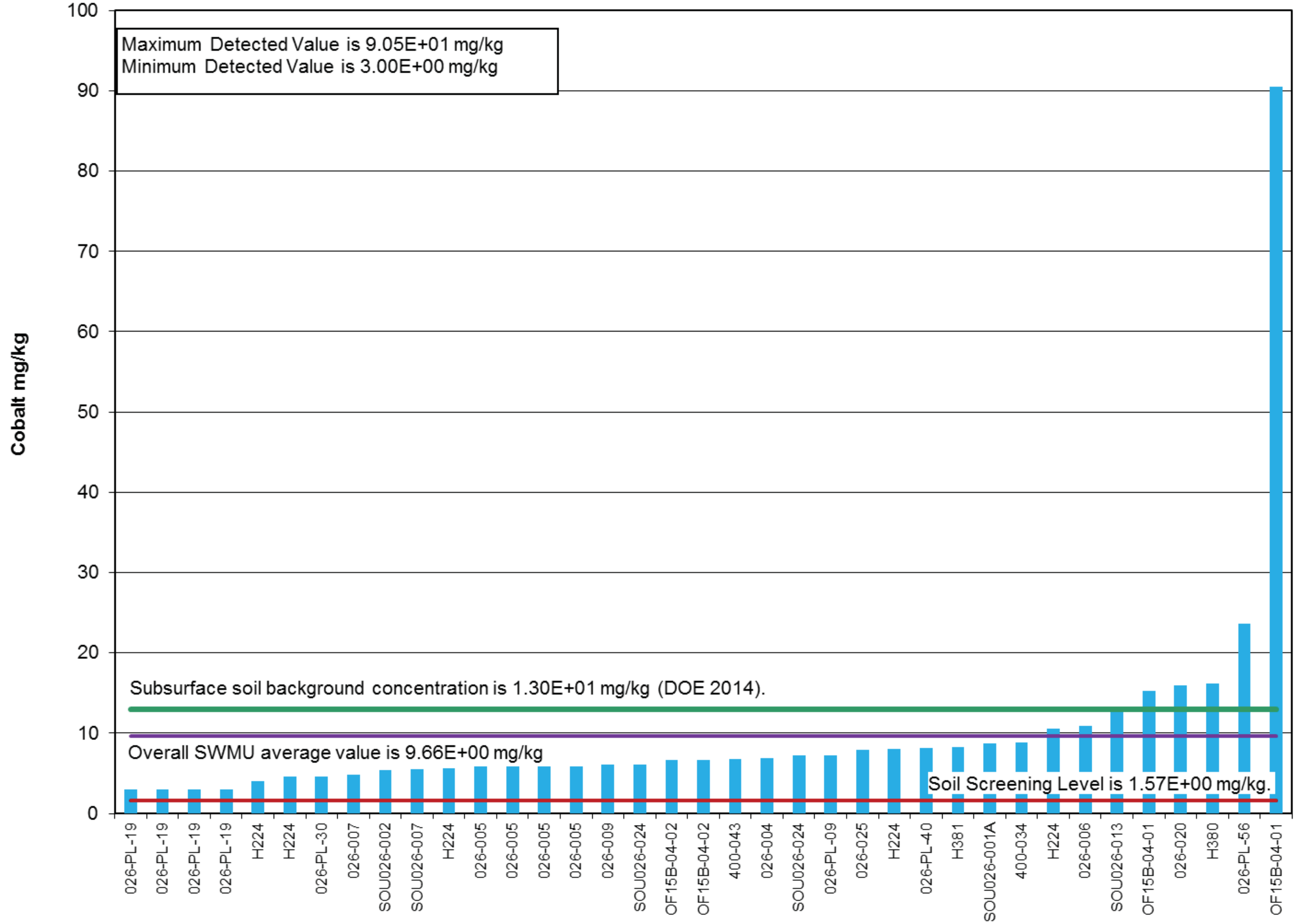

Figure C2.3.4. Cobalt Detections at SWMU 26

Copper was detected in 92 of 150 samples. The detections are shown in Figure C2.3.5. The average concentration over SWMU 26 for copper is greater than the background concentration, but less than the RG SSL; therefore, copper does not meet the screening criteria for fate and transport modeling for SWMU 26.

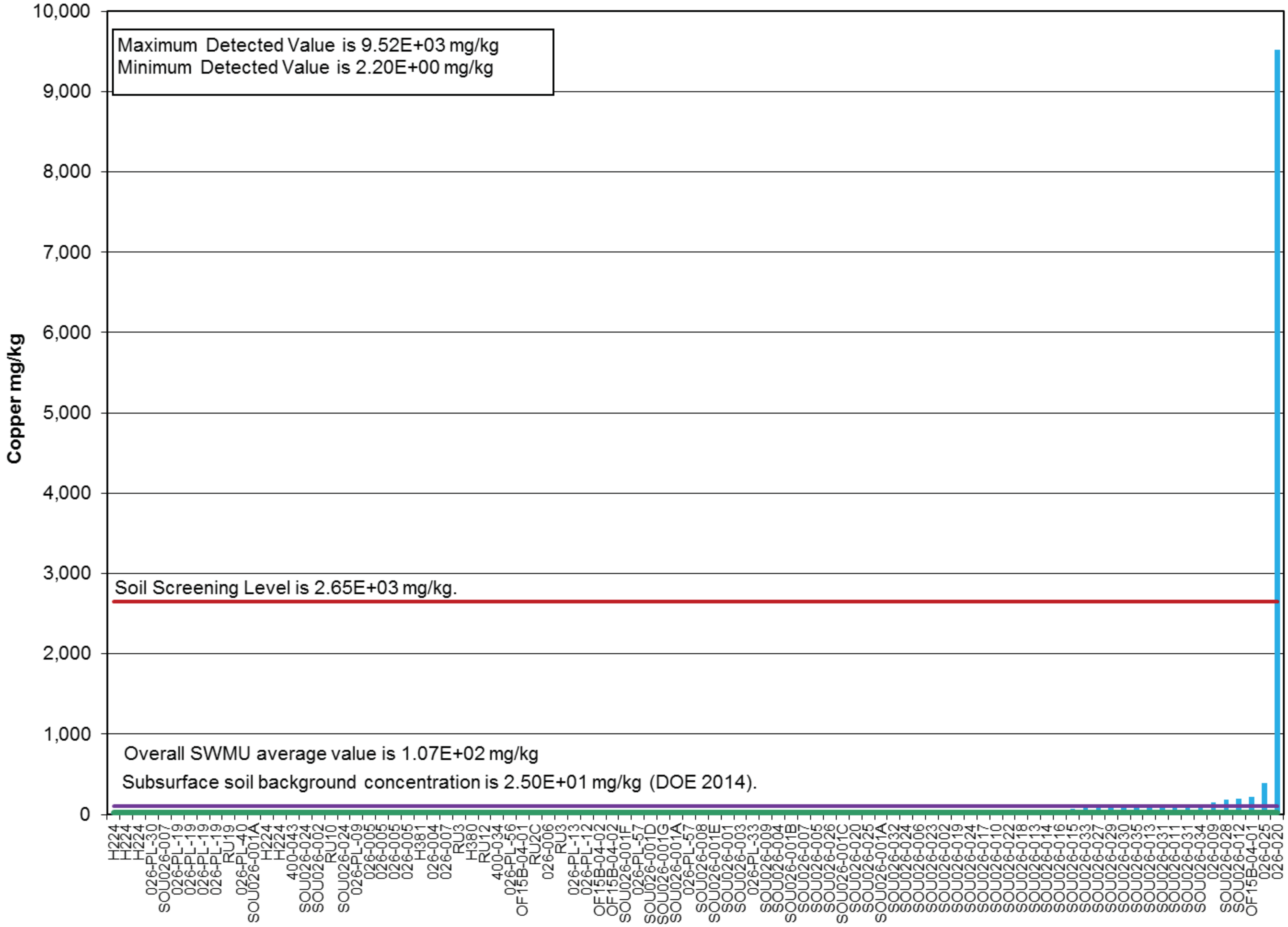

Figure C2.3.5. Copper Detections at SWMU 26

Iron was detected in 144 of 150 samples. The detections are shown in Figure C2.3.6. The average concentration over SWMU 26 for iron is greater than the RG SSL, but less than the background concentration; therefore, iron does not meet the screening criteria for fate and transport modeling for SWMU 26.

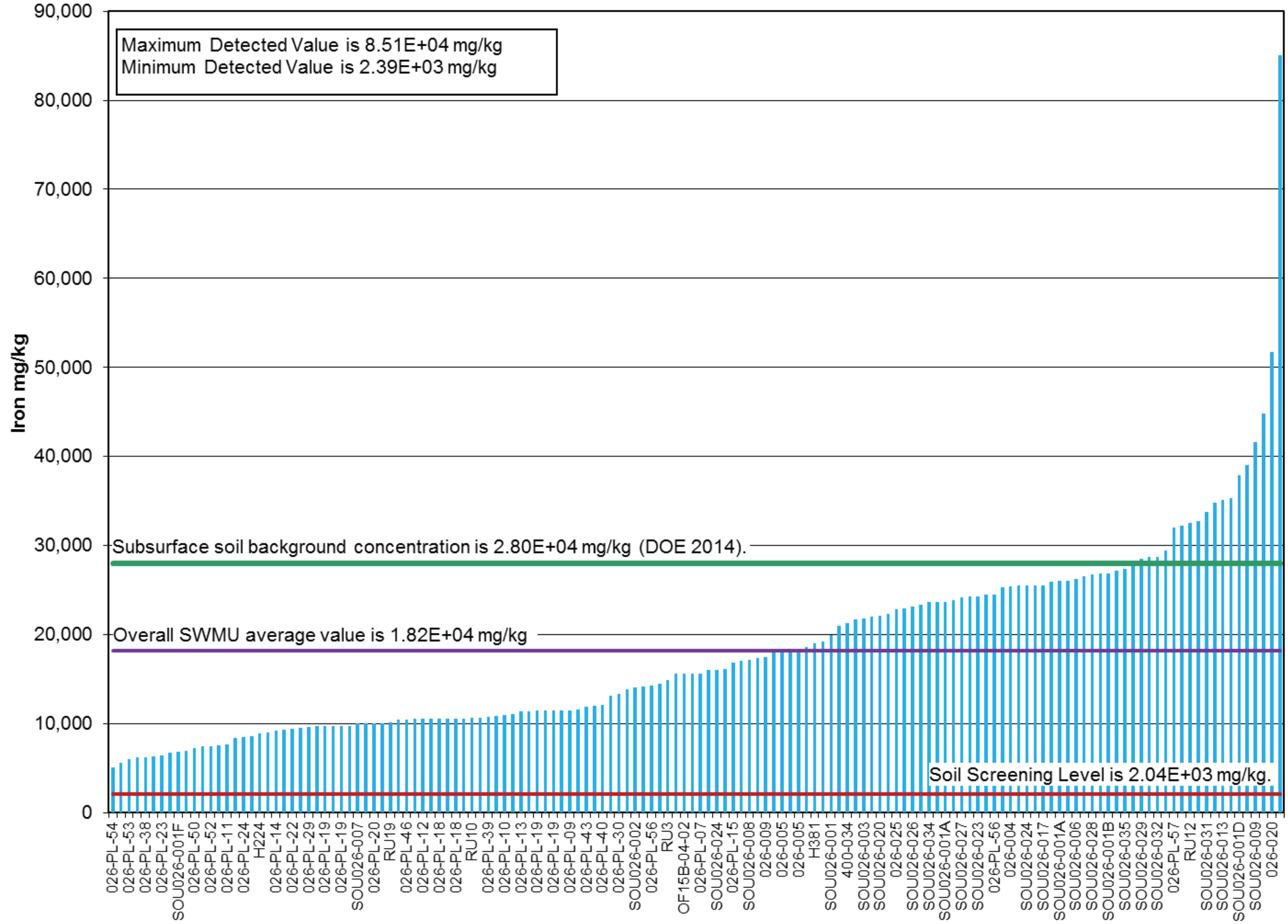

Figure C2.3.6. Iron Detections at SWMU 26

Manganese was detected in 143 of 150 samples. The detections are shown in Figure C2.3.7. The average concentration over SWMU 26 for manganese is greater than the RG SSL, but less than the background concentration; therefore, manganese does not meet the screening criteria for fate and transport modeling for SWMU 26.

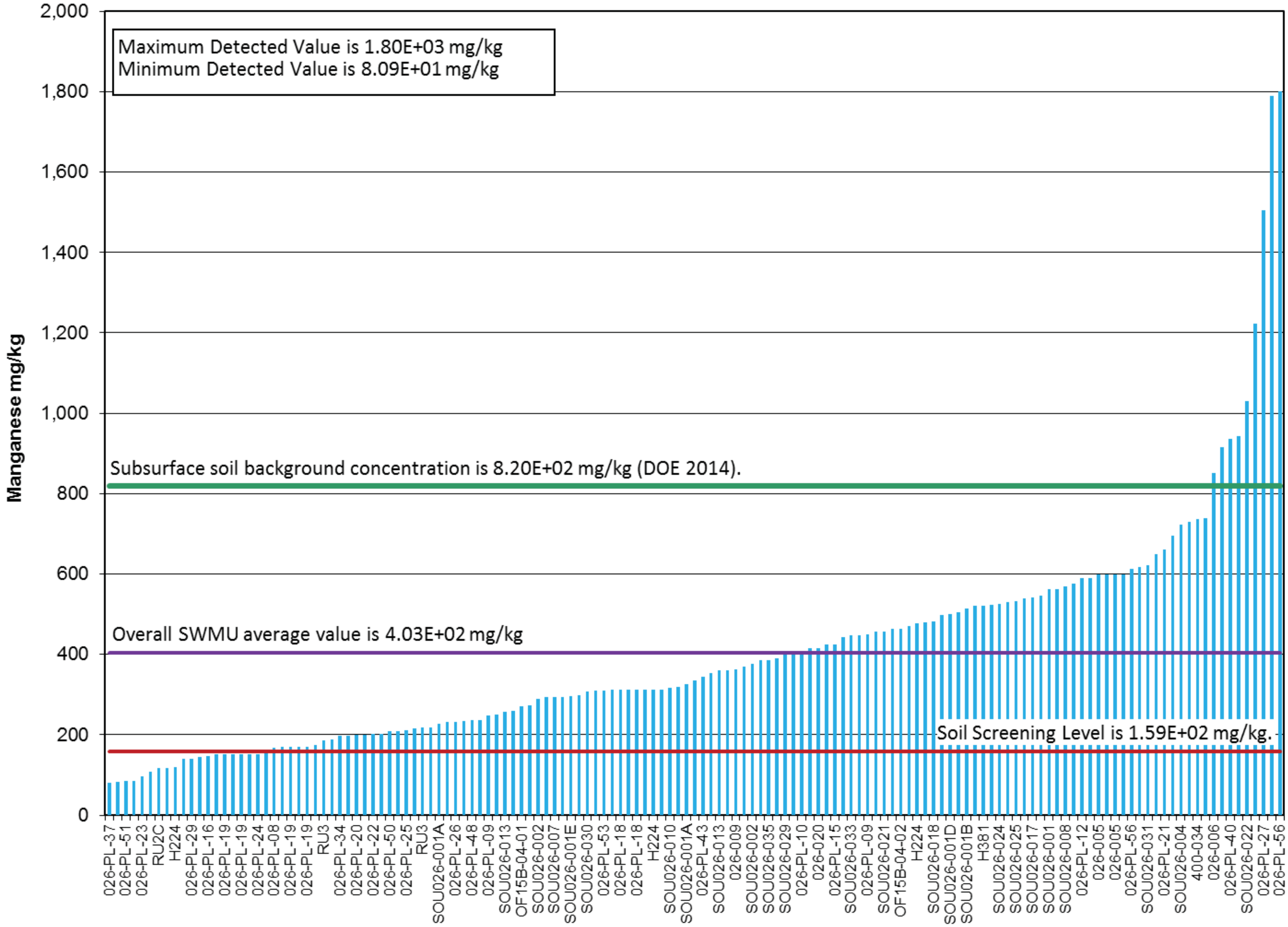

Figure C2.3.7. Manganese Detections at SWMU 26

Mercury was detected in 36 of 160 samples. The detections are shown in Figure C2.3.8. The average concentration over SWMU 26 for mercury is greater than both the RG SSL and the background concentration. Mercury was not identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). Mercury does not meet the screening criteria for fate and transport modeling for SWMU 26.

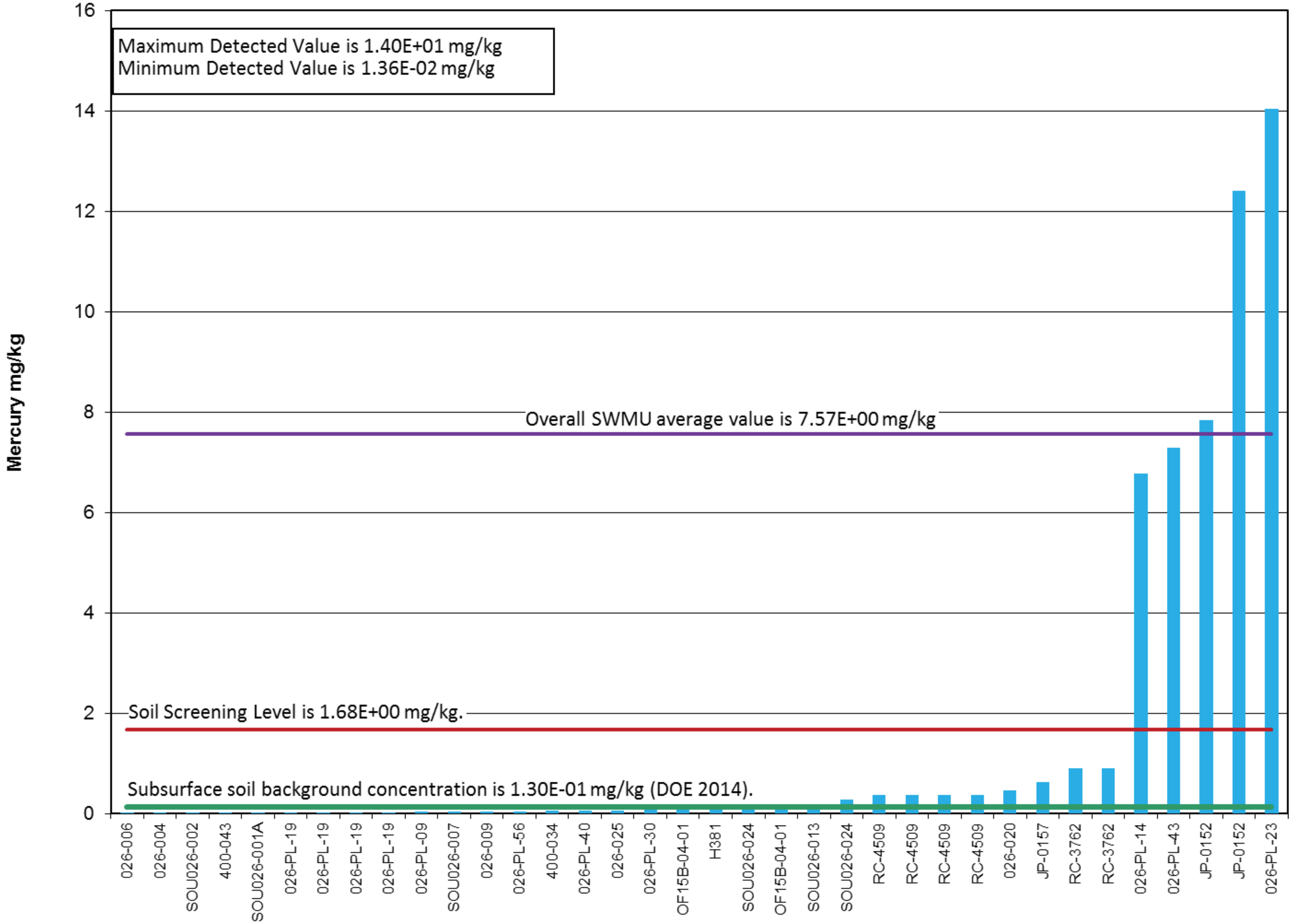

Figure C2.3.8. Mercury Detections at SWMU 26

Molybdenum was detected in 20 of the 115 samples. The detections are shown in Figure C2.3.9. The average concentration over SWMU 26 for molybdenum is less than the RG SSL; therefore, molybdenum does not meet the screening criteria for fate and transport modeling for SWMU 26.

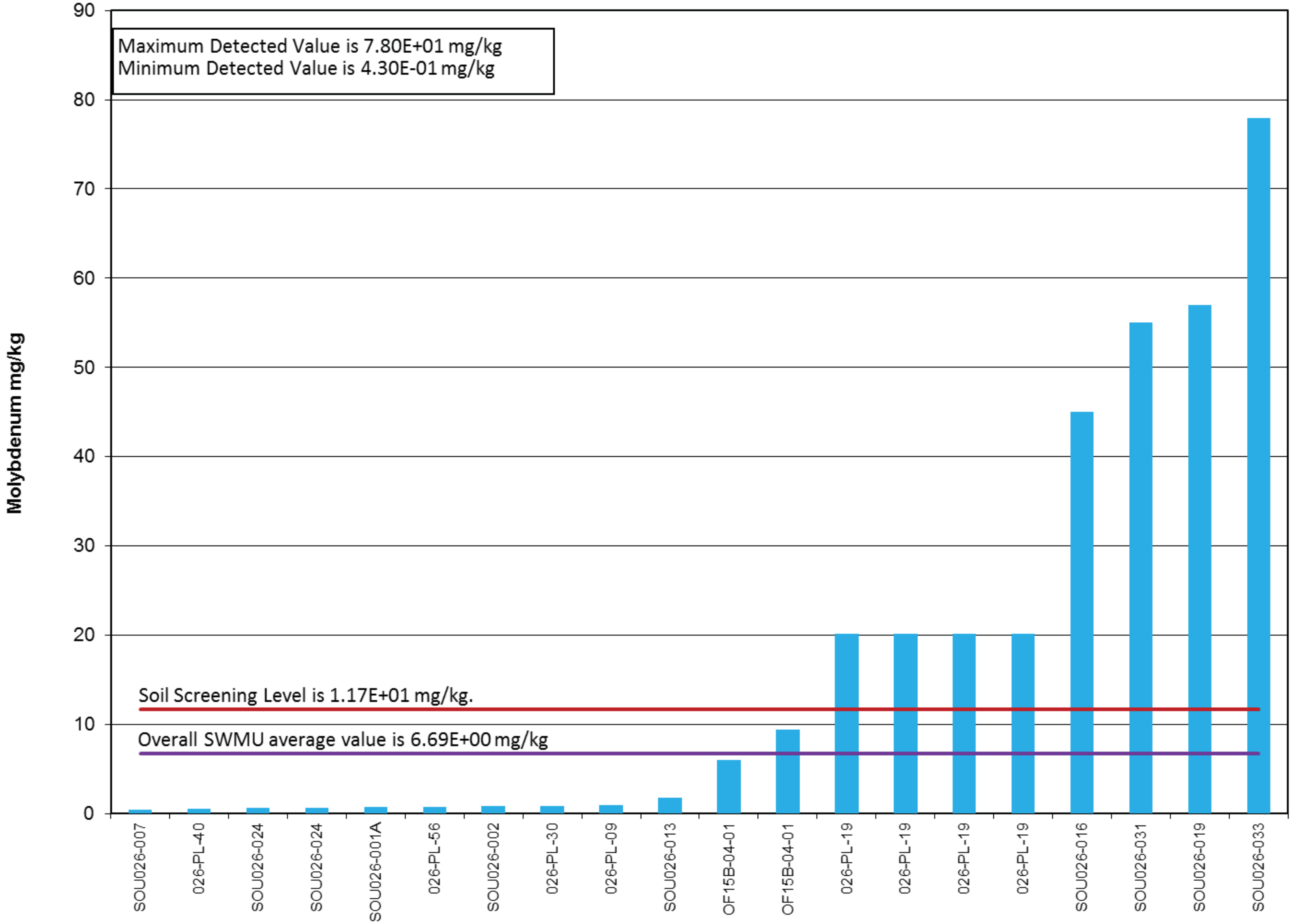

Figure C2.3.9. Molybdenum Detections at SWMU 26

Naphthalene was detected in 2 of the 74 samples. The detections are shown in Figure C2.3.10. The average concentration over SWMU 26 for naphthalene is greater than the RG SSL. Naphthalene was not identified as a COC in the groundwater plumes associated with PGDP (DOE 2001) and does not meet the screening criteria for fate and transport modeling for SWMU 26.

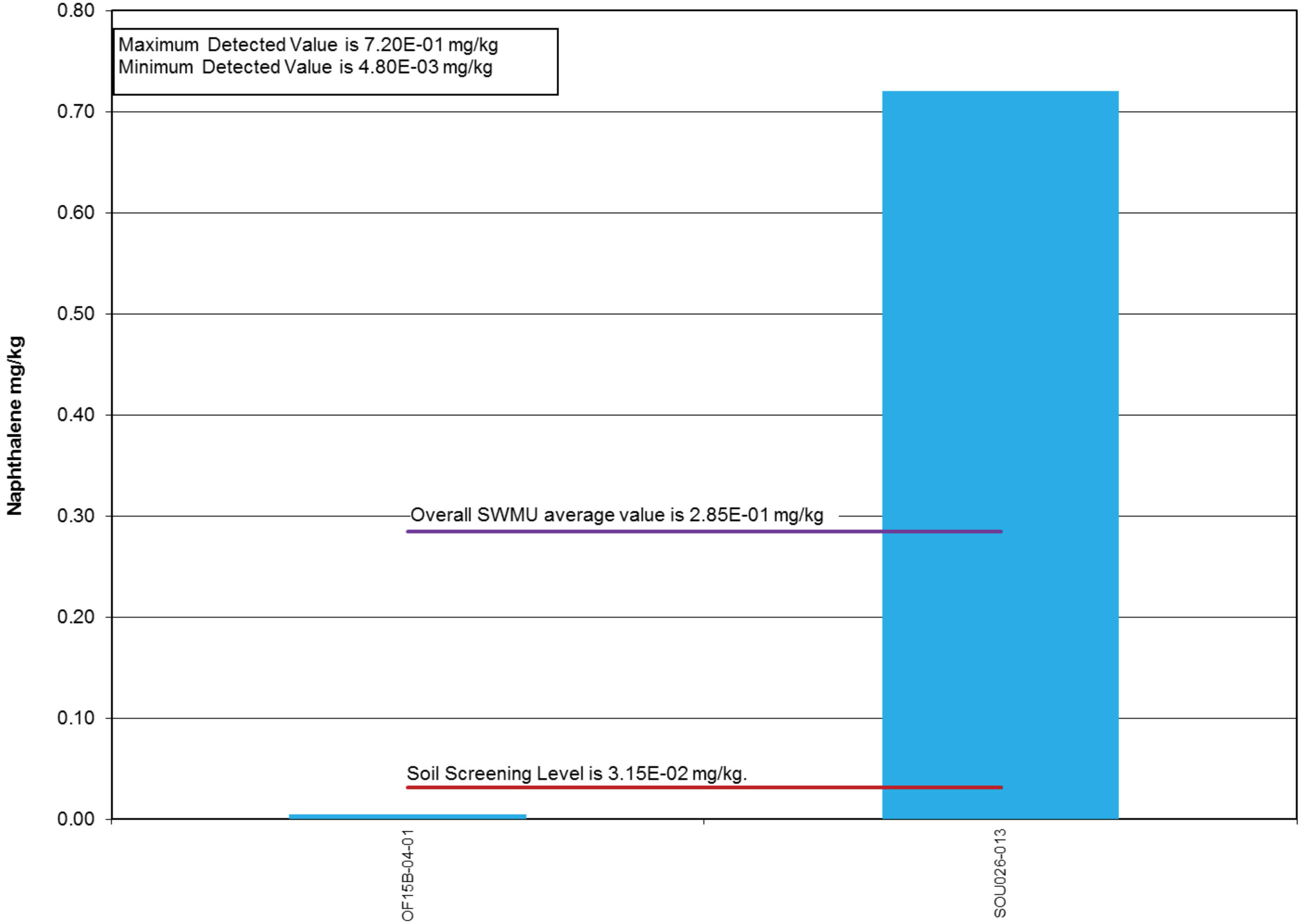

Figure C2.3.10. Naphthalene Detections at SWMU 26

Neptunium-237 was detected in 22 of the 44 samples. The detections are shown in Figure C2.3.11. The average activity concentration over SWMU 26 for neptunium-237 is greater than the RG SSL. Neptunium-237 was not identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). Neptunium-237 does not meet the screening criteria for fate and transport modeling at SWMU 26.

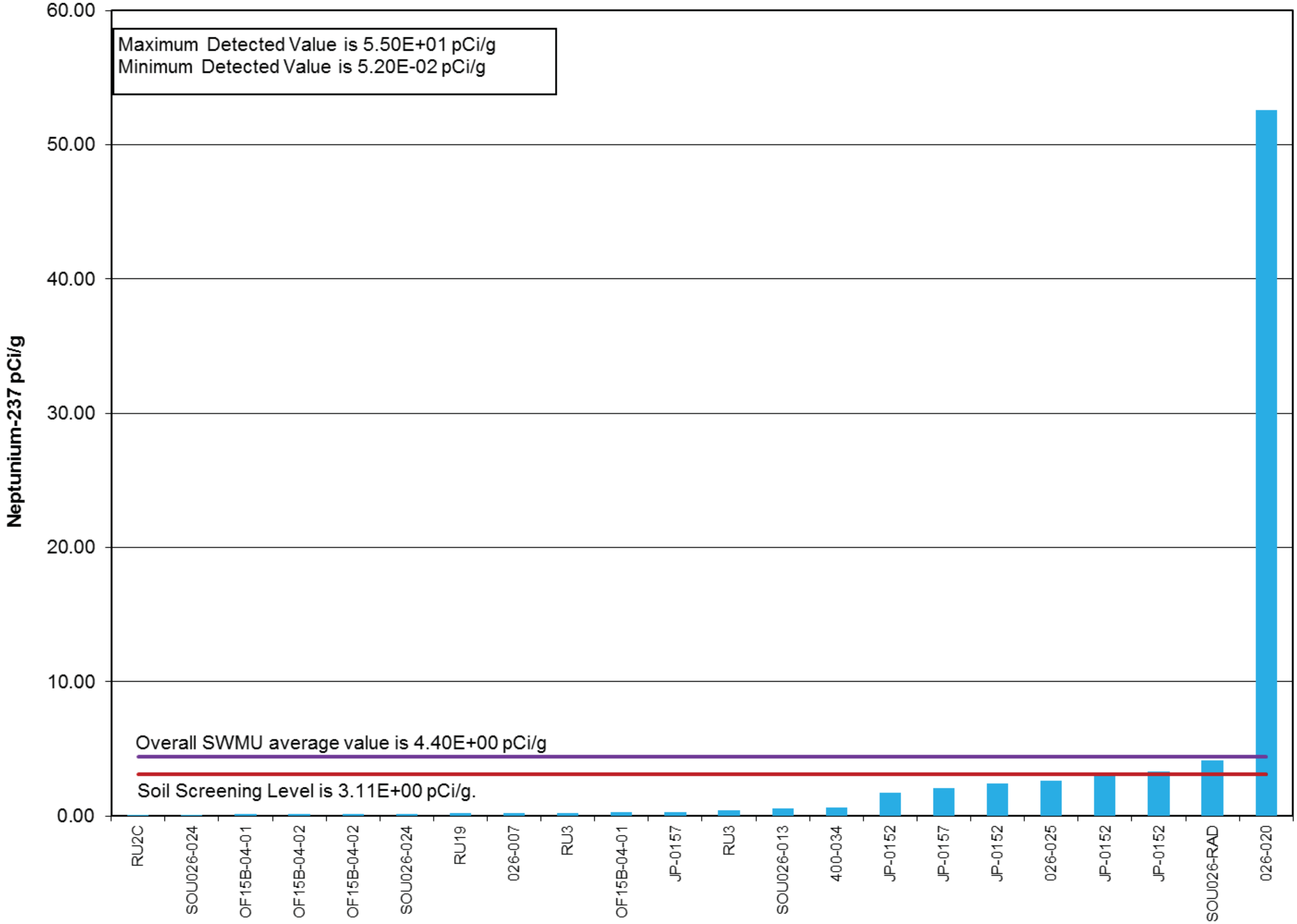

Figure C2.3.11. Neptunium-237 Detections at SWMU 26

Nickel was detected in 97 of the 154 samples. The detections are shown in Figure C2.3.12. The average concentration over SWMU 26 for nickel is greater than both the background concentration and the RG SSL. Nickel was evaluated as part of the GWOU FS and identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). Nickel was modeled at SWMU 14 in the Soils OU RI Report (DOE 2013); therefore, fate and transport modeling was not performed for nickel in SWMU 26.

MVS was used to evaluate the distribution of nickel across SWMU 26. Figure C2.3.13 shows the distribution of detections in depth intervals: 0–5 ft bgs, 5–10 ft bgs, and 10–15 ft bgs. Based on results of the hot spot analysis shown in Figure C2.3.13, the distribution is not clustered and, therefore, not indicative of a source location. Because of the lack of a hot spot and also because nickel was modeled at SWMU 14 in the Soils OU RI Report (DOE 2013) and did not indicate nickel impacts to RGA groundwater, fate and transport modeling was not performed for nickel in SWMU 26.

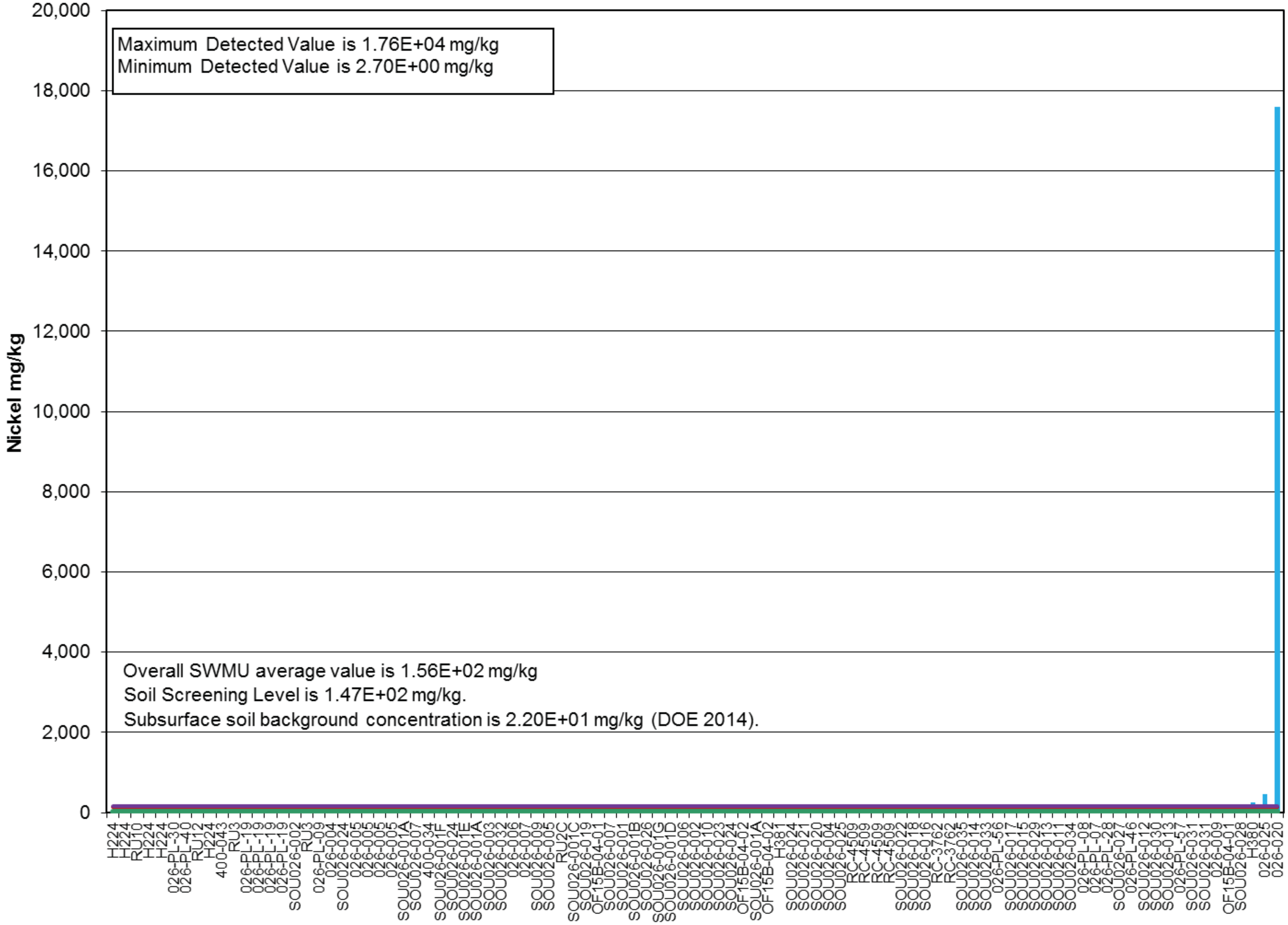

Figure C2.3.12. Nickel Detections at SWMU 26

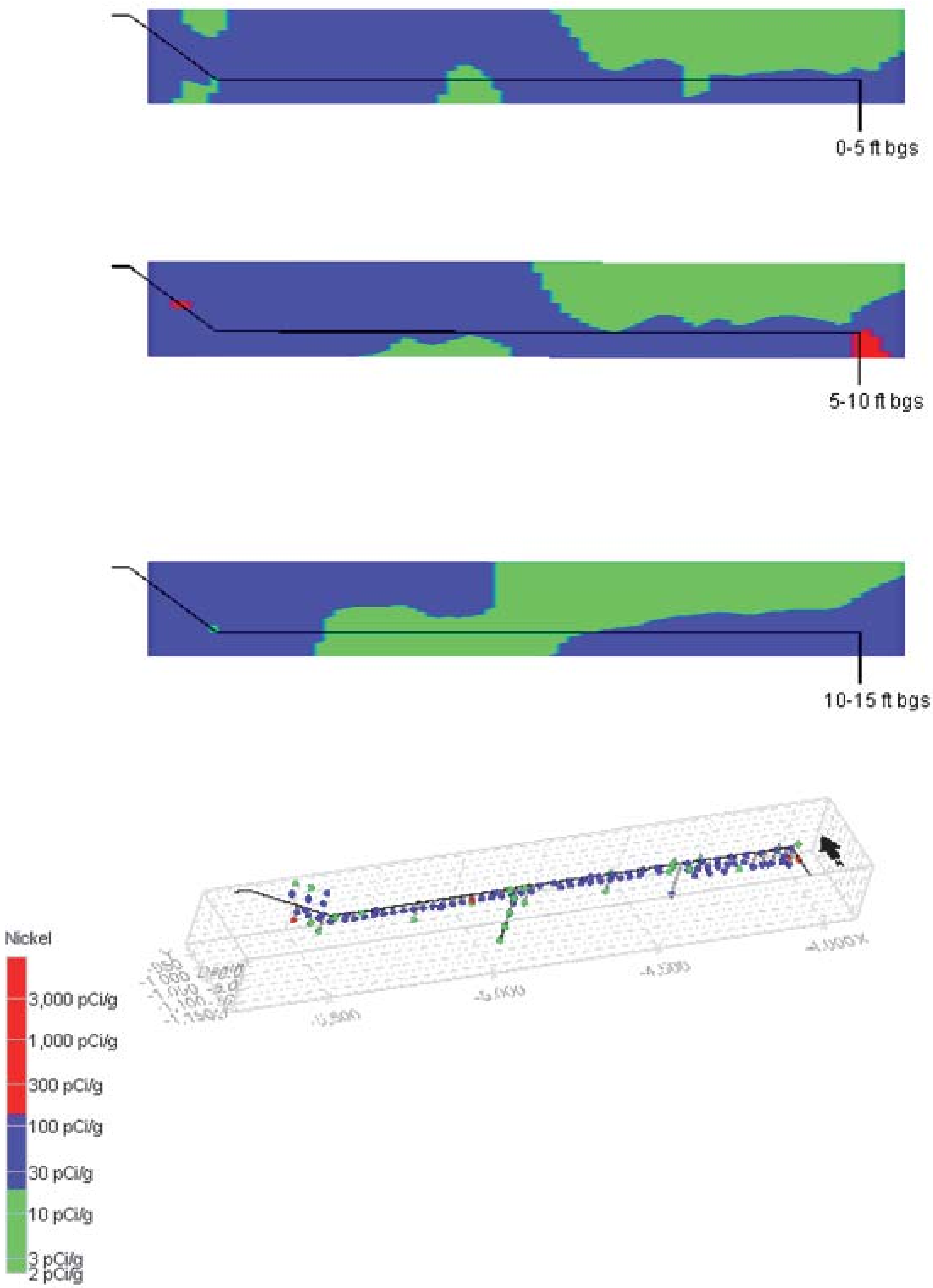

Figure C2.3.13. Nickel distribution at SWMU 26

Phenanthrene was detected in 11 of the 71 samples. The detections are shown in Figure C2.3.14. The average concentration over SWMU 26 for phenanthrene is less than the RG SSL; therefore, phenanthrene does not meet the screening criteria for fate and transport modeling at SWMU 26. Additionally, phenanthrene was not identified as a COC in the groundwater plumes associated with PGDP (DOE 2001).

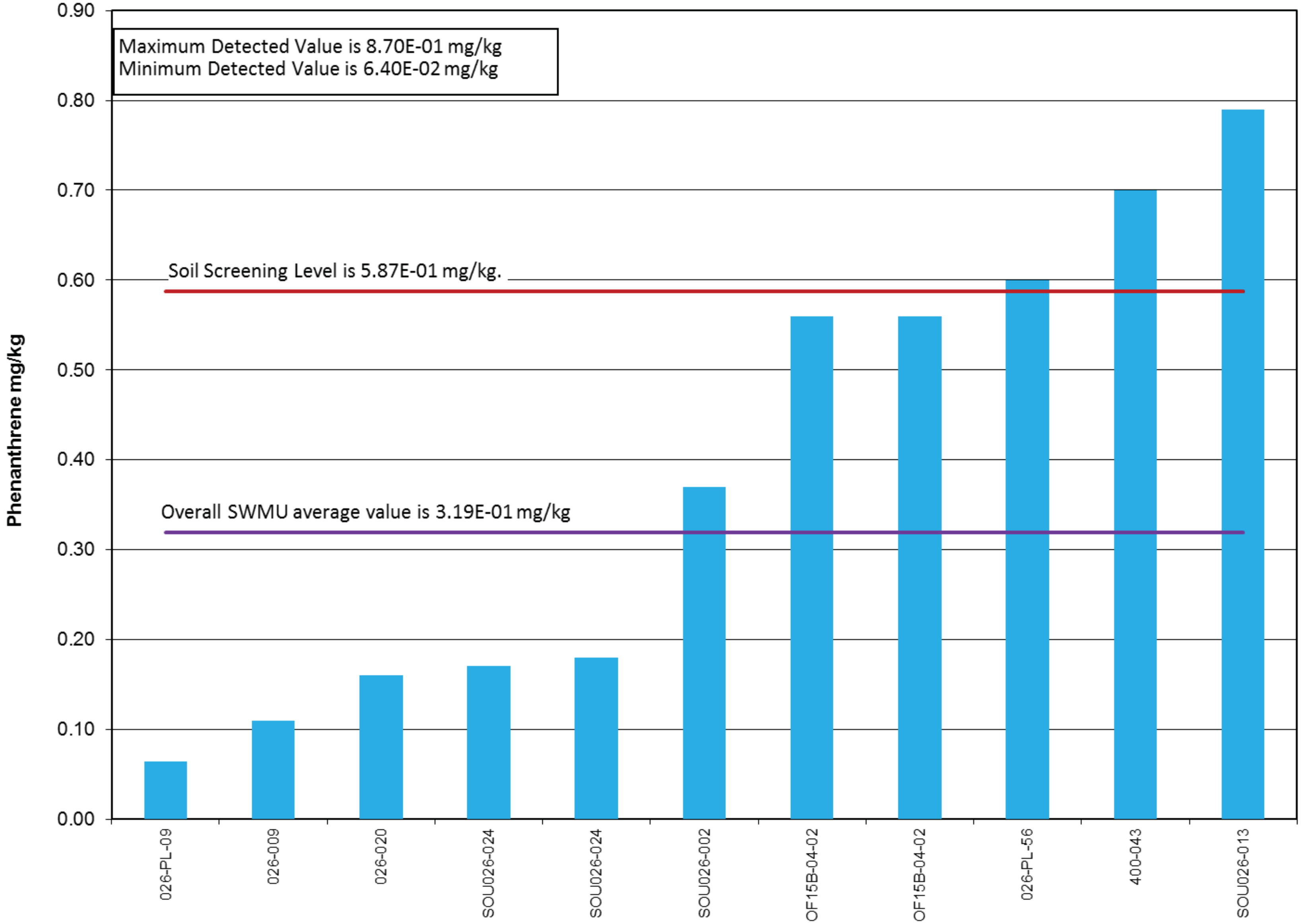

Figure C2.3.14. Phenanthrene Detections at SWMU 26

Plutonium-239/240 was detected in 26 of the 50 samples. The detections are shown in Figure C2.3.15. The average concentration over SWMU 26 for plutonium-239/240 is less than the RG SSL; therefore, plutonium-239/240 does not meet the screening criteria for fate and transport modeling at SWMU 26.

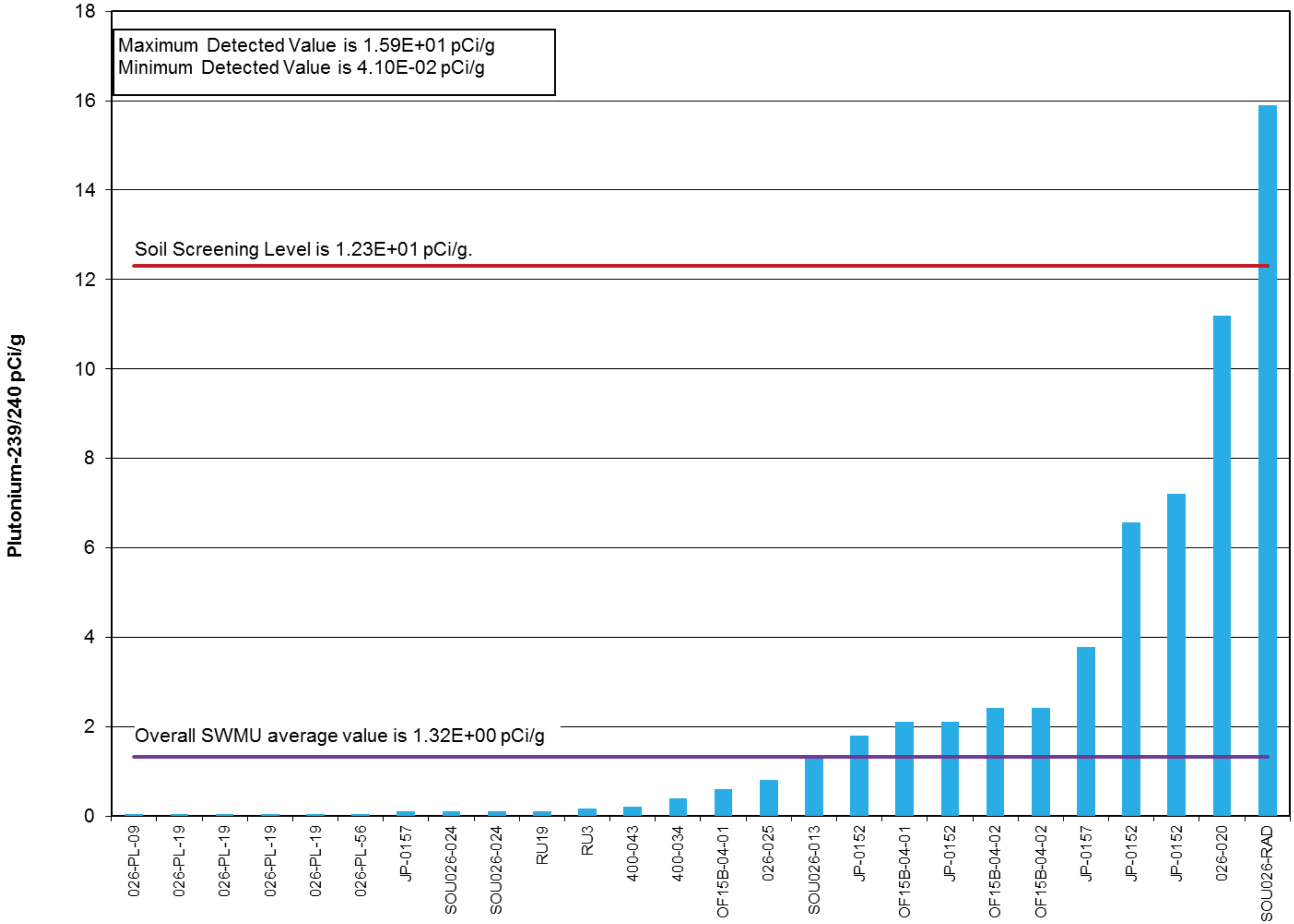

Figure C2.3.15. Plutonium-239/240 Detections at SWMU 26

Silver was detected in 27 of the 157 samples. The detections are shown in Figure C2.3.16. The average concentration over SWMU 26 for silver is greater than both the background concentration and the RG SSL. Silver was evaluated as part of the GWOU FS and identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). The evaluation presented in Attachment C1 to Appendix C of the Soils OU RI Report (DOE 2013) did not identify any RGA silver impacts to groundwater; therefore, silver does not meet the screening criteria for groundwater fate and transport modeling for SWMU 26.

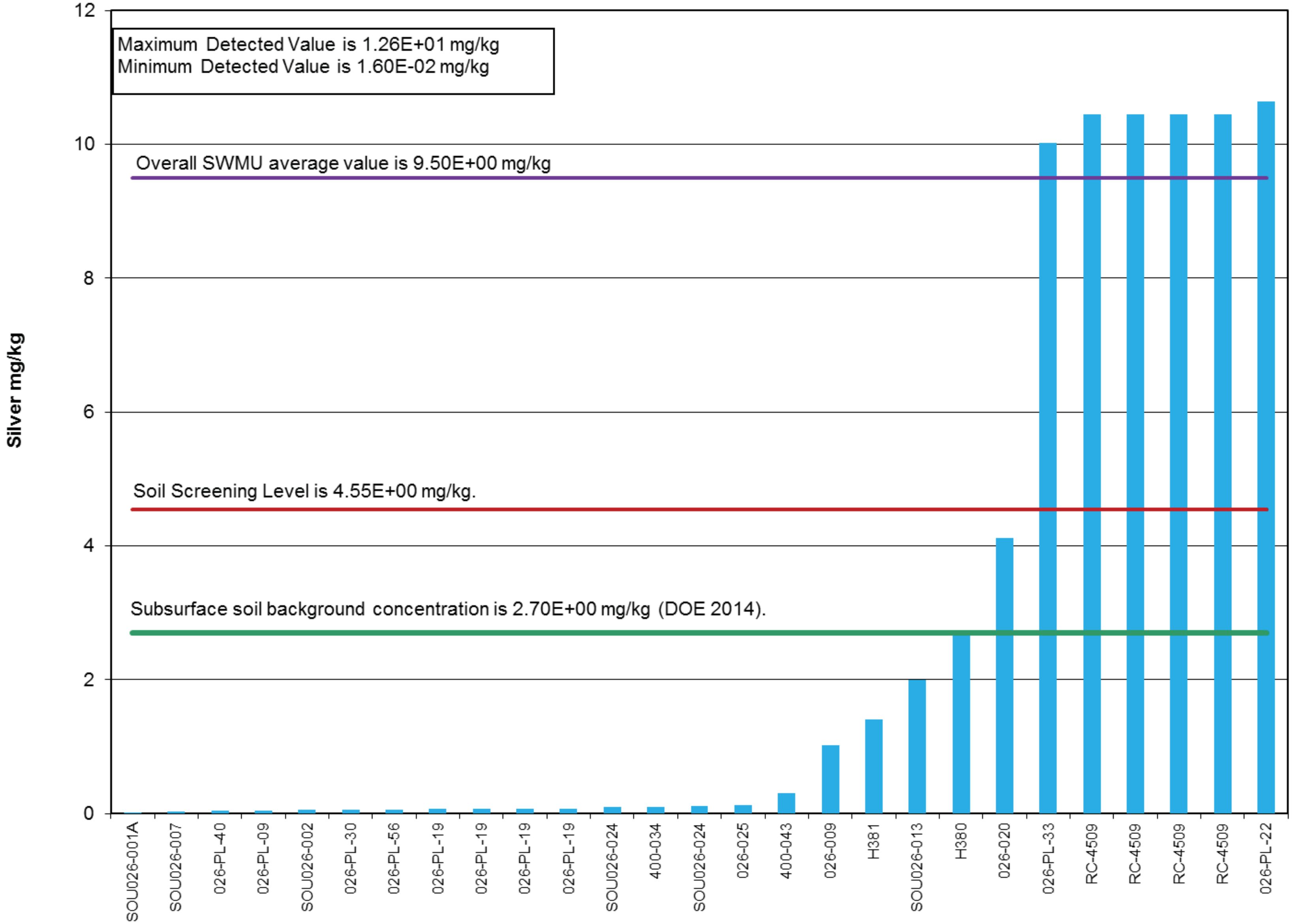

Figure C2.3.16. Silver Detections at SWMU 26

Tc-99 was detected in 30 of the 47 samples. The detections are shown in Figure C2.3.17. The average activity concentration over SWMU 26 for Tc-99 is greater than both the RG SSL and the background concentration. Tc-99 was evaluated as part of the GWOU FS and identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). Because of the presence of Tc-99 in RGA groundwater and the close proximity of SWMU 13 to the Tc-99 plume, SWMU 26 may be a secondary source of Tc-99. Twenty-two of the samples were detected above both the RG SSL and the background activity concentration; therefore, a hot spot evaluation was performed.

MVS was used to evaluate the distribution of Tc-99 across SWMU 26. Figure C2.3.18 shows the distribution of detections in depth intervals: 0 to 5 ft bgs and 5 to 10 ft bgs. A hot spot appears to be present.

Tc-99 in SWMU 26 appears to meet the screening criteria for fate and transport modeling.

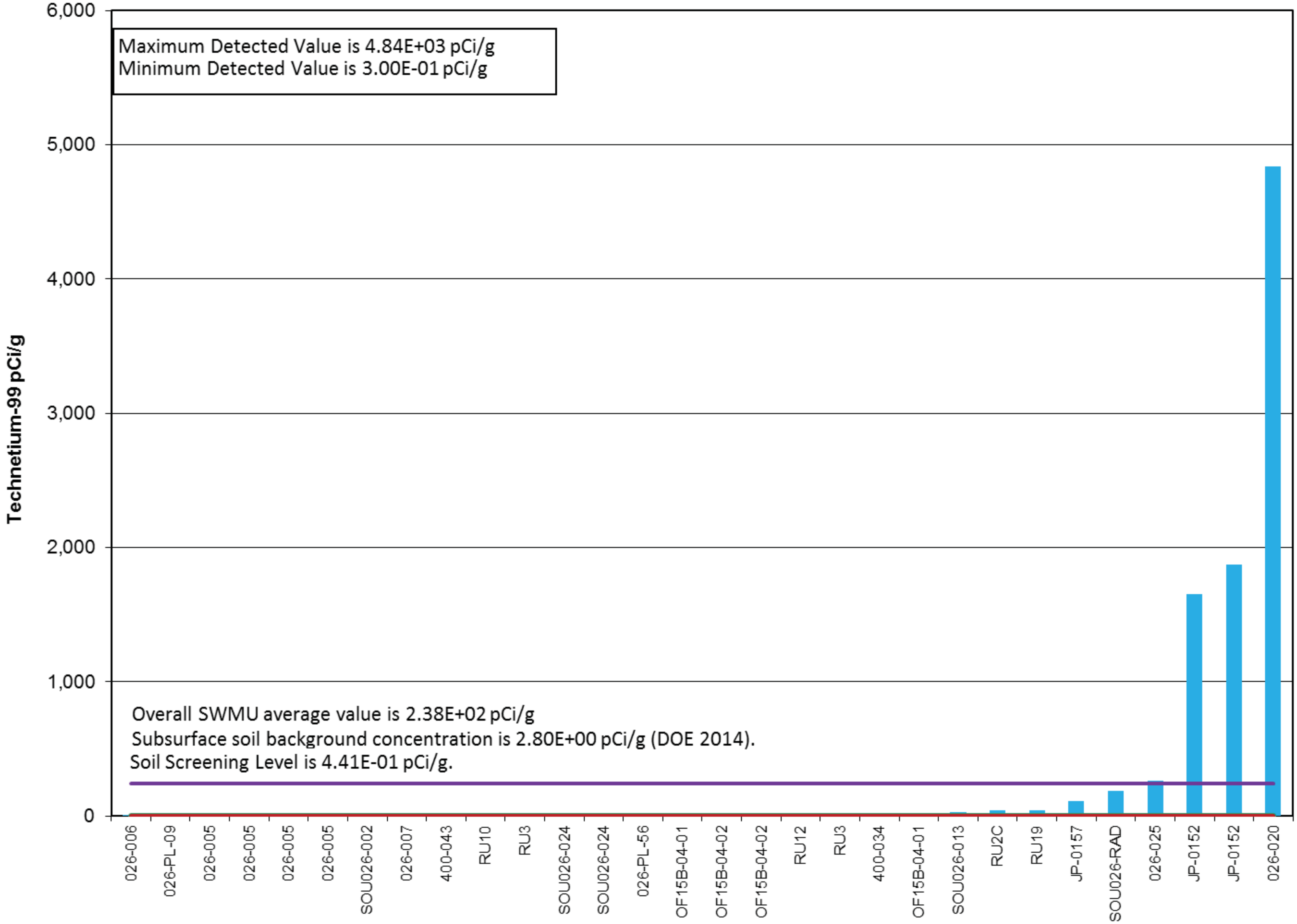

Figure C2.3.17. Tc-99 Detections at SWMU 26

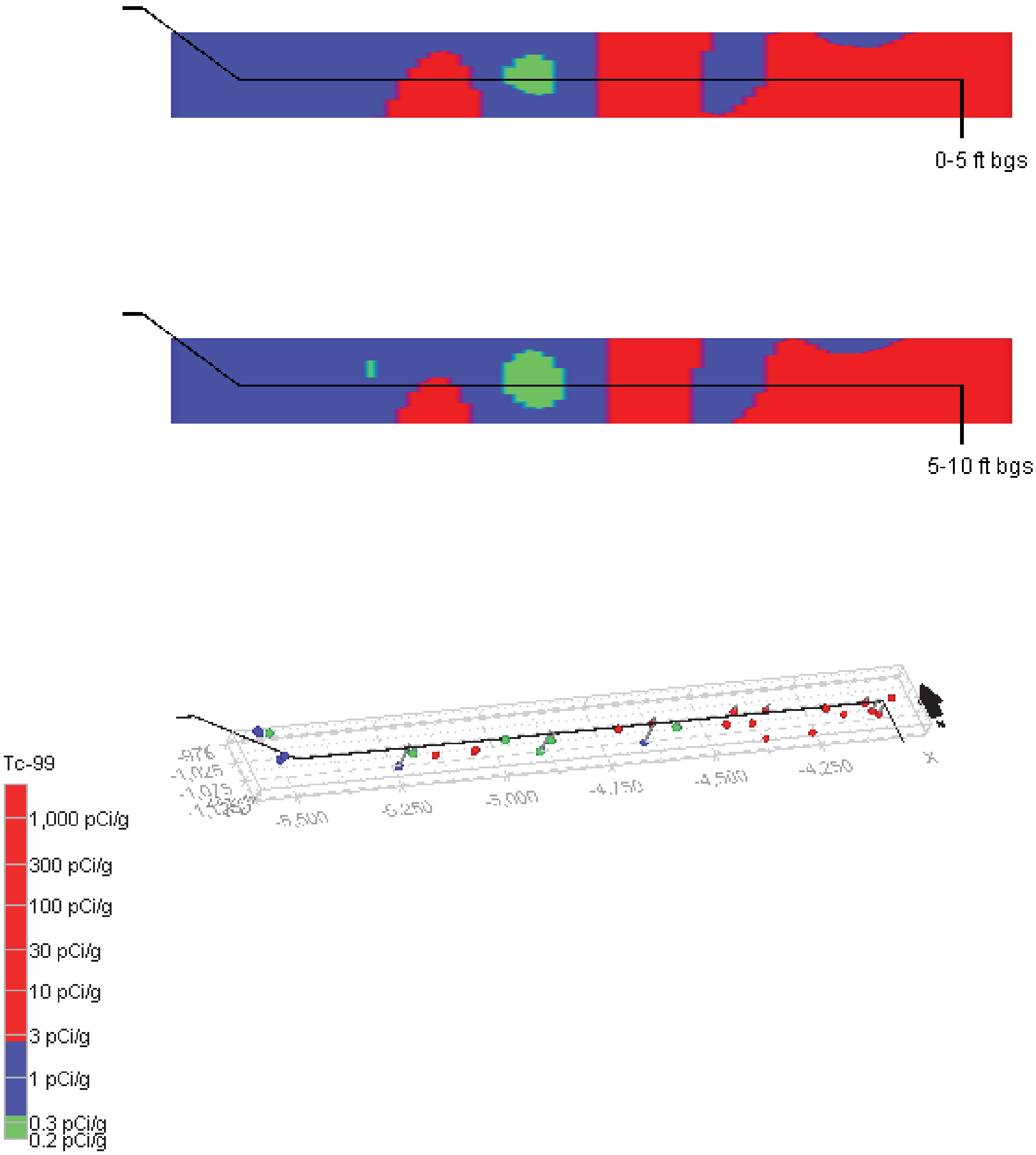

Figure C2.3.18. Distribution of Tc-99 at SWMU 26

Thallium was detected in 18 of the 53 samples. The detections are shown in Figure C2.3.19. The average concentration over SWMU 26 for thallium is greater than the background concentration, but less than the RG SSL; therefore, thallium does not meet the screening criteria for groundwater fate and transport modeling for SWMU 26.

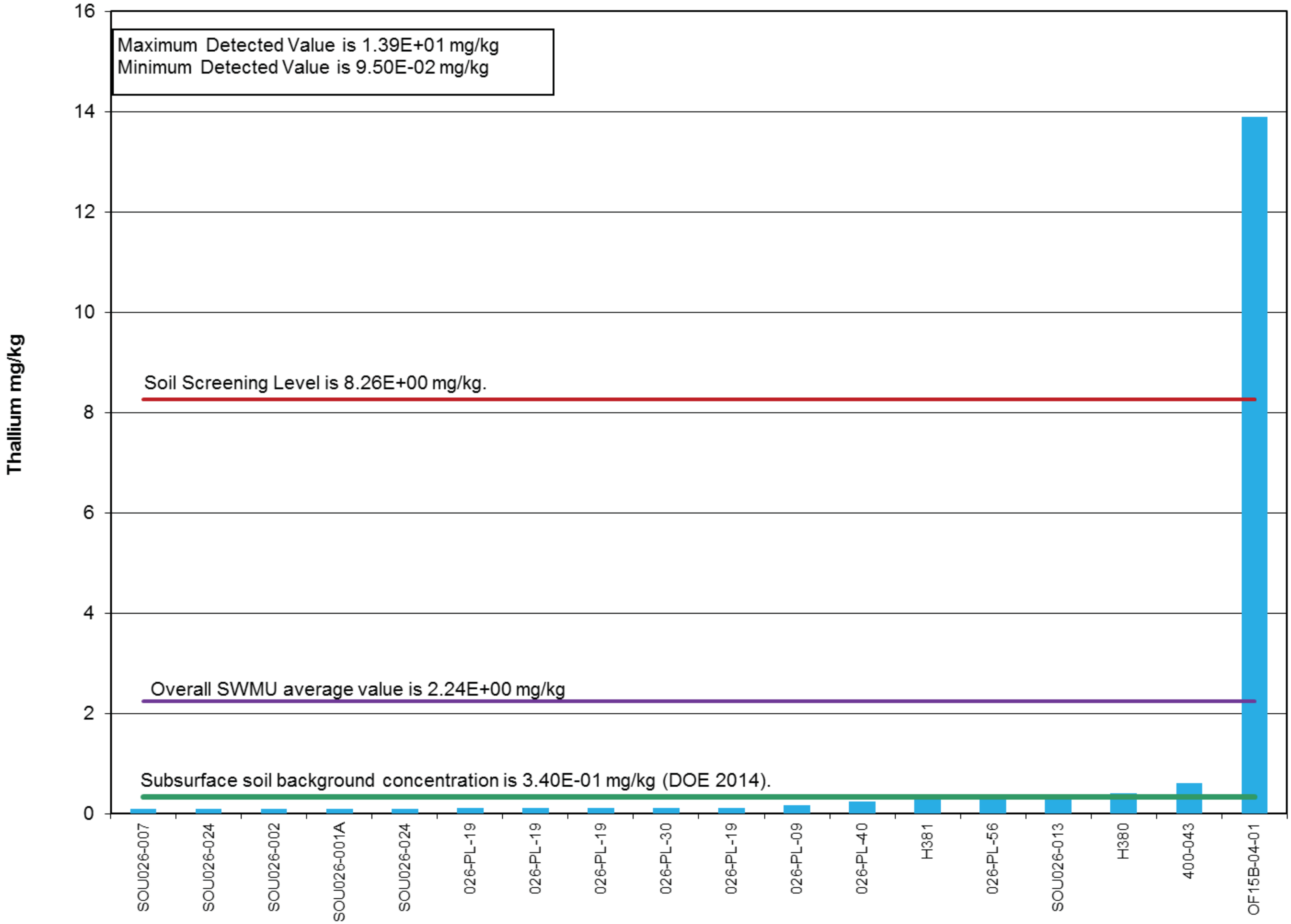

Figure C2.3.19. Thallium Detections at SWMU 26

Thorium-230 was detected in 39 of the 47 samples. The detections are shown in Figure C2.3.20. The average activity concentration over SWMU 26 for thorium-230 is greater than the background activity concentration, but less than the RG SSL; therefore, thorium-230 does not meet the screening criteria for groundwater fate and transport modeling for SWMU 26.

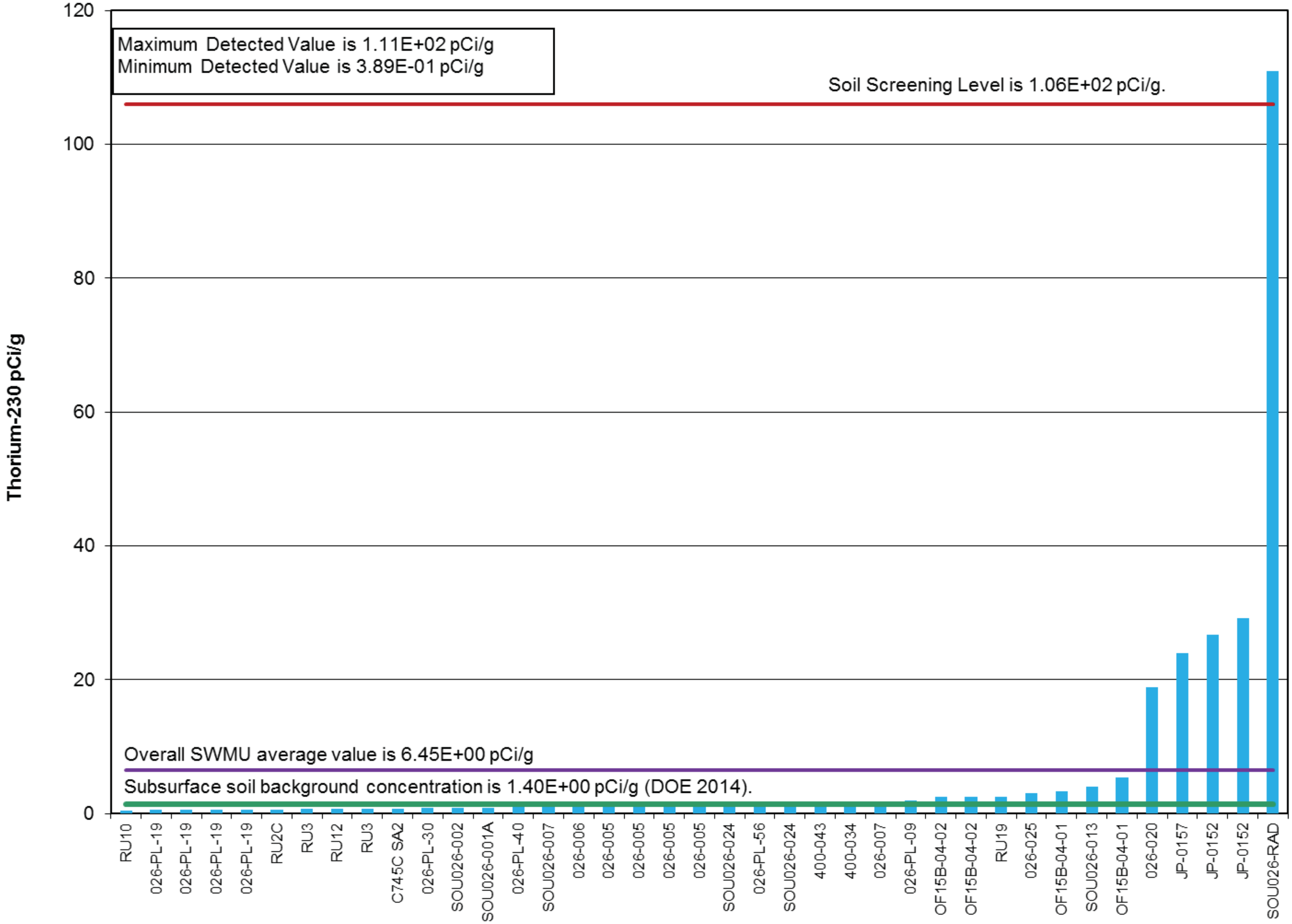

Figure C2.3.20. Thorium-230 Detections at SWMU 26

Uranium was detected in 76 of the 142 samples. The detections are shown in Figure C2.3.21. The average concentration over SWMU 26 for uranium is greater than the background concentration, but less than the RG SSL; therefore, uranium does not meet the screening criteria for groundwater fate and transport modeling for SWMU 26.

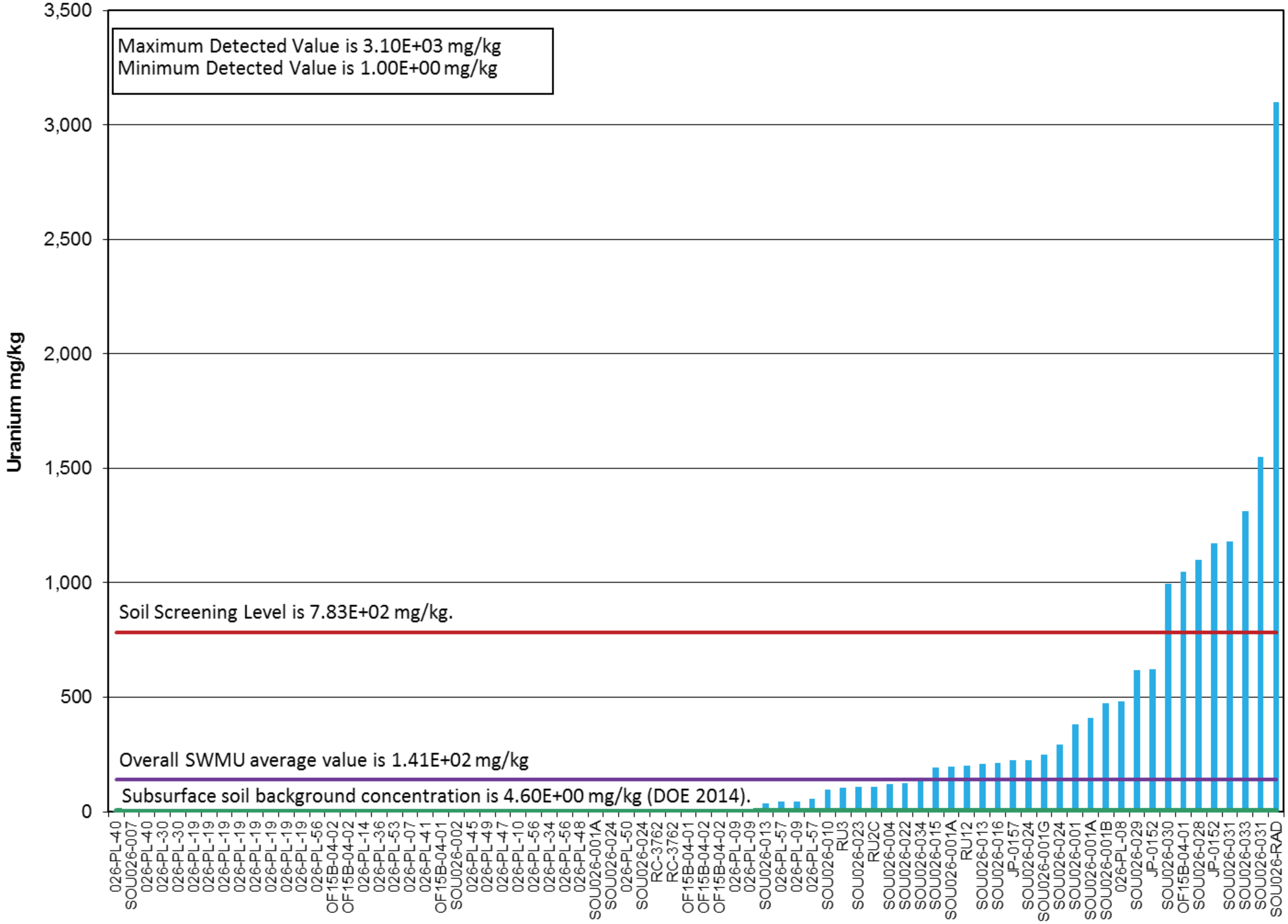

Figure C2.3.21. Uranium Detections at SWMU 26

Uranium-234 was detected in 42 of the 51 samples. The detections are shown in Figure C2.3.22. The average activity concentration over SWMU 26 for uranium-234 is greater than both the background activity concentration and the RG SSL. Uranium-234 was evaluated as part of the GWOU FS and identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). Seventeen samples exceed both the background and the RG SSL; therefore, a hot spot evaluation was performed.

MVS was used to evaluate the distribution of uranium-234 across SWMU 26. Figure C2.3.23 shows the distribution of uranium-234 at 0 to 5 ft bgs and 5 to 10 ft bgs. Uranium-234 meets the requirement for fate and transport modeling for SWMU 26; however, hot spot analysis shows the distribution is not clustered and, therefore, not indicative of a source location over the smaller area SWMU 26. Additionally, uranium was modeled at the larger SWMU 81 [presented in the Soils OU RI Report (DOE 2013)] that did not indicate uranium-234 RGA groundwater impacts. The SWMU 81 (which has greater activity concentrations and a larger areal extent) evaluation presented in Attachment C1 to Appendix C of the Soils OU RI Report (DOE 2013) did not identify any uranium-234 impacts to RGA groundwater; therefore, uranium-234 does not meet the screening criteria for fate and transport modeling for SWMU 26.

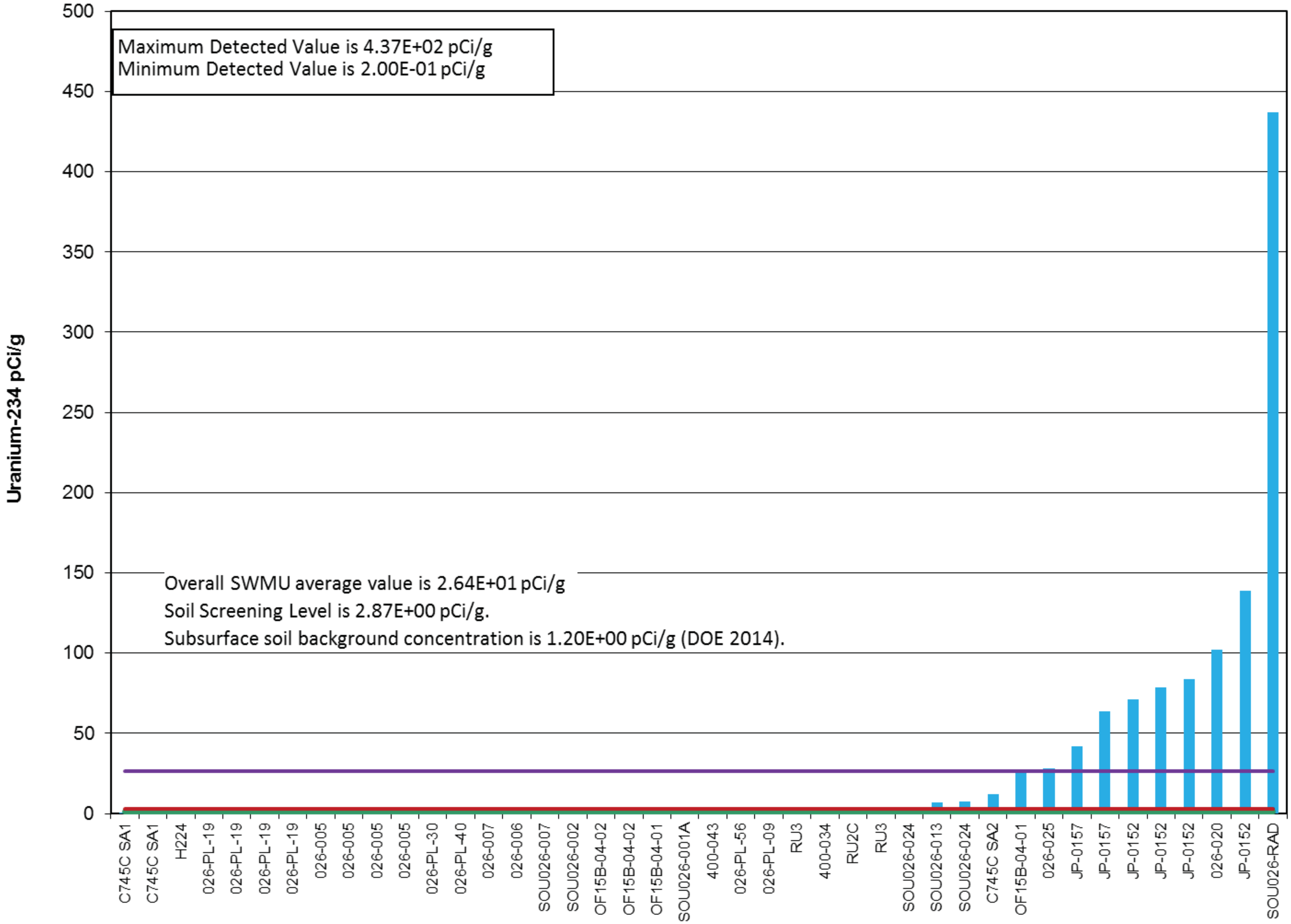

Figure C2.3.22. Uranium-234 Detections at SWMU 26

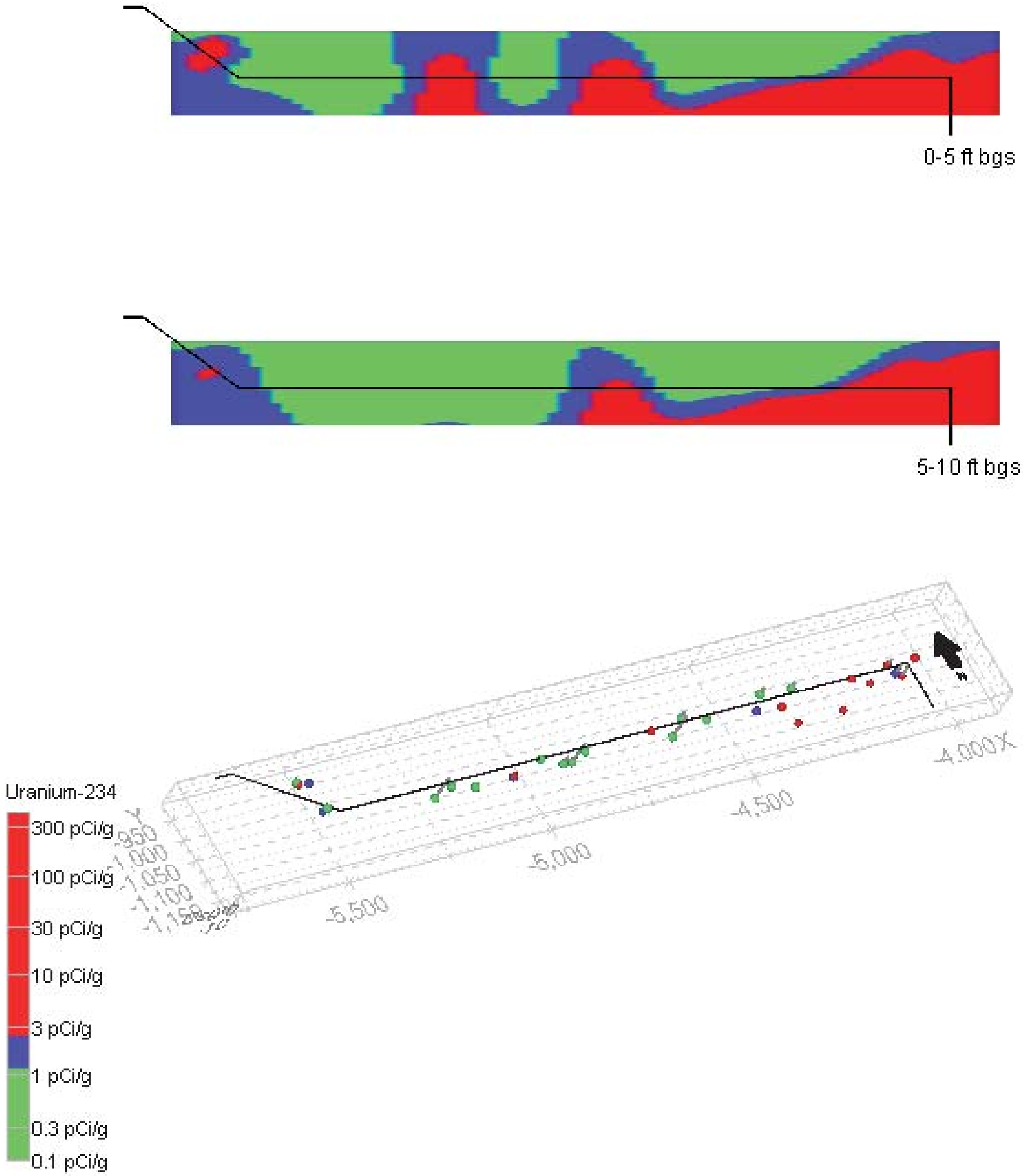

Figure C2.3.23. Uranium-234 Distribution at SWMU 26

Uranium-235 was detected in 36 of the 49 samples. The detections are shown in Figure C2.3.24. The average activity concentration over SWMU 26 for uranium-235 is greater than the background activity concentration, but less than the RG SSL; therefore, uranium-235 does not meet the screening criteria for fate and transport modeling for SWMU 26.

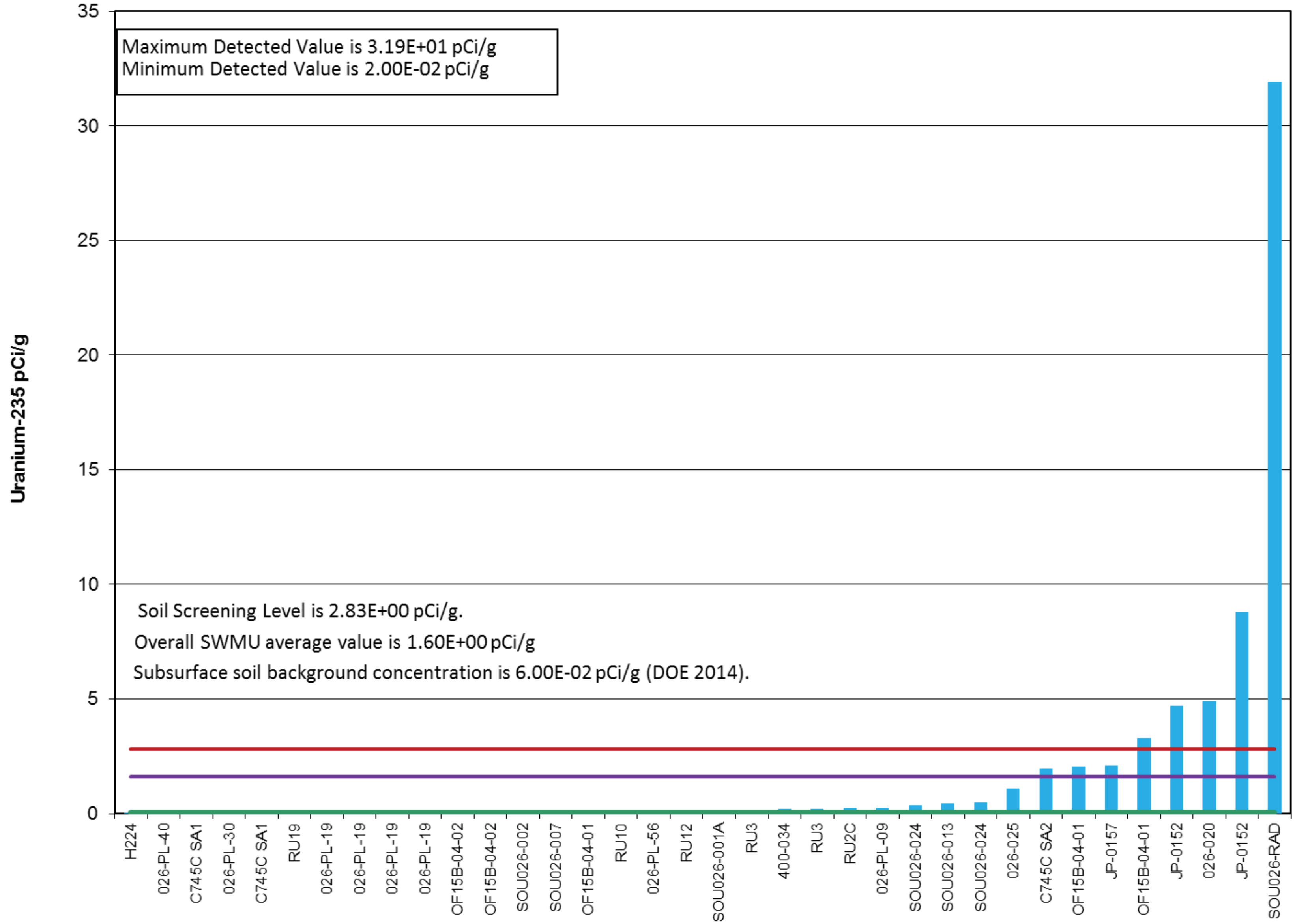

Figure C2.3.24. Uranium-235 Detections at SWMU 26

Uranium-238 was detected in 46 of the 52 samples. The detections are shown in Figure C2.3.25. The average activity concentration over SWMU 26 for uranium-238 is greater than both the background activity concentration and the RG SSL. Uranium-238 was evaluated as part of the GWOU FS and identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). The evaluation presented in Attachment C1 to Appendix C of the Soils OU RI Report (DOE 2013) did not identify any uranium-238 impacts to RGA groundwater; therefore, uranium-238 does not meet the screening criteria for fate and transport modeling for SWMU 26.

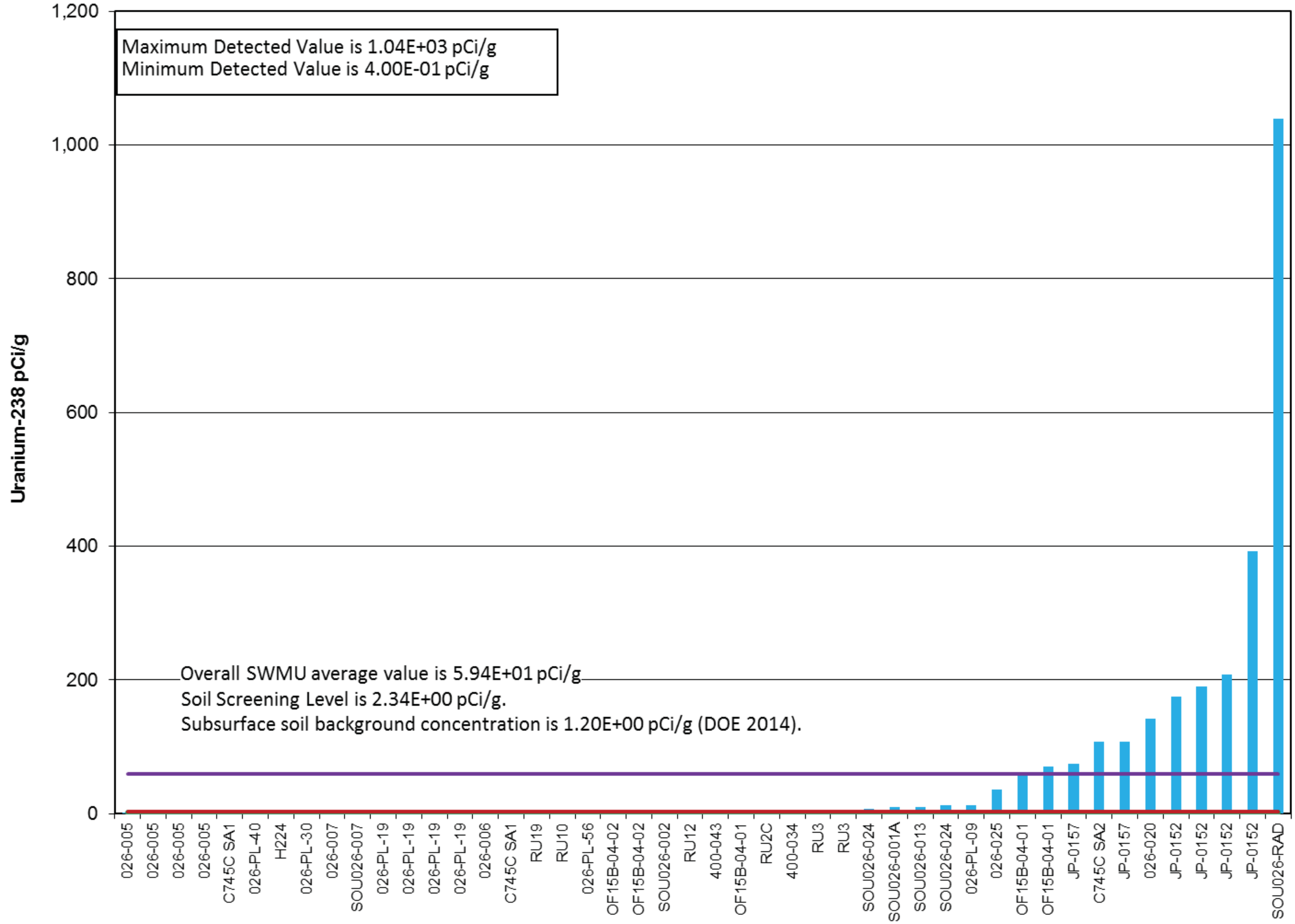

Figure C2.3.25. Uranium-238 Detections at SWMU 26

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C.2.4 SWMU 77

Data for SWMU 77 consist of some historical data, but mostly RI-collected data. SWMU 77 exceedances of the RG SSL include the following soil constituents: cobalt, iron, manganese, Total PCBs, Tc-99, uranium-234, and uranium-238.

Cobalt was detected in 2 of 2 samples. The detections are shown in Figure C2.4.1. The average concentration over SWMU 77 for cobalt is greater than the RG SSL, but less than the background concentration; therefore, cobalt does not meet the screening criteria for fate and transport modeling for SWMU 77.

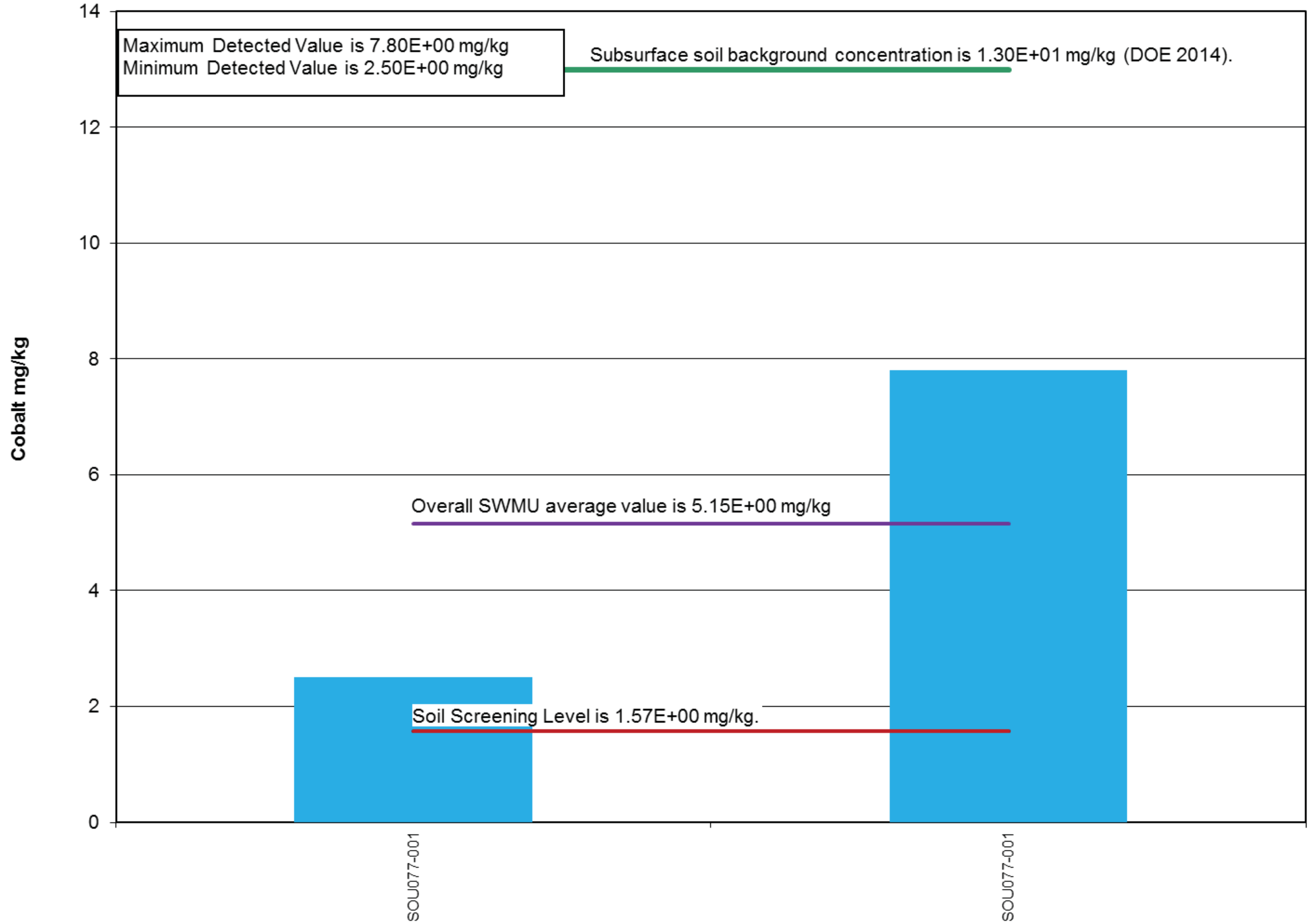

Figure C2.4.1. Cobalt Detections at SWMU 77

Iron was detected in 15 of 15 samples. The detections are shown in Figure C2.4.2. The average concentration over SWMU 77 for iron is greater than both the RG SSL and the background concentration. Iron was evaluated as part of the GWOU FS and identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). The evaluation presented in Attachment C1 to Appendix C of the Soils OU RI Report (DOE 2013) did not identify any iron impacts to RGA groundwater; therefore, iron does not meet the screening criteria for fate and transport modeling for SWMU 77.

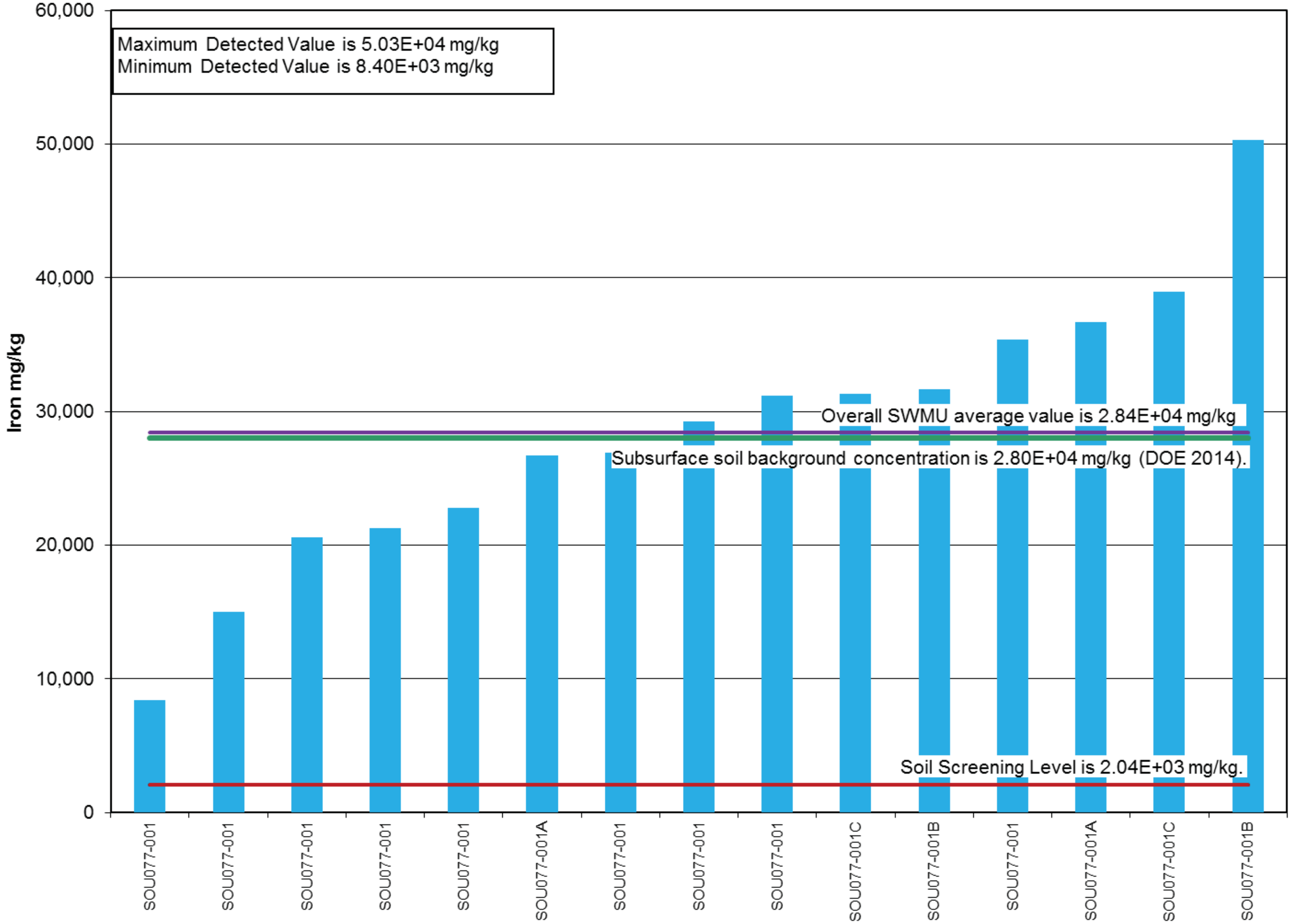

Figure C2.4.2. Iron Detections at SWMU 77

Manganese was detected in all 15 samples. The detections are shown in Figure C2.4.3. The average concentration over SWMU 77 for manganese is greater than the RG SSL, but less than the background concentration; therefore, manganese does not meet the screening criteria for fate and transport modeling for SWMU 77.

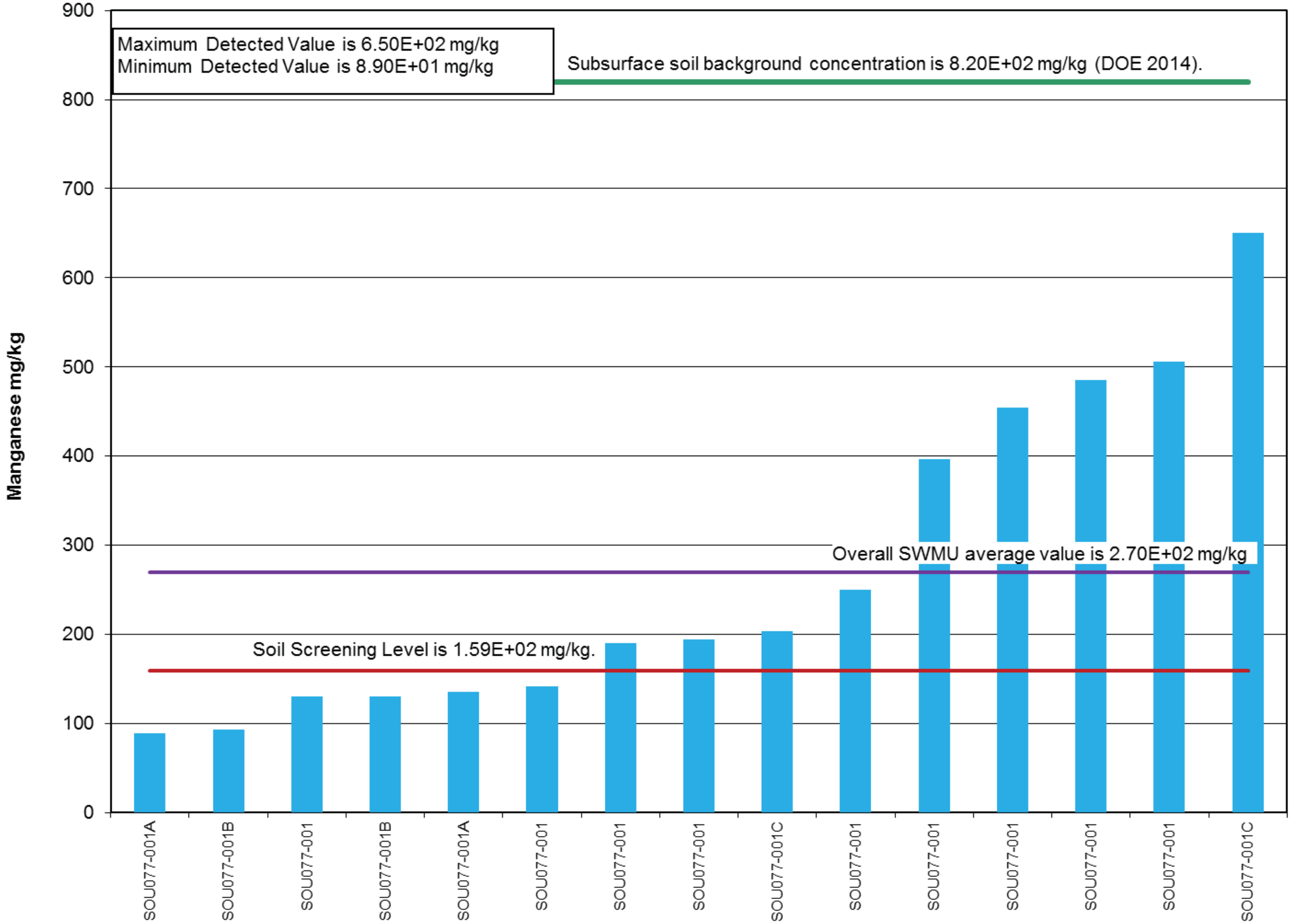

Figure C2.4.3. Manganese Detections at SWMU 77

Total PCBs was detected in 4 of the 13 samples. The detections are shown in Figure C2.4.4. The average concentration over SWMU 77 for Total PCBs is less than the RG SSL; therefore, Total PCBs does not meet the screening criteria for groundwater fate and transport modeling for SWMU 77.

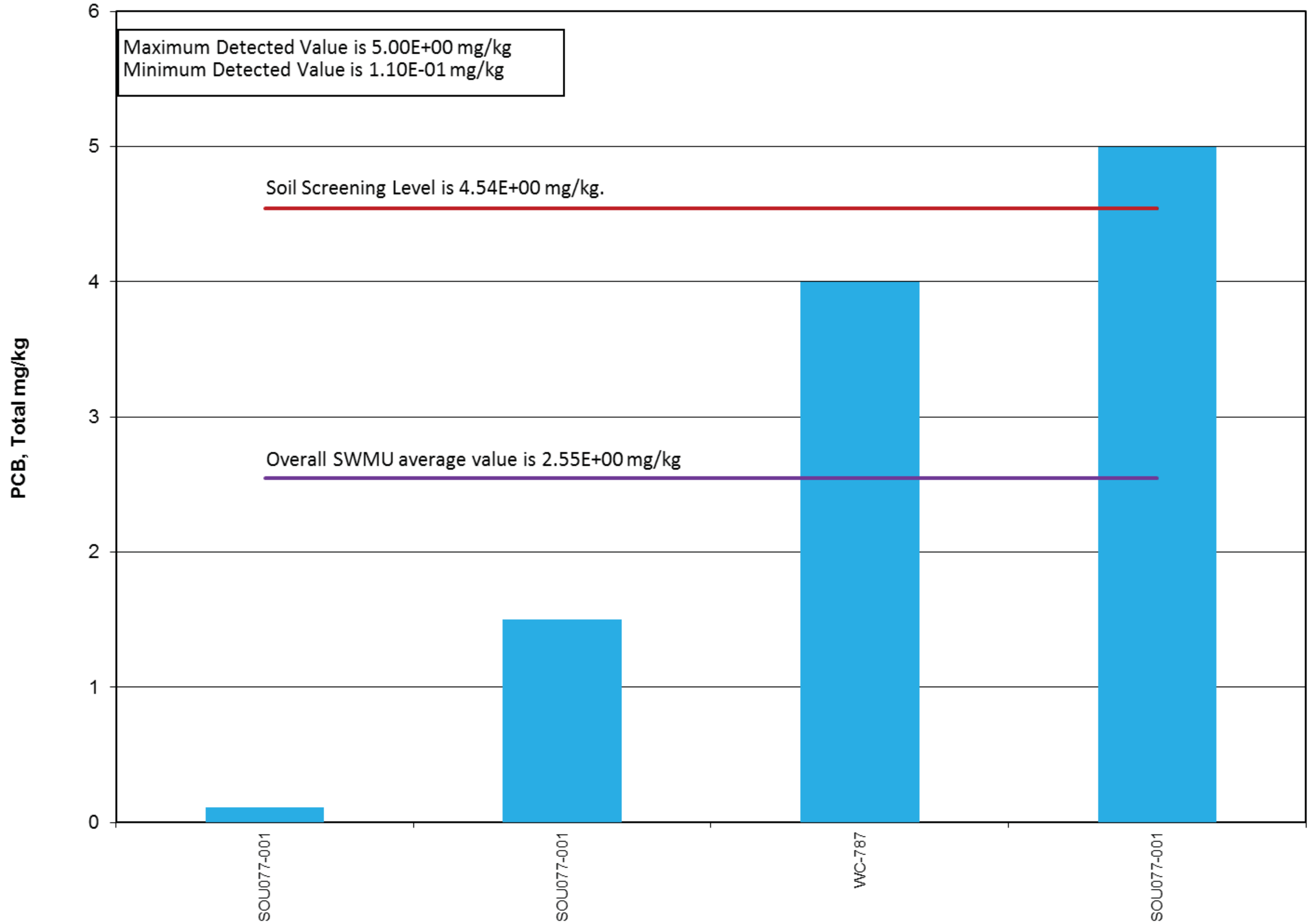

Figure C2.4.4. Total PCBs Detections at SWMU 77

Tc-99 was detected in 1 of the 3 samples. The detections are shown in Figure C2.4.5. The average activity concentration over SWMU 77 for Tc-99 is greater than both the RG SSL and the background activity concentration. Tc-99 was evaluated as part of the GWOU FS and identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). Because of the presence of Tc-99 in RGA groundwater and the close proximity of SWMU 13 to the Tc-99 plume, SWMU 77 may be a secondary source of Tc-99. Only one sample had a detected concentration; therefore, Tc-99 does not meet the screening criteria for fate and transport modeling for SWMU 77.

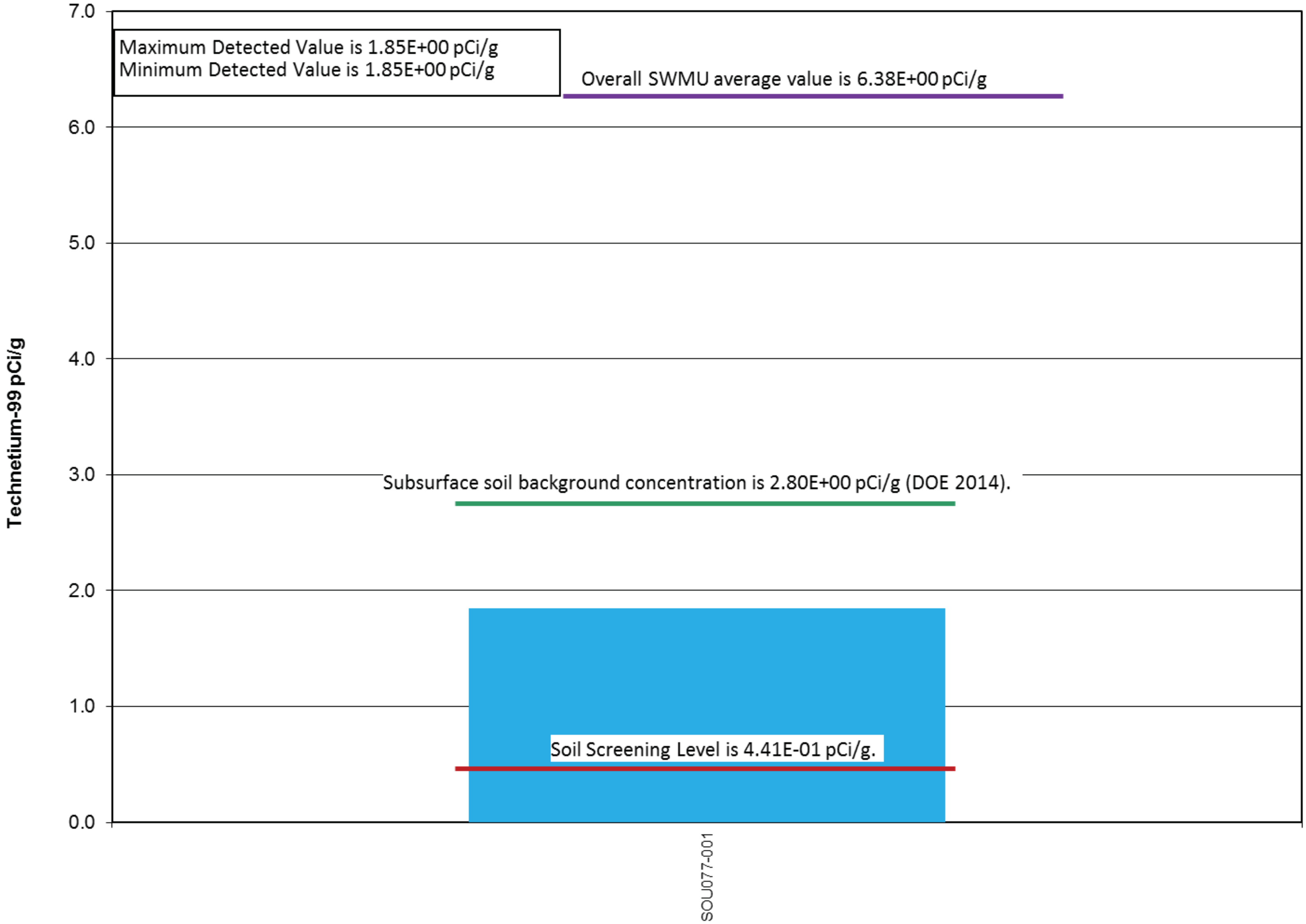

Figure C2.4.5. Tc-99 Detections at SWMU 77

Uranium-234 was detected in both of the samples. The detections are shown in Figure C2.4.6. The average activity concentration over SWMU 77 for uranium-234 is greater than the background activity concentration, but less than the RG SSL; therefore, uranium-243 does not meet the requirements for fate and transport modeling for SWMU 77.

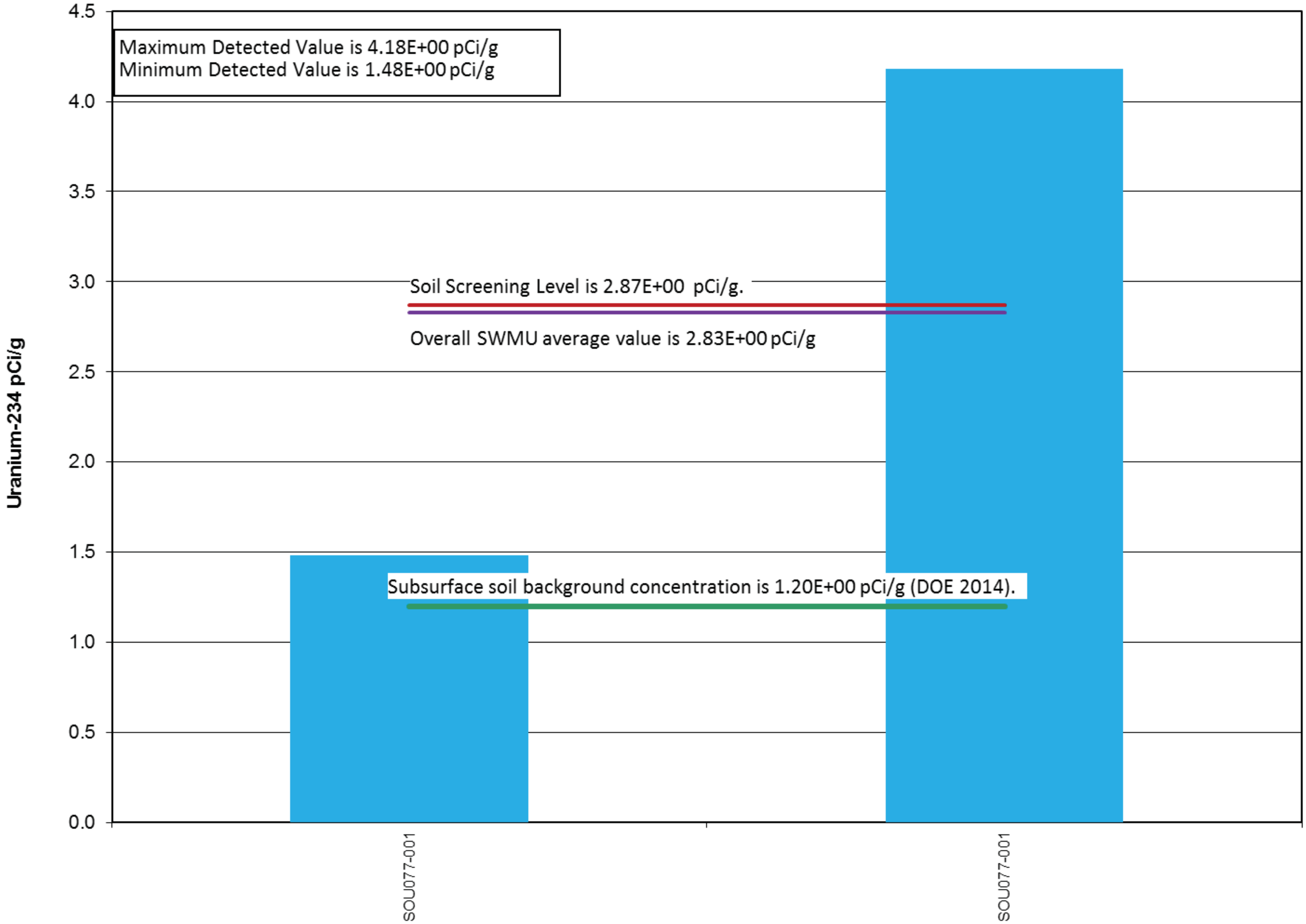

Figure C2.4.6. Uranium-234 Detections at SWMU 77

Uranium-238 was detected in 2 of 2 samples. The detections are shown in Figure C2.4.7. The average activity concentration at SWMU 77 for uranium-238 is greater than both the background activity concentration and the RG SSL. Uranium-238 was evaluated as part of the GWOU FS and identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). The evaluation presented in Attachment C1 to Appendix C of the Soils OU RI Report (DOE 2013) did not identify any uranium-238 impacts to RGA groundwater; therefore, uranium-238 does not meet the screening criteria for fate and transport modeling for SWMU 77.

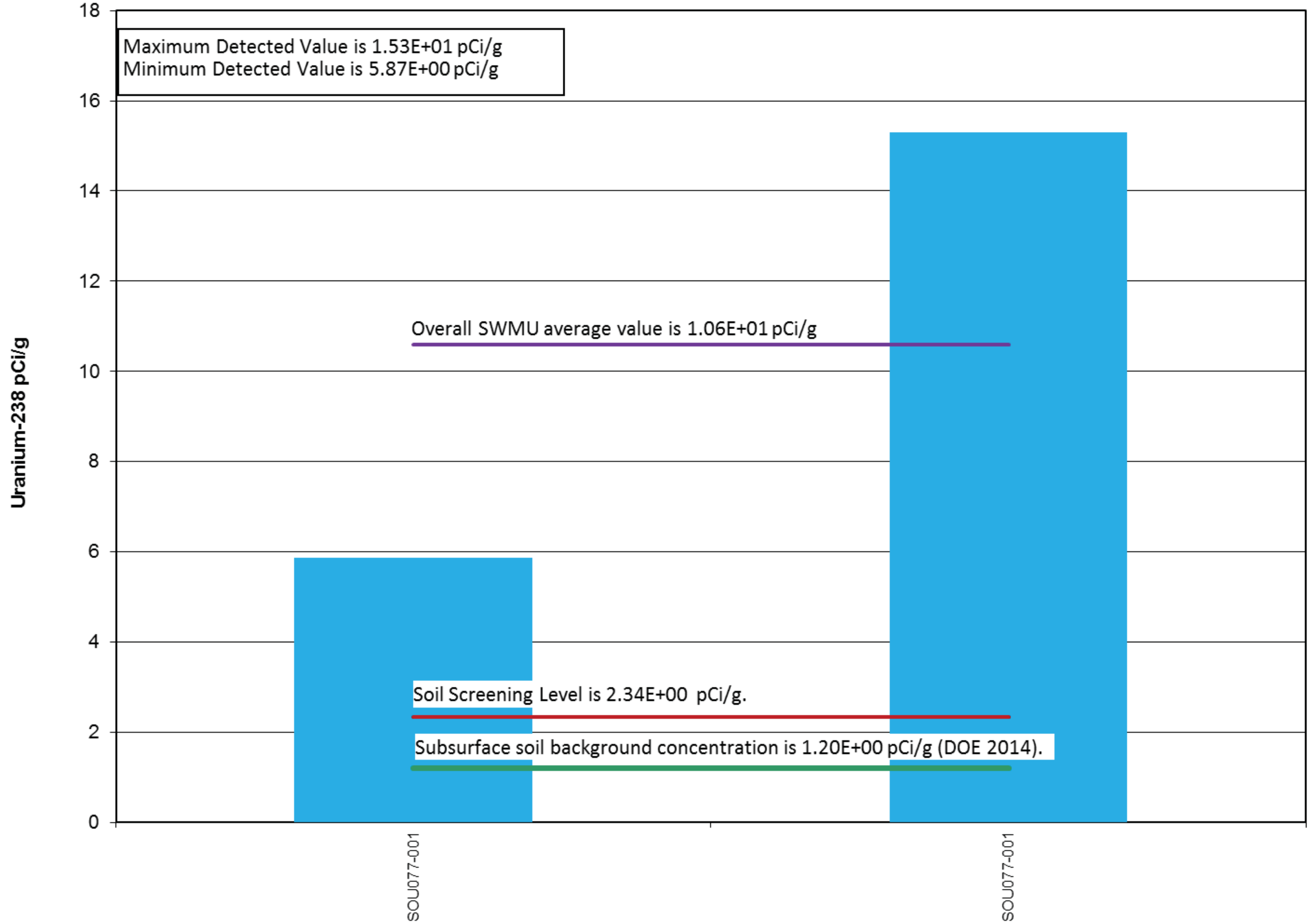

Figure C2.4.7. Uranium-238 Detections at SWMU 77

C.2.5 SWMUs 56 AND 80, C-540-A PCB STAGING AREA AND C-540 PCB SPILL SITE

Data for SWMUs 56 and 80 consist of both historical data and RI-collected data. SWMUs 56 and 80 exceedances of the RG SSL include the following soil constituents: antimony, cobalt, iron, manganese, mercury, molybdenum, naphthalene, Total PCBs, phenanthrene, Tc-99, uranium, uranium-234, uranium-235, and uranium-238.

Antimony was detected in 12 of 15 samples. The detections are shown in Figure C2.5.1. The average concentration over SWMUs 56 and 80 for antimony is greater than both the background and the RG SSL. Antimony is a groundwater COC, but groundwater information discussed in the Soils OU RI Report (DOE 2013) indicate there are no antimony groundwater impacts; therefore, antimony does not meet the screening criteria for fate and transport modeling for SWMUs 56 and 80.

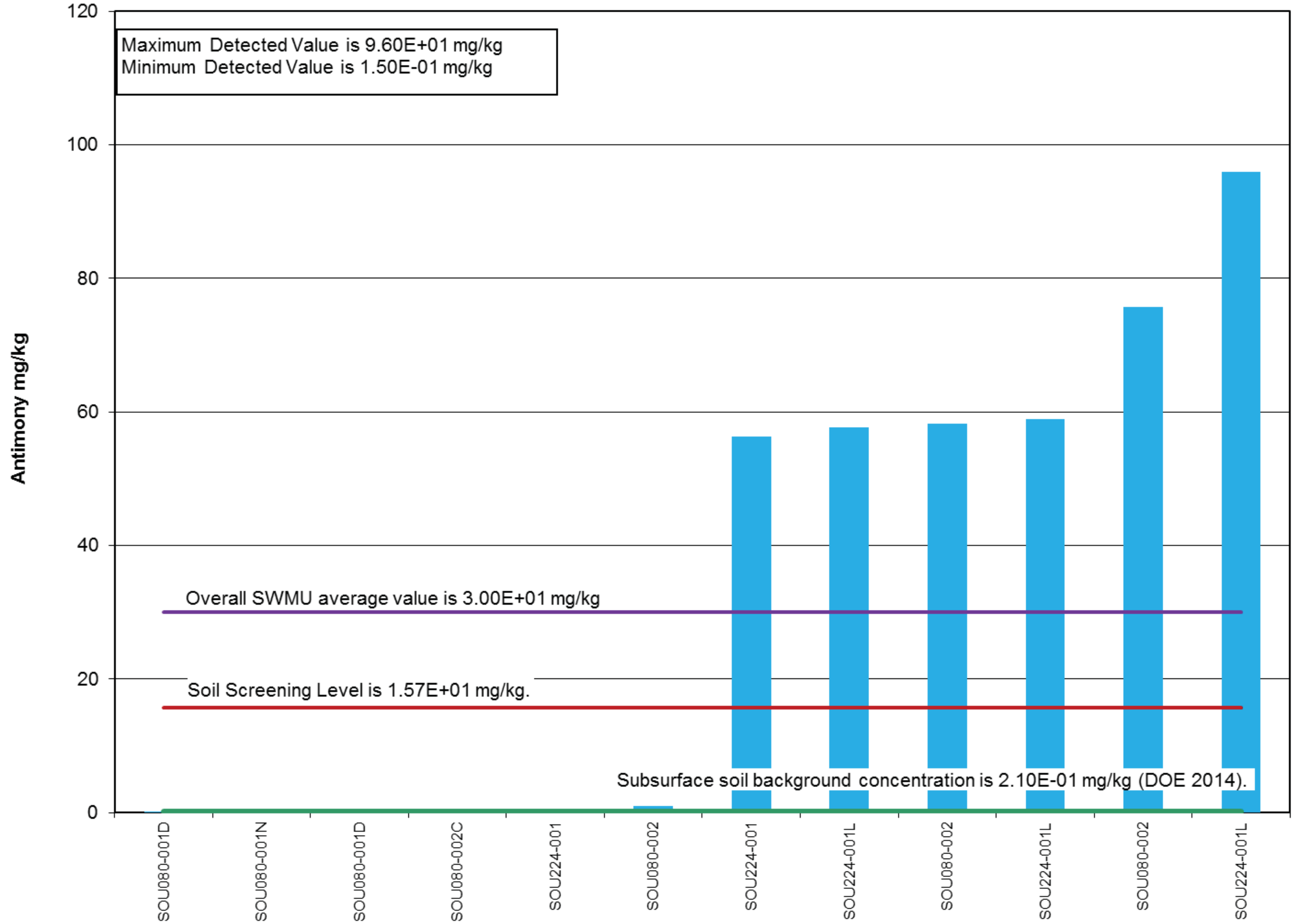

Figure C2.5.1. Antimony Detections at SWMUs 56 and 80

Cobalt was detected in 6 of the 6 samples. The detections are shown in Figure C2.5.2. The average concentration over SWMUs 56 and 80 for cobalt is greater than the RG SSL, but less than the background concentration; therefore, cobalt does not meet the screening criteria for fate and transport modeling for SWMUs 56 and 80.

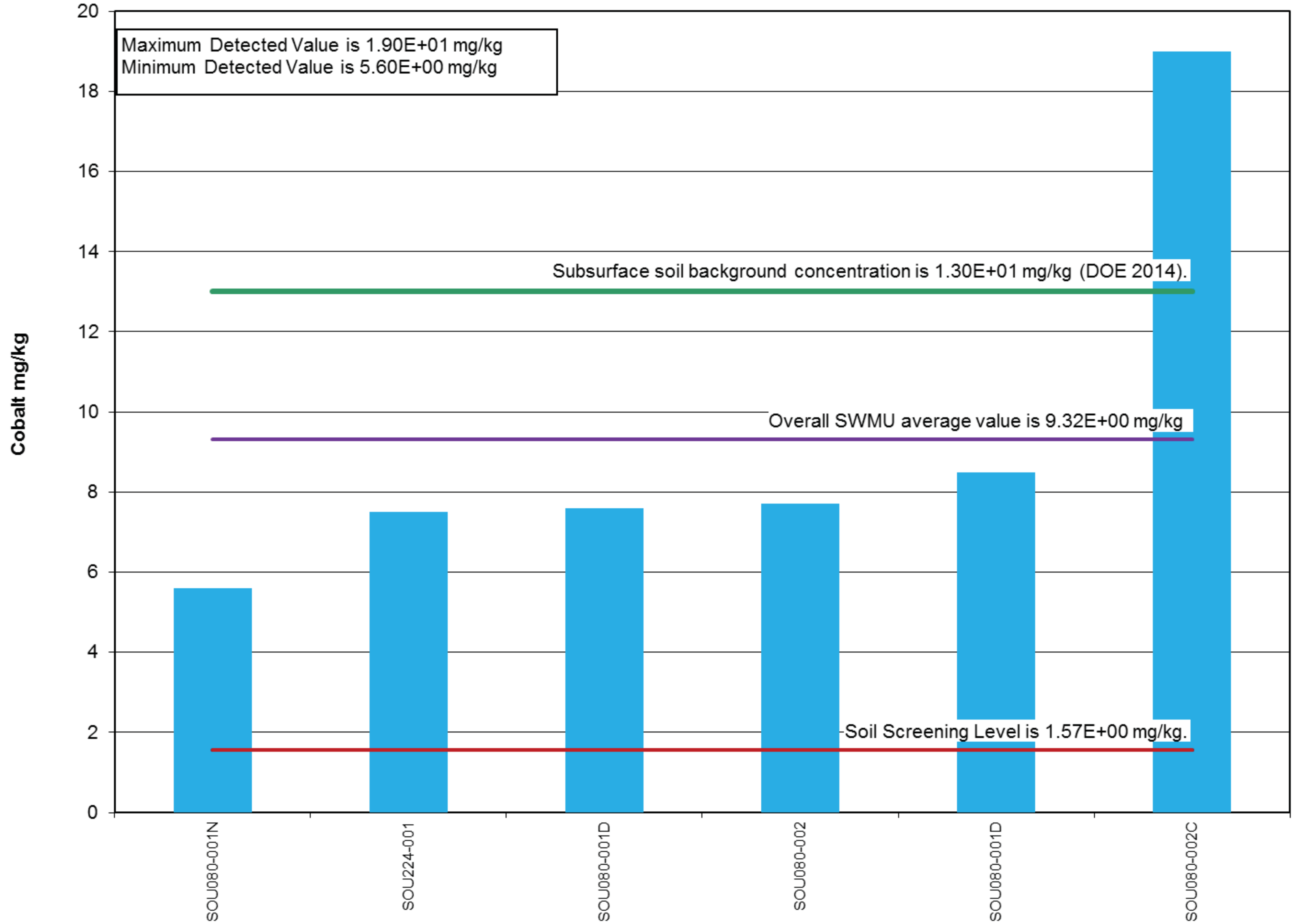

Figure C2.5.2. Cobalt Detections at SWMUs 56 and 80

Iron was detected in 65 of 65 samples. The detections are shown in Figure C2.5.3. The average concentration at SWMUs 56 and 80 for iron is greater than the RG SSL, but less than the background concentration; therefore, iron does not meet the screening criteria for fate and transport modeling for SWMUs 56 and 80.

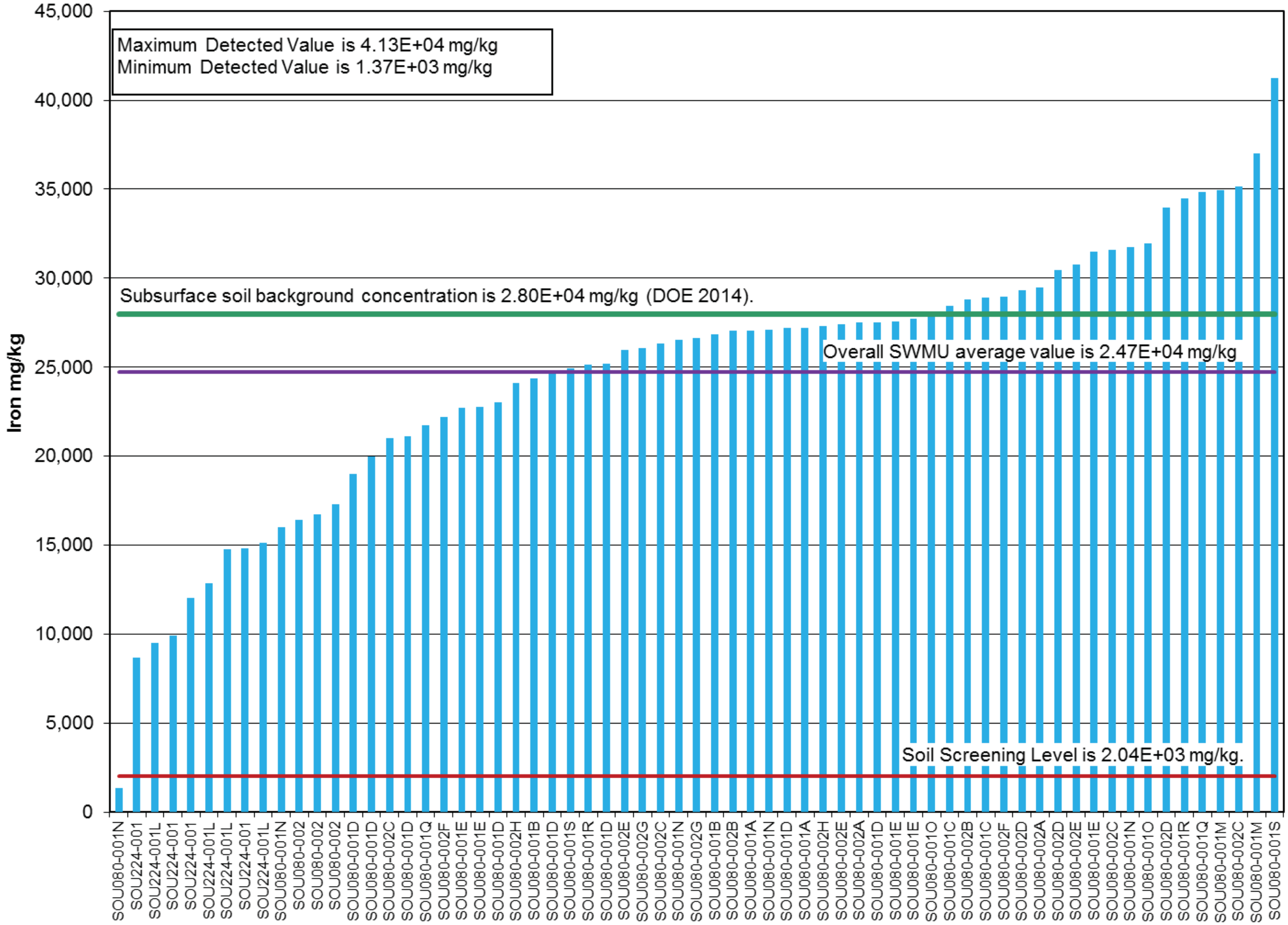

Figure C2.5.3. Iron Detections at SWMUs 56 and 80

Manganese was detected in 64 of 65 samples. The detections are shown in Figure C2.5.4. The average concentration over SWMUs 56 and 80 for manganese is greater than the RG SSL, but less than the background concentration; therefore, manganese does not meet the screening criteria for fate and transport modeling for SWMUs 56 and 80.

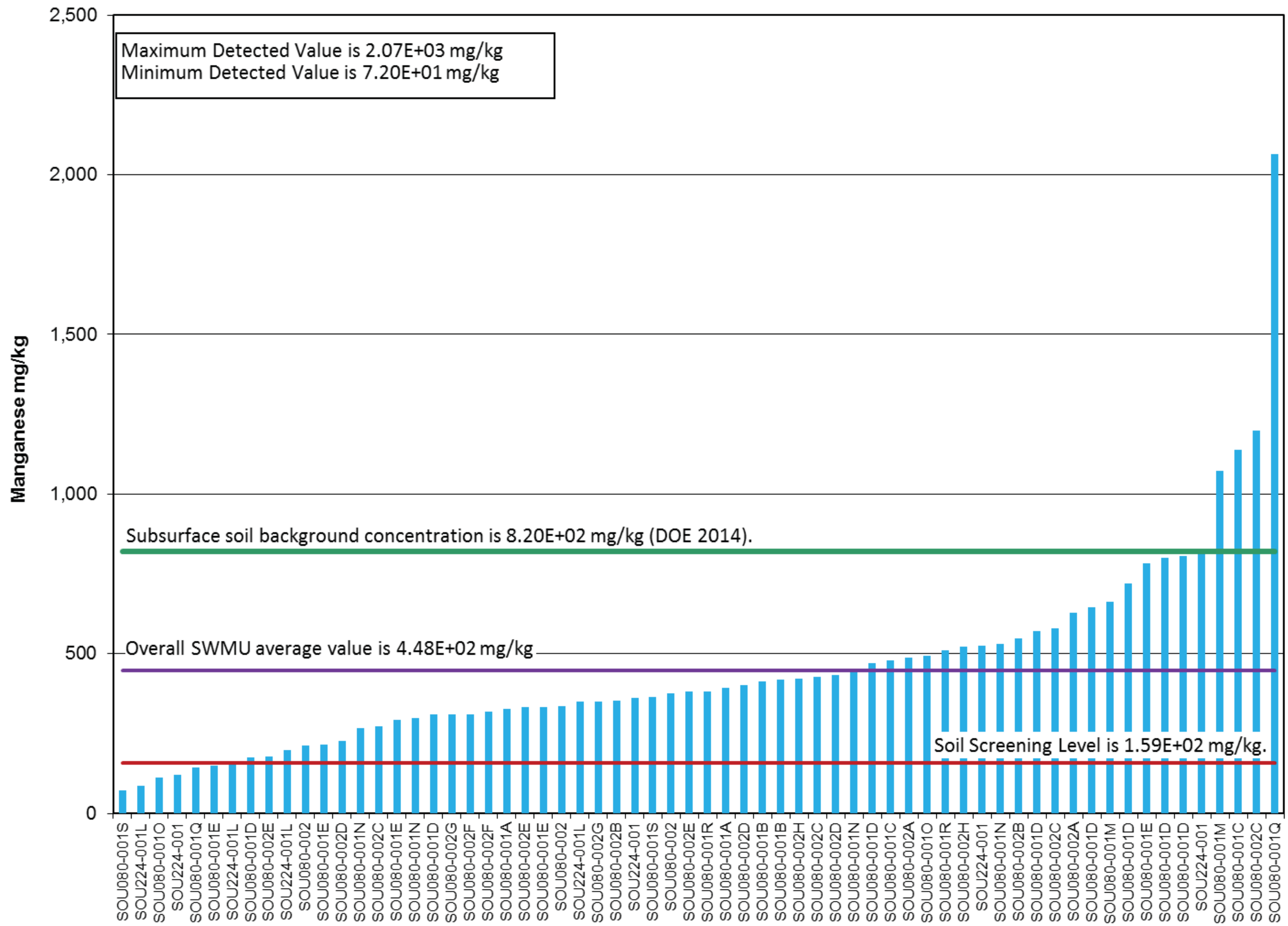

Figure C2.5.4. Manganese Detections at SWMUs 56 and 80

Mercury was detected in 5 of 66 samples. The detections are shown in Figure C2.5.5. The average concentration over SWMUs 56 and 80 for mercury is greater than both the RG SSL and the background concentration. Mercury was not identified as a COC in the groundwater plumes associated with PGDP (DOE 2001); therefore, mercury does not meet the screening criteria for fate and transport modeling for SWMUs 56 and 80.

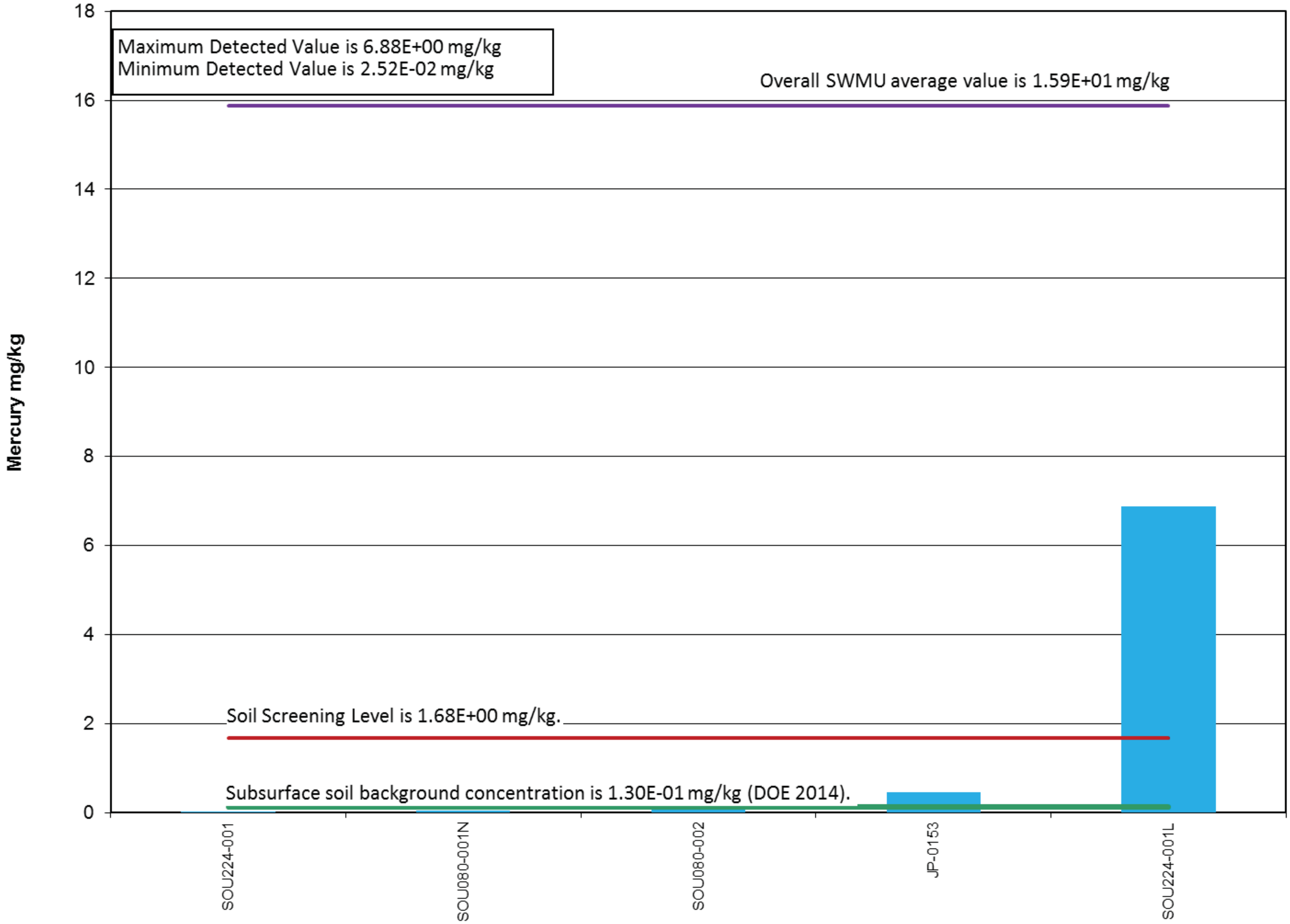

Figure C2.5.5. Mercury Detections at SWMUs 56 and 80

Molybdenum was detected in 11 of the 65 samples. The detections are shown in Figure C2.5.6. The average concentration over SWMUs 56 and 80 for molybdenum is less than the RG SSL; therefore, molybdenum does not meet the screening criteria for fate and transport modeling for SWMUs 56 and 80.

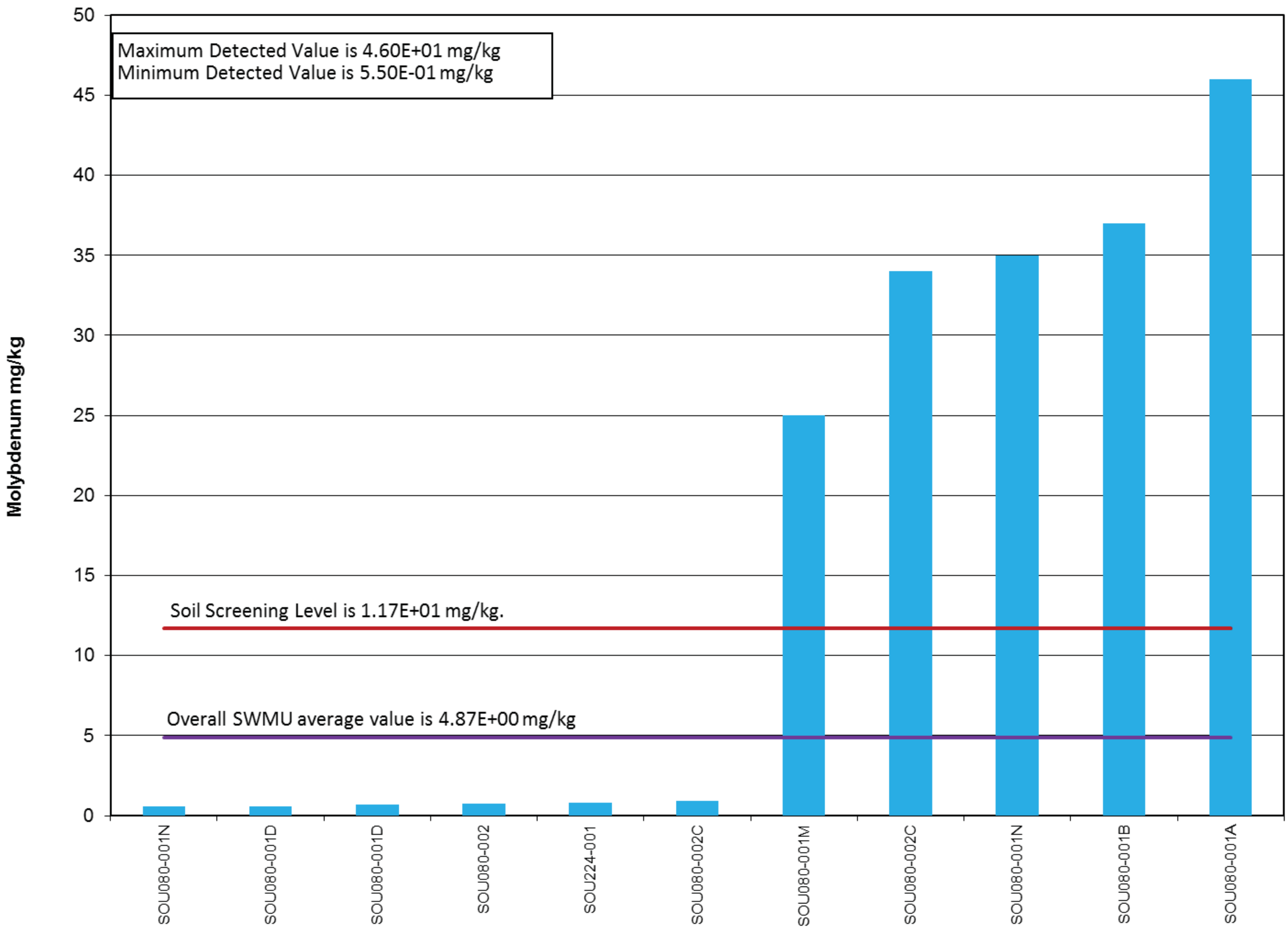

Figure C2.5.6. Molybdenum Detections at SWMUs 56 and 80

Naphthalene was detected in 1 of the 8 samples. The detection is shown in Figure C2.5.7. Although the average concentration (equal to the single detection) over SWMUs 56 and 80 for naphthalene is greater than the RG SSL, naphthalene was not identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). Naphthalene does not meet the screening criteria for fate and transport modeling for SWMUs 56 and 80.

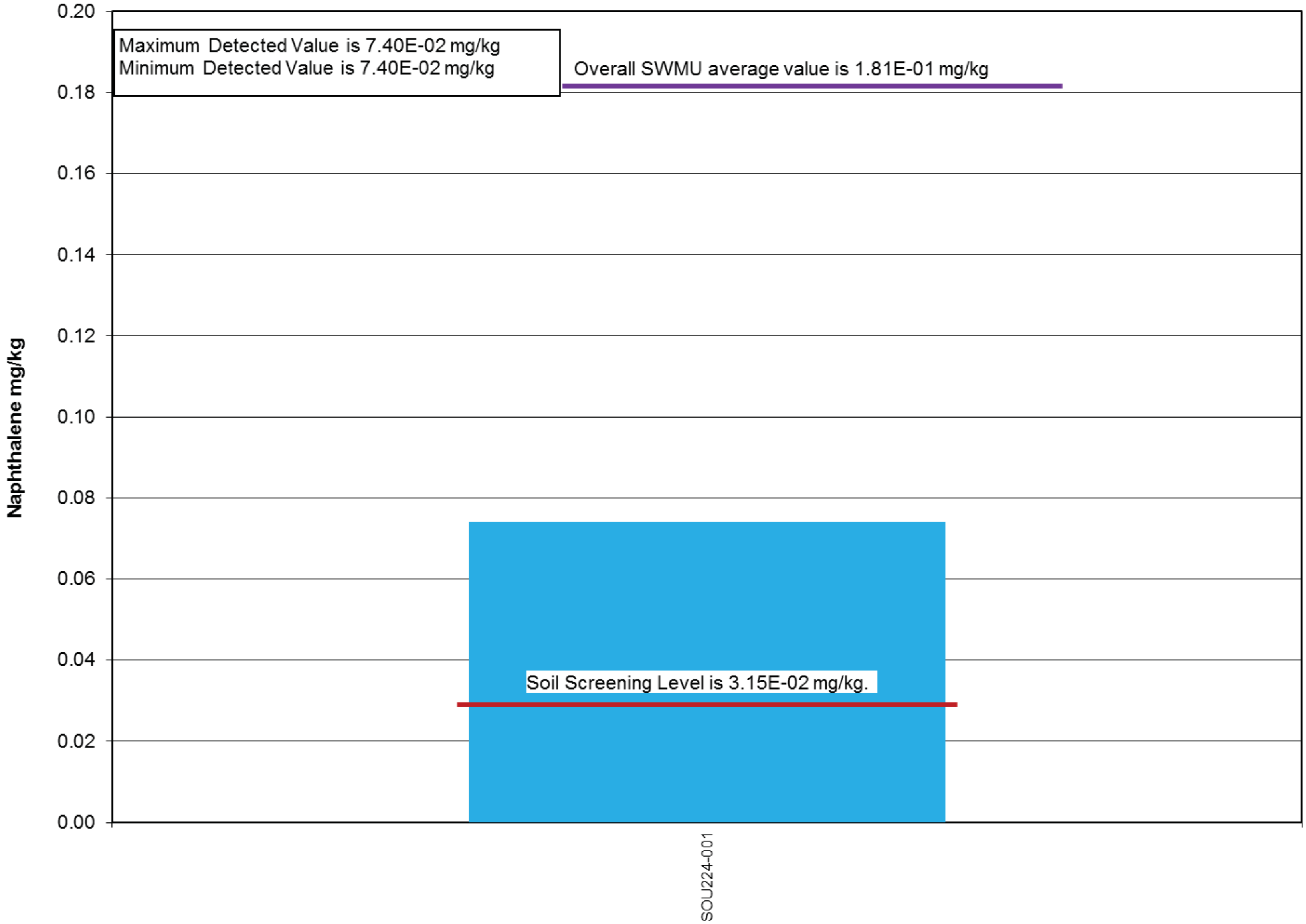

Figure C2.5.7. Naphthalene Detections at SWMUs 56 and 80

Total PCBs was detected in 78 of the 214 samples. The detections are shown in Figure C2.5.8. The average concentration over SWMUs 56 and 80 for Total PCBs is greater than the RG SSL. Total PCBs was evaluated as part of the GWOU FS and identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). The evaluation presented in Attachment C1 to Appendix C of the Soils OU RI Report (DOE 2013) did not identify any Total PCBs impact to RGA groundwater; therefore, Total PCBs does not meet the screening criteria for groundwater fate and transport modeling for SWMUs 56 and 80.

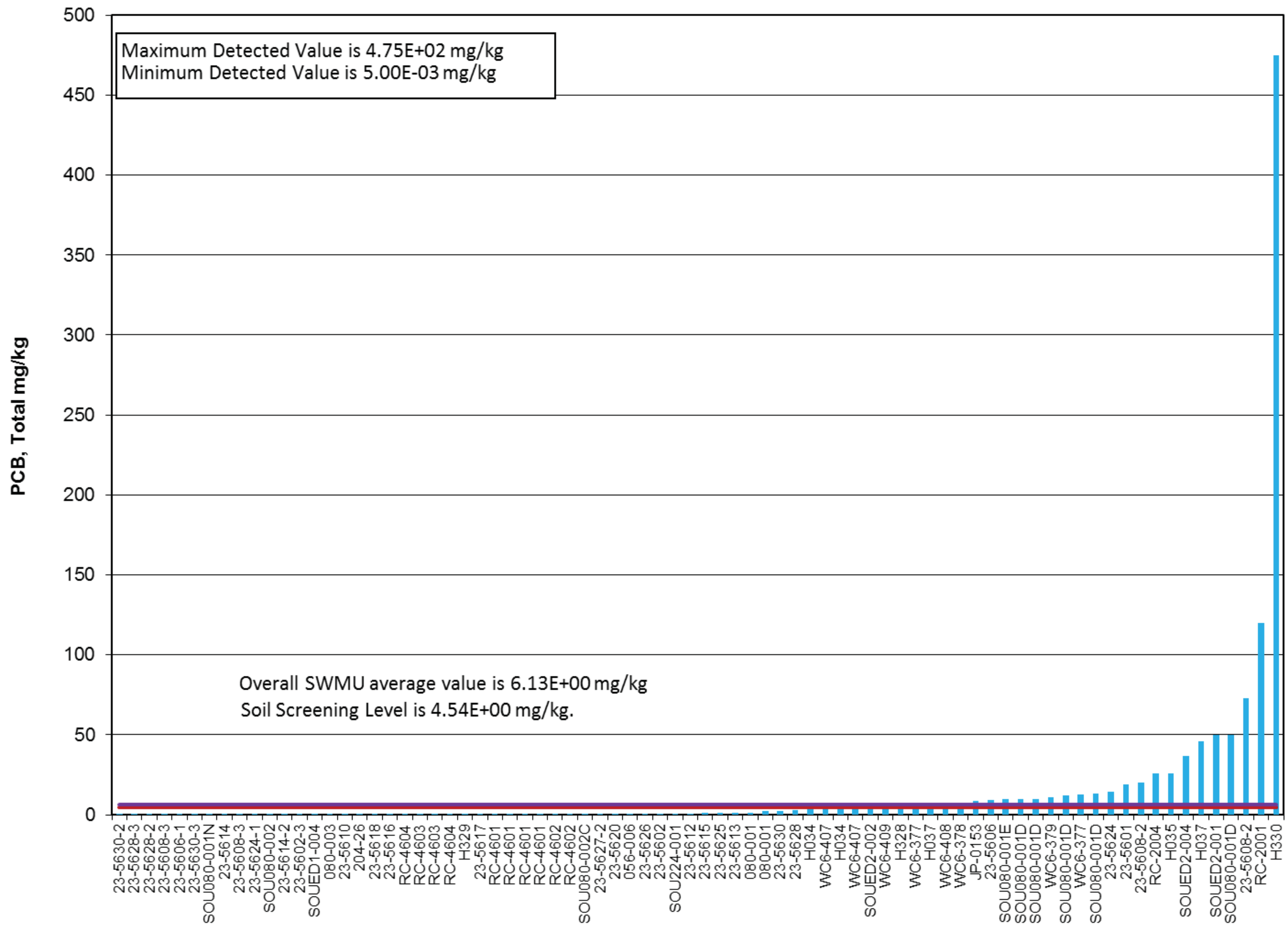

Figure C2.5.8. Total PCBs Detections at SWMUs 56 and 80

Phenanthrene was detected in 4 of the 8 samples. The detections are shown in Figure C2.5.9. The average concentration over SWMUs 56 and 80 for phenanthrene is less than the RG SSL; therefore, phenanthrene does not meet the screening criteria for fate and transport modeling at SWMUs 56 and 80. Additionally, phenanthrene was not identified as a COC in the groundwater plumes associated with PGDP (DOE 2001).

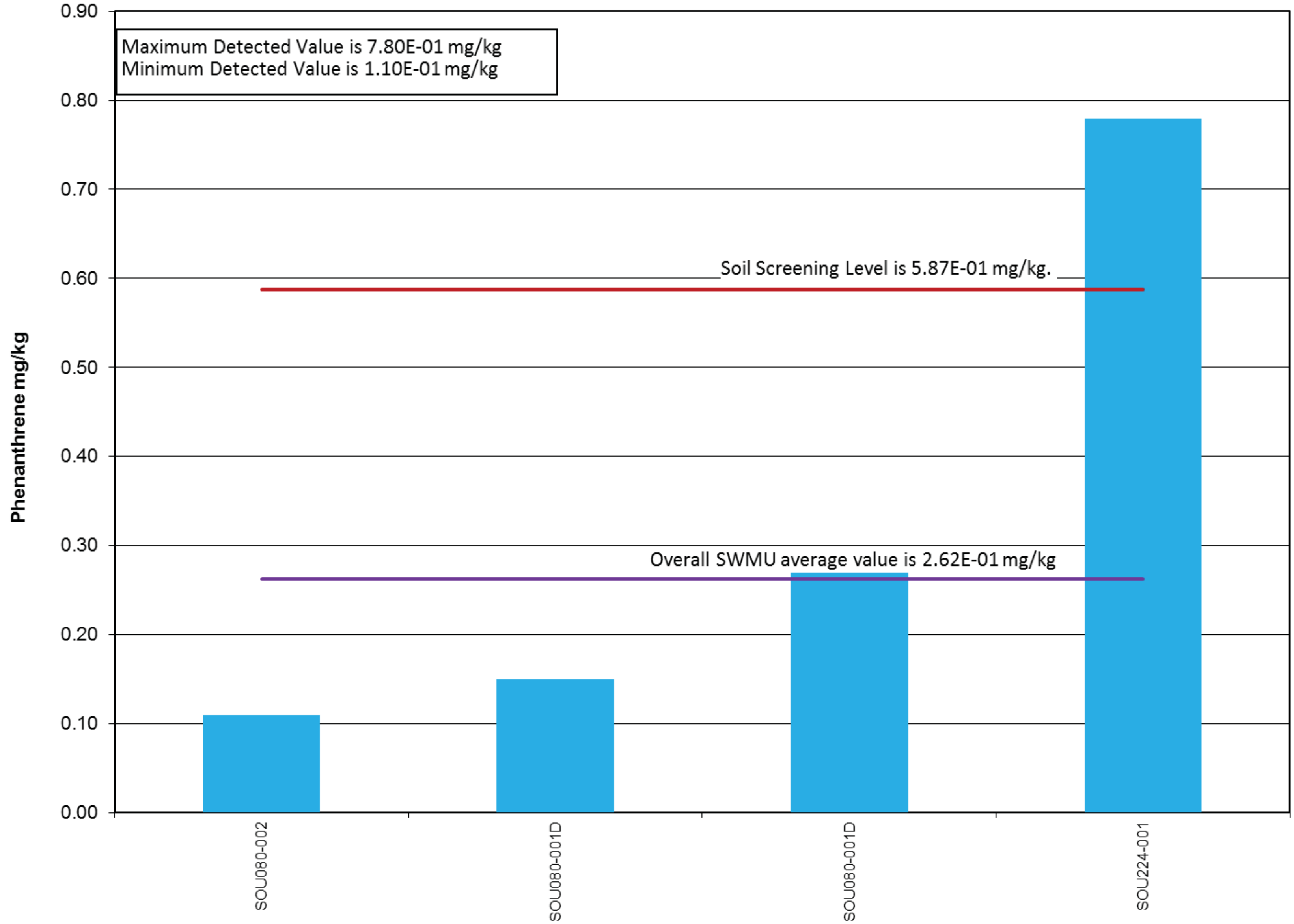

Figure C2.5.9. Phenanthrene Detections at SWMUs 56 and 80

Tc-99 was detected in 2 of the 9 samples. The detections are shown in Figure C2.5.10. The average activity concentration over SWMUs 56 and 80 for Tc-99 is greater than both the RG SSL and the background activity concentration. Tc-99 was evaluated as part of the GWOU FS and identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). Because of the presence of Tc-99 in RGA groundwater and the close proximity of SWMU 13 to the Tc-99 plume, SWMUs 56 and 80 may be a secondary source of Tc-99. Only two samples were detected above both the RG SSL and the background concentration; therefore, Tc-99 fate and transport modeling was not required for SWMUs 56 and 80.

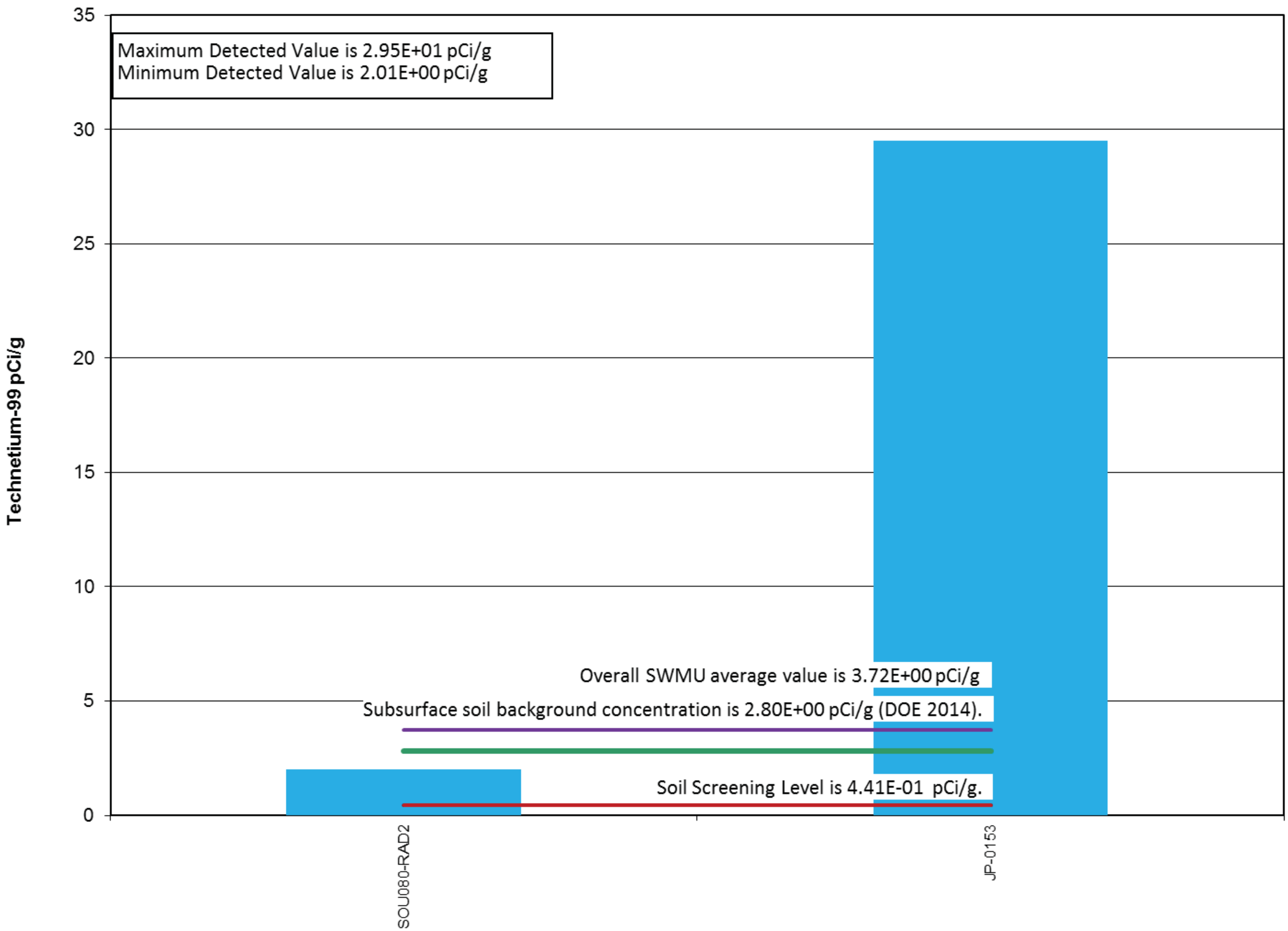

Figure C2.5.10. Tc-99 Detections at SWMUs 56 and 80

Uranium was detected in 27 of the 72 samples. The detections are shown in Figure C2.5.11. The average concentration over SWMUs 56 and 80 for uranium is greater than the background concentration, but less than the RG SSL; therefore, uranium does not meet the screening criteria for groundwater fate and transport modeling for SWMUs 56 and 80.

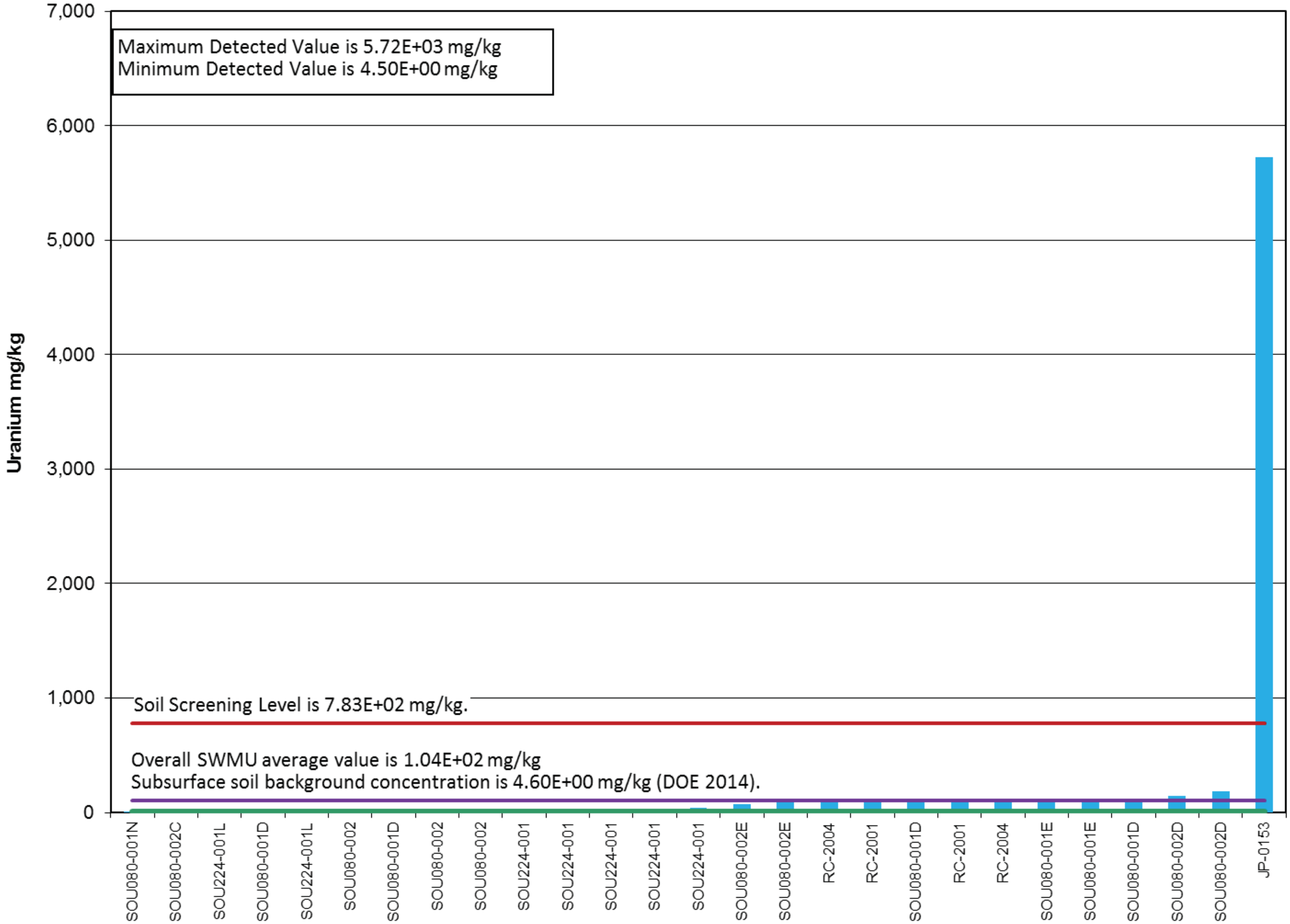

Figure C2.5.11. Uranium Detections at SWMUs 56 and 80

Uranium-234 was detected in all 9 of the samples. The detections are shown in Figure C2.5.12. The average activity concentration over SWMUs 56 and 80 for uranium-234 is greater than both the background activity concentration and the RG SSL. Uranium-234 was evaluated as part of the GWOU FS and identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). Three samples exceed both the background and the RG SSL; therefore, a hot spot evaluation was performed.

MVS was used to evaluate the distribution of uranium-234 across SWMUs 56 and 80. Figure C2.5.13 shows the distribution of uranium-234 at 0 to 5 ft bgs. Uranium-234 meets the requirement for fate and transport modeling for SWMUs 56 and 80; however, hot spot analysis shows the distribution is not clustered and, therefore, not indicative of a source location. Additionally, uranium was modeled at SWMU 81 [presented in the Soils OU RI Report (DOE 2013)] and simulation results did not predict RGA groundwater impacts due to uranium-234 leaching; therefore, uranium-234 fate and transport modeling was not performed for SWMUs 56 and 80 (see Attachment C1 to Appendix C).

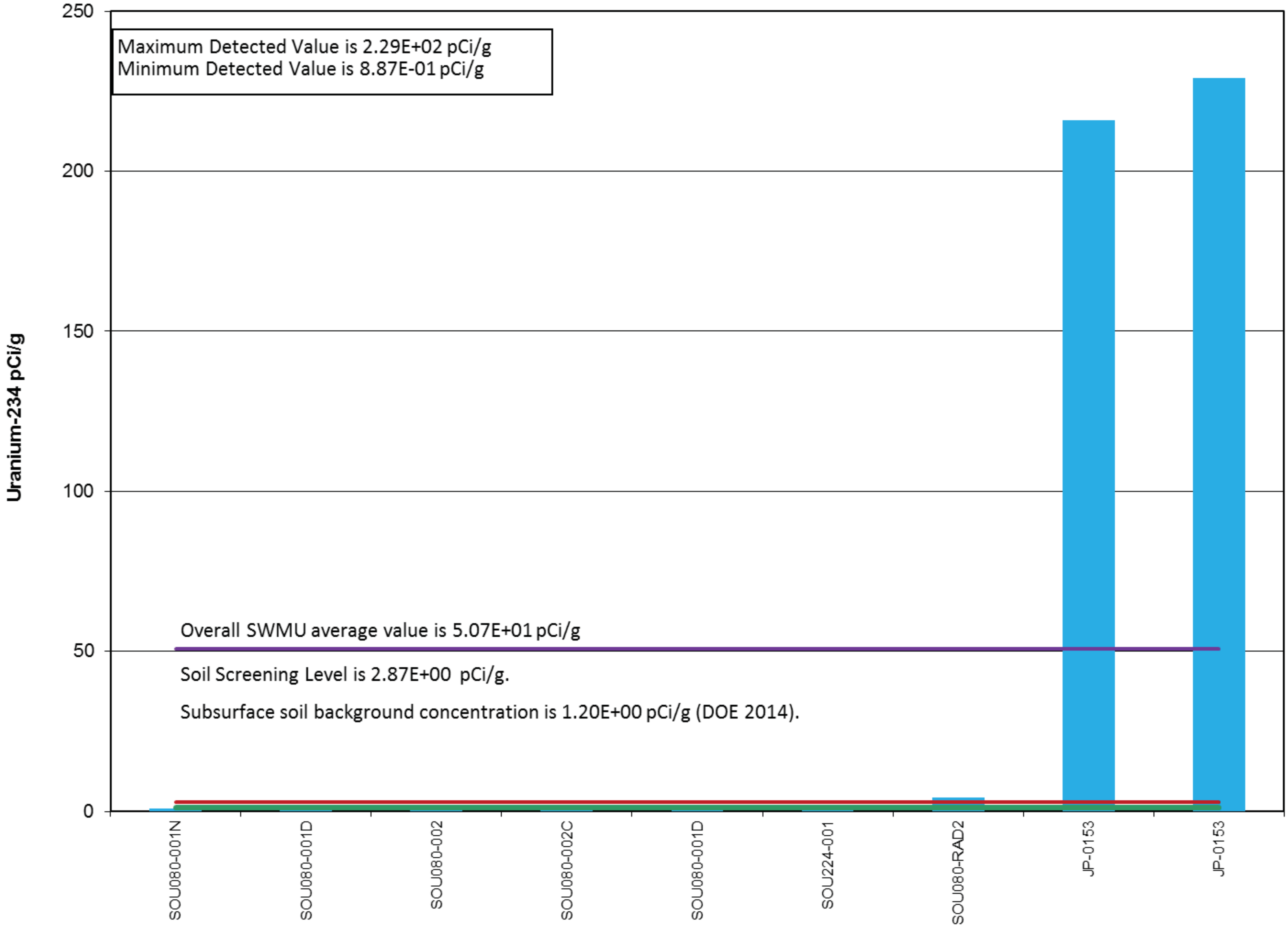

Figure C2.5.12. Uranium-234 Detections at SWMUs 56 and 80

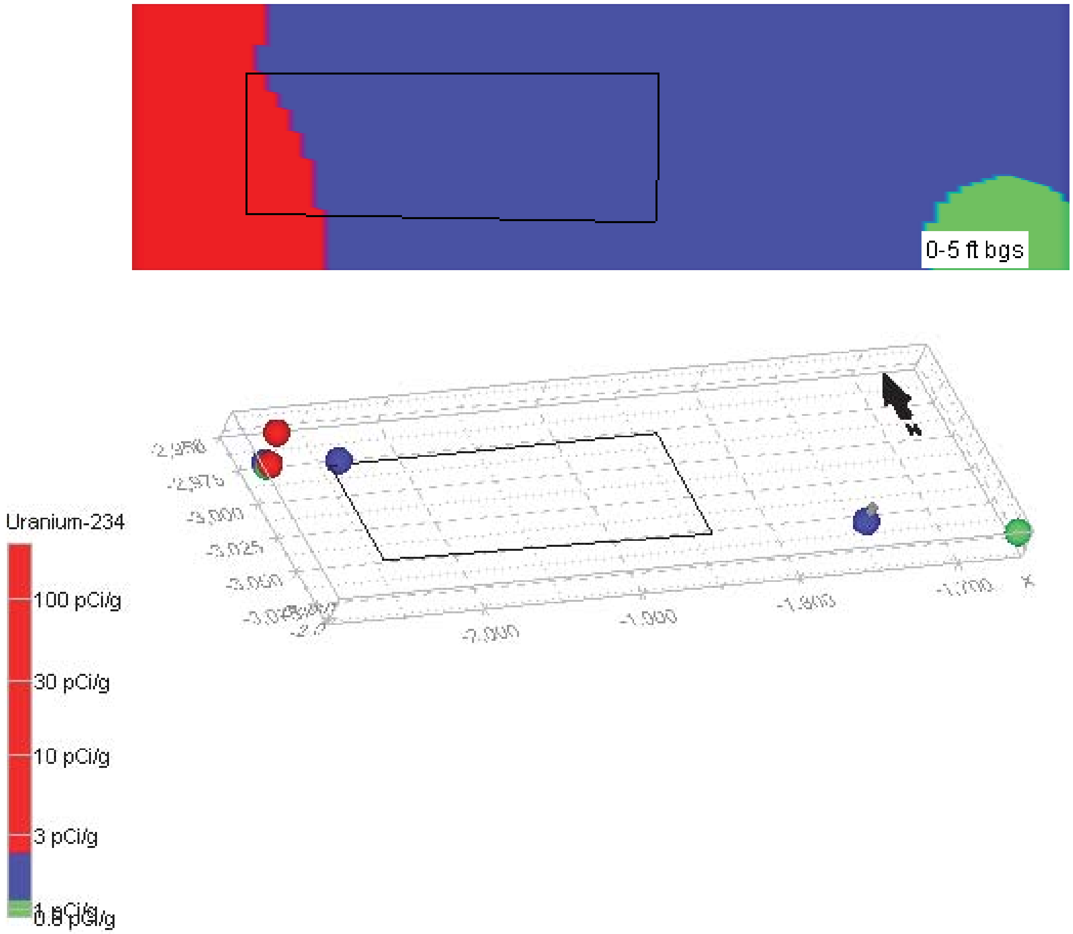

Figure C2.5.13. U-234 Distribution at SWMUs 56 and 80

Uranium-235 was detected in all 8 of the samples. The detections are shown in Figure C2.5.14. The average activity concentration over SWMUs 56 and 80 for uranium-235 is greater than both the background activity concentration and the RG SSL. Uranium-235 was evaluated as part of the GWOU FS and identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). Only one sample exceeds both the background concentration and the RG SSL; therefore, uranium-235 does not meet the screening criteria for fate and transport modeling for SWMUs 56 and 80.

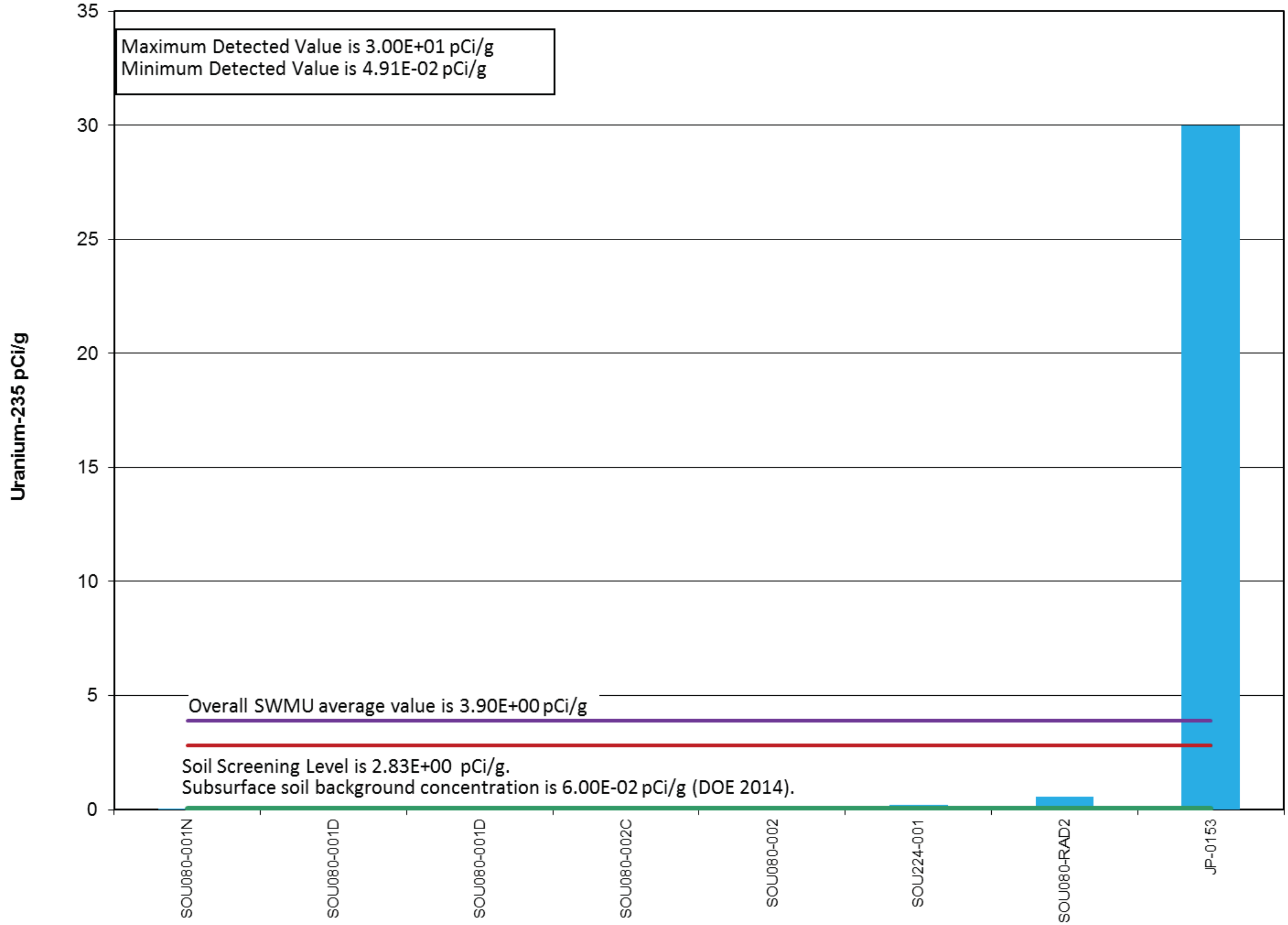

Figure C2.5.14. Uranium-235 Detections at SWMUs 56 and 80

Uranium-238 was detected in 9 of the 9 samples. The detections are shown in Figure C2.5.15. The average concentration over SWMUs 56 and 80 for uranium-238 is greater than both the background concentration and the RG SSL. Uranium-238 was evaluated as part of the GWOU FS and identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). The evaluation presented in Attachment C1 to Appendix C of the Soils OU RI Report (DOE 2013) did not identify any uranium-238 impacts to RGA groundwater; therefore, uranium-238 does not meet the screening criteria for fate and transport modeling for SWMUs 56 and 80.

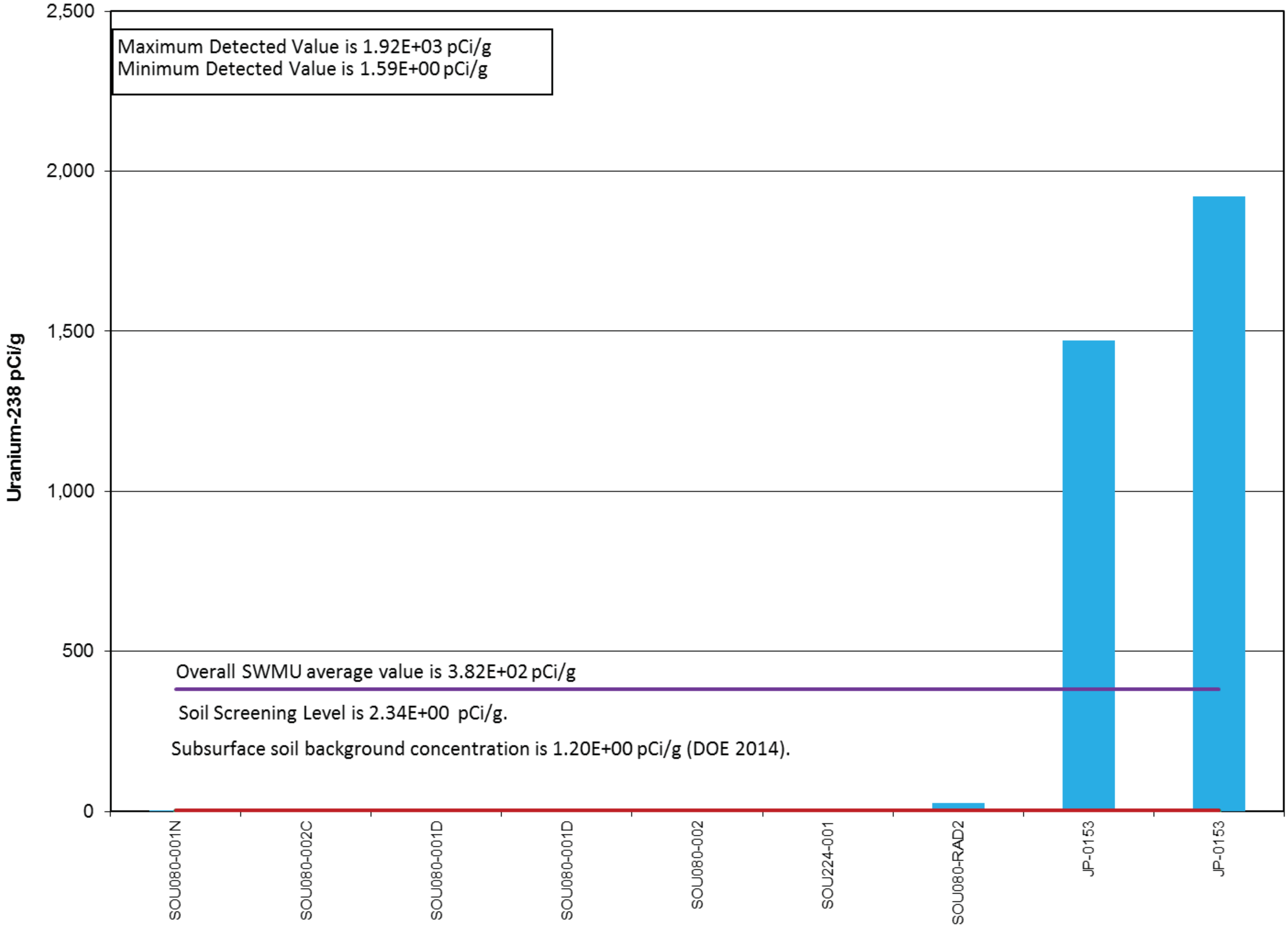

Figure C2.5.15. Uranium-238 Detections at SWMUs 56 and 80

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C.2.6 AOC 204, HISTORICAL STAGING AREA

Data for AOC 204 consists of both historical data and RI-collected data. AOC 204 exceedances of the RG SSL include the following soil constituents: arsenic, cobalt, iron, manganese, molybdenum, Total PCBs, silver, Tc-99, uranium, uranium-234, uranium-235, and uranium-238.

Arsenic was detected in 50 of 432 samples. The detections are shown in Figure C2.6.1. The average concentration over AOC 204 for arsenic is less than both the background and the RG SSL; therefore, arsenic does not meet the screening criteria for fate and transport modeling for AOC 204.

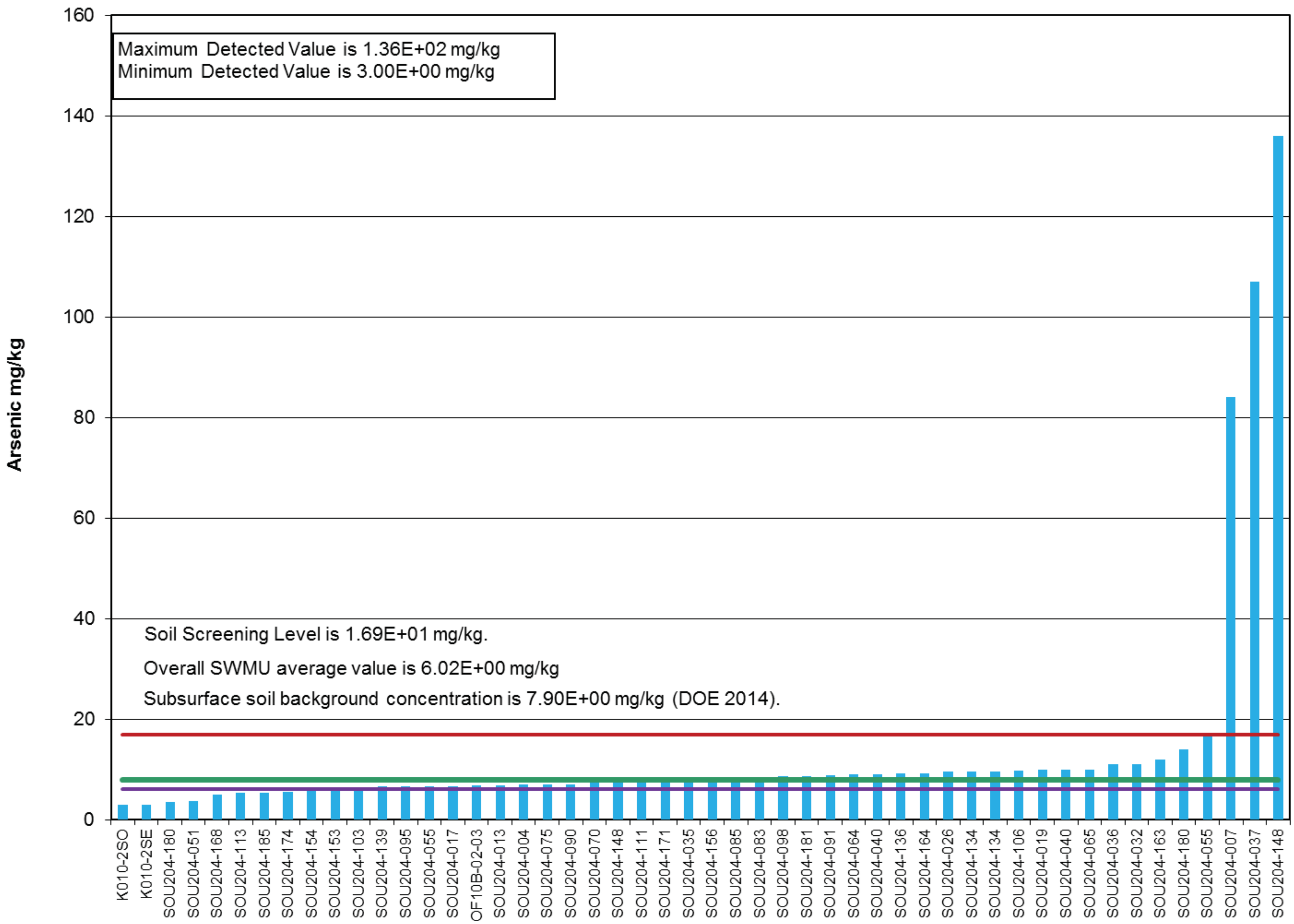

Figure C2.6.1. Arsenic Detections at AOC 204

Cobalt was detected in 49 of 50 samples. The detections are shown in Figure C2.6.2. The average concentration over AOC 204 for cobalt is greater than the RG SSL, but less than the background concentration; therefore, cobalt does not meet the screening criteria for fate and transport modeling for AOC 204.

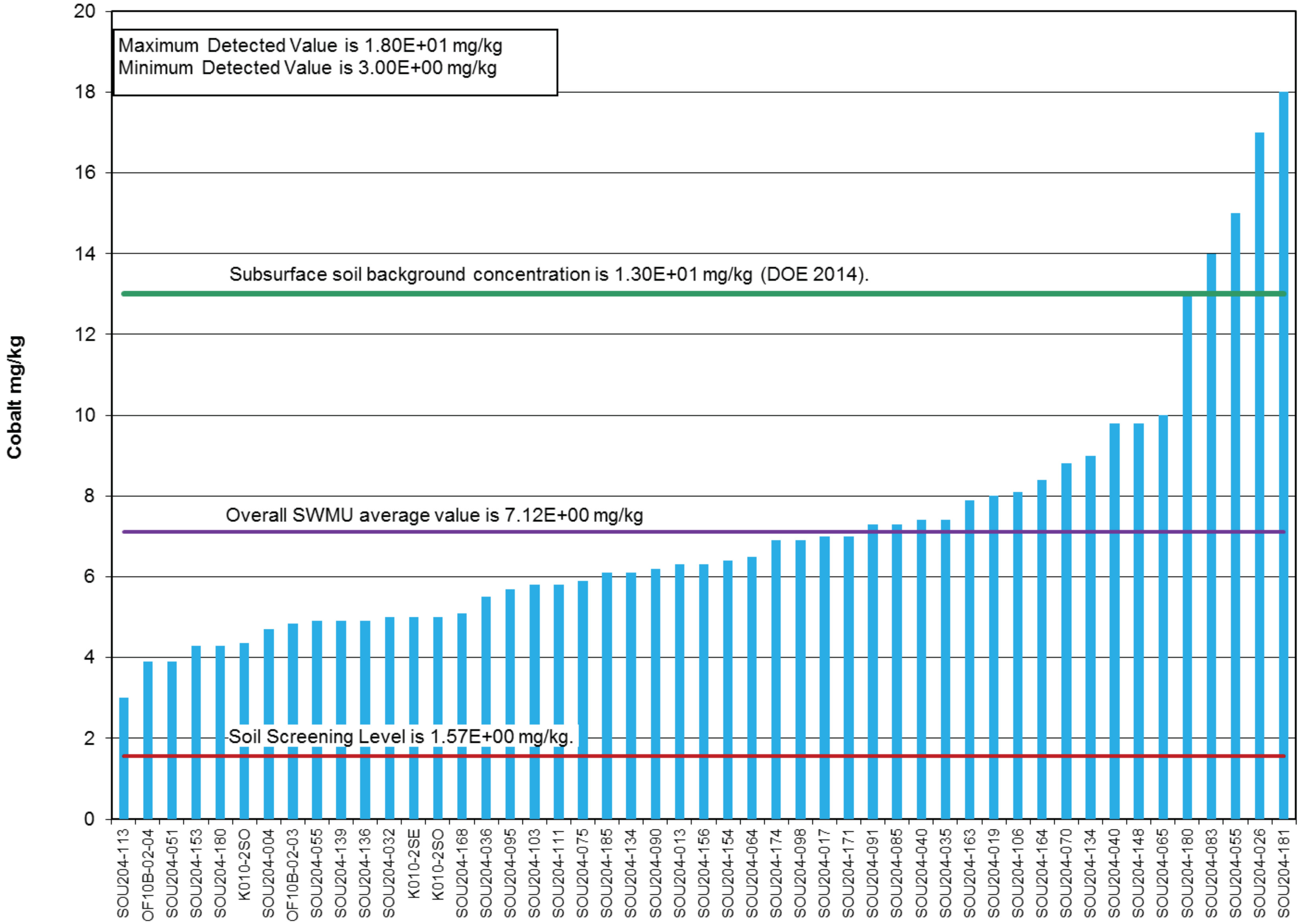

Figure C2.6.2. Cobalt Detections at AOC 204

Iron was detected in all 432 samples. The detections are shown in Figure C2.6.3. The average concentration over AOC 204 for iron is greater than the RG SSL, but less than the background concentration; therefore, iron does not meet the screening criteria for fate and transport modeling for AOC 204.

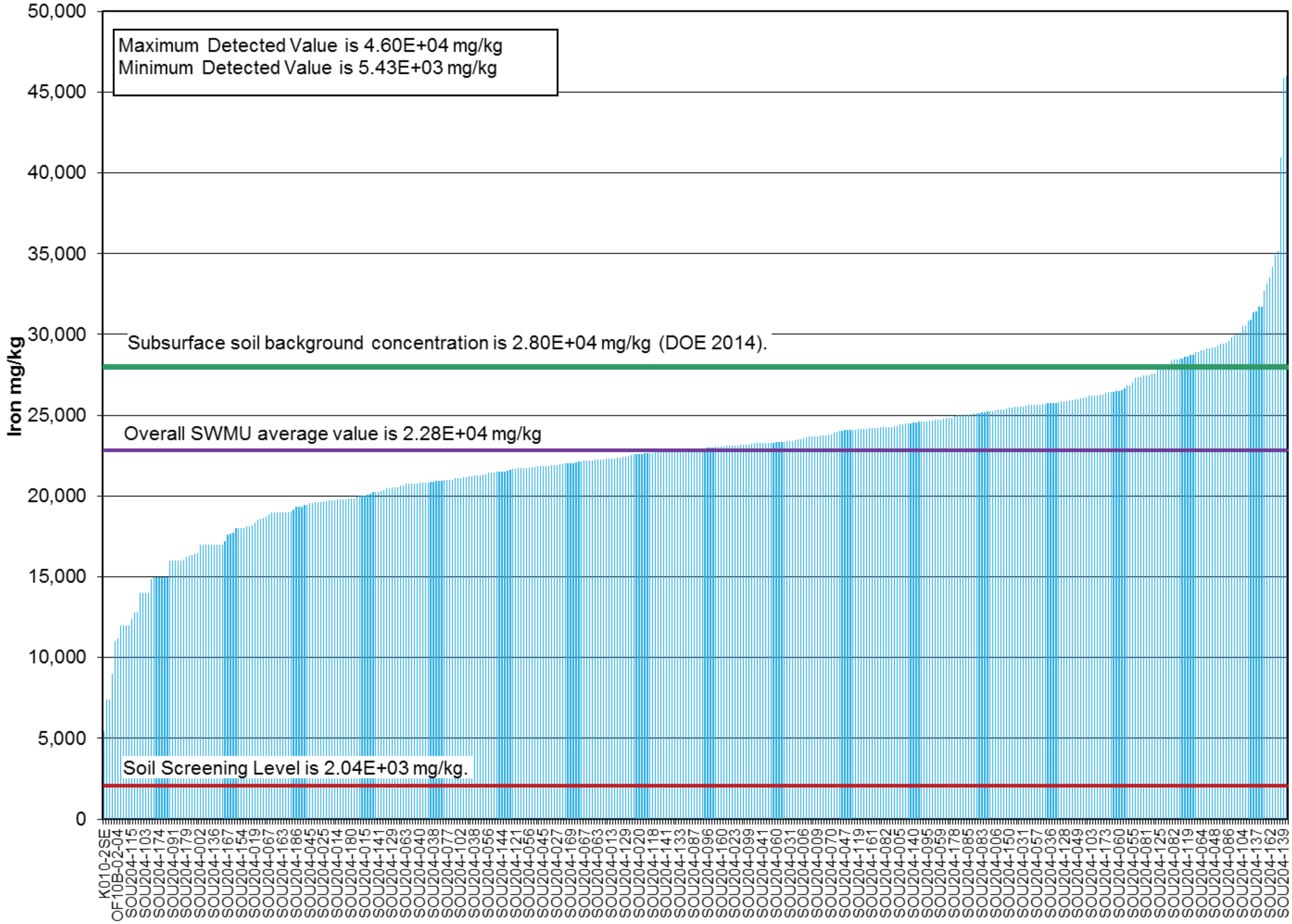

Figure C2.6.3. Iron Detections at AOC 204

Manganese was detected in all 432 samples. The detections are shown in Figure C2.6.4. The average concentration over AOC 204 for manganese is greater than the RG SSL, but less than the background concentration; therefore, manganese does not meet the screening criteria for fate and transport modeling for AOC 204.

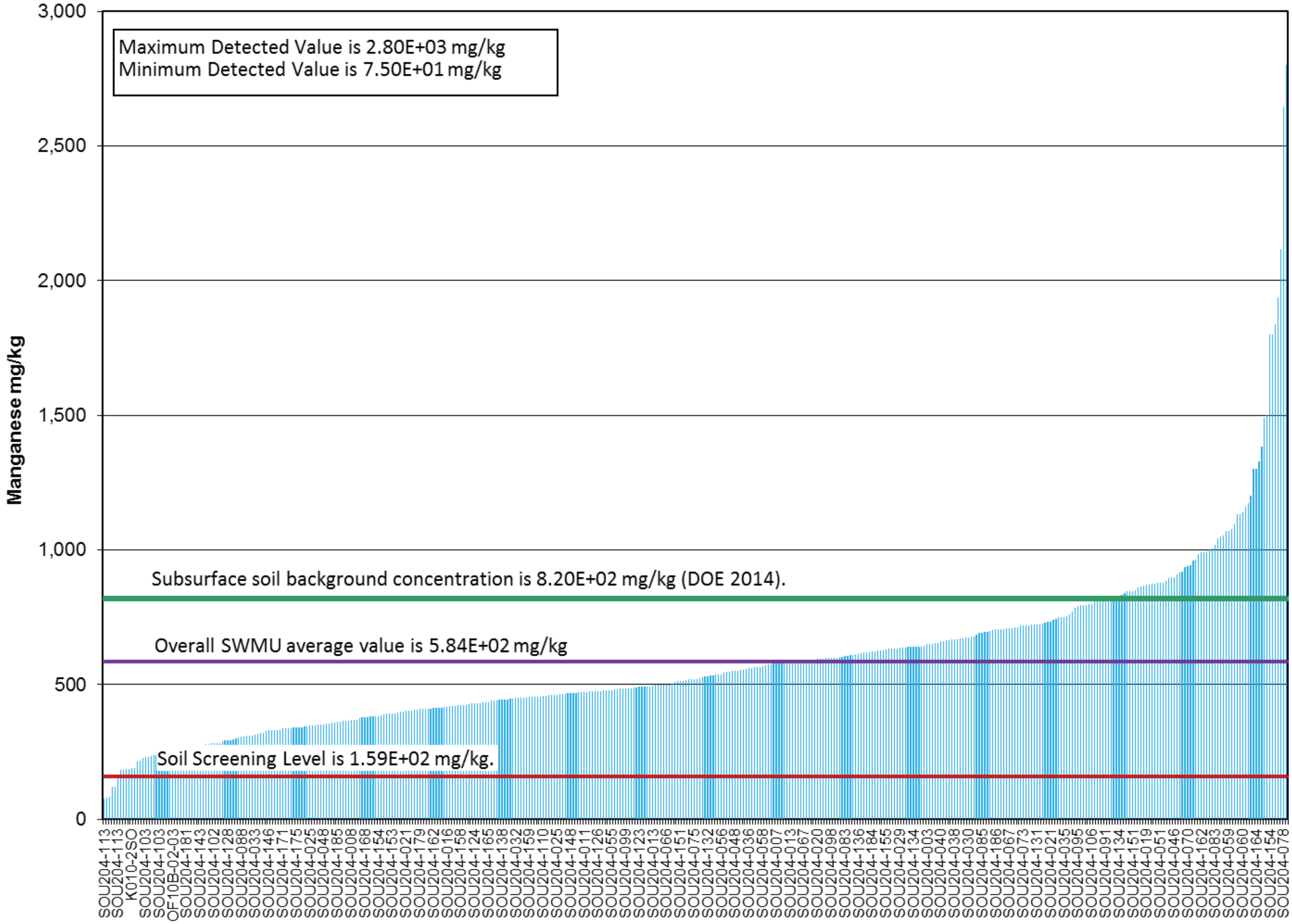

Figure C2.6.4. Manganese Detections at AOC 204

Molybdenum was detected in 75 of the 432 samples. The detections are shown in Figure C2.6.5. The average concentration over AOC 204 for molybdenum is less than the RG SSL; therefore, molybdenum does not meet the screening criteria for fate and transport modeling for AOC 204.

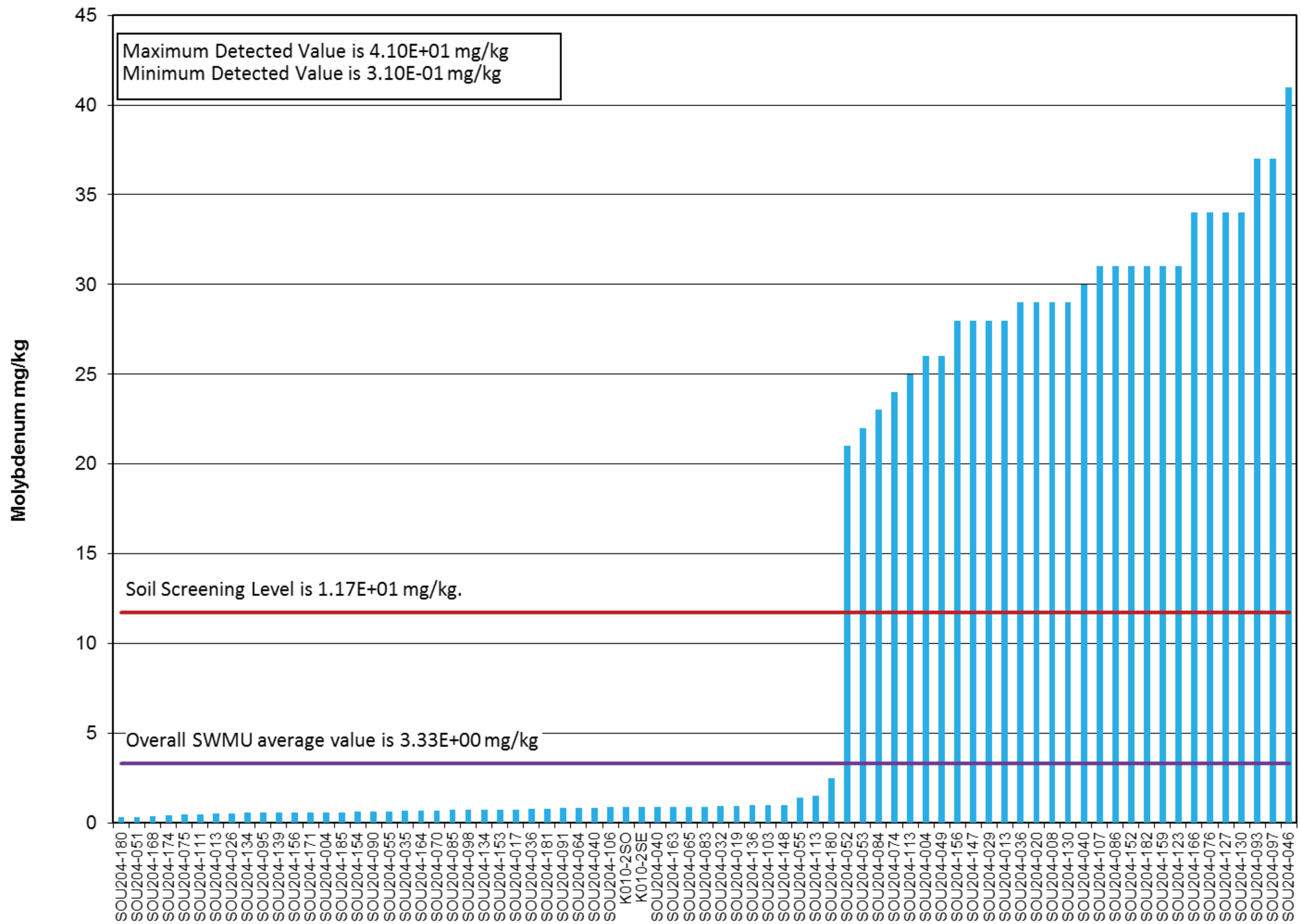

Figure C2.6.5. Molybdenum Detections at AOC 204

Total PCBs was detected in 4 of the 486 samples. The detections are shown in Figure C2.6.6. The average concentration over AOC 204 for Total PCBs is lower than the RG SSL; therefore, Total PCBs does not meet the screening criteria for groundwater fate and transport modeling for AOC 204.

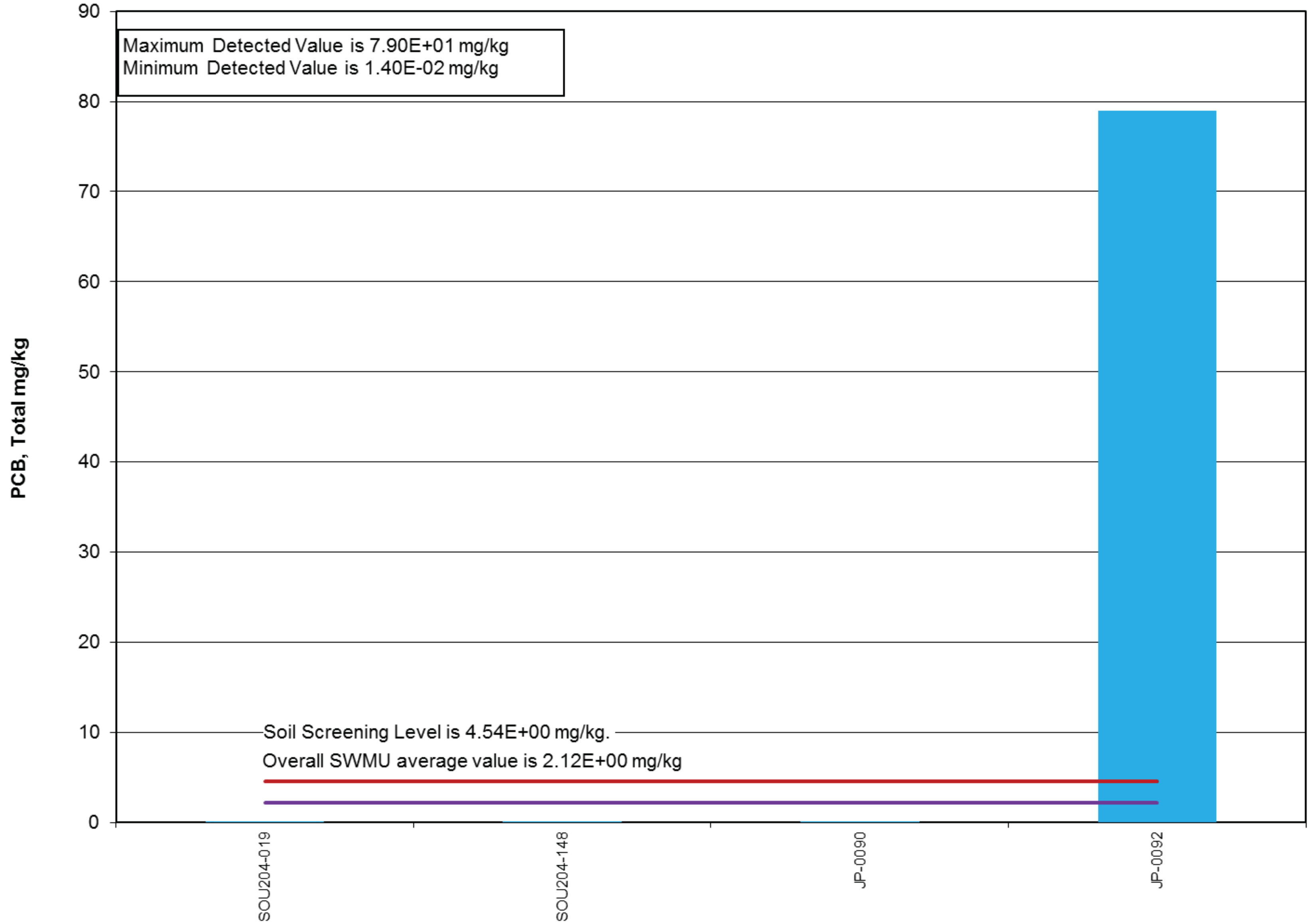

Figure C2.6.6. Total PCBs Detections at AOC 204

Silver was detected in 53 of the 432 samples. The detections are shown in Figure C2.6.7. The average concentration over AOC 204 for silver is greater than both the background concentration and the RG SSL. Silver was evaluated as part of the GWOU FS and identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). The evaluation presented in Attachment C1 to Appendix C of the Soils OU RI Report (DOE 2013) did not identify any silver impacts RGA to groundwater; therefore, silver does not meet the screening criteria for groundwater fate and transport modeling for AOC 204.

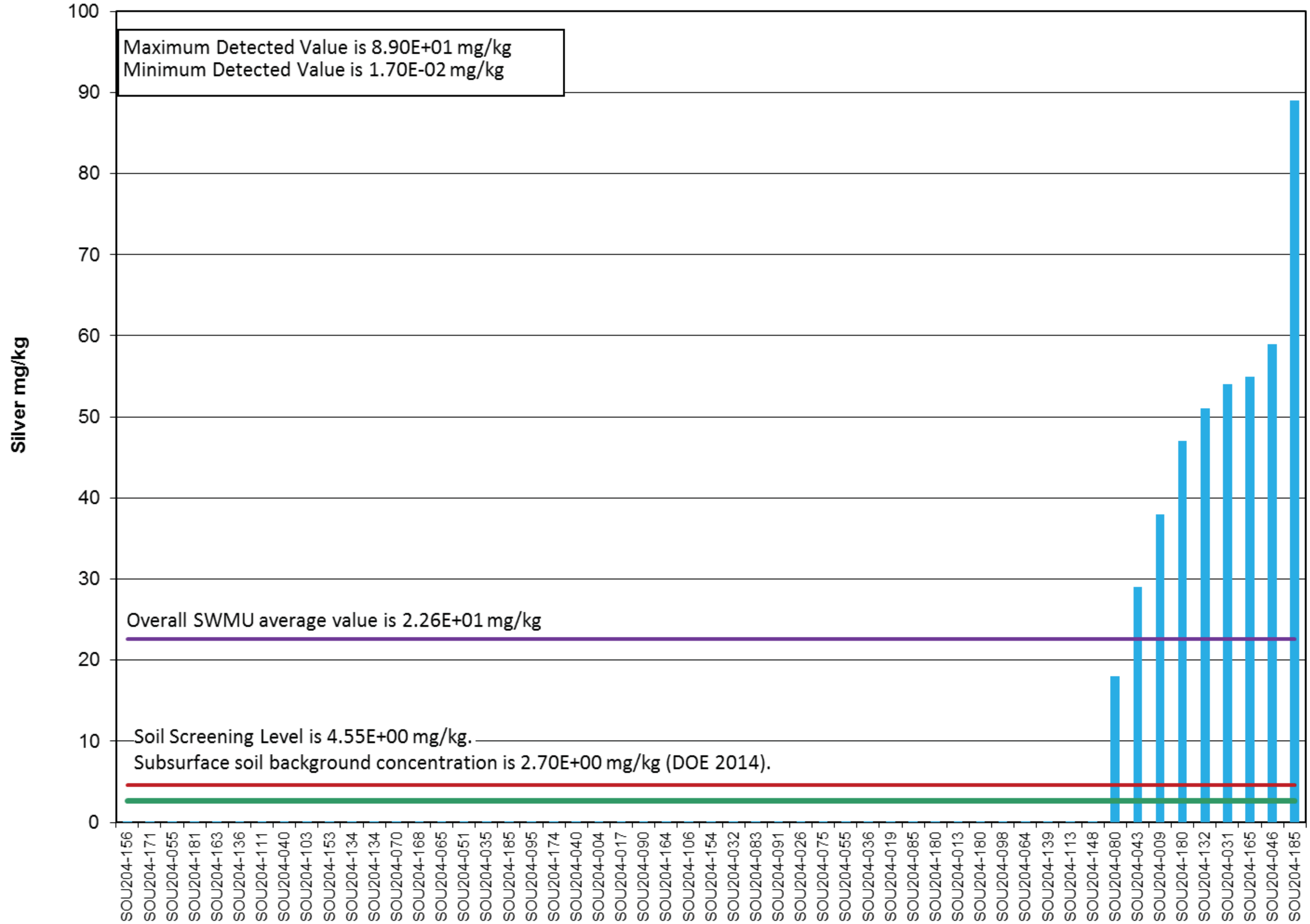

Figure C2.6.7. Silver Detections at AOC 204

Tc-99 was detected in 8 of the 58 samples. The detections are shown in Figure C2.6.8. The average activity concentration over AOC 204 for Tc-99 is greater than the RG SSL, but less than the background activity concentration; therefore, Tc-99 does not meet all the screening criteria for fate and transport modeling for AOC 204.

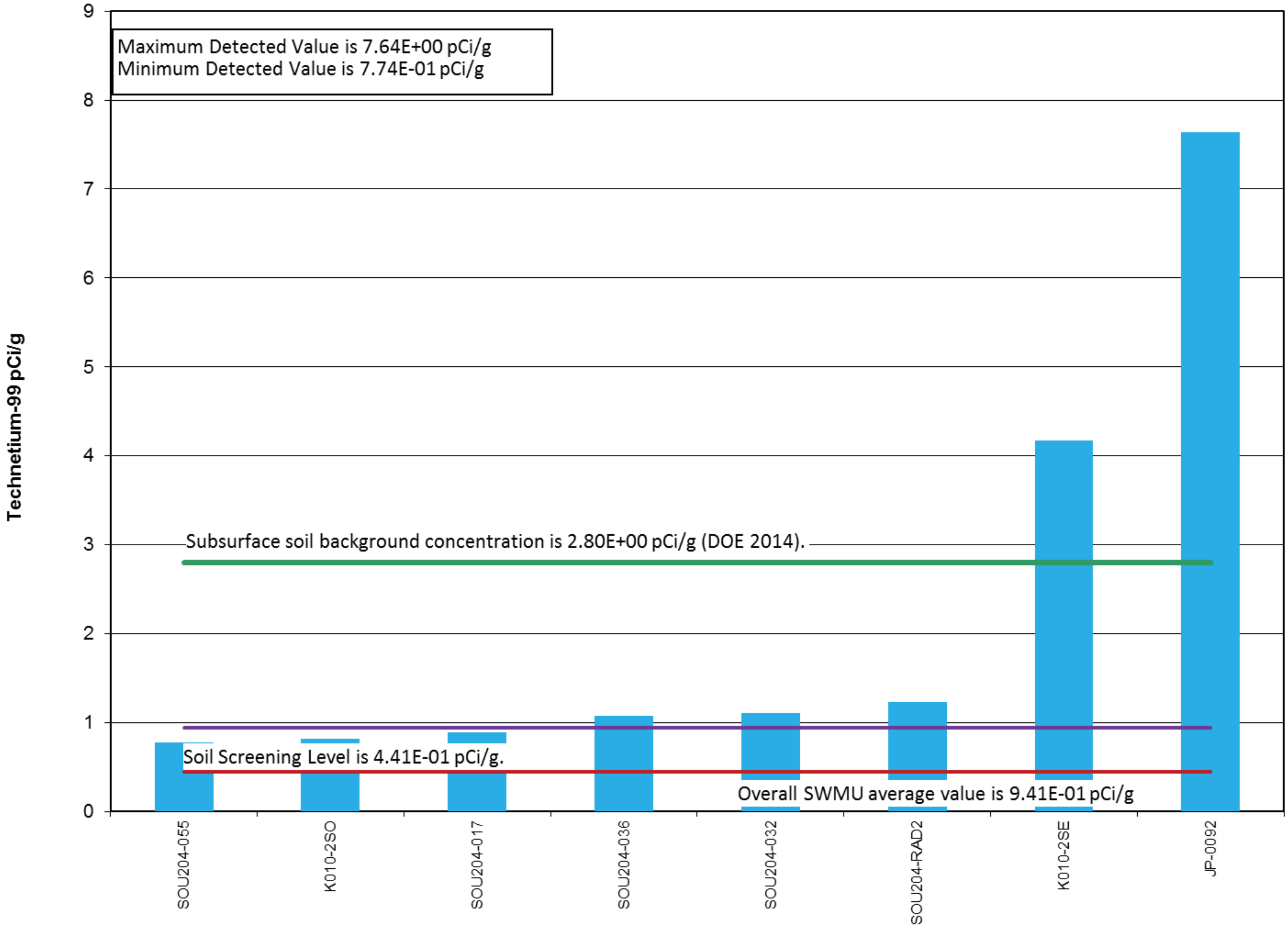

Figure C2.6.8. Tc-99 Detections at AOC 204

Uranium was detected in 53 of the 433 samples. The detections are shown in Figure C2.6.9. The average concentration over AOC 204 for uranium is greater than the background concentration, but less than the RG SSL; therefore, uranium does not meet the screening criteria for groundwater fate and transport modeling for AOC 204.

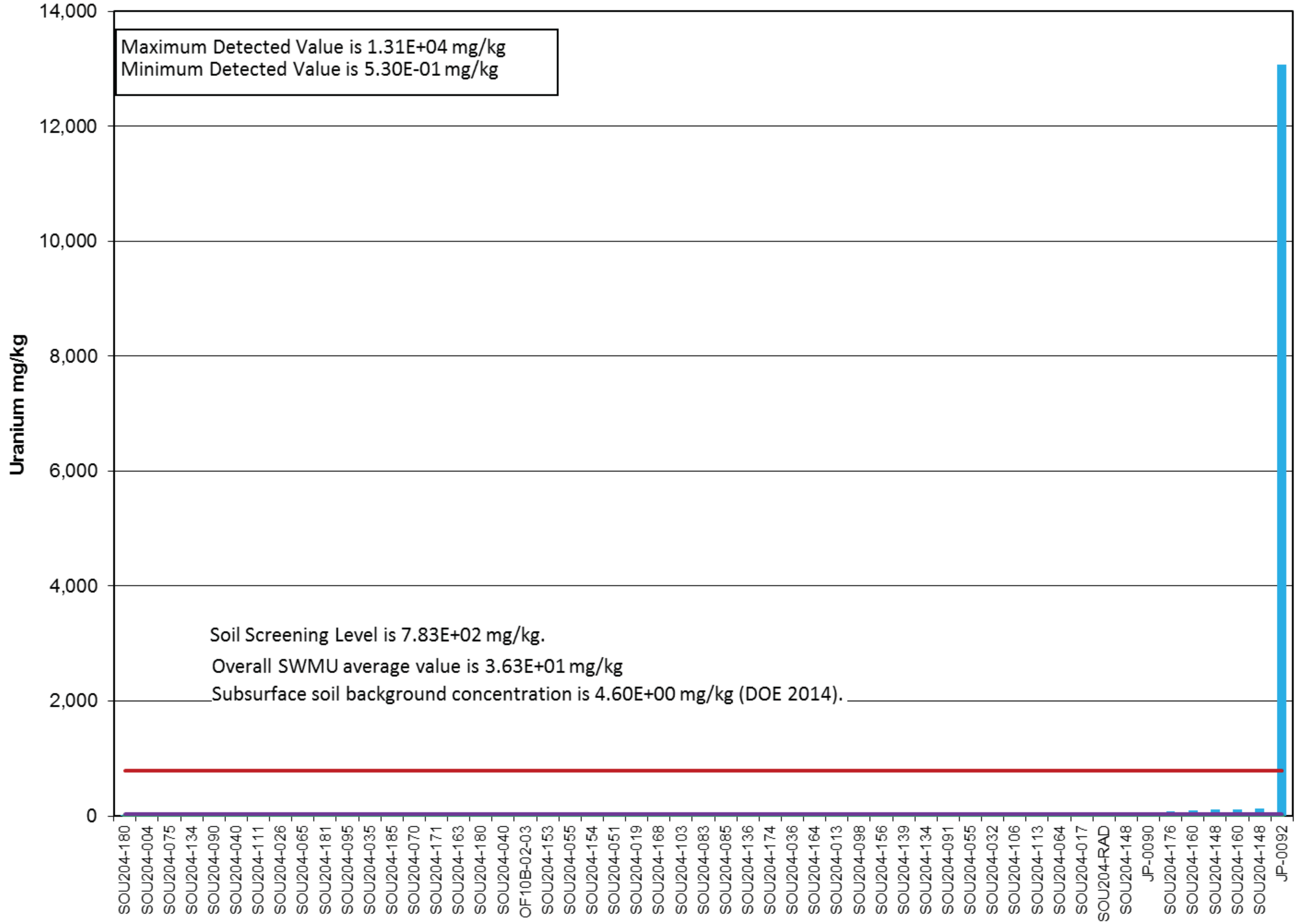

Figure C2.6.9. Uranium Detections at AOC 204

Uranium-234 was detected in 53 of the 54 samples. The detections are shown in Figure C2.6.10. The average activity concentration at AOC 204 for uranium-234 is greater than both the background activity concentration and the RG SSL. Uranium-234 was evaluated as part of the GWOU FS and identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). Only two samples exceed both the background and the RG SSL; therefore, uranium-234 does not meet the requirement for fate and transport modeling for AOC 204.

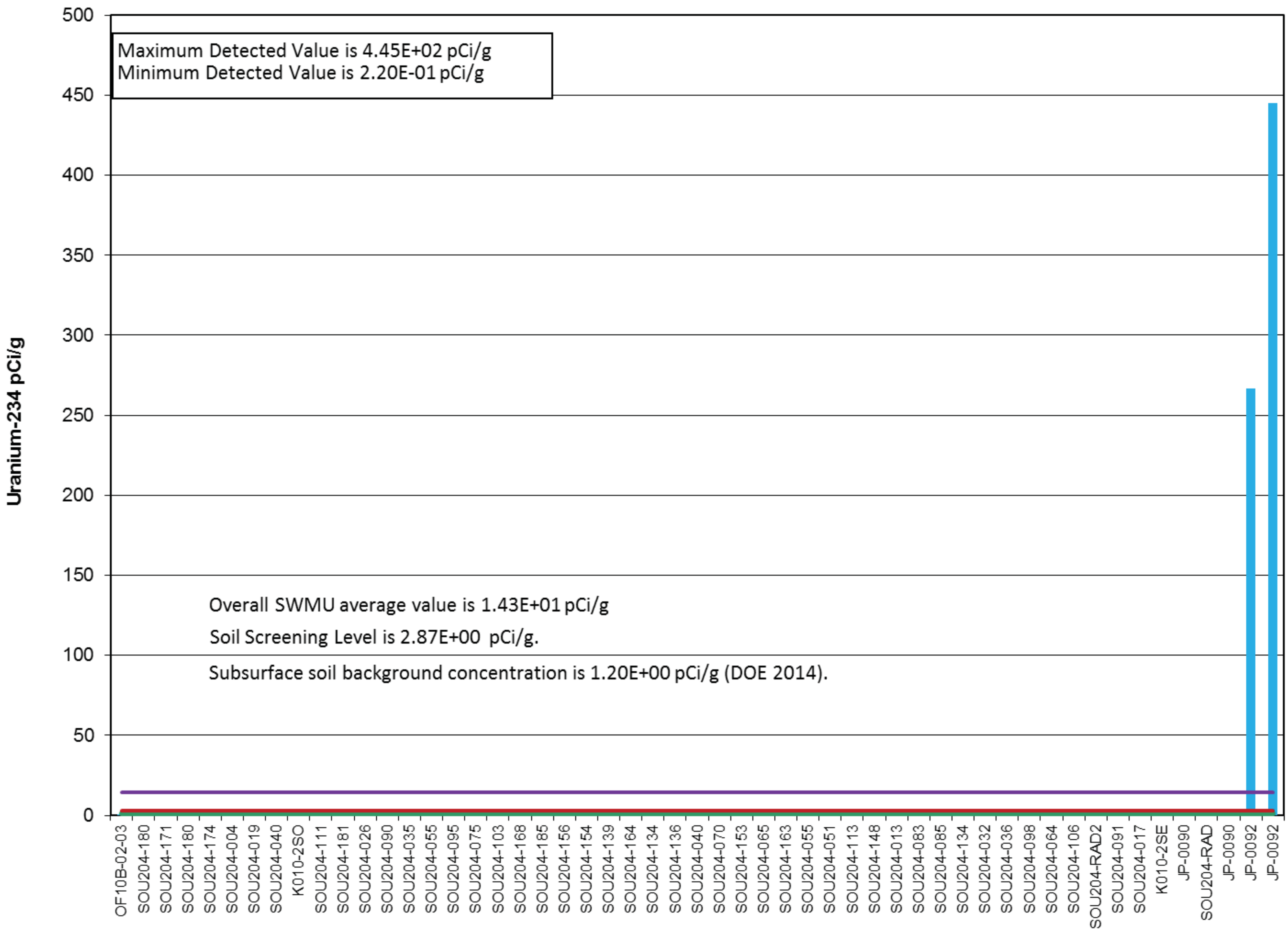

Figure C2.6.10. Uranium-234 Detections at AOC 204

Uranium-235 was detected in 42 of the 62 samples. The detections are shown in Figure C2.6.11. The average activity concentration over AOC 204 for uranium-235 is greater than the background activity concentration, but less than the RG SSL; therefore, uranium-235 does not meet the screening criteria for fate and transport modeling for AOC 204.

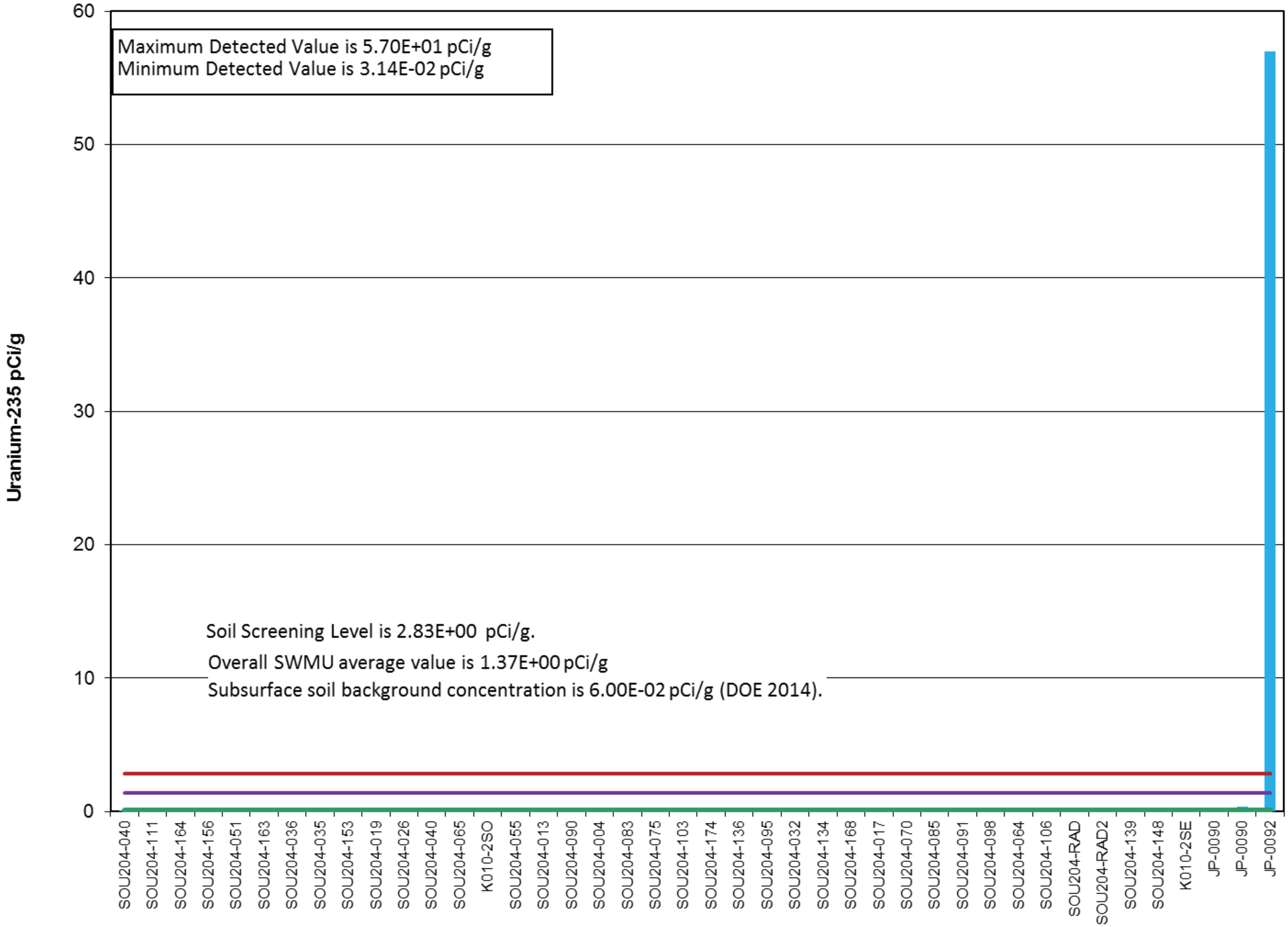

Figure C2.6.11. Uranium-235 Detections at AOC 204

Uranium-238 was detected in 54 of the 54 samples. The detections are shown in Figure C2.6.12. The average activity concentration over AOC 204 for uranium-238 is greater than both the background activity concentration and the RG SSL. Uranium-238 was evaluated as part of the GWOU FS and identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). The evaluation presented in Attachment C1 to Appendix C of the Soils OU RI Report (DOE 2013) did not identify any uranium-238 impacts to RGA groundwater; therefore, uranium-238 does not meet the screening criteria for fate and transport modeling for AOC 204.

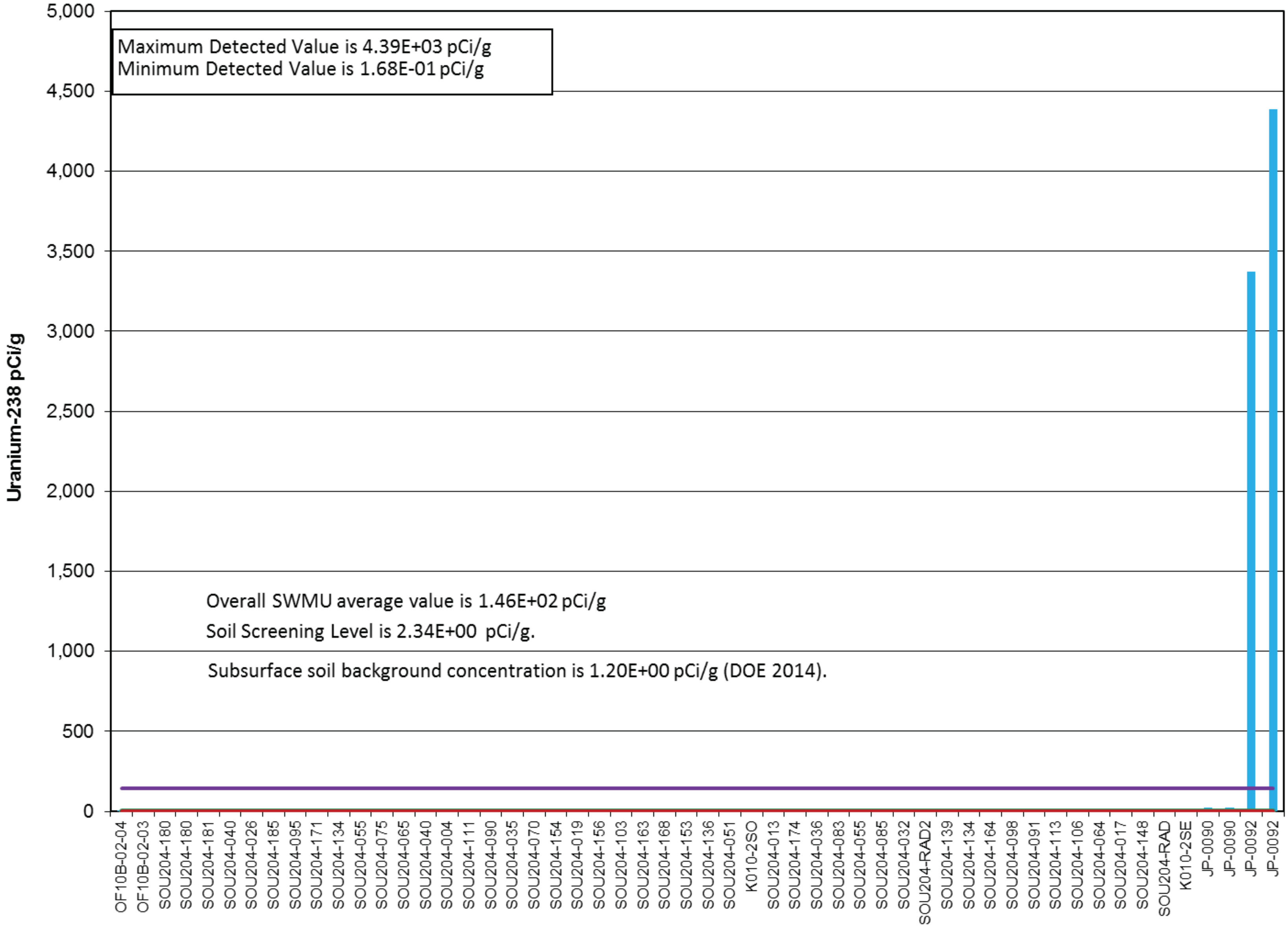

Figure C2.6.12. Uranium-238 Detections at AOC 204

C.2.7 SWMU 211-A, C-720 TCE SPILL SITE NORTHEAST

Data for SWMU 211-A consists of both historical data and RI-collected data. SWMU 211-A exceedances of the RG SSL include the following soil constituents: antimony, cobalt, iron, manganese, neptunium-237, Total PCBs, silver, Tc-99, uranium-234, uranium-235, and uranium-238. The average concentration of soil constituents at SWMU 211-A (see Attachment C1) included the following locations due to their proximity to the SWMU, but they were not included in the charts or nature and extent summaries because they fall outside of an RI 2 grid: 211-A-004, 211-A-005, 211-A-006, 211-A-013, 211-A-029, 211-A-030, 211-A-033, 211-A-044, 23-3208, 23-3209, 23-3209-1, 23-3209-2, 23-3209-3, 23-3218, 23-3219, 23-3220, H049, SOU211-001G, SOU211-001H, SOU211-001I, SOU211-001J, SOU211-001L, and SOU211-001M.

Antimony was detected in 16 of 34 samples. The detections are shown in Figure C2.7.1. The average concentration over SWMU 211-A for antimony is greater than both the background and the RG SSL. Antimony is a groundwater COC, but groundwater information included in the Soils OU RI Report (DOE 2013) suggests there are no antimony impacts; therefore, antimony does not meet the screening criteria for fate and transport modeling for SWMU 211-A.

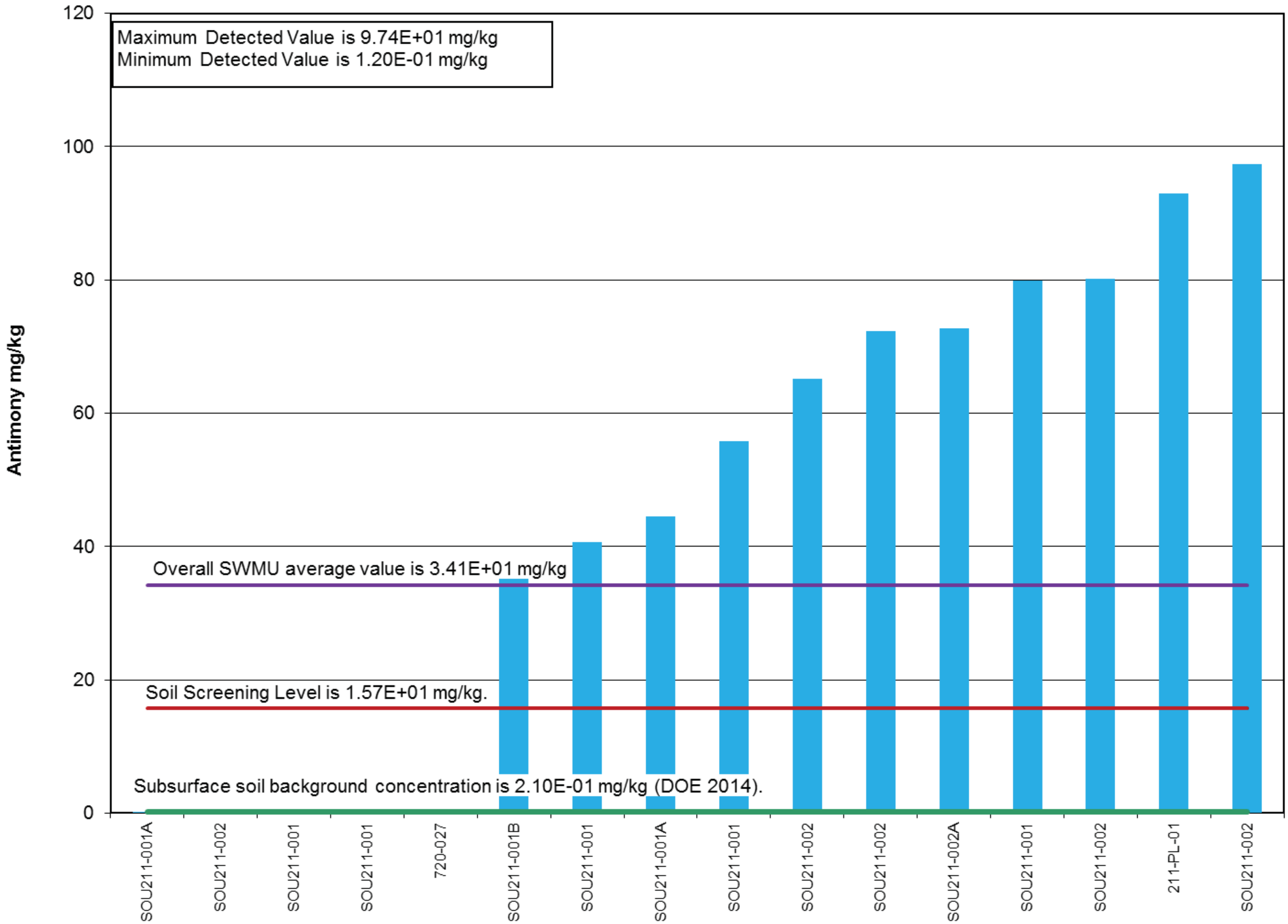

Figure C2.7.1. Antimony Detections at SWMU 211-A

Cobalt was detected in 8 of 11 samples. The detections are shown in Figure C2.7.2. The average concentration over SWMU 211-A for cobalt is greater than the RG SSL, but less than the background concentration; therefore, cobalt does not meet the screening criteria for fate and transport modeling for SWMU 211-A.

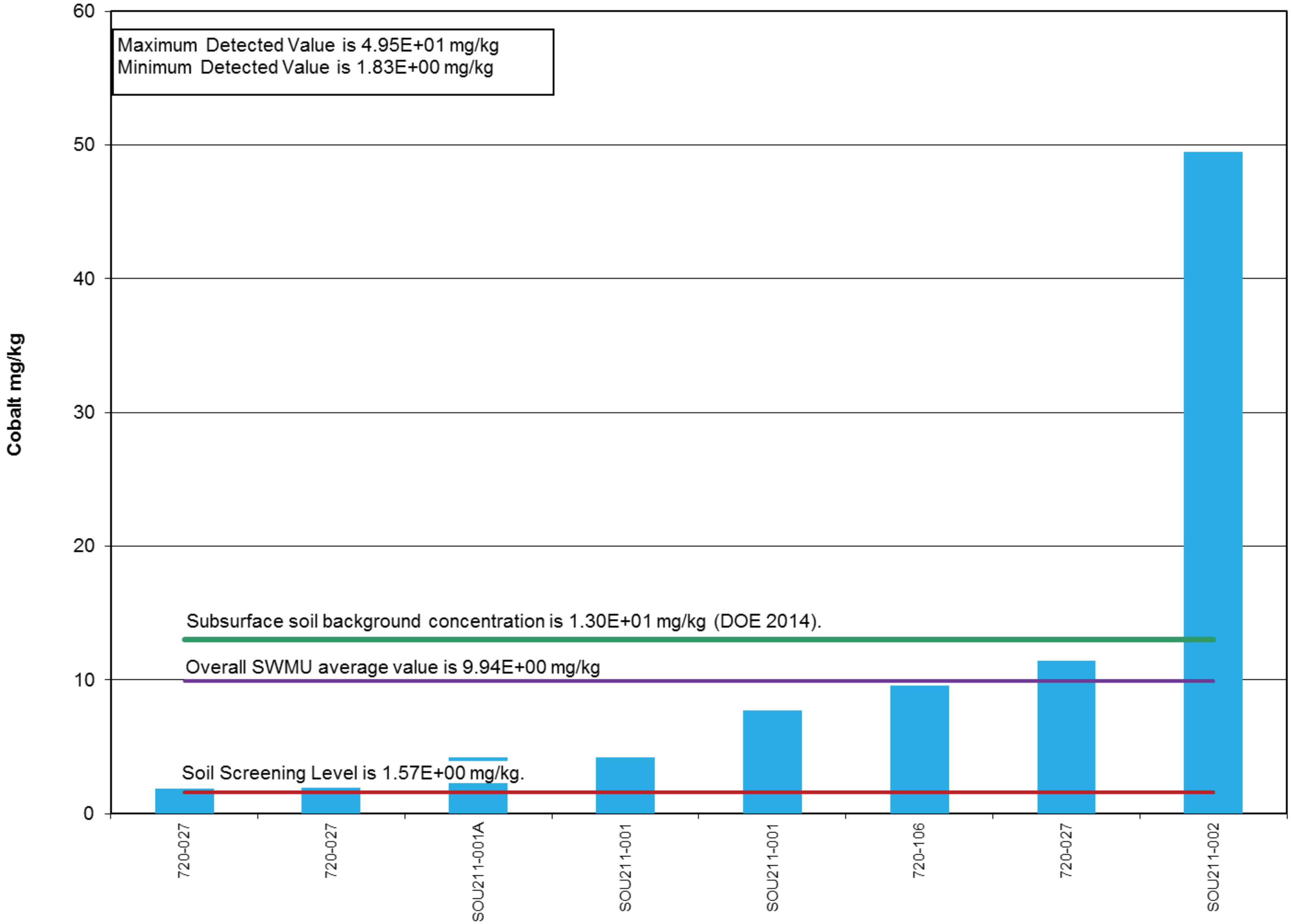

Figure C2.7.2. Cobalt Detections at SWMU 211-A

Iron was detected in 34 of 60 samples. The detections are shown in Figure C2.7.3. The average concentration over SWMU 211-A for iron is greater than the RG SSL, but less than the background concentration; therefore, iron does not meet the screening criteria for fate and transport modeling for SWMU 211-A.

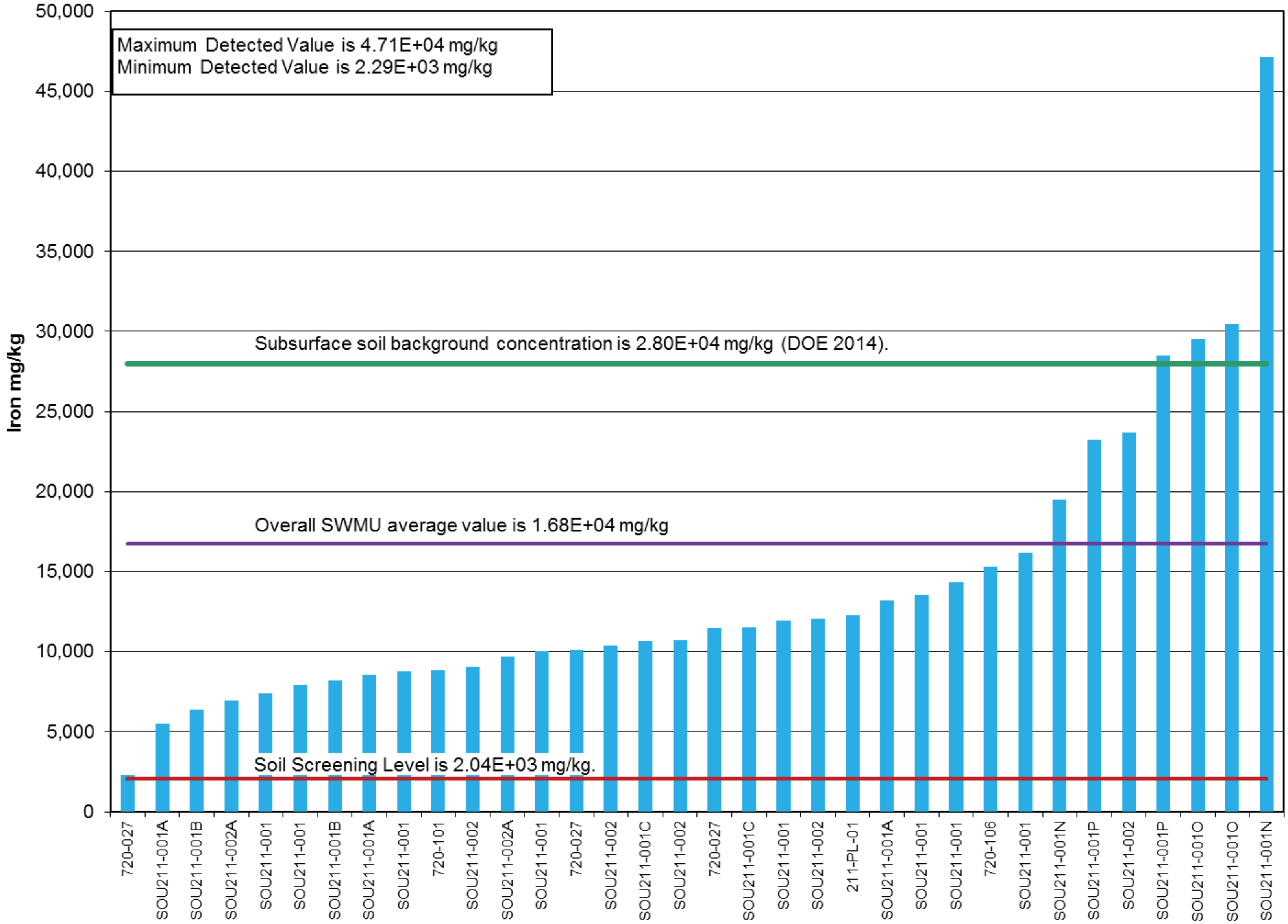

Figure C2.7.3. Iron Detections at SWMU 211-A

Manganese was detected in 33 of 60 samples. The detections are shown in Figure C2.7.4. The average concentration over SWMU 211-A for manganese is greater than the RG SSL, but less than the background concentration; therefore, manganese does not meet the screening criteria for fate and transport modeling for SWMU 211-A.

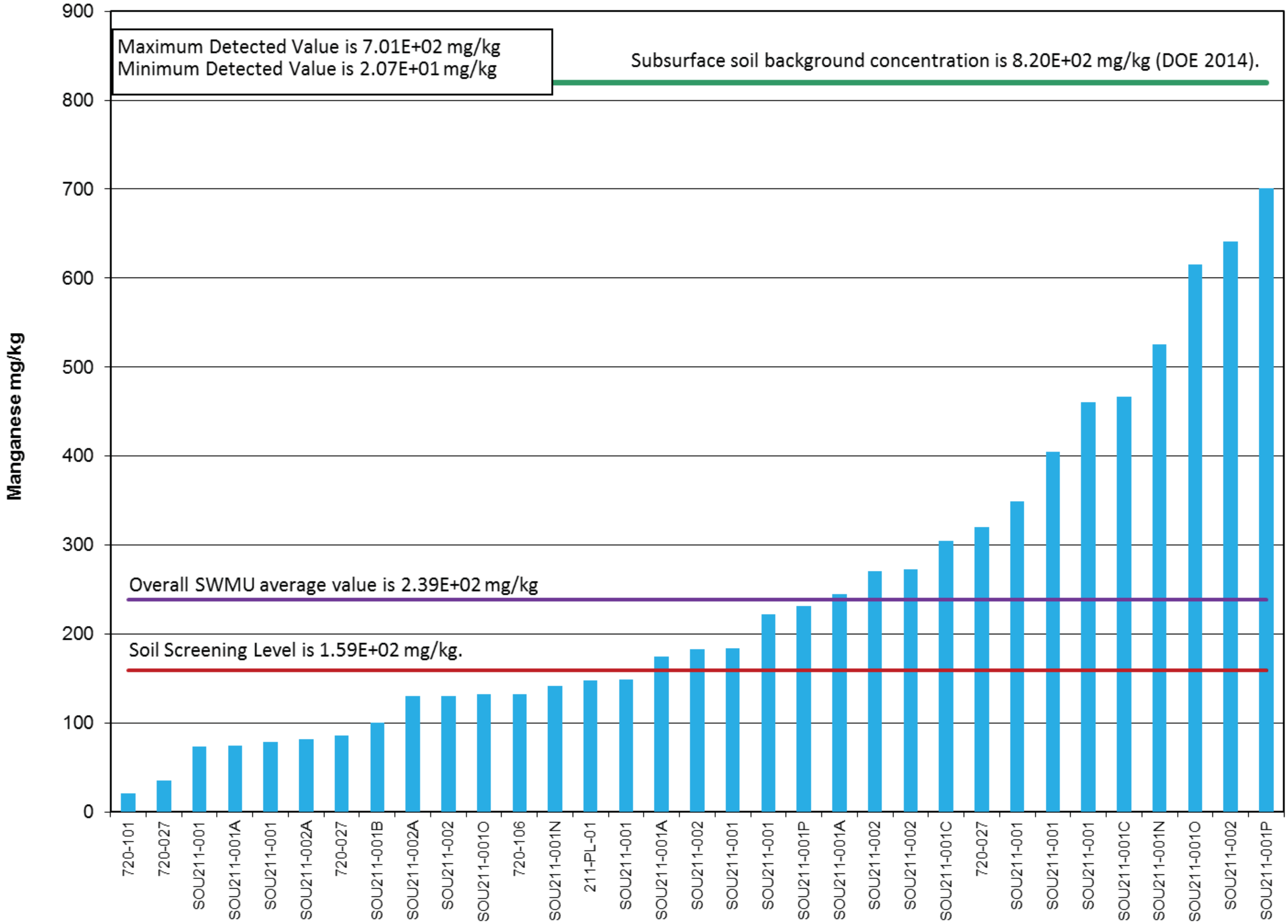

Figure C2.7.4. Manganese Detections at SWMU 211-A

Neptunium-237 was detected in 4 of the 10 samples. The detections are shown in Figure C2.7.5. The average activity concentration over SWMU 211-A for neptunium-237 is less than RG SSL; therefore, neptunium-237 does not meet the screening criteria for fate and transport modeling at SWMU 211-A.

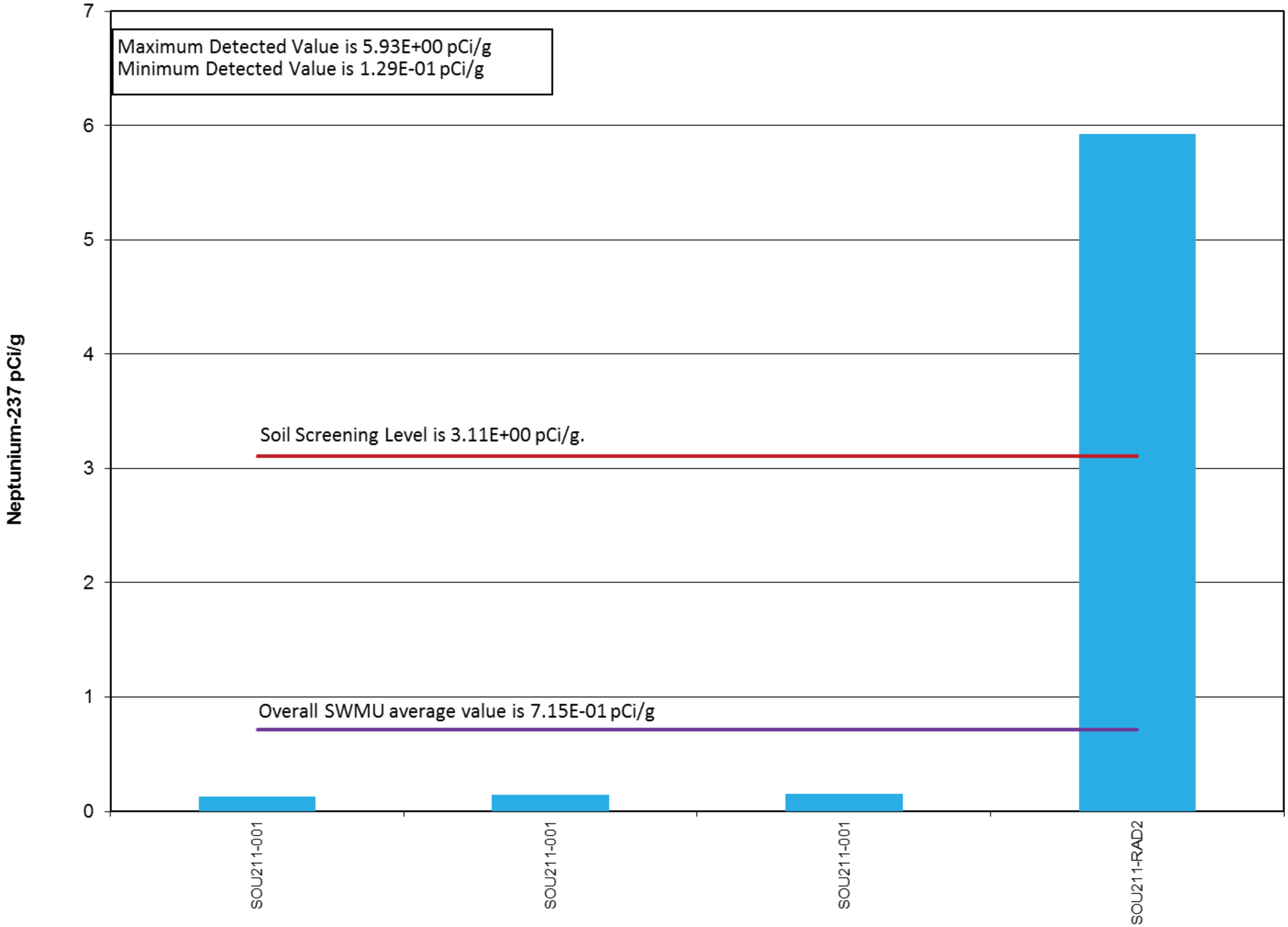

Figure C2.7.5. Neptunium-237 Detections at SWMU 211-A

Total PCBs was detected in 8 of the 75 samples. The detections are shown in Figure C2.7.6. The average concentration over SWMU 211-A for Total PCBs is greater than the RG SSL. Total PCBs was evaluated as part of the GWOU FS and identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). The evaluation presented in Attachment C1 to Appendix C of the Soils OU RI Report (DOE 2013) did not identify any Total PCBs impacts to RGA groundwater; therefore, Total PCBs does not meet the screening criteria for groundwater fate and transport modeling for SWMU 211-A.

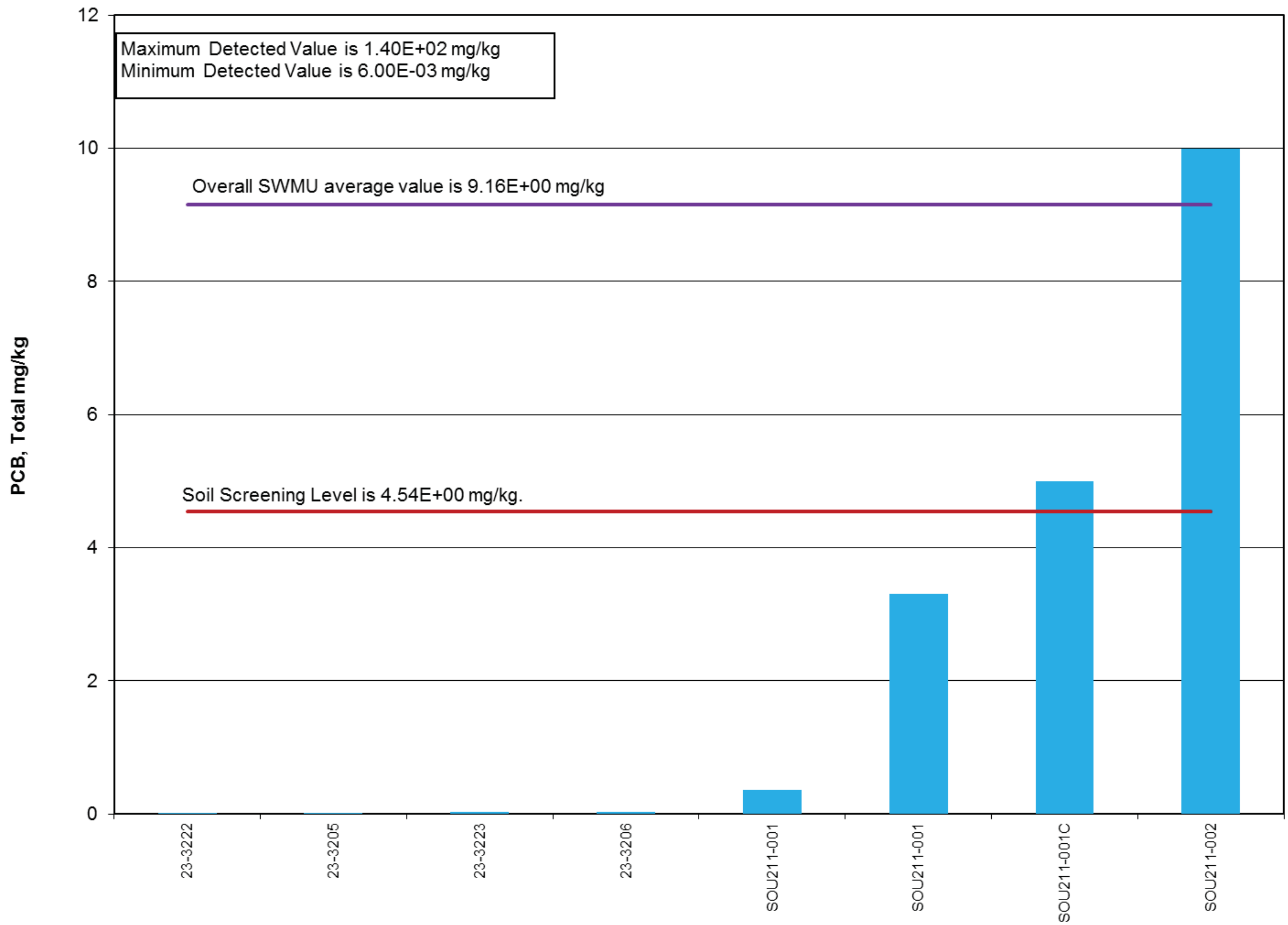

Figure C2.7.6. Total PCBs Detections at SWMU 211-A

Silver was detected in 5 of the 60 samples. The detections are shown in Figure C2.7.7. The average concentration over SWMU 211-A for silver is greater than both the background concentration and the RG SSL. Silver was evaluated as part of the GWOU FS and identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). The evaluation presented in Attachment C1 to Appendix C of the Soils OU RI Report (DOE 2013) did not identify any silver impacts to RGA groundwater; therefore, silver does not meet the screening criteria for groundwater fate and transport modeling for SWMU 211-A.

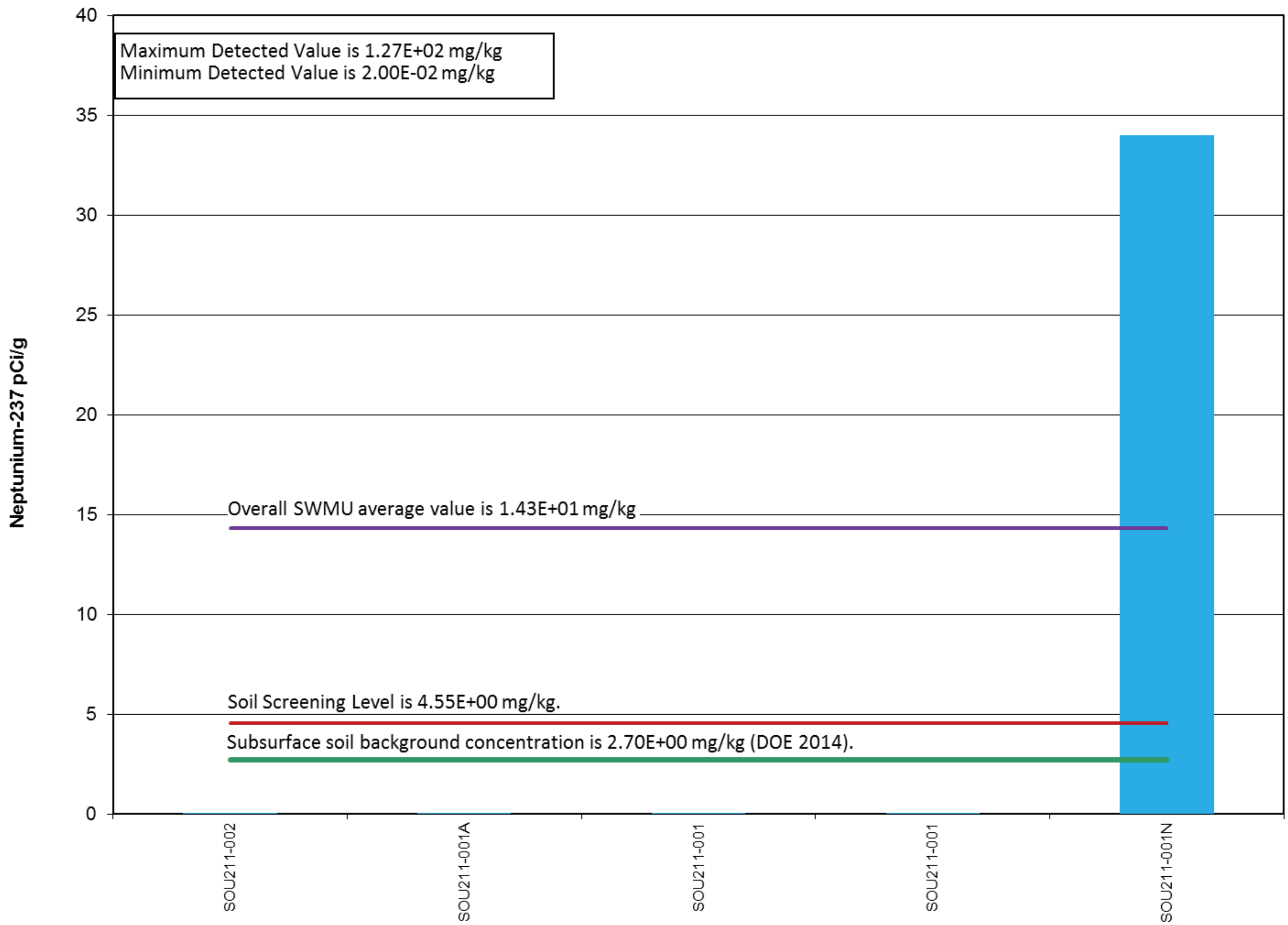

Figure C2.7.7. Silver Detections at SWMU 211-A

Tc-99 was detected in 4 of the 7 samples. The detections are shown in Figure C2.7.8. The average activity concentration over SWMU 211-A for Tc-99 is greater than both the RG SSL and the background activity concentration. Tc-99 was evaluated as part of the GWOU FS and identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). Because of the presence of Tc-99 in RGA groundwater and the close proximity of SWMU 13 to the Tc-99 plume, SWMU 211-A may be a secondary source of Tc-99. Only two samples exceed the RG SSL and the background concentration; therefore, Tc-99 does not meet the screening criteria for fate and transport modeling for SWMU 211-A.

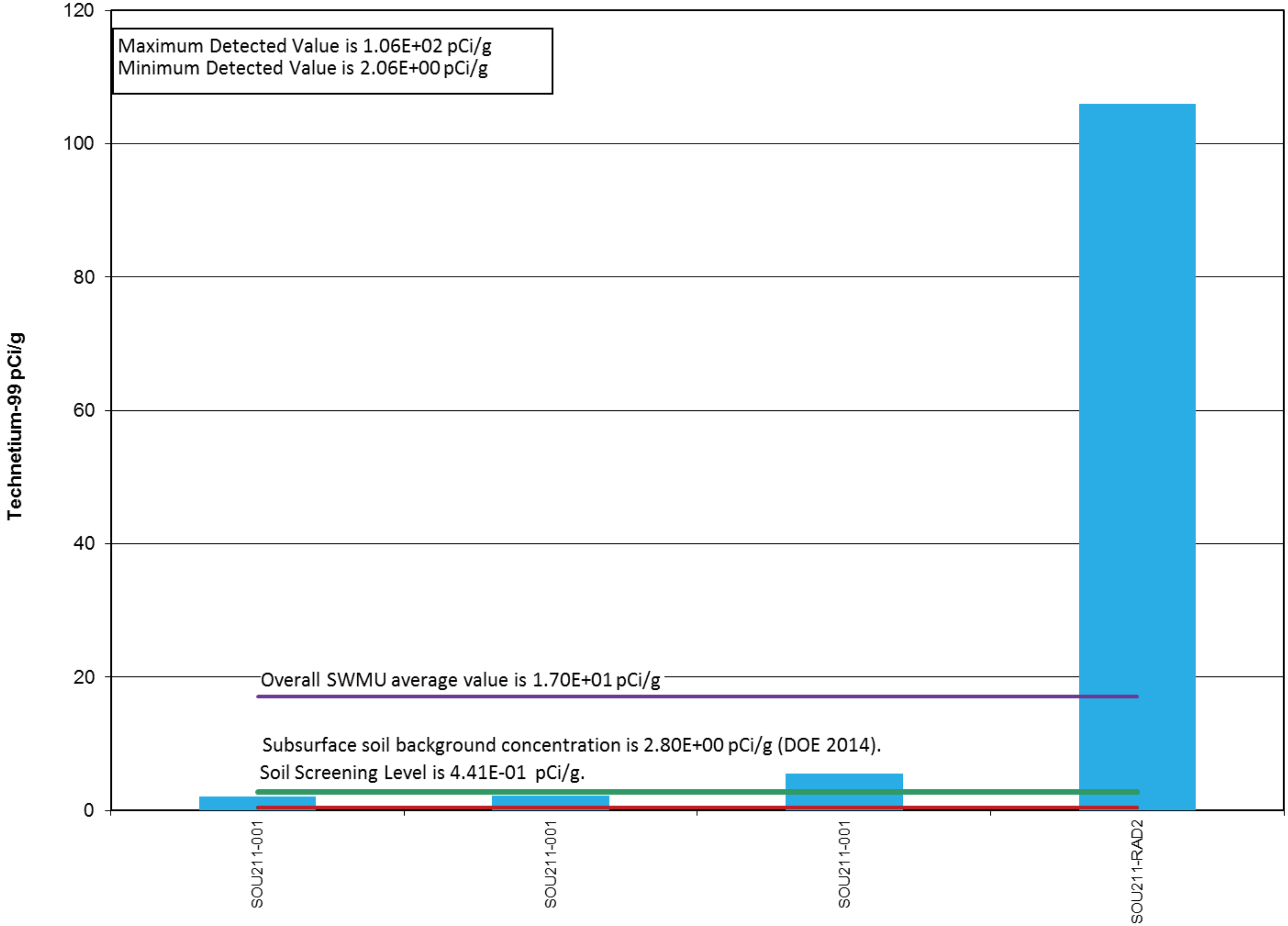

Figure C2.7.8. Tc-99 Detections at SWMU 211-A

Uranium-234 was detected in 4 of the 10 samples. The detections are shown in Figure C2.7.9. The average activity concentration over SWMU 211-A for uranium-234 is greater than both the background activity concentration and the RG SSL. Uranium-234 was evaluated as part of the GWOU FS and identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). Three samples exceed both the background activity concentration and the RG SSL; therefore, a hot spot evaluation was performed.

MVS was used to evaluate the distribution of uranium-234 across SWMU 211-A. Figure C2.7.10 shows the distribution of uranium-234 at 0–5 ft bgs, 5–10 ft bgs, and 10–15 ft bgs. Uranium-234 meets the requirement for fate and transport modeling for SWMU 211-A; however, hot spot analysis shows the distribution is not clustered and, therefore, not indicative of a source location. Additionally, uranium was modeled at SWMU 81 [presented in the Soils OU RI Report (DOE 2013)] with no uranium impacts to RGA groundwater predicted; therefore, uranium-234 fate and transport modeling was not performed for SWMU 211-A.

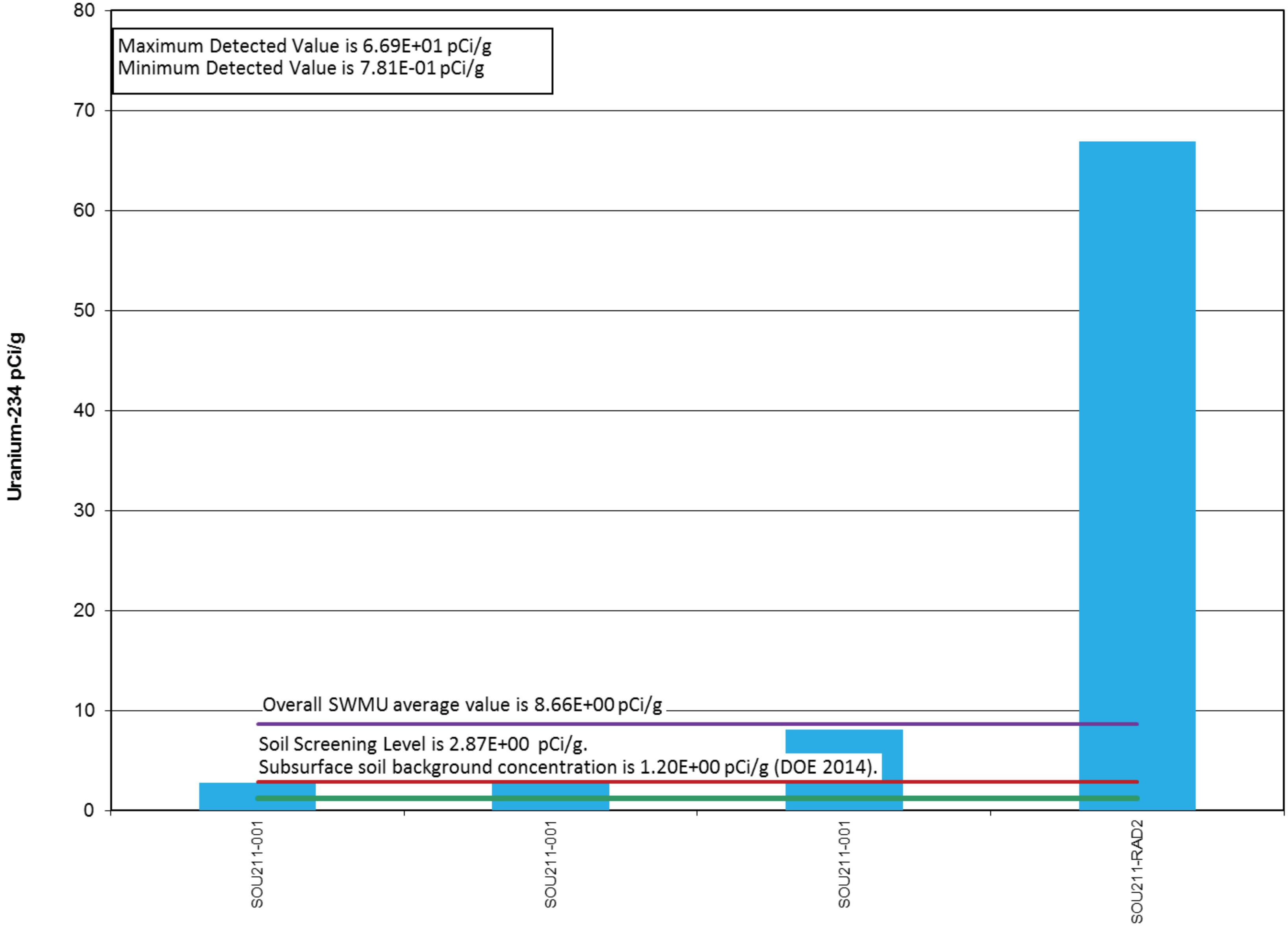

Figure C2.7.9. Uranium-234 Detections at SWMU 211-A

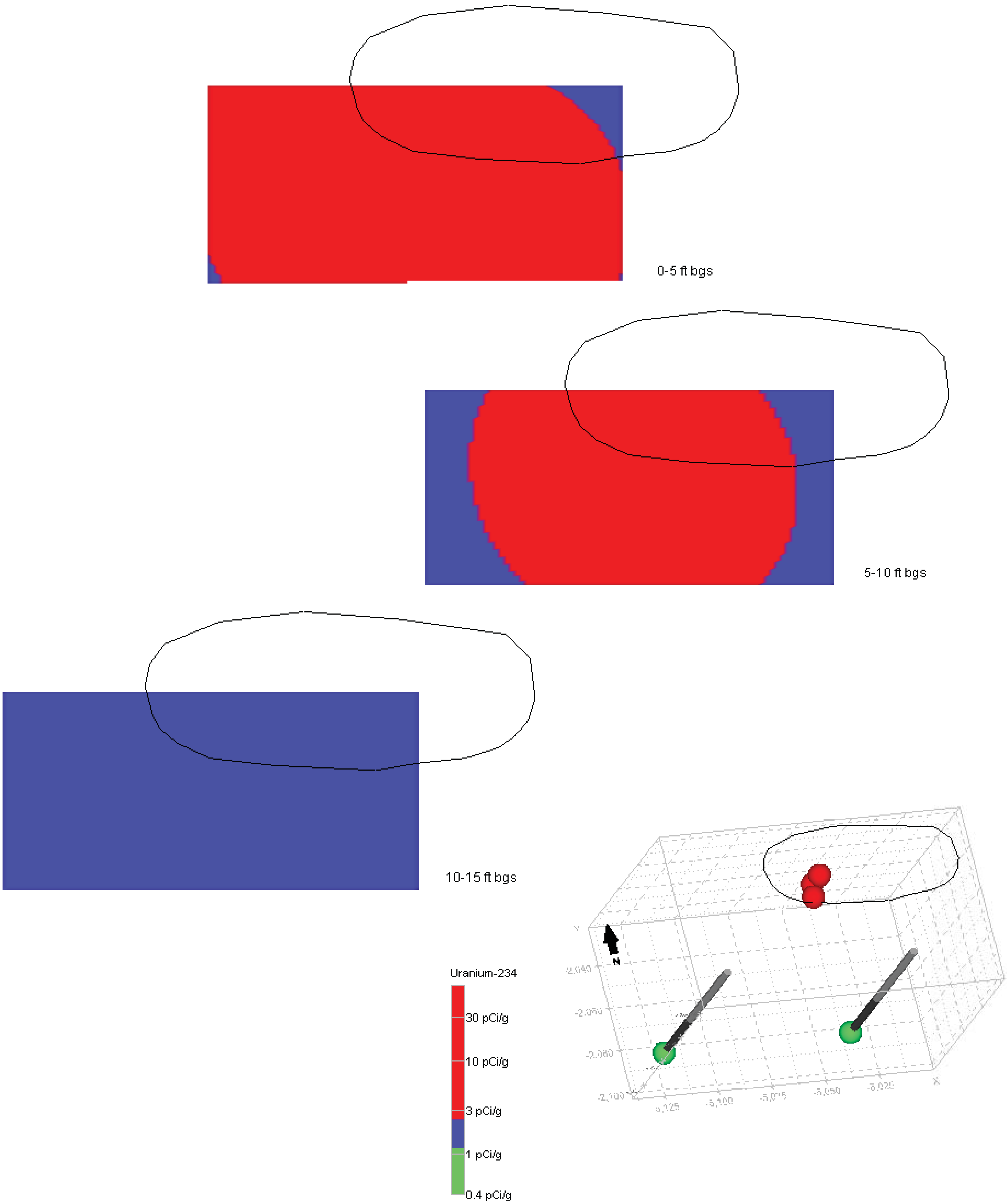

Figure C2.7.10. Uranium-234 Distribution at SWMU 211-A

Uranium-235 was detected in 4 of the 7 samples. The detections are shown in Figure C2.7.11. The average activity concentration over SWMU 211-A for uranium-235 is greater than the background activity concentration, but less than the RG SSL; therefore, uranium-235 does not meet the screening criteria for fate and transport modeling for SWMU 211-A.

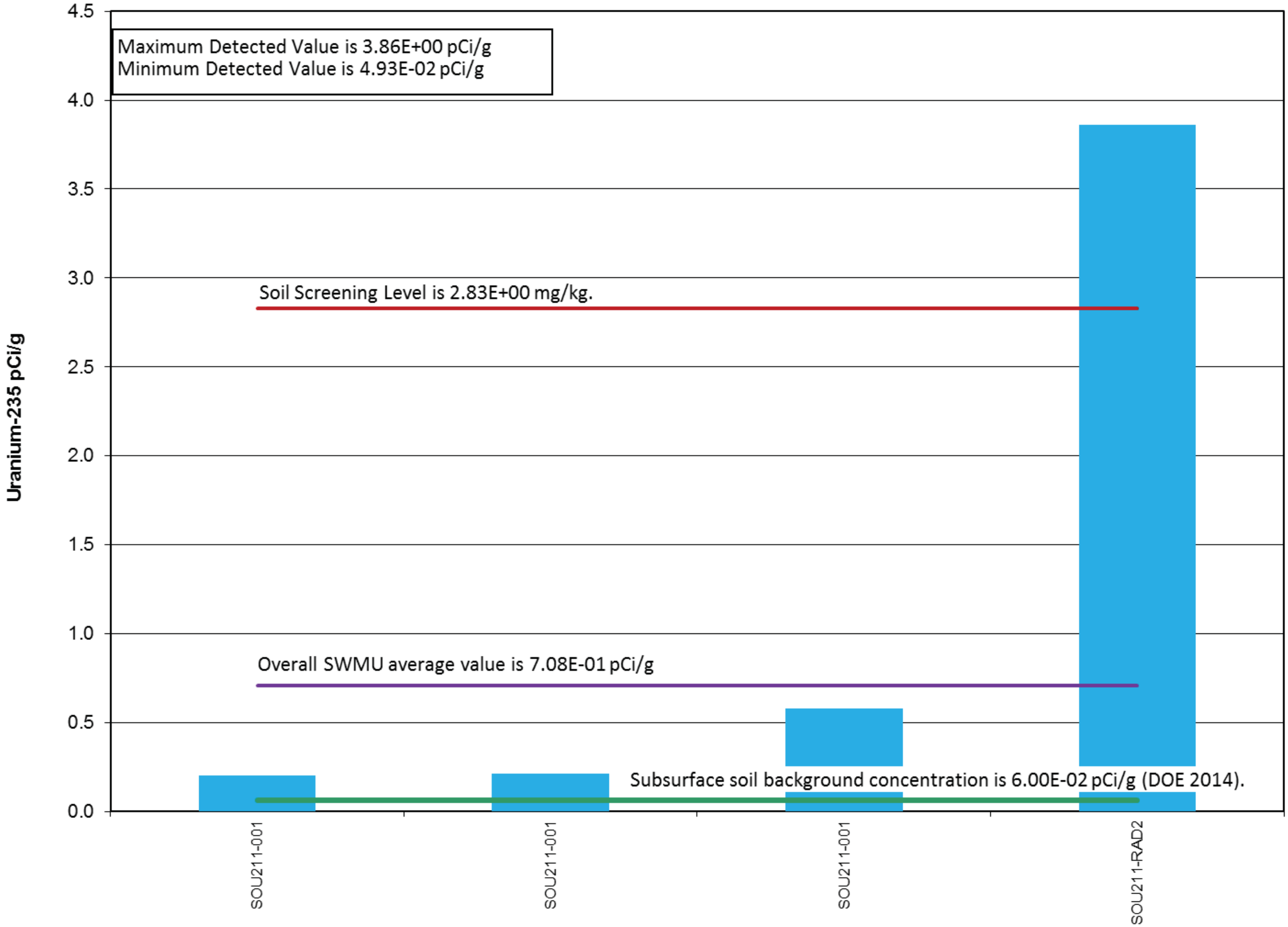

Figure C2.7.11. Uranium-235 Detections at SWMU 211-A

Uranium-238 was detected in 4 of the 9 samples. The detections are shown in Figure C2.7.12. The average concentration at SWMU 211-A for uranium-238 is greater than both the background activity concentration and the RG SSL. Uranium-238 was evaluated as part of the GWOU FS and identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). The evaluation presented in Attachment C1 to Appendix C of the Soils OU RI Report (DOE 2013) did not identify any uranium-238 impacts to RGA groundwater; therefore, uranium-238 does not meet the screening criteria for fate and transport modeling for SWMU 211-A.

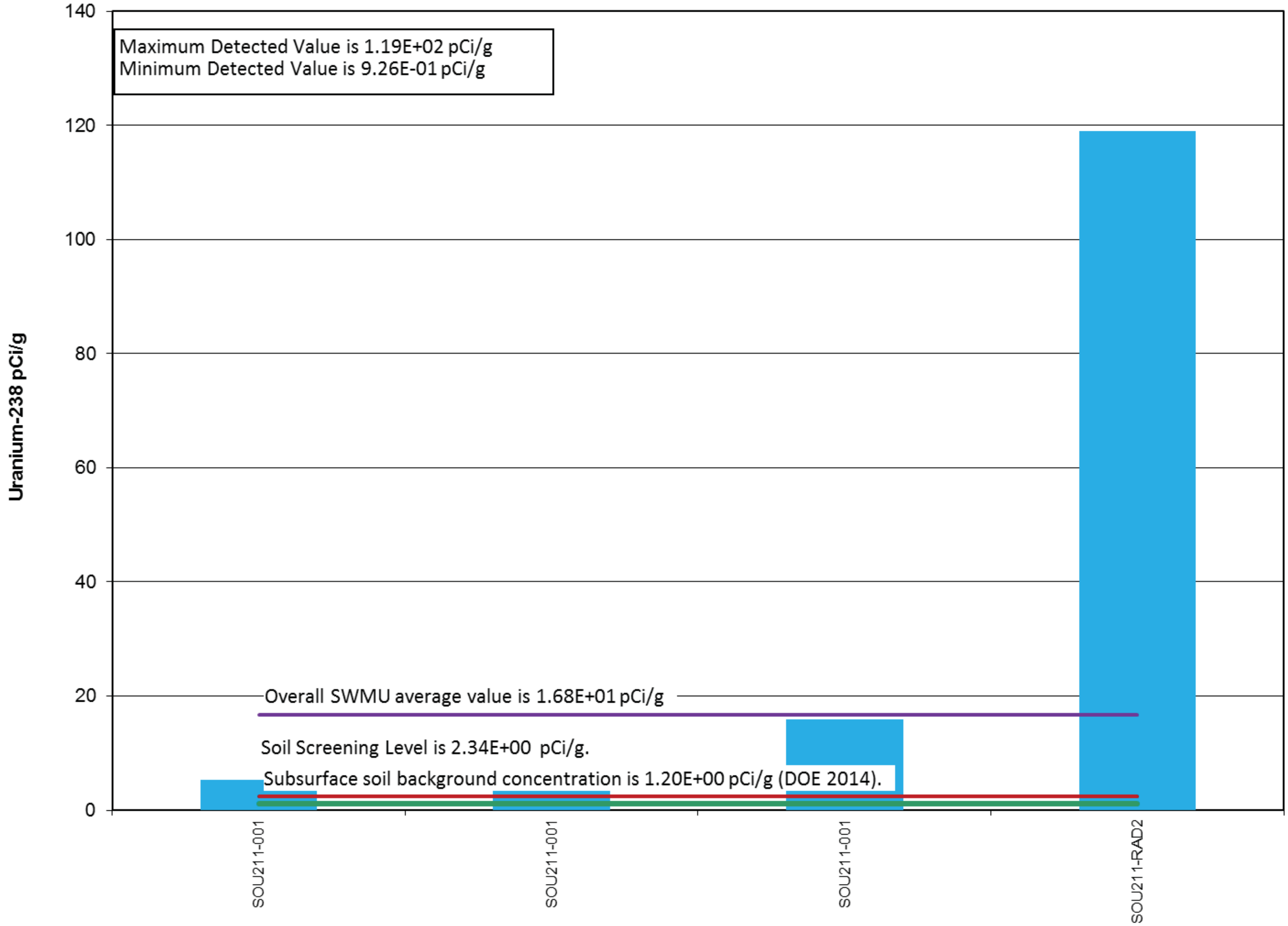

Figure C2.7.12. Uranium-238 Detections at SWMU 211-A

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C.2.8 SWMU 224, C-340, AND DMSA OS-13

Data for SWMU 224 consists of both historical data and RI-collected data. SWMU 224 exceedances of the RG SSL include the following soil constituents: antimony, cobalt, iron, manganese, naphthalene, Tc-99, and uranium-238.

Antimony was detected in all 6 of the samples. The detections are shown in Figure C2.8.1. The average concentration over SWMU 224 for antimony is greater than both the background and the RG SSL. Antimony is a groundwater COC, but groundwater information included in the Soils OU RI Report (DOE 2013) suggests there are no antimony impacts to RGA groundwater; therefore, antimony does not meet the screening criteria for fate and transport modeling for SWMU 224.

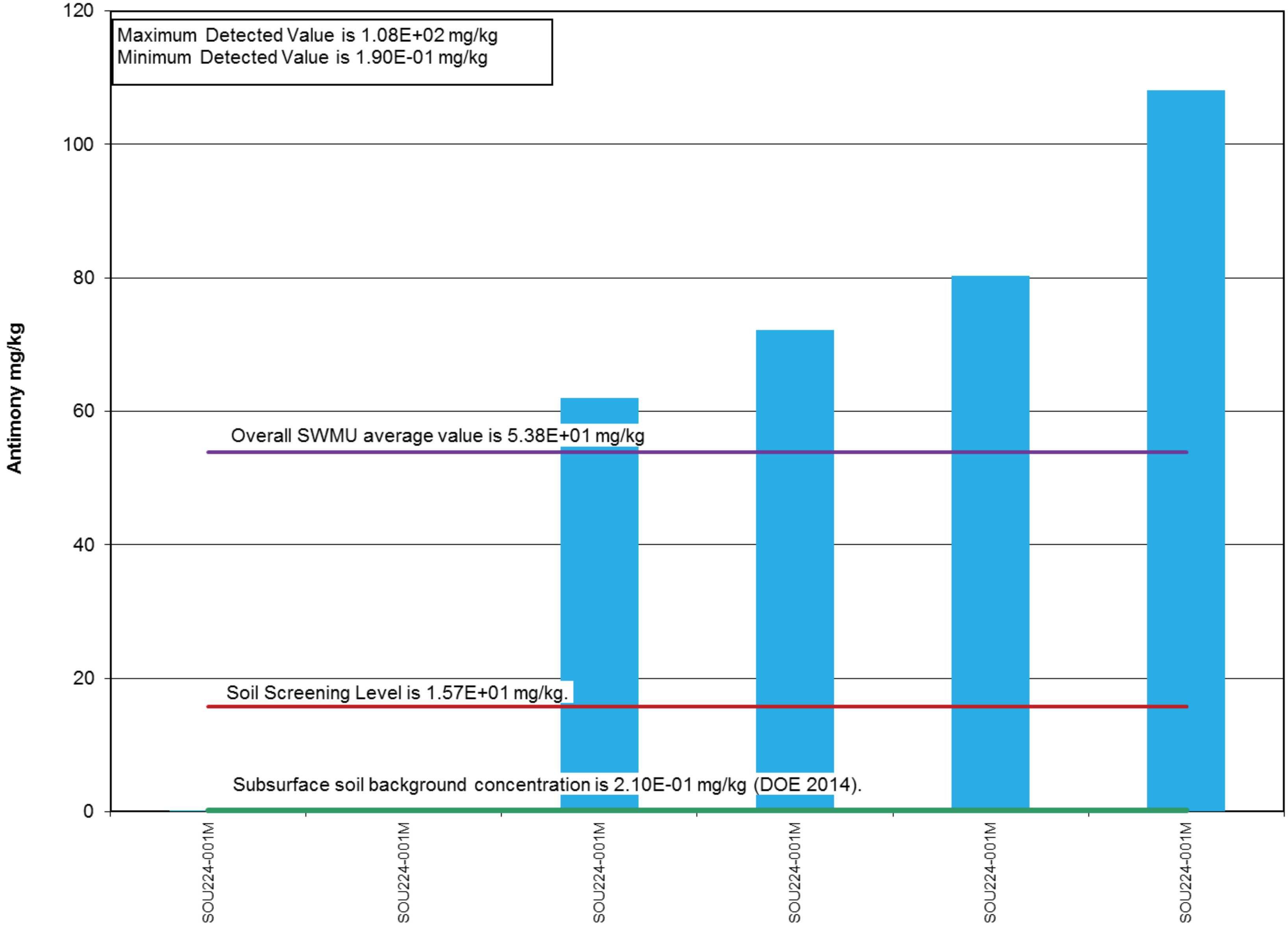

Figure C2.8.1. Antimony Detections at SWMU 224

Cobalt was detected in both analyzed samples. The detections are shown in Figure C2.8.2. The average concentration over SWMU 224 for cobalt is greater than the RG SSL, but less than the background concentration; therefore, cobalt does not meet the screening criteria for fate and transport modeling for SWMU 224.

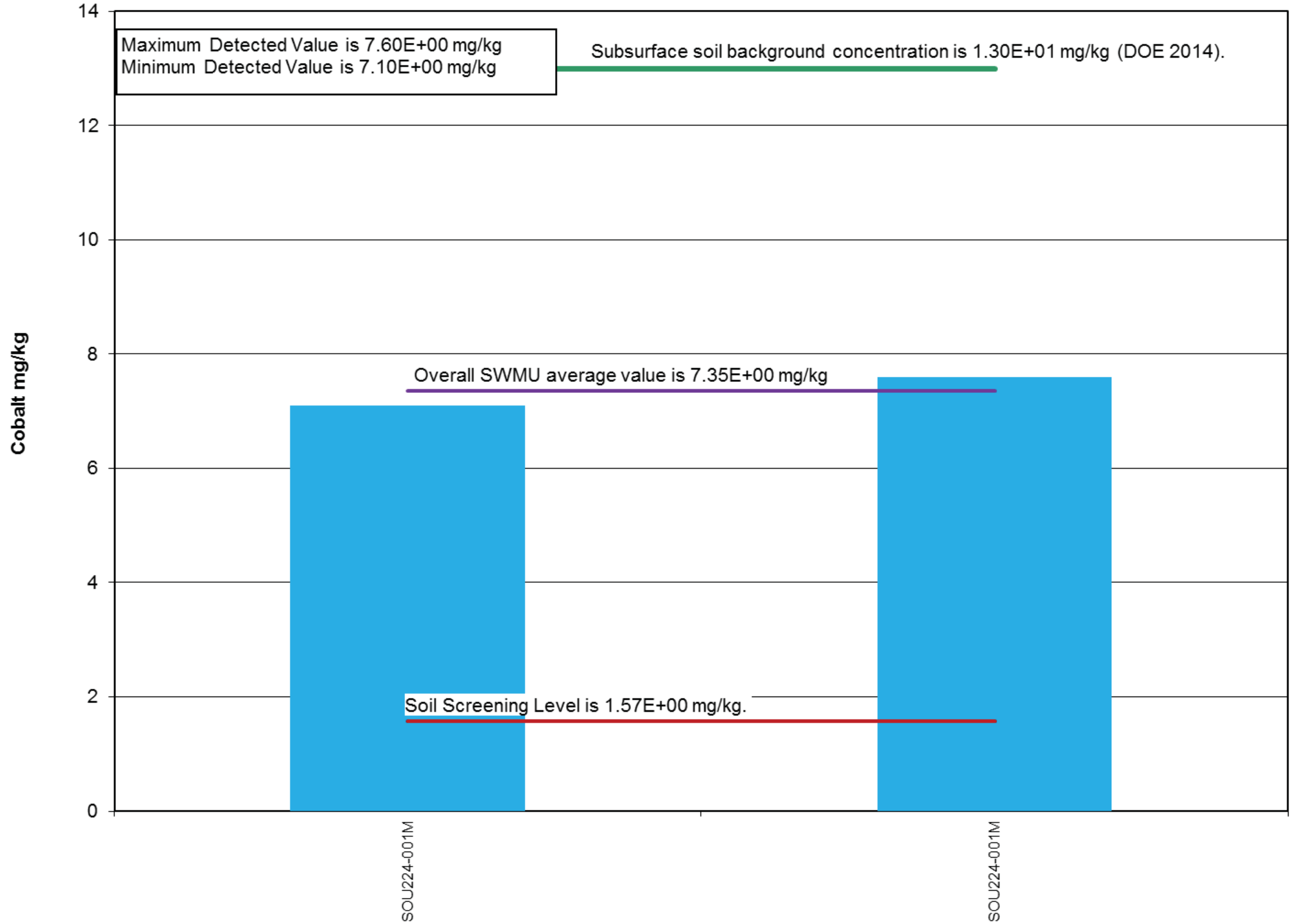

Figure C2.8.2. Cobalt Detections at SWMU 224

Iron was detected in 6 of 6 samples. The detections are shown in Figure C2.8.3. The average concentration over SWMU 224 for iron is greater than the RG SSL, but less than the background concentration; therefore, iron does not meet the screening criteria for fate and transport modeling for SWMU 224.

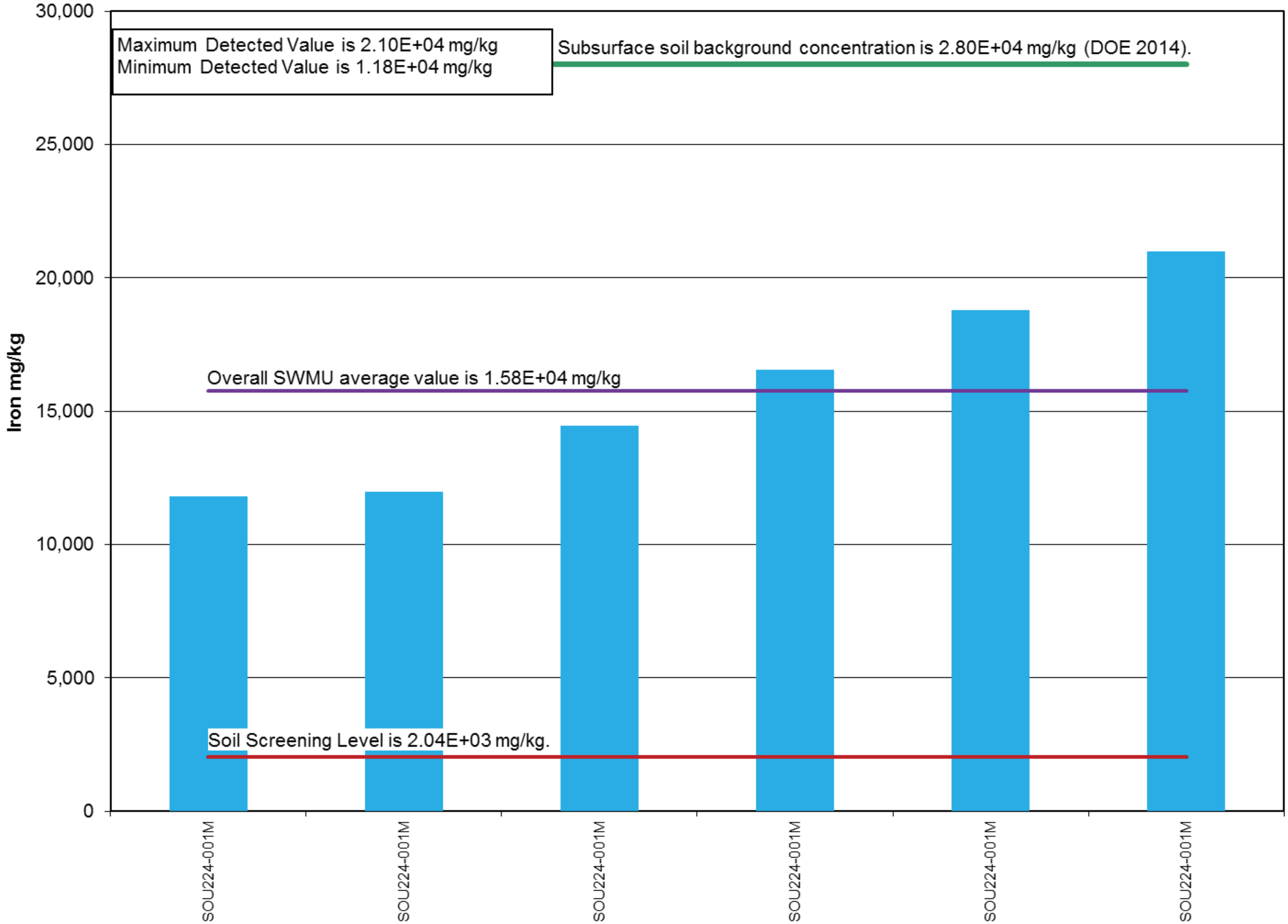

Figure C2.8.3. Iron Detections at SWMU 224

Manganese was detected in 6 of 6 samples. The detections are shown in Figure C2.8.4. The average concentration over SWMU 224 for manganese is greater than the RG SSL, but less than the background concentration; therefore, manganese does not meet the screening criteria for fate and transport modeling for SWMU 224.

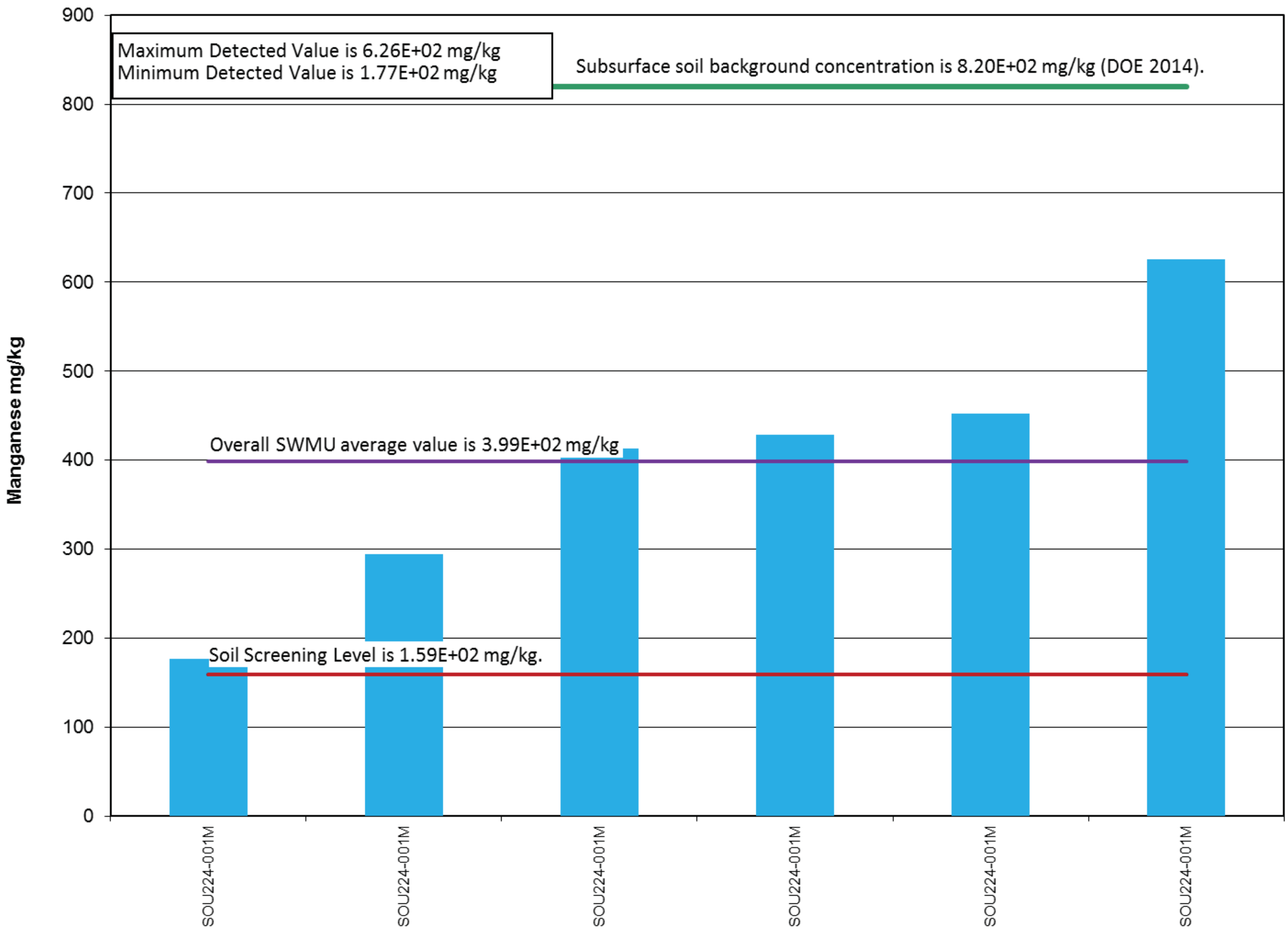

Figure C2.8.4. Manganese Detections at SWMU 224

Naphthalene was detected in 1 of the 2 samples. The detections are shown in Figure C2.8.5. The average concentration over SWMU 224 for naphthalene is greater than RG SSL. Naphthalene was not identified as a COC in the groundwater plumes associated with PGDP (DOE 2001); therefore, naphthalene does not meet the screening criteria for fate and transport modeling for SWMU 224.

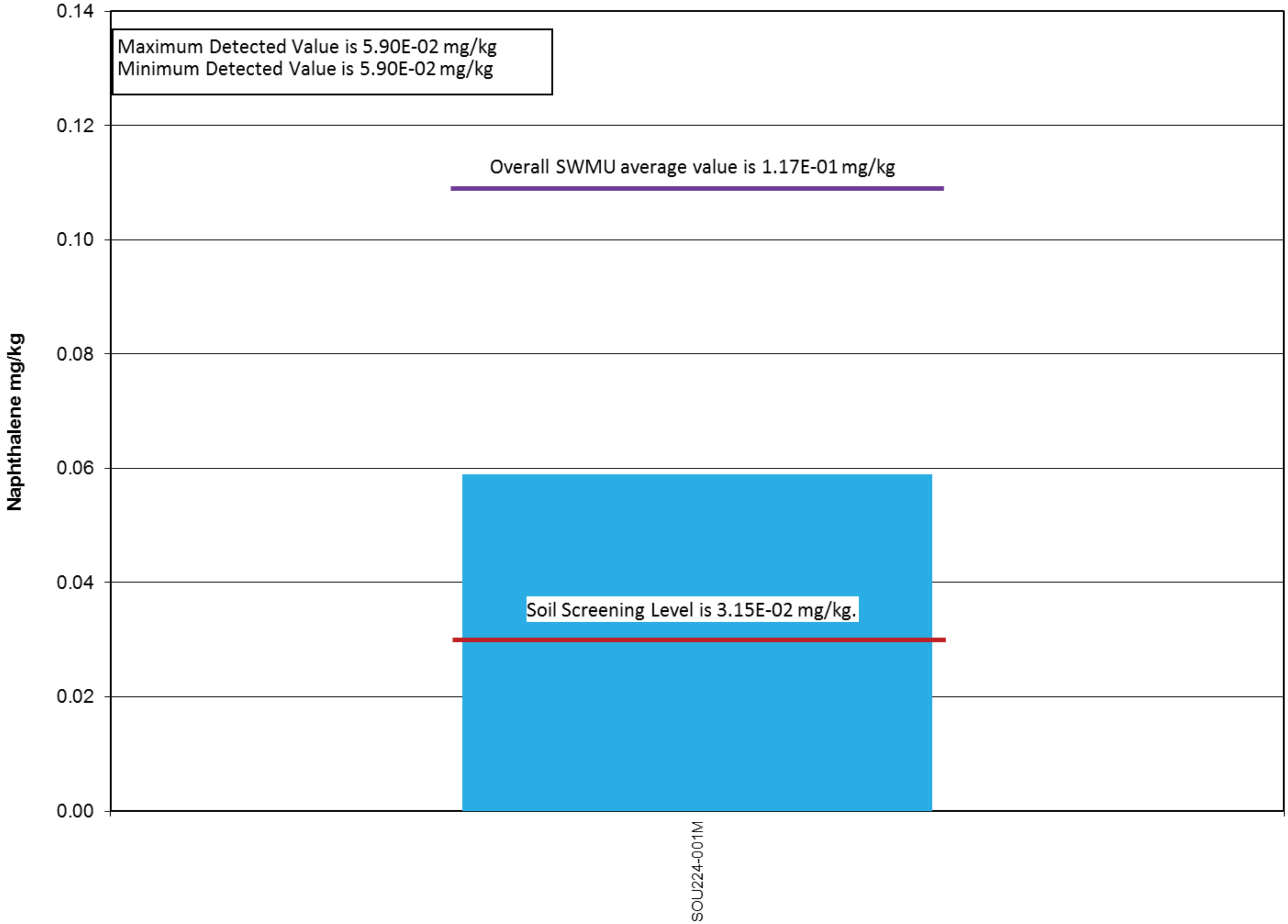

Figure C2.8.5. Naphthalene Detections at SWMU 224

Tc-99 was detected in 1 of the 3 samples. The detections are shown in Figure C2.8.6. The average activity concentration over SWMU 224 for Tc-99 is less than the RG SSL and the background concentration; therefore, Tc-99 does not meet the screening criteria for fate and transport modeling for SWMU 224.

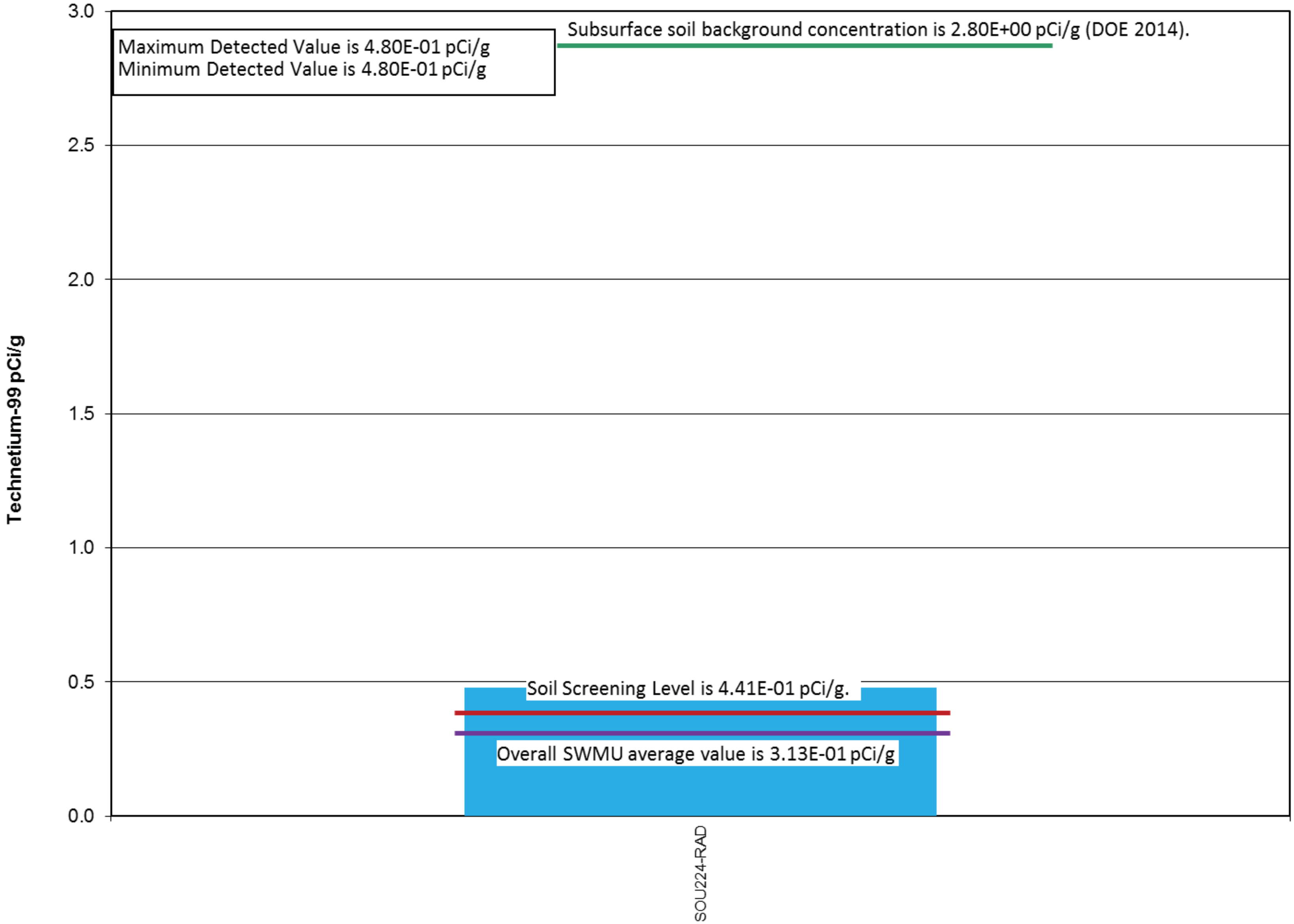

Figure C2.8.6. Tc-99 Detections at SWMU 224

Uranium-238 was detected in all 3 of the samples. The detections are shown in Figure C2.8.7. The average activity concentration over SWMU 224 for uranium-238 is greater than both the background activity concentration and the RG SSL. Uranium-238 was evaluated as part of the GWOU FS and identified as a COC in the groundwater plumes associated with PGDP (DOE 2001). The evaluation presented in Attachment C1 to Appendix C of the Soils OU RI Report (DOE 2013) did not identify any uranium-238 impacts to RGA groundwater; therefore, U-238 does not meet the screening criteria for fate and transport modeling for SWMU 224. Additionally, only two samples exceed both the background and the RG SSL.

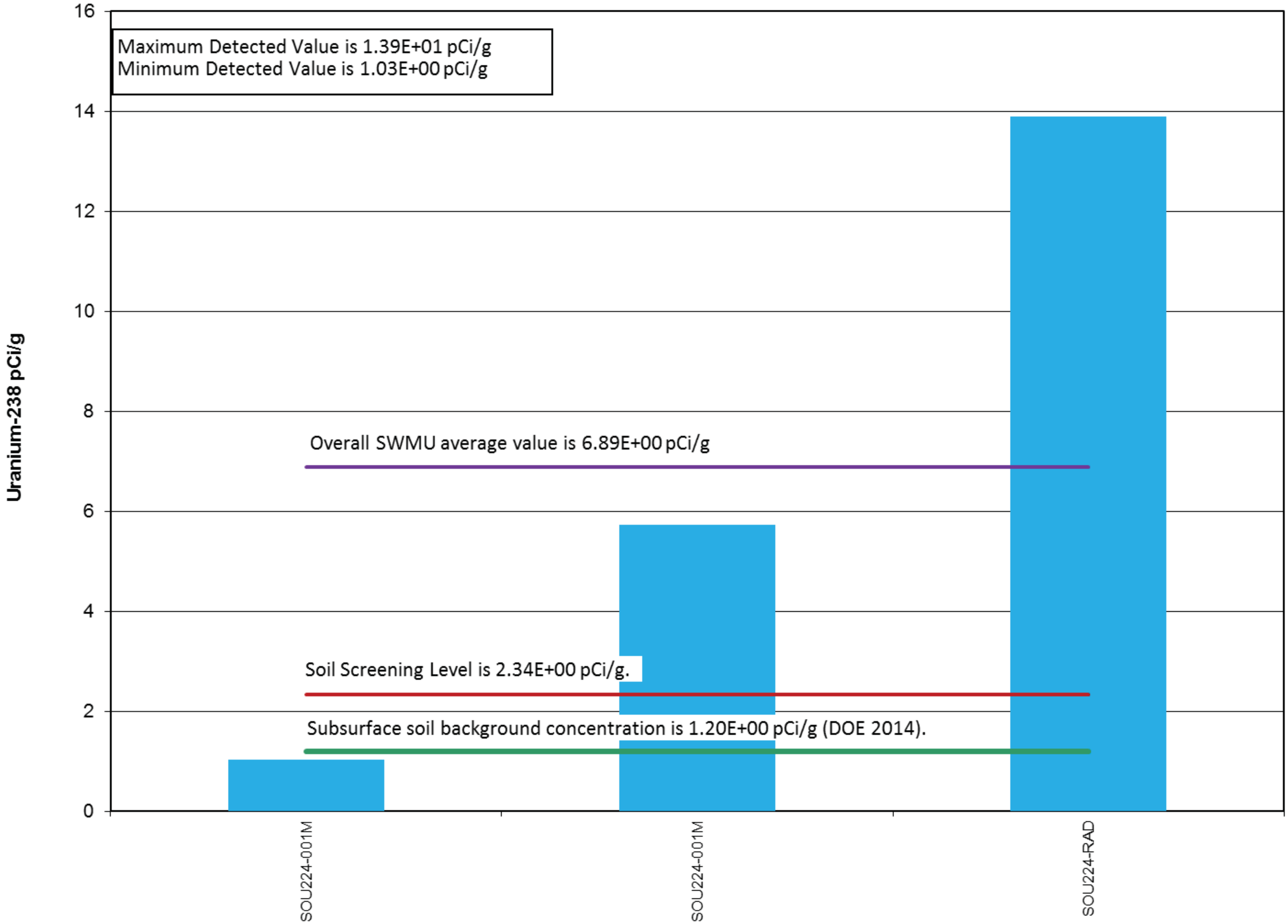

Figure C2.8.7. Uranium-238 Detections at SWMU 224

C.2.9 SWMU 225, C-533-1, DMSA OS-14, RAIL CARS AND CONTAMINATED SOIL AREA NEAR C-533-1 DMSA OS-14

Data for SWMU 225 consists of both historical data and RI-collected data. SWMU 225 exceedances of the RG SSL include the following soil constituents: antimony, cobalt, iron, manganese, and molybdenum.

Antimony was detected in 4 of the 5 samples. The detections are shown in Figure C2.9.1. The average concentration over SWMU 225 for antimony is greater than both the background and the RG SSL. Antimony is a groundwater COC, but groundwater information included in the Soils OU RI Report (DOE 2013) suggests there are no antimony impacts to RGA groundwater; therefore, antimony does not meet the screening criteria for fate and transport modeling for SWMU 225.

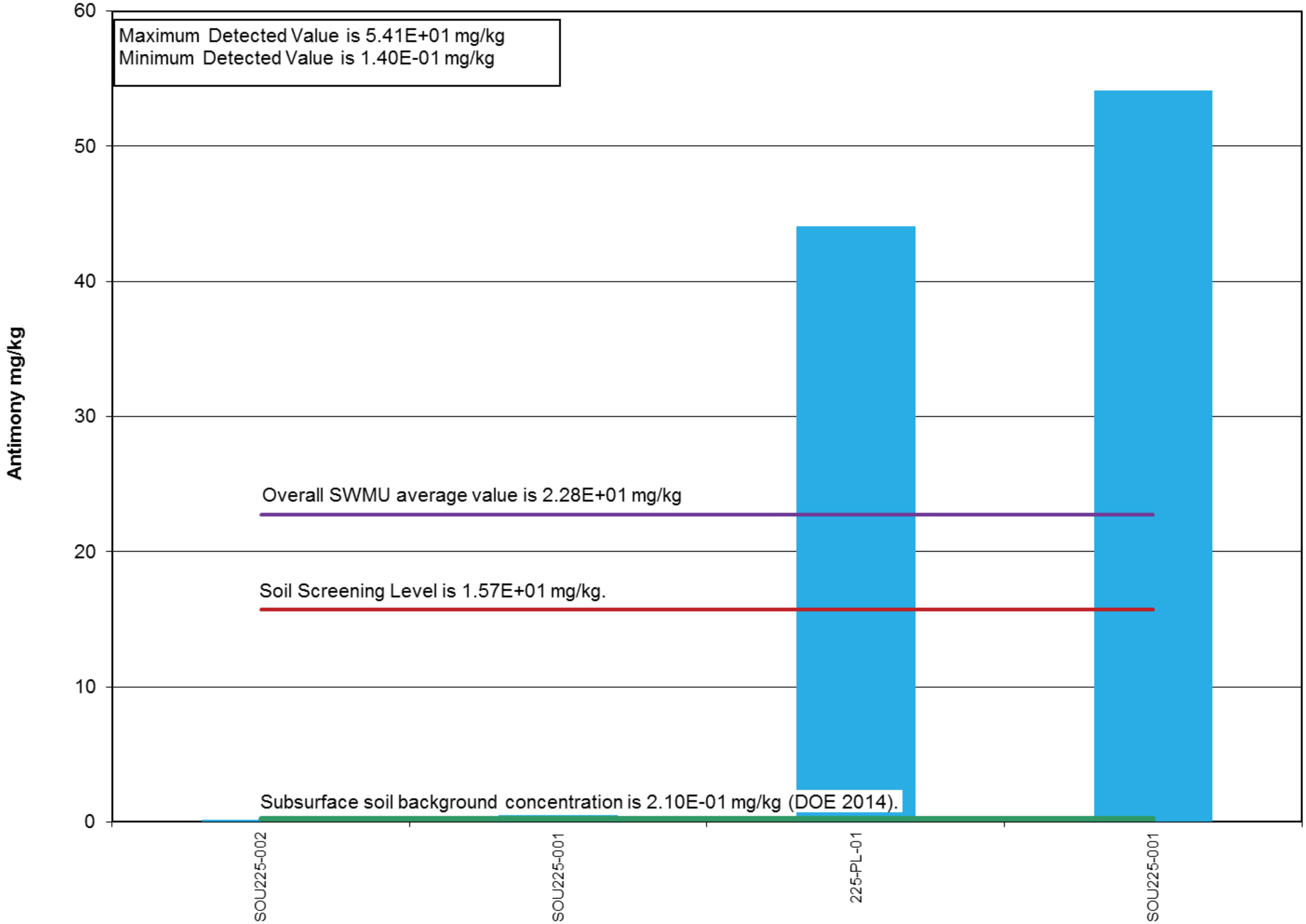

Figure C2.9.1. Antimony Detections at SWMU 225

Cobalt was detected in 2 of 2 samples. The detections are shown in Figure C2.9.2. The average concentration over SWMU 225 for cobalt is greater than the RG SSL, but less than the background concentration; therefore, cobalt does not meet the screening criteria for fate and transport modeling for SWMU 225.

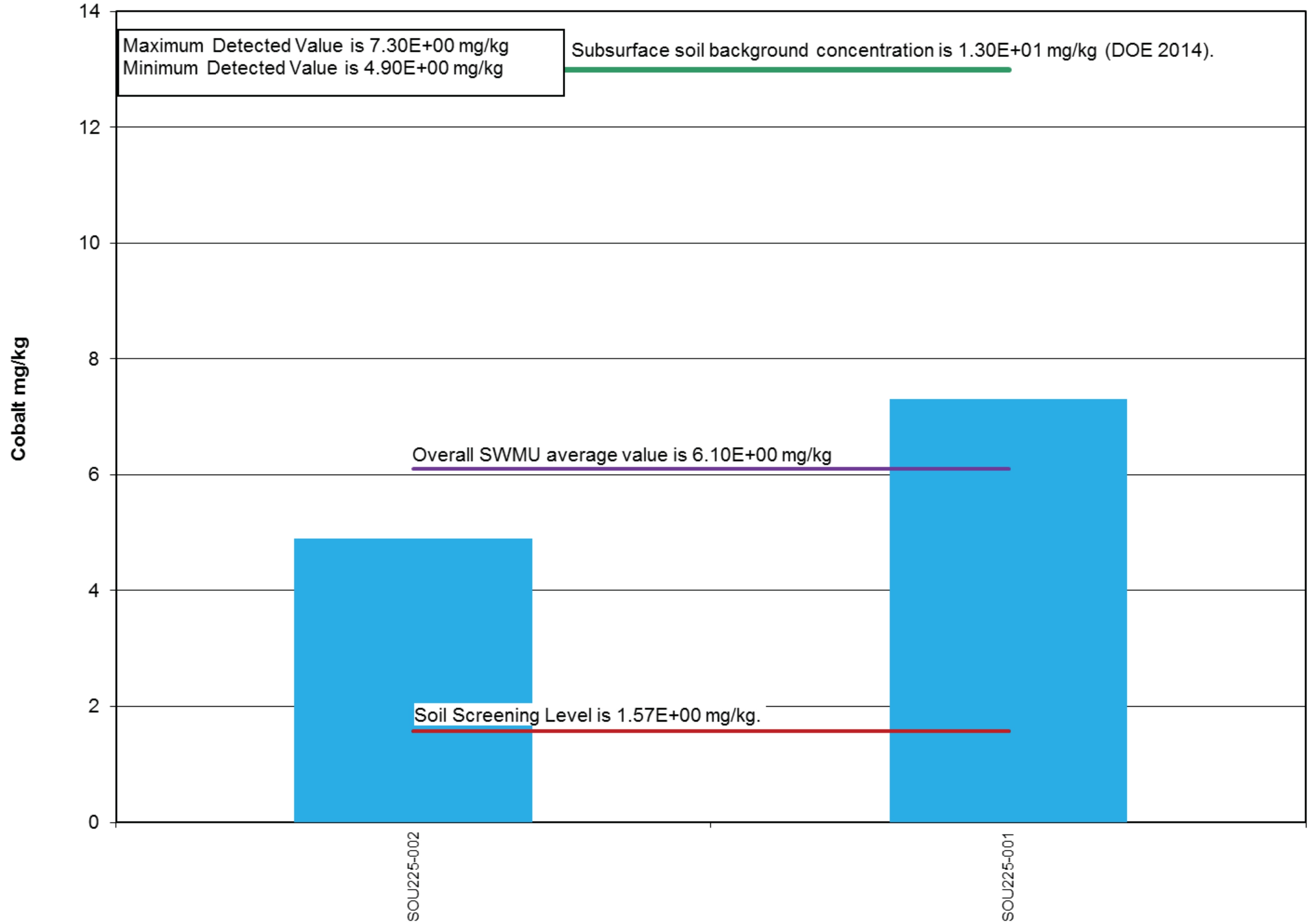

Figure C2.9.2. Cobalt Detections at SWMU 225

Iron was detected in 7 of 7 samples. The detections are shown in Figure C2.9.3. The average concentration over SWMU 225 for iron is greater than the RG SSL, but less than the background concentration; therefore, iron does not meet the screening criteria for fate and transport modeling for SWMU 225.

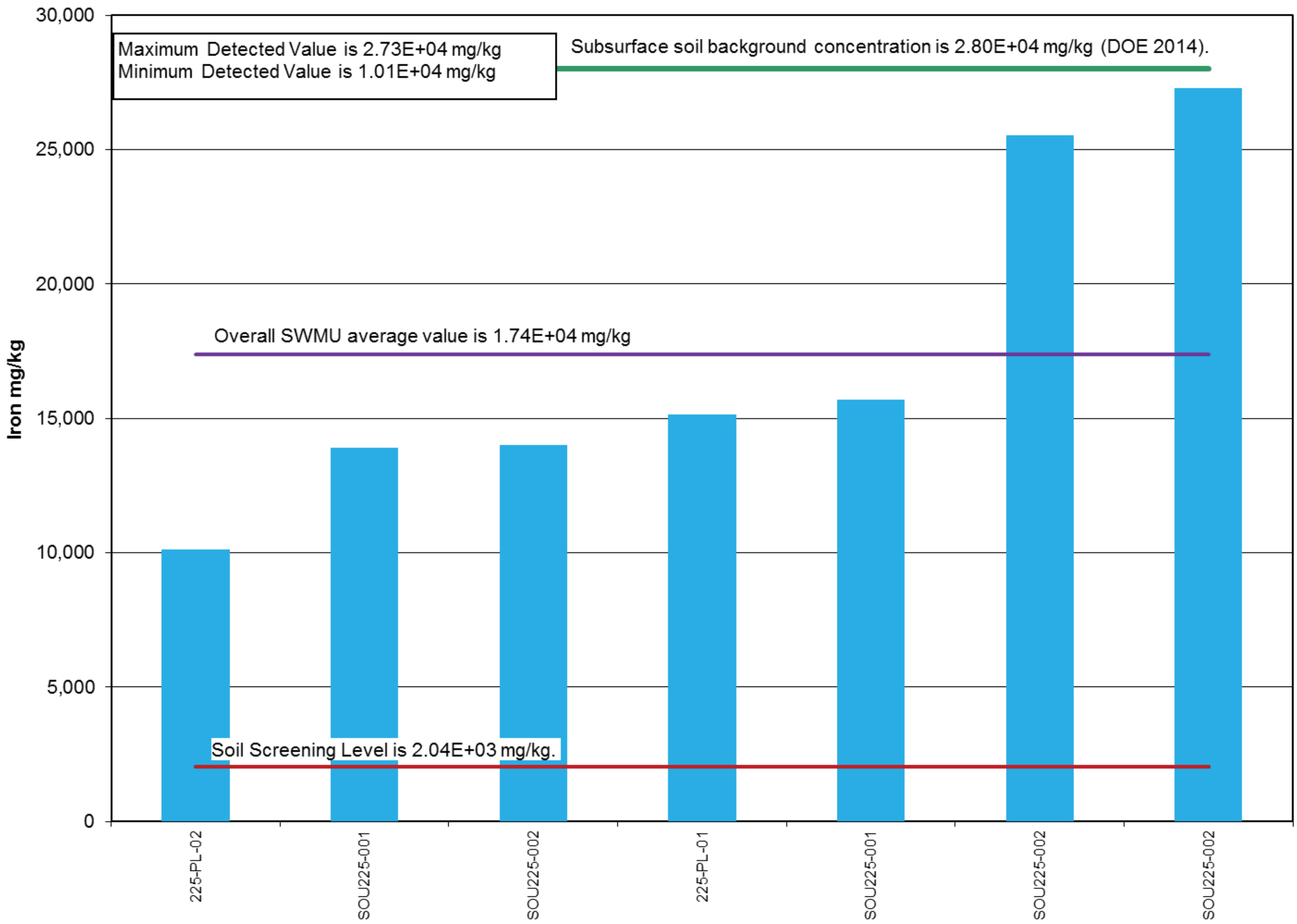

Figure C2.9.3. Iron Detections at SWMU 225

Manganese was detected in 7 of 7 samples. The detections are shown in Figure C2.9.4. The average concentration over SWMU 225 for manganese is greater than the RG SSL, but less than the background concentration; therefore, manganese does not meet the screening criteria for fate and transport modeling for SWMU 225.

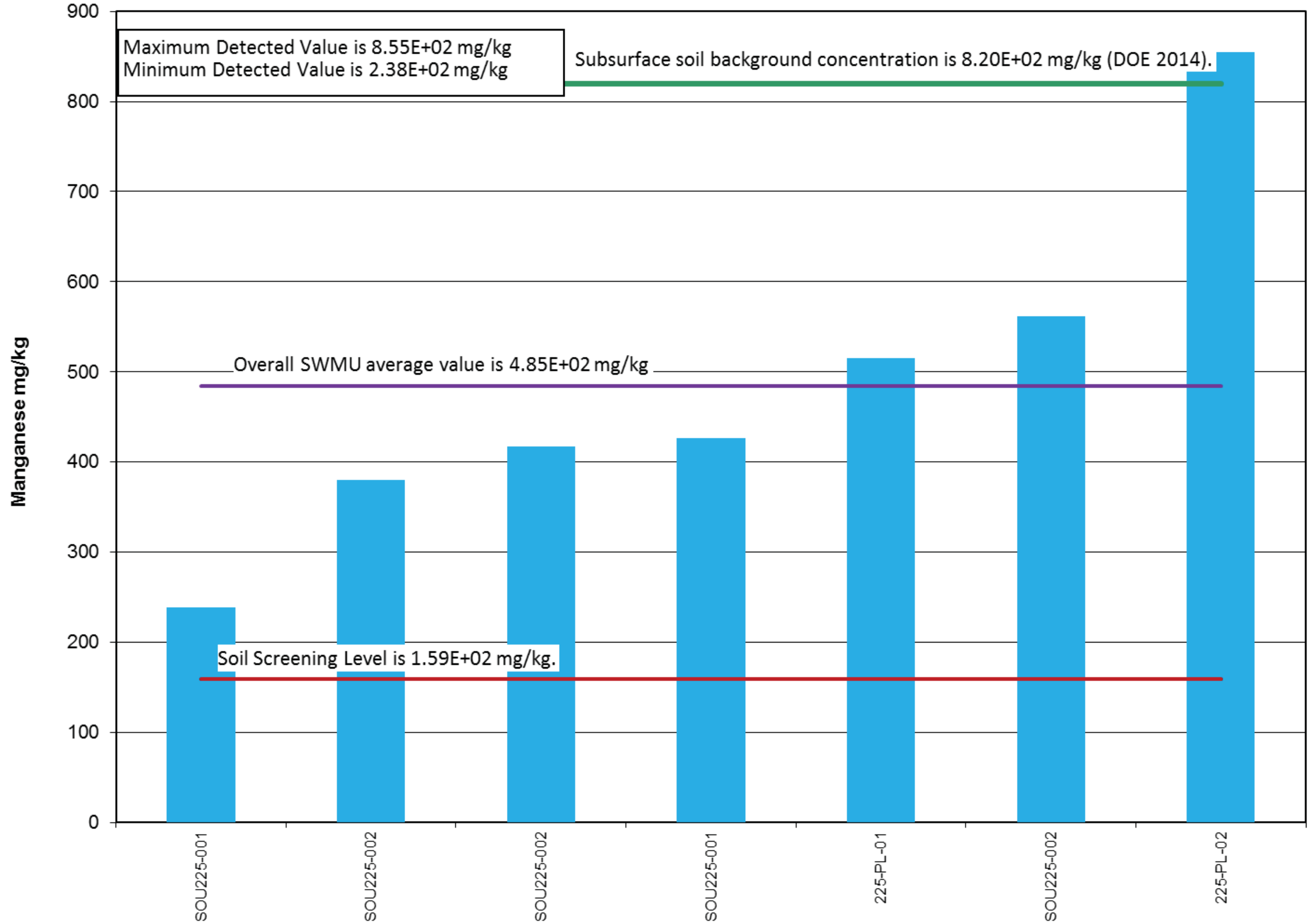

Figure C2.9.4. Manganese Detections at SWMU 225

Molybdenum was detected in 3 of the 7 samples. The detections are shown in Figure C2.9.5. The average concentration over SWMU 225 for molybdenum is less than RG SSL; therefore, molybdenum does not meet the screening criteria for fate and transport modeling for SWMU 225.

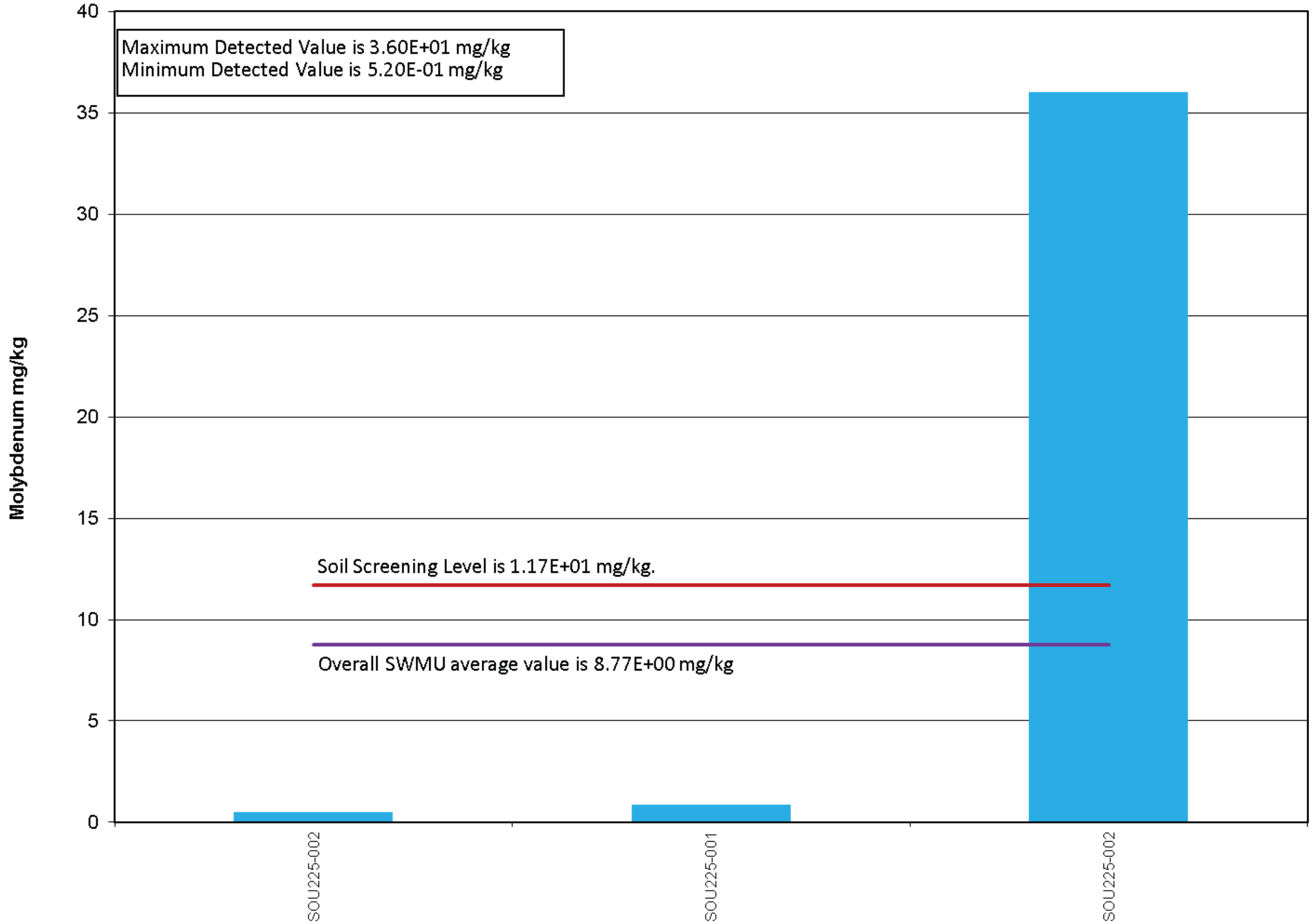

Figure C2.9.5. Molybdenum Detections at SWMU 225

C.2.10 REFERENCES

DOE 2001. *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1857&D2, U.S. Department of Energy, Paducah, KY, August.

DOE 2013. *Soils Operable Unit Remedial Investigation Report at the Paducah Gaseous Diffusion Plant Paducah, Kentucky*, LATA Environmental Services of Kentucky, DOE/LX/07-0358&D2/R1, February.

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ATTACHMENT C3

CALCULATION PACKAGE

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C3.1. CALCULATIONS SUMMARY

This attachment provides an example of the calculations used in performing the groundwater modeling. Seasonal Soil Compartment Model (SESOIL) and Analytical Transient 1-, 2-, 3-Dimensional Model (AT123D) groundwater and transport modeling were conducted as part of the Soils Operable Unit (OU) Remedial Investigation (RI) to determine potential Regional Gravel Aquifer (RGA) groundwater concentrations of technetium-99 (Tc-99), emanating from solid waste management units (SWMU) 13, 15, and 26 at the SWMU boundary.

The input files were developed in the graphic user interface SEVIEW v 7.1.17. It previously was agreed upon in the Soils OU Work Plan that the Soils Project would be limited to soil depths of 15 ft below ground surface (bgs) or less. Thus, site-specific input at depths greater than 15 ft was not available for the SESOIL and AT123D simulations. To overcome this limitation, SWMU 1 SESOIL and AT123D general input parameters were assumed representative of SWMUs 13, 15, and 26 and other SWMUs at the PGDP as described in "Appendix C Fate and Transport Modeling" prepared by Las Alamos Technical Associates (LATA) as part of the Soils OU RI Report (Appendix C). These input parameters are shown in Table C3.1.

Additional input parameters were provided in Appendix C; the RI Report for Waste Area Grouping 27 (DOE 1999); and the RI Report for the Burial Grounds Operable Unit at PGDP (DOE 2010). The remainder of data (flow path from source to points of exposure, source area size) was provided in ArcGIS files depicting particle tracking and flow paths, which were derived from information provided in the 2008 Update of the Paducah Gaseous Diffusion Plant Sitewide Groundwater Flow Model (PRS 2008).

Input concentrations are summarized in Appendix C main text Tables C3.2–C3.4. Table C3.2 lists reported average concentrations that were calculated using samples having detected concentrations. Table C.3.7 (Appendix C main text) presents the calculated adjusted soil contaminated area for each contaminant, which is the maximum area (of the three intervals) as listed in Table C.3.4 (Appendix C main text). Adjusted interval concentrations (Table C.3.7, Appendix C main text) were calculated using the ratio of SWMU total area to maximum impacted soil area as well as the ratio of number of detects to the total number of samples. That ratio then was applied to the Table C.3.3 (Appendix C main text) average concentration for each interval. For example, the calculation of SWMU 26 Tc-99 at a depth of between 0 cm to 152.4 cm bgs is as follows:

$$2.09\mathrm{E}-02\ \frac{\mu\mathrm{g}}{\mathrm{g}} \times \frac{0.041\text{ acres (total area)}}{0.041\text{ acres (max interval area)}} \times \frac{25\text{ samples with Tc}-99\text{ detection}}{32\text{ total Tc}-99\text{ samples}}$$

$$= 1.63\mathrm{E}-02\ \mu\mathrm{g/g}$$

Tc-99 concentrations were reported in units of activity (pCi/g) as well as on a mass basis. The activity was converted from mass concentration (μg/g) using the following formulas:

$$\lambda = \ln(2)/t_{1/2}$$

where (from PRS 2010a):

λ is the Tc-99 decay constant = 1.03×10^{-13} s
$t_{1/2}$ is the half-life of Tc-99 = 6.72×10^{12} s

The specific activity (SA) in disintegrations per second per gram (dps/g) is found by:

$$SA = N_A(\lambda)/M = 6.27 \times 10^8 \text{ dps/g}$$

where:

N_A is Avogadro's number = 6.02×10^{23} mol^{-1}
M is atomic mass (Tc-99 = 98.9 g/mol)

The unit conversion of dps to Curies (Ci) is 3.7×10^{10} dps/Ci, which equals an SA of 0.017 Ci/g or 1.7×10^4 pCi/µg. Activity concentrations then are calculated by multiplying the mass concentration (µg/g) by the SA (1.7×10^4 pCi/µg).

Therefore,

$$1.63\text{E} - 02\ \frac{\mu\text{g}}{\text{g}} * 1.7\text{E} + 04 \frac{\text{pCi}}{\mu\text{g}} = 277\ \frac{\text{pCi}}{\text{g}}$$

C3.2. REFERENCES

DOE (U.S. Department of Energy) 1999. *Remedial Investigation Report for Waste Area Grouping 27 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1777&D2, U.S. Department of Energy, June.

DOE 2010. *Remedial Investigation Report for the Burial Grounds Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-0030&D2/R1, U.S. Department of Energy, Paducah, KY, February.

Harbaugh, A. W., E. R. Banta, M. C. Hill, and M. G. McDonald 2000, MODFLOW-2000, Version 1.19.01, the U.S. Geological Survey Modular Ground-Water Model–Users Guide to Modularization Concepts and Groundwater Flow Process, U.S. Geological Survey, Open-File Report 00-92.

PRS 2008. *2008 Update of the Paducah Gaseous Diffusion Plant Sitewide Groundwater Flow Model*, PRS-ENR-0028, Paducah Remediation Services, LLC, Kevil, KY.

Table C3.1. SEVIEW Input Parameters

Parameter (Units)	Value	Source
SESOIL Parameters		
Temperature (Celsius) [Oct–Sept]	15.28 8.39 3.33 2.06 3.67 8.11 14.72 19.39 23.89 25.56 24.94 21.17	Template input files
Cloud Cover (Fraction) [Oct–Sept]	0.45 0.55 0.65 0.70 0.65 0.65 0.60 0.60 0.55 0.50 0.45 0.45	Template input files
Relative Humidity (Fraction) [Oct–Sept]	0.70 0.70 0.75 0.75 0.70 0.65 0.65 0.70 0.70 0.70 0.70 0.70	Template input files
Short Wave Albedo (Fraction) [Oct–Sept]	0.17 0.18 0.20 0.22 0.20 0.19 0.17 0.17 0.17 0.17 0.17 0.17	Template input files
Evapotranspiration (Cm/Day) [Oct–Sept]	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	Template input files
Precip (Cm/Month) [Oct–Sept]	9.98 10.67 15.19 16.08 12.19 15.32 13.72 10.26 12.85 10.54 7.39 11.38	Template input files
Storm Length (Days) [Oct–Sept]	0.32 0.45 0.49 0.47 0.41 0.40 0.37 0.30 0.25 0.25 0.23 0.27	Template input files
# Of Storms (Storms/Month) [Oct–Sept]	4.50 5.00 5.62 5.29 5.84 6.65 6.82 7.38 5.85 6.15 5.28 4.60	Template input files
Rainy Season (Days) [Oct–Sept]	30.40 30.40 30.40 30.40 30.40 30.40 30.40 30.40 30.40 30.40 30.40 30.40	Template input files
Water Solubility (Mg/L)	Tc-99 = 7,180	SEVIEW Chemical Database
Henry's Law Constant (M^3–Atm/Mol)	Tc-99 = 0	Remedial Investigation Report for the Burial Grounds Operable Unit at PGDP, Paducah, KY Feb. 2010
K_{oc} Adsorption–Desorption (µg/G)/(µg/Ml)	0	Remedial Investigation Report for the Burial Grounds Operable Unit at PGDP, Paducah, KY Feb. 2010 for Tc-99/SEVIEW Chemical Database for Cr, Ni, and Total PCBs
K_d Adsorption (µg/G)/(µg/mL) (Equivalent to 0.2 L/kg)	Tc-99 = 0.2	Remedial Investigation Report for the Burial Grounds Operable Unit at PGDP, Paducah, KY Feb. 2010
K_d Desorption (µg/G)/(µg/mL)	0	Template input files
Chemical Valence (G/Mole)	0	Template input files
Base Hydrolysis Rate Constant (1/Day)	0	Template input files
Liquid Phase Biodegradation Rate (1/Day)	Tc-99 = 8.92E-09	Remedial Investigation Report for the Burial Grounds Operable Unit at PGDP, Paducah, KY, Feb. 2010
Solid Phase Biodegradation Rate (1/Day)	Tc-99 = 8.92E-09	Remedial Investigation Report for the Burial Grounds Operable Unit at PGDP, Paducah, KY, Feb. 2010
Water Diffusion Coefficient (Cm^2/Sec)	Tc-99 = 1.0E-06	Remedial Investigation Report for the Burial Grounds Operable Unit at PGDP, Paducah, KY Feb. 2010

Table C3.1. SEVIEW Input Parameters (Continued)

Parameter (Units)	Value	Source
Air Diffusion Coefficient (Cm2/Sec)	Tc-99 = 0	Remedial Investigation Report for the Burial Grounds Operable Unit at PGDP, Paducah, KY Feb. 2010
Molecular Weight (G/Mole)	Tc-99 = 99	Remedial Investigation Report for the Burial Grounds Operable Unit at PGDP, Paducah, KY Feb. 2010
Neutral Hydrolysis Rate Constant (1/Day)	0	Template input files
Acid Hydrolysis Rate Constant (1/Day)	0	Template input files
Ligand Dissociation Constant (-)	0	Template input files
Moles Ligand/Mole Chemical (-)	0	Template input files
Molecular Weight Ligand (G/Mol)	0	Template input files
Soil Bulk Density (G/Cm^3)	1.46	Template input files
Intrinsic Permeability (Cm^2)	1.6E-10	Template input files
Soil Pore Disconnectedness Index (-)	10	Template input files
Effective Porosity (Fraction)	0.45	Template input files
Organic Carbon Content (Percent)	0.08	Template input files
CEC (Milliequivalents/100 G Dry Soil)	0	Template input files
Freundlich Exponent (-)	1	Template input files
Load Area (Cm^2)	Tc-99 SWMU 13 = 8.87E+07	ArcGIS shapefiles
	Tc-99 SWMU 15 = 1.62E+08	
	Tc-99 SWMU 26 = 1.66E+06	
Site Latitude (Decimal Degrees)	37.1	Template input files
Number Of Layers	4	Template input files
Upper Soil Layer Thickness (Cm)/Number Of Sublayers	152.4/1	Template input files
Second Soil Layer Thickness (Cm)/Number Of Sublayers	152.4/1	Template input files
Third Soil Layer Thickness [(Cm)/Number Of Sublayers]	152.4/1	Template input files
Lower Soil Layer Thickness (Cm)/Number Of Sublayers	1219.2/10	Template input files
Ph [Upper, Second, Third, And Lower Layer)	7	Template input files
Intrinsic Permeability (Cm^2) [Upper, Second, Third, And Lower Layer]	0	Template input files
Ratio Of Liquid Phase Biodegradation To Upper Layer (Fraction) [Upper, Second, Third, And Lower Layer]	1	Template input files
Ratio Of Solid Phase Biodegradation To Upper Layer (Fraction) [Upper, Second, Third, And Lower Layer]	1	Template input files
Organic Carbon Ratio To Upper Layer (Fraction) [Upper, Second, Third, And Lower Layer]	1	Template input files
CEC Ratio To Upper Layer (Fraction) [Upper, Second, Third, And Lower Layer]	1	Template input files

Table C3.1. SEVIEW Input Parameters (Continued)

Parameter (Units)	Value	Source
Freundlich Exponent Ratio To Upper Layer (Fraction) [Upper, Second, Third, And Lower Layer]	1	Template input files
Adsorption Coefficient Ratio To Upper Layer (Fraction) [Upper, Second, Third And Lower Layer]	1	Template input files
Layer 1–4 All Years VOLF1 (Fraction) [Oct-Sept]	1	Template input files
Layer 1 All Years ISRM (Fraction) And ASL1 (Fraction) [Oct–Sept]	0	Template input files
Layer 1–4 All Years POLIN1, TRANS1, SINK1, LIG1 (μg/Cm^2)	0	Template input files
Layer 1, Layer 2, Layer 3, And Layer 4 Adjusted Sublayer Tc-99 Concentrations (μg/G)	SWMU 13= 1.32E-03, 0, 0 SWMU 15 = 2.08E-03, 0, 0 SWMU 26 = 1.63E-02, 4.80E-05, 2.35E-04	Concentration average of Tc-99 data collected in SWMU 14 from 0–5, 5–10, and 10–15 feet below ground surface (bgs). Assumed concentration between 15 ft bgs and water table is zero.
AT123D		
Hydraulic Conductivity (M/Hr)	22.263	Historical sitewide model
Effective Porosity (-)	0.3	PGDP sitewide model calibrated value
Soil Bulk Density (Kg/M^3)	1670	Laboratory analysis
Hydraulic Gradient (M/M)	0.0015	ArcGIS particle tracking shapefiles
Number Of Eigenvalues	1000	Template input files
Longitudinal, Transverse, And Vertical Dispersivity (M)	1.5, 0.15, 0.003	Template input files
Aquifer Width (M)	Infinite	Template input files
Aquifer Depth (M)	9.14	Site Average
Organic Carbon Content (%)	0.02	Laboratory analysis
Water Diffusion Coefficient (M^2/Hr)/(Cm^2/S)	3.60E-07/1.0E-06	Remedial Investigation Report for the Burial Grounds Operable Unit at PGDP, Paducah, KY Feb. 2010
First Order Decay Coefficient (1/Year)	Tc-99 = 8.92E-09	Remedial Investigation Report for the Burial Grounds Operable Unit at PGDP, Paducah, KY, Feb. 2010
Carbon Adsorption Coefficient, K_{oc} (μg/G)/(μg/Ml)	0	Forces model to use K_d
Distribution Coefficient, K_d (M^3/kg) (Equivalent to 0.2 L/kg)	0.0002	Remedial Investigation Report for the Burial Grounds Operable Unit at PGDP, Paducah, KY Feb. 2010
Sol H_20	7,180	Remedial Investigation Report for the Burial Grounds Operable Unit at PGDP, Paducah, KY Feb. 2010
Starting Time Step	1	Desired time interval
Ending Time Step	11989	Desired time interval
Print Interval	1	Desired print interval
X-Axis Coordinates (M)	554, 502, 1089	Desired observation coordinates (SWMU 13, 15, 26 boundary)
Y-Axis Coordinates (M)	393, 378, 910	Centerline of SWMU 13, 15, 36

Table C3.1. SEVIEW Input Parameters (Continued)

Parameter (Units)	Value	Source
Z-Axis Coordinates (M)	0, 1.5, 3, 6, 7.5, 9	Desired observation depths
Release Coordinates Start/End X (Meters)	SWMU 13: 276.3, 450.2 SWMU 15:396.0, 465.8 SWMU 26**	Model space chosen coordinates
Release Coordinates Start/End Y (Meters)	SWMU 13: 365.7, 472.8 SWMU 15: 340.9, 419.1 SWMU 26**	Model space chosen coordinates
Release Coordinates Start/End Z (Meters)	0, 0	Model space chosen coordinates
Initial Concentration (Mg/L)	0	Assumption: conc.= 0 at time = 0
Single Mass Load (Kg)	0	Assumption: conc.= 0 at time = 0
Model Time Step (Hours)	730	SESOIL default, one month
Continuous Release	11988	Number of time steps required for 1,000 year simulation
Load Release Rate (Kg/Hr)	Output from SESOIL	SESOIL***

*In keeping with the convention documented in Appendix C to the Soils Operable Unit Remedial Investigation, the average concentrations were assumed to be present across the entire SWMU within the associated depth interval as each sample was reported to have a detection of Tc-99.

**SWMU 26 was simulated with 15 release zones arranged in a sawtooth pattern from X = 712 m to X = 1242 m and from Y = 631 m to Y = 1156 m.

***Input for AT123D is derived directly from SESOIL output files.

Table C3.2. SWMU 26 Tc-99 Soil Data

Sample ID	Date	Easting (ft)	Northing (ft)	Start Depth (ft bgs)	End Depth (ft bgs)	Activity (pCi/g)	Concentration (μg/g)
Depth Interval 0–5'							
DOJ1-99-0152	9/30/1999	-4394.08	-1125.18	0	0	1,870	1.100E-01
DOJ1-99-0157	10/1/1999	-4281.16	-1122.78	0	0	113	6.647E-03
400043SA001	7/22/1997	-4463.86	-1074.84	0	1	3.1	1.824E-04
400034SA001	7/23/1997	-4404.04	-1078.69	0	1	17	1.000E-03
WC01-205D	1/9/2002	-4054.93	-1081.22	0	1	660	3.882E-02
NSDWCISSRU1	3/4/2004	-4028.79	-1063.08	0	4	37.2	2.188E-03
NSDWCISSRU10	3/4/2004	-4348.4539	-1037.5113	0	4	4.05	2.382E-04
NSDWCISSRU12	3/4/2004	-4422.7645	-1032.3041	0	4	10.7	6.294E-04
NSDWCISSRU19	3/4/2004	-4621.6	-1040.19	0	4	40.7	2.394E-03
NSDWCISSRU3D	3/4/2004	-4113.9	-1042.43	0	4	10.9	6.412E-04
NSDA2PESRU2	5/6/2004	-4062.2471	-1051.7182	0	0	38.4	2.259E-03
OF15B-04-01	7/28/2005	-5066.98	-1080.04	0	1	7.91	4.653E-04
OF15B-04-02	7/28/2005	-5160	-1080.08	0	1	8.93	5.253E-04
100506	10/19/2005	-5066.98	-1080.04	0	0	21.9	1.288E-03
SOU026RADSA001	10/7/2010	-4186.7	-1079.81	0	0.5	186	1.094E-02
SOU026013SA001	11/6/2014	-4714.84	-1058.22	0	1	24.8	1.459E-03
SOU026024SA001	11/6/2014	-4219.84	-1058.22	0	1	7.52	4.424E-04
SOU026002SA001	11/7/2014	-5503.1035	-1043.0148	0	1	1	5.882E-05
WC01-206	1/16/2002	-4054.93	-1081.22	1	2	586	3.447E-02
WC01-207	1/16/2002	-4054.93	-1081.22	2	3	32	1.882E-03
SOU026P09SA002	6/2/2010	-5506.12	-1040.16	2	2	0.51	3.000E-05
WC01-208	1/16/2002	-4054.93	-1081.22	3	4	91.5	5.382E-03
SOU026P56SA003	6/1/2010	-4099.84	-1058	3	3	7.67	4.512E-04
026020SA003	10/30/1997	-4085	-1064	3.5	3.5	4,840	2.847E-01
026025SA015	10/30/1997	-4085	-1064	3.5	3.5	265	1.559E-02
Depth Interval 5–10'							
026003SA007	8/5/1997	-5619.97	-952.39	4	8	1.5	8.824E-05
026006SA007	7/2/1997	-4875.02	-1050.79	4.5	8.5	0.3	1.765E-05
026005SA007	7/8/1997	-5209.92	-1049.32	5	9	0.6	3.529E-05
026007SA007	7/8/1997	-4625.07	-1049.68	5	9	2.1	1.235E-04
040005SD015	9/16/1997	-4020	-1208.74	7	11	0.4	2.353E-05
Depth Interval 10–15'							
400056SA015	8/27/1997	-4040.06	-1184.98	12	16	4	2.353E-04

Note: Concentrations used in the 0–5 ft, 5–10 ft, and 10–15 ft intervals in the SWMU 26 SESOIL model are simple arithmetic averages of available data within those intervals.

Table C3.3. SWMU 13 Tc-99 Soil Data

Sample ID	Date	Easting (ft)	Northing (ft)	Start Depth (ft bgs)	End Depth (ft bgs)	Activity (pCi/g)	Concentration (μg/g)
Depth Interval 0–5'							
C07311	10/2/1996	-6469.081	681.184	0	0	150	8.824E-03
SOU013RADSA001	10/28/2010	-6941.9958	406.454	0	1	6.81	4.006E-04
SOU013143SA001	10/30/2014	-6841.1619	400.261	0	1	0.75	4.400E-05
SOU013028SA001	11/3/2014	-6616.1619	625.261	0	1	8.75	5.147E-04
SOU013035SA001	11/3/2014	-6301.1619	625.261	0	1	20.8	1.224E-03
SOU013054SA001	11/3/2014	-6526.1619	580.261	0	1	2.63	1.547E-04
SOU013156SA001	11/4/2014	-6256.1619	400.261	0	1	2.56	1.506E-04
SOU013RADSB001	2/5/2015	-6339.6403	670.0428	0	1	142	8.353E-03
SYC746P1GR31	9/7/2004	-7182.66	551.73	3	3.5	4.60	2.706E-04
SYC746P1GR41	9/7/2004	-7172.3	594.25	3	3.5	2.92	1.718E-04
SYC746P1GR45	9/8/2004	-7036.98	591.9	3	3.5	1.84	1.082E-04
SYC746PGR104	9/10/2004	-6477.45	660.18	3	3.5	5.50	3.235E-04
SYC746PGR106	9/10/2004	-6365.37	636.44	3	3.5	9.1	5.335E-04
SYC746PGR58	9/10/2004	-6365.34	565.41	3	3.5	2.07	1.218E-04
SYC746PGR78	9/10/2004	-6193.08	589.44	3	3.5	2.90	1.706E-04
SYC746PGR83	9/10/2004	-6675.84	594.34	3	3.5	18.10	1.065E-03
SYC746PGR91	9/10/2004	-6314.71	596.78	3	3.5	2	1.171E-04

Note: Concentrations used in the 0–5 ft, 5–10 ft, and 10–15 ft intervals in the SWMU 13 SESOIL model are simple arithmetic averages of available data within those intervals.

Table C3.4. SWMU 15 Tc-99 Soil Data

Sample ID Depth Interval 0–5'	Date	Easting (ft)	Northing (ft)	Start Depth (ft bgs)	End Depth (ft bgs)	Activity (pCi/)g	Concentration (μg/g)
SOU015002SA001	6/10/2010	-5555.03	920.87	0	1	1.72	1.012E-04
SOU015007SA001	6/14/2010	-5330.03	920.87	0	1	0.65	3.824E-05
SOU015033SA001	6/16/2010	-5465.03	740.87	0	1	367	2.159E-02
SOU015044SA001	6/16/2010	-5330.03	695.87	0	1	46.3	2.724E-03
SOU015053SA001	6/18/2010	-5285.03	650.87	0	1	12.8	7.529E-04
SOU015067SA001	6/18/2010	-5420.03	605.87	0	1	32.5	1.912E-03
SOU015081SA001	6/18/2010	-5555.03	560.87	0	1	107	6.294E-03
SOU015111SA001	6/21/2010	-4970.03	515.87	0	1	4.13	2.429E-04
SOU015RADSA001	10/13/2010	-5396.4549	869.5885	0	1	11.3	6.647E-04
SOU015037ASA001	11/7/2014	-5239.6674	741.4044	0	1	11.2	6.588E-04
SOU015RADSB001	2/5/2015	-5468.3989	792.7407	0	1	34.6	2.035E-03
SOU015025SA004	6/15/2010	-5465.03	785.87	1	4	44.7	2.629E-03
SOU015028SA004	6/15/2010	-5330.03	785.87	1	4	12.1	7.118E-04
SOU015060SA004	6/17/2010	-4970.03	650.87	1	4	1.43	8.412E-05
SOU015052SA004	6/18/2010	-5330.03	650.87	1	4	0.76	4.471E-05
SOU015068SA004	6/18/2010	-5375.03	605.87	1	4	10.2	6.000E-04
SOU015072SA004	6/18/2010	-5195.03	605.87	1	4	0.86	5.059E-05
SOU015110SA004	6/21/2010	-5015.03	527.12	1	4	9.22	5.424E-04
SYC746CGR13	9/15/2004	-5609.94	763.22	3	3	2.1	1.235E-04
SYC746CGR16	9/15/2004	-5437.24	729.29	3	3	3.18	1.871E-04
SYC746CGR18	9/15/2004	-5358.37	725.74	3	3	13.1	7.706E-04
SYC746CGR29	9/15/2004	-5306.92	783.24	3	3	30.6	1.800E-03
SYC746CGR39	9/15/2004	-5329.78	845.96	3	3	4.43	2.606E-04
SYC746CGR45	9/15/2004	-5404.08	851.17	3	3	3.8	2.235E-04
SYC746CGR47	9/15/2004	-5335.6	876.13	3	3	2.75	1.618E-04
SYC746CGR5	9/15/2004	-5499.08	700.29	3	3	19.1	1.124E-03
SYC746CGR7	9/15/2004	-5468	827.87	3	3	183	1.076E-02
SYC746CGR24	9/16/2004	-5532.73	778.44	3	3	20.1	1.182E-03

Note: Concentrations used in the 0–5 ft, 5–10 ft, and 10–15 ft intervals in the SWMU 15 SESOIL model are simple arithmetic averages of available data within those intervals.

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APPENDIX D

BASELINE HUMAN HEALTH RISK ASSESSMENT

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CONTENTS

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FIGURES

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TABLES

ACRONYMS

ABS	dermal absorption factor
AOC	area of concern
AT	averaging time
BAF	bioaccumulation factor
bgs	below ground surface
BHHRA	Baseline Human Health Risk Assessment
BRA	baseline risk assessment
BW	body weight
CAS	Chemical Abstract Service
CDI	chronic daily intake
COC	contaminant of concern
COPC	chemical of potential concern
CSM	conceptual site model
DMSA	U.S. Department of Energy Material Storage Area
DOE	U.S. Department of Energy
DQA	data quality analysis
EC	exposure concentration
ED	exposure duration
EF	exposure frequency
ELCR	excess lifetime cancer risk
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
EU	exposure unit
FS	feasibility study
GI	gastrointestinal tract
HEAST	Health Effects Assessment Summary Tables
HI	hazard index
HQ	hazard quotient
IRIS	Integrated Risk Information System
IUR	inhalation unit risk
KDEP	Kentucky Department for Environmental Protection
KDWM	Kentucky Division of Waste Management
KPDES	Kentucky Pollutant Discharge Elimination System
LLW	low-level waste
NAL	no action level
NCEA	National Center for Environmental Assessment
NFA	no further action
OREIS	Oak Ridge Environmental Information System
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PbB	blood lead
PCB	polychlorinated biphenyl
PGDP	Paducah Gaseous Diffusion Plant
POC	pathway of concern
POE	point of exposure
RAGS	Risk Assessment Guidance for Superfund
RAIS	Risk Assessment Information System
RAO	remedial action objective

RfC	reference concentration
RfD	reference dose
RGA	Regional Gravel Aquifer
RGO	remedial goal option
RI	remedial investigation
RME	reasonable maximum exposure
SAR	SWMU Assessment Report
SE	site evaluation
SF	slope factor
SI	site investigation
SQL	sample quantitation limit
SSL	soil screening level
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TCE	trichloroethene
TEF	toxicity equivalence factor
TPU	total propagated uncertainty
TSCA	Toxic Substances Control Act
UCL95	95% upper confidence limit of the mean
UCRS	Upper Continental Recharge System
VOA	volatile organic analyte
VOC	volatile organic compound
WAG	waste area grouping
WKWMA	West Kentucky Wildlife Management Area
XRF	X-ray fluorescence

BASELINE HUMAN HEALTH RISK ASSESSMENT

This baseline human health risk assessment (BHHRA) addresses 12 solid waste management units (SWMUs)/areas of concern (AOCs) that initially were included in the Soils Operable Unit (OU) remedial investigation (RI) (DOE 2010a). These SWMUs/AOCs include the following: 13, 15, 26, 56 (addressed with 80), 77, 80, 204, 211-A, 224, 225-A (listed as 225 and addressed with 225-B), 225-B (listed as 225 and addressed with 225-A), and 565. During development of the RI Report, it was decided that insufficient information was available for these SWMUs/AOCs and a second RI (i.e., Soils OU RI 2) was planned. Sampling for Soils OU RI 2 activities generally followed the initial Soils OU Work Plan (Work Plan) (DOE 2010a), with exceptions noted in the work plan addendum (DOE 2014). This BHHRA uses information collected during the two RIs, in addition to historical information collected during previous investigations (listed in Section D.1), to characterize the potential baseline risks posed to human health from contact with contaminants in soil at these SWMUs/AOCs and at locations to which contaminants may migrate. A summary of the data is presented Section 5 of the main text.

Part of Goal 3 for the Soils OU RI 2, as presented in the Work Plan (DOE 2010a), was to determine if contaminants at the Soils OU units are present at levels sufficiently high to pose a cancer risk or noncancer hazard to human health or the environment. Risk assessments for potential residential (although not reasonably anticipated), industrial, excavation, and recreational scenarios are presented here. The sampling information collected during the RIs and in earlier investigations, the analyses of these data presented in Section 5 of the main text, and the results of this BHHRA are inputs to determine if response actions are appropriate for the SWMUs/AOCs. This risk assessment also includes modeled concentrations of contaminants in the Regional Gravel Aquifer (RGA) to support the refinement of an assessment of potential risks to human health and the environment through groundwater for those SWMUs/AOCs that had contaminant concentrations exceeding the respective soil screening levels (SSLs) for the RGA (see Appendix C).

The methods and presentations used in this BHHRA are consistent with those presented in *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant* (DOE 2015a). The Risk Methods Document integrates the human health risk assessment guidance from the U.S. Environmental Protection Agency (EPA) and the Kentucky Department for Environmental Protection (KDEP) and incorporates resolutions made in response to regulatory agency comments on earlier risk assessments performed for Paducah Gaseous Diffusion Plant (PGDP). Screening levels have been updated for this Soils OU RI 2 Report and are presented in this appendix.

Consistent with the 2015 revision to the Risk Methods Document (DOE 2015a), the Soils OU RI 2 BHHRA is presented in nine sections, as described below.

- The first section (D.1) reviews the results of previous risk assessments that are useful in understanding the potential cancer risks or noncancer hazards posed to human health by contaminants at or migrating from the source areas.

- The second section (D.2) includes identification of chemicals of potential concern (COPCs) and calculation of exposure point concentrations (EPCs).

- The third section (D.3) documents the exposure assessment for the sources, including the following:

  — The characterization of the exposure setting,

  — Identification of exposure pathways,

— Consideration of land use,

— Determination of potential receptors,

— Delineation of exposure points and routes [including development of the conceptual site model (CSM)], and

— Calculation of chronic daily intakes (CDIs) and exposure concentrations (ECs).

- The fourth section (D.4) presents the following:

— The toxicity assessment, including information on the noncarcinogenic (i.e., systemic toxicity or hazard) and carcinogenic effects of the COPCs, and

— The uncertainties in the toxicity information.

- The fifth section (D.5) reports the following:

— The results of the risk characterization for current and future land uses; and
— Identifies contaminants, pathways, and land use scenarios of concern.

- The sixth section (D.6) contains qualitative and quantitative analyses of the uncertainties affecting the results of the BHHRA.

- The seventh section (D.7) summarizes the methods used in the BHHRA and presents the BHHRA's conclusions and observations.

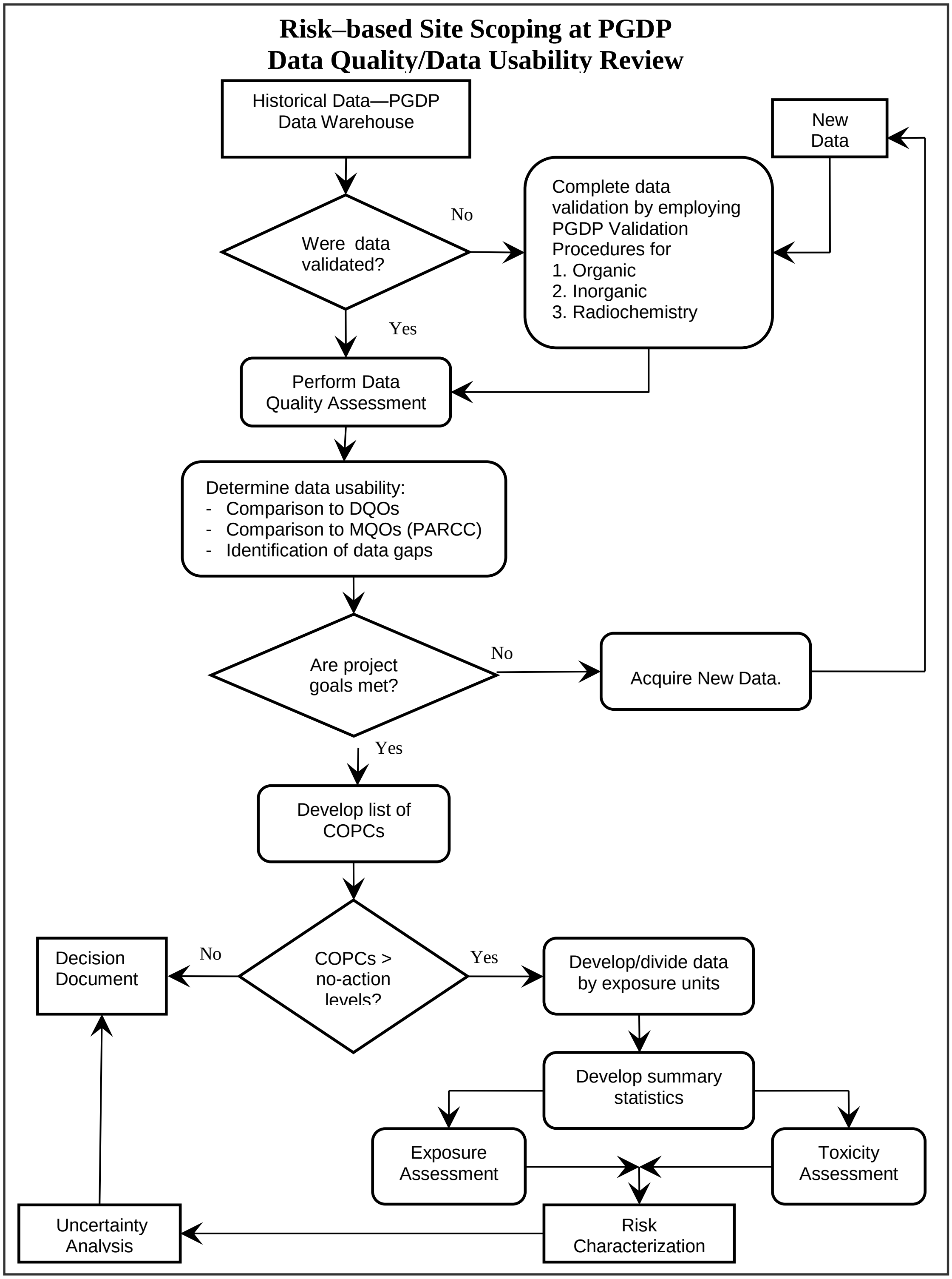
- The eighth section (D.8) uses the results of the BHHRA to develop site-specific risk-based remedial goal options (RGOs).

- The ninth section (D.9) contains references.

The overall risk assessment process is presented in Figure D.1, which graphically displays the steps identified in the preceding section.

D.1. RESULTS OF PREVIOUS STUDIES

Several previous reports contain risk assessment results for one or more of the SWMUs/AOCs considered in this Soils OU RI 2. The results of these assessments are summarized here for each SWMU/AOC. This Soils OU RI 2 includes new soil data (DOE 2010a; DOE 2014) and up-to-date toxicity and exposure parameters (DOE 2015a); therefore, a comparison with historical cancer risk and non-cancer hazard index data was not considered further. Reports containing previous assessments and the year during which the assessment was completed are included in the references to this section. Methodologies used in previous risk assessment likely are different than those used in this BHHRA; therefore, results may differ between the two risk assessments. A comprehensive list of historical projects from which data were collected is presented in Appendix B.



DOE 2013 (Figure D.1)

Figure D.1. BHHRA Flow Chart

D.1.1 SWMU 13, C-746-P CLEAN SCRAP YARDS

These storage yards were emptied, as specified by the *Action Memorandum for Scrap Metal Disposition at the Paducah Gaseous Diffusion Plant* (DOE 2001a) and documented in the *Removal Action Report for the Scrap Metal Removal Action at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 2008a).

The Phase II Site Investigation (SI) (1991) sampled shallow soils in the area. Suspected contaminants of concern for the SWMU soils include semivolatile organic compounds (SVOCs), metals, and radionuclides.

D.1.2 SWMU 15, C-746-C SCRAP YARD

The storage yard was emptied as specified by the *Action Memorandum for Scrap Metal Disposition* (DOE 2001a) and documented in the *Removal Action Report for the Scrap Metal Removal Action* (DOE 2008a).

SWMU 15 is suspected to be a source of radiological and possibly metals contamination, though no documented release has occurred from the area.

D.1.3 SWMU 26, C-400 TO C-404 UNDERGROUND TRANSFER LINE

The area surrounding the line was sampled during the Phase II SI (CH2M HILL 1992) and the Waste Area Grouping (WAG) 6 RI (DOE 1999a), which located SWMU 26 in Sector 8 (refer to Section 4.2.1.3, SWMU 11, *"Background"*). Results of the investigation indicate metals, polycyclic aromatic hydrocarbons (PAHs), and radionuclide contamination occurred from leaks in the pipeline.

Metals and radiological contaminants were found in high concentrations in soil samples collected directly beneath the pipeline, and nickel and copper were detected in a soil sample collected at 7.5 ft bgs in a boring adjacent to the excavated pipeline area. A shallow soil sample (4 ft to 8 ft bgs) at the western most boring exhibited an isolated occurrence of trichloroethene (TCE) and its degradation product, *cis*-1,2-dichloroethene, at a low concentration; but the sample had high radioactivity results. The surface soil did not contain elevated radionuclide activity, which implies that the impact may be the result of a subsurface release.

The summary table from the Baseline Risk Assessment (BRA) for WAG 6, showing which human health risks exceed *de minimis*, is presented as Figure D.2.

D.1.4 SWMU 77, C-634-B SULFURIC ACID STORAGE TANK

The tank was used for the storage of sulfuric acid. Spills and/or releases of sulfuric acid from the storage tank potentially occurred when the unit was in use. This SWMU will be addressed as part of the Soils and Slabs OU, which is scheduled to occur during post-gaseous diffusion plant shutdown activities. No prior risk assessments have been performed for this SWMU.

Scenairo	WAG 6	Location (Sector Number) 1	2	3	4	5	6	7	8	9
Results for ELCR										
Current Industrial Worker	X	–	X	X	X	X	X	X	X	X
Future Industrial Worker		–	X	X	X	X	X	X	X	X
Exposure to Soil	X									
Exposure to Water[a]	X									
Future Excavation Worker	X	X	X	X	X	X	X	X	X	X
Future Recreational User	X	–	–	X	–	X	X	–	X	–
Future On-site Resident		–	X	X	X	X	X	X	X	X
Exposure to Soil	X									
Exposure to Water[a]	X									
Results for systemic toxicity[b]										
Current Industrial Worker	X	–	–	–	–	X	X	X	–	X
Future Industrial Worker		–	–	–	–	X	X	X	–	X
Exposure to Soil	X									
Exposure to Water[a]	X									
Future Excavation Worker	X	X	X	–	X	X	X	X	X	X
Future Recreational User	–	–	–	–	–	–	–	–	–	–
Future On-site Resident		–	X	X	X	X	X	X	X	X
Exposure to Soil	X									
Exposure to Water[a]	X									

[a] In the BHHRA, the risk from exposure to water was assessed on a WAG 6 area basis; therefore, these risks are not summed with those from exposure to soil. Additionally, in the BHHRA, risks associated with use of water drawn from the RGA were assessed separately from risks associated with use of water drawn from the McNairy Formation. The value reported here is for use of water drawn from the RGA.

[b] For the future recreational user and the future on-site resident scenarios, the results for child exposure are presented.

Notes: Scenarios in which risk exceeded *de minimis* levels are marked with an "X". Scenarios in which risk did not exceed *de minimis* levels are marked with a "–".

DOE 1999a (Table 6.1)

Figure D.2. Summary Table from the BRA for WAG 6

D.1.5 SWMUS 56 AND 80, C-540-A PCB STAGING AREA AND C-540 PCB SPILL SITE

Soil boring samples were obtained during the Phase I and Phase II SIs (CH2M HILL 1991, 1992) and during the WAG 23 RI (DOE 1994). Results of these investigations indicate the presence of polychlorinated biphenyls (PCBs).

In 1997, as part of the WAG 23 (DOE 1998a) non-time-critical removal action, 23 yd^3 of soil contaminated with dioxins and 72 yd^3 of soil contaminated with PCBs were excavated from SWMUs 56 and 80. A summary of conclusions from the WAG 23 Remedial Action Report (DOE 1998a), based on the future use scenario of unrestricted industrial, is as follows:

> Following the removal action at WAG 23 sites, the residual PCB ELCR based on a 250 day/year exposure scenario is 2×10^{-6} at SWMUs 56 and 80 and below *de minimis* (i.e., 1×10^{-6}) at SWMUs 57 and 81. In addition, the PCB ELCR at SWMU 1 also is below *de minimis*. These risk levels are well within the EPA's acceptable risk range of 1×10^{-4} to 1×10^{-6}, as required by the NCP.

D.1.6 AOC 204, DYKE ROAD HISTORICAL STAGING AREA

The AOC was sampled during the SE (DOE 1995) at Kentucky Pollutant Discharge Elimination System (KPDES) Outfalls 010, 011, and 012 in September 1995 and again as part of the WAG 28 RI/Feasibility Study (FS) in 1999 (DOE 1998b), which showed TCE was a concern at this location.

A BHHRA was performed on AOC 204. It was evaluated under different scenarios for which human health risk exceeds *de minimis* levels [i.e., a cumulative human health excess lifetime cancer risk (ELCR) of 1E-06 or a cumulative hazard index (HI) of 1]. Results from the BHHRA indicated risks above *de minimis* levels for the following scenarios:

- Current industrial worker exposure to RGA groundwater;
- Future industrial worker exposure to RGA groundwater;
- Current off-site resident exposure to groundwater;
- Future off-site resident exposure to groundwater;
- Current on-site resident exposure to RGA groundwater;
- Future on-site resident exposure to RGA groundwater; and
- Future excavation worker exposure to soil.

A Baseline Ecological Risk Assessment was not required due to the potential source of contamination being contained within the subsurface.

D.1.7 SWMU 211-A, C-720 TCE SPILL SITE NORTHEAST

Subsurface soil borings and groundwater samples were collected and analyzed as part of the WAG 27 RI/FS for the C-720 complex. Results of the investigation detected the presence of arsenic, beryllium, and vinyl chloride in subsurface soils. WAG 27 stated that surface soils were not evaluated because most of the surface surrounding the C-720 was covered with asphalt and concrete. Conclusions from WAG 27 are that the ELCR and systemic toxicity exceed KDEP and EPA accepted standards for future excavation worker (DOE 1999b).

D.1.8 SWMU 224, C-340, OS-13

U.S. Department of Energy (DOE) Material Storage Area (DMSA) C-340, OS-13 has been fully characterized and contains no fissionable material (DOE 2002). No prior risk assessments have been performed for this SWMU.

D.1.9 SWMU 225, C-533-1, OS-14

SWMU 225 includes both SWMU 225-A and 225-B. SWMU 225-A, also known as DMSA C-533-1, OS-14, has been fully characterized and contains no fissionable material (DOE 2001b). No prior risk assessments have been performed for this SWMU.

D.1.10 AOC 565, RUBBLE AREA K-19

Investigation results can be found in the SE Report for Rubble Area (DOE 2010b).

This area was discovered in November 2006 during walkover/radiological surveys after soil and rubble areas were found along Little Bayou and Bayou Creeks. This rubble area was designated as Rubble Area K-19. The readings collected in November 2006 were unfiltered 200 cpm (background is ~ 50 cpm), fixed contamination, and no measurable dose. The area was posted immediately. The area was cleared and revisited on March 25, 2009, at which time only the top of the creek bank was accessible due to water in the creek.

During a site visit on March 25, 2009, the following information was gathered:

(1) There are no visible oil stains on the rubble;

(2) The material is serving a beneficial function (erosion control of the creek bank); and

(3) The radiological readings obtained during March 2009 on top of the creek bank were background. Radiological readings obtained on an accessible concrete slab within the creek bank during November 2006 indicated 200 cpm fixed readings, no measurable dose.

D.2. IDENTIFICATION OF COPCs

This subsection describes the process used to determine the list of COPCs used in the BHHRA. Specifically, this subsection describes the sources of data, the procedures used to screen the data, and the methods used to derive EPCs under both current and future conditions. Additionally, this section describes the site characterization data used in the exposure assessment performed in Section D.3.

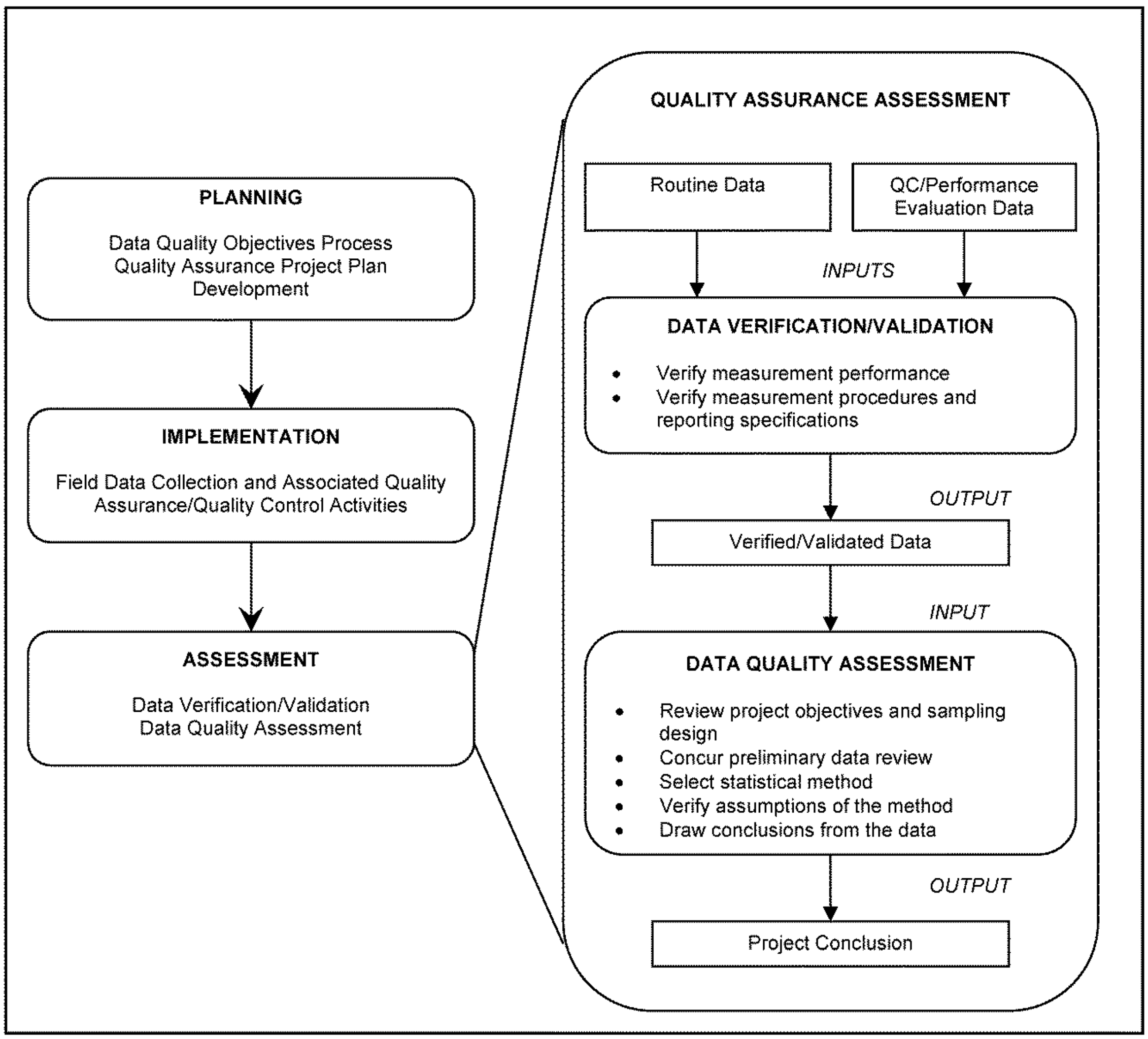
The SWMU/AOC evaluations in the Nature and Extent sections of the main text focused on summarizing the representative analytical results for surface and subsurface soils. The process for highlighting chemicals of greatest potential interest in the Nature and Extent sections of the main text, consistent with the Soils OU Work Plan (DOE 2010a), considered background concentrations, action levels and no action levels (NALs) (for industrial worker on-site and teen recreator off-site, see Attachment D1), and groundwater protection SSLs for the Upper Continental Recharge System (UCRS) and RGA (see Appendix C). This screening, discussed above, was independent of COPC identification (i.e., using background concentrations and residential NALs) for this BHHRA.

D.2.1 SOURCES OF DATA

Data used in the BHHRA describing current contaminant concentrations in surface and subsurface soil and modeled groundwater concentrations at all SWMUs/AOCs that were sampled during the summer of 2010 and the fall of 2014 were derived from the recently completed Soils OU RI sampling (DOE 2010a) and RI 2 sampling (DOE 2014), as well as historical data acquired from the Paducah Oak Ridge Environmental Information System (OREIS) database. The nature and extent of contamination in surface and subsurface soils are described in Section 5 of the main text.

D.2.2 GENERAL DATA EVALUATION CONSIDERATIONS

This section describes the data evaluation steps that were used to ensure that the soil data were appropriate for use in BHHRAs. A general description of the eight steps used and their outcome in relation to the Soils OU RI 2 BHHRA data set are provided in this section. A graphical presentation of this process is shown in Figure D.3.



DOE 2015a (Figure 3.2)

Figure D.3. Data Evaluation Steps

D.2.2.1 Evaluation of Sampling

Data were examined to ensure that sampling methods were adequate for determining the nature and extent of contamination and were representative of site conditions. It was determined that samples of the Soils OU RI, Soils OU RI 2, and those selected from the Paducah OREIS database were collected using appropriate methods that were consistent with each project's work plan.

D.2.2.2 Evaluation of Analytical Methods

Methods used to collect and analyze the selected surface soil and subsurface soil samples were evaluated to determine if they were those approved by EPA. As described in work plans and project reports (see Section 5 of the main text and Appendix B), the analytical methods used for surface and subsurface soil samples meet these requirements.

The data evaluation and COPC identification steps include a comprehensive evaluation of the analytical data collected during the nature and extent definition for a site. The data collection and evaluation by media were included as part of the nature and extent discussion section for each SWMU/AOC. The data quality analysis (DQA) section (Appendix B) identifies the quality assurance/quality control-related issues to determine which data are useable for evaluations performed in the Soils OU RI 2. The data used for the COPC selection were validated in accordance with the DQA.

To address the data set for the SWMUs more comprehensively, plutonium-239 data were evaluated as plutonium-239/240 and uranium-235/236 were evaluated as uranium-235.

The Soils OU RI and Soils OU RI 2 data include field screening such as X-ray fluorescence (XRF) data. The primary use of such data is for site characterization, but this survey-type data [called field data in the Work Plan (DOE 2010a)] also can play a role in risk-based decision making. Survey-type data assist in determining the distribution of COPCs and can be used to identify which sets of laboratory data should be combined to develop site average contaminant concentrations. The XRF data were evaluated to determine if some or all could be combined with laboratory data for use in the risk assessment to determine the average concentrations for contaminants by evaluating whether the laboratory and XRF data possess similar detection limits and analytical uncertainty. This analysis was conducted (included in Appendix B) and indicated that a subset of XRF data qualified for use in the risk assessment in conjunction with the laboratory data. Similarly, use of XRF data was applied to historical data. The Risk Methods Document (DOE 2015a) allows for use of this type of data after the DQA is performed. Any uncertainties associated with the results that impact potential decisions are highlighted in the Uncertainties Section, D.6.

D.2.2.3 Evaluation of Sample Quantitation Limits

The sample quantitation limits (SQLs) used in the analyses of the selected soil samples were examined to determine if these limits were below the concentration at which the contaminant may pose a risk to human health. Generally, the SQLs for each analyte met this goal. Table D.1 presents a comparison between each undetected analyte's maximum SQLs for soil for the Soils OU RI 2 data set and the analyte's residential use no action screening value. Appendix B presents a comparison between each undetected analyte's maximum SQL for soil and the historical data set and the analytes residential use no action screening value. The implications of this finding upon risk characterization (presented in this BHHRA) are discussed in Section D.6, "Uncertainty in the Risk Assessment."

Table D.1. Comparison between Undetected Analyte's Maximum SQLs and Site-Specific Soil Screening Levels[a]

Analyte	Frequency of Detection[b]	Maximum SQL	No Action Screening Value[c]	Units	Screening Value Exceeded?
Inorganic Compounds					
Arsenic	77/749	10	0.267	mg/kg	Yes
Cadmium	72/73	0.02	5.07	mg/kg	No
Chromium	79/749	12	16.4	mg/kg	No
Copper	691/749	4	313	mg/kg	No
Lead	130/749	3	400	mg/kg	No
Manganese	748/749	24	183	mg/kg	No
Mercury	67/748	40	2.35	mg/kg	Yes
Molybdenum	125/749	3	39.1	mg/kg	No
Nickel	596/749	4	155	mg/kg	No
Selenium	75/749	3	39.1	mg/kg	No
Silver	90/749	50	39.1	mg/kg	Yes
Uranium	115/749	10	23.4	mg/kg	No
Vanadium	743/749	5	39.3	mg/kg	No
Zinc	748/749	1	2350	mg/kg	No
PCBs					
PCB, Total	27/738	5	0.0782	mg/kg	Yes
Semivolatile Organic Compounds					
2-Nitrobenzenamine	0/73	0.93	33.2	mg/kg	No
Acenaphthene	0/73	0.46	171	mg/kg	No
Acenaphthylene	0/73	0.46	171	mg/kg	No
Anthracene	0/73	0.46	854	mg/kg	No
bis(2-ethylhexyl)phthalate	1/73	0.46	14.3	mg/kg	No
Fluoranthene	19/73	0.43	114	mg/kg	No
Fluorene	0/73	0.46	114	mg/kg	No
Hexachlorobenzene	0/73	0.0046	0.126	mg/kg	No
Naphthalene	1/73	0.46	3.83	mg/kg	No
N-Nitroso-di-n-propylamine	0/73	0.46	0.0287	mg/kg	Yes
Pentachlorophenol	0/73	0.83	0.243	mg/kg	Yes
Phenanthrene	15/73	0.46	171	mg/kg	No
Pyrene	18/73	0.46	85.4	mg/kg	No
Volatile Organic Compounds					
1,1,1-Trichloroethane	0/23	0.0058	815	mg/kg	No
1,1,2-Trichloroethane	0/23	0.0058	0.15	mg/kg	No
1,1-Dichloroethane	0/23	0.0058	3.55	mg/kg	No
1,1-Dichloroethene	0/23	0.0058	22.7	mg/kg	No
1,2-Dichloroethane	0/23	0.0058	0.464	mg/kg	No
1,2-Dimethylbenzene	0/23	0.0058	64.5	mg/kg	No
Acrylonitrile	0/23	0.058	0.255	mg/kg	No
Benzene	0/23	0.0058	1.16	mg/kg	No
Bromodichloromethane	0/23	0.0058	0.293	mg/kg	No
Carbon Tetrachloride	0/23	0.0058	0.653	mg/kg	No
Chloroform	0/23	0.0058	0.316	mg/kg	No
cis-1,2-Dichloroethene	0/23	0.0058	15.6	mg/kg	No
Dichlorodifluoromethane	0/23	0.0058	8.72	mg/kg	No
Ethylbenzene	0/23	0.0058	5.78	mg/kg	No
m,p-Xylene	1/23	0.0058	58.4	mg/kg	No

Table D.1. Comparison between Undetected Analyte's Maximum SQLs and Site-Specific Soil Screening Levels (Continued)

Analyte	Frequency of Detection[b]	Maximum SQL	No Action Screening Value[c]	Units	Screening Value Exceeded?
Tetrachloroethene	0/23	0.0058	8.1	mg/kg	No
trans-1,2-Dichloroethene	0/23	0.0058	14.3	mg/kg	No
Trichloroethene	0/23	0.0058	0.412	mg/kg	No
Vinyl Chloride	0/23	0.0058	0.0592	mg/kg	No
Radionuclides					
Americium-241	3/79	0.0462	3.03	pCi/g	No
Cesium-137	41/79	0.0265	0.116	pCi/g	No
Neptunium-237	19/79	0.0258	0.239	pCi/g	No
Plutonium-238	25/79	0.02	4.42	pCi/g	No
Plutonium-239/240	30/79	0.0273	3.87	pCi/g	No
Technetium-99	21/79	0.71	117	pCi/g	No
Uranium-235	66/79	0.0396	0.347	pCi/g	No

[a] Results shown are over all soil samples collected within SWMUs/AOCs investigated for the Soils OU RI 2 in the fall of 2014. Comparison for historical data is shown in Appendix B.
[b] Number of detected results over total number of samples collected within SWMUs/AOCs investigated for the Soils OU RI 2 in the fall of 2014.
[c] Risk-based screening values are derived in Attachment D1. The screening values are the lesser of the HI and ELCR NALs used for the child resident of 0.1 and 1E-06, respectively. Only those for PGDP significant COPCs are shown (Table 2.1 of DOE 2015a).

Consistent with the Risk Methods Document (DOE 2015a), if the maximum SQL for an analyte over all samples within a medium exceeded the no action screening value, then the data for that analyte was deemed of uncertain quality, and a qualitative assessment for that analyte was performed. In developing the qualitative assessment for such chemicals, the maximum SQL for the chemical is used in the qualitative assessment if historical or process knowledge indicates that the chemical potentially could be present. If historical or process knowledge indicates that the chemical is not expected to be present, one-half of the SQL is used in the qualitative assessment (EPA 1991). The qualitative analysis is presented in Section D.6, "Uncertainty in the Risk Assessment."

D.2.2.4 Evaluation of Data Qualifiers and Codes

The soil data used in the BHHRA were tagged with various qualifiers and codes. Tagged data were evaluated following rules in Exhibits 5-4 and 5-5 of the Risk Assessment Guidance for Superfund (RAGS) (EPA 1998). Generally, this resulted in the retention of all results for which the identity of the analyte was certain even if there was substantial uncertainty in the analyte concentration within an individual sample. The qualifiers and codes attached to the soil data used in the BHHRA are defined in Table D.2. (Note: Consistent with the Risk Methods Document, radionuclides with negative activity values[1] were used in the calculation of EPCs in this BHHRA.)

Data rejected by validation were not used in the human health and ecological risk assessments. The Soils OU RI 2 data rejected by validation were volatile organic compound (VOC) analyses: acrolein (1 rejected of 6 data points), ethyl methacrylate (1 rejected of 6 data points), and vinyl acetate (1 rejected of 6 data points). These VOCs were rejected for having 0% recovery in their matrix spike/matrix spike duplicate quality control samples. The risk assessment does not identify any of the rejected VOC analyses as a COPC for the Soils OU RI 2 because none of these VOCs were detected; thus, the rejection of these data points has little importance.

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[1] Negative results may be reported due to a statistical determination of the counts seen by a detector, minus a background count.

Table D.2. Definitions of Qualifiers and Codes Present in the OREIS Data Set Used for the BHHRA of the Soils Operable Unit Remedial Investigation

Qualifier	Definition	Data Used?
Field = VALIDATION (Validation Qualifier)		
=	Validated result that is detected and unqualified.	Yes
E	E = ?	Yes
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.	Yes
N	The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification."	Yes
R	Result rejected due to quality deficiency.	No
U	The analyte was analyzed for, but was not detected above the reported sample quantitation limit.	Yes
X	Not validated; refer to RSLTQUAL field for more information.	Yes
XV	Not validated; refer to RSLTQUAL field for more information.	Yes
?	Not validated; refer to RSLTQUAL field for more information.	Yes
Field = RSLTQUAL (Result Qualifier)		
Blank	Result not qualified.	Yes
*	Duplicate analysis is not within control limits.	Yes
<	Numerical value reported was less than the requested reporting limit (e.g., MDL, MDA, RRL, IDL).	Yes
>	Actual value was greater than the reported result.	Yes
A	Semivolatile organic analyte/volatile organic analyte (SVOA/VOA): TIC (Tentatively Identified Compound) was suspected aldol condensation product; PPCB/SVOA/VOA: Suspected aldol-condensation product (pre-05/30/03 definition); RADS: Analyzed but not detected at the analyte quantitation limit.	Yes
B	Inorganic: The result is less than the project contract required detection limit, but greater than the instrument detection limit.	Yes
C	PPCB: Pesticide confirmed by GC/MS(Gas Chromatography/Mass Spectrometry); METAL: Possible contamination	Yes
D	Identified at secondary dilution.	Yes
E	Inorganic: Estimated value; matrix interference.	Yes
	Organic: Concentration exceeds calibration range of gas chromatograph/mass spectrometer.	Yes
G	BIOTOX: Male	Yes
J	Estimated value, tentatively identified compound, or less than specified detection limit.	Yes
K	RADS: Missing one or more lines in spectrum	Yes
N	Inorganic: Spike recovery not within control limits.	Yes
	Organic: Applied to TIC results, except generic characteristics.	Yes
P	HERB/PPCB: > 25% difference between two columns for Pesticides/Aroclors	Yes
R	Rejected	No
S	METAL/TCLPMET: Determined by Method of Standard Additions; DI FURA: Signal-to-noise ratio of the confirmation ion does not meet 2.5 S/N requirement but peak was determined to be positive in the judgment of the GC/MS analyst	Yes
T	Tracer recovery is less than 20% or greater than 105%.	Yes
U	ALL ANALYSIS TYPES EXCEPT RADS: Not detected; RADS: Value reported is < MDA and/or total propagated uncertainty (TPU).	Yes
W	METAL: Post-digestion spike for atomic absorption out of control limit.	Yes
X	Flag one; defined in COMMENTS field.	Yes
Y	Chemical yield exceeds acceptance limits; Organic: matrix spike, matrix spike duplicate recovery, and/or relative percent difference failed acceptance criteria.	Yes

D.2.2.5 Elimination of Chemicals Not Detected

Consistent with the Risk Methods Document (DOE 2015a), any analyte passing the earlier screens and not detected in at least one sample using an appropriate SQL was eliminated from the data set. These data are not considered further in this BHHRA.

D.2.2.6 Examination of Toxicity of Detected Analytes

Each analyte's maximum detected concentration in the data set was compared to that analyte's residential use no action human health risk-based screening value for soil. These screening values are derived in Attachment D1 in order to use the most recent toxicity values and exposure parameters. Consistent with the Risk Methods Document (DOE 2015a), this screen was not applied to those analytes known to accumulate significantly in biota (i.e., not used for analytes with a bioaccumulation factor for fish greater than 100).

D.2.2.7 Examination of Analyte Maximum Concentrations for Essential Human Nutrients Detected in Site Samples to Recommended Dietary Allowances for Children

Seven analytes known to be essential nutrients and known to be toxic only at extremely high concentrations were removed from the data set. These analytes were calcium, chloride, iodine, magnesium, phosphorus, potassium, and sodium. Consistent with the Risk Methods Document (DOE 2015a), no other analytes were removed from the data set based upon the essential nutrient screen.

D.2.2.8 Comparison of Analyte Maximum Concentrations and Activities Detected in Site Samples to Analyte Concentrations and Activities Detected in Background Samples

Consistent with the 2015 revision to the Risk Methods Document, a background screen was used to develop the BHHRA data set. Table D.3 shows the current PGDP background concentration for surface and subsurface soils used in the screening process.

D.2.2.9 RI Analytes

For this project, both historical, Soils OU RI data, and Soils OU RI 2 data were combined into one dataset; however, only those analytes listed in the approved Work Plan (DOE 2010a) were evaluated for this BHHRA. Data were downloaded from the Paducah OREIS database in November 2014. Data from within the grids and exposure units (EUs) for each SWMU/AOC that were in the approved work plan addendum (DOE 2014) in addition to stepout grids necessary for the SWMU/AOC, were downloaded. Appendix B addresses data quality and applicability of the historical data. The potential for undetermined risk from historical data not evaluated during this BHHRA is addressed in the Uncertainties Section, D.6.

D.2.3 RISK ASSESSMENT SPECIFIC DATA EVALUATION

This section discusses details associated with the surface soil data set, the subsurface soil data set, and groundwater modeling data set used to examine potential current and future ELCRs and HIs to human health presented in this BHHRA.

Table D.3. Provisional Background Concentrations for Surface and Subsurface Soil at PGDP

Analyte	Background Value	
Inorganic Chemicals (mg/kg)	**Surface**	**Subsurface**
Aluminum	13,000	12,000
Antimony	0.21	0.21
Arsenic	12	7.9
Barium	200	170
Beryllium	0.67	0.69
Cadmium	0.21	0.21
Calcium	200,000	6,100
Chromium (III)	16	43
Cobalt	14	13
Copper	19	25
Iron	28,000	28,000
Lead	36	23
Magnesium	7,700	2,100
Manganese	1,500	820
Mercury	0.2	0.13
Nickel	21	22
Potassium	1,300	950
Selenium	0.8	0.7
Silver	2.3	2.7
Sodium	320	340
Thallium	0.21	0.34
Uranium	4.9	4.6
Vanadium	38	37
Zinc	65	60
Radionuclide (pCi/g)	**Surface**	**Subsurface**
Cesium-137	0.49	0.28
Neptunium-237[a]	0.1	---
Plutonium-238[a]	0.073	---
Plutonium-239[a]	0.025	---
Potassium-40	16	16
Radium-226	1.5	1.5
Strontium-90[a]	4.7	---
Technetium-99	2.5	2.8
Thorium-228	1.6	1.6
Thorium-230	1.5	1.4
Thorium-232	1.5	1.5
Uranium-234	1.2[b]	1.2[b]
Uranium-235	0.06[b]	0.06[b]
Uranium-238	1.2	1.2

Notes: Cells with "---" indicated data are not available or not applicable.
Values contained in this table are taken from the Risk Methods Document (DOE 2015a), but have not been approved for all uses by the PGDP Risk Assessment Working Group; therefore, the values presented here are provisional values and subject to change.
[a] Concentrations for these radionuclides in subsurface soil were not derived.
[b] The values listed for uranium-234 and uranium-235 are not from the 1996 background study, but are derived from the natural isotopic abundance ratio and the uranium-238 values. The values for these radionuclides that appeared in the 2001 version of the Risk Methods Document (DOE 2001c) were the upper tolerance limits (UTLs) of measured values for the individual isotopes as reported in the PGDP background study (DOE 1997).

D.2.3.1 Current Conditions

The specific processes used to evaluate data and calculate EPCs under current conditions are described in this section. The analyte's names were checked to ensure that names and Chemical Abstract Services (CAS) numbers were uniform. This activity was performed so that the analyte names and CAS numbers in the data set matched those used in the PGDP toxicity database presented in the Risk Methods Document (DOE 2015a).

D.2.3.2 Evaluation of Concentrations for Soil

The following describes the processes that were used in the surface and subsurface COPC selection. For this screening and the subsequent BHHRA, surface soil was defined as 0–1 ft bgs and subsurface soil was defined as 0–16 ft bgs. All surface soil samples at the sites were evaluated together as soil whether the sample came from the SWMU/AOC surface area or the surrounding ditches. For SWMU 13, samples collected during the fall of 2014 remedial investigation collected "surface soil" samples at first contact of soil beneath overlying rock. These samples, despite the depth collected, are considered surface samples for purposes of this Soils OU RI 2.

SWMUs/AOCs were divided into EUs consistent with the Risk Methods Document (DOE 2015a). EUs are areas within a site that, because of similar levels of contamination or because of expected human activity patterns, can be assessed reasonably using one EPC for each COPC. EUs typically are 0.5 acre in size.

- *Convert units of measure to a consistent basis.* The units of measure used for analyte classes (i.e., inorganic chemicals, organic compounds, and radionuclides) were assigned consistent units of measure. The units of measure used were mg/kg for inorganic chemicals and organic compounds and pCi/g for radionuclides. This activity was performed so that the units of measure in the data set matched those found in the equations that are used to calculate CDIs and ECs as part of the BHHRA.

- *Categorize all sample results as detects or nondetects.* Each result was coded either detected or nondetected based upon the data qualifier codes present in the data set. Any data assigned a "U" or "UJ" qualifier was considered to be nondetected. All radiological data were considered detects for this project and used at the reported value. This coding subsequently was used to calculate the frequency of detection statistics and to assign surrogate values to results listed as nondetects.

- *Analyze duplicate samples.* Duplicate samples were available for some sample analyses. In cases where the value from the original sample and its duplicate both were detected values, the greater of the results from the original sample and its duplicate was retained in the data set. In cases where one value was a detected value and the other was a nondetect, the detected value was retained in the data set. Finally, when both values were listed as nondetects, the lesser of the two detection limits was retained in the data set.

- *Compare maximum detected concentrations to human health screening values.* The maximum detected result for each analyte within a SWMU/AOC or EU (for SWMUs/AOCs large enough to contain more than one EU) was compared to NAL screening values for soil use as part of the toxicity screen. Analytes with a maximum detected value less than the analyte's NAL were not retained as COPCs. The values used to screen surface and subsurface soil were the direct contact residential child NAL values are derived in Attachment D1, consistent with methods in the Risk Methods Document (DOE 2015a). The EPA residential screening levels for lead in soil (400 mg/kg) were used to screen lead to determine if it is a COPC. For all scenarios, PCBs and PAHs were screened and evaluated in the BHHRA using the Total PCB values and Total PAH values calculated following the Risk Methods Document (DOE 2015a).

- *Compare maximum detected concentrations to PGDP background soil levels for metals and radionuclides.* The maximum detected result for each analyte within a SWMU/AOC or EU (for SWMUs/AOCs large enough to contain more than one EU) was compared to the background levels of metals and radionuclides (Table D.3) that have been negotiated with EPA and KDEP. [Surface soil background levels were used for all but the outdoor worker (exposed to surface and subsurface soil) and the excavation worker where subsurface soil background levels were used for screening.] Analytes with a maximum detected value less than the analyte's associated background value are not retained as COPCs.

- *Remove essential nutrients from the data sets.* Results for the seven essential nutrients listed earlier were removed from the data sets.

- *Remove protactinium-234m (Pa-234m), potassium-40 (K-40), and thorium-234 (Th-234) from the data sets.* All results for Pa-234m were removed to prevent double-counting its contribution to cancer risk through use of a toxicity value for U-238 that includes its short-lived progeny. All K-40 and Th-234 results were removed to be consistent with the Risk Methods Document and earlier BHHRAs prepared for PGDP (DOE 2015a).

Analytes retained as surface soil COPCs under current conditions are presented for each SWMU/AOC in Table D.4 (located on CD). Analytes retained as subsurface soil COPCs under current conditions are presented for each SWMU/AOC in Table D.5 (located on CD). Tables D.4 and D.5 include a listing of all detected analytes in soil samples. In addition to the analyte's name, human health risk-based screening value, and background value, each table also contains the analyte's frequency of detection, whether it was chosen as a COPC, and the COPC's EPCs for use in the risk and hazard calculations.

EPCs were calculated for each EU for those constituents that are retained as COPCs. For each COPC, data were summarized within each sampling grid before calculating the EPC for the EU. This was necessary to ensure that each sampling grid was represented equally (i.e., received equal weight) in the EU EPC calculation. Section 4 of the main text further illustrates this implementation. Tables D.6 and D.7 (located on CD) present the Soils OU RI 2 data set for surface and subsurface soils, respectively, with the assigned grid values and the EPC.

The representative sampling design for the SWMUs was gridding. In instances where a grid lacks a sample result, the average of the grids within the EU with sampling results was used. Attachment D2 presents an uncertainty evaluation in determining EPC values using these averages against EPC values calculated without using the averages or the maximum value, as applicable. An example for determining the EPC through averaging is illustrated below.

If the SWMU/EU combination had less than 10 grids, the maximum grid result was used as the EPC. If the SWMU/EU combination had 10 or more grids, the grid values were used to determine the 95% upper confidence level of the mean (UCL95). Grid values were determined following guidance in the Work Plan (DOE 2010a). Basically, the maximum detected result from within the grid applies to the grid. If not detected, the minimum detection limit applies to the grid.

If a grid had no result (detect or nondetect) for the COPC, an average of the results for the grids with results was used. See Figure D.4 for an example illustrating this average.

The UCL95 is calculated using the recommended result from ProUCL (Version 5.0), an EPA-provided software (EPA 2013), as specified in the Risk Methods Document (DOE 2015a).

In some instances, ProUCL (Version 5.0) will calculate the UCL95 as greater than the maximum value. In these cases, the UCL95 was used at the EPC. The uncertainty of using a UCL95 greater than the maximum detected result is discussed in Section D.6.

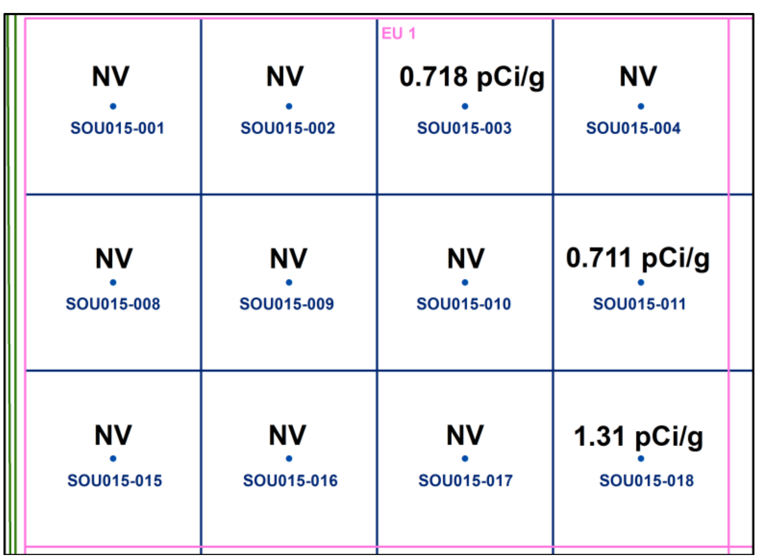
NO RESULT	RESULT = 9	NO RESULT	RESULT = 2
RESULT = 7	NO RESULT	RESULT = 3	NO RESULT
RESULT = 3	NO RESULT	RESULT = 5	RESULT = 5

For grids with “NO RESULT,” the average of the grids with results was used [i.e., (9+2+7+3+3+5+5)/7= 4.86]. The UCL95 would be calculated from the following:

4.86
9
4.86
2
7
4.86
3
4.86
3
4.86
5
5

Figure D.4. Example Illustrating Average Calculation in Soils OU EU

A representative calculation using uranium-238 results for SWMU 15, EU 1 is shown here as an example. For SWMU 15, uranium-238 is a COPC for EU 1. Grid concentrations are listed in Figure D.5.



NV indicates no value for the grid.

Uranium-238 in EU 1	
0.913*	0.913*
0.913*	0.711
0.718	0.913*
0.913*	0.913*
0.913*	0.913*
0.913*	1.31
EPC =	0.989

*Indicates average of actual values used for calculation (i.e., the average of actual values 0.718, 0.711, and 1.31).

Figure D.5. Values for Calculating UCL95 of Uranium-238 in Subsurface Soil at SWMU 15, EU 1

The EPC is determined consistent with the Risk Methods Document (DOE 2015a). If results from ten or more samples are available, then a distribution check is performed, and the EPC latest version of EPA's ProUCL software (Version 5.0) incorporates a number of different distributional tests to calculate the most appropriate UCL95 (EPA 2013). If more than one potential UCL95 is suggested, the first value is used. Attachment D3 presents the output from the ProUCL software (Version 5.0).

D.2.3.3 Evaluation of Modeled Concentrations for Groundwater

Groundwater modeling was done in a similar manner as the process described above for surface/subsurface soil. SSLs are risk-based soil concentrations considered to be protective of groundwater (DOE 2015a). These SSLs were derived as described in Appendix C and used to screen soil sampling results to select COPCs for RGA groundwater. Analytes retained as COPCs are presented for each SWMU/AOC in Appendix C. Selected analytes then were modeled as described in Appendix C.

As presented in Appendix C, technetium-99 present in soil at SWMUs 13 and 15 has the potential to impact the RGA groundwater at the SWMU/AOC boundary.

D.3. EXPOSURE ASSESSMENT

This section describes the exposure assessment used to determine the pathways of exposure that were considered for the surface and subsurface soil at the source units that are part of the Soils OU RI 2. Specifically, the exposure assessment process is delineated, the exposure settings of the Soils OU are described, the routes of exposure are outlined, and the daily intakes and doses are derived. The ultimate products presented in this section are the CSM for the Soils OU and the CDIs and ECs used when calculating ELCR and HI in Section D.5.

D.3.1 DESCRIPTION OF THE EXPOSURE ASSESSMENT PROCESS

Exposure is the contact of an organism with a chemical or physical agent. The magnitude of exposure (i.e., dose) is determined by measuring or estimating the amount of an agent available at exchange boundaries (e.g., gut, skin, etc.) during a specified period. Exposure assessment is a process that uses information about the exposure setting and human activities to develop CSMs under current and potential future conditions.

The first step in the exposure assessment is to characterize the exposure setting. This includes describing the activities of the human population (on or near a site) that may affect the extent of exposure and the physical characteristics of the site. During this process, sensitive subpopulations that may be present at the site or that may be exposed to contamination migrating from the site also are considered. Generally, site characterization results in a qualitative evaluation of the site and the surrounding population.

The second step in the exposure assessment is to identify exposure pathways. Exposure pathways describe the path a contaminant travels from its source to an individual. A complete exposure pathway includes all links between the source and the exposed population; therefore, a complete pathway consists of a source of release, a mechanism of release, a transport medium, a point of potential human contact, and an exposure route.

The third step in the exposure assessment is to calculate dose by quantifying the magnitude, frequency, and duration of exposure for the populations for the exposure pathways selected for quantitative evaluation. This step involves using the EPCs developed for each COPC to quantify the pathway-specific CDIs and ECs for that COPC.

D.3.2 CHARACTERIZATION OF THE EXPOSURE SETTING

The first step in evaluating exposure is to characterize surface features, meteorology, geology, demography and land use, ecology, hydrology, and hydrogeology of the area inhabited by potential receptors. These aspects are discussed in Section 3 of the main text. Physical descriptions of the SWMUs/AOCs are summarized within this exposure assessment to support later discussions of the conceptual model and its uncertainties.

D.3.2.1 SWMU 13, C-746-P Clean Scrap Yards

The C-746-P and C-746-P1 Clean Scrap Yard (SWMU 13) are located in the northwest corner of the plant site. SWMU 13 includes scrap yards C-746-P and C-746-P1 and is approximately 314,000 ft^2 (290 ft × 1,076 ft). This SWMU is part of the Soils OU and the Burial Grounds OU.

SWMU 13, C-746-P Clean Scrap Yard, was an aboveground scrap yard used for storage from the 1950s to 2005 for clean scrap metal prior to sale to metal reclaimers. During the summer of 1989, some scrap at the yard was found to be contaminated by uranium. Based on this discovery, the site was divided into a contaminated scrap yard, comprising approximately the eastern two-thirds of the original waste management unit and designated as C-746-P, and a clean scrap yard, comprising approximately the western one-third of the original unit and designated C-746-P1. Suspected contaminants of the scrap metal include uranium and asbestos. The scrap yard also contained drums of “heels” of remnant fluids potentially contaminated by petroleum hydrocarbons and TCE.

These storage yards were emptied, as specified by the *Action Memorandum for Scrap Metal Disposition* (DOE 2001a) and documented in the *Removal Action Report for the Scrap Metal Removal Action* (DOE 2008a).

D.3.2.2 SWMU 15, C-746-C Scrap Yard

The C-746-C Scrap Yard (SWMU 15) is located in the northwest corner of the plant site. SWMU 15 is approximately 250,000 ft^2.

The C-746-C Scrap Yard originally was used to store uncontaminated scrap metal prior to being shipped off-site; however, it was converted to long-term storage of scrap metal after off-site shipments were discontinued. It is divided into north and south areas to segregate the space into two different storage yards. A large portion of the south section was used for storage of ingots produced in the C-746 smelting operations and turnings from the machine shop. Most of the north section was used in the construction of the C-616 Chromate Treatment Facility and clarifiers.

The storage yard was emptied as specified by the *Action Memorandum for Scrap Metal Disposition at* (DOE 2001a) and documented in the *Removal Action Report for the Scrap Metal Removal Action* (DOE 2008a).

D.3.2.3 SWMU 26, C-400 to C-404 Underground Transfer Line

The C-400 to C-404 Underground Transfer Line (SWMU 26) is located in the central portion of the plant site. SWMU 26 is a 4-inch steel line, approximately 1,500-ft long. From 1951 to 1956, SWMU 26 was used to transfer uranium-contaminated solutions from C-400 to C-404 for settling prior to discharge. The transfer line was abandoned in 1957.

D.3.2.4 SWMU 77, C-634-B Sulfuric Acid Storage Tank

The C-634-B Sulfuric Acid Storage Tank (SWMU 77) is located in the southeast portion of the plant site. The tank has been removed, but the concrete dike still is in place. The tank was used for the storage of sulfuric acid. Spills and/or releases of sulfuric acid from the storage tank potentially occurred when the unit was in use. This SWMU will be addressed as part of the Soils and Slabs OU, which is scheduled to occur during post-gaseous diffusion plant shutdown activities.

D.3.2.5 SWMUs 56 and 80, C-540-A PCB Staging Area and C-540 PCB Spill Site

The C-540-A PCB Staging Area (SWMU 56) is located in the west-central portion of the plant site. SWMU 56 is made up of leaks and spills of oils containing PCBs as a result of past operations that contaminated the soils.

The C-540 PCB Spill Site (SWMU 80) is located in the east-central portion of the plant site. SWMU 80 is made up of leaks and spills of oils containing PCBs as a result of past operations that contaminated the soils.

D.3.2.6 AOC 204, Dyke Road Historical Staging Area

The Dyke Road Historical Staging Area (AOC 204) is located between the eastern boundary of the plant and Dyke Road and between Outfalls 010 and 011. AOC 204 is a mounded area of approximately 3 acres with heavy vegetation and several trees. A small ditch (approximately 4-ft wide and 3-ft deep) is situated across the mound from north to south.

The AOC 204 is suspected of having been a staging area or construction debris burial ground during construction of PGDP (approximately 1951 through the mid 1950s).

The types of debris identified on the mound include asphalt, concrete, telephone poles, railroad ties, and cable. Debris was not reported in subsurface samples collected during the drilling of WAG 28 borings within the mound (DOE 2000). A geophysical survey conducted during the SI using electromagnetometer equipment indicated four anomalies in the AOC 204 area, but detected no presence of a landfill.

D.3.2.7 SWMU 211-A, C-720 TCE Spill Site Northeast

The C-720 TCE Spill Site Northeast (SWMU 211-A) is located northeast of the C-720 Building in the central portion of the plant site. Suspected past practices were to rinse and clean parts with TCE and to dispose of the solvent on the ground.

D.3.2.8 SWMU 224, C-340, OS-13

DMSA OS-13 (SWMU 224) is located south of C-340 in the east-central portion of the plant site. SWMU 224 is approximately 800 ft^2. Empty vendor drums used for the C-340 reroofing project were stored here, beginning in 1996. During 1997 or 1998, the drums were removed. This DMSA now qualifies as a Phase 3 DMSA because it has been characterized fully and contains no fissionable material (DOE 2002).

D.3.2.9 SWMU 225, C-533-1, OS-14

DMSA OS-14 (SWMU 225-A) consists of four tanker cars, three empty flatbeds, and one flatbed with three tanks/containers on it located south of C-533-1 and west of the C-633 Cooling Towers in the southeast portion of the plant site. The area containing SWMU 225-A is approximately 7,800 ft^2 (390 ft × 20 ft).

Rail tank cars and liquid containers were used as material storage areas. The tanker cars may have been brought on-site containing acid product, lube oil, or Freon®. Some personnel recall the three containers on the flatbed being used to hold water for fire-fighting purposes. This DMSA now qualifies as a Phase 3 DMSA because it has been fully characterized and contains no fissionable material (DOE 2001b).

SWMU 225-B is a grassy area near SWMU 225-A.

D.3.2.10 AOC 565, Rubble Area K-19

This rubble area is used for erosion control along the north wall of Bayou Creek, north of the C-611 Water Treatment Plant, and is approximately 60 ft by 30 ft.

This area was discovered in November 2006, during walkover/radiological surveys after soil and rubble areas were found along Little Bayou and Bayou Creeks. This rubble area was designated as Rubble Area KY-19. The readings collected in November 2006 were unfiltered 200 cpm (background is ~ 50 cpm), fixed contamination, and no measurable dose. The area was posted immediately. Investigation results can be found in the *Site Evaluation Report for Rubble Areas* (DOE 2010b).

D.3.3 DEMOGRAPHY AND LAND USE

As shown in the physical descriptions presented above, current land use of all sources investigated during the Soils OU RI 2 is either industrial or recreational. Under current use, because of access restrictions, only plant workers and authorized visitors are allowed access to the areas located inside the limited area. The two areas outside the limited area have industrial restricted access or are part of the West Kentucky Wildlife Management Area (WKWMA). The sources that are in the WKWMA have land uses of recreational and outdoor worker. As discussed in the PGDP Site Management Plan (DOE 2015b), foreseeable future land use of PGDP industrial area is expected to be industrial. The land use of the WKWMA also is not expected to change; it will remain recreational and available to the outdoor worker.

At present, both recreational and residential land uses occur in areas surrounding PGDP. Recreational use occurs in WKWMA. WKWMA is used primarily for hunting and fishing, but other activities include horseback riding, field trials, hiking, and bird watching. An estimated 7,500 fishermen visit the area annually, according to the Kentucky Department of Fish and Wildlife Resources manager of the WKWMA (DOE 2015a). Residential use near the plant and in areas to which the groundwater from the PGDP may migrate is rural residential and includes agricultural activities. No SWMUs/AOCs located outside the limited area and evaluated in this Soils OU RI 2 currently are in residential areas nor are they reasonably anticipated to be residential. Response actions have eliminated exposure of these rural residents to contaminated groundwater. More urban residential use occurs in the villages of Heath, Grahamville, and Kevil, which are within 3 miles of DOE property boundaries, but outside of the area that may be impacted by the Soils OU. The closest major urban area is the municipality of Paducah, Kentucky, which has a population of approximately 25,000 and is approximately 10 miles from PGDP. Other municipalities in the region near PGDP are Cape Girardeau, Missouri, which is approximately 40 miles west of the plant; and the cities of Metropolis and Joppa, Illinois, which are across the Ohio

River from PGDP. Total population within a 50-mile radius of the plant is approximately 534,000 people, with about 89,000 people living within 10 miles. The population of McCracken County, in which PGDP lies, is estimated at 66,000 people.

D.3.4 IDENTIFICATION OF EXPOSURE PATHWAYS

The general principles of the exposure assessment, as addressed in the Risk Methods Document (DOE 2015a), provide the basis for the evaluations provided in this assessment. This subsection describes the potential exposure scenarios and receptors. Only the receptors potentially exposed to each media and location were evaluated. The exposure scenarios evaluated represent potential future scenarios, because most of the exposure assumptions are based on conservative input factors for the administered or absorbed dose estimations. Thus, most, if not all, exposure scenarios represent future hypothetical exposure assumptions, because current exposures are minimal or are not occurring at the site. As a result, the exposure assumptions either are the available default values or are conservatively selected based on assumed receptor behavior.

The current on-site land use is industrial, and this can be expected to continue in the foreseeable future; however, the expected exposure frequencies and durations may be higher in the future than duration and frequency of the current exposure. The "future industrial worker" reflects default assumptions (i.e., 250 days/year for 25 years). A "current industrial worker" scenario has been added to the default scenario to be more reflective of current site conditions and practices with a lower exposure frequency (i.e., 14 days/years for 25 years). Additionally, use of groundwater drawn from the RGA at these SWMUs/AOCs is not expected; however, uses of areas surrounding PGDP indicate that it would be prudent to examine a range of land uses to provide decision makers with estimates of the risk that may be posed to humans under alternate uses. To provide consideration of a range of land uses, the BHHRA reports the hazards and risks for current and several hypothetical future uses, consistent with regulatory guidance. The exposure scenarios and receptors evaluated in this BHHRA are the following: current and future industrial, hypothetical future residential (although not reasonably anticipated), recreational, excavation, and outdoor worker for each of the EUs.

A future on-site rural resident is not a reasonably anticipated land use scenario because land use controls are in place that prevent residential exposure at the site. More likely future scenarios may include recreational uses (hunting), considering the WKWMA is adjacent to a buffer area that surrounds the industrial areas of the site. Further, although unauthorized access to the area (trespassing) is unlikely under current conditions, evaluation of this scenario could be represented under the assessment of the recreational user. The exposure rates for a trespasser likely would be less than that of a recreational user. Current and future industrial worker, outdoor worker, and excavation worker also are considered in this assessment.

As discussed in the Risk Methods Document (DOE 2015a), risks from water drawn from the UCRS will not be presented in the main body of the risk assessment.

The exposure factors primarily are based on a reasonable maximum exposure (RME) assumption. The intent of the RME assumption is to estimate the highest exposure level that reasonably could be expected to occur (EPA 1989; EPA 1991). The RME assumptions were developed by EPA to represent an upper-bound estimate for the plausible exposures. In keeping with the EPA guidance (EPA 1991), the variables chosen for a baseline RME scenario for the intake rate, exposure frequency (EF), and exposure duration (ED) are generally upper-bounds. Other variables, such as body weight (BW) and exposed skin surface area are generally central tendency or average values. The conservatism built into the individual variables ensures that the entire estimate for the contact rate is more than sufficiently conservative.

The scenarios described in the following subsections assume that 100% of a receptor's time is spent in contact with the contaminated medium at the site. For all sites, a worker is assumed to spend all of a workday in the area, which is a conservative estimate for the intake from a given site.

The averaging time (AT) for noncancer evaluation is computed as the product of ED (years) multiplied by 365 days per year, to estimate an average daily dose over the entire exposure period (EPA 1989). For the cancer evaluation, AT is computed as the product of 70 years, the assumed human lifetime, multiplied by 365 days per year, to estimate an average daily dose prorated over a lifetime, regardless of the frequency or duration of exposure. This methodology assumes that the risk from a short-term exposure to a high dose of a given carcinogen is equivalent to a long-term exposure to a correspondingly lower dose, provided that the total lifetime doses are equivalent. For example, the current and future exposure scenarios represent exposures mostly under future hypothetical scenarios, because exposed soils are limited at most of these sites and a maintenance worker or a recreational visitor would not spend the amount of time assumed in the exposure assumptions. The more conservative exposure assumptions used are for conservatism in the potential exposure evaluations during site management. Thus, the estimated intake or exposure doses apply mostly to the future hypothetical exposure scenarios. The scenarios are discussed in the following text.

D.3.4.1 Potential Receptor Populations

The receptors and exposure factors are summarized in Table D.8, with an overview presented following. Exposure factors were updated from the most recent Risk Methods Document (DOE 2015a), consistent with agreements made with the PGDP Risk Assessment Working Group. These updated exposure factors are reflected in Table D.8 and are published in the 2015 Risk Methods Document (DOE 2015a).

Values in the table marked as "chemical-specific" are listed in Attachment D4. The dermal absorption (ABS) factors used are from the KDEP values presented in the 2015 Risk Methods Document. Because these factors apply only to COPCs evaluated for dermal toxicity, these ABS factors are presented in Attachment D4 along with the dermal toxicity values.

Current On-site and Off-site Industrial Workers. The current on-site industrial worker exposure scenario was evaluated for direct contact to surface soils (0 ft–1 ft). The current worker differs from the future industrial worker only by a lower EF equivalent to the current maintenance schedule for these areas [14 days for current on-site industrial worker (such as maintenance worker) versus 250 days for future industrial worker default scenario]. For workers outside the limited area, the workers also are assumed to have direct contact with surface soils (0 ft–1 ft) under current conditions. This limited frequency reflects the size (roughly 0.5 acre or less for each EU) and limited activities at these SWMUs/AOCs.

Future Industrial Workers. The future industrial worker exposure scenario 0 ft–1 ft was evaluated using standard default assumptions as outlined in the Risk Methods Document (DOE 2015a) (e.g., 80-kg adult who works 8 hours per day, approximately 5 days per week, year-round on-site, for a total of 250 days per year for 25 years). No ingestion of or contact with groundwater was assumed for the future industrial worker (only for the resident).

Future Recreational Users. Per the Risk Methods Document (DOE 2015a), recreational uses (child, teen, adult) are focused primarily on sediments, where areas are more attractive for wading. However, a plausible future use on-site and off-site is for recreational use, specifically hunting (deer, rabbits, quail). Hunters are assumed primarily to be teens and adults, and direct contact to soils for these receptors is assumed to be limited because repeated contact with contaminated media at sites less than 0.5 acre would

Table D.8. Exposure Factors Used for Intake Calculations in BHHRA[a]

Pathway Variable	Units	Current Industrial Worker[b]	Future Industrial Worker	Outdoor Worker	Excavation Worker	Adult Resident	Child Resident	Adult Recreational User	Teen Recreational User	Child Recreational User
EF	days/year	14	250	185	185	350	350	104	140	140
ED	years	25	25	25	5	20	6	10	10	6
BW	kg	80	80	80	80	80	15	80	43	15
AT—cancer	days	70 × 365	70 × 365	70 × 365	70 × 365	70 × 365	70 × 365	70 × 365	70 × 365	70 × 365
AT—noncancer	days	365 × 25	365 × 25	365 × 25	365 × 5	365 × 20	365 × 6	365 × 10	365 × 10	365 × 6
Incidental Ingestion of Soil/Sediment										
Incidental ingestion rate	mg/day	50	50	480	480	100	200	100	100	200
Fraction ingested		1	1	1	1	1	1	1	1	1
Dermal Contact with Soil/Sediment										
Body surface area exposed	m^2/day	0.347	0.347	0.347	0.347	0.6032	0.269	0.6032	0.75	0.269
Soil-to-skin adherence factor	mg/cm^2–day	1	1	1	1	1	1	1	1	1
Inhalation of Vapors and Particulates Emitted from Soil/Sediment										
Total inhalation rate	m^3/hour	2.5	2.5	2.5	2.5	0.833	0.833	2.5	2.5	2.5
Exposure time	hours/day	8	8	8	8	24	24	5	5	5
Particulate emission factor	m^3/kg	6.20E+08	6.20E+08	6.20E+08	6.20E+08	9.30E+08	9.30E+08	9.30E+08	9.30E+08	9.30E+08
External Exposure to Ionizing Radiation from Soil/Sediment										
EF	day/day	14/365	250/365	185/365	185/365	350/365	350/365	104/365	140/365	140/365
Gamma shielding factor	unitless	0.2	0.2	0.2	0.2	0.2	0.2	0	0	0
Gamma exposure time factor	hr/hr	8/24	8/24	8/24	8/24	18/24	18/24	5/24	5/24	5/24
Ingestion of Groundwater										
Drinking water ingestion rate	L/day	N/A	N/A	N/A	N/A	2.5	0.78	N/A	N/A	N/A
Dermal Contact with RGA Groundwater (showering)										
Body surface area exposed	m^2	N/A	N/A	N/A	N/A	2.09	0.6378	N/A	N/A	N/A
Event time	hour/event	N/A	N/A	N/A	N/A	0.71	0.71	N/A	N/A	N/A
Event frequency	events/day	N/A	N/A	N/A	N/A	1	1	N/A	N/A	N/A

Table D.8. Exposure Factors Used for Intake Calculations in BHHRA (Continued)

Pathway Variable	Units	Current Industrial Worker[b]	Future Industrial Worker	Outdoor Worker	Excavation Worker	Adult Resident	Child Resident	Adult Recreational User	Teen Recreational User	Child Recreational User
Inhalation RGA Groundwater										
Indoor inhalation rate	m^3/hour	N/A	N/A	N/A	N/A	0.833	0.833	N/A	N/A	N/A
Exposure time in the shower	hours/day	N//A	N/A	N/A	N/A	0.71	0.71	N/A	N/A	N/A
Time of shower	hour	N/A	N/A	N/A	N/A	0.1	0.1	N/A	N/A	N/A
Time after shower	hour	N/A	N/A	N/A	N/A	0.1	0.1	N/A	N/A	N/A
Fraction volatilized while showering	unitless	N/A	N/A	N/A	N/A	0.75	0.75	N/A	N/A	N/A
Water flow rate	L/h	N/A	N/A	N/A	N/A	890	890	N/A	N/A	N/A
Bathroom volume	m^3	N/A	N/A	N/A	N/A	11	11	N/A	N/A	N/A
AT—cancer	hours	N/A	N/A	N/A	N/A	24 × 70 × 365	24 × 70 × 365	N/A	N/A	N/A
AT—noncancer	hours	N/A	N/A	N/A	N/A	24 × 365 × 20	24 × 365 × 6	N/A	N/A	N/A
Exposure time household use	hours/day	N/A	N/A	N/A	N/A	24	24	N/A	N/A	N/A
Exchange rate	changes/day	N/A	N/A	N/A	N/A	10	10	N/A	N/A	N/A
Mixing coefficient	unitless	N/A	N/A	N/A	N/A	0.5	0.5	N/A	N/A	N/A
Fraction volatilized household use	unitless	N/A	N/A	N/A	N/A	0.5	0.5	N/A	N/A	N/A
Water flow rate	L/day	N/A	N/A	N/A	N/A	890	890	N/A	N/A	N/A
House volume	m^3	N/A	N/A	N/A	N/A	450	450	N/A	N/A	N/A

Notes:
[a] Information compiled September 2014, See DOE 2015a, *Methods for Conducting Risk Assessment and Risk Evaluation at the Paducah Gaseous Diffusion Plant*, *Paducah, Kentucky, Volume 1. Human Health*, DOE/LX/07-0107&D2/R5/V1, June.
[b] Best professional judgment; similar to value used for DOE 2008b, *Surface Water Operable Unit (On-Site)Site Investigation and Baseline Risk Assessment at the Paducah Gaseous Diffusion Plant*, DOE/LX/07-0001&D2/R1, U.S. Department of Energy, Paducah, KY, February.
N/A = Not available or not applicable

be unlikely for hunting activities. This pathway was evaluated as a basis for SWMU-specific decisions in this assessment only for the teen, which is the more conservative of the two, and is consistent with planning and scoping for the OU. Consumption of wild game was not included in this evaluation.

Future Hypothetical Rural Resident. The future residential scenario is evaluated using both an adult and a child potentially exposed to site surface soils for SWMUs/AOCs both within and outside the limited area. Although this land use is not reasonably anticipated, this evaluation provides information on potential for adverse impacts if no land use restrictions were in place. Future residents are assumed to be exposed to RGA groundwater for those SWMUs/AOCs where potential impacts to groundwater are identified from the soils. Appendix C describes the groundwater modeling. Similarly, potential exposure to soil VOCs that have migrated to indoor air through vapor intrusion have been considered only for the sites with releases of VOCs from the soils. Consumption of wild game was not included in this evaluation.

Future Outdoor Worker and Excavation Worker. For evaluation of potential future direct contact issues with subsurface soil, two scenarios were considered: excavation worker and outdoor worker. Each assumes contact with both surface and subsurface soils, but differ in that the excavation addresses contact during the excavation/construction process, so for each SWMU/AOC, ED was limited to 5 years. Additional detail is provided below. For the outdoor worker exposed to surface and subsurface soils, it is assumed that surface and subsurface soils are mixed (brought to the surface) (e.g., during landscaping or other outdoor activities) where EDs may be extended. The outdoor worker also was evaluated for direct contact with surface soil.[2]

According to the Risk Methods Document (DOE 2015a), 185 days per year and 25 years are recommended for the EF and the ED, respectively, for the outdoor worker. However, the Risk Methods Document provides flexibility in this assumption when applying to an excavation worker. According to the Risk Methods Document (DOE 2015a), "…the exposure duration of 25 years for the outdoor worker may be replaced with a shorter duration of 1 to 5 years that is more likely to reflect the potential exposures at the site. The shorter exposure duration and possibly a revised exposure frequency combined with the other default parameters for the outdoor worker scenario also may be used to produce an excavation worker scenario." When used for the excavation worker scenario, the ED has been reduced to 5 years (DOE 2015a). Further, from a practical standpoint, defaulting to outdoor worker exposure assumptions for an excavation scenario will exceed the reasonable assumptions for many SWMUs/AOCs because the excavation scenario typically represents a soil removal action associated with construction of a foundation or excavation of contaminated soil. For nearly all waste sites or foundation construction sites, this is a one-time event of short duration.

D.3.4.2 Delineation of Exposure Point/Exposure Routes

As discussed, human health risks are assessed by determining points of exposure (POEs) and exposure routes. POEs are locations where human receptors can contact contaminated media. Exposure routes are the processes by which human receptors contact contaminated media. The exposure routes considered during

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[2] For all locations inside the industrialized area at PGDP where surface soil contamination is of concern, the industrial worker as the potential receptor is appropriate. However, if the scenario involves outdoor maintenance type activities, the outdoor worker receptor also should be considered. For locations inside the industrialized area at PGDP where contact with surface soil and subsurface soil is of concern (i.e., soil from the surface down to 10 or 16 ft bgs, as appropriate), the excavation worker as the potential receptor is appropriate. For locations, outside the industrialized area where surface soil contamination is of concern, screening using the recreator and/or resident risk-based screening values is appropriate (DOE 2015a). See DOE 2015a for additional information.

the exposure assessment for all BHHRAs per the Risk Methods Document (DOE 2015a) are listed in the following paragraphs. This material also presents reasons for selecting or not selecting each exposure route for each of the potentially exposed populations in this BHHRA. The exposure routes evaluated and those that were assessed quantitatively in this BHHRA are described below.

Surface water. Although some SWMUs/AOCs are located near drainageways, significant surface water contamination is not expected as a result of these SWMUs/AOCs (UK 2007). Further, due to the physical cover at the SWMUs that limits the potential for particulate transport through sheet flow and based upon the modeling performed as part of the SI report for the outfalls and their associated internal ditches, no contaminants are migrating in surface water (dissolved or through sediment) from ditches to surrounding creeks at concentrations that may impact human health adversely (DOE 2008b). As a result, human health risks associated with exposure to surface water were not assessed in this BHHRA.

Groundwater. Residential and industrial use of RGA groundwater is common in western Kentucky. There is no current complete pathway for domestic use of RGA groundwater downgradient of the facility; however, a conservative assumption for evaluating impacts to the RGA is based on hypothetical future use of RGA groundwater by a resident. SWMUs 13, 15, and 26 were identified with soil concentrations that could yield potentially unacceptable concentrations in groundwater associated with migration from the areas; however, as noted in Appendix C, there is no evidence of impact on RGA groundwater from migration from soils in these SWMUs. The potential POEs as completed in the modeling are the SWMU boundary, the property boundary, and a downgradient RGA discharge point. The most stringent assumptions for risk estimates at the SWMU boundary are used for the risk estimates.

For domestic use of groundwater by a hypothetical future resident, the following routes of exposure are evaluated:

- Groundwater ingestion (potable use of RGA groundwater),
- Inhalation of volatile constituents emitted while using groundwater (all household uses), and
- Dermal contact with groundwater while showering.

Vapor Intrusion. Transport of vapors from subsurface soils into buildings is considered a potential future exposure pathway (EPA 2015a). The POE—location where this is complete—is focused at the source areas where volatile compounds were released. These are the primary locations where VOCs may be in the soils (i.e., AOC 204 and SWMU 211-A) where a building may be constructed in the future. Although future residential use is not reasonably anticipated, this exposure route was considered in this BHHRA for rural residential scenario. No additional contribution via inhalation of vapors that may be transported into basements is expected.

Soil. A primary consideration for risks associated with contamination in soils is direct contact with these at the SWMUs/AOCs; therefore, these are the POEs either under current conditions where exposure may be to contaminants in the 0 ft–1 ft depth or possible future contact with contaminants in the subsurface. To estimate risks for the receptors described in the previous section, the following routes of exposure are quantified:

- Incidental ingestion of contaminated soil,
- Dermal contact with contaminated soil,
- Inhalation of particulates emitted from contaminated soil,
- Inhalation of volatile constituents emitted from contaminated soil, and
- External exposure to ionizing radiation emitted from contaminated soil.

D.3.5 QUANTIFICATION OF EXPOSURE

D.3.5.1 Calculation of EPCs of COPCs

The EPCs were determined as described in Section D.2.3.2.

Soil—Direct Contact Exposure. In determining the UCL95 for soil, the data are segregated into depth intervals relevant to receptors. For all scenarios, except the excavation worker and the outdoor worker (exposed to surface and subsurface soil), data from samples collected from 0 to 1 ft bgs are used to estimate the EPC.[3] For the excavation worker and the outdoor worker (exposed to surface and subsurface soil), data collected from 0 to 16 ft bgs are used to estimate the EPC.

Groundwater—Residential Use. The groundwater COPC concentrations in the RGA groundwater at the SWMU/AOC boundary are based on the results of the modeling as presented in the fate and transport discussion.

D.3.5.2 Chronic Daily Intakes

The EPC for each COPC was used to calculate potential chemical intakes. The equations to be used to combine the EPCs and exposure factors to estimate chemical intake followed the general format presented in RAGS, Part A (EPA 1989) as follows:

$$\text{Chemical Intake}\,[\text{mg/(kg} \times \text{day)}] = \frac{C_s \times CF \times EF \times FI \times ED \times IR}{BW \times AT}$$

Where:

Chemical Intake = the dose
C_s = average concentration contacted over the exposure period
CF = contact rate or amount of contaminated medium contacted per unit time or event
EF = exposure frequency
FI = fraction ingested
ED = exposure duration
IR = ingestion rate
BW = average body weight of the receptor over the term of exposure
AT = averaging time or period over which exposure is averaged

and

$$\text{Radionuclide Intake (pCi)} = A_s \times CF_{rad} \times EF \times FI \times ED \times IR$$

[3] See additional information regarding SWMU 13 in Section D.2.3.2.

Where:

Radionuclide Intake = the dose

A_s = average activity contacted over the exposure period

CF_{rad} = conversion factor.

EF = exposure frequency

FI = fraction ingested

ED = exposure duration

IR = ingestion rate

Calculation of intake, both noncancerous and cancerous, is presented in Tables D.9 through D.25 (located on CD) of this BHHRA for the following scenarios:

- Current industrial worker exposure to surface soil
- Future industrial worker exposure to surface soil
- Outdoor worker exposure to surface soil
- Outdoor worker exposure to surface and subsurface soil
- Excavation worker exposure to surface and subsurface soil
- Future hypothetical adult resident exposure to surface soil
- Future hypothetical child resident exposure to surface soil
- Adult recreational user exposure to surface soil
- Teen recreational user exposure to surface soil
- Child recreational user exposure to surface soil

D.3.6 SUMMARY OF EXPOSURE ASSESSMENT

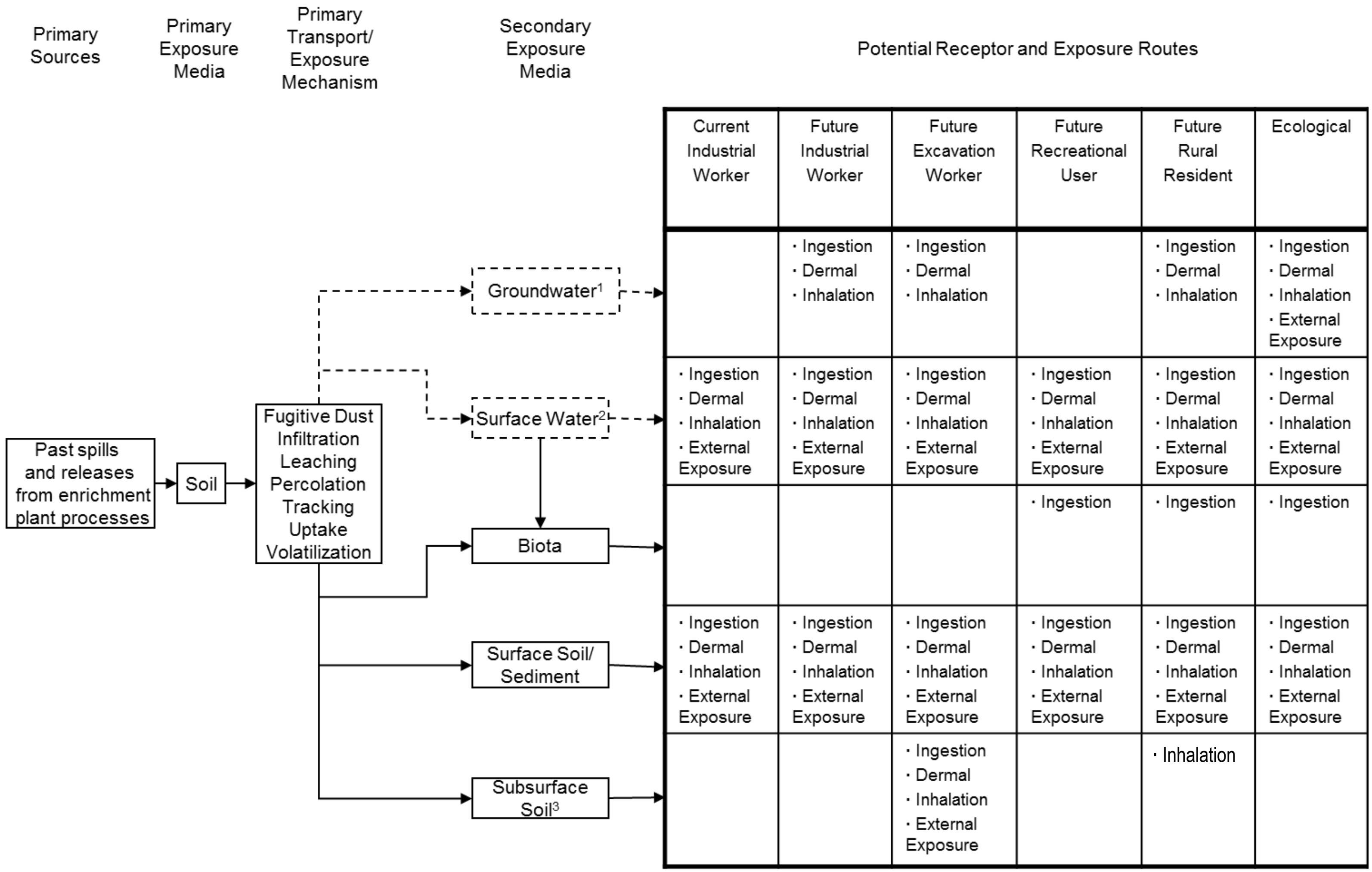
Consistent with the data collected during the Soils OU RI 2, the receptors selected for assessment are the current and future industrial worker, recreational user, and rural resident (although not reasonably anticipated). Additionally, outdoor workers and excavation worker receptors also are assessed.

D.3.6.1 Development of Conceptual Site Models

The scope of the sampling in support of the Soils OU RI and Soils OU RI 2 discussed in Section 1 of the Work Plan (DOE 2010a) is as follows:

> The objective of this investigation is to determine the nature and extent of contamination in the soils to a depth of 10 ft below ground surface (bgs) or up to 16 ft bgs at infrastructure (e.g., pipelines). For all source units, the initial focus of the investigation will be surface and subsurface soil contamination to a depth of 4 ft bgs. If contamination at the 4 ft bgs is found, then secondary sources from the unit located in the subsurface soil, which extend to a depth of 10 ft bgs, will be investigated. Any contamination that is found to extend past the depths specified in this investigation will be addressed under another OU.

This scope and the uncertainties in site conditions subsequently were used in the BHHRA to develop a generalized CSM that identified the sources of contamination (from both process releases and unspecified releases), release mechanisms, primary and secondary contaminated environmental media, transport mechanisms, potential receptors, and routes of exposure consistent with the Soils OU RI 2. This generalized CSM, which does not consider conditions unique to each SWMU/AOC, is presented in Figure D.6. The impacts of the conditions unique to each SWMU/AOC upon the generalized CSM are discussed below.



Secondary Exposure Media	Current Industrial Worker	Future Industrial Worker	Future Excavation Worker	Future Recreational User	Future Rural Resident	Ecological
Groundwater[1]		· Ingestion · Dermal · Inhalation	· Ingestion · Dermal · Inhalation		· Ingestion · Dermal · Inhalation	· Ingestion · Dermal · Inhalation · External Exposure
Surface Water[2]	· Ingestion · Dermal · Inhalation · External Exposure	· Ingestion · Dermal · Inhalation · External Exposure	· Ingestion · Dermal · Inhalation · External Exposure	· Ingestion · Dermal · Inhalation · External Exposure	· Ingestion · Dermal · Inhalation · External Exposure	· Ingestion · Dermal · Inhalation · External Exposure
Biota				· Ingestion	· Ingestion	· Ingestion
Surface Soil/ Sediment	· Ingestion · Dermal · Inhalation · External Exposure	· Ingestion · Dermal · Inhalation · External Exposure	· Ingestion · Dermal · Inhalation · External Exposure	· Ingestion · Dermal · Inhalation · External Exposure	· Ingestion · Dermal · Inhalation · External Exposure	· Ingestion · Dermal · Inhalation · External Exposure
Subsurface Soil[3]			· Ingestion · Dermal · Inhalation · External Exposure		· Inhalation	

- - - - - Incomplete/Potential Pathway
——— Complete Pathway

[1] The groundwater pathway is complete for SWMU 1 and potentially complete for SWMU 14. Information from this RI will be provided to the GWOU.
[2] Contamination currently in sediments in ditches or surface water will be evaluated as part of the SWOU.
[3] For the PCB areas grouping, the pathway impacting subsurface soil is incomplete.

Revised from DOE 2013 (Figure D.3)

Figure D.6. CSM for the Soils OU

SWMU 13. The conditions at SWMU 13 generally are consistent with the generalized CSM. Groundwater modeling (see Appendix C) indicates that the groundwater pathway for SWMU 13 potentially is complete. The uncertainty of this pathway in regard to a potential contaminant source to groundwater will be managed in the FS. Inhalation of vapors from subsurface soils into buildings is not complete because VOCs were not detected above groundwater protection SSLs for the UCRS at SWMU 13 in subsurface soils (i.e., no source of contamination, which is required for a completed exposure pathway).

SWMU 15. The conditions at SWMU 15 are consistent with the generalized CSM. Groundwater modeling (see Appendix C) indicates that the groundwater pathway for SWMU 15 potentially is complete. The uncertainty of this pathway in regard to a potential contaminant source to groundwater will be managed in the FS.

SWMU 26. For SWMU 26, the groundwater pathway was considered a potentially complete pathway and was evaluated through data screening; comparison to SSLs; and, in some cases, groundwater modeling—see Appendix C. This evaluation concluded that the groundwater pathway is incomplete for this SWMU.

SWMU 77. The conditions at SWMU 77 generally are consistent with the generalized CSM. Inhalation of vapors from subsurface soils into buildings is not complete. There are no VOC data for SWMU 77 in subsurface soils because they were determined not to be contaminants of interest (DOE 2010a).

SWMUs 56 and 80. The conditions at SWMUs 56 and 80 generally are consistent with the generalized CSM. Inhalation of vapors from subsurface soils into buildings is not complete because VOCs were not detected above groundwater protection SSLs for the UCRS at SWMUs 56 and 80 in subsurface soils (i.e., no source of contamination, which is required for a completed exposure pathway).

AOC 204. The conditions at AOC 204 are consistent with the generalized CSM.

SWMU 211-A. The conditions at SWMU 211-A are consistent with the generalized CSM.

SWMU 224. The conditions at SWMU 224 generally are consistent with the generalized CSM. Inhalation of vapors from subsurface soils into buildings is not complete. There are no VOC data for SWMU 224 in subsurface soils because they were determined not to be contaminants of interest (DOE 2010a).

SWMU 225. The conditions at SWMU 225-A and SWMU 225-B are generally consistent with the generalized CSM. Inhalation of vapors from subsurface soils into buildings is not complete. There are no VOC data for SWMU 225 in subsurface soils because they were determined not to be contaminants of interest (DOE 2010a).

AOC 565. The conditions at AOC 565 generally are consistent with the generalized CSM. Inhalation of vapors from subsurface soils into buildings is not complete. There are no VOC data for AOC 565 in subsurface soils because they were determined not to be contaminants of interest (DOE 2010a).

Conditions unique to each SWMU/AOC not reflected in the generalized CSM that might affect alternatives development in the FS will be addressed in the FS, as appropriate.

Each SWMU/AOC with the stepout gridding includes the following:

- SWMU 13 (6.83 acres): 14 EUs
- SWMU 15 (5.29 acres): 10 EUs
- SWMU 26 (0.041 acres): 4 EUs

- SWMU 77 (0.017 acres): 1 EUs
- SWMUs 56 and 80 (0.345 acres): 3 EUs
- AOC 204 (11.3 acres): 21 EUs
- SWMU 211-A (0.062 acres): 1 EU
- SWMU 224 (0.149 acres): 1 EU
- SWMU 225 (0.186 acres): 1 EU
- AOC 565 (0.012 acres): 1 EU

D.4. TOXICITY ASSESSMENT

This section summarizes the potential toxicological effects of the COPCs on exposed populations. Many of the toxicological summaries were obtained from the *Risk Assessment Information System* (RAIS) Web site, available at http://rais.ornl.gov/ (UT 2013). This site also lists toxicity values taken from EPA's Integrated Risk Information System (IRIS) database (EPA 2015b), National Center for Environmental Assessment (NCEA), and Health Effects Assessment Summary Tables (HEAST) database (EPA 1998). This list formed the basis of the toxicity values reported in this section. For those chemicals not profiled in RAIS, a brief summary of information drawn from Agency for Toxic Substances and Disease Registry or other library research sources is included in this section. The last paragraph of each profile contains the toxicity values used in this BHHRA.

The toxicity information considered in the assessment of potential carcinogenic risks includes (1) a weight-of-evidence classification and (2) a slope factor (SF) or inhalation unit risk (IUR). The weight-of-evidence classification qualitatively describes the likelihood that an agent is a human carcinogen, based on the available data from animal and human studies. A chemical may be placed in one of three groups to indicate its potential for carcinogenic effects: Group A, a known human carcinogen; Group B, a probable human carcinogen; and Group C, a possible human carcinogen. Group B is divided into Subgroups B1 and B2. Assignment of a chemical to Subgroup B1 indicates that the judgment that the chemical is a probable human carcinogen is based on limited human data, and assignment of a chemical to Subgroup B2 indicates that the judgment that the chemical is a probable human carcinogen is based on animal data because human data are lacking or inadequate. Chemicals that cannot be classified as human carcinogens because of a lack of data are categorized in Group D, and those for which there is evidence of noncarcinogenicity in humans are categorized in Group E.

The SF for chemicals is defined as a plausible upperbound estimate of the probability of a response (i.e., development of cancer) per unit intake of a chemical over a lifetime (EPA 1989). SFs are specific for each chemical and route of exposure. Similarly, IURs may be called the inhalation slope factor. SFs and IURs currently are available for ingestion and inhalation pathways. The SFs and IURs used for oral and inhalation routes of exposure for the COPCs considered in this report are shown in Attachment D4.

Toxicity values used in risk calculations also include the chronic reference dose (RfD) and reference concentration (RfC), which is used to estimate the potential for systemic toxicity or noncarcinogenic risk. The chronic RfD is defined as an estimate of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime (EPA 1989). RfD values are specific to the route of exposure. The RfDs used for oral routes of exposure and the RfCs used for inhalation routes of exposure for the COPCs considered in this report are presented in Attachment D4.

For the dermal routes of exposure (i.e., dermal exposure to contaminated water while showering or bathing or dermal contact with contaminated soil), it is necessary to consider the absorbed dose received by a receptor. This is reflected by the addition of an absorption coefficient in the equations used to calculate the CDI for these pathways. Because the CDI is expressed as an absorbed dose, it is necessary to use RfDs and SFs that also are expressed in terms of absorbed dose. Currently, EPA has not produced lists of RfDs and SFs based on absorbed dose, but has produced guidance concerning the estimation of absorbed dose RfDs and SFs from administered dose RfDs and SFs. This guidance is found in *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)* (EPA 2004a) and states, "that to convert an administered dose slope factor to an absorbed dose slope factor, the administered dose slope factor is divided by the gastrointestinal (GI) absorption efficiency of the contaminant." Alternatively, to convert an administered dose RfD to an absorbed dose RfD, the administered dose RfD is multiplied by the GI absorption efficiency of the contaminant. The absorbed dose slope factors and RfDs and the information used in their derivation are presented in Attachment D4.

Toxicity profiles for primary COCs identified in this assessment are included in Attachment D5.

D.4.1 CHEMICALS FOR WHICH NO EPA TOXICITY VALUES ARE AVAILABLE

Chemicals for which no EPA toxicity values are available have been evaluated as an uncertainty included in Attachment D1.

D.4.2 UNCERTAINTIES RELATED TO TOXICITY INFORMATION

Standard EPA RfDs/RfCs and SFs/IURs were used to estimate potential noncarcinogenic and carcinogenic health effects from exposure to detected chemical contaminants. Considerable uncertainty is associated with the methodology applied to derive SFs/IURs and RfDs/RfCs. EPA working groups review all relevant human and animal studies for each compound and select the studies pertinent to the derivation of the specific RfD/RfC and SF/IUR. These studies often involve data from experimental studies in animals, high exposure levels, and exposures under acute or occupational conditions. Extrapolation of these data to humans under low-dose, chronic conditions introduces uncertainties. The magnitude of these uncertainties is addressed by applying uncertainty factors to the dose response data for each applicable uncertainty. These factors are incorporated to provide a margin of safety for use in human health assessments.

D.4.2.1 Development of Dermal Toxicity Factors

Dermal RfDs and SFs are derived from the corresponding oral values, using a route-to-route extrapolation based on the absorption efficiency of the chemical though the exposure route (for example, through the gastrointestinal tract), provided that there is no evidence to suggest that dermal exposure induces exposure route-specific effects that are not appropriately modeled by oral exposure data. In the derivation of a dermal RfD, the oral RfD is multiplied by the gastrointestinal absorption factor (ABS_{GI}), expressed as a decimal fraction. The resulting dermal RfD, therefore, is based on absorbed dose. The RfD based on absorbed dose is the appropriate value with which to compare a dermal dose, because dermal doses are expressed as absorbed rather than exposure doses. The dermal SF is derived by dividing the oral SF by the ABS_{GI}. The oral SF is divided, rather than multiplied, by the ABS_{GI} because SFs are expressed as a reciprocal dose.

Dermal contact with soil has been a driving exposure route in previous BHHRAs at PGDP, with most of this risk arising from contact with metals (e.g., beryllium, vanadium). This is a direct result of using dermal absorption factors that exceed GI absorption values and may be overly conservative. In such circumstances, risk estimates from the dermal exposure route may be unrealistic and exceed the real risk posed by this route of exposure. Although chemical-specific ABS values were used when available, default ABS values were used for most chemicals because chemical-specific values are lacking. It should be noted that risk management decisions based on the dermal contact with soil exposure route should be considered carefully because of the uncertainty associated with risk from this exposure route.

In the past, it has been assumed that 5% of the inorganic materials will be absorbed through the skin as from the gastrointestinal tract. This was considered conservative because the primary function of the GI tract is to allow absorption of minerals and nutrients, where the function of the skin is to act as a barrier to entry of foreign materials. Therefore, absorption of materials from the GI tract generally is considered to occur more readily than dermal absorption. In addition, once ingested, it will remain in contact with the GI tract for approximately 24 hours or more, while materials on skin most likely will be washed off more frequently.

D.4.2.2 Lead Toxicity

Although it is known that exposure to lead can result in systemic toxic effects and possibly cancer, the approved toxicity values required to estimate potential for systemic toxicity and carcinogenesis are not available. Thus, the approach to evaluating health risks associated with exposure to lead is different from other chemicals detected at the site. To determine if exposure to lead has occurred, the amount of lead present in the blood can be measured; the level of lead in the blood is measured in micrograms per deciliter (µg/dL). Ten µg/dL is considered the national health criteria that no more than 5% of the population should exceed this level before health effects may be exhibited (EPA 2003a). Based on the target blood lead (PbB) level of 10 µg/dL, EPA has derived a residential screening level of 400 mg/kg lead in soil, which is considered protective for young children exposed routinely under a residential scenario. This residential screening value of 400 mg/kg also is adopted as the NAL for lead in soils at PGDP for identifying lead as a COPC. EPA also has derived an industrial screening level of 800 mg/kg lead in soil.

Lead is unique in that a continuous level of exposure is needed to detect an increase in PbB. According to EPA guidance on intermittent exposures to lead (EPA 2003b), the magnitude and duration of the increase in PbB will vary depending on the temporal pattern of exposure at a site. According to EPA guidance (EPA 2003a; 2003b), an increase in PbB will be greatest if exposure occurs every day in succession over an extended period of time (e.g., summer); in comparison to intermittent exposures (e.g., once every 7 days) would give rise to smaller PbB increases. Infrequent exposures (i.e., less than 1 day per week) over a minimum duration of 90 days would be expected to produce oscillations in blood lead concentrations associated with the absorption and subsequent clearance of lead from the blood between each exposure event. As a result, EPA's Technical Review Workgroup recommends that PbB models for evaluating child and adult exposure to lead be applied to exposure that exceed a minimum frequency of one day per week and a duration of 3 consecutive months (EPA 2003b).

For PGDP, the preliminary risk characterization of lead is conducted for each SWMU/EU by comparing the maximum detected result to the residential screening value of 400 mg/kg. Lead is considered a COPC at each SWMU/EU that exceeds the screening value. Additional analysis was conducted for these SWMU/EUs by comparing the arithmetic average lead concentration to the NAL. This is consistent with EPA guidance for estimating soil lead concentrations for use in lead uptake models (EPA 2003a; EPA 2003b; EPA 2007), which emphasized the importance that the frequency of exposure and the duration of exposure be over a sufficient duration for the blood lead concentration to become nearly constant over time.

Sites with average lead concentrations exceeding the NAL undergo additional risk analysis using the results of EPA's Integrated Exposure Uptake Biokinetic Model (EPA 2004b) for evaluating exposures of children and the EPA Adult Lead Model (EPA 2003b) for evaluating lead exposure to adults.

D.4.2.3 Carcinogenic PAHs

During the development of the list of COPCs, concentrations of total cancerous PAHs were derived based on the methodology in the Risk Methods Document (DOE 2015a). When deriving Total PAHs, the toxicity equivalence factors (TEFs) presented in Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities (EPA 2005) were used. These TEFs were applied to the concentrations of detected PAHs in each sample and then the Total PAH concentration in a sample was the sum of the products of each carcinogenic PAH and its TEF. When calculating the EPC for carcinogenic PAHs, for samples in which PAHs are not detected, the value for the minimum detection limit of the PAHs with TEFs were used.

D.4.2.4 Total Dioxins/Furans

During the development of the list of COPCs, concentrations of total dioxins and furans were derived based on the methodology in the Risk Methods Document (DOE 2015a). When deriving total dioxins/furans, TEFs presented in *Federal Register*: May 10, 2007 (Volume 72, Number 90*), Dioxin and Dioxin-like Compounds; Toxic Equivalency Information* were used. Note that these TEFs will be applied to both the concentrations of detected dioxins and furans and to one-half the sample quantitation limit of undetected dioxins and furans, when one or more dioxin or furan is detected. The total dioxin concentration in a sample will be the sum of the products of each dioxin/furan and its TEF. For samples in which no dioxin or furan was detected, the minimum detection limit for 2,3,7,8-TCDD will be used as the value for the total dioxin concentration.

D.5. RISK CHARACTERIZATION

Risk characterization is the final step in the risk assessment process. In this step, the information from the exposure and toxicity assessments is integrated to quantitatively estimate both carcinogenic health risks and noncarcinogenic hazard potential. For this assessment, risk is defined as both the lifetime probability of excess cancer incidence for carcinogens and the estimate of daily intake exceeding intake that may lead to toxic effects for noncarcinogens.

D.5.1 DETERMINATION OF POTENTIAL FOR NONCANCER EFFECTS

In this BHHRA, the numeric estimate of the potential for noncancer effects posed by a single chemical within one pathway of exposure is derived as the ratio of the CDI or EC of a chemical, from a single pathway to the appropriate RfD or RfC. This ratio also is referred to as a hazard quotient (HQ). This value is calculated as shown in the following equations, as appropriate:

$$\mathrm{HQ}_i = \frac{\mathrm{CDI}_i[\mathrm{mg/(kg} \times \mathrm{day)}]}{\mathrm{RfD}_i[\mathrm{mg/(kg} \times \mathrm{day)}]}$$

where:

HQ_i is the hazard quotient, an estimate of the systemic toxicity posed by a single chemical, dimensionless

CDI_i is the estimate of chronic daily intake (or absorbed dose for some exposure routes) from the exposure assessment

RfD_i is the chronic reference dose for administered or absorbed dose, as appropriate

or

$$\mathrm{HQ}_i = \frac{\mathrm{EC}_i\ (\mu\mathrm{g/m}^3)}{[\mathrm{RfC}_i\ (\mathrm{mg/m}^3) \times 1000\ (\mu\mathrm{g/mg})]}$$

where:

HQ_i is the hazard quotient, an estimate of the systemic toxicity posed by a single chemical for inhalation, dimensionless

EC_i is the exposure concentration for chronic exposure

RfC_i is the reference concentration for chronic inhalation exposure

When performing this calculation, the proper RfD/RfC was used for each CDI/EC. For CDIs that reflect ingestion, the RfD used was that for administered dose. For CDIs that reflect absorption, as in dermal contact, the RfD used was that for absorbed dose. Finally, for ECs that reflect inhalation exposure, the RfC used was that for inhalation. For all exposures, regardless of duration, the chronic RfD was used (DOE 2015a).

If several chemicals may reach a receptor through a common pathway, guidance (DOE 2015a) recommends adding the HQs of all chemicals reaching the receptor through the common pathway to calculate a pathway HI. This can be represented by the following equation:

$$HI_p = \sum_{i=1}^{n} HQ_i$$

where:

HI_p or the pathway HI is the sum of the individual chemical HQs, dimensionless

HQ_1 to HQ_n are the individual chemical hazard quotients relevant to the pathway, dimensionless

Similarly, guidance (DOE 2015a) recommends summing the pathway HIs for all pathways relevant to an individual receptor to develop a total HI. The total HI is not an estimate of the systemic toxicity posed by all contaminants that may reach the receptor, but can be used to estimate if a toxic effect may result if all contaminants reaching the receptor have additive effects over all pathways. This can be represented as in the following equation:

$$HI_{total} = \sum_{p=1}^{n} HI_p$$

where:

HI_{total} or total HI is the sum of all pathways relevant to a single receptor, dimensionless

HI_1 to HI_n are the individual pathway HIs

Note that the HQ, the pathway HI, and the total HI do not define a dose-response relationship. That is, the magnitude of the HQ or HI does not represent a statistical probability of incurring an adverse effect. If the HQ is less than 1, the estimated exposure to a substance may be judged to be below a level that could present a toxic effect. If the HQ is greater than 1, a toxic effect may or may not result depending on the assumptions used to develop the CDI/EC and assumptions used in deriving the RfD/RfC. Similarly, if the pathway HI is less than 1, then the estimated exposure to multiple chemicals contributing to the pathway HI should not be expected to present a toxic effect. If the pathway HI is greater than 1, then exposure may or may not result in a toxic effect depending on what assumptions were used to develop the pathway and how the chemicals included in the pathway interact. Finally, if the total HI is less than 1, then the estimated exposure to multiple chemicals over multiple pathways should not be expected to result in a toxic effect. If the total HI is greater than 1, then a toxic effect may or may not result depending on the rigor used to develop the CSM for all pathways and the interaction between pathways and individual chemicals.

D.5.2 DETERMINATION OF EXCESS LIFETIME CANCER RISK

Estimates of the potential for cancer induction are measured by calculating estimates of ELCR. Generally, ELCR can be defined as the incremental increase in the probability that a receptor may develop cancer if the receptor is exposed to chemicals or radionuclides or both. ELCRs are specific to the CSM used to define the routes and magnitude of exposure. The magnitude of the ELCRs could vary markedly if the exposure assumptions used to develop the CSM are varied.

D.5.2.1 Chemical Excess Cancer Risk

The numeric estimate of the ELCR resulting from exposure to a single chemical carcinogen is derived by multiplying the CDI or EC through a particular pathway by the SF or IUR appropriate to that pathway. The resulting value is referred to as a chemical-specific ELCR. These values are calculated as shown in the following equations:

$$\mathrm{ELCR}_i = \mathrm{CDI}_i[\mathrm{mg/(kg \times day)}] \times \mathrm{SF}_i[\mathrm{mg/(kg \times day)}]^1$$

where:

ELCR$_i$ or chemical-specific ELCR is an estimate of the excess lifetime probability of developing cancer that results because of exposure to the specific chemical, dimensionless

CDI$_i$ is the chronic daily intake of the chemical

SF$_i$ is the slope factor for the specific chemical

or

$$\mathrm{ELCR}_i = \mathrm{EC}_i\ (\mu\mathrm{g/m}^3) \times \mathrm{IUR}_i\ (\mu\mathrm{g/m}^3)^{-1}$$

where:

ELCR$_i$ or chemical-specific ELCR is an estimate of the excess lifetime probability of developing cancer that results because of exposure to the specific chemical, dimensionless

EC$_i$ is the exposure concentration for chronic exposure to the chemical

IUR$_i$ is the unit risk for chronic inhalation exposure for the specific chemical

As with the calculation used to derive HQs, the proper SF/IUR was used for each CDI/EC when performing this calculation. For CDIs that reflect ingestion, the SF was that for an administered dose. For CDIs that reflect absorption, the SF was that for absorbed dose. Finally, for ECs that reflect inhalation exposure, the IUR was that for inhalation.

If several chemicals may reach a receptor through a common pathway, the chemical specific ELCRs of all chemicals reaching the receptor through the common pathway are summed to calculate a pathway ELCR. This can be represented by the following equation:

$$\mathrm{ELCR}_p = \sum_{i=1}^{n} \mathrm{ELCR}_i$$

where:

ELCR_p or the pathway ELCR is the sum of the individual chemical-specific ELCRs, dimensionless
ELCR_1 to ELCR_n are the chemical-specific ELCRs relevant to the pathway; dimensionless

Similarly, the pathway ELCRs for all pathways relevant to an individual receptor are summed to develop a total ELCR. The total ELCR is not an actuarial estimate of an individual developing cancer, but can be used to estimate the total ELCR that may result if all contaminants reaching the receptor have additive effects over all pathways. This can be represented as in the following equation:

$$\mathrm{ELCR}_{total} = \sum_{p=1}^{n} \mathrm{ELCR}_p$$

where:

ELCR_{total} or total ELCR is the sum of all pathways relevant to a single receptor, dimensionless
ELCR_1 to ELCR_n is the individual pathway ELCRs

Unlike the HQ, the pathway HI and the total HI, the chemical-specific ELCR, the pathway ELCR, and total ELCR define a dose-response relationship. That is, the ELCRs represent a statistical probability of the increased risk of developing cancer that exists in receptors exposed under the assumptions used in the calculation of the CDI/EC.

D.5.2.2 Radionuclide Excess Cancer Risk

Calculation of cancer risk due to exposure to radionuclides through ingestion or inhalation is conceptually similar to calculation of risks for chemical carcinogens. In performing this calculation, ELCR due to exposure to a particular radionuclide within a specific pathway is calculated by multiplying the intake of the radionuclide by the route-specific cancer slope factor. This can be represented by the following equations:

For ingestion:

$$\mathrm{ELCR}_i = \mathrm{CDI}_i\,(\mathrm{pCi}) \times \mathrm{SF}_i\,(\mathrm{risk/pCi})$$

where:

ELCR_i or radionuclide-specific ELCR is an estimate of the excess lifetime probability of developing cancer that results because of exposure to the specific radionuclide, dimensionless

CDI_i is the ingestion chronic daily intake of the radionuclide

SF_i is the ingestion slope factor for the specific radionuclide

For external exposure to ionizing radiation, the equation above is used, except units for CDI and SF are pCi-year/g and risk-g/pCi-year, respectively.

For inhalation:

$$\text{ELCR}_i = \text{EC}_i\,(\text{pCi}) \times \text{IUR}_i\,(\text{risk/pCi})$$

where:

$ELCR_i$ or radionuclide-specific ELCR is an estimate of the excess lifetime probability of developing cancer that results because of exposure to the specific radionuclide, dimensionless

EC_i is the exposure concentration for chronic exposure to the radionuclide

IUR_i is the unit risk for chronic inhalation exposure for the specific chemical

As with the calculation used to derive chemical-specific ELCRs, the proper SF or IUR was used for each CDI when performing this calculation. For CDIs that reflect ingestion, the SF was that for ingestion. Similarly, for ECs that reflect inhalation exposure, the IUR was that for inhalation.

Both the pathway ELCR for radionuclides and the total ELCR from exposure to multiple radionuclides within a pathway and over multiple pathways, respectively, are calculated as illustrated for chemical carcinogens in the Risk Methods Document (DOE 2015a). These equations will not be presented in this risk assessment. The uncertainties related to this method of determining ELCR from exposure to radionuclides is discussed in detail in Section D.6.

In this risk assessment, ELCRs from exposure to chemicals and radionuclides were summed within pathways and over all pathways to indicate the potential health risk to a receptor that may be exposed to radionuclides and chemicals over all pathways. The uncertainties associated with combining radionuclide and chemical ELCRs are discussed in detail in Section D.6.

D.5.3 RISK CHARACTERIZATION FOR SOIL

This subsection presents the systemic toxicity (HI) and ELCR for soil exposure at each source area calculated from the COPCs at each unit. Both HI and ELCR are presented for the following receptors:

- Current industrial worker exposure to surface soil
- Future industrial worker exposure to surface soil
- Outdoor worker exposure to surface soil
- Outdoor worker exposure to surface and subsurface soil
- Excavation worker exposure to surface and subsurface soil
- Future hypothetical adult resident exposure to surface soil
- Future hypothetical child resident exposure to surface soil
- Adult recreational user exposure to surface soil
- Teen recreational user exposure to surface soil
- Child recreational user exposure to surface soil

The results of the quantitative risk assessment are presented in Tables D.26 through D.42 (located on CD) and include (1) risks by contaminant for each pathway, (2) risks by contaminant across all pathways (shown in "Total" column), (3) total pathway risks for all contaminants (shown across "Total" row, and d) total risk for all contaminants across all pathways (bold value in "Total" row).

D.5.3.1 Systemic Toxicity (Direct Exposure to Soil)

Tables D.29 through D.38 summarize the computed HIs for soil exposure for each receptor. Total HIs greater than 1 were observed for the following scenarios by SWMU/AOC:

- *Industrial Worker (current):* none;
- *Industrial Worker (future):* SWMU 26 and AOC 204;
- *Outdoor Worker (exposed to surface soil):* SWMUs/AOC 15, 26, 77, 56/80, 204;
- *Outdoor Worker (exposed to surface and subsurface soil):* SWMUs/AOC 15, 26, 77, 56/80, 204, and 211-A;
- *Excavation Worker:* SWMUs/AOC 15, 26, 77, 56/80, 204, and 211-A;
- *Future Hypothetical Adult Residential Receptor:* SWMUs/AOC 15, 26, 56/80, and 204;
- *Future Hypothetical Child Residential Receptor:* SWMUs/AOCs 13, 15, 26, 77, 56/80, 204, 211-A, 224, and 225;
- *Adult Recreational User:* SWMU 26 and AOC 204;
- *Teen Recreational User:* SWMUs/AOC 15, 26, 56/80, and 204; and
- *Child Recreational User:* SWMUs/AOCs 13, 15, 26, 77, 56/80, 204, 211-A, and 224.

D.5.3.2 Excess Lifetime Cancer Risk (Direct Exposure to Soil)

Tables D.36 through D.42 (on CD) summarize the computed lifetime cancer risks for soil exposure for all receptors from all COPCs (including radionuclides). ELCRs greater than 1E-06 were observed at most SWMUs/AOCs for all receptors. Total ELCRs greater than 1E-04 were observed for the following scenarios by SWMU/AOC:

- *Industrial Worker (current):* SWMUs 56/80 and AOC 204;
- *Industrial Worker (future):* SWMUs/AOC 15, 26, 56/80, 204, and 211-A;
- *Outdoor Worker (exposed to surface soil):* SWMUs/AOC 13, 15, 26, 56/80, 204, and 211-A;
- *Outdoor Worker (exposed to surface and subsurface soil):* SWMUs/AOC 13, 15, 26, 56/80, 204, and 211-A;
- *Excavation Worker:* SWMUs/AOC 15, 26, 56/80, and 204;
- *Future Hypothetical Residential Receptor:* SWMUs/AOC 13, 15, 26, 56/80, 204, 211-A; and

- *Recreational User:* SWMUs/AOC 15, 26, 56/80, and 204.

D.5.4 RISK CHARACTERIZATION FOR RESIDENTIAL USE OF GROUNDWATER DRAWN FROM THE RGA (MODELED FROM SOIL CONCENTRATIONS)

This subsection presents the risk for residential use of groundwater drawn from the RGA (although this scenario is not reasonably anticipated). Tables and discussion in this subsection provide the total HI or ELCR for the each source area and list the major exposure routes and COPCs contributing to the total HI or ELCR. Environmental data for each source area was used to model groundwater concentrations at the POEs (see Appendix C for details of the groundwater modeling). The groundwater assessment is conducted only for the residential scenario. Characterization of risks from groundwater at off-site POEs (plant boundary, property boundary, and Ohio River) are discussed in Section D.3.4.2.

D.5.4.1 Systemic Toxicity (Groundwater Use)

Technetium-99 from SWMU 13 and from SWMU 15 is present in soils at concentrations that required modeling to determine if it was at concentrations that could migrate to the RGA to exceed 900 pCi/L. Results of modeling indicate technetium-99 does not exceed 900 pCi/L at either SWMU boundary. Further, the technetium-99 plume at PGDP does not indicate a contribution from SWMUs 13 or 15 (LATA Kentucky 2014). Technetium-99 does not contribute to hazard; therefore, it is not summarized here.

D.5.4.2 Excess Lifetime Cancer Risk (Groundwater Use)

Table D.43 summarizes the ELCRs for the modeled groundwater exposure above SWMUs 13 and 15 for the rural resident (although this scenario is not reasonably anticipated). The EPC is taken from the modeled activity at each SWMU boundary (i.e., 510 pCi/L and 680 pCi/L, respectively, see Appendix C). As shown in these tables, the total ELCR (bold value in "ELCR" column) is 2.7E-05 for SWMU 13 and 3.6E-05 for SWMU 15, so technetium-99 is a COC for the units.

Table D.43. ELCR for the Residential Receptor Exposed to RGA Groundwater at the SWMU Boundary

SWMU	COPC	EPC (pCi/L)	Ingestion	Dermal	Inhalation through showering	Inhalation through household use	ELCR	Percent
13	Technetium-99	5.10E+02	2.7E-05	N/A	N/A	N/A	2.7E-05	100%
13	**Totals**		**2.7E-05**	**N/A**	**N/A**	**N/A**	**2.7E-05**	
13	**Percent**		**100%**					
15	Technetium-99	6.80E+02	3.6E-05	N/A	N/A	N/A	3.6E-05	100%
15	**Totals**		**3.6E-05**	**N/A**	**N/A**	**N/A**	**3.6E-05**	
15	**Percent**		**100%**					

N/A = not applicable

D.5.5 LEAD ASSESSMENT

SWMUs/AOCs for which lead was identified as a COPC were identified as such by comparing the maximum detected result for the grid to the residential screening value of 400 mg/kg. Those SWMUs/AOCs were evaluated for modeling for lead. An average lead concentration was determined for each SWMU, consistent with EPA guidance for estimating soil lead concentration for integrated exposure uptake (EPA 2004b). The average lead concentration did not exceed the NAL (400 mg/kg) at any of these SWMUs/AOCs; therefore, lead is not considered further as a COPC, nor is it considered a COC.

D.5.6 DOSE ASSESSMENT

A dose assessment was performed for radionuclides (separate from the ELCR evaluation) selected as COPCs within each SWMU/EU (Section D.2). Calculation of dose was performed using the following equation and screening values provided in the Risk Methods Document (DOE 2015a):

$$\mathbf{Dose} = \frac{\mathbf{EPC}}{\mathbf{SSL}} \times \mathbf{Target\,Dose}$$

where:

EPC = exposure point concentration
SSL = soil screening level provided in the Risk Methods Document (DOE 2015a, Table A.8)
Target Dose = The target dose upon which the SSL was based (1 mrem).

Tables D.44 and D.45 (included on the Appendix D CD) provide the results of the dose assessment.

Dose greater than 12 mrem were observed for the following pathways by SWMU:

- *Industrial Worker (future):* SWMUs/AOCs 15, 26, 56/80, and 204;
- *Outdoor Worker (exposed to surface soil):* SWMUs/AOCs 15, 26, 56/80, and 204;
- *Outdoor Worker (exposed to surface and subsurface soil):* SWMUs/AOCs 15, 26, 56/80, and 204;
- *Excavation Worker:* SWMUs/AOCs 15, 26, 56/80, and 204;
- *Future Hypothetical Adult Residential Receptor:* SWMUs/AOCs 15, 26, 56/80, 204, and 211;
- *Future Hypothetical Child Residential Receptor:* SWMUs/AOCs 15, 26, 56/80, 204, and 211;
- *Adult Recreational User:* SWMUs/AOCs 56/80 and 204;
- *Teen Recreational User:* SWMUs/AOCs 56/80 and 204; and
- *Child Recreational User:* SWMUs/AOCs 26, 56/80, and 204.

D.5.7 IDENTIFICATION OF LAND USE SCENARIOS, PATHWAYS, MEDIA, AND COCS

This subsection outlines those chemicals, land use scenarios, exposure pathways, and media for each source area. Section D.8 presents the RGOs for each location and land use scenario.

D.5.7.1 Land Use Scenarios of Concern

To make a determination whether land use scenarios are of concern, quantitative risk and hazard results were compared to risk and hazard benchmarks for each land use scenario. The benchmarks used for this comparison were HI $\geq$ 1 and/or ELCR $\geq$ 1E-06. Land use scenarios with total HIs exceeding the benchmark of 1 are deemed land use scenarios of concern for noncancer hazard. Land use scenarios with a total ELCR exceeding the benchmark of 1E-06 are deemed land use scenarios of concern for cancer risk. The following are land uses of concern for the Soils OU at the SWMUs/AOCs indicated.

- Industrial (based on the future industrial worker):

- SWMU 13 (ELCR)
- SWMU 15 (ELCR)
- SWMU 26 (HI and ELCR)
- SWMU 77 (ELCR)
- SWMUs 56/80 (ELCR)
- AOC 204 (HI and ELCR)
- SWMU 211-A (ELCR)
- SWMU 224 (ELCR)
- SWMU 225 (ELCR)

- Outdoor worker (exposed to surface soil):

  - SWMU 13 (ELCR)
  - SWMU 15 (HI and ELCR)
  - SWMU 26 (HI and ELCR)
  - SWMU 77 (HI and ELCR)
  - SWMUs 56/80 (HI and ELCR)
  - AOC 204 (HI and ELCR)
  - SWMU 211-A (ELCR)
  - SWMU 224 (ELCR)
  - SWMU 225 (ELCR)

- Outdoor worker (exposed to surface and subsurface soil):

  - SWMU 13 (ELCR)
  - SWMU 15 (HI and ELCR)
  - SWMU 26 (HI and ELCR)
  - SWMU 77 (HI and ELCR)
  - SWMUs 56/80 (HI and ELCR)
  - AOC 204 (HI and ELCR)
  - SWMU 211-A (HI and ELCR)
  - SWMU 224 (ELCR)
  - SWMU 225 (ELCR)
  - AOC 565 (ELCR)
  -

- Excavation worker (exposed to surface and subsurface soil):

  - SWMU 13 (ELCR)
  - SWMU 15 (HI and ELCR)
  - SWMU 26 (HI and ELCR)
  - SWMU 77 (HI and ELCR)
  - SWMUs 56/80 (HI and ELCR)
  - AOC 204 (HI and ELCR)
  - SWMU 211-A (HI and ELCR)
  - SWMU 224 (ELCR)
  - SWMU 225 (ELCR)

- Hypothetical future resident (for ELCR, the dose method incorporates age-adjusted values for the 30-year exposure duration; for HI, the child resident exposure assumptions are shown):

- SWMU 13 (HI and ELCR)
- SWMU 15 (HI and ELCR)
- SWMU 26 (HI and ELCR)
- SWMU 77 (HI and ELCR)
- SWMUs 56/80 (HI and ELCR)
- AOC 204 (HI and ELCR)
- SWMU 211-A (HI and ELCR)
- SWMU 224 (HI and ELCR)
- SWMU 225 (HI and ELCR)

- Adult recreational user (for ELCR, the dose method incorporates age-adjusted values for the 30-year exposure duration):

  - SWMU 13 (ELCR)
  - SWMU 15 (ELCR)
  - SWMU 26 (HI and ELCR)
  - SWMU 77 (ELCR)
  - SWMUs 56/80 (ELCR)
  - AOC 204 (HI and ELCR)
  - SWMU 211-A (ELCR)
  - SWMU 224 (ELCR)
  - SWMU 225 (ELCR)

- Teen recreational user (for ELCR, the dose method incorporates age-adjusted values for the 30-year exposure duration):

  - SWMU 13 (ELCR)
  - SWMU 15 (HI and ELCR)
  - SWMU 26 (HI and ELCR)
  - SWMU 77 (ELCR)
  - SWMUs 56/80 (HI and ELCR)
  - AOC 204 (HI and ELCR)
  - SWMU 211-A (ELCR)
  - SWMU 224 (ELCR)
  - SWMU 225 (ELCR)

- Child recreational user (for ELCR, the dose method incorporates age-adjusted values for the 30-year exposure duration):

  - SWMU 13 (HI and ELCR)
  - SWMU 15 (HI and ELCR)
  - SWMU 26 (HI and ELCR)
  - SWMU 77 (HI and ELCR)
  - SWMUs 56/80 (HI and ELCR)
  - AOC 204 (HI and ELCR)
  - SWMU 211-A (HI and ELCR)
  - SWMU 224 (HI and ELCR)
  - SWMU 225 (ELCR)

D.5.7.2 Contaminants of Concern

To make a determination about whether contaminants are of concern, quantitative risk and hazard results over all pathways were compared to risk and hazard benchmarks for land use scenarios of concern. The benchmarks used for this comparison were HI ≥ 0.1 and/or ELCR ≥ 1E-06. COCs based on the toxicity factors listed in Attachment D4 are shown in summary tables in Attachment D6.

Contaminants with chemical-specific HIs or ELCRs exceeding these benchmarks were deemed COCs. Priority COCs are contaminants where chemical-specific HI is greater than 1 or where ELCR is greater than 1E-04 for one or more scenarios. These priority COCs can be found in Attachment D6.

D.5.7.3 Contaminants of Concern (Groundwater—Modeled from Soil)

Similarly, no priority COCs were identified (i.e., contaminants whose chemical-specific HI is greater than 1 or whose ELCR is greater than 1E-04) for domestic use of groundwater for a hypothetical future residential use of the SWMU (although this scenario is not reasonably anticipated).

D.5.7.4 Pathways of Concern

To determine whether pathways are of concern, the quantitative risks and hazards for each exposure route are summed over all contaminants and compared to benchmarks for land use scenarios of concern. The benchmarks used for this comparison were HI ≥ 0.1 and/or ELCR ≥ 1E-06. Exposure routes with HIs and ELCRs exceeding these benchmarks are considered pathways of concern (POCs). Each of the pathways included in the BHHRA is a POC for at least one SWMU. Specific POCs are listed below. The current industrial worker is not summarized.

- Incidental ingestion of contaminated soil:
  - SWMU 13
    - Industrial (based on the future industrial worker)
    - Outdoor worker (exposed to surface soil)
    - Outdoor worker (exposed to surface and subsurface soil)
    - Excavation worker (exposed to surface and subsurface soil)
    - Hypothetical future resident
    - Adult recreational user (based on age-adjusted values for the 30-year exposure duration)
    - Teen recreational user
    - Child recreational user
  - SWMU 15
    - Industrial (based on the future industrial worker)
    - Outdoor worker (exposed to surface soil)
    - Outdoor worker (exposed to surface and subsurface soil)
    - Excavation worker (exposed to surface and subsurface soil)
    - Hypothetical future resident
    - Adult recreational user
    - Teen recreational user
    - Child recreational user

- SWMU 26
  - Industrial (based on the future industrial worker)
  - Outdoor worker (exposed to surface soil)
  - Outdoor worker (exposed to surface and subsurface soil)
  - Excavation worker (exposed to surface and subsurface soil)
  - Hypothetical future resident
  - Adult recreational user
  - Teen recreational user
  - Child recreational user
- SWMU 77
  - Industrial (based on the future industrial worker)
  - Outdoor worker (exposed to surface soil)
  - Outdoor worker (exposed to surface and subsurface soil)
  - Excavation worker (exposed to surface and subsurface soil)
  - Hypothetical future resident
  - Adult recreational user
  - Teen recreational user
  - Child recreational user
- SWMUs 56/80
  - Industrial (based on the future industrial worker)
  - Outdoor worker (exposed to surface soil)
  - Outdoor worker (exposed to surface and subsurface soil)
  - Excavation worker (exposed to surface and subsurface soil)
  - Hypothetical future resident
  - Adult recreational user
  - Teen recreational user
  - Child recreational user
- AOC 204
  - Industrial (based on the future industrial worker)
  - Outdoor worker (exposed to surface soil)
  - Outdoor worker (exposed to surface and subsurface soil)
  - Excavation worker (exposed to surface and subsurface soil)
  - Hypothetical future resident
  - Adult recreational user
  - Teen recreational user
  - Child recreational user
- SWMU 211-A
  - Industrial (based on the future industrial worker)
  - Outdoor worker (exposed to surface soil)
  - Outdoor worker (exposed to surface and subsurface soil)
  - Excavation worker (exposed to surface and subsurface soil)
  - Hypothetical future resident

  - Adult recreational user (based on age-adjusted values for the 30-year exposure duration)
  - Teen recreational user
  - Child recreational user

- SWMU 224

  - Industrial (based on the future industrial worker)
  - Outdoor worker (exposed to surface soil)
  - Outdoor worker (exposed to surface and subsurface soil)
  - Excavation worker (exposed to surface and subsurface soil)
  - Hypothetical future resident
  - Adult recreational user
  - Teen recreational user
  - Child recreational user

- SWMU 225

  - Industrial (based on the future industrial worker)
  - Outdoor worker (exposed to surface soil)
  - Outdoor worker (exposed to surface and subsurface soil)
  - Excavation worker (exposed to surface and subsurface soil)
  - Hypothetical future resident
  - Teen recreational user
  - Child recreational user

- AOC 565

  - Outdoor worker (exposed to surface and subsurface soil)
  - Excavation worker (exposed to surface and subsurface soil)

- Dermal contact with contaminated soil:

  - SWMU 13

    - Industrial (based on the future industrial worker)
    - Outdoor worker (exposed to surface soil)
    - Outdoor worker (exposed to surface and subsurface soil)
    - Excavation worker (exposed to surface and subsurface soil)
    - Hypothetical future resident
    - Adult recreational user (based on age-adjusted values for the 30-year exposure duration)
    - Teen recreational user (based on age-adjusted values for the 30-year exposure duration)
    - Child recreational user (based on age-adjusted values for the 30-year exposure duration)

  - SWMU 15

    - Industrial (based on the future industrial worker)
    - Outdoor worker (exposed to surface soil)
    - Outdoor worker (exposed to surface and subsurface soil)
    - Excavation worker (exposed to surface and subsurface soil)
    - Hypothetical future resident
    - Adult recreational user

    - Teen recreational user
    - Child recreational user

- SWMU 26

    - Industrial (based on the future industrial worker)
    - Outdoor worker (exposed to surface soil)
    - Outdoor worker (exposed to surface and subsurface soil)
    - Excavation worker (exposed to surface and subsurface soil)
    - Hypothetical future resident
    - Adult recreational user
    - Teen recreational user
    - Child recreational user

- SWMU 77

    - Outdoor worker (exposed to surface soil)
    - Outdoor worker (exposed to surface and subsurface soil)
    - Excavation worker (exposed to surface and subsurface soil)
    - Hypothetical future resident
    - Adult recreational user (based on age-adjusted values for the 30-year exposure duration)
    - Teen recreational user (based on age-adjusted values for the 30-year exposure duration)
    - Child recreational user (based on age-adjusted values for the 30-year exposure duration)

- SWMUs 56/80

    - Industrial (based on the future industrial worker)
    - Outdoor worker (exposed to surface soil)
    - Outdoor worker (exposed to surface and subsurface soil)
    - Excavation worker (exposed to surface and subsurface soil)
    - Hypothetical future resident
    - Adult recreational user (based on age-adjusted values for the 30-year exposure duration)
    - Teen recreational user (based on age-adjusted values for the 30-year exposure duration)
    - Child recreational user (based on age-adjusted values for the 30-year exposure duration)

- AOC 204

    - Industrial (based on the future industrial worker)
    - Outdoor worker (exposed to surface soil)
    - Outdoor worker (exposed to surface and subsurface soil)
    - Excavation worker (exposed to surface and subsurface soil)
    - Hypothetical future resident
    - Adult recreational user
    - Teen recreational user
    - Child recreational user

- SWMU 211-A

    - Industrial (based on the future industrial worker)
    - Outdoor worker (exposed to surface soil)
    - Outdoor worker (exposed to surface and subsurface soil)

- Excavation worker (exposed to surface and subsurface soil)
- Hypothetical future resident
- Adult recreational user (based on age-adjusted values for the 30-year exposure duration)
- Teen recreational user (based on age-adjusted values for the 30-year exposure duration)
- Child recreational user (based on age-adjusted values for the 30-year exposure duration)

— SWMU 224

- Industrial (based on the future industrial worker)
- Outdoor worker (exposed to surface soil)
- Outdoor worker (exposed to surface and subsurface soil)
- Excavation worker (exposed to surface and subsurface soil)
- Hypothetical future resident
- Adult recreational user (based on age-adjusted values for the 30-year exposure duration)
- Teen recreational user (based on age-adjusted values for the 30-year exposure duration)
- Child recreational user (based on age-adjusted values for the 30-year exposure duration)

— SWMU 225

- Industrial (based on the future industrial worker)
- Outdoor worker (exposed to surface soil)
- Outdoor worker (exposed to surface and subsurface soil)
- Excavation worker (exposed to surface and subsurface soil)
- Hypothetical future resident
- Adult recreational user (based on age-adjusted values for the 30-year exposure duration)
- Teen recreational user (based on age-adjusted values for the 30-year exposure duration)
- Child recreational user (based on age-adjusted values for the 30-year exposure duration)

• Inhalation of particulates emitted from contaminated soil and/or inhalation of volatile constituents emitted from contaminated soil:

— SWMU 13

- Industrial (based on the future industrial worker)
- Outdoor worker (exposed to surface soil)
- Outdoor worker (exposed to surface and subsurface soil)
- Excavation worker (exposed to surface and subsurface soil)

— SWMU 15

- Industrial (based on the future industrial worker)
- Outdoor worker (exposed to surface soil)
- Outdoor worker (exposed to surface and subsurface soil)
- Excavation worker (exposed to surface and subsurface soil)
- Hypothetical future resident

— SWMU 26

- Industrial (based on the future industrial worker)
- Outdoor worker (exposed to surface soil)
- Outdoor worker (exposed to surface and subsurface soil)

    - Excavation worker (exposed to surface and subsurface soil)
    - Hypothetical future resident

  - SWMU 77

    - Industrial (based on the future industrial worker)
    - Outdoor worker (exposed to surface soil)
    - Outdoor worker (exposed to surface and subsurface soil)
    - Excavation worker (exposed to surface and subsurface soil)

  - SWMUs 56/80

    - Industrial (based on the future industrial worker)
    - Outdoor worker (exposed to surface soil)
    - Outdoor worker (exposed to surface and subsurface soil)
    - Excavation worker (exposed to surface and subsurface soil)
    - Hypothetical future resident

  - AOC 204

    - Industrial (based on the future industrial worker)
    - Outdoor worker (exposed to surface soil)
    - Outdoor worker (exposed to surface and subsurface soil)
    - Excavation worker (exposed to surface and subsurface soil)
    - Hypothetical future resident
    - Adult recreational user (based on age-adjusted values for the 30-year exposure duration)
    - Teen recreational user (based on age-adjusted values for the 30-year exposure duration)
    - Child recreational user (based on age-adjusted values for the 30-year exposure duration)

  - SWMU 211-A

    - Industrial (based on the future industrial worker)
    - Outdoor worker (exposed to surface soil)
    - Outdoor worker (exposed to surface and subsurface soil)
    - Excavation worker (exposed to surface and subsurface soil)

  - SWMU 224

    - Industrial (based on the future industrial worker)
    - Outdoor worker (exposed to surface soil)
    - Outdoor worker (exposed to surface and subsurface soil)
    - Excavation worker (exposed to surface and subsurface soil)

  - SWMU 225

    - Industrial (based on the future industrial worker)
    - Outdoor worker (exposed to surface soil)
    - Outdoor worker (exposed to surface and subsurface soil)
    - Excavation worker (exposed to surface and subsurface soil)

- External exposure to ionizing radiation emitted from contaminated soil:

— SWMU 13

- – Industrial (based on the future industrial worker)
- – Outdoor worker (exposed to surface soil)
- – Outdoor worker (exposed to surface and subsurface soil)
- – Excavation worker (exposed to surface and subsurface soil)
- – Hypothetical future resident
- – Adult recreational user (based on age-adjusted values for the 30-year exposure duration)
- – Teen recreational user (based on age-adjusted values for the 30-year exposure duration)
- – Child recreational user (based on age-adjusted values for the 30-year exposure duration)

— SWMU 15

- – Industrial (based on the future industrial worker)
- – Outdoor worker (exposed to surface soil)
- – Outdoor worker (exposed to surface and subsurface soil)
- – Excavation worker (exposed to surface and subsurface soil)
- – Hypothetical future resident
- – Adult recreational user (based on age-adjusted values for the 30-year exposure duration)
- – Teen recreational user (based on age-adjusted values for the 30-year exposure duration)
- – Child recreational user (based on age-adjusted values for the 30-year exposure duration)

— SWMU 26

- – Industrial (based on the future industrial worker)
- – Outdoor worker (exposed to surface soil)
- – Outdoor worker (exposed to surface and subsurface soil)
- – Excavation worker (exposed to surface and subsurface soil)
- – Hypothetical future resident
- – Adult recreational user (based on age-adjusted values for the 30-year exposure duration)
- – Teen recreational user (based on age-adjusted values for the 30-year exposure duration)
- – Child recreational user (based on age-adjusted values for the 30-year exposure duration)

— SWMU 77

- – Industrial (based on the future industrial worker)
- – Outdoor worker (exposed to surface soil)
- – Outdoor worker (exposed to surface and subsurface soil)
- – Excavation worker (exposed to surface and subsurface soil)
- – Hypothetical future resident
- – Adult recreational user (based on age-adjusted values for the 30-year exposure duration)
- – Teen recreational user (based on age-adjusted values for the 30-year exposure duration)
- – Child recreational user (based on age-adjusted values for the 30-year exposure duration)

— SWMUs 56/80

- – Industrial (based on the future industrial worker)
- – Outdoor worker (exposed to surface soil)
- – Outdoor worker (exposed to surface and subsurface soil)
- – Excavation worker (exposed to surface and subsurface soil)

  - Hypothetical future resident
  - Adult recreational user (based on age-adjusted values for the 30-year exposure duration)
  - Teen recreational user (based on age-adjusted values for the 30-year exposure duration)
  - Child recreational user (based on age-adjusted values for the 30-year exposure duration)

- AOC 204

  - Industrial (based on the future industrial worker)
  - Outdoor worker (exposed to surface soil)
  - Outdoor worker (exposed to surface and subsurface soil)
  - Excavation worker (exposed to surface and subsurface soil)
  - Hypothetical future resident
  - Adult recreational user (based on age-adjusted values for the 30-year exposure duration)
  - Teen recreational user (based on age-adjusted values for the 30-year exposure duration)
  - Child recreational user (based on age-adjusted values for the 30-year exposure duration)

- SWMU 211-A

  - Industrial (based on the future industrial worker)
  - Outdoor worker (exposed to surface soil)
  - Outdoor worker (exposed to surface and subsurface soil)
  - Excavation worker (exposed to surface and subsurface soil)
  - Hypothetical future resident
  - Adult recreational user (based on age-adjusted values for the 30-year exposure duration)
  - Teen recreational user (based on age-adjusted values for the 30-year exposure duration)
  - Child recreational user (based on age-adjusted values for the 30-year exposure duration)

- SWMU 224

  - Industrial (based on the future industrial worker)
  - Outdoor worker (exposed to surface soil)
  - Outdoor worker (exposed to surface and subsurface soil)
  - Excavation worker (exposed to surface and subsurface soil)
  - Hypothetical future resident
  - Adult recreational user (based on age-adjusted values for the 30-year exposure duration)
  - Teen recreational user (based on age-adjusted values for the 30-year exposure duration)
  - Child recreational user (based on age-adjusted values for the 30-year exposure duration)

- SWMU 225

  - Industrial (based on the future industrial worker)
  - Outdoor worker (exposed to surface soil)
  - Outdoor worker (exposed to surface and subsurface soil)
  - Excavation worker (exposed to surface and subsurface soil)
  - Hypothetical future resident
  - Adult recreational user (based on age-adjusted values for the 30-year exposure duration)
  - Teen recreational user (based on age-adjusted values for the 30-year exposure duration)
  - Child recreational user (based on age-adjusted values for the 30-year exposure duration)

– AOC 565

  – Outdoor worker (exposed to surface and subsurface soil)
  – Excavation worker (exposed to surface and subsurface soil)

D.5.7.5 Media of Concern

Media of concern are those media that appear in at least one POC. Because they contribute to at least one POC, soil is a medium of concern for all SWMUs/AOCs.

Though not quantified in this evaluation, UCRS groundwater could pose as a medium of concern under certain exposure scenarios; however, these risks were not quantified due to the high improbability of the UCRS at these SWMUs/AOCs being used as a drinking water aquifer [see Section 3.3.4.3 of the Risk Methods Document (DOE 2015a)].

D.5.7.6 Summary of Risk Characterization

Attachment D6 presents summaries of the risk characterization by location considered in the BHHRA. They present land use scenarios of concern, COCs, and POCs. In addition, each table lists the following:

- Receptor risks for each land use scenario of concern;
- Percent contribution by pathway to the total risk; and
- Percent contribution each COC contributes to the total risk.

D.6. UNCERTAINTY IN THE RISK ASSESSMENT

Uncertainties are associated with each step of the risk assessment process. The potential effect of the uncertainties on the final risk characterization must be considered when interpreting the results of the risk characterization because a number of assumptions are made during the risk assessment. Types of uncertainties to consider are divided into four broad categories: (1) those associated with data, (2) exposure assessment, (3) toxicity assessment, and (4) risk characterization.

Specific uncertainties in each of these categories are discussed in the following sections. Magnitude of the effect of the uncertainty on the risk characterization is categorized as small, moderate, or large. Uncertainties categorized as small are assumed to not affect the risk estimates by more than one order of magnitude; those categorized as moderate are assumed to affect the risk estimates by between one and two orders of magnitude, and uncertainties categorized as large are assumed to affect the risk estimate by more than two orders of magnitude.

In evaluating these uncertainties and their estimated effect on the risk estimates, it should be remembered that the following uncertainties are neither independent nor mutually exclusive; therefore, the total effect of all uncertainties on the risk estimates (i.e., total ELCRs and HIs) is not necessarily the sum of the estimated effects.

D.6.1 UNCERTAINTIES ASSOCIATED WITH DATA AND DATA EVALUATION

The purpose of data evaluation is to determine which constituents, if any, are present at concentrations requiring evaluation in the risk assessment. Uncertainty with respect to data evaluation can arise from many sources, such as the quality of data used to characterize the site and the process used to select data and COPCs used in the risk assessment.

Since many of the detection limits for XRF data are above background concentrations (see Attachment B3) and possibly NALs, the COPCs identified using these data are expected to overstate the presence of these metals. The potential uncertainty associated with this issue is small.

COPCs were selected for each EU for those analytes that were detected above background and where maximum detected value is greater than the no action level [consistent with the Risk Methods Document (DOE 2015a) for the child residential scenario and presented in Attachment D1]. For those analytes that never were detected within an EU, even if the detection limit is greater than the no action level, the analyte was not considered a COPC. Uncertainties are associated with this assumption. To assist in evaluating this uncertainty, the maximum detection limit was used as an EPC and hazard and ELCR calculated for the nondetected analyses. Attachment D7 presents the results of these calculations. The potential uncertainty associated with this assumption is small.

For determining COPCs, maximum detected values within each EU were screened against background values presented in the Risk Methods Document regardless of analytical method used (DOE 2015a). For uranium-238, this presents an uncertainty with respect to those samples analyzed using nitric extraction. The adjusted background value for uranium-238 is lower that the value used to screen. This uncertainty potentially affects two SWMUs/AOCs: 13 and 15. In neither SWMU was uranium-238 eliminated as a COPC based on background screening alone; therefore, the potential uncertainty associated with the use of a single background screening value for uranium-238 is small.

The use of historical data in addition to data collected during the Soils OU RI 2 is an uncertainty. As noted earlier, these data were added to the data set to augment the information collected during the Soils OU RI 2. Use of these data is consistent with current EPA guidelines (EPA 1989). No statistical determination was performed to see if historical data and data collected during the Soils OU RI 2 were comparable; however, the estimated effect of this uncertainty on this risk assessment is assumed to be small.

The full range of background was not considered beyond the initial screening against site-specific background. Further, surface soil background levels were used for all but the outdoor worker (exposed to surface and subsurface soil) and the excavation worker, where subsurface soil background levels were used for screening to determine COPCs. If sample data used in determining COPCs for the outdoor worker (exposed to surface and subsurface soil) and the excavation worker actually were collected from the surface, the inappropriate background value was used for comparison. The potential uncertainty associated with this assumption is small.

Some SQLs for the data are above screening levels. Since nondetect results were used at their SQL in determining EPCs, the potential uncertainty for the high SQL is small.

D.6.2 UNCERTAINTIES ASSOCIATED WITH EXPOSURE ASSESSMENT

Uncertainties associated with dermal absorption have been included in Section 6.5.

In accordance with EPA guidance, UCL95 concentrations were used as EPCs if there were a sufficient number of samples and distinct results to calculate a UCL95. This likely will lead to an overestimation of actual exposure because receptors are assumed to be exposed to the UCL95 concentration for the entire ED. As the data indicate, many COPCs were not detected in all samples. Thus, the assumption that all potential exposures are to the UCL95 concentrations likely results in an overestimation of actual exposures and estimates of potential risk. The potential uncertainty for use of the UCL95 is small.

Significant uncertainty exists in the exposure assumptions used to calculate chemical intakes from exposure to various media (e.g., rate of soil ingestion, frequency and duration of exposure, absorption through the skin). Conservative (i.e., health protective) exposure factors are used when information available is limited in the form of using RME exposure assumptions as per the update of the Risk Methods Document (DOE 2015a). This may result in an overestimation of potential risk; this potential uncertainty is moderate.

Some of the SWMUs/AOCs evaluated in this assessment are very small (< 0.1 acre), and the assumptions used for the levels of exposures (duration, frequency) overstate potential chronic exposures in these units. This potential uncertainty is moderate.

D.6.3 UNCERTAINTIES ASSOCIATED WITH TOXICITY ASSESSMENT

Uncertainty is involved in characterizing EPCs for environmental media under future conditions in this BHHRA. In calculating the EPCs at the Soils OU RI 2 sources, the concentrations of COPCs are kept constant throughout the exposure period. That is, the risk assessment does not consider that concentrations of some COCs may be lower or higher in the future because of processes such as degradation and attenuation. Because the COCs driving risk at the SWMUs/AOCs are not expected to degrade significantly throughout a lifetime, the effect of this uncertainty is estimated to be small.

A second uncertainty is the potential risk that may develop as COPCs in media at the Soils OU RI 2 sources migrate to groundwater below the SWMU and are transported off-site. To address this uncertainty, results from a fate and transport model were used to estimate potential contributions from each SWMU to POEs for groundwater exposure away from the source area (see Appendix C). While the modeling estimated contaminant transport though groundwater based on contaminant concentrations in the surrounding soil, uncertainty still exists in the POE at which exposure may occur in the future and the contaminant mass that is present in the source areas contributing to the future groundwater concentrations of contaminants. These uncertainties are discussed in Appendix C. Generally, the estimated effect for most of the modeling uncertainties is moderate to small, indicating that the ELCR and HI estimates generated using the modeled concentrations can be expected to vary by less than an order of magnitude.

Additional information regarding uncertainties associated with toxicity assessment can be found in Section D.4.2.

D.6.4 UNCERTAINTIES ASSOCIATED WITH RISK CHARACTERIZATION

The potential risk of adverse health effects is characterized based on potential exposures to COPCs and potential dose-response relationships for the COPCs. Two important additional sources of uncertainty are introduced in this phase of the BHHRA: the evaluation of potential simultaneous exposure to multiple chemicals and the combination of upper-bound exposure estimates with upper-bound toxicity estimates.

As prescribed by the Risk Methods Document (DOE 2015a), after potential exposures and potential risks from each COPC are calculated, the total potential upper-bound risk and HI associated with each receptor scenario are calculated by combining the estimated potential health risk from each COPC for each scenario. For virtually all combinations of chemicals, little if any evidence of interaction is available, and synergistic/antagonistic effects and magnitude of effects cannot be addressed; therefore, additivity is assumed. For noncarcinogenic effects, this is equivalent to the assumption of simple similar action. Whether assuming additivity can lead to an underestimation or overestimation of risk is unknown. The general consensus is that the effect of this uncertainty is small to moderate.

Additionally, some uncertainty is associated with adding risks from chemical exposure to those from exposure to radionuclides. Because the Soils OU RI 2 SWMUs/AOCs have multiple chemicals and radionuclides driving risk and these COCs have differing endpoints, the effect of this uncertainty could be moderate.

Though not quantified in this evaluation, UCRS groundwater could pose as a medium of concern under certain exposure scenarios; however, these risks were not quantified due to the high improbability of the UCRS at these SWMUs/AOCs being used as a drinking water aquifer (DOE 2015a).

D.6.5 UNCERTAINTIES ASSOCIATED WITH DERMAL ABSORPTION

Due to the circumstances presented in Section D.4.2.1, "Development of Dermal Toxicity Factors," Attachment D8 has been developed. Attachment D8 presents summaries of the risk characterization by location considered for metals in the BHHRA, as an analysis using an alternative approach to that described in the Risk Methods Document to incorporate recent guidance. The alternative approach considers dermal absorption for all metals because RAGS Part E lists ABS values for all metals as zero except arsenic and cadmium. The summaries presented in Attachment D8 are similar to those presented in Attachment D6. They present land use scenarios of concern, COCs, and POCs. In addition, each table lists the following:

- Receptor risks for each land use scenario of concern;
- Percent contribution by pathway to the total risk; and
- Percent contribution each COC contributes to the total risk.

Because the effects of this uncertainty are large, they have been considered further in selection of COCs. This COCs selection is provided in Section D.7.4.2.

D.6.6 SUMMARY OF UNCERTAINTIES

The large number of assumptions used in the risk assessment could introduce a great deal of uncertainty. While it is theoretically possible that this leads to underestimates of potential risk, the use of numerous upper-bound assumptions most likely results in conservative estimates of potential risks. Any individual's potential exposure and subsequent potential risk are influenced by their individual exposure and toxicity parameters and will vary on a case-by-case basis. Despite inevitable uncertainties associated with the steps used to derive potential risks, the use of numerous health-protective assumptions most likely will result in a protective estimate of potential health risks for receptors that could be exposed to site contaminants at EUs evaluated in this Soils OU RI 2.

D.7. CONCLUSIONS

This section summarizes the results of the BHHRA and draws conclusions from the results. The primary purpose of this section is to provide a concise summary of each of the BHHRA steps without the use of tables, extensive explanations, or justifications. This section also includes a series of observations in which the results of the BHHRA are combined with the uncertainties in the risk assessment.

D.7.1 CHEMICALS OF POTENTIAL CONCERN

COPCs were selected from soil data collected in the recently completed Soils OU RI 2 and historical data from the OREIS database. This data set was screened to produce final COPCs lists aggregated by location.

Through a series of screening steps, which follow the Risk Methods Document (DOE 2015a) and other regulatory agency approved guidance, the data sets were reduced to lists of COPCs for the entire Soils OU.

D.7.2 EXPOSURE ASSESSMENT

Historical information and newly collected data were used to develop a CSM. After consideration of the available data and scope of the SI, the potential receptor population under current conditions at the source units is industrial workers, and the potential receptor populations under future conditions are industrial workers, outdoor workers, excavation workers, residents (although not reasonably anticipated), and recreational users.

Industrial Worker

Incidental ingestion of surface soil
Dermal contact with surface soil
Inhalation of vapors emitted by surface soil
External exposure to ionizing radiation in surface soil

Outdoor Worker Exposed to Surface Soil

Incidental ingestion of surface soil
Dermal contact with surface soil
Inhalation of vapors emitted by surface soil
External exposure to ionizing radiation in surface soil

Outdoor Worker and Excavation Worker Exposed to Surface and Subsurface Soil

Incidental ingestion of surface and subsurface soil
Dermal contact with surface and subsurface soil
Inhalation of vapors emitted by surface and subsurface soil
External exposure to ionizing radiation in surface and subsurface soil

Future Rural Resident

Incidental ingestion of surface soil
Dermal contact with surface soil
Inhalation of vapors emitted by surface soil
External exposure to ionizing radiation in surface soil
Ingestion of groundwater (from modeled concentrations)

Dermal contact with groundwater while showering (from modeled concentrations)
Inhalation of vapors emitted by groundwater during household use/showering (from modeled concentrations) and
Inhalation of vapors indoors from transport from subsurface VOCs

Recreational User

Incidental ingestion of surface soil
Dermal contact with surface soil
Inhalation of vapors emitted by surface soil
External exposure to ionizing radiation in surface soil

After selection of the exposure routes, CDIs were calculated using standard exposure models. Most parameters used in models were default values.

D.7.3 TOXICITY ASSESSMENT

The toxicity values used in the risk assessment were taken from the update of the Risk Methods Document (DOE 2015a), except as noted within this BHHRA. After compiling toxicity information, the determination was made that the majority of the COPCs had a toxicity value available for one or more routes of exposure (see Section D.3.5.2).

D.7.4 RISK CHARACTERIZATION

Quantitative risks were computed by integrating the CDIs tabulated from the exposure assessment and toxicity values calculated from the toxicity assessment. The quantitative risks indicate elevated risks associated with exposure to subsurface soil, surface soil, and groundwater exposure from modeling. Significant findings are summarized below.

D.7.4.1 Land Use Scenarios of Concern

A list of land uses of concern for Soils OU SWMUs/AOC is shown in Section D.5.7.1. The list shows that each land use has at least one SWMU/AOC, which it is a concern.

D.7.4.2 Contaminants of Concern for Soil

To determine use scenarios of concern, risk characterization results for cumulative systemic toxicity (HI) and cumulative risk (ELCR) are compared to benchmarks of 1.0 and 1E-06, respectively. Use scenarios with cumulative HI or cumulative ELCR exceeding either of these benchmarks is deemed use scenarios of concern. To make a determination about whether contaminants are of concern, quantitative risk and hazard results over all pathways were compared to risk and hazard benchmarks for land use scenarios of concern, with the alternative evaluation approach described in Section D.6.5 considered. The benchmarks used for this comparison were (a) 0.1 for a chemical-specific HQ and (b) 1E-06 for a chemical-specific ELCR.

In the subsections that follow, all COPCs are listed that meet the benchmarks above in the HI and ELCR calculations (Tables D.26–D.35 and D.36–D.42, respectively). After considering this list, including an evaluation of additional potential COCs based on dermal absorption assumptions (see Section D.6.5 and

Attachment D8), contaminants with chemical-specific HQs or ELCRs exceeding these benchmarks were deemed COCs.

Priority COCs are identified to highlight those COCs contributing most to cumulative HI and ELCR for each SWMU/AOC. Priority COCs are contaminants deemed COCs where chemical-specific HQ is greater than 1 or where chemical-specific ELCR is greater than 1E-04 for one or more scenarios. The priority COCs found in soil at individual SWMUs/AOCs are summarized in the subsections that follow.

The chemical-specific benchmark for ELCR is set at 1.0E-06; however, many of the COPCs listed in Appendix D, Tables D.36 through D.42, correspond to individual risks less than 1.0E-06 for the particular receptor evaluated. Nevertheless, these individual risk values are summed to get the cumulative risk values shown in these tables, as well as in Appendix D Attachment 6; Tables D6.1 through D6.10; and Attachment 8 Tables D8.1 through D8.10.

D.7.4.2.1 SWMU 13

As calculated and shown in Attachment D6, COCs for all exposure scenarios for SWMU 13 include those listed below. Uncertainty calculations, shown in Attachment D8, did not support addition of any COCs to the SWMU.

In SWMU 13 surface soil, COCs for systemic toxicity are the metals aluminum, iron, manganese, silver, uranium, and vanadium; COCs for ELCR include Total PAHs, Total PCBs, neptunium-237, technetium-99, uranium-234, uranium-235, and uranium-238. In subsurface soil, COCs are arsenic, Total PAHs, Total PCBs, cesium-137, neptunium-237, technetium-99, uranium-234, uranium-235, uranium-238. The entire list of COCs is provided with the RGOs in Section D.8.
Priority COCs are located in EUs 4, 6, 10, and 11. These include the following:

- *Future Industrial Worker:* None
- *Outdoor Worker (exposed to surface soil):* None
- *Outdoor Worker (exposed to surface and subsurface soil):* None
- *Excavation Worker:* None
- *Future Hypothetical Residential Receptor:* Total PCBs and manganese
- *Recreational User:* None

D.7.4.2.2 SWMU 15

As calculated and shown in Attachment D6, COCs for all exposure scenarios for SWMU 15 include those listed below. Uncertainty calculations, shown in Attachment D8, show that three metals (manganese, nickel, and vanadium) would have been COCs had dermal absorption been considered and the majority of the toxicity for the land use would not have been dermal. These three metals, however, were considered as COPCs in the initial evaluation; therefore, they have not been added as COCs for the SWMU.

In SWMU 15 surface soil, COCs for systemic toxicity are the metals antimony, arsenic, cadmium, cobalt, copper, iron, manganese, mercury, nickel, thallium, uranium, and vanadium; COCs for ELCR include arsenic, Total PAHs, Total PCBs, neptunium-237, technetium-99, thorium-230, uranium-234, uranium-235, and uranium-238. In subsurface soil, COCs are antimony, arsenic, cadmium, cobalt, copper, iron, manganese, mercury, nickel, thallium, uranium, Total PAHs, Total PCBs, neptunium-237, technetium-99, thorium-230, uranium-234, uranium-235, uranium-238. The entire list of COCs is provided with the RGOs in Section D.8.

Priority COCs are located in all of the EUs. These include the following:

- *Future Industrial Worker:* Total PCBs, uranium-238
- *Outdoor Worker (exposed to surface soil):* Total PCBs, antimony, and uranium-238
- *Outdoor Worker (exposed to surface and subsurface soil):* Total PCBs, antimony, thallium, and uranium-238
- *Excavation Worker:* Antimony, thallium, and uranium-238
- *Future Hypothetical Residential Receptor:* Total PCBs, arsenic, antimony, cobalt, copper, iron, mercury, nickel, uranium-235, and uranium-238
- *Recreational User:* Total PCBs, antimony, nickel, and uranium-238

D.7.4.2.3 SWMU 26

As calculated and shown in Attachment D6, COCs for all exposure scenarios for SWMU 26 include those listed below. Uncertainty calculations, shown in Attachment D8, show that four metals (aluminum, beryllium, nickel, and vanadium) would have been COCs had dermal absorption been considered and the majority of the toxicity for the land use would not have been dermal. These metals, however, were considered as a COPCs in the initial evaluation; therefore, they have not been added as COCs for the SWMU.

In SWMU 26 surface soil, COCs for systemic toxicity are the metals aluminum, arsenic, cobalt, iron, mercury, molybdenum, nickel, thallium, uranium, vanadium; COCs for ELCR include arsenic, Total PAHs, Total PCBs, cesium-137, neptunium-237, plutonium-239/240, radium-228, technetium-99, thorium-230, uranium-234, uranium-235, and uranium-238. In subsurface soil, COCs are antimony, arsenic, cobalt, copper, iron, manganese, mercury, molybdenum, nickel, thallium, uranium, Total PAHs, Total PCBs, pentachlorophenol, cesium-137, neptunium-237, plutonium-239/240, radium-228, technetium-99, thorium-230, uranium-234, uranium-235, and uranium-238. The entire list of COCs is provided with the RGOs in Section D.8.

Priority COCs are located in all of the EUs. These include the following:

- *Future Industrial Worker:* Thallium and uranium-238
- *Outdoor Worker (exposed to surface soil):* Arsenic, thallium, uranium, and uranium-238
- *Outdoor Worker (exposed to surface and subsurface soil):* Arsenic, antimony, nickel, thallium, uranium, neptunium-237, uranium-234, and uranium-238
- *Excavation Worker:* Antimony, nickel, thallium, uranium, and uranium-238
- *Future Hypothetical Residential Receptor:* Total PAHs, Total PCBs; arsenic, cobalt, mercury, molybdenum, thallium, uranium, cesium-137, uranium-235, and uranium-238
- *Recreational User:* Total PAHs, arsenic, cobalt, mercury, thallium, uranium, and uranium-238

D.7.4.2.4 SWMU 77

As calculated and shown in Attachment D6, COCs for all exposure scenarios for SWMU 77 include those listed below. Uncertainty calculations, shown in Attachment D8, did not support addition of any COCs to the SWMU.

In SWMU 77 surface soil, COCs for systemic toxicity are the metals iron, uranium, and vanadium; COCs for ELCR include Total PAHs, Total PCBs, thorium-230, and uranium-238. In subsurface soil, COCs are iron, uranium, vanadium, Total PAHs, Total PCBs, thorium-230, and uranium-238. The entire list of COCs is provided with the RGOs in Section D.8.

Priority COCs include the following:

- *Future Industrial Worker:* None
- *Outdoor Worker (exposed to surface soil):* None
- *Outdoor Worker (exposed to surface and subsurface soil):* None
- *Excavation Worker:* None
- *Future Hypothetical Residential Receptor:* Uranium
- *Recreational User:* Uranium

D.7.4.2.5 SWMUs 56 and 80

As calculated and shown in Attachment D6, COCs for all exposure scenarios for SWMUs 56 and 80 include those listed below. Uncertainty calculations, shown in Attachment D8, show that three metals (molybdenum, nickel, and vanadium) would have been COCs had dermal absorption been considered and the majority of the toxicity for the land use would not have been dermal. These metals, however, were considered as a COPCs in the initial evaluation; therefore, they have not been added as COCs for the SWMU.

Protactinium-231 and thorium-229 will not be considered COCs for any scenario in SWMUs 56 and 80 because of the available the results for SWMUs 56 and 80, the radiological counting error and TPU were greater than the reported results.

In SWMUs 56 and 80 surface soil, COCs for systemic toxicity are the metals antimony, cobalt, iron, manganese, molybdenum, uranium, and vanadium and total dioxins/furans; COCs for ELCR include PAHs, PCBs, dioxins/furans, and the radionuclides americium-241, cesium-137, neptunium-237, uranium-234, uranium-235, and uranium-238. In subsurface soil, COCs are antimony, arsenic, cobalt, iron, manganese, mercury, molybdenum, uranium, PAHs, PCBs, americium-241, cesium-137, neptunium-237, uranium-234, uranium-235, and uranium-238. The entire list of COCs is provided with the RGOs in Section D.8.

Priority COCs are located in all of the EUs. These include the following:

- *Future Industrial Worker:* Total PCBs and uranium-238
- *Outdoor Worker (exposed to surface soil):* Uranium, Total PCBs, and uranium-238
- *Outdoor Worker (exposed to surface and subsurface soil):* Uranium, Total PCBs, and uranium-238
- *Excavation Worker:* Uranium, Total PCBs, and uranium-238

- *Future Hypothetical Residential Receptor:* Antimony, uranium, dioxins/furans, Total PCBs, uranium-235, and uranium-238

- *Recreational User:* Uranium, Total PCBs, and uranium-238

D.7.4.2.6 AOC 204

As calculated and shown in Attachment D6, COCs for all exposure scenarios for AOC 204 include those listed below. Uncertainty calculations, shown in Attachment D8, show that five metals (beryllium, molybdenum, nickel, silver, and vanadium) would have been COCs had dermal absorption been considered and the majority of the toxicity for the land use would not have been dermal. These metals, however, were considered as a COPCs in the initial evaluation; therefore, they have not been added as COCs for the SWMU.

In AOC 204 surface soil, COCs for systemic toxicity are the metals antimony, arsenic, cobalt, iron, manganese, molybdenum, silver, thallium, uranium, and vanadium; COCs for ELCR include arsenic, PAHs, PCBs, and the radionuclides americium-241, protactinium-231, uranium-234, uranium-235, and uranium-238. In subsurface soil, COCs are arsenic, cobalt, iron, manganese, uranium, PAHs, PCBs, americium-241, cesium-137, protactinium-231, uranium-234, uranium-235, and uranium-238. The entire list of COCs is provided with the RGOs in Section D.8.

Priority COCs are located in EUs 2, 4, 5, 7, 9, 14, and 20. These include the following:

- *Future Industrial Worker:* Uranium, Total PCBs, uranium-235, and uranium-238

- *Outdoor Worker (exposed to surface soil):* Arsenic, uranium, Total PCBs, uranium-234, uranium-235, and uranium-238

- *Outdoor Worker (exposed to surface and subsurface soil):* Arsenic, uranium, Total PCBs, uranium-234, uranium-235, and uranium-238

- *Excavation Worker:* Arsenic, uranium, and uranium-238

- *Future Hypothetical Residential Receptor:* Arsenic, manganese, molybdenum, uranium, Totals PAHs, Total PCBs, uranium-235, and uranium-238

- *Recreational User:* Arsenic, uranium, Total PCBs, and uranium-238

D.7.4.2.7 SWMU 211-A

As calculated and shown in Attachment D6, COCs for all exposure scenarios for SWMU 211-A include those listed below. Uncertainty calculations, shown in Attachment D8, show that four metals, barium, nickel, silver, and uranium would have been COCs had dermal absorption been considered. However, since the majority of the contribution of toxicity for these COCs were from dermal absorption, they have not been added as COCs for the SWMU.

In SWMU 211-A surface soil, COCs for systemic toxicity are the metals antimony, iron, thallium, and vanadium; COCs for ELCR include PAHs, PCBs, cesium-137, neptunium-237, uranium-234, and uranium-238. In subsurface soil, COCs are antimony, arsenic, cobalt, iron, thallium, PAHs, PCBs, uranium-234, uranium-235, and uranium-238. The entire list of COCs is provided with the RGOs in Section D.8.

Priority COCs include the following:

- *Future Industrial Worker:* None
- *Outdoor Worker (exposed to surface soil):* Uranium-238
- *Outdoor Worker (exposed to surface and subsurface soil):* Uranium-238
- *Excavation Worker:* None
- *Future Hypothetical Residential Receptor:* Antimony and uranium-238
- *Recreational User:* None

D.7.4.2.8 SWMU 224

As calculated and shown in Attachment D6, COCs for all exposure scenarios for SWMU 224 include those listed below. Uncertainty calculations, shown in Attachment D8, did not support addition of any COCs to the SWMU.

In SWMU 224 surface soil, COCs for systemic toxicity are the metals antimony and uranium; COCs for ELCR include PAHs and uranium-238. In subsurface soil, COCs are arsenic, PAHs, cesium-137, and uranium-238. The entire list of COCs is provided with the RGOs in Section D.8.

Priority COCs include the following:

- *Future Industrial Worker:* None
- *Outdoor Worker (exposed to surface soil):* None
- *Outdoor Worker (exposed to surface and subsurface soil):* None
- *Excavation Worker:* None
- *Future Hypothetical Residential Receptor:* Antimony
- *Recreational User:* Antimony

D.7.4.2.9 SWMU 225

As calculated and shown in Attachment D6, COCs for all exposure scenarios for SWMUs 225-A and -B include those listed below. Uncertainty calculations, shown in Attachment D8, did not support addition of any COCs to the SWMU.

In SWMU 225 surface soil, COCs for systemic toxicity are the metals antimony, thallium, and vanadium; COCs for ELCR include PAHs and uranium-238. In subsurface soil, COCs are arsenic, PAHs, cesium-137, and uranium-238. The entire list of COCs is provided with the RGOs in Section D.8.

Priority COCs include the following:

- *Future Industrial Worker:* None
- *Outdoor Worker (exposed to surface soil):* None
- *Outdoor Worker (exposed to surface and subsurface soil):* None
- *Excavation Worker:* None
- *Future Hypothetical Residential Receptor:* Antimony
- *Recreational User:* None

D.7.4.2.10 AOC 565

As calculated and shown in Attachment D6, COCs for all exposure scenarios for AOC 565 include those listed below. Uncertainty calculations, shown in Attachment D8, did not support addition of any COCs to the SWMU.

In AOC 565 surface soil, there are no COCs. for systemic toxicity. In subsurface soil, the only COC is cesium-137. Because the cesium-137 result actually is located in surface soil and is less than the surface background value (DOE 2015a), cesium-137 will not be considered a COC at AOC 565.

There are no COCs associated with AOC 565.

D.7.4.3 Contaminants of Concern for Soils Potentially Contributing to Groundwater Contamination

Similarly for soil potentially contributing to groundwater contamination, to determine whether modeled concentrations of contaminants are of concern, quantitative risk and hazard results over all pathways were compared to risk and hazard benchmarks for land use scenarios of concern. The benchmarks used for this comparison were HI ≥ 0.1 and/or ELCR ≥ 1E-06 for ELCR.

"Priority COCs" are identified in this section as an aid to risk managers during decision making.

There were no priority COCs identified above in this risk assessment are based on the modeled groundwater concentrations at all POEs.

D.7.4.4 Pathways of Concern

Each of the pathways included in the BHHRA is a POC.

D.7.4.5 Media of Concern

Media of concern are those media that appear in at least one POC. Because they contribute to at least one POC, soil is a media of concern at all SWMUs/AOCs.

D.7.5 OBSERVATIONS

Consistent with regulatory guidance and agreements contained in the Risk Methods Document (DOE 2015a), this BHHRA presents ELCRs and HIs for land use scenarios representing current use, as well as for several hypothetical future uses. Risk evaluation of surface soil was conducted for all SWMUs/AOCs as part of the evaluation of the scenarios specified in the Work Plan (DOE 2010a). The scenarios described in the BHHRA are as follows:

- Current industrial use (site maintenance)—direct contact with surface soil (soil 0 to 1 ft bgs).
- Future on-site industrial use—direct contact with surface soil (soil 0 to 1 ft bgs).
- On-site outdoor use—direct contact with surface soil (soil 0 to 1 ft bgs).
- Off-site outdoor use—direct contact with surface and subsurface soil (soil 0 to 16 ft bgs).

- On-site excavation worker—direct contact with surface and subsurface soil (soil 0 to 16 ft bgs).

- Future hypothetical on-site rural resident—direct contact with surface soil (soil 0 to 1 ft bgs) and use of groundwater drawn from the RGA at source areas.

- Recreational use—direct contact with surface soil (soil 0 to 1 ft bgs).

Specific observations for this BHHRA are presented in Tables D.46a and D.46b.

Table D.46a. Summary of Direct Contact Risks for the Soils OU SWMUs/AOCs

		Direct Contact*		
SWMU	**Scenario**	**Total HI**	**Total ELCR**	**Total Dose (mrem/yr)**
Former Facilities				
13	Future Industrial Worker	< 1	**7.8E-05**	1.6
15	Future Industrial Worker	< 1	***6.5E-04***	24.1
26	Future Industrial Worker	**1.5**	***7.2E-04***	25.3
77	Future Industrial Worker	< 1	**2.7E-05**	0.5
56 and 80	Future Industrial Worker	< 1	***1.9E-03***	52.1
204	Teen Recreational User	***3.9***	***1.9E-03***	50.2
211-A	Future Industrial Worker	< 1	***1.2E-04***	5.2
224	Future Industrial Worker	< 1	**1.5E-05**	0.3
225	Future Industrial Worker	< 1	**2.1E-06**	< 0.1
565	Teen Recreational User	< 1	< 1.0E-06	N/A

For each SWMU, the total HI, total ELCR, and total dose from the EU showing the highest result is presented.
Bold indicates total HI > 1 or total ELCR > 1E-6; ***bold italics*** indicates total HI > 3 or total ELCR > 1E-4.
N/A[1] = Total dose was not assessed because there were no radiological COPCs for the SWMU.
*For direct contact, future industrial worker for SWMUs/AOCs inside the limited area and the teen recreational user for SWMUs/AOCs outside the industrial area are presented. Total HI and Total ELCR represent the cumulative value across all exposure routes assessed within this BHHRA (i.e., incidental ingestion, dermal contact, inhalation, and external exposure).
Only total dose above 0.1 mrem/year is summarized.

Table D.46b. Summary of RGA Groundwater Risks for the Soils OU SWMUs/AOCs

		RGA Groundwater Exposure*	
SWMU	**Scenario**	**Total HI**	**Total ELCR**
13	Resident	N/A	**2.7E-05**
15	Resident	N/A	**3.6E-05**

For the SWMU, the ELCR for the modeled groundwater concentrations from above the SWMU is presented.
Bold indicates ELCR > 1E-6; ***bold italics*** indicates ELCR > 1E-4.
N/A = no risks/hazards are applicable for the SWMU.
*For RGA groundwater exposure, ingestion, dermal exposure, inhalation through showering, and inhalation through household use is included. The combined lifetime exposure is presented for the resident.

D.8. REMEDIAL GOAL OPTIONS

This section presents RGOs for the COCs identified in this BHHRA and the methods used to calculate the RGOs. These RGOs should not be interpreted as being clean-up goals, but as risk-based values that may be used to guide the development of clean-up goals by risk managers. Cleanup goals will be determined in later decision documents.

RGOs were calculated for each COC based on targets presented in the Risk Methods Document (DOE 2015a) and consistent with EPA guidance (EPA 1995). Target risks for the RGOs were 1E-4, 1E-5, and 1E-6. Target hazards were 0.1, 1, and 3. Additionally for dose, RGOs were calculated for 1, 12, and 25 mrem/yr, based on benchmarks presented in the Risk Methods Document (DOE 2015a). When calculating the HI-based RGOs, the more conservative child-based values are reported.

D.8.1 CALCULATION OF RGOS

EPA guidance directs that RGOs are to be calculated for all COCs identified in a BHHRA (EPA 1991). The COCs identified in this risk assessment and their RGOs are presented in Tables D.47 and D.48. These COCs were calculated using the following equation:

$$\frac{\textbf{Concentration}}{\textbf{Risk}} = \frac{\textbf{RGO}}{\textbf{Target Risk}}$$

where:

Concentration is the exposure concentration for the medium.
Risk is the risk posed by exposure to the contaminated medium.
RGO is the RGO.
Target Risk is one of the values listed in Tables D.47 and D.48.

D.8.2 PRESENTATION OF RGOS

The equation developed in the previous subsection was applied for each soil COC. The RGOs developed for all COCs using this equation are presented in Table D.47. Grayed cells in Table D.47 indicate the EPC value is higher than the RGO value, or an RGO value is not applicable. RGOs for dose are presented in Table D.48.

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APPENDIX D INFORMATION ON CD

TABLES D.4–D.7, D.9–D.42, D.44, D.45, D.47, D.48
ATTACHMENT D1: NO ACTION LEVEL SCREENING VALUES
ATTACHMENT D2: EPC UNCERTAINTY EVALUATION
ATTACHMENT D3: PROUCL OUTPUT
ATTACHMENT D4: TOXICITY VALUES
ATTACHMENT D5: TOXICITY PROFILES
ATTACHMENT D6: RISK SUMMARIES
ATTACHMENT D7: NONDETECT UNCERTAINTY EVALUATION
ATTACHMENT D8: RISK SUMMARIES, ADDING DERMAL ABSORPTION OF METALS

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APPENDIX E

SCREENING ECOLOGICAL RISK ASSESSMENT

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CONTENTS

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FIGURES

TABLES

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ACRONYMS

AOC	area of concern
COPEC	chemical of potential ecological concern
CSM	conceptual site model
DMSA	DOE Material Storage Area
DOE	U.S. Department of Energy
EPC	exposure point concentration
ESV	ecological screening value
HI	hazard index
HQ	hazard quotient
NFA	no further action
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PGDP	Paducah Gaseous Diffusion Plant
RI	remedial investigation
SERA	screening ecological risk assessment
SVOC	semivolatile organic compound
SWMU	solid waste management unit
UCL	upper confidence limit
VOC	volatile organic compound
WKWMA	West Kentucky Wildlife Management Area

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E.1. INTRODUCTION

E.1.1 SITE LOCATION

This appendix provides the results of the screening ecological risk assessments (SERAs) completed for Soils Operable Unit (OU) Remedial Investigation (RI) 2 solid waste management units (SWMUs)/areas of concern (AOCs) at the Paducah Gaseous Diffusion Plant (PGDP) (Figure E.1). Some of the area surrounding the PGDP facility is a recreational wildlife area, the West Kentucky Wildlife Management Area (WKWMA), with residential areas lying beyond the WKWMA. Private land in rural residential and agricultural areas also borders the PGDP facility.

E.1.2 SITE HISTORY

All the SWMUs/AOCs considered in the SERAs are described in-depth in Chapter 5 of this RI Report.

E.2. PROBLEM FORMULATION

The first step in a SERA includes the problem formulation. This step encompasses development of the preliminary conceptual site model (CSM), determination of potentially complete exposure pathways and potentially contaminated media, selection of exposure endpoints, and selection of screening levels protective of the endpoints and potentially exposed receptors at the site.

E.2.1 PRELIMINARY CONCEPTUAL SITE MODEL

The preliminary CSM includes a description of the environmental setting, known site contaminants, and a figure (Figure E.2) representing the potential exposure pathways. The figure shows several pathways as incomplete because groundwater recharge to surface water is not expected as a potential release mechanism at the Soils OU SWMUs. This preliminary CSM is used as the basis for selection of benchmark values used to screen the site for potential ecological risk. The primary ecological receptors (i.e., the exposure endpoints) shown in the preliminary CSM are terrestrial animals and terrestrial plants. Specific groups included in terrestrial animals and plants that are the exposure endpoints shown in the preliminary CSM include reptiles and amphibians, birds, and mammals. Specific species observed in the nonindustrial areas of PGDP and at the adjacent WKWMA are listed in Section E.2.1.1. Protection of these populations from negative impact on survival and reproduction resulting from exposure to chemical of potential ecological concern (COPECs) in surface soil are the measurement endpoints. The measurement endpoints are determined by comparing results to the screening values. Screening values are protective of these endpoints and are discussed in Section E.3.

E.2.1.1 Site Environmental Setting and Habitat Descriptions

The SWMUs located inside the Limited Area are generally similar in topography and process history, and the SWMUs/AOCs located outside the Limited Area also generally are similar in topography and process history. Although there is potential for contamination below the surface to migrate laterally toward surface water, the direction of shallow groundwater flow is primarily downward and represents limited risks to terrestrial receptors near these sites. This section presents a brief summary of the ecosystem relevant to defining the CSM and exposure pathways. Table E.1 and the text below lists the Soils OU RI 2

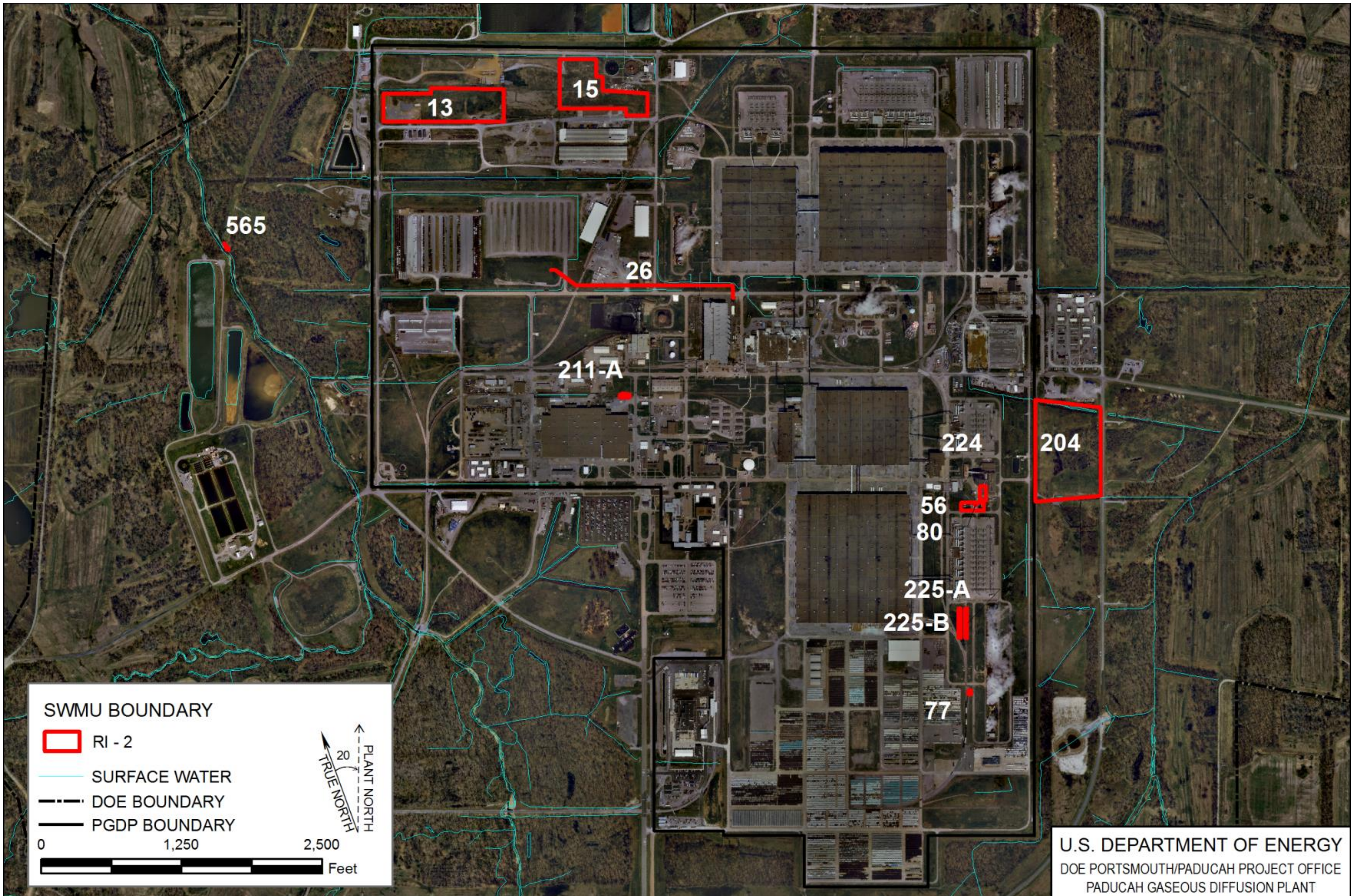

Figure E.1. Location of the Soils OU RI 2 SWMUs/AOCs

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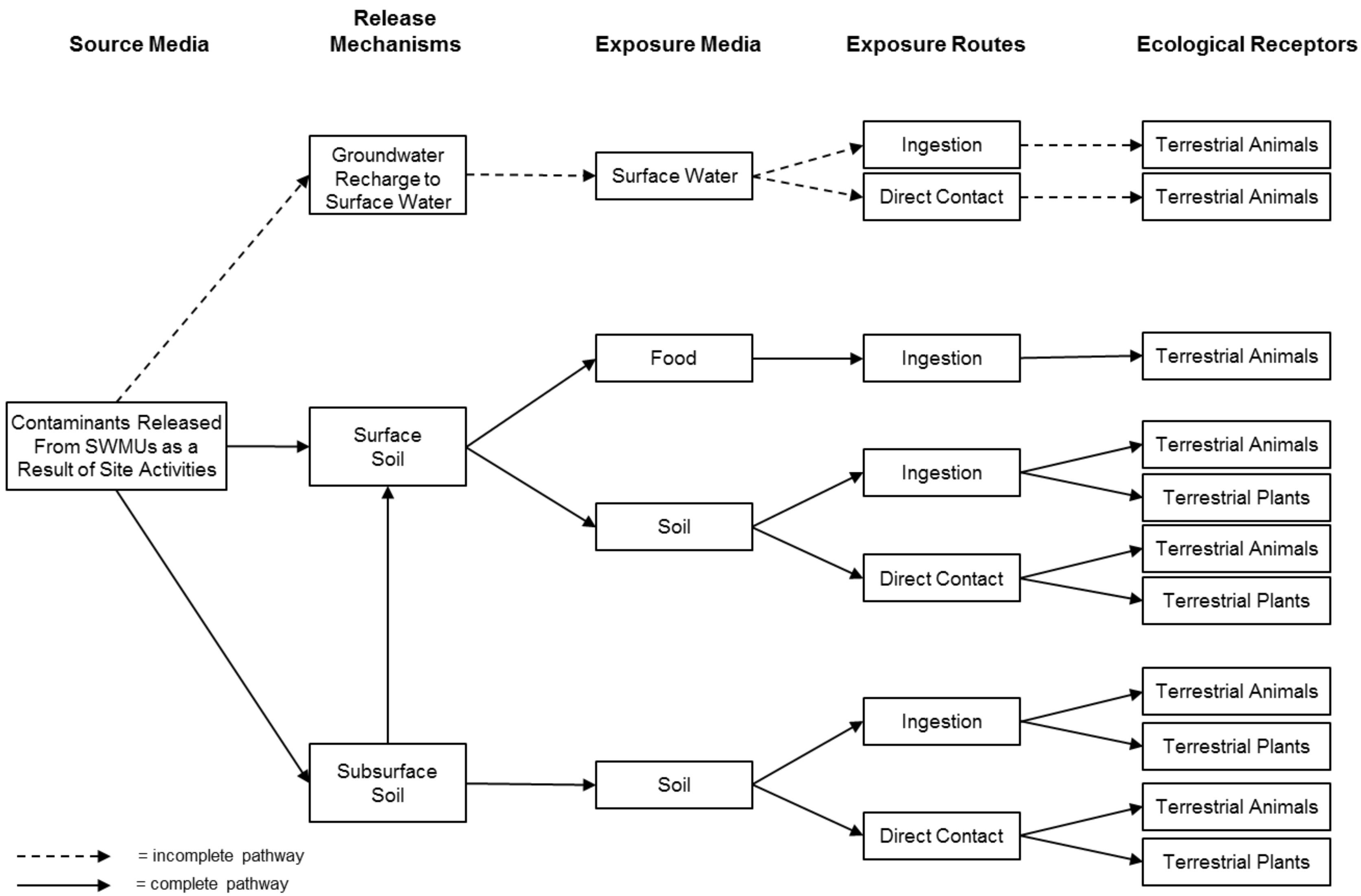

Figure E.2. Preliminary Conceptual Site Model for Soils OU RI 2 SWMUs

Table E.1. Ecological Screening

Description	SWMU	Area Acres	Ground Cover	Near a Surface Water Body?	Total HI[a]	Priority COPECs	Background (mg/kg)[b]	Soil ESV (mg/kg)	Maximum Detection or ½ Maximum Detection Limit (mg/kg)[c]	HQ (max conc)	EPC (mg/kg)[d]	HQ (EPC)
Scrap Yards	13	6.83	gravel with a soil/grass mix	No	673.9	Aluminum	13,000	50	14,000	280.0	7078	141.6
						Antimony	0.21	0.2750	10 (½ DL)	37.04	7.666	28.4
						Iron	28,000	200	47,830	239.15	22,491	112.5
						Mercury	0.2	0.1	20 (½ DL)	200	20.49	204.9
						PCB, Total	N/A	0.02	2.5 (½ DL)	125	2.557	127.9
						Vanadium	38	7.8	158	20.26	98.61	12.6
Scrap Yard	15	5.29	gravel with a soil/grass mix	Yes	1325.5	Aluminum	13,000	50	9,250	185.0	8,455	169.1
						Antimony	0.21	0.2750	283.01	1048.19	87.04	322.4
						Cadmium	0.21	0.36	24.15	67.08	8.604	23.9
						Copper	19	28	6,122.47	218.66	571.9	20.4
						High molecular weight PAHs	N/A	1.1	15.99	14.54	12.35	11.2
						Iron	28,000	200	171,000	855	37,414	187.1
						Lead	36	11	1,040.18	94.56	134.7	12.2
						Mercury	0.2	0.1	20 (½ DL)	200	6.116	61.2
						Nickel	21	38	3,787.15	99.66	411.8	10.8
						PCB, Total	N/A	0.02	55	2750	8.604	430.2
						Selenium	0.8	0.52	26.71	51.37	10.2	19.6
						Uranium	4.9	5	459	91.8	91.33	18.3
						Zinc	65	46	3,168.62	68.88	474.4	10.3
4-inch Underground Transfer Line	26	0.041	soil/gravel mix	Yes	1125.3	Aluminum	13,000	50	34,600	692.0	17,359	347.2
						Antimony	0.21	0.2750	8.95 (½ DL)	33.15	6.596	24.4
						High molecular weight PAHs	N/A	1.1	29.4	26.73	15.07	13.7
						Iron	28,000	200	85,100	425.5	30,020	150.1
						Mercury	0.2	0.1	20 (½ DL)	200	21.16	211.6
						PCB, Total	N/A	0.02	2.5 (½ DL)	125	2.115	105.8
						Uranium	4.9	5	3,100	620	792.6	158.5
						Vanadium	38	7.8	195	25	141.6	18.2

Table E.1. Ecological Screening (Continued)

Description	SWMU	Area Acres	Ground Cover	Near a Surface Water Body?	Total HI[a]	Priority COPECs	Background (mg/kg)[b]	Soil ESV (mg/kg)	Maximum Detection or ½ Maximum Detection Limit (mg/kg)[c]	HQ (max conc)	EPC (mg/kg)[c]	HQ (EPC)
Sulfuric Acid Storage Tank	77	0.017	concrete with some gravel	No	764.7	Iron	28,000	200	50,329	251.65	50,329	251.6
						Mercury	0.2	0.1	20 (½ DL)	200	20	200.0
						PCB, Total	N/A	0.02	2.5 (½ DL)	125	2.5	125.0
						Uranium	4.9	5	666	133.2	666	133.2
						Vanadium	38	7.8	168	21.54	168	21.5
PCB Staging Area and Spill Site	56/80	0.345	gravel/soil/grass with gravel driveways, and concrete pads	Yes	2864.5	Aluminum	13,000	50	9,320	186.4	9,320	186.4
						Antimony	0.21	0.27	58.17	215.44	40.4	149.6
						Cadmium	0.21	0.36	6 (½ DL)	16.7	6.72	18.7
						Iron	28,000	200	41,269	206.35	28,735	143.7
						Mercury	0.2	0.1	20 (½ DL)	200	19.9	198.9
						PCB, Total	N/A	0.02	475	23,750	41.8	2,091.5
						Selenium	0.8	0.52	10 (½ DL)	19.2	5.62	10.8
						Uranium	4.9	5	5,724	1144.8	77.4	15.5
						Vanadium	38	7.8	138	17.7	113	14.5
Historical Staging Area	204	11.3	soil/grass mix	Yes	1191.7	Aluminum	13,000	50	13,700	274.0	8,971	179.4
						Antimony	0.21	0.27	10 (½ DL)	37.04	4.35	16.1
						Iron	28,000	200	33,542	167.71	24,076	120.4
						Mercury	0.2	0.1	20 (½ DL)	200	20.5	204.8
						PCB, Total	N/A	0.02	79	3,950	2.47	123.5
						Trichloroethene	N/A	0.001	0.5 (½ DL)	500	0.5	500.0
						Vanadium	38	7.8	151	19.4	113	14.5
Trichloroethene Spill Site Northwest	211-A	0.062	mostly grass, but a gravel patch on the south side of the SWMU; asphalt to the south	No	1041.6	Aluminum	13,000	50	8,800	176.0	8,800	176.0
						Antimony	0.21	0.27	65.23	241.59	59.9	221.7
						Cadmium	0.21	0.36	6 (½ DL)	16.67	6	16.7
						Iron	28,000	200	30,465	152.33	30,465	152.3
						Mercury	0.2	0.1	20 (½ DL)	200	20.9	209.0
						PCB, Total	N/A	0.02	2.5 (½ DL)	125	4.09	204.7
						Selenium	0.8	0.52	10 (½ DL)	19.2	13.3	25.7
DMSA OS-13, Empty Drum Storage	224	0.149	mostly gravel with some soil/grass	No	688.2	Aluminum	13,000	50	4,910	98.2	4,910	98.2
						Antimony	0.21	0.27	108.07	400.26	108.07	400.3
						Cadmium	0.21	0.36	6 (½ DL)	16.67	6	16.7
						Iron	28,000	200	14,444.19	72.22	14,444.19	72.2
						Mercury	0.2	0.1	5 (½ DL)	50	5	50.0
						Selenium	0.8	0.52	10 (½ DL)	19.2	10	19.2

Table E.1. Ecological Screening (Continued)

Description	SWMU	Area Acres	Ground Cover	Near a Surface Water Body?	Total HI[a]	Priority COPECs	Background (mg/kg)[b]	Soil ESV (mg/kg)	Maximum Detection or ½ Maximum Detection Limit (mg/kg)[c]	HQ (max conc)	EPC (mg/kg)[d]	HQ (EPC)
DMSA OS-14, Rail Cars	225	0.186	soil/gravel mix	No	796.0	Aluminum	13,000	50	8,480	169.6	8,480	169.6
						Antimony	0.21	0.27	54.12	200.44	54.12	200.4
						Cadmium	0.21	0.36	6 (½ DL)	16.67	6	16.7
						Iron	28,000	200	27,274	136.37	27,274	136.4
						Mercury	0.2	0.1	20 (½ DL)	200	20	200.0
						Molybdenum	N/A	2	36	18	36	18.0
						Selenium	0.8	0.52	10 (½ DL)	19.2	10	19.2
						Vanadium	38	7.8	109	13.97	109	14.0
Rubble Area K, North of C-611 Water Treatment Plant	565	0.012	concrete rubble with soil/grass	Yes	0.0	none						

[a] Total hazard index (HI) includes contributions from all of the COPECs (listed in Table E4.1); only priority COPECS (i.e., the COPECs with HQs greater than 10 using the EPCs) are shown in this table.
[b] Background values are for surface soil taken from DOE 2015b; ecological screening values (ESVs) are taken from DOE 2015a.
[c] The screening value shown is the maximum detected value unless denoted with the following: "(½ DL, where ½ DL means ½ of the detection limit)."
[d] EPC is the 95% upper confidence limit (UCL), as shown in Table E4.1.

SWMUs/AOCs along with each ground cover and proximity to surface water/drainageways. Attachment E1 contains photographs of the Soils OU RI 2 SWMUs/AOCs.

The human health and ecological risk assessments utilized acreage for a SWMU based on Global Positioning System coordinates and mapping tools. This acreage is reflected in the figures within this document. Of note, the acreage presented in the Background sections of this document may be inconsistent with acreage utilized in the risk assessments due to its being based on historical safety analysis report administrative boundaries, which typically were estimated utilizing a map/figure.

The primary ecosystem in the area outside the industrial area around the SWMUs/AOCs is upland grassland interspersed with developed industrial areas. The vegetation over these SWMUs/AOCs is maintained with routine mowing (see Section 3.1) approximately eight times per year. Most of the SWMUs/AOCs also are surrounded by fencing and/or roads. The buffer area and areas bordering the PGDP facility include forest, thickets, and agricultural land. Much of the PGDP facility is surrounded by the WKWMA, which includes managed native prairie and deciduous forest. Species documented to occur in the area include numerous small mammals, particularly shrews, mice, and voles. Numerous bird species, including doves, turkey, quail, bluebirds and other songbirds, as well as hawks and owls, are found in this area. There also are amphibians, reptiles (primarily lizards and turtles), and bats. Table E.2 lists species observed in the nonindustrial areas of the PGDP and at the adjacent WKWMA.

A number of state and federal listed, threatened, and endangered species may be present on the buffer areas within PGDP and the surrounding WKWMA land, though they are unlikely to be found on the maintained surface within the SWMUs/AOCs (DOE 2008). These species are listed in Table E.3 of this document. As noted in the footnote to Table E.3, none of the species listed in the table have been reported as sighted on the U.S. Department of Energy (DOE) Reservation.

SWMU 13. SWMU 13 is a former scrap yard. The contents of the yard were removed in 2008, and it is now a grassy field. The SWMU is bordered to the north, south, and west by drainage ditches. Surface water flow through these ditches, however, is intermittent.

SWMU 15. SWMU 15 is a former scrap yard. The contents of the yard were removed in 2008, and it is now a grassy field. The SWMU is bordered to the north and east by a ditch. The ditch to the east is intermittent with insignificant surface water flow. The ditch to the north drains several areas, with surface water flowing into the C-613 Sedimentation Basin before discharging to Outfall 001. Surface water in this northern ditch is more significant than the ditch to the east.

SWMU 26. SWMU 26 is an abandoned 4-inch underground transfer line. The surface above the line is grassy. A drainage ditch borders the entire SWMU on the south and drains into Outfall 015. The eastern portion of the SWMU is bordered on the north by the location of the North-South Diversion Ditch. One portion of the line underlies what is now a gravel parking lot.

SWMU 77. SWMU 77 is a concrete dike that formerly contained a sulfuric acid storage tank. No surface water is near this SWMU.

SWMUs 56 and 80. SWMUs 56 and 80 are a polychlorinated biphenyl (PCB) staging area and spill site near an electrical switchyard. A drainage ditch borders the southern portion of the SWMU area. Drainage along this ditch enters and exits a culvert to the east of the SWMUs.

AOC 204. AOC 204 is a historical staging area. The area is located between two outfalls and is grassy/wooded.

Table E.2. Wildlife Species Present or Potentially Present at the PGDP Site*

Common Name	Scientific Name
Fish	
Black buffalo	*Ictiobus niger*
Blackspotted topminnow	*Fundulus olivaceus*
Creek chub	*Semotilus atromaculatus*
Bluegill sunfish	*Lepomis macrochirus*
Green sunfish	*Lepomis cyanellus*
Redspotted sunfish	*Lepomis miniatus*
Largemouth bass	*Micropterus salmoides*
Longear sunfish	*Lepomis megalotis*
Stoneroller	*Campostoma sp.*
Reptiles and Amphibians	
American toad	*Bufo americanus*
Bull frog	*Rana catesbeiana*
Eastern box turtle	*Terrapene carolina*
Leopard frog	*Rana sphenocephala*
Salamanders	Various species
Snakes	Various species
Green treefrog	*Hyla cinerea*
Woodhouse toad	*Bufo woodhousei*
Northern crawfish frog	*Rana areolata circulosa*
Green frog	*Rana clamitans melanota*
Upland chorus frog	*Pseudacris triseriata feriiarum*
Birds	
American robin	*Turdus migratorius*
American woodcock	*Scolopax minor*
Bald eagle	*Haliaeetus leucocephalus*
Barred owl	*Strix varia*
Belted kingfisher	*Ceryle alcyon*
Blue jay	*Cyanocitta cristata*
Blue-winged teal	*Anas discors*
Canada goose	*Branta canadensis*
Coot	*Fulica americana*
American crow	*Corvus brachyrhynchos*
Downy woodpecker	*Picoides pubescens*
Eastern bluebird	*Sialia sialus*
Eastern kingbird	*Tyrannus tyrannus*
Eastern meadowlark	*Sturnella magna*
Eastern phoebe	*Sayornis phoebe*
Eastern wood pewee	*Contopus virens*
Gadwall duck	*Anas strepera*
Great blue heron	*Ardea herodias*
Great crested flycatcher	*Myiarchus crinitus*
Great-horned owl	*Bubo virginianus*
Hairy woodpecker	*Picoides villosus*
Hawks	Various species
Herons and egrets	Various species
Killdeer	*Charadrius vociferus*
Loggerhead shrike	*Lanius ludovicianus*
Mallard duck	*Anas platyrhynchus*
Mourning dove	*Zenaida macroura*
Northern bobwhite (aka bobwhite quail)	*Colinus virgianus*
Northern cardinal	*Cardinalis cardinalis*

Table E.2. Wildlife Species Present or Potentially Present at the PGDP Site* (Continued)

Common Name	Scientific Name
Bird (Continued)	
Northern flicker	*Colaptes auratus*
Pileated woodpecker	*Dryocopus pileatus*
Red-bellied woodpecker	*Melanerpes erythrocephalus*
Red-shouldered hawk	*Buteo lineatus*
Red-tailed hawk	*Buteo jamaicensis*
Red-winged blackbird	*Agelaius phoeniceus*
Ruby-throated hummingbird	*Archilochus colubris*
Screech owl	*Megascops asio*
Song sparrow	*Melospiza melodia*
Swallows	Various species
Vireos	Various *vireo sp.*
Tufted titmouse	*Baeolophus bicolor*
Turkey vulture	*Cathartes aura*
Warblers	*Various species*
Chuck-will's widow	*Caprimulgus carolinensis*
White-breasted nuthatch	*Sitta carolinensis*
Whip-poor-will	*Caprimulgis vocifierous*
Wild turkey	*Meleagris gallopavo*
Wood cock	*Scolopax minor*
Wood duck	*Aix sponsa*
Wrens	Various species
Yellow-billed cuckoo	*Coccyzus americanus*
Mammals	
American beaver	*Castor canadensis*
American mink (aka mink)	*Mustela vison*
Bobcat	*Lynx rufus*
Common muskrat	*Ondatra zibethicus*
Coyote	*Canis latrans*
Eastern cottontail	*Sylvilagus floridanus*
Eastern grey squirrel and fox squirrel	*Sciurus carolinensis*
Evening bat	*Nycticeceius humeralis*
Groundhog	*Marmota monax*
Indiana bat	*Myotis sodalis*
Mice	Various species
Moles	Various species
Opposum	*Didelphis virginiana*
Raccoon	*Procyon lotor*
Red fox	*Vuples vulpes*
Grey fox	*Urocyon cinereoargenteus*
Shrews	Various species
Skunk	*Mephitis mephitis*
Southeastern myotis bat	*Myotis sodalis*
Voles	Various species
White-tailed deer	*Odocoileus virginianus*

*The listed species are from the Surface Water OU Report (DOE 2008) and the WKWMA species information Web site (http://fw.ky.gov/kfwis/arcims/WmaSpecies.asp?strID=137).

Table E.3. Federally Listed, Proposed, and Candidate Species Potentially Occurring within the Paducah Site Study Area[a]

Group	Common Name	Scientific Name	Endangered Species Act Status
Mammals	Indiana Bat	*Myotis sodalis*	Endangered
	Northern Long-eared Bat	*Myotis septentrionalis*	Proposed
Mussels	Fanshell	*Cyprogenia stegaria*	Endangered
	Pink Mucket	*Lampsilis abrupta*	Endangered
	Ring Pink	*Obovaria retusa*	Endangered
	Orangefoot Pimpleback	*Plethobasus cooperianus*	Endangered
	Clubshell	*Pleurobema clava*	Endangered
	Rough Pigtoe	*Pleurobema plenum*	Endangered
	Fat Pocketbook	*Potamilus capax*	Endangered
	Spectaclecase	*Cumberlandia monodonta*	Endangered
	Sheepnose	*Plethobasus cyphyus*	Endangered
	Rabbitsfoot	*Quadrula c. cylindrical*	Threatened
Birds	Interior Least Tern	*Sterna antillarum athalassos*	Endangered

[a] All of the listed species are identified as an Endangered, Threatened, or Candidate Species known or with the potential to be located within McCracken County, Kentucky, by the U.S. Fish and Wildlife Service (November 2013).

SWMU 211-A. SWMU 211-A is a TCE spill site, northwest of the C-720 Building. The area is partially covered with asphalt. No surface water is near this SWMU; runoff from the area is drained by storm sewers.

SWMU 224. SWMU 224 is an outside DOE Material Storage Area (DMSA). The area stored empty drums. No surface water is near this SWMU.

SWMU 225. SWMU 225 is an outside DMSA. The area stored material inside a rail car. No surface water is near this SWMU.

AOC 565. AOC 565 is a rubble area, located north of the C-611 Water Treatment Plant. The AOC forms a surface used for erosion control along the north wall of Bayou Creek.

E.2.1.2 Data

The dataset for surface soils (i.e., 0–1 ft bgs) used in the SERA is comprised of historical sampling events as well as data collected during the fall of 2014 for this RI (DOE 2014). Chapter 5 describes the data set used for each SWMU/AOC. Chapter 4 describes the use of grids to subdivide data by location. Appendix B addresses data quality and applicability of the historical data.

For purposes of this SERA, high molecular weight polycyclic aromatic hydrocarbon (PAHs) consist of the following: benz(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(k)fluoranthene; chrysene; dibenz(a,h)anthracene; fluoranthene; indeno(1,2,3-cd)pyrene; and pyrene. Low molecular weight PAHs consist of acenaphthene, acenaphthylene, anthracene, fluorene, naphthalene, and phenanthrene. Results of analyses for the PAHs are summed and assessed within the group (i.e., high molecular weight PAHs and low molecular weight PAHs). Individual PAHs are not assessed.

E.2.1.3 Site Contaminants

Only surface soil contaminants at the SWMUs/AOCs were considered in the SERAs. Site contaminants at all SWMUs/AOCs included inorganic chemicals, organic chemicals, and radionuclides.

E.2.1.4 Fate and Transport Mechanisms

Potential migration pathways for contaminants from soil at the Soils OU RI 2 SWMUs/AOCs include transport of contaminated surface soil off-site by surface water, migration of contaminants to the subsurface soil, migration to groundwater, and uptake of soil contaminants through the on-site food chain. In addition, subsurface contaminants may be brought to the surface through bioturbation by burrowing animals or uptake by vegetation on the site. Migration of contaminants through these pathways is not considered significant and is not evaluated within this SERA.

The surface soils at most of the Soils OU RI 2 SWMUs/AOCs considered here are held in place by vegetation. Transport of surface soil off-site is likely to be minimal. Migration of contaminants to subsurface soil and through subsurface soil to groundwater is not likely to occur at the Soils OU RI 2 SWMUs/AOCs. Contaminants in groundwater may be discharged to surface water at areas away from the Soils OU RI 2 SWMUs/AOCs. Contaminants in surface soil are likely to be taken up into plants and soil invertebrates at these sites and would enter higher trophic level organisms through the food chain.

E.2.2 POTENTIALLY COMPLETE EXPOSURE PATHWAYS

The potential exposure pathways for ecological receptors are direct contact with and ingestion of soil and ingestion of plants or animals thereby exposed to substances in soil. Significant contaminant transport through runoff directly to surface water is unlikely because most of the sites have vegetated surfaces. The pathways through which receptors could contact contaminants in surface soil include direct ingestion of soil, ingestion of plant or animals from the site as food, external exposure to ionizing radiation, and dermal contact with soil or surface water. A CSM reflective of current site conditions is shown in Figure E.2. This SERA evaluates ecological risks associated with surface soils only.

E.2.3 POTENTIALLY CONTAMINATED MEDIA

Soil is the media of concern for all the Soils OU RI 2 SWMUs/AOCs. The substances detected in surface soils [metals, radionuclides, semivolatile organic compounds (SVOCs) and volatile organic compounds (VOCs)] are capable of causing adverse effects on terrestrial receptors. This SERA evaluates only terrestrial receptors (see Sect. E.2.1) for COPECs.

Although some SWMUs/AOCs are located near drainageways, significant surface water contamination is not expected as a result of these SWMUs/AOCs (UK 2007). As a result, ecological risks associated with exposure to surface water were not assessed in this SERA.

E.3. SCREENING-LEVEL EFFECTS EVALUATION

For the Soils OU RI 2 SWMUs/AOCs, the maximum site concentration of the reported values of each potential contaminant was compared to a single ecological screening level selected from the Ecological Risk Methods Document. ESVs were taken from Tables A.2 and A.3 of the Ecological Risk Methods Document (DOE 2015a). These ESVs are the PGDP no further action (NFA) values for soil. For the detected chemical and radiological results for which no ESV was available in the Ecological Risk Methods Document, one was calculated following similar methodology, or values from other sources were used. These values are presented in Attachment E2.

The maximum site concentration for a substance reported as detected in any sample is the larger of the maximum detected concentration and one half of the maximum reported detection limit for the substance in samples reported as nondetect. Maximum detected site concentrations, frequencies of detection, and detection limit ranges are provided in Chapter 5.

The maximum site concentration was used to calculate a HQ, using a ratio of the maximum site concentration with the ESV, as shown below:

$$\mathbf{HQ} = \frac{\mathbf{EPC}}{\mathbf{ESV}}$$

For those chemicals with at least one detection and whose maximum HQ was greater than or equal to 1, and at least 10 results were available, an EPC was calculated as the 95% UCL using ProUCL. The output from this program is included as Attachment E3. COPECs were further evaluated by calculating an HQ using the EPCs.

A total HI then was calculated by summing the HQs within each SWMU/AOC. Priority COPECs were selected from the chemicals at each SWMU/AOC showing the HQs greater than 10 calculated with the EPC. "Priority COPECs" are identified in this RI as an aid to risk managers during decision making. Table E.1 summarized these values. Background values from the Risk Methods Document (DOE 2015b) also are shown for comparison.

A summary of the results of the site data is provided in Table E.4, which lists the number of COPECs within each analytical suite (i.e., metals, radiological constituents, PCBs, SVOCs, and VOCs) retained for each SWMU/AOC for further consideration. As shown, all Soils OU RI 2 SWMUs/AOCs except AOC 565 had one or more COPECs retained. The entire screening list is provided in Attachment E4.

Table E.4. Summary of Suite of COPECs Retained in Surface Soil

SWMU/ AOC	Media	Number of Metals	Number of Rads	Number of PCBs	Number of SVOCs	Number of VOCs
13	Soil	19	---	1	1	---
15	Soil	21	---	1	2	---
26	Soil	25	14	1	6	10
77	Soil	16	---	1	---	---
56/80	Soil	18	11	1	17	---
204	Soil	22	13	1	1	1
211-A	Soil	18	---	1	1	---
224	Soil	17	---	1	1	---
225	Soil	17	---	---	1	---
565	Soil	---	---	---	---	---

---: no COPECs

E.4. UNCERTAINTIES

A number of uncertainties impact the potential usefulness of the results of this SERA. An uncertainty in these screening assessments is that the ecological screening levels are protective of entire suites of receptors, some of which may not be present at these disturbed sites. The grassy areas of these sites would be attractive to ecological receptors, but most of the Soils OU RI 2 SWMUs/AOCs are relatively small, and the surrounding industrial area may limit the extent to which ecological receptors use these areas. The potential risk from exposure to subsurface soil was not quantified in this SERA and is, therefore, unknown.

For SWMUs/AOCs in which no pH data are available, aluminum has been evaluated as if pH were less than 5.5. While soils in the vicinity of PGDP tend to have a low pH, ranging from 4.5 to 5.5 (DOE 1999) (see Section 3.5 of the main text), the pH of the soils for the Soils OU RI 2 SWMUs/AOCs (with the exception of SWMU 77) is unknown. Aluminum may be subsequently evaluated further by collection of soil pH data. Soil pH was analyzed at SWMU 77 and found to be 8.12 in the surface soil. Because soil pH results can be variable, however, whether aluminum should be considered a COPEC at any of the Soils OU RI 2 SWMUs/AOCs is an uncertainty. Additionally, a number of chemicals were retained as COPECs for which no benchmarks were available. These chemicals, upon further evaluation, may have no negative impacts on the ecological receptors.

These uncertainties, combined with the results of the SERAs, indicate the need for further evaluation of these sites. Risk managers may determine that sites do not need further evaluation (if exposure pathways are not complete or planned actions will eliminate the exposure pathway) or may recommend additional evaluation of the sites to better define the potential ecological risk indicated by the results. Alternatively, the benchmarks used in the screenings presented here and in the NFA levels in the PGDP Ecological Risk Methods Document (DOE 2015a) may be used as the ecologically based remedial goal options.

E.5. CONCLUSIONS

All of the sites, except AOC 565, evaluated in this SERA retained a number of COPECs. AOC 565 had no COPECs. Of the remaining SWMUs/AOCs, some metals were retained as COPECs at all SWMUs/AOCs. Total PCBs were retained as COPECs for all remaining SWMUs/AOCs with the exception of SWMU 225. Radionuclides, SVOCs, and VOCs also were retained. COPECs are listed below.

Metals:

- Aluminum (SWMUs/AOCs 13, 15, 26, 56/80, 204, 211-A, 224, and 225)
- Antimony (SWMUs/AOCs 13, 15, 26, 77, 56/80, 204, 211-A, 224, and 225)
- Arsenic (SWMUs/AOCs 15, 26, and 204)
- Barium (SWMUs/AOCs 15, 26, 211-A, 224, and 225)
- Beryllium (SWMU 26)
- Cadmium (SWMUs/AOCs 13, 15, 26, 77, 56/80, 204, 211-A, 224, and 225)
- Calcium (SWMUs/AOCs 13, 15, 26, 77, 56/80, 204, 211-A, 224, and 225)[1]
- Chromium (SWMUs/AOCs 15, 26, 77, 56/80, 204, 211-A, 224, and 225)
- Cobalt (SWMUs/AOCs 15, 26, 56/80, and 204)
- Copper (SWMUs/AOCs 13, 15, 26, 77, 56/80, 204, and 211-A)
- Iron (SWMUs/AOCs 13, 15, 26, 77, 56/80, 204, 211-A, 224, and 225)
- Lead (SWMUs/AOCs 13, 15, 26, 77, 56/80, 204, 211-A, 224, and 225)
- Lithium (SWMU 13)

[1] COPEC was retained because no ESV was available.

- Manganese (SWMUs/AOCs 13, 15, 26, 77, 56/80, 204, 211-A, 224, and 225)
- Mercury (SWMUs/AOCs 13, 15, 26, 77, 56/80, 204, 211-A, 224, and 225)
- Molybdenum (SWMUs/AOCs 13, 15, 26, 56/80, 204, 211-A, 224, and 225)
- Nickel (SWMUs/AOCs 13, 15, 26, and 77)
- Potassium (SWMU 26 and AOC 204)[2]
- Selenium (SWMUs/AOCs 13, 15, 26, 77, 56/80, 204, 211-A, 224, and 225)
- Silicon (SWMU 26 and AOC 204)[2]
- Silver (SWMUs/AOCs 13, 15, 26, 77, 56/80, 204, 211-A, 224, and 225)
- Sodium (SWMUs/AOCs 13, 15, 26, 77, 56/80, 204, 211-A, 224, and 225)[2]
- Thallium (SWMUs/AOCs 13, 26, and 204)
- Uranium (SWMUs/AOCs 13, 15, 26, 77, 56/80, 204, 211-A, 224, and 225)
- Vanadium (SWMUs/AOCs 13, 15, 26, 77, 56/80, 204, 211-A, 224, and 225)
- Zinc (SWMUs/AOCs 13, 15, 26, 77, 56/80, 204, 211-A, 224, and 225)

Total PCBs: (SWMUs/AOCs 13, 15, 26, 77, 56/80, 204, 211-A, and 224)

SVOCs:

- 1,2-Dichlorobenzene (SWMU 26)
- 1,3-Dichlorobenzene (SWMU 26)
- 1,4-Dichlorobenzene (SWMU 26)
- High molecular weight PAHs (SWMUs/AOCs 13, 15, 26, 56/80, 204, 211-A, 224, and 225)
- 1,2,3,4,6,7,8-Heptachlorodibenzofuran (SWMUs 56/80)[2]
- 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (SWMUs 56/80)[2]
- 1,2,3,4,7,8,9-Heptachlorodibenzofuran (SWMUs 56/80)[2]
- 1,2,3,4,7,8-Hexachlorodibenzofuran (SWMUs 56/80)[2]
- 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (SWMUs 56/80)[2]
- 1,2,3,6,7,8-Hexachlorodibenzofuran (SWMUs 56/80)[2]
- 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (SWMUs 56/80)[2]
- 1,2,3,7,8,9-Hexachlorodibenzofuran (SWMUs 56/80)[2]
- 1,2,3,7,8-Pentachlorodibenzofuran (SWMUs 56/80)[2]
- 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (SWMUs 56/80)[2]
- 2,3,4,6,7,8-Hexachlorodibenzofuran (SWMUs 56/80)[2]
- 2,3,4,7,8-Pentachlorodibenzofuran (SWMUs 56/80)[2]
- 2,3,7,8-Tetrachlorodibenzofuran (SWMUs 56/80)[2]
- Octachloro-dibenzo[b,e][1,4]dioxin (SWMUs 56/80)[2]
- Octachlorodibenzofuran (SWMUs 56/80)[2]

VOCs:

- (1,1-Dimethylethyl)benzene (SWMU 26)[2]
- (1-Methylpropyl)benzene (SWMU 26)[2]
- 1-Methyl-4-(1-methylethyl)benzene (SWMU 26)[2]
- Benzene (SWMU 26)
- Butylbenzene (SWMU 26)[2]

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[2] COPEC was retained because no ESV was available.

- Ethylbenzene (SWMU 26)
- Propylbenzene (SWMU 26)[3]
- Trichloroethene (SWMU 26 and AOC 204)

Radionuclides:

- Actinium-228 (SWMUs 26 and 56/80 and AOC 204)[3]
- Bismuth-211 (SWMUs 26 and 56/80 and AOC 204)[3]
- Bismuth-212 (SWMUs 26 and AOC 204)[3]
- Bismuth-214 (SWMUs 26 and 56/80 and AOC 204)[3]
- Lead-211 (SWMUs 26 and 56/80 and AOC 204)[3]
- Lead-212 (SWMUs 26 and 56/80 and AOC 204)[3]
- Lead-214 (SWMUs 26 and 56/80 and AOC 204)[3]
- Protactinium-233 (SWMUs 26 and 56/80)[3]
- Protactinium-234m (SWMUs 26 and 56/80 and AOC 204)[3]
- Radium-223 (SWMU 26 and AOC 204)[3]
- Radon-219 (SWMU 26 and AOC 204)[3]
- Thallium-208 (SWMUs 26 and 56/80 and AOC 204)[3]
- Thorium-227 (SWMU 26)[3]
- Thorium-234 (SWMUs 26 and 56/80 and AOC 204)[3]
- Uranium-238 (SWMUs 56/80 and AOC 204)

Further, some of these COPECs had an HQ, based on EPC, above 10. These COPECs are listed in Table E.1.

E.6. REFERENCES

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[3] COPEC was retained because no ESV was available.

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ATTACHMENT E1

SWMU/AOC PHOTOGRAPHS

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C-746-P Scrap Yard

C-746-P1 Scrap Yard

Figure E1.1. Photographs of SWMU 13

Figure E1.2. Photograph of SWMU 15

Figure E1.3. Photograph of SWMU 26

77. C-634-B H_2SO_4 Storage Tank

Figure E1.4. Photograph of SWMU 77

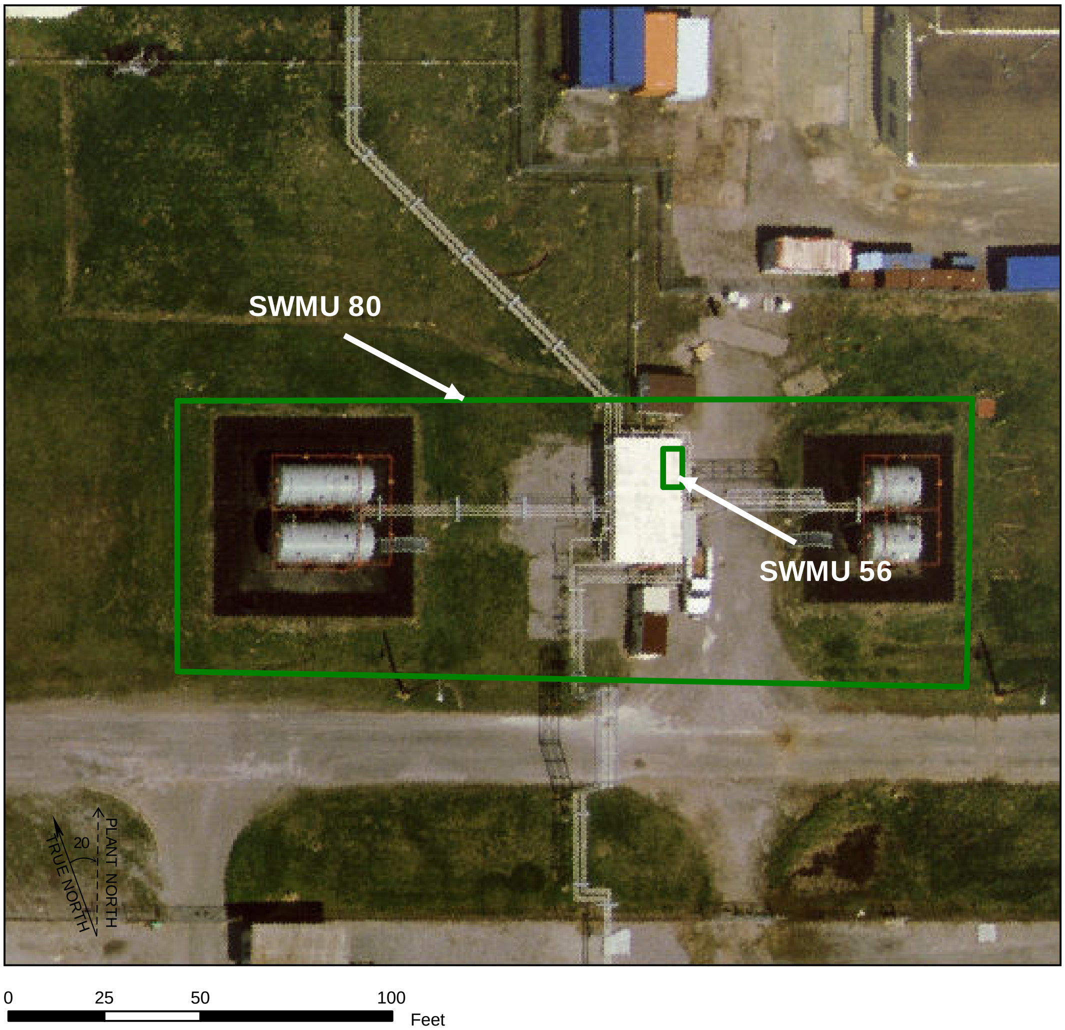

Figure E1.5. Photograph of SWMUs 56 and 80

Figure E1.6. Photograph of AOC 204

Figure E1.7. Photograph of SWMU 211-A

SWMU 224
DMSA OS-13
August 26, 2008

Figure E1.8. Photograph of SWMU 224

SWMU 225A (Looking North)
DMSA OS-14
June 6, 2013

Figure E1.9. Photograph of SWMU 225

Figure E1.10. Photograph of AOC 565

ATTACHMENT E2

ADDITIONAL ESVs

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Table E2.1. PGDP Soil NFA Screening Values for Additional Radionuclides

Radionuclide	NFA (pCi/g)
Actinium-228	Not available
Bismuth-211	Not available
Bismuth-212	Not available
Bismuth-214	Not available
Lead-211	Not available
Lead-212	Not available
Lead-214	Not available
Potassium-40	1.19E+02
Protactinium-231	1.17E+02
Protactinium-233	Not available
Protactinium-234m	Not available
Radium-223	Not available
Radium-226	2.88E+01
Radium-228	2.45E+01
Radon-219	Not available
Strontium-90	2.25E+01
Thallium-208	Not available
Thorium-227	Not available
Thorium-228	5.30E+02
Thorium-232	1.52E+03
Thorium-234	Not available

NFA = activity (pCi/g) resulting in dose of 0.1 rad/day assuming secular equilibrium of parent and daughter products.
NFA values from RESRAD-BIOTA, Version 1.5, Report for Level 2 (default values, except dose adjusted to 0.1 rad/day) RESRAD-BIOTA software is available at http://web.ead.anl.gov/resrad/home2/biota.cfm.

Table E2.2. PGDP Soil NFA Screening Values for Additional Chemicals

Analyte	PGDP NFA Screening Value (mg/kg)	Source for Screening Value
Magnesium	4.40E+05	KDEP[a]
Iron	2.00E+02	KDEP[a]
1,1,1-Trichloroethane	1.00E-01	KDEP[a]
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	1.00E-01	KDEP[a]
1,2,4-Trichlorobenzene	1.00E-02	KDEP[a]
1,2,4-Trimethylbenzene	1.00E-01	KDEP[a]
1,2-Dichloroethene, *cis*-	1.00E-01	KDEP[a]
1,2-Dimethylbenzene	5.00E-02	KDEP[a]
1,3,5-Trimethylbenzene	1.00E-01	KDEP[a]
2-Methylnaphthalene	2.02E-02	KDEP[b]
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1.00E-08	Table A.4[c]
Acetone	9.90E-03	Table A.4[c]
Benzo(ghi)perylene	1.19E+02	KDEP[a]
Benzoic acid	6.50E+02	KDEP[a]
Butyl benzyl phthalate	2.39E-01	KDEP[a]
Carbon disulfide	2.39E-04	Table A.4[c]
Dibenzofuran	1.52E+00	KDEP[b]
Dioxins/Furans, Total	2.50E-06	Table A.4[c]

Table E2.2. PGDP Soil NFA Screening Values for Additional Chemicals (Continued)

Analyte	PGDP NFA Screening Value (mg/kg)	Source for Screening Value
Methylene chloride	2.00E+00	KDEP[a]
m,p-Xylene	1.00E-01	Total xylene value used

[a] KY ESVs are provided in Appendix F of the Ecological Risk Methods Document (DOE 2015a).
[b] KY ESV for sediment was used for screening.
[c] Screening value for sediment from the Ecological Risk Methods Document was used for screening.

ATTACHMENT E3

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UCL Statistics for Uncensored Full Data Sets			
User Selected Options			
Date/Time of Computation	3/4/2015 4:22:41 PM		
From File	013_UCL95.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
Anthracene			
General Statistics			
Total Number of Observations	22	Number of Distinct Observations	9
		Number of Missing Observations	145
Minimum	0.015	Mean	0.206
Maximum	0.25	Median	0.205
SD	0.0477	Std. Error of Mean	0.0102
Coefficient of Variation	0.232	Skewness	-3.146
Normal GOF Test			
Shapiro Wilk Test Statistic	0.614	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.326	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.189	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.223	95% Adjusted-CLT UCL (Chen-1995)	0.215
		95% Modified-t UCL (Johnson-1978)	0.222
Gamma GOF Test			
A-D Test Statistic	4.515	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.746	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.43	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.186	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	6.226	k star (bias corrected MLE)	5.407
Theta hat (MLE)	0.033	Theta star (bias corrected MLE)	0.038
nu hat (MLE)	273.9	nu star (bias corrected)	237.9
MLE Mean (bias corrected)	0.206	MLE Sd (bias corrected)	0.0885
		Approximate Chi Square Value (0.05)	203.2
Adjusted Level of Significance	0.0386	Adjusted Chi Square Value	200.8
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	0.241	95% Adjusted Gamma UCL (use when n<50)	0.244
Lognormal GOF Test			

Shapiro Wilk Test Statistic	0.362	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.457	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.189	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-4.2	Mean of logged Data	-1.664
Maximum of Logged Data	-1.386	SD of logged Data	0.575
Assuming Lognormal Distribution			
95% H-UCL	0.29	90% Chebyshev (MVUE) UCL	0.307
95% Chebyshev (MVUE) UCL	0.346	97.5% Chebyshev (MVUE) UCL	0.4
99% Chebyshev (MVUE) UCL	0.505		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.222	95% Jackknife UCL	0.223
95% Standard Bootstrap UCL	0.222	95% Bootstrap-t UCL	0.219
95% Hall's Bootstrap UCL	0.218	95% Percentile Bootstrap UCL	0.22
95% BCA Bootstrap UCL	0.217		
90% Chebyshev(Mean, Sd) UCL	0.236	95% Chebyshev(Mean, Sd) UCL	0.25
97.5% Chebyshev(Mean, Sd) UCL	0.269	99% Chebyshev(Mean, Sd) UCL	0.307
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	0.25		
Recommended UCL exceeds the maximum observation			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			
Antimony			
General Statistics			
Total Number of Observations	22	Number of Distinct Observations	15
		Number of Missing Observations	145
Minimum	0.092	Mean	3.329
Maximum	10	Median	0.215
SD	4.667	Std. Error of Mean	0.995
Coefficient of Variation	1.402	Skewness	0.836
Normal GOF Test			

Shapiro Wilk Test Statistic	0.609	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.386	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.189	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	5.041	95% Adjusted-CLT UCL (Chen-1995)	5.155
		95% Modified-t UCL (Johnson-1978)	5.07
Gamma GOF Test			
A-D Test Statistic	3.189	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.826	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.325	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.198	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.401	k star (bias corrected MLE)	0.377
Theta hat (MLE)	8.301	Theta star (bias corrected MLE)	8.838
nu hat (MLE)	17.64	nu star (bias corrected)	16.57
MLE Mean (bias corrected)	3.329	MLE Sd (bias corrected)	5.424
		Approximate Chi Square Value (0.05)	8.367
Adjusted Level of Significance	0.0386	Adjusted Chi Square Value	7.933
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	6.593	95% Adjusted Gamma UCL (use when n<50)	6.953
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.736	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.291	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.189	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-2.386	Mean of logged Data	-0.438
Maximum of Logged Data	2.303	SD of logged Data	1.968
Assuming Lognormal Distribution			
95% H-UCL	26.37	90% Chebyshev (MVUE) UCL	9.348
95% Chebyshev (MVUE) UCL	11.94	97.5% Chebyshev (MVUE) UCL	15.55
99% Chebyshev (MVUE) UCL	22.63		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	4.965	95% Jackknife UCL	5.041
95% Standard Bootstrap UCL	4.923	95% Bootstrap-t UCL	5.697

95% Hall's Bootstrap UCL	4.908	95% Percentile Bootstrap UCL	5.089
95% BCA Bootstrap UCL	5.085		
90% Chebyshev(Mean, Sd) UCL	6.314	95% Chebyshev(Mean, Sd) UCL	7.666
97.5% Chebyshev(Mean, Sd) UCL	9.542	99% Chebyshev(Mean, Sd) UCL	13.23
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	7.666		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Benzo(a)pyrene

General Statistics			
Total Number of Observations	22	Number of Distinct Observations	15
		Number of Missing Observations	145
Minimum	0.0019	Mean	0.122
Maximum	0.56	Median	0.028
SD	0.15	Std. Error of Mean	0.0319
Coefficient of Variation	1.227	Skewness	1.264
Normal GOF Test			
Shapiro Wilk Test Statistic	0.742	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.273	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.189	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.177	95% Adjusted-CLT UCL (Chen-1995)	0.184
		95% Modified-t UCL (Johnson-1978)	0.178
Gamma GOF Test			
A-D Test Statistic	1.48	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.814	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.247	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.197	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.454	k star (bias corrected MLE)	0.423
Theta hat (MLE)	0.269	Theta star (bias corrected MLE)	0.289
nu hat (MLE)	19.99	nu star (bias corrected)	18.6
MLE Mean (bias corrected)	0.122	MLE Sd (bias corrected)	0.188
		Approximate Chi Square Value (0.05)	9.827
Adjusted Level of Significance	0.0386	Adjusted Chi Square Value	9.352

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	0.231	95% Adjusted Gamma UCL (use when n<50)	0.243
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.845	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.249	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.189	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-6.266	Mean of logged Data	-3.522
Maximum of Logged Data	-0.58	SD of logged Data	2.105
Assuming Lognormal Distribution			
95% H-UCL	2.011	90% Chebyshev (MVUE) UCL	0.563
95% Chebyshev (MVUE) UCL	0.724	97.5% Chebyshev (MVUE) UCL	0.947
99% Chebyshev (MVUE) UCL	1.385		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.175	95% Jackknife UCL	0.177
95% Standard Bootstrap UCL	0.173	95% Bootstrap-t UCL	0.188
95% Hall's Bootstrap UCL	0.192	95% Percentile Bootstrap UCL	0.173
95% BCA Bootstrap UCL	0.185		
90% Chebyshev(Mean, Sd) UCL	0.218	95% Chebyshev(Mean, Sd) UCL	0.261
97.5% Chebyshev(Mean, Sd) UCL	0.321	99% Chebyshev(Mean, Sd) UCL	0.44
Suggested UCL to Use			
97.5% Chebyshev (Mean, Sd) UCL	0.321		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Cadmium			
General Statistics			
Total Number of Observations	22	Number of Distinct Observations	15
		Number of Missing Observations	145
Minimum	0.025	Mean	0.471
Maximum	1.2	Median	0.185
SD	0.462	Std. Error of Mean	0.0986
Coefficient of Variation	0.982	Skewness	0.391
Normal GOF Test			
Shapiro Wilk Test Statistic	0.754	**Shapiro Wilk GOF Test**	

5% Shapiro Wilk Critical Value	0.911	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.275	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.189	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.641	95% Adjusted-CLT UCL (Chen-1995)	0.642
		95% Modified-t UCL (Johnson-1978)	0.642
Gamma GOF Test			
A-D Test Statistic	1.652	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.782	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.236	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.193	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.763	k star (bias corrected MLE)	0.689
Theta hat (MLE)	0.617	Theta star (bias corrected MLE)	0.683
nu hat (MLE)	33.58	nu star (bias corrected)	30.34
MLE Mean (bias corrected)	0.471	MLE Sd (bias corrected)	0.567
		Approximate Chi Square Value (0.05)	18.76
Adjusted Level of Significance	0.0386	Adjusted Chi Square Value	18.08
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	0.762	95% Adjusted Gamma UCL (use when n<50)	0.79
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.843	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.237	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.189	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-3.689	Mean of logged Data	-1.535
Maximum of Logged Data	0.182	SD of logged Data	1.451
Assuming Lognormal Distribution			
95% H-UCL	1.733	90% Chebyshev (MVUE) UCL	1.197
95% Chebyshev (MVUE) UCL	1.484	97.5% Chebyshev (MVUE) UCL	1.881
99% Chebyshev (MVUE) UCL	2.662		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.633	95% Jackknife UCL	0.641
95% Standard Bootstrap UCL	0.626	95% Bootstrap-t UCL	0.651
95% Hall's Bootstrap UCL	0.624	95% Percentile Bootstrap UCL	0.626

95% BCA Bootstrap UCL	0.644		
90% Chebyshev(Mean, Sd) UCL	0.767	95% Chebyshev(Mean, Sd) UCL	0.901
97.5% Chebyshev(Mean, Sd) UCL	1.087	99% Chebyshev(Mean, Sd) UCL	1.452
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	0.901		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Copper			
General Statistics			
Total Number of Observations	166	Number of Distinct Observations	48
		Number of Missing Observations	1
Minimum	2	Mean	37.96
Maximum	186	Median	36
SD	23.61	Std. Error of Mean	1.832
Coefficient of Variation	0.622	Skewness	2.794
Normal GOF Test			
Shapiro Wilk Test Statistic	0.723	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.236	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0688	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	40.99	95% Adjusted-CLT UCL (Chen-1995)	41.4
		95% Modified-t UCL (Johnson-1978)	41.06
Gamma GOF Test			
A-D Test Statistic	16.47	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.765	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.29	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0733	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.19	k star (bias corrected MLE)	2.155
Theta hat (MLE)	17.33	Theta star (bias corrected MLE)	17.62
nu hat (MLE)	727.2	nu star (bias corrected)	715.4
MLE Mean (bias corrected)	37.96	MLE Sd (bias corrected)	25.86
		Approximate Chi Square Value (0.05)	654.3
Adjusted Level of Significance	0.0486	Adjusted Chi Square Value	653.8
Assuming Gamma Distribution			

95% Approximate Gamma UCL (use when n>=50))	41.5	95% Adjusted Gamma UCL (use when n<50)	41.53
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.677	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.339	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0688	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.693	Mean of logged Data	3.391
Maximum of Logged Data	5.226	SD of logged Data	0.881
Assuming Lognormal Distribution			
95% H-UCL	50.45	90% Chebyshev (MVUE) UCL	54.1
95% Chebyshev (MVUE) UCL	58.83	97.5% Chebyshev (MVUE) UCL	65.4
99% Chebyshev (MVUE) UCL	78.31		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	40.97	95% Jackknife UCL	40.99
95% Standard Bootstrap UCL	40.94	95% Bootstrap-t UCL	41.36
95% Hall's Bootstrap UCL	41.72	95% Percentile Bootstrap UCL	41.05
95% BCA Bootstrap UCL	41.25		
90% Chebyshev(Mean, Sd) UCL	43.46	95% Chebyshev(Mean, Sd) UCL	45.95
97.5% Chebyshev(Mean, Sd) UCL	49.4	99% Chebyshev(Mean, Sd) UCL	56.19
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	45.95		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Fluoranthene			
General Statistics			
Total Number of Observations	15	Number of Distinct Observations	8
		Number of Missing Observations	142
Minimum	0.14	Mean	0.234
Maximum	0.71	Median	0.2
SD	0.136	Std. Error of Mean	0.0352
Coefficient of Variation	0.584	Skewness	3.45
Normal GOF Test			
Shapiro Wilk Test Statistic	0.483	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.881	Data Not Normal at 5% Significance Level	

Lilliefors Test Statistic	0.436	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.229	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.296	95% Adjusted-CLT UCL (Chen-1995)	0.325
		95% Modified-t UCL (Johnson-1978)	0.301
Gamma GOF Test			
A-D Test Statistic	2.604	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.738	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.413	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.222	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	5.915	k star (bias corrected MLE)	4.776
Theta hat (MLE)	0.0395	Theta star (bias corrected MLE)	0.0489
nu hat (MLE)	177.4	nu star (bias corrected)	143.3
MLE Mean (bias corrected)	0.234	MLE Sd (bias corrected)	0.107
		Approximate Chi Square Value (0.05)	116.6
Adjusted Level of Significance	0.0324	Adjusted Chi Square Value	113.7
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	0.287	95% Adjusted Gamma UCL (use when n<50)	0.295
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.65	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.881	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.388	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.229	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-1.966	Mean of logged Data	-1.541
Maximum of Logged Data	-0.342	SD of logged Data	0.374
Assuming Lognormal Distribution			
95% H-UCL	0.279	90% Chebyshev (MVUE) UCL	0.296
95% Chebyshev (MVUE) UCL	0.327	97.5% Chebyshev (MVUE) UCL	0.369
99% Chebyshev (MVUE) UCL	0.452		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.292	95% Jackknife UCL	0.296
95% Standard Bootstrap UCL	0.291	95% Bootstrap-t UCL	0.486
95% Hall's Bootstrap UCL	0.662	95% Percentile Bootstrap UCL	0.296
95% BCA Bootstrap UCL	0.34		

90% Chebyshev(Mean, Sd) UCL	0.339	95% Chebyshev(Mean, Sd) UCL	0.387
97.5% Chebyshev(Mean, Sd) UCL	0.454	99% Chebyshev(Mean, Sd) UCL	0.584
Suggested UCL to Use			
95% Student's-t UCL	0.296	or 95% Modified-t UCL	0.301
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Lead			
General Statistics			
Total Number of Observations	166	Number of Distinct Observations	30
		Number of Missing Observations	1
Minimum	1.5	Mean	24.18
Maximum	657	Median	1.5
SD	77.18	Std. Error of Mean	5.99
Coefficient of Variation	3.192	Skewness	5.442
Normal GOF Test			
Shapiro Wilk Test Statistic	0.355	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.413	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0688	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	34.09	95% Adjusted-CLT UCL (Chen-1995)	36.73
		95% Modified-t UCL (Johnson-1978)	34.51
Gamma GOF Test			
A-D Test Statistic	36.7	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.858	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.456	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0782	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.343	k star (bias corrected MLE)	0.341
Theta hat (MLE)	70.41	Theta star (bias corrected MLE)	70.87
nu hat (MLE)	114	nu star (bias corrected)	113.3
MLE Mean (bias corrected)	24.18	MLE Sd (bias corrected)	41.39
		Approximate Chi Square Value (0.05)	89.7
Adjusted Level of Significance	0.0486	Adjusted Chi Square Value	89.52
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	30.53	95% Adjusted Gamma UCL (use when n<50)	30.59

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.574	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.452	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0688	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.405	Mean of logged Data	1.221
Maximum of Logged Data	6.488	SD of logged Data	1.568
Assuming Lognormal Distribution			
95% H-UCL	16.13	90% Chebyshev (MVUE) UCL	17.4
95% Chebyshev (MVUE) UCL	20.12	97.5% Chebyshev (MVUE) UCL	23.89
99% Chebyshev (MVUE) UCL	31.31		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	34.03	95% Jackknife UCL	34.09
95% Standard Bootstrap UCL	34.14	95% Bootstrap-t UCL	39.13
95% Hall's Bootstrap UCL	41.16	95% Percentile Bootstrap UCL	34.96
95% BCA Bootstrap UCL	36.98		
90% Chebyshev(Mean, Sd) UCL	42.15	95% Chebyshev(Mean, Sd) UCL	50.29
97.5% Chebyshev(Mean, Sd) UCL	61.59	99% Chebyshev(Mean, Sd) UCL	83.78
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	50.29		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Lithium			
General Statistics			
Total Number of Observations	7	Number of Distinct Observations	6
		Number of Missing Observations	160
Minimum	2.5	Mean	5.069
Maximum	8.59	Median	5.31
SD	2.112	Std. Error of Mean	0.798
Coefficient of Variation	0.417	Skewness	0.268
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0			

Normal GOF Test			
Shapiro Wilk Test Statistic	0.902	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.226	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.335	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	6.62	95% Adjusted-CLT UCL (Chen-1995)	6.468
		95% Modified-t UCL (Johnson-1978)	6.633
Gamma GOF Test			
A-D Test Statistic	0.528	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.71	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.28	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.313	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	6.119	k star (bias corrected MLE)	3.592
Theta hat (MLE)	0.828	Theta star (bias corrected MLE)	1.411
nu hat (MLE)	85.67	nu star (bias corrected)	50.29
MLE Mean (bias corrected)	5.069	MLE Sd (bias corrected)	2.674
		Approximate Chi Square Value (0.05)	35.01
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	31.2
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	7.282	95% Adjusted Gamma UCL (use when n<50)	8.169
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.862	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.297	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.335	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.916	Mean of logged Data	1.539
Maximum of Logged Data	2.151	SD of logged Data	0.459
Assuming Lognormal Distribution			
95% H-UCL	8.089	90% Chebyshev (MVUE) UCL	7.763
95% Chebyshev (MVUE) UCL	8.971	97.5% Chebyshev (MVUE) UCL	10.65
99% Chebyshev (MVUE) UCL	13.94		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			

95% CLT UCL	6.381	95% Jackknife UCL	6.62
95% Standard Bootstrap UCL	6.298	95% Bootstrap-t UCL	6.646
95% Hall's Bootstrap UCL	6.642	95% Percentile Bootstrap UCL	6.314
95% BCA Bootstrap UCL	6.324		
90% Chebyshev(Mean, Sd) UCL	7.463	95% Chebyshev(Mean, Sd) UCL	8.548
97.5% Chebyshev(Mean, Sd) UCL	10.05	99% Chebyshev(Mean, Sd) UCL	13.01

Suggested UCL to Use

95% Student's-t UCL	6.62		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Mercury

General Statistics

Total Number of Observations	166	Number of Distinct Observations	3
		Number of Missing Observations	1
Minimum	0.017	Mean	19.04
Maximum	20	Median	20
SD	4.277	Std. Error of Mean	0.332
Coefficient of Variation	0.225	Skewness	-4.258

Normal GOF Test

Shapiro Wilk Test Statistic	0.226	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.541	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0688	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	19.59	95% Adjusted-CLT UCL (Chen-1995)	19.47
		95% Modified-t UCL (Johnson-1978)	19.57

Gamma GOF Test

A-D Test Statistic	62.6	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.763	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.566	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.0732	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.46	k star (bias corrected MLE)	2.419
Theta hat (MLE)	7.741	Theta star (bias corrected MLE)	7.871
nu hat (MLE)	816.6	nu star (bias corrected)	803.2
MLE Mean (bias corrected)	19.04	MLE Sd (bias corrected)	12.24
		Approximate Chi Square Value (0.05)	738.4

Adjusted Level of Significance	0.0486	Adjusted Chi Square Value	737.9
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	20.71	95% Adjusted Gamma UCL (use when n<50)	20.73
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.236	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.54	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0688	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-4.075	Mean of logged Data	2.73
Maximum of Logged Data	2.996	SD of logged Data	1.193
Assuming Lognormal Distribution			
95% H-UCL	38.78	90% Chebyshev (MVUE) UCL	42.05
95% Chebyshev (MVUE) UCL	47.05	97.5% Chebyshev (MVUE) UCL	54
99% Chebyshev (MVUE) UCL	67.65		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	19.59	95% Jackknife UCL	19.59
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	20.04	95% Chebyshev(Mean, Sd) UCL	20.49
97.5% Chebyshev(Mean, Sd) UCL	21.11	99% Chebyshev(Mean, Sd) UCL	22.34
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	20.49		
Recommended UCL exceeds the maximum observation			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			
Molybdenum			
General Statistics			
Total Number of Observations	159	Number of Distinct Observations	11
		Number of Missing Observations	0

Minimum	0.205	Mean	4.004
Maximum	43	Median	1.5
SD	8.596	Std. Error of Mean	0.682
Coefficient of Variation	2.147	Skewness	3.276
Normal GOF Test			
Shapiro Wilk Test Statistic	0.326	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.533	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0703	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	5.132	95% Adjusted-CLT UCL (Chen-1995)	5.315
		95% Modified-t UCL (Johnson-1978)	5.162
Gamma GOF Test			
A-D Test Statistic	54.46	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.793	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.558	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.077	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.797	k star (bias corrected MLE)	0.786
Theta hat (MLE)	5.023	Theta star (bias corrected MLE)	5.092
nu hat (MLE)	253.5	nu star (bias corrected)	250.1
MLE Mean (bias corrected)	4.004	MLE Sd (bias corrected)	4.516
		Approximate Chi Square Value (0.05)	214.5
Adjusted Level of Significance	0.0485	Adjusted Chi Square Value	214.2
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	4.669	95% Adjusted Gamma UCL (use when n<50)	4.676
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.358	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.527	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0703	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-1.585	Mean of logged Data	0.643
Maximum of Logged Data	3.761	SD of logged Data	0.859
Assuming Lognormal Distribution			
95% H-UCL	3.171	90% Chebyshev (MVUE) UCL	3.39
95% Chebyshev (MVUE) UCL	3.684	97.5% Chebyshev (MVUE) UCL	4.092
99% Chebyshev (MVUE) UCL	4.894		

Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	5.126	95% Jackknife UCL	5.132
95% Standard Bootstrap UCL	5.122	95% Bootstrap-t UCL	5.427
95% Hall's Bootstrap UCL	5.336	95% Percentile Bootstrap UCL	5.149
95% BCA Bootstrap UCL	5.304		
90% Chebyshev(Mean, Sd) UCL	6.049	95% Chebyshev(Mean, Sd) UCL	6.976
97.5% Chebyshev(Mean, Sd) UCL	8.261	99% Chebyshev(Mean, Sd) UCL	10.79
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	6.976		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Nickel			
General Statistics			
Total Number of Observations	166	Number of Distinct Observations	44
		Number of Missing Observations	1
Minimum	2	Mean	16.44
Maximum	140	Median	14
SD	15.96	Std. Error of Mean	1.239
Coefficient of Variation	0.971	Skewness	3.814
Normal GOF Test			
Shapiro Wilk Test Statistic	0.696	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.213	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0688	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	18.49	95% Adjusted-CLT UCL (Chen-1995)	18.87
		95% Modified-t UCL (Johnson-1978)	18.55
Gamma GOF Test			
A-D Test Statistic	5.652	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.772	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.157	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0739	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.448	k star (bias corrected MLE)	1.426

Theta hat (MLE)	11.35	Theta star (bias corrected MLE)	11.53
nu hat (MLE)	480.9	nu star (bias corrected)	473.5
MLE Mean (bias corrected)	16.44	MLE Sd (bias corrected)	13.77
		Approximate Chi Square Value (0.05)	424.1
Adjusted Level of Significance	0.0486	Adjusted Chi Square Value	423.7
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	18.36	95% Adjusted Gamma UCL (use when n<50)	18.38
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.856	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.215	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0688	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.693	Mean of logged Data	2.417
Maximum of Logged Data	4.942	SD of logged Data	0.96
Assuming Lognormal Distribution			
95% H-UCL	20.83	90% Chebyshev (MVUE) UCL	22.42
95% Chebyshev (MVUE) UCL	24.55	97.5% Chebyshev (MVUE) UCL	27.52
99% Chebyshev (MVUE) UCL	33.36		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	18.48	95% Jackknife UCL	18.49
95% Standard Bootstrap UCL	18.43	95% Bootstrap-t UCL	18.82
95% Hall's Bootstrap UCL	19.22	95% Percentile Bootstrap UCL	18.51
95% BCA Bootstrap UCL	18.9		
90% Chebyshev(Mean, Sd) UCL	20.16	95% Chebyshev(Mean, Sd) UCL	21.84
97.5% Chebyshev(Mean, Sd) UCL	24.18	99% Chebyshev(Mean, Sd) UCL	28.77
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	21.84		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
PCB, Total			
General Statistics			
Total Number of Observations	166	Number of Distinct Observations	4
		Number of Missing Observations	1
Minimum	0.05	Mean	2.393

Maximum	2.5	Median	2.5
SD	0.486	Std. Error of Mean	0.0377
Coefficient of Variation	0.203	Skewness	-4.463
Normal GOF Test			
Shapiro Wilk Test Statistic	0.227	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.539	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0688	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2.455	95% Adjusted-CLT UCL (Chen-1995)	2.441
		95% Modified-t UCL (Johnson-1978)	2.453
Gamma GOF Test			
A-D Test Statistic	60.37	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.756	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.55	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0726	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	4.725	k star (bias corrected MLE)	4.644
Theta hat (MLE)	0.506	Theta star (bias corrected MLE)	0.515
nu hat (MLE)	1569	nu star (bias corrected)	1542
MLE Mean (bias corrected)	2.393	MLE Sd (bias corrected)	1.11
		Approximate Chi Square Value (0.05)	1452
Adjusted Level of Significance	0.0486	Adjusted Chi Square Value	1451
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	2.542	95% Adjusted Gamma UCL (use when n<50)	2.543
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.212	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.534	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0688	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-2.996	Mean of logged Data	0.763
Maximum of Logged Data	0.916	SD of logged Data	0.739
Assuming Lognormal Distribution			
95% H-UCL	3.153	90% Chebyshev (MVUE) UCL	3.354
95% Chebyshev (MVUE) UCL	3.599	97.5% Chebyshev (MVUE) UCL	3.94
99% Chebyshev (MVUE) UCL	4.609		
Nonparametric Distribution Free UCL Statistics			

Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	2.455	95% Jackknife UCL	2.455
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	2.506	95% Chebyshev(Mean, Sd) UCL	2.557
97.5% Chebyshev(Mean, Sd) UCL	2.628	99% Chebyshev(Mean, Sd) UCL	2.768
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	2.557		
Recommended UCL exceeds the maximum observation			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			
Phenanthrene			
General Statistics			
Total Number of Observations	22	Number of Distinct Observations	11
		Number of Missing Observations	145
Minimum	0.084	Mean	0.215
Maximum	0.35	Median	0.205
SD	0.0468	Std. Error of Mean	0.00997
Coefficient of Variation	0.217	Skewness	0.121
Normal GOF Test			
Shapiro Wilk Test Statistic	0.828	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.204	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.189	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.232	95% Adjusted-CLT UCL (Chen-1995)	0.232
		95% Modified-t UCL (Johnson-1978)	0.232
Gamma GOF Test			
A-D Test Statistic	1.698	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.741	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.234	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.185	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	18.97	k star (bias corrected MLE)	16.42
Theta hat (MLE)	0.0113	Theta star (bias corrected MLE)	0.0131
nu hat (MLE)	834.8	nu star (bias corrected)	722.3
MLE Mean (bias corrected)	0.215	MLE Sd (bias corrected)	0.0531
		Approximate Chi Square Value (0.05)	660.9
Adjusted Level of Significance	0.0386	Adjusted Chi Square Value	656.6
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	0.235	95% Adjusted Gamma UCL (use when n<50)	0.237
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.741	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.911	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.258	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.189	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-2.477	Mean of logged Data	-1.563
Maximum of Logged Data	-1.05	SD of logged Data	0.252
Assuming Lognormal Distribution			
95% H-UCL	0.239	90% Chebyshev (MVUE) UCL	0.251
95% Chebyshev (MVUE) UCL	0.267	97.5% Chebyshev (MVUE) UCL	0.289
99% Chebyshev (MVUE) UCL	0.333		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.232	95% Jackknife UCL	0.232
95% Standard Bootstrap UCL	0.231	95% Bootstrap-t UCL	0.233
95% Hall's Bootstrap UCL	0.237	95% Percentile Bootstrap UCL	0.231
95% BCA Bootstrap UCL	0.23		
90% Chebyshev(Mean, Sd) UCL	0.245	95% Chebyshev(Mean, Sd) UCL	0.259
97.5% Chebyshev(Mean, Sd) UCL	0.277	99% Chebyshev(Mean, Sd) UCL	0.314
Suggested UCL to Use			
95% Student's-t UCL	0.232	or 95% Modified-t UCL	0.232
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Pyrene			

General Statistics			
Total Number of Observations	22	Number of Distinct Observations	12
		Number of Missing Observations	145
Minimum	0.11	Mean	0.233
Maximum	0.64	Median	0.205
SD	0.099	Std. Error of Mean	0.0211
Coefficient of Variation	0.424	Skewness	3.498
Normal GOF Test			
Shapiro Wilk Test Statistic	0.579	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.911	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.343	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.189	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.27	95% Adjusted-CLT UCL (Chen-1995)	0.285
		95% Modified-t UCL (Johnson-1978)	0.272
Gamma GOF Test			
A-D Test Statistic	2.11	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.744	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.283	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.185	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	9.239	k star (bias corrected MLE)	8.009
Theta hat (MLE)	0.0253	Theta star (bias corrected MLE)	0.0291
nu hat (MLE)	406.5	nu star (bias corrected)	352.4
MLE Mean (bias corrected)	0.233	MLE Sd (bias corrected)	0.0825
		Approximate Chi Square Value (0.05)	309.9
Adjusted Level of Significance	0.0386	Adjusted Chi Square Value	306.9
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	0.265	95% Adjusted Gamma UCL (use when n<50)	0.268
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.786	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.911	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.255	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.189	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-2.207	Mean of logged Data	-1.51
Maximum of Logged Data	-0.446	SD of logged Data	0.313
Assuming Lognormal Distribution			
95% H-UCL	0.263	90% Chebyshev (MVUE) UCL	0.279

95% Chebyshev (MVUE) UCL	0.3	97.5% Chebyshev (MVUE) UCL	0.329
99% Chebyshev (MVUE) UCL	0.388		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.268	95% Jackknife UCL	0.27
95% Standard Bootstrap UCL	0.267	95% Bootstrap-t UCL	0.309
95% Hall's Bootstrap UCL	0.43	95% Percentile Bootstrap UCL	0.273
95% BCA Bootstrap UCL	0.291		
90% Chebyshev(Mean, Sd) UCL	0.297	95% Chebyshev(Mean, Sd) UCL	0.325
97.5% Chebyshev(Mean, Sd) UCL	0.365	99% Chebyshev(Mean, Sd) UCL	0.443
Suggested UCL to Use			
95% Student's-t UCL	0.27	or 95% Modified-t UCL	0.272
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Selenium			
General Statistics			
Total Number of Observations	166	Number of Distinct Observations	4
		Number of Missing Observations	1
Minimum	0.195	Mean	1.471
Maximum	5	Median	1.5
SD	0.355	Std. Error of Mean	0.0276
Coefficient of Variation	0.241	Skewness	4.856
Normal GOF Test			
Shapiro Wilk Test Statistic	0.27	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.484	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0688	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1.517	95% Adjusted-CLT UCL (Chen-1995)	1.527
		95% Modified-t UCL (Johnson-1978)	1.518
Gamma GOF Test			
A-D Test Statistic	56.06	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.751	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.516	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0723	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics			
k hat (MLE)	15.85	k star (bias corrected MLE)	15.57
Theta hat (MLE)	0.0928	Theta star (bias corrected MLE)	0.0945
nu hat (MLE)	5262	nu star (bias corrected)	5168
MLE Mean (bias corrected)	1.471	MLE Sd (bias corrected)	0.373
		Approximate Chi Square Value (0.05)	5002
Adjusted Level of Significance	0.0486	Adjusted Chi Square Value	5001
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1.52	95% Adjusted Gamma UCL (use when n<50)	1.52
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.305	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.523	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0688	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-1.635	Mean of logged Data	0.354
Maximum of Logged Data	1.609	SD of logged Data	0.287
Assuming Lognormal Distribution			
95% H-UCL	1.543	90% Chebyshev (MVUE) UCL	1.586
95% Chebyshev (MVUE) UCL	1.632	97.5% Chebyshev (MVUE) UCL	1.695
99% Chebyshev (MVUE) UCL	1.82		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1.516	95% Jackknife UCL	1.517
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	1.554	95% Chebyshev(Mean, Sd) UCL	1.591
97.5% Chebyshev(Mean, Sd) UCL	1.643	99% Chebyshev(Mean, Sd) UCL	1.745
Suggested UCL to Use			
95% Student's-t UCL	1.517	or 95% Modified-t UCL	1.518
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Silver			
General Statistics			

Total Number of Observations	166	Number of Distinct Observations	9
		Number of Missing Observations	1
Minimum	0.08	Mean	26.01
Maximum	146	Median	25
SD	14.96	Std. Error of Mean	1.161
Coefficient of Variation	0.575	Skewness	5.718
Normal GOF Test			
Shapiro Wilk Test Statistic	0.294	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.491	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0688	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	27.93	95% Adjusted-CLT UCL (Chen-1995)	28.47
		95% Modified-t UCL (Johnson-1978)	28.01
Gamma GOF Test			
A-D Test Statistic	50.68	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.759	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.498	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0729	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	3.251	k star (bias corrected MLE)	3.196
Theta hat (MLE)	8	Theta star (bias corrected MLE)	8.137
nu hat (MLE)	1079	nu star (bias corrected)	1061
MLE Mean (bias corrected)	26.01	MLE Sd (bias corrected)	14.55
		Approximate Chi Square Value (0.05)	986.4
Adjusted Level of Significance	0.0486	Adjusted Chi Square Value	985.8
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	27.97	95% Adjusted Gamma UCL (use when n<50)	27.99
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.345	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.514	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0688	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-2.526	Mean of logged Data	3.097
Maximum of Logged Data	4.984	SD of logged Data	0.787
Assuming Lognormal Distribution			
95% H-UCL	34.06	90% Chebyshev (MVUE) UCL	36.33
95% Chebyshev (MVUE) UCL	39.16	97.5% Chebyshev (MVUE) UCL	43.1

99% Chebyshev (MVUE) UCL	50.82		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	27.92	95% Jackknife UCL	27.93
95% Standard Bootstrap UCL	27.9	95% Bootstrap-t UCL	29.29
95% Hall's Bootstrap UCL	38.47	95% Percentile Bootstrap UCL	28.2
95% BCA Bootstrap UCL	28.68		
90% Chebyshev(Mean, Sd) UCL	29.49	95% Chebyshev(Mean, Sd) UCL	31.07
97.5% Chebyshev(Mean, Sd) UCL	33.26	99% Chebyshev(Mean, Sd) UCL	37.56
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	31.07		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Thallium			
General Statistics			
Total Number of Observations	22	Number of Distinct Observations	9
		Number of Missing Observations	145
Minimum	0.086	Mean	3.275
Maximum	10	Median	0.12
SD	4.703	Std. Error of Mean	1.003
Coefficient of Variation	1.436	Skewness	0.838
Normal GOF Test			
Shapiro Wilk Test Statistic	0.599	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.404	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.189	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	5	95% Adjusted-CLT UCL (Chen-1995)	5.115
		95% Modified-t UCL (Johnson-1978)	5.03
Gamma GOF Test			
A-D Test Statistic	3.76	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.836	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.383	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.2	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics			
k hat (MLE)	0.354	k star (bias corrected MLE)	0.336
Theta hat (MLE)	9.251	Theta star (bias corrected MLE)	9.746
nu hat (MLE)	15.57	nu star (bias corrected)	14.78
MLE Mean (bias corrected)	3.275	MLE Sd (bias corrected)	5.649
		Approximate Chi Square Value (0.05)	7.111
Adjusted Level of Significance	0.0386	Adjusted Chi Square Value	6.716
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	6.807	95% Adjusted Gamma UCL (use when n<50)	7.208
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.669	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.358	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.189	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-2.453	Mean of logged Data	-0.71
Maximum of Logged Data	2.303	SD of logged Data	2.134
Assuming Lognormal Distribution			
95% H-UCL	37.52	90% Chebyshev (MVUE) UCL	9.955
95% Chebyshev (MVUE) UCL	12.81	97.5% Chebyshev (MVUE) UCL	16.78
99% Chebyshev (MVUE) UCL	24.56		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	4.924	95% Jackknife UCL	5
95% Standard Bootstrap UCL	4.915	95% Bootstrap-t UCL	4.922
95% Hall's Bootstrap UCL	4.687	95% Percentile Bootstrap UCL	5.054
95% BCA Bootstrap UCL	5.069		
90% Chebyshev(Mean, Sd) UCL	6.283	95% Chebyshev(Mean, Sd) UCL	7.645
97.5% Chebyshev(Mean, Sd) UCL	9.537	99% Chebyshev(Mean, Sd) UCL	13.25
Suggested UCL to Use			
97.5% Chebyshev (Mean, Sd) UCL	9.537		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Uranium			
General Statistics			
Total Number of Observations	167	Number of Distinct Observations	6

		Number of Missing Observations	0
Minimum	5	Mean	8.091
Maximum	130	Median	5
SD	13.77	Std. Error of Mean	1.065
Coefficient of Variation	1.702	Skewness	5.755
Normal GOF Test			
Shapiro Wilk Test Statistic	0.263	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.523	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0686	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	9.853	95% Adjusted-CLT UCL (Chen-1995)	10.35
		95% Modified-t UCL (Johnson-1978)	9.932
Gamma GOF Test			
A-D Test Statistic	58.37	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.77	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.551	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0734	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.631	k star (bias corrected MLE)	1.605
Theta hat (MLE)	4.962	Theta star (bias corrected MLE)	5.04
nu hat (MLE)	544.6	nu star (bias corrected)	536.2
MLE Mean (bias corrected)	8.091	MLE Sd (bias corrected)	6.386
		Approximate Chi Square Value (0.05)	483.5
Adjusted Level of Significance	0.0486	Adjusted Chi Square Value	483
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	8.973	95% Adjusted Gamma UCL (use when n<50)	8.981
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.281	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.535	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0686	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.609	Mean of logged Data	1.754
Maximum of Logged Data	4.868	SD of logged Data	0.565
Assuming Lognormal Distribution			
95% H-UCL	7.348	90% Chebyshev (MVUE) UCL	7.721
95% Chebyshev (MVUE) UCL	8.153	97.5% Chebyshev (MVUE) UCL	8.752
99% Chebyshev (MVUE) UCL	9.928		

Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	9.843	95% Jackknife UCL	9.853
95% Standard Bootstrap UCL	9.833	95% Bootstrap-t UCL	10.78
95% Hall's Bootstrap UCL	10.91	95% Percentile Bootstrap UCL	9.996
95% BCA Bootstrap UCL	10.57		
90% Chebyshev(Mean, Sd) UCL	11.29	95% Chebyshev(Mean, Sd) UCL	12.74
97.5% Chebyshev(Mean, Sd) UCL	14.74	99% Chebyshev(Mean, Sd) UCL	18.69
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	12.74		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			

UCL Statistics for Uncensored Full Data Sets			
User Selected Options			
Date/Time of Computation	3/11/2015 12:09:01 PM		
From File	Eco2_SWMU13.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
Aluminum			
General Statistics			
Total Number of Observations	22	Number of Distinct Observations	21
		Number of Missing Observations	144
Minimum	4000	Mean	6215
Maximum	14000	Median	5590
SD	2352	Std. Error of Mean	501.4
Coefficient of Variation	0.378	Skewness	2.351
Normal GOF Test			
Shapiro Wilk Test Statistic	0.724	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.911	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.24	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.189	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	7078	95% Adjusted-CLT UCL (Chen-1995)	7308
		95% Modified-t UCL (Johnson-1978)	7120
Gamma GOF Test			
A-D Test Statistic	1.241	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.744	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.186	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.185	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	10.18	k star (bias corrected MLE)	8.821
Theta hat (MLE)	610.6	Theta star (bias corrected MLE)	704.5
nu hat (MLE)	447.9	nu star (bias corrected)	388.1
MLE Mean (bias corrected)	6215	MLE Sd (bias corrected)	2093
		Approximate Chi Square Value (0.05)	343.5
Adjusted Level of Significance	0.0386	Adjusted Chi Square Value	340.3
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	7023	95% Adjusted Gamma UCL (use when n<50)	7088
Lognormal GOF Test			

Shapiro Wilk Test Statistic	0.867	**Shapiro Wilk Lognormal GOF Test**		
5% Shapiro Wilk Critical Value	0.911	Data Not Lognormal at 5% Significance Level		
Lilliefors Test Statistic	0.161	**Lilliefors Lognormal GOF Test**		
5% Lilliefors Critical Value	0.189	Data appear Lognormal at 5% Significance Level		
Data appear Approximate Lognormal at 5% Significance Level				
Lognormal Statistics				
Minimum of Logged Data	8.294		Mean of logged Data	8.685
Maximum of Logged Data	9.547		SD of logged Data	0.301
Assuming Lognormal Distribution				
95% H-UCL	6983		90% Chebyshev (MVUE) UCL	7381
95% Chebyshev (MVUE) UCL	7928		97.5% Chebyshev (MVUE) UCL	8687
99% Chebyshev (MVUE) UCL	10179			
Nonparametric Distribution Free UCL Statistics				
Data appear to follow a Discernible Distribution at 5% Significance Level				
Nonparametric Distribution Free UCLs				
95% CLT UCL	7040		95% Jackknife UCL	7078
95% Standard Bootstrap UCL	7030		95% Bootstrap-t UCL	7941
95% Hall's Bootstrap UCL	11642		95% Percentile Bootstrap UCL	7040
95% BCA Bootstrap UCL	7335			
90% Chebyshev(Mean, Sd) UCL	7719		95% Chebyshev(Mean, Sd) UCL	8401
97.5% Chebyshev(Mean, Sd) UCL	9346		99% Chebyshev(Mean, Sd) UCL	11204
Suggested UCL to Use				
95% Student's-t UCL	7078		or 95% Modified-t UCL	7120
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.				
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)				
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.				
For additional insight the user may want to consult a statistician.				
Manganese				
General Statistics				
Total Number of Observations	166		Number of Distinct Observations	155
			Number of Missing Observations	0
Minimum	119		Mean	653.8
Maximum	3114		Median	531.5
SD	472		Std. Error of Mean	36.63
Coefficient of Variation	0.722		Skewness	2.718
Normal GOF Test				
Shapiro Wilk Test Statistic	0.734	**Shapiro Wilk GOF Test**		
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level		
Lilliefors Test Statistic	0.187	**Lilliefors GOF Test**		
5% Lilliefors Critical Value	0.0688	Data Not Normal at 5% Significance Level		
Data Not Normal at 5% Significance Level				

Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	714.4	95% Adjusted-CLT UCL (Chen-1995)	722.3
		95% Modified-t UCL (Johnson-1978)	715.6
Gamma GOF Test			
A-D Test Statistic	3.092	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.76	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.109	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0729	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.987	k star (bias corrected MLE)	2.937
Theta hat (MLE)	218.9	Theta star (bias corrected MLE)	222.6
nu hat (MLE)	991.6	nu star (bias corrected)	975
MLE Mean (bias corrected)	653.8	MLE Sd (bias corrected)	381.5
		Approximate Chi Square Value (0.05)	903.5
Adjusted Level of Significance	0.0486	Adjusted Chi Square Value	902.9
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	705.5	95% Adjusted Gamma UCL (use when n<50)	705.9
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.974	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0.103	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0646	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0688	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.779	Mean of logged Data	6.306
Maximum of Logged Data	8.044	SD of logged Data	0.569
Assuming Lognormal Distribution			
95% H-UCL	699.2	90% Chebyshev (MVUE) UCL	735
95% Chebyshev (MVUE) UCL	776.5	97.5% Chebyshev (MVUE) UCL	834.1
99% Chebyshev (MVUE) UCL	947.1		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	714	95% Jackknife UCL	714.4
95% Standard Bootstrap UCL	712.6	95% Bootstrap-t UCL	719.6
95% Hall's Bootstrap UCL	722.7	95% Percentile Bootstrap UCL	716.3
95% BCA Bootstrap UCL	720.7		
90% Chebyshev(Mean, Sd) UCL	763.7	95% Chebyshev(Mean, Sd) UCL	813.4
97.5% Chebyshev(Mean, Sd) UCL	882.5	99% Chebyshev(Mean, Sd) UCL	1018

Suggested UCL to Use			
95% H-UCL	699.2		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
ProUCL computes and outputs H-statistic based UCLs for historical reasons only.			
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.			
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.			
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.			
Vanadium			
General Statistics			
Total Number of Observations	166	Number of Distinct Observations	67
		Number of Missing Observations	0
Minimum	17.8	Mean	95.4
Maximum	158	Median	94.5
SD	25.02	Std. Error of Mean	1.942
Coefficient of Variation	0.262	Skewness	-0.588
Normal GOF Test			
Shapiro Wilk Test Statistic	0.915	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	2.234E-13	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.117	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0688	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	98.61	95% Adjusted-CLT UCL (Chen-1995)	98.5
		95% Modified-t UCL (Johnson-1978)	98.6
Gamma GOF Test			
A-D Test Statistic	8.5	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.752	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.181	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0723	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	9.866	k star (bias corrected MLE)	9.691
Theta hat (MLE)	9.67	Theta star (bias corrected MLE)	9.844
nu hat (MLE)	3275	nu star (bias corrected)	3218
MLE Mean (bias corrected)	95.4	MLE Sd (bias corrected)	30.65
		Approximate Chi Square Value (0.05)	3087
Adjusted Level of Significance	0.0486	Adjusted Chi Square Value	3086

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	99.44	95% Adjusted Gamma UCL (use when n<50)	99.48
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.706	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.217	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0688	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	2.879	Mean of logged Data	4.507
Maximum of Logged Data	5.063	SD of logged Data	0.371
Assuming Lognormal Distribution			
95% H-UCL	102.1	90% Chebyshev (MVUE) UCL	105.7
95% Chebyshev (MVUE) UCL	109.6	97.5% Chebyshev (MVUE) UCL	115
99% Chebyshev (MVUE) UCL	125.7		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	98.6	95% Jackknife UCL	98.61
95% Standard Bootstrap UCL	98.6	95% Bootstrap-t UCL	98.58
95% Hall's Bootstrap UCL	98.65	95% Percentile Bootstrap UCL	98.33
95% BCA Bootstrap UCL	98.52		
90% Chebyshev(Mean, Sd) UCL	101.2	95% Chebyshev(Mean, Sd) UCL	103.9
97.5% Chebyshev(Mean, Sd) UCL	107.5	99% Chebyshev(Mean, Sd) UCL	114.7
Suggested UCL to Use			
95% Student's-t UCL	98.61	or 95% Modified-t UCL	98.6
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			
Zinc			
General Statistics			
Total Number of Observations	166	Number of Distinct Observations	71
		Number of Missing Observations	0
Minimum	17.1	Mean	85.45
Maximum	1043	Median	36
SD	163.1	Std. Error of Mean	12.66
Coefficient of Variation	1.909	Skewness	4.44

Normal GOF Test			
Shapiro Wilk Test Statistic	0.393	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.355	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0688	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	106.4	95% Adjusted-CLT UCL (Chen-1995)	110.9
		95% Modified-t UCL (Johnson-1978)	107.1
Gamma GOF Test			
A-D Test Statistic	23.49	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.783	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.288	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0745	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.026	k star (bias corrected MLE)	1.012
Theta hat (MLE)	83.24	Theta star (bias corrected MLE)	84.44
nu hat (MLE)	340.8	nu star (bias corrected)	336
MLE Mean (bias corrected)	85.45	MLE Sd (bias corrected)	84.94
		Approximate Chi Square Value (0.05)	294.5
Adjusted Level of Significance	0.0486	Adjusted Chi Square Value	294.2
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	97.48	95% Adjusted Gamma UCL (use when n<50)	97.59
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.752	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.211	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0688	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	2.839	Mean of logged Data	3.887
Maximum of Logged Data	6.95	SD of logged Data	0.814
Assuming Lognormal Distribution			
95% H-UCL	77.15	90% Chebyshev (MVUE) UCL	82.42
95% Chebyshev (MVUE) UCL	89.07	97.5% Chebyshev (MVUE) UCL	98.31
99% Chebyshev (MVUE) UCL	116.4		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			

95% CLT UCL	106.3	95% Jackknife UCL	106.4
95% Standard Bootstrap UCL	106.2	95% Bootstrap-t UCL	114.7
95% Hall's Bootstrap UCL	110.4	95% Percentile Bootstrap UCL	106.1
95% BCA Bootstrap UCL	110.6		
90% Chebyshev(Mean, Sd) UCL	123.4	95% Chebyshev(Mean, Sd) UCL	140.6
97.5% Chebyshev(Mean, Sd) UCL	164.5	99% Chebyshev(Mean, Sd) UCL	211.4
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	140.6		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)

and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.

For additional insight the user may want to consult a statistician.

UCL Statistics for Uncensored Full Data Sets	
User Selected Options	
Date/Time of Computation	3/4/2015 4:23:56 PM
From File	015_UCL95.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Anthracene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	10
		Number of Missing Observations	103
Minimum	0.064	Mean	0.271
Maximum	0.77	Median	0.2
SD	0.203	Std. Error of Mean	0.0611
Coefficient of Variation	0.749	Skewness	1.628

Normal GOF Test			
Shapiro Wilk Test Statistic	0.843	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.85	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.209	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.267	Data appear Normal at 5% Significance Level	
Data appear Approximate Normal at 5% Significance Level			

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.382	95% Adjusted-CLT UCL (Chen-1995)	0.403
		95% Modified-t UCL (Johnson-1978)	0.387

Gamma GOF Test			
A-D Test Statistic	0.322	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.738	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.172	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.258	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics			
k hat (MLE)	2.227	k star (bias corrected MLE)	1.681
Theta hat (MLE)	0.122	Theta star (bias corrected MLE)	0.161
nu hat (MLE)	49	nu star (bias corrected)	36.97
MLE Mean (bias corrected)	0.271	MLE Sd (bias corrected)	0.209
		Approximate Chi Square Value (0.05)	24.05
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	22.37

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	0.416	95% Adjusted Gamma UCL (use when n<50)	0.448

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.942	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.85	Data appear Lognormal at 5% Significance Level	

Lilliefors Test Statistic	0.215	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.267	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-2.749	Mean of logged Data	-1.547
Maximum of Logged Data	-0.261	SD of logged Data	0.748
Assuming Lognormal Distribution			
95% H-UCL	0.514	90% Chebyshev (MVUE) UCL	0.465
95% Chebyshev (MVUE) UCL	0.553	97.5% Chebyshev (MVUE) UCL	0.674
99% Chebyshev (MVUE) UCL	0.911		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.371	95% Jackknife UCL	0.382
95% Standard Bootstrap UCL	0.365	95% Bootstrap-t UCL	0.452
95% Hall's Bootstrap UCL	0.857	95% Percentile Bootstrap UCL	0.37
95% BCA Bootstrap UCL	0.399		
90% Chebyshev(Mean, Sd) UCL	0.454	95% Chebyshev(Mean, Sd) UCL	0.537
97.5% Chebyshev(Mean, Sd) UCL	0.653	99% Chebyshev(Mean, Sd) UCL	0.879
Suggested UCL to Use			
95% Student's-t UCL	0.382		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Antimony			
General Statistics			
Total Number of Observations	117	Number of Distinct Observations	93
		Number of Missing Observations	2
Minimum	0.8	Mean	69.93
Maximum	283	Median	72.3
SD	42.46	Std. Error of Mean	3.925
Coefficient of Variation	0.607	Skewness	1.019
Normal GOF Test			
Shapiro Wilk Test Statistic	0.917	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	3.3437E-8	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.124	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0819	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	76.44	95% Adjusted-CLT UCL (Chen-1995)	76.78

		95% Modified-t UCL (Johnson-1978)	76.5
Gamma GOF Test			
A-D Test Statistic	4.49	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.765	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.157	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0862	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.072	k star (bias corrected MLE)	2.025
Theta hat (MLE)	33.75	Theta star (bias corrected MLE)	34.54
nu hat (MLE)	484.9	nu star (bias corrected)	473.8
MLE Mean (bias corrected)	69.93	MLE Sd (bias corrected)	49.15
		Approximate Chi Square Value (0.05)	424.3
Adjusted Level of Significance	0.0479	Adjusted Chi Square Value	423.7
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	78.09	95% Adjusted Gamma UCL (use when n<50)	78.19
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.839	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.173	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0819	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-0.223	Mean of logged Data	3.987
Maximum of Logged Data	5.645	SD of logged Data	0.855
Assuming Lognormal Distribution			
95% H-UCL	91.76	90% Chebyshev (MVUE) UCL	98.56
95% Chebyshev (MVUE) UCL	108.2	97.5% Chebyshev (MVUE) UCL	121.5
99% Chebyshev (MVUE) UCL	147.6		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	76.39	95% Jackknife UCL	76.44
95% Standard Bootstrap UCL	76.16	95% Bootstrap-t UCL	77.28
95% Hall's Bootstrap UCL	77.12	95% Percentile Bootstrap UCL	76.6
95% BCA Bootstrap UCL	76.35		
90% Chebyshev(Mean, Sd) UCL	81.71	95% Chebyshev(Mean, Sd) UCL	87.04
97.5% Chebyshev(Mean, Sd) UCL	94.45	99% Chebyshev(Mean, Sd) UCL	109
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	87.04		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			

For additional insight the user may want to consult a statistician.			
Arsenic			
General Statistics			
Total Number of Observations	119	Number of Distinct Observations	76
		Number of Missing Observations	0
Minimum	5	Mean	11.08
Maximum	62.55	Median	7.89
SD	9.753	Std. Error of Mean	0.894
Coefficient of Variation	0.88	Skewness	3.062
Normal GOF Test			
Shapiro Wilk Test Statistic	0.614	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.267	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0812	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	12.57	95% Adjusted-CLT UCL (Chen-1995)	12.82
		95% Modified-t UCL (Johnson-1978)	12.61
Gamma GOF Test			
A-D Test Statistic	8.633	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.762	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.202	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0854	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.527	k star (bias corrected MLE)	2.469
Theta hat (MLE)	4.386	Theta star (bias corrected MLE)	4.49
nu hat (MLE)	601.4	nu star (bias corrected)	587.6
MLE Mean (bias corrected)	11.08	MLE Sd (bias corrected)	7.054
		Approximate Chi Square Value (0.05)	532.4
Adjusted Level of Significance	0.048	Adjusted Chi Square Value	531.7
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	12.23	95% Adjusted Gamma UCL (use when n<50)	12.25
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.82	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.181	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0812	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.609	Mean of logged Data	2.195
Maximum of Logged Data	4.136	SD of logged Data	0.577

Assuming Lognormal Distribution			
95% H-UCL	11.72	90% Chebyshev (MVUE) UCL	12.39
95% Chebyshev (MVUE) UCL	13.21	97.5% Chebyshev (MVUE) UCL	14.34
99% Chebyshev (MVUE) UCL	16.57		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	12.55	95% Jackknife UCL	12.57
95% Standard Bootstrap UCL	12.56	95% Bootstrap-t UCL	12.89
95% Hall's Bootstrap UCL	12.88	95% Percentile Bootstrap UCL	12.58
95% BCA Bootstrap UCL	12.72		
90% Chebyshev(Mean, Sd) UCL	13.77	95% Chebyshev(Mean, Sd) UCL	14.98
97.5% Chebyshev(Mean, Sd) UCL	16.67	99% Chebyshev(Mean, Sd) UCL	19.98
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	14.98		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Barium			
General Statistics			
Total Number of Observations	117	Number of Distinct Observations	115
		Number of Missing Observations	2
Minimum	50	Mean	305.1
Maximum	629.9	Median	317.9
SD	114.8	Std. Error of Mean	10.61
Coefficient of Variation	0.376	Skewness	-0.153
Normal GOF Test			
Shapiro Wilk Test Statistic	0.967	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0.0539	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.093	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0819	Data Not Normal at 5% Significance Level	
Data appear Approximate Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	322.7	95% Adjusted-CLT UCL (Chen-1995)	322.4
		95% Modified-t UCL (Johnson-1978)	322.7
Gamma GOF Test			
A-D Test Statistic	3.86	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.755	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.159	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0852	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	5.178	k star (bias corrected MLE)	5.051
Theta hat (MLE)	58.93	Theta star (bias corrected MLE)	60.41
nu hat (MLE)	1212	nu star (bias corrected)	1182
MLE Mean (bias corrected)	305.1	MLE Sd (bias corrected)	135.8
		Approximate Chi Square Value (0.05)	1103
Adjusted Level of Significance	0.0479	Adjusted Chi Square Value	1102
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	326.9	95% Adjusted Gamma UCL (use when n<50)	327.2
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.843	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.192	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0819	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	3.912	Mean of logged Data	5.621
Maximum of Logged Data	6.446	SD of logged Data	0.505
Assuming Lognormal Distribution			
95% H-UCL	342.1	90% Chebyshev (MVUE) UCL	359.8
95% Chebyshev (MVUE) UCL	380.9	97.5% Chebyshev (MVUE) UCL	410.1
99% Chebyshev (MVUE) UCL	467.4		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	322.6	95% Jackknife UCL	322.7
95% Standard Bootstrap UCL	322.6	95% Bootstrap-t UCL	321.9
95% Hall's Bootstrap UCL	322.2	95% Percentile Bootstrap UCL	322.4
95% BCA Bootstrap UCL	322.7		
90% Chebyshev(Mean, Sd) UCL	337	95% Chebyshev(Mean, Sd) UCL	351.4
97.5% Chebyshev(Mean, Sd) UCL	371.4	99% Chebyshev(Mean, Sd) UCL	410.7
Suggested UCL to Use			
95% Student's-t UCL	322.7		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			
Cadmium			

General Statistics			
Total Number of Observations	117	Number of Distinct Observations	24
		Number of Missing Observations	2
Minimum	0.42	Mean	7.934
Maximum	24.15	Median	6
SD	4.368	Std. Error of Mean	0.404
Coefficient of Variation	0.551	Skewness	1.887
Normal GOF Test			
Shapiro Wilk Test Statistic	0.554	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.483	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0819	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	8.604	95% Adjusted-CLT UCL (Chen-1995)	8.674
		95% Modified-t UCL (Johnson-1978)	8.616
Gamma GOF Test			
A-D Test Statistic	26.53	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.755	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.471	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.0853	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	4.544	k star (bias corrected MLE)	4.433
Theta hat (MLE)	1.746	Theta star (bias corrected MLE)	1.79
nu hat (MLE)	1063	nu star (bias corrected)	1037
MLE Mean (bias corrected)	7.934	MLE Sd (bias corrected)	3.768
		Approximate Chi Square Value (0.05)	963.6
Adjusted Level of Significance	0.0479	Adjusted Chi Square Value	962.7
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	8.542	95% Adjusted Gamma UCL (use when n<50)	8.55
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.562	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.447	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.0819	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-0.868	Mean of logged Data	1.957
Maximum of Logged Data	3.184	SD of logged Data	0.478
Assuming Lognormal Distribution			
95% H-UCL	8.603	90% Chebyshev (MVUE) UCL	9.03
95% Chebyshev (MVUE) UCL	9.531	97.5% Chebyshev (MVUE) UCL	10.22

99% Chebyshev (MVUE) UCL	11.59		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	8.599	95% Jackknife UCL	8.604
95% Standard Bootstrap UCL	8.611	95% Bootstrap-t UCL	8.724
95% Hall's Bootstrap UCL	8.669	95% Percentile Bootstrap UCL	8.619
95% BCA Bootstrap UCL	8.684		
90% Chebyshev(Mean, Sd) UCL	9.146	95% Chebyshev(Mean, Sd) UCL	9.695
97.5% Chebyshev(Mean, Sd) UCL	10.46	99% Chebyshev(Mean, Sd) UCL	11.95
Suggested UCL to Use			
95% Student's-t UCL	8.604	or 95% Modified-t UCL	8.616
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Chromium			
General Statistics			
Total Number of Observations	119	Number of Distinct Observations	50
		Number of Missing Observations	0
Minimum	6	Mean	48.76
Maximum	150.7	Median	42.5
SD	20.82	Std. Error of Mean	1.908
Coefficient of Variation	0.427	Skewness	2.852
Normal GOF Test			
Shapiro Wilk Test Statistic	0.603	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.345	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0812	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	51.92	95% Adjusted-CLT UCL (Chen-1995)	52.43
		95% Modified-t UCL (Johnson-1978)	52.01
Gamma GOF Test			
A-D Test Statistic	17.33	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.753	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.317	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0846	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	7.187	k star (bias corrected MLE)	7.012

Theta hat (MLE)	6.784	Theta star (bias corrected MLE)	6.954
nu hat (MLE)	1711	nu star (bias corrected)	1669
MLE Mean (bias corrected)	48.76	MLE Sd (bias corrected)	18.41
		Approximate Chi Square Value (0.05)	1575
Adjusted Level of Significance	0.048	Adjusted Chi Square Value	1574
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	51.67	95% Adjusted Gamma UCL (use when n<50)	51.7
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.652	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.291	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0812	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.792	Mean of logged Data	3.816
Maximum of Logged Data	5.015	SD of logged Data	0.391
Assuming Lognormal Distribution			
95% H-UCL	52.27	90% Chebyshev (MVUE) UCL	54.44
95% Chebyshev (MVUE) UCL	56.92	97.5% Chebyshev (MVUE) UCL	60.35
99% Chebyshev (MVUE) UCL	67.08		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	51.9	95% Jackknife UCL	51.92
95% Standard Bootstrap UCL	51.82	95% Bootstrap-t UCL	52.94
95% Hall's Bootstrap UCL	52.46	95% Percentile Bootstrap UCL	51.92
95% BCA Bootstrap UCL	52.28		
90% Chebyshev(Mean, Sd) UCL	54.49	95% Chebyshev(Mean, Sd) UCL	57.08
97.5% Chebyshev(Mean, Sd) UCL	60.68	99% Chebyshev(Mean, Sd) UCL	67.75
Suggested UCL to Use			
95% Student's-t UCL	51.92	or 95% Modified-t UCL	52.01
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Copper			
General Statistics			
Total Number of Observations	119	Number of Distinct Observations	97
		Number of Missing Observations	0
Minimum	17.5	Mean	287
Maximum	6122	Median	104.2
SD	713.1	Std. Error of Mean	65.37

Coefficient of Variation	2.485	Skewness	6.437
Normal GOF Test			
Shapiro Wilk Test Statistic	0.372	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.353	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0812	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	395.3	95% Adjusted-CLT UCL (Chen-1995)	435.7
		95% Modified-t UCL (Johnson-1978)	401.8
Gamma GOF Test			
A-D Test Statistic	4.368	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.81	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.153	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0888	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.597	k star (bias corrected MLE)	0.588
Theta hat (MLE)	480.5	Theta star (bias corrected MLE)	488.2
nu hat (MLE)	142.2	nu star (bias corrected)	139.9
MLE Mean (bias corrected)	287	MLE Sd (bias corrected)	374.3
		Approximate Chi Square Value (0.05)	113.6
Adjusted Level of Significance	0.048	Adjusted Chi Square Value	113.3
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	353.5	95% Adjusted Gamma UCL (use when n<50)	354.4
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.922	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	9.9471E-8	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.116	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0812	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	2.862	Mean of logged Data	4.624
Maximum of Logged Data	8.72	SD of logged Data	1.371
Assuming Lognormal Distribution			
95% H-UCL	362.3	90% Chebyshev (MVUE) UCL	387.5
95% Chebyshev (MVUE) UCL	446.5	97.5% Chebyshev (MVUE) UCL	528.5
99% Chebyshev (MVUE) UCL	689.5		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	394.5	95% Jackknife UCL	395.3

95% Standard Bootstrap UCL	392.2	95% Bootstrap-t UCL	538.1
95% Hall's Bootstrap UCL	903.1	95% Percentile Bootstrap UCL	411.8
95% BCA Bootstrap UCL	447.5		
90% Chebyshev(Mean, Sd) UCL	483.1	95% Chebyshev(Mean, Sd) UCL	571.9
97.5% Chebyshev(Mean, Sd) UCL	695.2	99% Chebyshev(Mean, Sd) UCL	937.4
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	571.9		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Fluoranthene			
General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
		Number of Missing Observations	103
Minimum	0.08	Mean	1.303
Maximum	3.6	Median	0.51
SD	1.258	Std. Error of Mean	0.379
Coefficient of Variation	0.966	Skewness	0.654
Normal GOF Test			
Shapiro Wilk Test Statistic	0.855	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.281	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.267	Data Not Normal at 5% Significance Level	
Data appear Approximate Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1.99	95% Adjusted-CLT UCL (Chen-1995)	2.007
		95% Modified-t UCL (Johnson-1978)	2.003
Gamma GOF Test			
A-D Test Statistic	0.528	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.755	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.204	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.263	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.921	k star (bias corrected MLE)	0.73
Theta hat (MLE)	1.415	Theta star (bias corrected MLE)	1.784
nu hat (MLE)	20.26	nu star (bias corrected)	16.07
MLE Mean (bias corrected)	1.303	MLE Sd (bias corrected)	1.524
		Approximate Chi Square Value (0.05)	8.01
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	7.102
Assuming Gamma Distribution			

95% Approximate Gamma UCL (use when n>=50))	2.613	95% Adjusted Gamma UCL (use when n<50)	2.948
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.913	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.208	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.267	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-2.526	Mean of logged Data	-0.369
Maximum of Logged Data	1.281	SD of logged Data	1.313
Assuming Lognormal Distribution			
95% H-UCL	7.398	90% Chebyshev (MVUE) UCL	3.296
95% Chebyshev (MVUE) UCL	4.133	97.5% Chebyshev (MVUE) UCL	5.295
99% Chebyshev (MVUE) UCL	7.577		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1.927	95% Jackknife UCL	1.99
95% Standard Bootstrap UCL	1.897	95% Bootstrap-t UCL	2.16
95% Hall's Bootstrap UCL	1.905	95% Percentile Bootstrap UCL	1.919
95% BCA Bootstrap UCL	1.976		
90% Chebyshev(Mean, Sd) UCL	2.441	95% Chebyshev(Mean, Sd) UCL	2.957
97.5% Chebyshev(Mean, Sd) UCL	3.672	99% Chebyshev(Mean, Sd) UCL	5.078
Suggested UCL to Use			
95% Student's-t UCL	1.99		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Lead			
General Statistics			
Total Number of Observations	119	Number of Distinct Observations	113
		Number of Missing Observations	0
Minimum	1.5	Mean	99.03
Maximum	1040	Median	40.94
SD	159.6	Std. Error of Mean	14.63
Coefficient of Variation	1.611	Skewness	3.451
Normal GOF Test			
Shapiro Wilk Test Statistic	0.593	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.271	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0812	Data Not Normal at 5% Significance Level	

Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	123.3	95% Adjusted-CLT UCL (Chen-1995)	128
		95% Modified-t UCL (Johnson-1978)	124.1
Gamma GOF Test			
A-D Test Statistic	3.081	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.797	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.119	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.088	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.731	k star (bias corrected MLE)	0.718
Theta hat (MLE)	135.5	Theta star (bias corrected MLE)	137.9
nu hat (MLE)	173.9	nu star (bias corrected)	170.9
MLE Mean (bias corrected)	99.03	MLE Sd (bias corrected)	116.9
		Approximate Chi Square Value (0.05)	141.7
Adjusted Level of Significance	0.048	Adjusted Chi Square Value	141.3
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	119.5	95% Adjusted Gamma UCL (use when n<50)	119.7
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.978	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0.394	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0533	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0812	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.405	Mean of logged Data	3.773
Maximum of Logged Data	6.947	SD of logged Data	1.29
Assuming Lognormal Distribution			
95% H-UCL	134.7	90% Chebyshev (MVUE) UCL	144.7
95% Chebyshev (MVUE) UCL	165.5	97.5% Chebyshev (MVUE) UCL	194.3
99% Chebyshev (MVUE) UCL	251.1		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	123.1	95% Jackknife UCL	123.3
95% Standard Bootstrap UCL	122.3	95% Bootstrap-t UCL	131.1
95% Hall's Bootstrap UCL	132.2	95% Percentile Bootstrap UCL	124.4
95% BCA Bootstrap UCL	127.2		
90% Chebyshev(Mean, Sd) UCL	142.9	95% Chebyshev(Mean, Sd) UCL	162.8
97.5% Chebyshev(Mean, Sd) UCL	190.4	99% Chebyshev(Mean, Sd) UCL	244.6
Suggested UCL to Use			

95% H-UCL	134.7		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
ProUCL computes and outputs H-statistic based UCLs for historical reasons only.			
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.			
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.			
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.			
Mercury			
General Statistics			
Total Number of Observations	119	Number of Distinct Observations	9
		Number of Missing Observations	0
Minimum	5	Mean	5.702
Maximum	20	Median	5
SD	2.723	Std. Error of Mean	0.25
Coefficient of Variation	0.477	Skewness	4.387
Normal GOF Test			
Shapiro Wilk Test Statistic	0.292	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.518	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0812	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	6.116	95% Adjusted-CLT UCL (Chen-1995)	6.22
		95% Modified-t UCL (Johnson-1978)	6.133
Gamma GOF Test			
A-D Test Statistic	38.09	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.752	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.527	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0845	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	9.36	k star (bias corrected MLE)	9.129
Theta hat (MLE)	0.609	Theta star (bias corrected MLE)	0.625
nu hat (MLE)	2228	nu star (bias corrected)	2173
MLE Mean (bias corrected)	5.702	MLE Sd (bias corrected)	1.887
		Approximate Chi Square Value (0.05)	2065
Adjusted Level of Significance	0.048	Adjusted Chi Square Value	2064
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	5.999	95% Adjusted Gamma UCL (use when n<50)	6.002

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.315	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.526	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0812	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.609	Mean of logged Data	1.687
Maximum of Logged Data	2.996	SD of logged Data	0.276
Assuming Lognormal Distribution			
95% H-UCL	5.863	90% Chebyshev (MVUE) UCL	6.043
95% Chebyshev (MVUE) UCL	6.239	97.5% Chebyshev (MVUE) UCL	6.512
99% Chebyshev (MVUE) UCL	7.047		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	6.113	95% Jackknife UCL	6.116
95% Standard Bootstrap UCL	6.111	95% Bootstrap-t UCL	6.322
95% Hall's Bootstrap UCL	6.133	95% Percentile Bootstrap UCL	6.131
95% BCA Bootstrap UCL	6.232		
90% Chebyshev(Mean, Sd) UCL	6.451	95% Chebyshev(Mean, Sd) UCL	6.79
97.5% Chebyshev(Mean, Sd) UCL	7.261	99% Chebyshev(Mean, Sd) UCL	8.186
Suggested UCL to Use			
95% Student's-t UCL	6.116	or 95% Modified-t UCL	6.133
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Molybdenum			
General Statistics			
Total Number of Observations	119	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	1.5	Mean	7.665
Maximum	23.6	Median	7.5
SD	2.207	Std. Error of Mean	0.202
Coefficient of Variation	0.288	Skewness	4.56
Normal GOF Test			
Shapiro Wilk Test Statistic	0.295	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.488	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0812	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	8.001	95% Adjusted-CLT UCL (Chen-1995)	8.089
		95% Modified-t UCL (Johnson-1978)	8.015
Gamma GOF Test			
A-D Test Statistic	38.11	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.751	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.479	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.0844	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	13.76	k star (bias corrected MLE)	13.42
Theta hat (MLE)	0.557	Theta star (bias corrected MLE)	0.571
nu hat (MLE)	3274	nu star (bias corrected)	3193
MLE Mean (bias corrected)	7.665	MLE Sd (bias corrected)	2.093
		Approximate Chi Square Value (0.05)	3063
Adjusted Level of Significance	0.048	Adjusted Chi Square Value	3061
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	7.992	95% Adjusted Gamma UCL (use when n<50)	7.996
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.307	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.495	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.0812	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.405	Mean of logged Data	2
Maximum of Logged Data	3.161	SD of logged Data	0.298
Assuming Lognormal Distribution			
95% H-UCL	8.101	90% Chebyshev (MVUE) UCL	8.367
95% Chebyshev (MVUE) UCL	8.659	97.5% Chebyshev (MVUE) UCL	9.065
99% Chebyshev (MVUE) UCL	9.863		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	7.998	95% Jackknife UCL	8.001
95% Standard Bootstrap UCL	7.996	95% Bootstrap-t UCL	8.198
95% Hall's Bootstrap UCL	10.32	95% Percentile Bootstrap UCL	8.028
95% BCA Bootstrap UCL	8.143		
90% Chebyshev(Mean, Sd) UCL	8.272	95% Chebyshev(Mean, Sd) UCL	8.547
97.5% Chebyshev(Mean, Sd) UCL	8.929	99% Chebyshev(Mean, Sd) UCL	9.678
Suggested UCL to Use			
95% Student's-t UCL	8.001	or 95% Modified-t UCL	8.015

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Naphthalene			
General Statistics			
Total Number of Observations	11	Number of Distinct Observations	5
		Number of Missing Observations	103
Minimum	0.12	Mean	0.176
Maximum	0.2	Median	0.18
SD	0.02	Std. Error of Mean	0.00602
Coefficient of Variation	0.114	Skewness	-2.417
Normal GOF Test			
Shapiro Wilk Test Statistic	0.668	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.391	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.267	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.187	95% Adjusted-CLT UCL (Chen-1995)	0.181
		95% Modified-t UCL (Johnson-1978)	0.186
Gamma GOF Test			
A-D Test Statistic	1.826	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.727	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.407	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.255	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	70.98	k star (bias corrected MLE)	51.68
Theta hat (MLE)	0.00248	Theta star (bias corrected MLE)	0.0034
nu hat (MLE)	1562	nu star (bias corrected)	1137
MLE Mean (bias corrected)	0.176	MLE Sd (bias corrected)	0.0245
		Approximate Chi Square Value (0.05)	1060
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	1048
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	0.189	95% Adjusted Gamma UCL (use when n<50)	0.191
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.613	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.415	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.267	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			

Lognormal Statistics			
Minimum of Logged Data	-2.12	Mean of logged Data	-1.745
Maximum of Logged Data	-1.609	SD of logged Data	0.131
Assuming Lognormal Distribution			
95% H-UCL	0.19	90% Chebyshev (MVUE) UCL	0.197
95% Chebyshev (MVUE) UCL	0.206	97.5% Chebyshev (MVUE) UCL	0.219
99% Chebyshev (MVUE) UCL	0.245		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.186	95% Jackknife UCL	0.187
95% Standard Bootstrap UCL	0.186	95% Bootstrap-t UCL	0.183
95% Hall's Bootstrap UCL	0.182	95% Percentile Bootstrap UCL	0.184
95% BCA Bootstrap UCL	0.183		
90% Chebyshev(Mean, Sd) UCL	0.194	95% Chebyshev(Mean, Sd) UCL	0.202
97.5% Chebyshev(Mean, Sd) UCL	0.214	99% Chebyshev(Mean, Sd) UCL	0.236
Suggested UCL to Use			
95% Student's-t UCL	0.187	or 95% Modified-t UCL	0.186
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			
Nickel			
General Statistics			
Total Number of Observations	119	Number of Distinct Observations	95
		Number of Missing Observations	0
Minimum	21	Mean	237
Maximum	3787	Median	128.2
SD	437.5	Std. Error of Mean	40.1
Coefficient of Variation	1.846	Skewness	5.917
Normal GOF Test			
Shapiro Wilk Test Statistic	0.443	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.311	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0812	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	303.5	95% Adjusted-CLT UCL (Chen-1995)	326.2
		95% Modified-t UCL (Johnson-1978)	307.1

Gamma GOF Test			
A-D Test Statistic	3.764	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.786	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.127	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0873	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.942	k star (bias corrected MLE)	0.924
Theta hat (MLE)	251.5	Theta star (bias corrected MLE)	256.4
nu hat (MLE)	224.3	nu star (bias corrected)	220
MLE Mean (bias corrected)	237	MLE Sd (bias corrected)	246.5
		Approximate Chi Square Value (0.05)	186.6
Adjusted Level of Significance	0.048	Adjusted Chi Square Value	186.3
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	279.3	95% Adjusted Gamma UCL (use when n<50)	279.9
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.947	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	3.0093E-4	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.127	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0812	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	3.045	Mean of logged Data	4.851
Maximum of Logged Data	8.239	SD of logged Data	1.027
Assuming Lognormal Distribution			
95% H-UCL	268.1	90% Chebyshev (MVUE) UCL	289.1
95% Chebyshev (MVUE) UCL	322.5	97.5% Chebyshev (MVUE) UCL	368.9
99% Chebyshev (MVUE) UCL	460		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	302.9	95% Jackknife UCL	303.5
95% Standard Bootstrap UCL	301.9	95% Bootstrap-t UCL	364.4
95% Hall's Bootstrap UCL	602.8	95% Percentile Bootstrap UCL	306.6
95% BCA Bootstrap UCL	335.5		
90% Chebyshev(Mean, Sd) UCL	357.3	95% Chebyshev(Mean, Sd) UCL	411.8
97.5% Chebyshev(Mean, Sd) UCL	487.4	99% Chebyshev(Mean, Sd) UCL	636
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	411.8		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			

PCB, Total			
General Statistics			
Total Number of Observations	119	Number of Distinct Observations	9
		Number of Missing Observations	0
Minimum	2.5	Mean	5.036
Maximum	55	Median	2.5
SD	8.929	Std. Error of Mean	0.819
Coefficient of Variation	1.773	Skewness	4.809
Normal GOF Test			
Shapiro Wilk Test Statistic	0.312	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.393	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0812	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	6.393	95% Adjusted-CLT UCL (Chen-1995)	6.768
		95% Modified-t UCL (Johnson-1978)	6.453
Gamma GOF Test			
A-D Test Statistic	27.42	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.774	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.448	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.0864	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.363	k star (bias corrected MLE)	1.334
Theta hat (MLE)	3.695	Theta star (bias corrected MLE)	3.774
nu hat (MLE)	324.4	nu star (bias corrected)	317.6
MLE Mean (bias corrected)	5.036	MLE Sd (bias corrected)	4.36
		Approximate Chi Square Value (0.05)	277.3
Adjusted Level of Significance	0.048	Adjusted Chi Square Value	276.8
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	5.768	95% Adjusted Gamma UCL (use when n<50)	5.777
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.503	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.451	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.0812	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.916	Mean of logged Data	1.207
Maximum of Logged Data	4.007	SD of logged Data	0.663

Assuming Lognormal Distribution			
95% H-UCL	4.691	90% Chebyshev (MVUE) UCL	4.988
95% Chebyshev (MVUE) UCL	5.365	97.5% Chebyshev (MVUE) UCL	5.887
99% Chebyshev (MVUE) UCL	6.914		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	6.382	95% Jackknife UCL	6.393
95% Standard Bootstrap UCL	6.384	95% Bootstrap-t UCL	7.371
95% Hall's Bootstrap UCL	6.339	95% Percentile Bootstrap UCL	6.471
95% BCA Bootstrap UCL	6.949		
90% Chebyshev(Mean, Sd) UCL	7.492	95% Chebyshev(Mean, Sd) UCL	8.604
97.5% Chebyshev(Mean, Sd) UCL	10.15	99% Chebyshev(Mean, Sd) UCL	13.18
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	8.604		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Phenanthrene			
General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
		Number of Missing Observations	103
Minimum	0.11	Mean	0.872
Maximum	2.9	Median	0.31
SD	0.91	Std. Error of Mean	0.274
Coefficient of Variation	1.044	Skewness	1.228
Normal GOF Test			
Shapiro Wilk Test Statistic	0.825	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.85	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.277	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.267	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.37	95% Adjusted-CLT UCL (Chen-1995)	1.432
		95% Modified-t UCL (Johnson-1978)	1.387
Gamma GOF Test			
A-D Test Statistic	0.555	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.752	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.247	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.262	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics			
k hat (MLE)	1.002	k star (bias corrected MLE)	0.789
Theta hat (MLE)	0.871	Theta star (bias corrected MLE)	1.105
nu hat (MLE)	22.04	nu star (bias corrected)	17.36
MLE Mean (bias corrected)	0.872	MLE Sd (bias corrected)	0.982
		Approximate Chi Square Value (0.05)	8.931
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	7.963
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	1.696	95% Adjusted Gamma UCL (use when n<50)	1.902
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.907	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.197	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.267	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-2.207	Mean of logged Data	-0.713
Maximum of Logged Data	1.065	SD of logged Data	1.174
Assuming Lognormal Distribution			
95% H-UCL	3.382	90% Chebyshev (MVUE) UCL	1.904
95% Chebyshev (MVUE) UCL	2.362	97.5% Chebyshev (MVUE) UCL	2.999
99% Chebyshev (MVUE) UCL	4.249		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1.324	95% Jackknife UCL	1.37
95% Standard Bootstrap UCL	1.301	95% Bootstrap-t UCL	1.574
95% Hall's Bootstrap UCL	1.437	95% Percentile Bootstrap UCL	1.303
95% BCA Bootstrap UCL	1.394		
90% Chebyshev(Mean, Sd) UCL	1.696	95% Chebyshev(Mean, Sd) UCL	2.069
97.5% Chebyshev(Mean, Sd) UCL	2.586	99% Chebyshev(Mean, Sd) UCL	3.603
Suggested UCL to Use			
95% Adjusted Gamma UCL	1.902		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Pyrene			
General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
		Number of Missing Observations	103

Minimum	0.089	Mean	1.025
Maximum	3	Median	0.44
SD	0.981	Std. Error of Mean	0.296
Coefficient of Variation	0.957	Skewness	0.878
Normal GOF Test			
Shapiro Wilk Test Statistic	0.863	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.85	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.27	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.267	Data Not Normal at 5% Significance Level	
Data appear Approximate Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.562	95% Adjusted-CLT UCL (Chen-1995)	1.596
		95% Modified-t UCL (Johnson-1978)	1.575
Gamma GOF Test			
A-D Test Statistic	0.419	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.751	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.204	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.262	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.037	k star (bias corrected MLE)	0.815
Theta hat (MLE)	0.988	Theta star (bias corrected MLE)	1.258
nu hat (MLE)	22.82	nu star (bias corrected)	17.93
MLE Mean (bias corrected)	1.025	MLE Sd (bias corrected)	1.136
		Approximate Chi Square Value (0.05)	9.342
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	8.349
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1.968	95% Adjusted Gamma UCL (use when n<50)	2.202
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.932	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.85	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.2	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.267	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-2.419	Mean of logged Data	-0.529
Maximum of Logged Data	1.099	SD of logged Data	1.201
Assuming Lognormal Distribution			
95% H-UCL	4.4	90% Chebyshev (MVUE) UCL	2.377
95% Chebyshev (MVUE) UCL	2.956	97.5% Chebyshev (MVUE) UCL	3.759
99% Chebyshev (MVUE) UCL	5.337		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			

Nonparametric Distribution Free UCLs			
95% CLT UCL	1.512	95% Jackknife UCL	1.562
95% Standard Bootstrap UCL	1.497	95% Bootstrap-t UCL	1.758
95% Hall's Bootstrap UCL	1.543	95% Percentile Bootstrap UCL	1.512
95% BCA Bootstrap UCL	1.536		
90% Chebyshev(Mean, Sd) UCL	1.913	95% Chebyshev(Mean, Sd) UCL	2.315
97.5% Chebyshev(Mean, Sd) UCL	2.873	99% Chebyshev(Mean, Sd) UCL	3.969
Suggested UCL to Use			
95% Student's-t UCL	1.562		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Selenium			
General Statistics			
Total Number of Observations	119	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	1.5	Mean	9.884
Maximum	26.71	Median	10
SD	2.098	Std. Error of Mean	0.192
Coefficient of Variation	0.212	Skewness	2.686
Normal GOF Test			
Shapiro Wilk Test Statistic	0.262	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.488	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0812	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	10.2	95% Adjusted-CLT UCL (Chen-1995)	10.25
		95% Modified-t UCL (Johnson-1978)	10.21
Gamma GOF Test			
A-D Test Statistic	41.42	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.751	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.519	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0844	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	14.98	k star (bias corrected MLE)	14.61
Theta hat (MLE)	0.66	Theta star (bias corrected MLE)	0.677
nu hat (MLE)	3565	nu star (bias corrected)	3477
MLE Mean (bias corrected)	9.884	MLE Sd (bias corrected)	2.586
		Approximate Chi Square Value (0.05)	3341

Adjusted Level of Significance	0.048	Adjusted Chi Square Value	3339
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	10.29	95% Adjusted Gamma UCL (use when n<50)	10.29
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.241	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.523	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0812	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.405	Mean of logged Data	2.257
Maximum of Logged Data	3.285	SD of logged Data	0.319
Assuming Lognormal Distribution			
95% H-UCL	10.58	90% Chebyshev (MVUE) UCL	10.95
95% Chebyshev (MVUE) UCL	11.36	97.5% Chebyshev (MVUE) UCL	11.93
99% Chebyshev (MVUE) UCL	13.04		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	10.2	95% Jackknife UCL	10.2
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	10.46	95% Chebyshev(Mean, Sd) UCL	10.72
97.5% Chebyshev(Mean, Sd) UCL	11.09	99% Chebyshev(Mean, Sd) UCL	11.8
Suggested UCL to Use			
95% Student's-t UCL	10.2	or 95% Modified-t UCL	10.21
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Silver			
General Statistics			
Total Number of Observations	119	Number of Distinct Observations	17
		Number of Missing Observations	0
Minimum	5	Mean	6.47
Maximum	25	Median	5
SD	4.002	Std. Error of Mean	0.367
Coefficient of Variation	0.619	Skewness	3.189
Normal GOF Test			
Shapiro Wilk Test Statistic	0.429	**Shapiro Wilk GOF Test**	

5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.492	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0812	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	7.078	95% Adjusted-CLT UCL (Chen-1995)	7.188
		95% Modified-t UCL (Johnson-1978)	7.096
Gamma GOF Test			
A-D Test Statistic	31.76	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.755	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.506	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0847	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	5.081	k star (bias corrected MLE)	4.958
Theta hat (MLE)	1.273	Theta star (bias corrected MLE)	1.305
nu hat (MLE)	1209	nu star (bias corrected)	1180
MLE Mean (bias corrected)	6.47	MLE Sd (bias corrected)	2.906
		Approximate Chi Square Value (0.05)	1101
Adjusted Level of Significance	0.048	Adjusted Chi Square Value	1100
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	6.933	95% Adjusted Gamma UCL (use when n<50)	6.938
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.453	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.505	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0812	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.609	Mean of logged Data	1.766
Maximum of Logged Data	3.219	SD of logged Data	0.389
Assuming Lognormal Distribution			
95% H-UCL	6.717	90% Chebyshev (MVUE) UCL	6.996
95% Chebyshev (MVUE) UCL	7.311	97.5% Chebyshev (MVUE) UCL	7.749
99% Chebyshev (MVUE) UCL	8.61		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	7.073	95% Jackknife UCL	7.078
95% Standard Bootstrap UCL	7.073	95% Bootstrap-t UCL	7.265
95% Hall's Bootstrap UCL	7.167	95% Percentile Bootstrap UCL	7.099
95% BCA Bootstrap UCL	7.215		
90% Chebyshev(Mean, Sd) UCL	7.57	95% Chebyshev(Mean, Sd) UCL	8.069

97.5% Chebyshev(Mean, Sd) UCL	8.761	99% Chebyshev(Mean, Sd) UCL	10.12
Suggested UCL to Use			
95% Student's-t UCL	7.078	or 95% Modified-t UCL	7.096
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Uranium			
General Statistics			
Total Number of Observations	120	Number of Distinct Observations	93
		Number of Missing Observations	0
Minimum	5	Mean	60.82
Maximum	459	Median	32.84
SD	76.66	Std. Error of Mean	6.998
Coefficient of Variation	1.26	Skewness	2.611
Normal GOF Test			
Shapiro Wilk Test Statistic	0.692	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.233	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0809	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	72.42	95% Adjusted-CLT UCL (Chen-1995)	74.12
		95% Modified-t UCL (Johnson-1978)	72.7
Gamma GOF Test			
A-D Test Statistic	3.335	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.785	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.127	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0869	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.97	k star (bias corrected MLE)	0.951
Theta hat (MLE)	62.7	Theta star (bias corrected MLE)	63.93
nu hat (MLE)	232.8	nu star (bias corrected)	228.3
MLE Mean (bias corrected)	60.82	MLE Sd (bias corrected)	62.36
		Approximate Chi Square Value (0.05)	194.4
Adjusted Level of Significance	0.048	Adjusted Chi Square Value	194
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	71.46	95% Adjusted Gamma UCL (use when n<50)	71.6
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.929	**Shapiro Wilk Lognormal GOF Test**	

5% Shapiro Wilk P Value	9.0963E-7	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.141	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0809	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.609	Mean of logged Data	3.511
Maximum of Logged Data	6.129	SD of logged Data	1.089
Assuming Lognormal Distribution			
95% H-UCL	76.31	90% Chebyshev (MVUE) UCL	82.31
95% Chebyshev (MVUE) UCL	92.35	97.5% Chebyshev (MVUE) UCL	106.3
99% Chebyshev (MVUE) UCL	133.7		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	72.33	95% Jackknife UCL	72.42
95% Standard Bootstrap UCL	72.11	95% Bootstrap-t UCL	74.83
95% Hall's Bootstrap UCL	74.55	95% Percentile Bootstrap UCL	73.16
95% BCA Bootstrap UCL	74.37		
90% Chebyshev(Mean, Sd) UCL	81.82	95% Chebyshev(Mean, Sd) UCL	91.33
97.5% Chebyshev(Mean, Sd) UCL	104.5	99% Chebyshev(Mean, Sd) UCL	130.5
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	91.33		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Vanadium			
General Statistics			
Total Number of Observations	119	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	35	Mean	38.12
Maximum	122	Median	35
SD	13.34	Std. Error of Mean	1.223
Coefficient of Variation	0.35	Skewness	4.604
Normal GOF Test			
Shapiro Wilk Test Statistic	0.266	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.534	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0812	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	

95% Student's-t UCL	40.15	95% Adjusted-CLT UCL (Chen-1995)	40.68
		95% Modified-t UCL (Johnson-1978)	40.23
Gamma GOF Test			
A-D Test Statistic	41.19	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.751	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.539	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0844	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	15.6	k star (bias corrected MLE)	15.21
Theta hat (MLE)	2.444	Theta star (bias corrected MLE)	2.506
nu hat (MLE)	3713	nu star (bias corrected)	3620
MLE Mean (bias corrected)	38.12	MLE Sd (bias corrected)	9.774
		Approximate Chi Square Value (0.05)	3482
Adjusted Level of Significance	0.048	Adjusted Chi Square Value	3480
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	39.64	95% Adjusted Gamma UCL (use when n<50)	39.66
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.269	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.537	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0812	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	3.555	Mean of logged Data	3.608
Maximum of Logged Data	4.804	SD of logged Data	0.219
Assuming Lognormal Distribution			
95% H-UCL	39.12	90% Chebyshev (MVUE) UCL	40.09
95% Chebyshev (MVUE) UCL	41.13	97.5% Chebyshev (MVUE) UCL	42.57
99% Chebyshev (MVUE) UCL	45.41		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	40.13	95% Jackknife UCL	40.15
95% Standard Bootstrap UCL	40.08	95% Bootstrap-t UCL	41.36
95% Hall's Bootstrap UCL	40.33	95% Percentile Bootstrap UCL	40.28
95% BCA Bootstrap UCL	40.76		
90% Chebyshev(Mean, Sd) UCL	41.79	95% Chebyshev(Mean, Sd) UCL	43.45
97.5% Chebyshev(Mean, Sd) UCL	45.76	99% Chebyshev(Mean, Sd) UCL	50.29
Suggested UCL to Use			
95% Student's-t UCL	40.15	or 95% Modified-t UCL	40.23
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			

and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

UCL Statistics for Uncensored Full Data Sets			
User Selected Options			
Date/Time of Computation	3/11/2015 12:08:25 PM		
From File	Eco2_SWMU15.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
Aluminum			
General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
		Number of Missing Observations	103
Minimum	4160	Mean	7693
Maximum	9250	Median	8310
SD	1395	Std. Error of Mean	420.6
Coefficient of Variation	0.181	Skewness	-1.738
Normal GOF Test			
Shapiro Wilk Test Statistic	0.837	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.85	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.216	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.267	Data appear Normal at 5% Significance Level	
Data appear Approximate Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	8455	95% Adjusted-CLT UCL (Chen-1995)	8149
		95% Modified-t UCL (Johnson-1978)	8418
Gamma GOF Test			
A-D Test Statistic	0.928	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.729	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.225	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.255	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	26.22	k star (bias corrected MLE)	19.13
Theta hat (MLE)	293.4	Theta star (bias corrected MLE)	402.1
nu hat (MLE)	576.9	nu star (bias corrected)	420.9
MLE Mean (bias corrected)	7693	MLE Sd (bias corrected)	1759
		Approximate Chi Square Value (0.05)	374.3
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	367.1
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	8650	95% Adjusted Gamma UCL (use when n<50)	8818
Lognormal GOF Test			

Shapiro Wilk Test Statistic	0.747	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.234	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.267	Data appear Lognormal at 5% Significance Level	
Data appear Approximate Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	8.333	Mean of logged Data	8.929
Maximum of Logged Data	9.132	SD of logged Data	0.22
Assuming Lognormal Distribution			
95% H-UCL	8806	90% Chebyshev (MVUE) UCL	9252
95% Chebyshev (MVUE) UCL	9949	97.5% Chebyshev (MVUE) UCL	10916
99% Chebyshev (MVUE) UCL	12816		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	8385	95% Jackknife UCL	8455
95% Standard Bootstrap UCL	8367	95% Bootstrap-t UCL	8266
95% Hall's Bootstrap UCL	8225	95% Percentile Bootstrap UCL	8285
95% BCA Bootstrap UCL	8203		
90% Chebyshev(Mean, Sd) UCL	8955	95% Chebyshev(Mean, Sd) UCL	9526
97.5% Chebyshev(Mean, Sd) UCL	10320	99% Chebyshev(Mean, Sd) UCL	11878
Suggested UCL to Use			
95% Student's-t UCL	8455		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			
Benzo(a)pyrene			
General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
		Number of Missing Observations	103
Minimum	0.015	Mean	0.686
Maximum	1.6	Median	0.36
SD	0.626	Std. Error of Mean	0.189
Coefficient of Variation	0.913	Skewness	0.36
Normal GOF Test			
Shapiro Wilk Test Statistic	0.847	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data Not Normal at 5% Significance Level	

Lilliefors Test Statistic	0.244	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.267	Data appear Normal at 5% Significance Level	
Data appear Approximate Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1.028	95% Adjusted-CLT UCL (Chen-1995)	1.019
		95% Modified-t UCL (Johnson-1978)	1.032
Gamma GOF Test			
A-D Test Statistic	0.467	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.758	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.208	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.264	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.848	k star (bias corrected MLE)	0.678
Theta hat (MLE)	0.809	Theta star (bias corrected MLE)	1.013
nu hat (MLE)	18.66	nu star (bias corrected)	14.91
MLE Mean (bias corrected)	0.686	MLE Sd (bias corrected)	0.834
		Approximate Chi Square Value (0.05)	7.196
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	6.342
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1.421	95% Adjusted Gamma UCL (use when n<50)	1.612
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.896	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.208	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.267	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-4.2	Mean of logged Data	-1.071
Maximum of Logged Data	0.47	SD of logged Data	1.503
Assuming Lognormal Distribution			
95% H-UCL	7.223	90% Chebyshev (MVUE) UCL	2.188
95% Chebyshev (MVUE) UCL	2.777	97.5% Chebyshev (MVUE) UCL	3.594
99% Chebyshev (MVUE) UCL	5.199		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.997	95% Jackknife UCL	1.028
95% Standard Bootstrap UCL	0.978	95% Bootstrap-t UCL	1.056
95% Hall's Bootstrap UCL	0.944	95% Percentile Bootstrap UCL	0.991
95% BCA Bootstrap UCL	1.011		

90% Chebyshev(Mean, Sd) UCL	1.253	95% Chebyshev(Mean, Sd) UCL	1.509
97.5% Chebyshev(Mean, Sd) UCL	1.865	99% Chebyshev(Mean, Sd) UCL	2.565
Suggested UCL to Use			
95% Student's-t UCL	1.028		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Cobalt			
General Statistics			
Total Number of Observations	11	Number of Distinct Observations	10
		Number of Missing Observations	103
Minimum	7.1	Mean	11.65
Maximum	34.1	Median	8.5
SD	7.928	Std. Error of Mean	2.39
Coefficient of Variation	0.68	Skewness	2.695
Normal GOF Test			
Shapiro Wilk Test Statistic	0.612	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.301	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.267	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	15.99	95% Adjusted-CLT UCL (Chen-1995)	17.66
		95% Modified-t UCL (Johnson-1978)	16.31
Gamma GOF Test			
A-D Test Statistic	1.266	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.733	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.281	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.256	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	4.046	k star (bias corrected MLE)	3.003
Theta hat (MLE)	2.88	Theta star (bias corrected MLE)	3.88
nu hat (MLE)	89.02	nu star (bias corrected)	66.08
MLE Mean (bias corrected)	11.65	MLE Sd (bias corrected)	6.725
		Approximate Chi Square Value (0.05)	48.37
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	45.91
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	15.92	95% Adjusted Gamma UCL (use when n<50)	16.77

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.767	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.85	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.263	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.267	Data appear Lognormal at 5% Significance Level	
Data appear Approximate Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.96	Mean of logged Data	2.327
Maximum of Logged Data	3.529	SD of logged Data	0.472
Assuming Lognormal Distribution			
95% H-UCL	15.77	90% Chebyshev (MVUE) UCL	16.26
95% Chebyshev (MVUE) UCL	18.49	97.5% Chebyshev (MVUE) UCL	21.59
99% Chebyshev (MVUE) UCL	27.68		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	15.59	95% Jackknife UCL	15.99
95% Standard Bootstrap UCL	15.41	95% Bootstrap-t UCL	27.38
95% Hall's Bootstrap UCL	30.67	95% Percentile Bootstrap UCL	16.04
95% BCA Bootstrap UCL	18.58		
90% Chebyshev(Mean, Sd) UCL	18.83	95% Chebyshev(Mean, Sd) UCL	22.07
97.5% Chebyshev(Mean, Sd) UCL	26.58	99% Chebyshev(Mean, Sd) UCL	35.44
Suggested UCL to Use			
95% Student's-t UCL	15.99	or 95% Modified-t UCL	16.31
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Manganese			
General Statistics			
Total Number of Observations	119	Number of Distinct Observations	119
		Number of Missing Observations	0
Minimum	118.6	Mean	576.2
Maximum	2903	Median	444.9
SD	464.2	Std. Error of Mean	42.56
Coefficient of Variation	0.806	Skewness	3.17
Normal GOF Test			
Shapiro Wilk Test Statistic	0.673	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.19	Lilliefors GOF Test	

5% Lilliefors Critical Value	0.0812	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	646.8	95% Adjusted-CLT UCL (Chen-1995)	659.4
		95% Modified-t UCL (Johnson-1978)	648.8
Gamma GOF Test			
A-D Test Statistic	2.56	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.761	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.13	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0853	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.689	k star (bias corrected MLE)	2.627
Theta hat (MLE)	214.3	Theta star (bias corrected MLE)	219.3
nu hat (MLE)	640.1	nu star (bias corrected)	625.3
MLE Mean (bias corrected)	576.2	MLE Sd (bias corrected)	355.5
		Approximate Chi Square Value (0.05)	568.3
Adjusted Level of Significance	0.048	Adjusted Chi Square Value	567.6
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	634	95% Adjusted Gamma UCL (use when n<50)	634.8
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.966	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0.0446	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0873	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0812	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.775	Mean of logged Data	6.159
Maximum of Logged Data	7.974	SD of logged Data	0.592
Assuming Lognormal Distribution			
95% H-UCL	624.7	90% Chebyshev (MVUE) UCL	661.2
95% Chebyshev (MVUE) UCL	705.8	97.5% Chebyshev (MVUE) UCL	767.8
99% Chebyshev (MVUE) UCL	889.6		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	646.2	95% Jackknife UCL	646.8
95% Standard Bootstrap UCL	645.8	95% Bootstrap-t UCL	662.6
95% Hall's Bootstrap UCL	668.2	95% Percentile Bootstrap UCL	648.5
95% BCA Bootstrap UCL	660.4		
90% Chebyshev(Mean, Sd) UCL	703.9	95% Chebyshev(Mean, Sd) UCL	761.7

97.5% Chebyshev(Mean, Sd) UCL	842	99% Chebyshev(Mean, Sd) UCL	999.7
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	761.7		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Zinc			
General Statistics			
Total Number of Observations	119	Number of Distinct Observations	119
		Number of Missing Observations	0
Minimum	21.87	Mean	297.1
Maximum	3169	Median	161.6
SD	443.7	Std. Error of Mean	40.67
Coefficient of Variation	1.493	Skewness	3.841
Normal GOF Test			
Shapiro Wilk Test Statistic	0.589	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.268	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0812	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	364.5	95% Adjusted-CLT UCL (Chen-1995)	379.3
		95% Modified-t UCL (Johnson-1978)	366.9
Gamma GOF Test			
A-D Test Statistic	3.012	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.787	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.106	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0873	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.923	k star (bias corrected MLE)	0.905
Theta hat (MLE)	321.9	Theta star (bias corrected MLE)	328.1
nu hat (MLE)	219.7	nu star (bias corrected)	215.5
MLE Mean (bias corrected)	297.1	MLE Sd (bias corrected)	312.2
		Approximate Chi Square Value (0.05)	182.5
Adjusted Level of Significance	0.048	Adjusted Chi Square Value	182.1
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	350.8	95% Adjusted Gamma UCL (use when n<50)	351.5

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.957	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0.0054	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0909	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0812	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	3.085	Mean of logged Data	5.063
Maximum of Logged Data	8.061	SD of logged Data	1.086
Assuming Lognormal Distribution			
95% H-UCL	358.9	90% Chebyshev (MVUE) UCL	387.1
95% Chebyshev (MVUE) UCL	434.3	97.5% Chebyshev (MVUE) UCL	499.9
99% Chebyshev (MVUE) UCL	628.7		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	364	95% Jackknife UCL	364.5
95% Standard Bootstrap UCL	363.9	95% Bootstrap-t UCL	387.6
95% Hall's Bootstrap UCL	405.2	95% Percentile Bootstrap UCL	367.9
95% BCA Bootstrap UCL	378.8		
90% Chebyshev(Mean, Sd) UCL	419.1	95% Chebyshev(Mean, Sd) UCL	474.4
97.5% Chebyshev(Mean, Sd) UCL	551.1	99% Chebyshev(Mean, Sd) UCL	701.8
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	474.4		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			

UCL Statistics for Uncensored Full Data Sets			
User Selected Options			
Date/Time of Computation	11/20/2015 3:35:25 PM		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
SWMU15_2-Methylnaphthalene			
General Statistics			
Total Number of Observations	11	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	0.052	Mean	0.17
Maximum	0.2	Median	0.18
SD	0.0397	Std. Error of Mean	0.012
Coefficient of Variation	0.234	Skewness	-3.094
Normal GOF Test			
Shapiro Wilk Test Statistic	0.509	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.85	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.462	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.267	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.191	95% Adjusted-CLT UCL (Chen-1995)	0.177
		95% Modified-t UCL (Johnson-1978)	0.19
Gamma GOF Test			
A-D Test Statistic	2.849	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.729	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.489	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.255	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	10.73	k star (bias corrected MLE)	7.866
Theta hat (MLE)	0.0158	Theta star (bias corrected MLE)	0.0216
nu hat (MLE)	236.1	nu star (bias corrected)	173.1
MLE Mean (bias corrected)	0.17	MLE Sd (bias corrected)	0.0605
		Approximate Chi Square Value (0.05)	143.6
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	139.3
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	0.204	95% Adjusted Gamma UCL (use when n<50)	0.211
Lognormal GOF Test			

Shapiro Wilk Test Statistic	0.437	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.491	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.267	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-2.957	Mean of logged Data	-1.821
Maximum of Logged Data	-1.609	SD of logged Data	0.379
Assuming Lognormal Distribution			
95% H-UCL	0.222	90% Chebyshev (MVUE) UCL	0.233
95% Chebyshev (MVUE) UCL	0.26	97.5% Chebyshev (MVUE) UCL	0.297
99% Chebyshev (MVUE) UCL	0.371		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.189	95% Jackknife UCL	0.191
95% Standard Bootstrap UCL	0.188	95% Bootstrap-t UCL	0.185
95% Hall's Bootstrap UCL	0.182	95% Percentile Bootstrap UCL	0.184
95% BCA Bootstrap UCL	0.182		
90% Chebyshev(Mean, Sd) UCL	0.206	95% Chebyshev(Mean, Sd) UCL	0.222
97.5% Chebyshev(Mean, Sd) UCL	0.245	99% Chebyshev(Mean, Sd) UCL	0.289
Suggested UCL to Use			
95% Student's-t UCL	0.191	or 95% Modified-t UCL	0.19
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			

UCL Statistics for Uncensored Full Data Sets			
User Selected Options			
Date/Time of Computation	3/4/2015 4:25:20 PM		
From File	026_UCL95.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

1,2-Dichlorobenzene

General Statistics			
Total Number of Observations	9	Number of Distinct Observations	8
		Number of Missing Observations	53
Minimum	0.0026	Mean	0.19
Maximum	0.365	Median	0.2
SD	0.127	Std. Error of Mean	0.0422
Coefficient of Variation	0.669	Skewness	-0.241

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.87	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.248	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.295	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			

Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.268	95% Adjusted-CLT UCL (Chen-1995)	0.255
		95% Modified-t UCL (Johnson-1978)	0.268

Gamma GOF Test			
A-D Test Statistic	1.387	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.751	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.41	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.289	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics			
k hat (MLE)	0.779	k star (bias corrected MLE)	0.593
Theta hat (MLE)	0.243	Theta star (bias corrected MLE)	0.319
nu hat (MLE)	14.02	nu star (bias corrected)	10.68
MLE Mean (bias corrected)	0.19	MLE Sd (bias corrected)	0.246
		Approximate Chi Square Value (0.05)	4.371
Adjusted Level of Significance	0.0231	Adjusted Chi Square Value	3.56

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.463	95% Adjusted Gamma UCL (use when n<50)	0.569
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.657	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.421	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.295	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-5.952	Mean of logged Data	-2.428
Maximum of Logged Data	-1.008	SD of logged Data	1.945
Assuming Lognormal Distribution			
95% H-UCL	26.88	90% Chebyshev (MVUE) UCL	1.133
95% Chebyshev (MVUE) UCL	1.472	97.5% Chebyshev (MVUE) UCL	1.942
99% Chebyshev (MVUE) UCL	2.867		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.259	95% Jackknife UCL	0.268
95% Standard Bootstrap UCL	0.255	95% Bootstrap-t UCL	0.267
95% Hall's Bootstrap UCL	0.269	95% Percentile Bootstrap UCL	0.251
95% BCA Bootstrap UCL	0.251		
90% Chebyshev(Mean, Sd) UCL	0.316	95% Chebyshev(Mean, Sd) UCL	0.374
97.5% Chebyshev(Mean, Sd) UCL	0.453	99% Chebyshev(Mean, Sd) UCL	0.61
Suggested UCL to Use			
95% Student's-t UCL	0.268		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			
1,3-Dichlorobenzene			
General Statistics			
Total Number of Observations	9	Number of Distinct Observations	8
		Number of Missing Observations	53
Minimum	0.0028	Mean	0.19
Maximum	0.365	Median	0.2
SD	0.127	Std. Error of Mean	0.0422
Coefficient of Variation	0.668	Skewness	-0.24
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.87	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.248	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.295	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.268	95% Adjusted-CLT UCL (Chen-1995)	0.255
		95% Modified-t UCL (Johnson-1978)	0.268
Gamma GOF Test			
A-D Test Statistic	1.387	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.75	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.409	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.289	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.786	k star (bias corrected MLE)	0.598
Theta hat (MLE)	0.241	Theta star (bias corrected MLE)	0.317
nu hat (MLE)	14.15	nu star (bias corrected)	10.77
MLE Mean (bias corrected)	0.19	MLE Sd (bias corrected)	0.245
		Approximate Chi Square Value (0.05)	4.428
Adjusted Level of Significance	0.0231	Adjusted Chi Square Value	3.61
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	0.461	95% Adjusted Gamma UCL (use when n<50)	0.565
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.655	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.42	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.295	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-5.878	Mean of logged Data	-2.419
Maximum of Logged Data	-1.008	SD of logged Data	1.928
Assuming Lognormal Distribution			
95% H-UCL	24.65	90% Chebyshev (MVUE) UCL	1.112
95% Chebyshev (MVUE) UCL	1.444	97.5% Chebyshev (MVUE) UCL	1.904
99% Chebyshev (MVUE) UCL	2.809		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			

95% CLT UCL	0.259	95% Jackknife UCL	0.268
95% Standard Bootstrap UCL	0.254	95% Bootstrap-t UCL	0.263
95% Hall's Bootstrap UCL	0.267	95% Percentile Bootstrap UCL	0.251
95% BCA Bootstrap UCL	0.251		
90% Chebyshev(Mean, Sd) UCL	0.316	95% Chebyshev(Mean, Sd) UCL	0.374
97.5% Chebyshev(Mean, Sd) UCL	0.453	99% Chebyshev(Mean, Sd) UCL	0.61

Suggested UCL to Use

95% Student's-t UCL	0.268		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

1,4-Dichlorobenzene

General Statistics

Total Number of Observations	9	Number of Distinct Observations	8
		Number of Missing Observations	53
Minimum	0.00335	Mean	0.19
Maximum	0.365	Median	0.2
SD	0.127	Std. Error of Mean	0.0422
Coefficient of Variation	0.667	Skewness	-0.237

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.87	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.247	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.295	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.268	95% Adjusted-CLT UCL (Chen-1995)	0.255
		95% Modified-t UCL (Johnson-1978)	0.268

Gamma GOF Test

A-D Test Statistic	1.371	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.749	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.406	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.289	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	0.815	k star (bias corrected MLE)	0.618
Theta hat (MLE)	0.233	Theta star (bias corrected MLE)	0.307
nu hat (MLE)	14.68	nu star (bias corrected)	11.12
MLE Mean (bias corrected)	0.19	MLE Sd (bias corrected)	0.241
		Approximate Chi Square Value (0.05)	4.652
Adjusted Level of Significance	0.0231	Adjusted Chi Square Value	3.809
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	0.453	95% Adjusted Gamma UCL (use when n<50)	0.554
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.656	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.419	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.295	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-5.699	Mean of logged Data	-2.389
Maximum of Logged Data	-1.008	SD of logged Data	1.867
Assuming Lognormal Distribution			
95% H-UCL	18.09	90% Chebyshev (MVUE) UCL	1.039
95% Chebyshev (MVUE) UCL	1.346	97.5% Chebyshev (MVUE) UCL	1.773
99% Chebyshev (MVUE) UCL	2.61		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.259	95% Jackknife UCL	0.268
95% Standard Bootstrap UCL	0.254	95% Bootstrap-t UCL	0.267
95% Hall's Bootstrap UCL	0.274	95% Percentile Bootstrap UCL	0.252
95% BCA Bootstrap UCL	0.251		
90% Chebyshev(Mean, Sd) UCL	0.316	95% Chebyshev(Mean, Sd) UCL	0.374
97.5% Chebyshev(Mean, Sd) UCL	0.453	99% Chebyshev(Mean, Sd) UCL	0.609
Suggested UCL to Use			
95% Student's-t UCL	0.268		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			
Anthracene			
General Statistics			

Total Number of Observations	11	Number of Distinct Observations	9
		Number of Missing Observations	51
Minimum	0.02	Mean	0.223
Maximum	0.365	Median	0.21
SD	0.0917	Std. Error of Mean	0.0277
Coefficient of Variation	0.412	Skewness	-0.516
Normal GOF Test			
Shapiro Wilk Test Statistic	0.887	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.23	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.267	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.273	95% Adjusted-CLT UCL (Chen-1995)	0.264
		95% Modified-t UCL (Johnson-1978)	0.272
Gamma GOF Test			
A-D Test Statistic	1.26	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.733	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.34	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.257	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	3.162	k star (bias corrected MLE)	2.36
Theta hat (MLE)	0.0704	Theta star (bias corrected MLE)	0.0944
nu hat (MLE)	69.56	nu star (bias corrected)	51.92
MLE Mean (bias corrected)	0.223	MLE Sd (bias corrected)	0.145
		Approximate Chi Square Value (0.05)	36.37
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	34.26
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	0.318	95% Adjusted Gamma UCL (use when n<50)	0.337
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.626	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.385	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.267	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-3.912	Mean of logged Data	-1.668
Maximum of Logged Data	-1.008	SD of logged Data	0.78
Assuming Lognormal Distribution			
95% H-UCL	0.485	90% Chebyshev (MVUE) UCL	0.429
95% Chebyshev (MVUE) UCL	0.511	97.5% Chebyshev (MVUE) UCL	0.626
99% Chebyshev (MVUE) UCL	0.851		

Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.268	95% Jackknife UCL	0.273
95% Standard Bootstrap UCL	0.266	95% Bootstrap-t UCL	0.273
95% Hall's Bootstrap UCL	0.272	95% Percentile Bootstrap UCL	0.263
95% BCA Bootstrap UCL	0.261		
90% Chebyshev(Mean, Sd) UCL	0.306	95% Chebyshev(Mean, Sd) UCL	0.343
97.5% Chebyshev(Mean, Sd) UCL	0.395	99% Chebyshev(Mean, Sd) UCL	0.498
Suggested UCL to Use			
95% Student's-t UCL	0.273		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			
Antimony			
General Statistics			
Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	52
Minimum	0.12	Mean	2.173
Maximum	8.95	Median	0.705
SD	2.967	Std. Error of Mean	0.938
Coefficient of Variation	1.365	Skewness	1.618
Normal GOF Test			
Shapiro Wilk Test Statistic	0.746	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.303	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.28	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	3.893	95% Adjusted-CLT UCL (Chen-1995)	4.229
		95% Modified-t UCL (Johnson-1978)	3.973
Gamma GOF Test			
A-D Test Statistic	0.52	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.768	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.187	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.279	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			

k hat (MLE)	0.615	k star (bias corrected MLE)	0.497
Theta hat (MLE)	3.534	Theta star (bias corrected MLE)	4.371
nu hat (MLE)	12.3	nu star (bias corrected)	9.942
MLE Mean (bias corrected)	2.173	MLE Sd (bias corrected)	3.082
		Approximate Chi Square Value (0.05)	3.906
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	3.275
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	5.532	95% Adjusted Gamma UCL (use when n<50)	6.596
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.917	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.169	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.28	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-2.12	Mean of logged Data	-0.225
Maximum of Logged Data	2.192	SD of logged Data	1.577
Assuming Lognormal Distribution			
95% H-UCL	27.72	90% Chebyshev (MVUE) UCL	5.734
95% Chebyshev (MVUE) UCL	7.323	97.5% Chebyshev (MVUE) UCL	9.529
99% Chebyshev (MVUE) UCL	13.86		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	3.716	95% Jackknife UCL	3.893
95% Standard Bootstrap UCL	3.606	95% Bootstrap-t UCL	4.999
95% Hall's Bootstrap UCL	3.86	95% Percentile Bootstrap UCL	3.784
95% BCA Bootstrap UCL	4.154		
90% Chebyshev(Mean, Sd) UCL	4.988	95% Chebyshev(Mean, Sd) UCL	6.263
97.5% Chebyshev(Mean, Sd) UCL	8.032	99% Chebyshev(Mean, Sd) UCL	11.51
Suggested UCL to Use			
95% Adjusted Gamma UCL	6.596		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Arsenic			
General Statistics			
Total Number of Observations	51	Number of Distinct Observations	15
		Number of Missing Observations	22
Minimum	4.66	Mean	13.24
Maximum	160	Median	5

SD	29.32	Std. Error of Mean	4.105
Coefficient of Variation	2.214	Skewness	4.184
Normal GOF Test			
Shapiro Wilk Test Statistic	0.325	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.445	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.124	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	20.12	95% Adjusted-CLT UCL (Chen-1995)	22.56
		95% Modified-t UCL (Johnson-1978)	20.52
Gamma GOF Test			
A-D Test Statistic	13.54	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.785	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.407	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.128	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.895	k star (bias corrected MLE)	0.856
Theta hat (MLE)	14.79	Theta star (bias corrected MLE)	15.47
nu hat (MLE)	91.33	nu star (bias corrected)	87.29
MLE Mean (bias corrected)	13.24	MLE Sd (bias corrected)	14.31
		Approximate Chi Square Value (0.05)	66.75
Adjusted Level of Significance	0.0453	Adjusted Chi Square Value	66.23
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	17.31	95% Adjusted Gamma UCL (use when n<50)	17.45
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.474	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.4	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.124	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.539	Mean of logged Data	1.93
Maximum of Logged Data	5.075	SD of logged Data	0.803
Assuming Lognormal Distribution			
95% H-UCL	12.1	90% Chebyshev (MVUE) UCL	13.01
95% Chebyshev (MVUE) UCL	14.62	97.5% Chebyshev (MVUE) UCL	16.87
99% Chebyshev (MVUE) UCL	21.28		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			

95% CLT UCL	19.99	95% Jackknife UCL	20.12
95% Standard Bootstrap UCL	20.02	95% Bootstrap-t UCL	30.75
95% Hall's Bootstrap UCL	49.85	95% Percentile Bootstrap UCL	20.62
95% BCA Bootstrap UCL	22.94		
90% Chebyshev(Mean, Sd) UCL	25.56	95% Chebyshev(Mean, Sd) UCL	31.13
97.5% Chebyshev(Mean, Sd) UCL	38.88	99% Chebyshev(Mean, Sd) UCL	54.08

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	31.13

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Barium

General Statistics

Total Number of Observations	14	Number of Distinct Observations	14
		Number of Missing Observations	48
Minimum	16.55	Mean	145.9
Maximum	815	Median	82
SD	201.3	Std. Error of Mean	53.79
Coefficient of Variation	1.379	Skewness	3.227

Normal GOF Test

Shapiro Wilk Test Statistic	0.555	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.874	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.335	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.237	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	241.2	95% Adjusted-CLT UCL (Chen-1995)	284
		95% Modified-t UCL (Johnson-1978)	248.9

Gamma GOF Test

A-D Test Statistic	0.837	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.757	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.236	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.234	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.145	k star (bias corrected MLE)	0.947
Theta hat (MLE)	127.4	Theta star (bias corrected MLE)	154
nu hat (MLE)	32.06	nu star (bias corrected)	26.53
MLE Mean (bias corrected)	145.9	MLE Sd (bias corrected)	149.9
		Approximate Chi Square Value (0.05)	15.79
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	14.69

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	245.2	95% Adjusted Gamma UCL (use when n<50)	263.4
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.927	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.169	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.237	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	2.806	Mean of logged Data	4.487
Maximum of Logged Data	6.703	SD of logged Data	0.985
Assuming Lognormal Distribution			
95% H-UCL	307.4	90% Chebyshev (MVUE) UCL	255.5
95% Chebyshev (MVUE) UCL	308.9	97.5% Chebyshev (MVUE) UCL	383
99% Chebyshev (MVUE) UCL	528.6		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	234.4	95% Jackknife UCL	241.2
95% Standard Bootstrap UCL	232.3	95% Bootstrap-t UCL	446.2
95% Hall's Bootstrap UCL	556.1	95% Percentile Bootstrap UCL	243.4
95% BCA Bootstrap UCL	324		
90% Chebyshev(Mean, Sd) UCL	307.3	95% Chebyshev(Mean, Sd) UCL	380.4
97.5% Chebyshev(Mean, Sd) UCL	481.8	99% Chebyshev(Mean, Sd) UCL	681.1
Suggested UCL to Use			
95% H-UCL	307.4		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
ProUCL computes and outputs H-statistic based UCLs for historical reasons only.			
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.			
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.			
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.			
Benzene			
General Statistics			
Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	8
Minimum	6.3000E-4	Mean	0.00199
Maximum	0.00335	Median	0.00199
Warning: This data set only has 2 observations!			

Data set is too small to compute reliable and meaningful statistics and estimates!			
The data set for variable Benzene was not processed!			
It is suggested to collect at least 8 to 10 observations before using these statistical methods!			
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.			
Benzo(a)pyrene			
General Statistics			
Total Number of Observations	11	Number of Distinct Observations	10
		Number of Missing Observations	51
Minimum	0.00205	Mean	0.827
Maximum	7.2	Median	0.24
SD	2.117	Std. Error of Mean	0.638
Coefficient of Variation	2.562	Skewness	3.296
Normal GOF Test			
Shapiro Wilk Test Statistic	0.399	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.495	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.267	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1.984	95% Adjusted-CLT UCL (Chen-1995)	2.555
		95% Modified-t UCL (Johnson-1978)	2.089
Gamma GOF Test			
A-D Test Statistic	1.192	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.804	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.364	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.273	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.382	k star (bias corrected MLE)	0.338
Theta hat (MLE)	2.165	Theta star (bias corrected MLE)	2.443
nu hat (MLE)	8.399	nu star (bias corrected)	7.442
MLE Mean (bias corrected)	0.827	MLE Sd (bias corrected)	1.421
		Approximate Chi Square Value (0.05)	2.416
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	1.976
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	2.546	95% Adjusted Gamma UCL (use when n<50)	3.113
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.882	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.257	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.267	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-6.19	Mean of logged Data	-1.927
Maximum of Logged Data	1.974	SD of logged Data	2.089
Assuming Lognormal Distribution			
95% H-UCL	44.35	90% Chebyshev (MVUE) UCL	2.473
95% Chebyshev (MVUE) UCL	3.218	97.5% Chebyshev (MVUE) UCL	4.252
99% Chebyshev (MVUE) UCL	6.282		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1.877	95% Jackknife UCL	1.984
95% Standard Bootstrap UCL	1.841	95% Bootstrap-t UCL	14.5
95% Hall's Bootstrap UCL	10.38	95% Percentile Bootstrap UCL	2.08
95% BCA Bootstrap UCL	2.72		
90% Chebyshev(Mean, Sd) UCL	2.742	95% Chebyshev(Mean, Sd) UCL	3.609
97.5% Chebyshev(Mean, Sd) UCL	4.813	99% Chebyshev(Mean, Sd) UCL	7.179
Suggested UCL to Use			
99% Chebyshev (Mean, Sd) UCL	7.179		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Beryllium			
General Statistics			
Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	52
Minimum	0.37	Mean	2.233
Maximum	15.7	Median	0.598
SD	4.759	Std. Error of Mean	1.505
Coefficient of Variation	2.132	Skewness	3.098
Normal GOF Test			
Shapiro Wilk Test Statistic	0.442	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.411	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.28	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	4.992	95% Adjusted-CLT UCL (Chen-1995)	6.284
		95% Modified-t UCL (Johnson-1978)	5.237

Gamma GOF Test			
A-D Test Statistic	1.828	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.765	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.368	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.278	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.647	k star (bias corrected MLE)	0.52
Theta hat (MLE)	3.451	Theta star (bias corrected MLE)	4.298
nu hat (MLE)	12.94	nu star (bias corrected)	10.39
MLE Mean (bias corrected)	2.233	MLE Sd (bias corrected)	3.098
		Approximate Chi Square Value (0.05)	4.188
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	3.53
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	5.54	95% Adjusted Gamma UCL (use when n<50)	6.573
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.726	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.28	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.28	Data appear Lognormal at 5% Significance Level	
Data appear Approximate Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-0.994	Mean of logged Data	-0.141
Maximum of Logged Data	2.754	SD of logged Data	1.137
Assuming Lognormal Distribution			
95% H-UCL	5.989	90% Chebyshev (MVUE) UCL	3.229
95% Chebyshev (MVUE) UCL	4.007	97.5% Chebyshev (MVUE) UCL	5.086
99% Chebyshev (MVUE) UCL	7.208		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	4.708	95% Jackknife UCL	4.992
95% Standard Bootstrap UCL	4.555	95% Bootstrap-t UCL	48.18
95% Hall's Bootstrap UCL	22.81	95% Percentile Bootstrap UCL	5.154
95% BCA Bootstrap UCL	6.741		
90% Chebyshev(Mean, Sd) UCL	6.748	95% Chebyshev(Mean, Sd) UCL	8.793
97.5% Chebyshev(Mean, Sd) UCL	11.63	99% Chebyshev(Mean, Sd) UCL	17.21
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	8.793		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			

Cadmium			
General Statistics			
Total Number of Observations	14	Number of Distinct Observations	11
		Number of Missing Observations	48
Minimum	0.039	Mean	1.227
Maximum	4.45	Median	0.89
SD	1.295	Std. Error of Mean	0.346
Coefficient of Variation	1.056	Skewness	1.357
Normal GOF Test			
Shapiro Wilk Test Statistic	0.824	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.874	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.284	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.237	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1.84	95% Adjusted-CLT UCL (Chen-1995)	1.93
		95% Modified-t UCL (Johnson-1978)	1.861
Gamma GOF Test			
A-D Test Statistic	0.39	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.769	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.15	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.237	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.794	k star (bias corrected MLE)	0.671
Theta hat (MLE)	1.546	Theta star (bias corrected MLE)	1.828
nu hat (MLE)	22.22	nu star (bias corrected)	18.79
MLE Mean (bias corrected)	1.227	MLE Sd (bias corrected)	1.497
		Approximate Chi Square Value (0.05)	9.966
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	9.123
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	2.313	95% Adjusted Gamma UCL (use when n<50)	2.527
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.914	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.223	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.237	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-3.244	Mean of logged Data	-0.544
Maximum of Logged Data	1.493	SD of logged Data	1.503
Assuming Lognormal Distribution			

95% H-UCL	8.383	90% Chebyshev (MVUE) UCL	3.667
95% Chebyshev (MVUE) UCL	4.623	97.5% Chebyshev (MVUE) UCL	5.951
99% Chebyshev (MVUE) UCL	8.559		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1.796	95% Jackknife UCL	1.84
95% Standard Bootstrap UCL	1.76	95% Bootstrap-t UCL	2.095
95% Hall's Bootstrap UCL	2.027	95% Percentile Bootstrap UCL	1.795
95% BCA Bootstrap UCL	1.894		
90% Chebyshev(Mean, Sd) UCL	2.265	95% Chebyshev(Mean, Sd) UCL	2.735
97.5% Chebyshev(Mean, Sd) UCL	3.388	99% Chebyshev(Mean, Sd) UCL	4.67
Suggested UCL to Use			
95% Adjusted Gamma UCL	2.527		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Chromium			
General Statistics			
Total Number of Observations	51	Number of Distinct Observations	19
		Number of Missing Observations	22
Minimum	2.565	Mean	18.75
Maximum	113	Median	6
SD	26.32	Std. Error of Mean	3.686
Coefficient of Variation	1.404	Skewness	2.213
Normal GOF Test			
Shapiro Wilk Test Statistic	0.575	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.366	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.124	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	24.93	95% Adjusted-CLT UCL (Chen-1995)	26.04
		95% Modified-t UCL (Johnson-1978)	25.12
Gamma GOF Test			
A-D Test Statistic	8.577	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.781	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.389	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.128	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics			
k hat (MLE)	0.972	k star (bias corrected MLE)	0.928
Theta hat (MLE)	19.3	Theta star (bias corrected MLE)	20.22
nu hat (MLE)	99.1	nu star (bias corrected)	94.61
MLE Mean (bias corrected)	18.75	MLE Sd (bias corrected)	19.47
		Approximate Chi Square Value (0.05)	73.17
Adjusted Level of Significance	0.0453	Adjusted Chi Square Value	72.63
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	24.25	95% Adjusted Gamma UCL (use when n<50)	24.43
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.686	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	2.426E-13	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.381	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.124	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.942	Mean of logged Data	2.335
Maximum of Logged Data	4.727	SD of logged Data	0.961
Assuming Lognormal Distribution			
95% H-UCL	22.31	90% Chebyshev (MVUE) UCL	23.81
95% Chebyshev (MVUE) UCL	27.26	97.5% Chebyshev (MVUE) UCL	32.05
99% Chebyshev (MVUE) UCL	41.46		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	24.82	95% Jackknife UCL	24.93
95% Standard Bootstrap UCL	24.73	95% Bootstrap-t UCL	26.68
95% Hall's Bootstrap UCL	26.04	95% Percentile Bootstrap UCL	24.81
95% BCA Bootstrap UCL	26.6		
90% Chebyshev(Mean, Sd) UCL	29.81	95% Chebyshev(Mean, Sd) UCL	34.82
97.5% Chebyshev(Mean, Sd) UCL	41.77	99% Chebyshev(Mean, Sd) UCL	55.43
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	34.82		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Copper			
General Statistics			
Total Number of Observations	47	Number of Distinct Observations	38
		Number of Missing Observations	26
Minimum	2	Mean	62.38

Maximum	220	Median	48
SD	45.94	Std. Error of Mean	6.701
Coefficient of Variation	0.736	Skewness	1.952
Normal GOF Test			
Shapiro Wilk Test Statistic	0.79	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.946	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.236	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.129	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	73.63	95% Adjusted-CLT UCL (Chen-1995)	75.44
		95% Modified-t UCL (Johnson-1978)	73.95
Gamma GOF Test			
A-D Test Statistic	1.336	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.761	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.152	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.131	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.178	k star (bias corrected MLE)	2.053
Theta hat (MLE)	28.64	Theta star (bias corrected MLE)	30.39
nu hat (MLE)	204.7	nu star (bias corrected)	193
MLE Mean (bias corrected)	62.38	MLE Sd (bias corrected)	43.54
		Approximate Chi Square Value (0.05)	161.8
Adjusted Level of Significance	0.0449	Adjusted Chi Square Value	160.9
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	74.38	95% Adjusted Gamma UCL (use when n<50)	74.8
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.89	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.946	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.16	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.129	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.693	Mean of logged Data	3.886
Maximum of Logged Data	5.394	SD of logged Data	0.787
Assuming Lognormal Distribution			
95% H-UCL	84.92	90% Chebyshev (MVUE) UCL	91.16
95% Chebyshev (MVUE) UCL	102.6	97.5% Chebyshev (MVUE) UCL	118.5
99% Chebyshev (MVUE) UCL	149.7		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			

Nonparametric Distribution Free UCLs			
95% CLT UCL	73.4	95% Jackknife UCL	73.63
95% Standard Bootstrap UCL	73.49	95% Bootstrap-t UCL	77.24
95% Hall's Bootstrap UCL	76.57	95% Percentile Bootstrap UCL	73.84
95% BCA Bootstrap UCL	75.63		
90% Chebyshev(Mean, Sd) UCL	82.48	95% Chebyshev(Mean, Sd) UCL	91.59
97.5% Chebyshev(Mean, Sd) UCL	104.2	99% Chebyshev(Mean, Sd) UCL	129.1
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	91.59		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Ethylbenzene			
General Statistics			
Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	8
Minimum	0.001	Mean	0.00218
Maximum	0.00335	Median	0.00218
Warning: This data set only has 2 observations!			
Data set is too small to compute reliable and meaningful statistics and estimates!			
The data set for variable Ethylbenzene was not processed!			
It is suggested to collect at least 8 to 10 observations before using these statistical methods!			
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.			
Fluoranthene			
General Statistics			
Total Number of Observations	11	Number of Distinct Observations	10
		Number of Missing Observations	51
Minimum	0.02	Mean	0.345
Maximum	0.84	Median	0.25
SD	0.243	Std. Error of Mean	0.0732
Coefficient of Variation	0.703	Skewness	1.142
Normal GOF Test			
Shapiro Wilk Test Statistic	0.872	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.21	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.267	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	

95% Student's-t UCL	0.478	95% Adjusted-CLT UCL (Chen-1995)	0.493
		95% Modified-t UCL (Johnson-1978)	0.482
Gamma GOF Test			
A-D Test Statistic	0.489	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.74	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.208	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.259	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.805	k star (bias corrected MLE)	1.373
Theta hat (MLE)	0.191	Theta star (bias corrected MLE)	0.251
nu hat (MLE)	39.71	nu star (bias corrected)	30.22
MLE Mean (bias corrected)	0.345	MLE Sd (bias corrected)	0.295
		Approximate Chi Square Value (0.05)	18.66
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	17.2
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	0.559	95% Adjusted Gamma UCL (use when n<50)	0.607
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.819	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.27	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.267	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-3.912	Mean of logged Data	-1.365
Maximum of Logged Data	-0.174	SD of logged Data	0.981
Assuming Lognormal Distribution			
95% H-UCL	1.036	90% Chebyshev (MVUE) UCL	0.756
95% Chebyshev (MVUE) UCL	0.922	97.5% Chebyshev (MVUE) UCL	1.152
99% Chebyshev (MVUE) UCL	1.604		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.466	95% Jackknife UCL	0.478
95% Standard Bootstrap UCL	0.461	95% Bootstrap-t UCL	0.577
95% Hall's Bootstrap UCL	1.359	95% Percentile Bootstrap UCL	0.468
95% BCA Bootstrap UCL	0.476		
90% Chebyshev(Mean, Sd) UCL	0.565	95% Chebyshev(Mean, Sd) UCL	0.664
97.5% Chebyshev(Mean, Sd) UCL	0.802	99% Chebyshev(Mean, Sd) UCL	1.074
Suggested UCL to Use			
95% Student's-t UCL	0.478		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			

and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Lead			
General Statistics			
Total Number of Observations	51	Number of Distinct Observations	21
		Number of Missing Observations	22
Minimum	1.5	Mean	39.63
Maximum	297	Median	1.5
SD	78.8	Std. Error of Mean	11.03
Coefficient of Variation	1.988	Skewness	2.144
Normal GOF Test			
Shapiro Wilk Test Statistic	0.549	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.383	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.124	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	58.13	95% Adjusted-CLT UCL (Chen-1995)	61.32
		95% Modified-t UCL (Johnson-1978)	58.68
Gamma GOF Test			
A-D Test Statistic	6.912	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.849	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.327	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.134	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.356	k star (bias corrected MLE)	0.348
Theta hat (MLE)	111.4	Theta star (bias corrected MLE)	113.9
nu hat (MLE)	36.28	nu star (bias corrected)	35.48
MLE Mean (bias corrected)	39.63	MLE Sd (bias corrected)	67.2
		Approximate Chi Square Value (0.05)	22.85
Adjusted Level of Significance	0.0453	Adjusted Chi Square Value	22.56
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	61.54	95% Adjusted Gamma UCL (use when n<50)	62.34
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.722	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	5.332E-12	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.339	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.124	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.405	Mean of logged Data	1.794

Maximum of Logged Data	5.694	SD of logged Data	1.879
Assuming Lognormal Distribution			
95% H-UCL	86.16	90% Chebyshev (MVUE) UCL	68.72
95% Chebyshev (MVUE) UCL	85.26	97.5% Chebyshev (MVUE) UCL	108.2
99% Chebyshev (MVUE) UCL	153.3		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	57.78	95% Jackknife UCL	58.13
95% Standard Bootstrap UCL	57.9	95% Bootstrap-t UCL	63.07
95% Hall's Bootstrap UCL	59.83	95% Percentile Bootstrap UCL	58.33
95% BCA Bootstrap UCL	60.99		
90% Chebyshev(Mean, Sd) UCL	72.74	95% Chebyshev(Mean, Sd) UCL	87.73
97.5% Chebyshev(Mean, Sd) UCL	108.5	99% Chebyshev(Mean, Sd) UCL	149.4
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	87.73		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Mercury			
General Statistics			
Total Number of Observations	51	Number of Distinct Observations	8
		Number of Missing Observations	22
Minimum	0.0206	Mean	16.51
Maximum	20	Median	20
SD	7.622	Std. Error of Mean	1.067
Coefficient of Variation	0.462	Skewness	-1.75
Normal GOF Test			
Shapiro Wilk Test Statistic	0.459	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.5	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.124	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	18.3	95% Adjusted-CLT UCL (Chen-1995)	17.98
		95% Modified-t UCL (Johnson-1978)	18.25
Gamma GOF Test			
A-D Test Statistic	14.9	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.79	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.531	**Kolmogrov-Smirnoff Gamma GOF Test**	

5% K-S Critical Value	0.129	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.819	k star (bias corrected MLE)	0.784
Theta hat (MLE)	20.15	Theta star (bias corrected MLE)	21.06
nu hat (MLE)	83.55	nu star (bias corrected)	79.96
MLE Mean (bias corrected)	16.51	MLE Sd (bias corrected)	18.64
		Approximate Chi Square Value (0.05)	60.36
Adjusted Level of Significance	0.0453	Adjusted Chi Square Value	59.86
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	21.87	95% Adjusted Gamma UCL (use when n<50)	22.05
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.49	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.496	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.124	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-3.882	Mean of logged Data	2.081
Maximum of Logged Data	2.996	SD of logged Data	2.045
Assuming Lognormal Distribution			
95% H-UCL	183.6	90% Chebyshev (MVUE) UCL	131.2
95% Chebyshev (MVUE) UCL	164.5	97.5% Chebyshev (MVUE) UCL	210.6
99% Chebyshev (MVUE) UCL	301.1		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	18.26	95% Jackknife UCL	18.3
95% Standard Bootstrap UCL	18.22	95% Bootstrap-t UCL	17.88
95% Hall's Bootstrap UCL	18.07	95% Percentile Bootstrap UCL	18.06
95% BCA Bootstrap UCL	18.06		
90% Chebyshev(Mean, Sd) UCL	19.71	95% Chebyshev(Mean, Sd) UCL	21.16
97.5% Chebyshev(Mean, Sd) UCL	23.17	99% Chebyshev(Mean, Sd) UCL	27.13
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	21.16		
Recommended UCL exceeds the maximum observation			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			

Molybdenum			
General Statistics			
Total Number of Observations	44	Number of Distinct Observations	8
		Number of Missing Observations	29
Minimum	1.5	Mean	6.905
Maximum	78	Median	1.5
SD	17.03	Std. Error of Mean	2.567
Coefficient of Variation	2.466	Skewness	3.187
Normal GOF Test			
Shapiro Wilk Test Statistic	0.365	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.944	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.497	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.134	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	11.22	95% Adjusted-CLT UCL (Chen-1995)	12.44
		95% Modified-t UCL (Johnson-1978)	11.43
Gamma GOF Test			
A-D Test Statistic	13.84	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.809	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.505	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.141	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.549	k star (bias corrected MLE)	0.526
Theta hat (MLE)	12.59	Theta star (bias corrected MLE)	13.12
nu hat (MLE)	48.28	nu star (bias corrected)	46.32
MLE Mean (bias corrected)	6.905	MLE Sd (bias corrected)	9.518
		Approximate Chi Square Value (0.05)	31.71
Adjusted Level of Significance	0.0445	Adjusted Chi Square Value	31.3
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	10.09	95% Adjusted Gamma UCL (use when n<50)	10.22
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.397	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.944	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.48	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.134	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.405	Mean of logged Data	0.791
Maximum of Logged Data	4.357	SD of logged Data	1.082

Assuming Lognormal Distribution			
95% H-UCL	5.946	90% Chebyshev (MVUE) UCL	6.15
95% Chebyshev (MVUE) UCL	7.178	97.5% Chebyshev (MVUE) UCL	8.604
99% Chebyshev (MVUE) UCL	11.41		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	11.13	95% Jackknife UCL	11.22
95% Standard Bootstrap UCL	10.97	95% Bootstrap-t UCL	15.24
95% Hall's Bootstrap UCL	10.65	95% Percentile Bootstrap UCL	11.64
95% BCA Bootstrap UCL	13.31		
90% Chebyshev(Mean, Sd) UCL	14.61	95% Chebyshev(Mean, Sd) UCL	18.09
97.5% Chebyshev(Mean, Sd) UCL	22.93	99% Chebyshev(Mean, Sd) UCL	32.44
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	18.09		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Naphthalene			
General Statistics			
Total Number of Observations	11	Number of Distinct Observations	9
		Number of Missing Observations	51
Minimum	0.02	Mean	0.269
Maximum	0.72	Median	0.24
SD	0.175	Std. Error of Mean	0.0529
Coefficient of Variation	0.652	Skewness	1.717
Normal GOF Test			
Shapiro Wilk Test Statistic	0.814	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.271	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.267	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.365	95% Adjusted-CLT UCL (Chen-1995)	0.385
		95% Modified-t UCL (Johnson-1978)	0.37
Gamma GOF Test			
A-D Test Statistic	0.809	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.738	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.281	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.258	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics			
k hat (MLE)	2.205	k star (bias corrected MLE)	1.664
Theta hat (MLE)	0.122	Theta star (bias corrected MLE)	0.162
nu hat (MLE)	48.51	nu star (bias corrected)	36.61
MLE Mean (bias corrected)	0.269	MLE Sd (bias corrected)	0.209
		Approximate Chi Square Value (0.05)	23.76
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	22.09
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	0.415	95% Adjusted Gamma UCL (use when n<50)	0.446
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.762	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.85	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.338	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.267	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-3.912	Mean of logged Data	-1.556
Maximum of Logged Data	-0.329	SD of logged Data	0.879
Assuming Lognormal Distribution			
95% H-UCL	0.671	90% Chebyshev (MVUE) UCL	0.545
95% Chebyshev (MVUE) UCL	0.657	97.5% Chebyshev (MVUE) UCL	0.814
99% Chebyshev (MVUE) UCL	1.12		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.356	95% Jackknife UCL	0.365
95% Standard Bootstrap UCL	0.35	95% Bootstrap-t UCL	0.424
95% Hall's Bootstrap UCL	0.845	95% Percentile Bootstrap UCL	0.36
95% BCA Bootstrap UCL	0.389		
90% Chebyshev(Mean, Sd) UCL	0.428	95% Chebyshev(Mean, Sd) UCL	0.5
97.5% Chebyshev(Mean, Sd) UCL	0.599	99% Chebyshev(Mean, Sd) UCL	0.795
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	0.5		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Nickel			
General Statistics			
Total Number of Observations	49	Number of Distinct Observations	37
		Number of Missing Observations	24

Minimum	2	Mean	41.45
Maximum	203	Median	26
SD	40.02	Std. Error of Mean	5.718
Coefficient of Variation	0.966	Skewness	2.674
Normal GOF Test			
Shapiro Wilk Test Statistic	0.678	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.947	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.24	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.127	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	51.04	95% Adjusted-CLT UCL (Chen-1995)	53.19
		95% Modified-t UCL (Johnson-1978)	51.41
Gamma GOF Test			
A-D Test Statistic	2.049	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.764	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.163	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.128	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.797	k star (bias corrected MLE)	1.701
Theta hat (MLE)	23.07	Theta star (bias corrected MLE)	24.38
nu hat (MLE)	176.1	nu star (bias corrected)	166.6
MLE Mean (bias corrected)	41.45	MLE Sd (bias corrected)	31.79
		Approximate Chi Square Value (0.05)	137.8
Adjusted Level of Significance	0.0451	Adjusted Chi Square Value	137
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	50.13	95% Adjusted Gamma UCL (use when n<50)	50.42
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.934	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.947	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.122	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.127	Data appear Lognormal at 5% Significance Level	
Data appear Approximate Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.693	Mean of logged Data	3.421
Maximum of Logged Data	5.313	SD of logged Data	0.775
Assuming Lognormal Distribution			
95% H-UCL	52.3	90% Chebyshev (MVUE) UCL	56.14
95% Chebyshev (MVUE) UCL	63	97.5% Chebyshev (MVUE) UCL	72.52
99% Chebyshev (MVUE) UCL	91.22		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			

Nonparametric Distribution Free UCLs			
95% CLT UCL	50.86	95% Jackknife UCL	51.04
95% Standard Bootstrap UCL	50.58	95% Bootstrap-t UCL	56.01
95% Hall's Bootstrap UCL	56.28	95% Percentile Bootstrap UCL	51.11
95% BCA Bootstrap UCL	54.31		
90% Chebyshev(Mean, Sd) UCL	58.61	95% Chebyshev(Mean, Sd) UCL	66.38
97.5% Chebyshev(Mean, Sd) UCL	77.16	99% Chebyshev(Mean, Sd) UCL	98.35
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	66.38		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
PCB, Total			
General Statistics			
Total Number of Observations	73	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	0.022	Mean	1.532
Maximum	2.5	Median	2.5
SD	1.144	Std. Error of Mean	0.134
Coefficient of Variation	0.747	Skewness	-0.356
Normal GOF Test			
Shapiro Wilk Test Statistic	0.65	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.377	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.104	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1.755	95% Adjusted-CLT UCL (Chen-1995)	1.746
		95% Modified-t UCL (Johnson-1978)	1.754
Gamma GOF Test			
A-D Test Statistic	9.949	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.789	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.375	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.108	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.823	k star (bias corrected MLE)	0.798
Theta hat (MLE)	1.861	Theta star (bias corrected MLE)	1.919
nu hat (MLE)	120.1	nu star (bias corrected)	116.5
MLE Mean (bias corrected)	1.532	MLE Sd (bias corrected)	1.714
		Approximate Chi Square Value (0.05)	92.61

Adjusted Level of Significance	0.0467	Adjusted Chi Square Value	92.18
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1.927	95% Adjusted Gamma UCL (use when n<50)	1.936
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.72	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.36	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.104	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-3.817	Mean of logged Data	-0.292
Maximum of Logged Data	0.916	SD of logged Data	1.531
Assuming Lognormal Distribution			
95% H-UCL	4.019	90% Chebyshev (MVUE) UCL	4.054
95% Chebyshev (MVUE) UCL	4.834	97.5% Chebyshev (MVUE) UCL	5.917
99% Chebyshev (MVUE) UCL	8.045		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1.752	95% Jackknife UCL	1.755
95% Standard Bootstrap UCL	1.751	95% Bootstrap-t UCL	1.75
95% Hall's Bootstrap UCL	1.737	95% Percentile Bootstrap UCL	1.742
95% BCA Bootstrap UCL	1.722		
90% Chebyshev(Mean, Sd) UCL	1.933	95% Chebyshev(Mean, Sd) UCL	2.115
97.5% Chebyshev(Mean, Sd) UCL	2.368	99% Chebyshev(Mean, Sd) UCL	2.864
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	2.115		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			
Phenanthrene			
General Statistics			
Total Number of Observations	11	Number of Distinct Observations	10
		Number of Missing Observations	51
Minimum	0.02	Mean	0.35
Maximum	0.79	Median	0.25
SD	0.239	Std. Error of Mean	0.0721
Coefficient of Variation	0.683	Skewness	0.76

Normal GOF Test			
Shapiro Wilk Test Statistic	0.912	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.208	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.267	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.481	95% Adjusted-CLT UCL (Chen-1995)	0.487
		95% Modified-t UCL (Johnson-1978)	0.484
Gamma GOF Test			
A-D Test Statistic	0.38	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.74	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.206	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.259	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.764	k star (bias corrected MLE)	1.343
Theta hat (MLE)	0.199	Theta star (bias corrected MLE)	0.261
nu hat (MLE)	38.8	nu star (bias corrected)	29.55
MLE Mean (bias corrected)	0.35	MLE Sd (bias corrected)	0.302
		Approximate Chi Square Value (0.05)	18.14
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	16.7
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	0.571	95% Adjusted Gamma UCL (use when n<50)	0.62
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.834	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.27	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.267	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-3.912	Mean of logged Data	-1.358
Maximum of Logged Data	-0.236	SD of logged Data	0.998
Assuming Lognormal Distribution			
95% H-UCL	1.09	90% Chebyshev (MVUE) UCL	0.779
95% Chebyshev (MVUE) UCL	0.952	97.5% Chebyshev (MVUE) UCL	1.191
99% Chebyshev (MVUE) UCL	1.662		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.469	95% Jackknife UCL	0.481
95% Standard Bootstrap UCL	0.461	95% Bootstrap-t UCL	0.516

95% Hall's Bootstrap UCL	0.507	95% Percentile Bootstrap UCL	0.465
95% BCA Bootstrap UCL	0.482		
90% Chebyshev(Mean, Sd) UCL	0.567	95% Chebyshev(Mean, Sd) UCL	0.665
97.5% Chebyshev(Mean, Sd) UCL	0.801	99% Chebyshev(Mean, Sd) UCL	1.068

Suggested UCL to Use

95% Student's-t UCL	0.481

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Pyrene

General Statistics

Total Number of Observations	11	Number of Distinct Observations	10
		Number of Missing Observations	51
Minimum	0.02	Mean	0.332
Maximum	0.71	Median	0.25
SD	0.205	Std. Error of Mean	0.0617
Coefficient of Variation	0.616	Skewness	0.696

Normal GOF Test

Shapiro Wilk Test Statistic	0.925	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.85	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.202	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.267	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.444	95% Adjusted-CLT UCL (Chen-1995)	0.448
		95% Modified-t UCL (Johnson-1978)	0.446

Gamma GOF Test

A-D Test Statistic	0.478	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.739	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.204	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.259	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.996	k star (bias corrected MLE)	1.512
Theta hat (MLE)	0.166	Theta star (bias corrected MLE)	0.22
nu hat (MLE)	43.91	nu star (bias corrected)	33.27
MLE Mean (bias corrected)	0.332	MLE Sd (bias corrected)	0.27
		Approximate Chi Square Value (0.05)	21.08
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	19.51

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.524	95% Adjusted Gamma UCL (use when n<50)	0.567

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.793	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.269	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.267	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-3.912	Mean of logged Data	-1.373
Maximum of Logged Data	-0.342	SD of logged Data	0.956
Assuming Lognormal Distribution			
95% H-UCL	0.965	90% Chebyshev (MVUE) UCL	0.725
95% Chebyshev (MVUE) UCL	0.882	97.5% Chebyshev (MVUE) UCL	1.099
99% Chebyshev (MVUE) UCL	1.526		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.434	95% Jackknife UCL	0.444
95% Standard Bootstrap UCL	0.427	95% Bootstrap-t UCL	0.474
95% Hall's Bootstrap UCL	0.513	95% Percentile Bootstrap UCL	0.434
95% BCA Bootstrap UCL	0.436		
90% Chebyshev(Mean, Sd) UCL	0.517	95% Chebyshev(Mean, Sd) UCL	0.601
97.5% Chebyshev(Mean, Sd) UCL	0.718	99% Chebyshev(Mean, Sd) UCL	0.946
Suggested UCL to Use			
95% Student's-t UCL	0.444		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Selenium			
General Statistics			
Total Number of Observations	51	Number of Distinct Observations	11
		Number of Missing Observations	22
Minimum	0.1	Mean	2.646
Maximum	13.6	Median	1.5
SD	3.053	Std. Error of Mean	0.427
Coefficient of Variation	1.154	Skewness	2.448
Normal GOF Test			
Shapiro Wilk Test Statistic	0.501	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.489	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.124	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			

Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	3.362	95% Adjusted-CLT UCL (Chen-1995)	3.505
		95% Modified-t UCL (Johnson-1978)	3.387
Gamma GOF Test			
A-D Test Statistic	11.32	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.768	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.476	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.127	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.471	k star (bias corrected MLE)	1.397
Theta hat (MLE)	1.799	Theta star (bias corrected MLE)	1.893
nu hat (MLE)	150	nu star (bias corrected)	142.5
MLE Mean (bias corrected)	2.646	MLE Sd (bias corrected)	2.238
		Approximate Chi Square Value (0.05)	115.9
Adjusted Level of Significance	0.0453	Adjusted Chi Square Value	115.2
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	3.252	95% Adjusted Gamma UCL (use when n<50)	3.272
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.624	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	1.443E-15	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.435	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.124	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-2.303	Mean of logged Data	0.596
Maximum of Logged Data	2.61	SD of logged Data	0.819
Assuming Lognormal Distribution			
95% H-UCL	3.249	90% Chebyshev (MVUE) UCL	3.491
95% Chebyshev (MVUE) UCL	3.933	97.5% Chebyshev (MVUE) UCL	4.546
99% Chebyshev (MVUE) UCL	5.75		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	3.349	95% Jackknife UCL	3.362
95% Standard Bootstrap UCL	3.346	95% Bootstrap-t UCL	3.624
95% Hall's Bootstrap UCL	3.401	95% Percentile Bootstrap UCL	3.345
95% BCA Bootstrap UCL	3.471		
90% Chebyshev(Mean, Sd) UCL	3.928	95% Chebyshev(Mean, Sd) UCL	4.509
97.5% Chebyshev(Mean, Sd) UCL	5.315	99% Chebyshev(Mean, Sd) UCL	6.899
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	4.509		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Silver			
General Statistics			
Total Number of Observations	51	Number of Distinct Observations	10
		Number of Missing Observations	22
Minimum	0.1	Mean	21.11
Maximum	25	Median	25
SD	8.619	Std. Error of Mean	1.207
Coefficient of Variation	0.408	Skewness	-1.86
Normal GOF Test			
Shapiro Wilk Test Statistic	0.474	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.497	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.124	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	23.14	95% Adjusted-CLT UCL (Chen-1995)	22.76
		95% Modified-t UCL (Johnson-1978)	23.08
Gamma GOF Test			
A-D Test Statistic	13.74	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.767	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.509	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.126	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.568	k star (bias corrected MLE)	1.489
Theta hat (MLE)	13.46	Theta star (bias corrected MLE)	14.18
nu hat (MLE)	159.9	nu star (bias corrected)	151.9
MLE Mean (bias corrected)	21.11	MLE Sd (bias corrected)	17.3
		Approximate Chi Square Value (0.05)	124.4
Adjusted Level of Significance	0.0453	Adjusted Chi Square Value	123.7
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	25.78	95% Adjusted Gamma UCL (use when n<50)	25.93
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.476	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.481	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.124	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			

Lognormal Statistics			
Minimum of Logged Data	-2.303	Mean of logged Data	2.698
Maximum of Logged Data	3.219	SD of logged Data	1.279
Assuming Lognormal Distribution			
95% H-UCL	54.03	90% Chebyshev (MVUE) UCL	54.95
95% Chebyshev (MVUE) UCL	65.01	97.5% Chebyshev (MVUE) UCL	78.97
99% Chebyshev (MVUE) UCL	106.4		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	23.1	95% Jackknife UCL	23.14
95% Standard Bootstrap UCL	23.08	95% Bootstrap-t UCL	22.86
95% Hall's Bootstrap UCL	22.81	95% Percentile Bootstrap UCL	23
95% BCA Bootstrap UCL	22.79		
90% Chebyshev(Mean, Sd) UCL	24.73	95% Chebyshev(Mean, Sd) UCL	26.38
97.5% Chebyshev(Mean, Sd) UCL	28.65	99% Chebyshev(Mean, Sd) UCL	33.12
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	26.38		
Recommended UCL exceeds the maximum observation			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			
Thallium			
General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
		Number of Missing Observations	51
Minimum	0.095	Mean	2.507
Maximum	13.9	Median	0.34
SD	4.528	Std. Error of Mean	1.365
Coefficient of Variation	1.806	Skewness	2.123
Normal GOF Test			
Shapiro Wilk Test Statistic	0.615	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.358	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.267	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	4.982	95% Adjusted-CLT UCL (Chen-1995)	5.686
		95% Modified-t UCL (Johnson-1978)	5.127
Gamma GOF Test			
A-D Test Statistic	0.912	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.794	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.226	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.271	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.433	k star (bias corrected MLE)	0.375
Theta hat (MLE)	5.796	Theta star (bias corrected MLE)	6.682
nu hat (MLE)	9.517	nu star (bias corrected)	8.255
MLE Mean (bias corrected)	2.507	MLE Sd (bias corrected)	4.093
		Approximate Chi Square Value (0.05)	2.884
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	2.392
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	7.178	95% Adjusted Gamma UCL (use when n<50)	8.655
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.874	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.85	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.191	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.267	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-2.354	Mean of logged Data	-0.583
Maximum of Logged Data	2.632	SD of logged Data	1.822
Assuming Lognormal Distribution			
95% H-UCL	45.25	90% Chebyshev (MVUE) UCL	5.998
95% Chebyshev (MVUE) UCL	7.731	97.5% Chebyshev (MVUE) UCL	10.14
99% Chebyshev (MVUE) UCL	14.86		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	4.753	95% Jackknife UCL	4.982
95% Standard Bootstrap UCL	4.64	95% Bootstrap-t UCL	14.73
95% Hall's Bootstrap UCL	16.81	95% Percentile Bootstrap UCL	4.931
95% BCA Bootstrap UCL	5.617		
90% Chebyshev(Mean, Sd) UCL	6.603	95% Chebyshev(Mean, Sd) UCL	8.458
97.5% Chebyshev(Mean, Sd) UCL	11.03	99% Chebyshev(Mean, Sd) UCL	16.09
Suggested UCL to Use			
95% Adjusted Gamma UCL	8.655		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Trichloroethene			
General Statistics			
Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	7
Minimum	0.0025	Mean	0.00308
Maximum	0.0034	Median	0.00335
SD	5.0580E-4	Std. Error of Mean	2.9202E-4
Coefficient of Variation	0.164	Skewness	-1.713
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.792	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.368	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.00394	95% Adjusted-CLT UCL (Chen-1995)	0.00326
		95% Modified-t UCL (Johnson-1978)	0.00389
Gamma GOF Test			
Not Enough Data to Perform GOF Test			
Gamma Statistics			
k hat (MLE)	51.88	k star (bias corrected MLE)	N/A
Theta hat (MLE)	5.9435E-5	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	311.3	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.786	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.37	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

Lognormal Statistics			
Minimum of Logged Data	-5.991	Mean of logged Data	-5.791
Maximum of Logged Data	-5.684	SD of logged Data	0.173
Assuming Lognormal Distribution			
95% H-UCL	0.00455	90% Chebyshev (MVUE) UCL	0.00401
95% Chebyshev (MVUE) UCL	0.00443	97.5% Chebyshev (MVUE) UCL	0.00501
99% Chebyshev (MVUE) UCL	0.00615		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.00356	95% Jackknife UCL	0.00394
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	0.00396	95% Chebyshev(Mean, Sd) UCL	0.00436
97.5% Chebyshev(Mean, Sd) UCL	0.00491	99% Chebyshev(Mean, Sd) UCL	0.00599
Suggested UCL to Use			
95% Student's-t UCL	0.00394		
Recommended UCL exceeds the maximum observation			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			
Uranium			
General Statistics			
Total Number of Observations	47	Number of Distinct Observations	25
		Number of Missing Observations	27
Minimum	5	Mean	277.3
Maximum	3100	Median	9.4
SD	565.7	Std. Error of Mean	82.51
Coefficient of Variation	2.04	Skewness	3.334
Normal GOF Test			
Shapiro Wilk Test Statistic	0.557	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.946	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.315	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.129	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	

95% Student's-t UCL	415.8	95% Adjusted-CLT UCL (Chen-1995)	455.9
		95% Modified-t UCL (Johnson-1978)	422.5
Gamma GOF Test			
A-D Test Statistic	3.841	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.854	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.288	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.14	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.335	k star (bias corrected MLE)	0.328
Theta hat (MLE)	827	Theta star (bias corrected MLE)	845.2
nu hat (MLE)	31.52	nu star (bias corrected)	30.84
MLE Mean (bias corrected)	277.3	MLE Sd (bias corrected)	484.1
		Approximate Chi Square Value (0.05)	19.16
Adjusted Level of Significance	0.0449	Adjusted Chi Square Value	18.86
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	446.5	95% Adjusted Gamma UCL (use when n<50)	453.4
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.786	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.946	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.306	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.129	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.609	Mean of logged Data	3.606
Maximum of Logged Data	8.039	SD of logged Data	2.209
Assuming Lognormal Distribution			
95% H-UCL	1496	90% Chebyshev (MVUE) UCL	879.1
95% Chebyshev (MVUE) UCL	1114	97.5% Chebyshev (MVUE) UCL	1440
99% Chebyshev (MVUE) UCL	2080		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	413	95% Jackknife UCL	415.8
95% Standard Bootstrap UCL	411.1	95% Bootstrap-t UCL	478.8
95% Hall's Bootstrap UCL	523.9	95% Percentile Bootstrap UCL	415.3
95% BCA Bootstrap UCL	467.1		
90% Chebyshev(Mean, Sd) UCL	524.8	95% Chebyshev(Mean, Sd) UCL	637
97.5% Chebyshev(Mean, Sd) UCL	792.6	99% Chebyshev(Mean, Sd) UCL	1098
Suggested UCL to Use			
97.5% Chebyshev (Mean, Sd) UCL	792.6		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			

and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Vanadium			
General Statistics			
Total Number of Observations	47	Number of Distinct Observations	39
		Number of Missing Observations	26
Minimum	2.5	Mean	114.8
Maximum	195	Median	121
SD	42.07	Std. Error of Mean	6.136
Coefficient of Variation	0.366	Skewness	-1.092
Normal GOF Test			
Shapiro Wilk Test Statistic	0.883	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.946	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.185	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.129	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	125.1	95% Adjusted-CLT UCL (Chen-1995)	123.9
		95% Modified-t UCL (Johnson-1978)	125
Gamma GOF Test			
A-D Test Statistic	5.002	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.755	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.276	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.13	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	3.379	k star (bias corrected MLE)	3.178
Theta hat (MLE)	33.98	Theta star (bias corrected MLE)	36.14
nu hat (MLE)	317.7	nu star (bias corrected)	298.7
MLE Mean (bias corrected)	114.8	MLE Sd (bias corrected)	64.42
		Approximate Chi Square Value (0.05)	259.7
Adjusted Level of Significance	0.0449	Adjusted Chi Square Value	258.5
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	132.1	95% Adjusted Gamma UCL (use when n<50)	132.7
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.623	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.946	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.317	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.129	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.916	Mean of logged Data	4.588

Maximum of Logged Data	5.273	SD of logged Data	0.755
Assuming Lognormal Distribution			
95% H-UCL	164.8	90% Chebyshev (MVUE) UCL	177.1
95% Chebyshev (MVUE) UCL	198.6	97.5% Chebyshev (MVUE) UCL	228.4
99% Chebyshev (MVUE) UCL	286.9		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	124.9	95% Jackknife UCL	125.1
95% Standard Bootstrap UCL	124.9	95% Bootstrap-t UCL	124.2
95% Hall's Bootstrap UCL	123.9	95% Percentile Bootstrap UCL	124
95% BCA Bootstrap UCL	123.7		
90% Chebyshev(Mean, Sd) UCL	133.2	95% Chebyshev(Mean, Sd) UCL	141.6
97.5% Chebyshev(Mean, Sd) UCL	153.2	99% Chebyshev(Mean, Sd) UCL	175.9
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	141.6		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			

UCL Statistics for Uncensored Full Data Sets			
User Selected Options			
Date/Time of Computation	3/11/2015 12:06:49 PM		
From File	Eco2_SWMU26.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
Aluminum			
General Statistics			
Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	26
Minimum	4300	Mean	10232
Maximum	34600	Median	6810
SD	9125	Std. Error of Mean	2886
Coefficient of Variation	0.892	Skewness	2.524
Normal GOF Test			
Shapiro Wilk Test Statistic	0.658	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.842	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.288	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.28	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	15522	95% Adjusted-CLT UCL (Chen-1995)	17440
		95% Modified-t UCL (Johnson-1978)	15906
Gamma GOF Test			
A-D Test Statistic	0.778	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.734	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.242	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.269	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.362	k star (bias corrected MLE)	1.72
Theta hat (MLE)	4331	Theta star (bias corrected MLE)	5947
nu hat (MLE)	47.25	nu star (bias corrected)	34.41
MLE Mean (bias corrected)	10232	MLE Sd (bias corrected)	7801
		Approximate Chi Square Value (0.05)	21.99
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	20.28
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	16010	95% Adjusted Gamma UCL (use when n<50)	17359
Lognormal GOF Test			

Shapiro Wilk Test Statistic	0.873	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.197	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.28	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	8.366	Mean of logged Data	9.007
Maximum of Logged Data	10.45	SD of logged Data	0.64
Assuming Lognormal Distribution			
95% H-UCL	16815	90% Chebyshev (MVUE) UCL	15877
95% Chebyshev (MVUE) UCL	18638	97.5% Chebyshev (MVUE) UCL	22470
99% Chebyshev (MVUE) UCL	29999		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	14978	95% Jackknife UCL	15522
95% Standard Bootstrap UCL	14722	95% Bootstrap-t UCL	23677
95% Hall's Bootstrap UCL	30521	95% Percentile Bootstrap UCL	15412
95% BCA Bootstrap UCL	17680		
90% Chebyshev(Mean, Sd) UCL	18889	95% Chebyshev(Mean, Sd) UCL	22810
97.5% Chebyshev(Mean, Sd) UCL	28253	99% Chebyshev(Mean, Sd) UCL	38944
Suggested UCL to Use			
95% Adjusted Gamma UCL	17359		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Cobalt			
General Statistics			
Total Number of Observations	9	Number of Distinct Observations	9
		Number of Missing Observations	27
Minimum	5.4	Mean	16.96
Maximum	90.5	Median	7.2
SD	27.68	Std. Error of Mean	9.225
Coefficient of Variation	1.632	Skewness	2.961
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0			
Normal GOF Test			

Shapiro Wilk Test Statistic	0.461	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.446	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.295	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	34.11	95% Adjusted-CLT UCL (Chen-1995)	41.86
		95% Modified-t UCL (Johnson-1978)	35.63
Gamma GOF Test			
A-D Test Statistic	1.804	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.742	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.381	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.287	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.057	k star (bias corrected MLE)	0.779
Theta hat (MLE)	16.04	Theta star (bias corrected MLE)	21.78
nu hat (MLE)	19.02	nu star (bias corrected)	14.02
MLE Mean (bias corrected)	16.96	MLE Sd (bias corrected)	19.22
		Approximate Chi Square Value (0.05)	6.582
Adjusted Level of Significance	0.0231	Adjusted Chi Square Value	5.545
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	36.11	95% Adjusted Gamma UCL (use when n<50)	42.86
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.667	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.326	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.295	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.686	Mean of logged Data	2.288
Maximum of Logged Data	4.505	SD of logged Data	0.874
Assuming Lognormal Distribution			
95% H-UCL	36.12	90% Chebyshev (MVUE) UCL	26.04
95% Chebyshev (MVUE) UCL	31.64	97.5% Chebyshev (MVUE) UCL	39.4
99% Chebyshev (MVUE) UCL	54.66		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	32.13	95% Jackknife UCL	34.11
95% Standard Bootstrap UCL	31.47	95% Bootstrap-t UCL	241.3

95% Hall's Bootstrap UCL	119.6	95% Percentile Bootstrap UCL	35.01
95% BCA Bootstrap UCL	44.37		
90% Chebyshev(Mean, Sd) UCL	44.63	95% Chebyshev(Mean, Sd) UCL	57.17
97.5% Chebyshev(Mean, Sd) UCL	74.57	99% Chebyshev(Mean, Sd) UCL	108.7
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	57.17		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Manganese			
General Statistics			
Total Number of Observations	47	Number of Distinct Observations	46
		Number of Missing Observations	0
Minimum	82	Mean	464.7
Maximum	1223	Median	456
SD	228	Std. Error of Mean	33.26
Coefficient of Variation	0.491	Skewness	0.992
Normal GOF Test			
Shapiro Wilk Test Statistic	0.932	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.946	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.131	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.129	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	520.5	95% Adjusted-CLT UCL (Chen-1995)	524.6
		95% Modified-t UCL (Johnson-1978)	521.3
Gamma GOF Test			
A-D Test Statistic	0.925	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.754	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.115	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.13	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	3.779	k star (bias corrected MLE)	3.552
Theta hat (MLE)	123	Theta star (bias corrected MLE)	130.8
nu hat (MLE)	355.2	nu star (bias corrected)	333.9
MLE Mean (bias corrected)	464.7	MLE Sd (bias corrected)	246.6
		Approximate Chi Square Value (0.05)	292.6
Adjusted Level of Significance	0.0449	Adjusted Chi Square Value	291.3

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	530.4	95% Adjusted Gamma UCL (use when n<50)	532.6
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.901	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.946	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.148	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.129	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.407	Mean of logged Data	6.003
Maximum of Logged Data	7.109	SD of logged Data	0.581
Assuming Lognormal Distribution			
95% H-UCL	566.2	90% Chebyshev (MVUE) UCL	606.7
95% Chebyshev (MVUE) UCL	665.3	97.5% Chebyshev (MVUE) UCL	746.7
99% Chebyshev (MVUE) UCL	906.5		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	519.4	95% Jackknife UCL	520.5
95% Standard Bootstrap UCL	517.2	95% Bootstrap-t UCL	524
95% Hall's Bootstrap UCL	530	95% Percentile Bootstrap UCL	521.1
95% BCA Bootstrap UCL	523.9		
90% Chebyshev(Mean, Sd) UCL	564.5	95% Chebyshev(Mean, Sd) UCL	609.7
97.5% Chebyshev(Mean, Sd) UCL	672.4	99% Chebyshev(Mean, Sd) UCL	795.7
Suggested UCL to Use			
95% Adjusted Gamma UCL	532.6		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Zinc			
General Statistics			
Total Number of Observations	46	Number of Distinct Observations	41
		Number of Missing Observations	1
Minimum	34.2	Mean	132.4
Maximum	800	Median	94
SD	128.9	Std. Error of Mean	19.01
Coefficient of Variation	0.974	Skewness	3.666
Normal GOF Test			
Shapiro Wilk Test Statistic	0.606	**Shapiro Wilk GOF Test**	

5% Shapiro Wilk Critical Value	0.945	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.274	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.131	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	164.4	95% Adjusted-CLT UCL (Chen-1995)	174.7
		95% Modified-t UCL (Johnson-1978)	166.1
Gamma GOF Test			
A-D Test Statistic	2.2	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.76	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.226	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.132	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.218	k star (bias corrected MLE)	2.088
Theta hat (MLE)	59.7	Theta star (bias corrected MLE)	63.42
nu hat (MLE)	204.1	nu star (bias corrected)	192.1
MLE Mean (bias corrected)	132.4	MLE Sd (bias corrected)	91.64
		Approximate Chi Square Value (0.05)	161
Adjusted Level of Significance	0.0448	Adjusted Chi Square Value	160.1
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	158	95% Adjusted Gamma UCL (use when n<50)	158.9
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.934	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.945	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.177	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.131	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	3.532	Mean of logged Data	4.644
Maximum of Logged Data	6.685	SD of logged Data	0.633
Assuming Lognormal Distribution			
95% H-UCL	153.1	90% Chebyshev (MVUE) UCL	164.5
95% Chebyshev (MVUE) UCL	181.7	97.5% Chebyshev (MVUE) UCL	205.7
99% Chebyshev (MVUE) UCL	252.8		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	163.7	95% Jackknife UCL	164.4
95% Standard Bootstrap UCL	163.3	95% Bootstrap-t UCL	190.1
95% Hall's Bootstrap UCL	305.4	95% Percentile Bootstrap UCL	164.7

95% BCA Bootstrap UCL	178.5		
90% Chebyshev(Mean, Sd) UCL	189.5	95% Chebyshev(Mean, Sd) UCL	215.3
97.5% Chebyshev(Mean, Sd) UCL	251.1	99% Chebyshev(Mean, Sd) UCL	321.6
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	215.3		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			

UCL Statistics for Uncensored Full Data Sets			
User Selected Options			
Date/Time of Computation	3/4/2015 4:27:11 PM		
From File	080_UCL95.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
Anthracene			
General Statistics			
Total Number of Observations	4	Number of Distinct Observations	3
		Number of Missing Observations	49
Minimum	0.17	Mean	0.184
Maximum	0.195	Median	0.185
SD	0.0131	Std. Error of Mean	0.00657
Coefficient of Variation	0.0716	Skewness	-0.124
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.813	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.304	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.199	95% Adjusted-CLT UCL (Chen-1995)	0.194
		95% Modified-t UCL (Johnson-1978)	0.199
Gamma GOF Test			
A-D Test Statistic	0.545	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.338	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	259.2	k star (bias corrected MLE)	64.97
Theta hat (MLE)	7.0891E-4	Theta star (bias corrected MLE)	0.00283
nu hat (MLE)	2074	nu star (bias corrected)	519.7
MLE Mean (bias corrected)	0.184	MLE Sd (bias corrected)	0.0228
		Approximate Chi Square Value (0.05)	467.9
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	0.204	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.817	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.304	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-1.772	Mean of logged Data	-1.696
Maximum of Logged Data	-1.635	SD of logged Data	0.0718
Assuming Lognormal Distribution			
95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	0.204
95% Chebyshev (MVUE) UCL	0.213	97.5% Chebyshev (MVUE) UCL	0.225
99% Chebyshev (MVUE) UCL	0.249		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.195	95% Jackknife UCL	0.199
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	0.203	95% Chebyshev(Mean, Sd) UCL	0.212
97.5% Chebyshev(Mean, Sd) UCL	0.225	99% Chebyshev(Mean, Sd) UCL	0.249
Suggested UCL to Use			
95% Student's-t UCL	0.199		
Recommended UCL exceeds the maximum observation			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			
Antimony			
General Statistics			
Total Number of Observations	5	Number of Distinct Observations	4
		Number of Missing Observations	49
Minimum	0.16	Mean	17.72

Maximum	58.17	Median	15
SD	23.79	Std. Error of Mean	10.64
Coefficient of Variation	1.343	Skewness	1.715
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.783	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.346	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	40.4	95% Adjusted-CLT UCL (Chen-1995)	43.94
		95% Modified-t UCL (Johnson-1978)	41.76
Gamma GOF Test			
A-D Test Statistic	0.424	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.724	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.264	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.375	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.408	k star (bias corrected MLE)	0.297
Theta hat (MLE)	43.42	Theta star (bias corrected MLE)	59.75
nu hat (MLE)	4.081	nu star (bias corrected)	2.966
MLE Mean (bias corrected)	17.72	MLE Sd (bias corrected)	32.54
		Approximate Chi Square Value (0.05)	0.362
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	0.135
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	145	95% Adjusted Gamma UCL (use when n<50)	388.4
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.847	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.306	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-1.833	Mean of logged Data	1.268
Maximum of Logged Data	4.063	SD of logged Data	2.656
Assuming Lognormal Distribution			

95% H-UCL	1.682E+9	90% Chebyshev (MVUE) UCL	103.3
95% Chebyshev (MVUE) UCL	136.9	97.5% Chebyshev (MVUE) UCL	183.7
99% Chebyshev (MVUE) UCL	275.4		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	35.22	95% Jackknife UCL	40.4
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	49.64	95% Chebyshev(Mean, Sd) UCL	64.1
97.5% Chebyshev(Mean, Sd) UCL	84.16	99% Chebyshev(Mean, Sd) UCL	123.6
Suggested UCL to Use			
95% Student's-t UCL	40.4		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Cadmium			
General Statistics			
Total Number of Observations	5	Number of Distinct Observations	3
		Number of Missing Observations	49
Minimum	0.022	Mean	3.648
Maximum	6	Median	6
SD	3.221	Std. Error of Mean	1.44
Coefficient of Variation	0.883	Skewness	-0.611
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.694	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.762	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.367	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Approximate Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	6.719	95% Adjusted-CLT UCL (Chen-1995)	5.597
		95% Modified-t UCL (Johnson-1978)	6.654

Gamma GOF Test			
A-D Test Statistic	0.788	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.712	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.4	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.372	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.495	k star (bias corrected MLE)	0.331
Theta hat (MLE)	7.372	Theta star (bias corrected MLE)	11.01
nu hat (MLE)	4.949	nu star (bias corrected)	3.313
MLE Mean (bias corrected)	3.648	MLE Sd (bias corrected)	6.339
		Approximate Chi Square Value (0.05)	0.471
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	0.179
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	25.67	95% Adjusted Gamma UCL (use when n<50)	67.48
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.773	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.356	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-3.817	Mean of logged Data	0.00889
Maximum of Logged Data	1.792	SD of logged Data	2.573
Assuming Lognormal Distribution			
95% H-UCL	1.418E+8	90% Chebyshev (MVUE) UCL	26.19
95% Chebyshev (MVUE) UCL	34.69	97.5% Chebyshev (MVUE) UCL	46.49
99% Chebyshev (MVUE) UCL	69.67		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	6.018	95% Jackknife UCL	6.719
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	7.97	95% Chebyshev(Mean, Sd) UCL	9.927
97.5% Chebyshev(Mean, Sd) UCL	12.64	99% Chebyshev(Mean, Sd) UCL	17.98
Suggested UCL to Use			
95% Student's-t UCL	6.719		
Recommended UCL exceeds the maximum observation			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			
Chromium			
General Statistics			
Total Number of Observations	22	Number of Distinct Observations	4
		Number of Missing Observations	32
Minimum	6	Mean	11.49
Maximum	42.5	Median	6
SD	12.22	Std. Error of Mean	2.605
Coefficient of Variation	1.064	Skewness	2.151
Normal GOF Test			
Shapiro Wilk Test Statistic	0.499	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.446	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.189	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	15.97	95% Adjusted-CLT UCL (Chen-1995)	17.05
		95% Modified-t UCL (Johnson-1978)	16.17
Gamma GOF Test			
A-D Test Statistic	5.152	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.757	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.468	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.188	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.757	k star (bias corrected MLE)	1.547
Theta hat (MLE)	6.539	Theta star (bias corrected MLE)	7.423
nu hat (MLE)	77.3	nu star (bias corrected)	68.09
MLE Mean (bias corrected)	11.49	MLE Sd (bias corrected)	9.234
		Approximate Chi Square Value (0.05)	50.1
Adjusted Level of Significance	0.0386	Adjusted Chi Square Value	48.94
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	15.61	95% Adjusted Gamma UCL (use when n<50)	15.98
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.54	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data Not Lognormal at 5% Significance Level	

Lilliefors Test Statistic	0.461	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.189	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.792	Mean of logged Data	2.13
Maximum of Logged Data	3.75	SD of logged Data	0.689
Assuming Lognormal Distribution			
95% H-UCL	14.83	90% Chebyshev (MVUE) UCL	15.49
95% Chebyshev (MVUE) UCL	17.74	97.5% Chebyshev (MVUE) UCL	20.85
99% Chebyshev (MVUE) UCL	26.98		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	15.77	95% Jackknife UCL	15.97
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	19.3	95% Chebyshev(Mean, Sd) UCL	22.84
97.5% Chebyshev(Mean, Sd) UCL	27.75	99% Chebyshev(Mean, Sd) UCL	37.41
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	22.84		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Copper			
General Statistics			
Total Number of Observations	22	Number of Distinct Observations	13
		Number of Missing Observations	32
Minimum	2	Mean	33.84
Maximum	45	Median	36.5
SD	11.11	Std. Error of Mean	2.368
Coefficient of Variation	0.328	Skewness	-1.481
Normal GOF Test			
Shapiro Wilk Test Statistic	0.835	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.233	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.189	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	37.92	95% Adjusted-CLT UCL (Chen-1995)	36.94
		95% Modified-t UCL (Johnson-1978)	37.79
Gamma GOF Test			
A-D Test Statistic	2.46	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.747	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.296	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.186	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	4.219	k star (bias corrected MLE)	3.674
Theta hat (MLE)	8.02	Theta star (bias corrected MLE)	9.21
nu hat (MLE)	185.6	nu star (bias corrected)	161.7
MLE Mean (bias corrected)	33.84	MLE Sd (bias corrected)	17.65
		Approximate Chi Square Value (0.05)	133.3
Adjusted Level of Significance	0.0386	Adjusted Chi Square Value	131.3
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	41.05	95% Adjusted Gamma UCL (use when n<50)	41.65
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.565	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.303	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.189	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.693	Mean of logged Data	3.399
Maximum of Logged Data	3.807	SD of logged Data	0.673
Assuming Lognormal Distribution			
95% H-UCL	51.64	90% Chebyshev (MVUE) UCL	54.09
95% Chebyshev (MVUE) UCL	61.79	97.5% Chebyshev (MVUE) UCL	72.49
99% Chebyshev (MVUE) UCL	93.51		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	37.74	95% Jackknife UCL	37.92
95% Standard Bootstrap UCL	37.65	95% Bootstrap-t UCL	37.52
95% Hall's Bootstrap UCL	37.02	95% Percentile Bootstrap UCL	37.55
95% BCA Bootstrap UCL	37.11		
90% Chebyshev(Mean, Sd) UCL	40.94	95% Chebyshev(Mean, Sd) UCL	44.16
97.5% Chebyshev(Mean, Sd) UCL	48.63	99% Chebyshev(Mean, Sd) UCL	57.4
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	44.16		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)

and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.

For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Fluoranthene

General Statistics			
Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	49
Minimum	0.17	Mean	0.441
Maximum	1.2	Median	0.198
SD	0.506	Std. Error of Mean	0.253
Coefficient of Variation	1.147	Skewness	1.996

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.654	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.748	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.433	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Approximate Normal at 5% Significance Level			

Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1.037	95% Adjusted-CLT UCL (Chen-1995)	1.127
		95% Modified-t UCL (Johnson-1978)	1.079

Gamma GOF Test			
A-D Test Statistic	0.846	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.663	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.455	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.4	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics			
k hat (MLE)	1.425	k star (bias corrected MLE)	0.523
Theta hat (MLE)	0.31	Theta star (bias corrected MLE)	0.844
nu hat (MLE)	11.4	nu star (bias corrected)	4.183
MLE Mean (bias corrected)	0.441	MLE Sd (bias corrected)	0.61
		Approximate Chi Square Value (0.05)	0.795
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	2.321	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.7	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.748	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.417	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Approximate Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-1.772	Mean of logged Data	-1.208
Maximum of Logged Data	0.182	SD of logged Data	0.93
Assuming Lognormal Distribution			
95% H-UCL	13.02	90% Chebyshev (MVUE) UCL	0.936
95% Chebyshev (MVUE) UCL	1.176	97.5% Chebyshev (MVUE) UCL	1.509
99% Chebyshev (MVUE) UCL	2.164		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.857	95% Jackknife UCL	1.037
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	1.2	95% Chebyshev(Mean, Sd) UCL	1.544
97.5% Chebyshev(Mean, Sd) UCL	2.021	99% Chebyshev(Mean, Sd) UCL	2.959
Suggested UCL to Use			
95% Student's-t UCL	1.037		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Lead			
General Statistics			
Total Number of Observations	22	Number of Distinct Observations	7
		Number of Missing Observations	32
Minimum	1.5	Mean	10.69
Maximum	113	Median	1.5
SD	24.56	Std. Error of Mean	5.236
Coefficient of Variation	2.298	Skewness	3.818
Normal GOF Test			

Shapiro Wilk Test Statistic	0.43	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.373	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.189	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	19.7	95% Adjusted-CLT UCL (Chen-1995)	23.85
		95% Modified-t UCL (Johnson-1978)	20.41
Gamma GOF Test			
A-D Test Statistic	4.134	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.802	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.447	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.196	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.524	k star (bias corrected MLE)	0.483
Theta hat (MLE)	20.4	Theta star (bias corrected MLE)	22.14
nu hat (MLE)	23.05	nu star (bias corrected)	21.24
MLE Mean (bias corrected)	10.69	MLE Sd (bias corrected)	15.38
		Approximate Chi Square Value (0.05)	11.77
Adjusted Level of Significance	0.0386	Adjusted Chi Square Value	11.24
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	19.28	95% Adjusted Gamma UCL (use when n<50)	20.18
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.625	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.442	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.189	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.405	Mean of logged Data	1.165
Maximum of Logged Data	4.727	SD of logged Data	1.337
Assuming Lognormal Distribution			
95% H-UCL	19.24	90% Chebyshev (MVUE) UCL	14.72
95% Chebyshev (MVUE) UCL	18.08	97.5% Chebyshev (MVUE) UCL	22.74
99% Chebyshev (MVUE) UCL	31.9		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	19.3	95% Jackknife UCL	19.7
95% Standard Bootstrap UCL	18.99	95% Bootstrap-t UCL	42.93

95% Hall's Bootstrap UCL	50.84	95% Percentile Bootstrap UCL	20.52
95% BCA Bootstrap UCL	25.09		
90% Chebyshev(Mean, Sd) UCL	26.39	95% Chebyshev(Mean, Sd) UCL	33.51
97.5% Chebyshev(Mean, Sd) UCL	43.39	99% Chebyshev(Mean, Sd) UCL	62.78
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	33.51		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Manganese			
General Statistics			
Total Number of Observations	22	Number of Distinct Observations	22
		Number of Missing Observations	32
Minimum	198.4	Mean	598.3
Maximum	2066	Median	485.5
SD	394.7	Std. Error of Mean	84.16
Coefficient of Variation	0.66	Skewness	2.759
Normal GOF Test			
Shapiro Wilk Test Statistic	0.698	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.234	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.189	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	743.1	95% Adjusted-CLT UCL (Chen-1995)	789.6
		95% Modified-t UCL (Johnson-1978)	751.3
Gamma GOF Test			
A-D Test Statistic	0.944	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.747	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.182	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.186	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	3.843	k star (bias corrected MLE)	3.349
Theta hat (MLE)	155.7	Theta star (bias corrected MLE)	178.6
nu hat (MLE)	169.1	nu star (bias corrected)	147.4
MLE Mean (bias corrected)	598.3	MLE Sd (bias corrected)	326.9
		Approximate Chi Square Value (0.05)	120.3
Adjusted Level of Significance	0.0386	Adjusted Chi Square Value	118.5

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	732.8	95% Adjusted Gamma UCL (use when n<50)	744.1
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.935	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.145	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.189	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	5.29	Mean of logged Data	6.258
Maximum of Logged Data	7.633	SD of logged Data	0.495
Assuming Lognormal Distribution			
95% H-UCL	732.2	90% Chebyshev (MVUE) UCL	779.7
95% Chebyshev (MVUE) UCL	867	97.5% Chebyshev (MVUE) UCL	988.3
99% Chebyshev (MVUE) UCL	1226		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	736.7	95% Jackknife UCL	743.1
95% Standard Bootstrap UCL	732.8	95% Bootstrap-t UCL	879.6
95% Hall's Bootstrap UCL	1405	95% Percentile Bootstrap UCL	747.2
95% BCA Bootstrap UCL	807.5		
90% Chebyshev(Mean, Sd) UCL	850.8	95% Chebyshev(Mean, Sd) UCL	965.1
97.5% Chebyshev(Mean, Sd) UCL	1124	99% Chebyshev(Mean, Sd) UCL	1436
Suggested UCL to Use			
95% Adjusted Gamma UCL	744.1		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Mercury			
General Statistics			
Total Number of Observations	22	Number of Distinct Observations	2
		Number of Missing Observations	32
Minimum	5	Mean	17.95
Maximum	20	Median	20
SD	5.269	Std. Error of Mean	1.123
Coefficient of Variation	0.293	Skewness	-2.278
Normal GOF Test			
Shapiro Wilk Test Statistic	0.411	**Shapiro Wilk GOF Test**	

5% Shapiro Wilk Critical Value	0.911	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.515	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.189	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	19.89	95% Adjusted-CLT UCL (Chen-1995)	19.22
		95% Modified-t UCL (Johnson-1978)	19.8
Gamma GOF Test			
A-D Test Statistic	6.774	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.746	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.522	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.186	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	6.323	k star (bias corrected MLE)	5.491
Theta hat (MLE)	2.839	Theta star (bias corrected MLE)	3.27
nu hat (MLE)	278.2	nu star (bias corrected)	241.6
MLE Mean (bias corrected)	17.95	MLE Sd (bias corrected)	7.662
		Approximate Chi Square Value (0.05)	206.6
Adjusted Level of Significance	0.0386	Adjusted Chi Square Value	204.2
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	20.99	95% Adjusted Gamma UCL (use when n<50)	21.24
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.411	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.515	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.189	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.609	Mean of logged Data	2.807
Maximum of Logged Data	2.996	SD of logged Data	0.487
Assuming Lognormal Distribution			
95% H-UCL	23.02	90% Chebyshev (MVUE) UCL	24.51
95% Chebyshev (MVUE) UCL	27.22	97.5% Chebyshev (MVUE) UCL	30.98
99% Chebyshev (MVUE) UCL	38.37		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	19.8	95% Jackknife UCL	N/A
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A

95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	21.32	95% Chebyshev(Mean, Sd) UCL	22.85
97.5% Chebyshev(Mean, Sd) UCL	24.97	99% Chebyshev(Mean, Sd) UCL	29.13
Suggested UCL to Use			
95% Student's-t UCL	19.89	or 95% Modified-t UCL	19.8

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Molybdenum

General Statistics			
Total Number of Observations	22	Number of Distinct Observations	4
		Number of Missing Observations	32
Minimum	1.5	Mean	5.818
Maximum	46	Median	1.5
SD	11.41	Std. Error of Mean	2.433
Coefficient of Variation	1.961	Skewness	3.029
Normal GOF Test			
Shapiro Wilk Test Statistic	0.437	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.42	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.189	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	10	95% Adjusted-CLT UCL (Chen-1995)	11.5
		95% Modified-t UCL (Johnson-1978)	10.27
Gamma GOF Test			
A-D Test Statistic	5.033	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.786	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.47	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.193	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.718	k star (bias corrected MLE)	0.65
Theta hat (MLE)	8.102	Theta star (bias corrected MLE)	8.944
nu hat (MLE)	31.6	nu star (bias corrected)	28.62
MLE Mean (bias corrected)	5.818	MLE Sd (bias corrected)	7.214
		Approximate Chi Square Value (0.05)	17.41

Adjusted Level of Significance	0.0386	Adjusted Chi Square Value	16.76
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	9.563	95% Adjusted Gamma UCL (use when n<50)	9.936
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.554	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.461	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.189	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.405	Mean of logged Data	0.922
Maximum of Logged Data	3.829	SD of logged Data	1.054
Assuming Lognormal Distribution			
95% H-UCL	8.087	90% Chebyshev (MVUE) UCL	7.468
95% Chebyshev (MVUE) UCL	8.936	97.5% Chebyshev (MVUE) UCL	10.97
99% Chebyshev (MVUE) UCL	14.98		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	9.82	95% Jackknife UCL	10
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	13.12	95% Chebyshev(Mean, Sd) UCL	16.42
97.5% Chebyshev(Mean, Sd) UCL	21.01	99% Chebyshev(Mean, Sd) UCL	30.02
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	16.42		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Naphthalene			
General Statistics			
Total Number of Observations	4	Number of Distinct Observations	3
		Number of Missing Observations	49
Minimum	0.074	Mean	0.16
Maximum	0.195	Median	0.185
SD	0.0579	Std. Error of Mean	0.029
Coefficient of Variation	0.363	Skewness	-1.849

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.743	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.748	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.354	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Approximate Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.228	95% Adjusted-CLT UCL (Chen-1995)	0.179
		95% Modified-t UCL (Johnson-1978)	0.223
Gamma GOF Test			
A-D Test Statistic	0.737	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.658	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.395	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.395	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	7.316	k star (bias corrected MLE)	1.996
Theta hat (MLE)	0.0218	Theta star (bias corrected MLE)	0.08
nu hat (MLE)	58.53	nu star (bias corrected)	15.97
MLE Mean (bias corrected)	0.16	MLE Sd (bias corrected)	0.113
		Approximate Chi Square Value (0.05)	7.938
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	0.321	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.708	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.748	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.384	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Approximate Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-2.604	Mean of logged Data	-1.904
Maximum of Logged Data	-1.635	SD of logged Data	0.469
Assuming Lognormal Distribution			
95% H-UCL	0.429	90% Chebyshev (MVUE) UCL	0.273
95% Chebyshev (MVUE) UCL	0.324	97.5% Chebyshev (MVUE) UCL	0.394
99% Chebyshev (MVUE) UCL	0.533		

Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.207	95% Jackknife UCL	0.228
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	0.247	95% Chebyshev(Mean, Sd) UCL	0.286
97.5% Chebyshev(Mean, Sd) UCL	0.341	99% Chebyshev(Mean, Sd) UCL	0.448
Suggested UCL to Use			
95% Student's-t UCL	0.228		
Recommended UCL exceeds the maximum observation			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			
PCB, Total			
General Statistics			
Total Number of Observations	67	Number of Distinct Observations	33
		Number of Missing Observations	3
Minimum	0.02	Mean	11.04
Maximum	475	Median	2.5
SD	57.81	Std. Error of Mean	7.063
Coefficient of Variation	5.235	Skewness	8.068
Normal GOF Test			
Shapiro Wilk Test Statistic	0.175	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.424	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.108	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	22.83	95% Adjusted-CLT UCL (Chen-1995)	30.1
		95% Modified-t UCL (Johnson-1978)	23.99
Gamma GOF Test			
A-D Test Statistic	6.625	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.854	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.325	**Kolmogrov-Smirnoff Gamma GOF Test**	

5% K-S Critical Value	0.118	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.347	k star (bias corrected MLE)	0.342
Theta hat (MLE)	31.82	Theta star (bias corrected MLE)	32.34
nu hat (MLE)	46.51	nu star (bias corrected)	45.76
MLE Mean (bias corrected)	11.04	MLE Sd (bias corrected)	18.9
		Approximate Chi Square Value (0.05)	31.24
Adjusted Level of Significance	0.0464	Adjusted Chi Square Value	30.98
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	16.18	95% Adjusted Gamma UCL (use when n<50)	16.31
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.881	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	5.4447E-7	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.269	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.108	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-3.912	Mean of logged Data	0.462
Maximum of Logged Data	6.163	SD of logged Data	1.92
Assuming Lognormal Distribution			
95% H-UCL	19.8	90% Chebyshev (MVUE) UCL	19.12
95% Chebyshev (MVUE) UCL	23.55	97.5% Chebyshev (MVUE) UCL	29.71
99% Chebyshev (MVUE) UCL	41.8		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	22.66	95% Jackknife UCL	22.83
95% Standard Bootstrap UCL	22.49	95% Bootstrap-t UCL	110
95% Hall's Bootstrap UCL	64.94	95% Percentile Bootstrap UCL	25.09
95% BCA Bootstrap UCL	38.68		
90% Chebyshev(Mean, Sd) UCL	32.23	95% Chebyshev(Mean, Sd) UCL	41.83
97.5% Chebyshev(Mean, Sd) UCL	55.15	99% Chebyshev(Mean, Sd) UCL	81.32
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	41.83		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Phenanthrene			

General Statistics			
Total Number of Observations	4	Number of Distinct Observations	3
		Number of Missing Observations	49
Minimum	0.11	Mean	0.32
Maximum	0.78	Median	0.195
SD	0.309	Std. Error of Mean	0.155
Coefficient of Variation	0.966	Skewness	1.897
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.739	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.748	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.407	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Approximate Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.684	95% Adjusted-CLT UCL (Chen-1995)	0.731
		95% Modified-t UCL (Johnson-1978)	0.708
Gamma GOF Test			
A-D Test Statistic	0.553	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.661	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.394	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.398	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.862	k star (bias corrected MLE)	0.632
Theta hat (MLE)	0.172	Theta star (bias corrected MLE)	0.506
nu hat (MLE)	14.9	nu star (bias corrected)	5.058
MLE Mean (bias corrected)	0.32	MLE Sd (bias corrected)	0.402
		Approximate Chi Square Value (0.05)	1.179
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1.373	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.869	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.346	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

Lognormal Statistics			
Minimum of Logged Data	-2.207	Mean of logged Data	-1.431
Maximum of Logged Data	-0.248	SD of logged Data	0.833
Assuming Lognormal Distribution			
95% H-UCL	5.059	90% Chebyshev (MVUE) UCL	0.67
95% Chebyshev (MVUE) UCL	0.835	97.5% Chebyshev (MVUE) UCL	1.063
99% Chebyshev (MVUE) UCL	1.512		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.574	95% Jackknife UCL	0.684
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	0.784	95% Chebyshev(Mean, Sd) UCL	0.994
97.5% Chebyshev(Mean, Sd) UCL	1.286	99% Chebyshev(Mean, Sd) UCL	1.859
Suggested UCL to Use			
95% Student's-t UCL	0.684		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Pyrene			
General Statistics			
Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	49
Minimum	0.17	Mean	0.461
Maximum	1	Median	0.338
SD	0.386	Std. Error of Mean	0.193
Coefficient of Variation	0.836	Skewness	1.31
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.856	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.255	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			

Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.915	95% Adjusted-CLT UCL (Chen-1995)	0.913
		95% Modified-t UCL (Johnson-1978)	0.936
Gamma GOF Test			
A-D Test Statistic	0.367	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.66	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.298	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.398	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.064	k star (bias corrected MLE)	0.683
Theta hat (MLE)	0.223	Theta star (bias corrected MLE)	0.676
nu hat (MLE)	16.51	nu star (bias corrected)	5.462
MLE Mean (bias corrected)	0.461	MLE Sd (bias corrected)	0.558
		Approximate Chi Square Value (0.05)	1.371
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1.837	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.907	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.265	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-1.772	Mean of logged Data	-1.035
Maximum of Logged Data	0	SD of logged Data	0.83
Assuming Lognormal Distribution			
95% H-UCL	7.315	90% Chebyshev (MVUE) UCL	0.991
95% Chebyshev (MVUE) UCL	1.234	97.5% Chebyshev (MVUE) UCL	1.572
99% Chebyshev (MVUE) UCL	2.235		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.778	95% Jackknife UCL	0.915
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	1.04	95% Chebyshev(Mean, Sd) UCL	1.302
97.5% Chebyshev(Mean, Sd) UCL	1.666	99% Chebyshev(Mean, Sd) UCL	2.38
Suggested UCL to Use			

95% Student's-t UCL	0.915		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Selenium			
General Statistics			
Total Number of Observations	22	Number of Distinct Observations	3
		Number of Missing Observations	32
Minimum	1.5	Mean	2.818
Maximum	10	Median	1.5
SD	3.014	Std. Error of Mean	0.643
Coefficient of Variation	1.069	Skewness	2.067
Normal GOF Test			
Shapiro Wilk Test Statistic	0.475	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.487	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.189	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	3.924	95% Adjusted-CLT UCL (Chen-1995)	4.178
		95% Modified-t UCL (Johnson-1978)	3.971
Gamma GOF Test			
A-D Test Statistic	5.885	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.758	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.503	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.188	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.724	k star (bias corrected MLE)	1.519
Theta hat (MLE)	1.635	Theta star (bias corrected MLE)	1.855
nu hat (MLE)	75.86	nu star (bias corrected)	66.85
MLE Mean (bias corrected)	2.818	MLE Sd (bias corrected)	2.286
		Approximate Chi Square Value (0.05)	49.03
Adjusted Level of Significance	0.0386	Adjusted Chi Square Value	47.9
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	3.842	95% Adjusted Gamma UCL (use when n<50)	3.934
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.486	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data Not Lognormal at 5% Significance Level	

Lilliefors Test Statistic	0.493	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.189	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.405	Mean of logged Data	0.719
Maximum of Logged Data	2.303	SD of logged Data	0.693
Assuming Lognormal Distribution			
95% H-UCL	3.636	90% Chebyshev (MVUE) UCL	3.796
95% Chebyshev (MVUE) UCL	4.349	97.5% Chebyshev (MVUE) UCL	5.117
99% Chebyshev (MVUE) UCL	6.624		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	3.875	95% Jackknife UCL	3.924
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	4.746	95% Chebyshev(Mean, Sd) UCL	5.619
97.5% Chebyshev(Mean, Sd) UCL	6.831	99% Chebyshev(Mean, Sd) UCL	9.212
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	5.619		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Silver			
General Statistics			
Total Number of Observations	22	Number of Distinct Observations	2
		Number of Missing Observations	32
Minimum	5	Mean	22.27
Maximum	25	Median	25
SD	7.025	Std. Error of Mean	1.498
Coefficient of Variation	0.315	Skewness	-2.278
Normal GOF Test			
Shapiro Wilk Test Statistic	0.411	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.515	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.189	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	24.85	95% Adjusted-CLT UCL (Chen-1995)	23.96
		95% Modified-t UCL (Johnson-1978)	24.73
Gamma GOF Test			
A-D Test Statistic	6.791	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.746	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.523	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.186	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	4.97	k star (bias corrected MLE)	4.323
Theta hat (MLE)	4.481	Theta star (bias corrected MLE)	5.152
nu hat (MLE)	218.7	nu star (bias corrected)	190.2
MLE Mean (bias corrected)	22.27	MLE Sd (bias corrected)	10.71
		Approximate Chi Square Value (0.05)	159.3
Adjusted Level of Significance	0.0386	Adjusted Chi Square Value	157.2
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	26.59	95% Adjusted Gamma UCL (use when n<50)	26.95
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.411	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.515	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.189	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.609	Mean of logged Data	2.999
Maximum of Logged Data	3.219	SD of logged Data	0.565
Assuming Lognormal Distribution			
95% H-UCL	30.36	90% Chebyshev (MVUE) UCL	32.21
95% Chebyshev (MVUE) UCL	36.22	97.5% Chebyshev (MVUE) UCL	41.79
99% Chebyshev (MVUE) UCL	52.73		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	24.74	95% Jackknife UCL	N/A
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	26.77	95% Chebyshev(Mean, Sd) UCL	28.8
97.5% Chebyshev(Mean, Sd) UCL	31.63	99% Chebyshev(Mean, Sd) UCL	37.18
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	28.8		

Recommended UCL exceeds the maximum observation			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			
Uranium			
General Statistics			
Total Number of Observations	24	Number of Distinct Observations	11
		Number of Missing Observations	30
Minimum	5	Mean	33.59
Maximum	183	Median	5
SD	49.22	Std. Error of Mean	10.05
Coefficient of Variation	1.465	Skewness	1.72
Normal GOF Test			
Shapiro Wilk Test Statistic	0.645	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.916	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.353	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.181	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	50.81	95% Adjusted-CLT UCL (Chen-1995)	53.89
		95% Modified-t UCL (Johnson-1978)	51.4
Gamma GOF Test			
A-D Test Statistic	3.52	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.793	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.345	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.186	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.641	k star (bias corrected MLE)	0.588
Theta hat (MLE)	52.42	Theta star (bias corrected MLE)	57.08
nu hat (MLE)	30.76	nu star (bias corrected)	28.25
MLE Mean (bias corrected)	33.59	MLE Sd (bias corrected)	43.79
		Approximate Chi Square Value (0.05)	17.12
Adjusted Level of Significance	0.0392	Adjusted Chi Square Value	16.51
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	55.42	95% Adjusted Gamma UCL (use when n<50)	57.47

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.704	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.916	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.345	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.181	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.609	Mean of logged Data	2.559
Maximum of Logged Data	5.209	SD of logged Data	1.335
Assuming Lognormal Distribution			
95% H-UCL	73.03	90% Chebyshev (MVUE) UCL	58.51
95% Chebyshev (MVUE) UCL	71.62	97.5% Chebyshev (MVUE) UCL	89.83
99% Chebyshev (MVUE) UCL	125.6		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	50.12	95% Jackknife UCL	50.81
95% Standard Bootstrap UCL	50.16	95% Bootstrap-t UCL	58.68
95% Hall's Bootstrap UCL	53.01	95% Percentile Bootstrap UCL	50.98
95% BCA Bootstrap UCL	54.35		
90% Chebyshev(Mean, Sd) UCL	63.73	95% Chebyshev(Mean, Sd) UCL	77.38
97.5% Chebyshev(Mean, Sd) UCL	96.33	99% Chebyshev(Mean, Sd) UCL	133.5
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	77.38		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Vanadium			
General Statistics			
Total Number of Observations	22	Number of Distinct Observations	18
		Number of Missing Observations	32
Minimum	35	Mean	101.6
Maximum	138	Median	112
SD	31.57	Std. Error of Mean	6.731
Coefficient of Variation	0.311	Skewness	-1.209
Normal GOF Test			
Shapiro Wilk Test Statistic	0.845	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.171	**Lilliefors GOF Test**	

5% Lilliefors Critical Value	0.189	Data appear Normal at 5% Significance Level	
Data appear Approximate Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	113.2	95% Adjusted-CLT UCL (Chen-1995)	110.9
		95% Modified-t UCL (Johnson-1978)	112.9
Gamma GOF Test			
A-D Test Statistic	2.022	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.745	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.204	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.186	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	7.216	k star (bias corrected MLE)	6.263
Theta hat (MLE)	14.08	Theta star (bias corrected MLE)	16.23
nu hat (MLE)	317.5	nu star (bias corrected)	275.6
MLE Mean (bias corrected)	101.6	MLE Sd (bias corrected)	40.61
		Approximate Chi Square Value (0.05)	238.1
Adjusted Level of Significance	0.0386	Adjusted Chi Square Value	235.5
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	117.6	95% Adjusted Gamma UCL (use when n<50)	118.9
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.718	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.233	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.189	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	3.555	Mean of logged Data	4.551
Maximum of Logged Data	4.927	SD of logged Data	0.432
Assuming Lognormal Distribution			
95% H-UCL	124.8	90% Chebyshev (MVUE) UCL	132.9
95% Chebyshev (MVUE) UCL	146.2	97.5% Chebyshev (MVUE) UCL	164.8
99% Chebyshev (MVUE) UCL	201.1		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	112.7	95% Jackknife UCL	113.2
95% Standard Bootstrap UCL	112.5	95% Bootstrap-t UCL	112
95% Hall's Bootstrap UCL	111	95% Percentile Bootstrap UCL	111.9
95% BCA Bootstrap UCL	110.8		
90% Chebyshev(Mean, Sd) UCL	121.8	95% Chebyshev(Mean, Sd) UCL	131

97.5% Chebyshev(Mean, Sd) UCL	143.7	99% Chebyshev(Mean, Sd) UCL	168.6
Suggested UCL to Use			
95% Student's-t UCL	113.2		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			
Zinc			
General Statistics			
Total Number of Observations	22	Number of Distinct Observations	21
		Number of Missing Observations	32
Minimum	24.69	Mean	113.5
Maximum	638	Median	83.5
SD	126	Std. Error of Mean	26.86
Coefficient of Variation	1.11	Skewness	3.732
Normal GOF Test			
Shapiro Wilk Test Statistic	0.549	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.289	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.189	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	159.7	95% Adjusted-CLT UCL (Chen-1995)	180.5
		95% Modified-t UCL (Johnson-1978)	163.2
Gamma GOF Test			
A-D Test Statistic	0.951	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.757	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.195	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.188	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.847	k star (bias corrected MLE)	1.625
Theta hat (MLE)	61.44	Theta star (bias corrected MLE)	69.81
nu hat (MLE)	81.26	nu star (bias corrected)	71.51
MLE Mean (bias corrected)	113.5	MLE Sd (bias corrected)	89
		Approximate Chi Square Value (0.05)	53.04
Adjusted Level of Significance	0.0386	Adjusted Chi Square Value	51.85

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	153	95% Adjusted Gamma UCL (use when n<50)	156.5
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.941	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.134	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.189	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	3.206	Mean of logged Data	4.437
Maximum of Logged Data	6.458	SD of logged Data	0.711
Assuming Lognormal Distribution			
95% H-UCL	153.5	90% Chebyshev (MVUE) UCL	159.7
95% Chebyshev (MVUE) UCL	183.5	97.5% Chebyshev (MVUE) UCL	216.4
99% Chebyshev (MVUE) UCL	281.1		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	157.6	95% Jackknife UCL	159.7
95% Standard Bootstrap UCL	156.5	95% Bootstrap-t UCL	222.1
95% Hall's Bootstrap UCL	338.5	95% Percentile Bootstrap UCL	157.1
95% BCA Bootstrap UCL	189.3		
90% Chebyshev(Mean, Sd) UCL	194	95% Chebyshev(Mean, Sd) UCL	230.5
97.5% Chebyshev(Mean, Sd) UCL	281.2	99% Chebyshev(Mean, Sd) UCL	380.7
Suggested UCL to Use			
95% H-UCL	153.5		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
ProUCL computes and outputs H-statistic based UCLs for historical reasons only.			
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.			
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.			
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.			

UCL Statistics for Uncensored Full Data Sets			
User Selected Options			
Date/Time of Computation	3/4/2015 4:28:43 PM		
From File	204_UCL95.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
Antimony			
General Statistics			
Total Number of Observations	24	Number of Distinct Observations	16
		Number of Missing Observations	179
Minimum	0.098	Mean	1.474
Maximum	12	Median	0.2
SD	3.227	Std. Error of Mean	0.659
Coefficient of Variation	2.189	Skewness	2.568
Normal GOF Test			
Shapiro Wilk Test Statistic	0.477	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.916	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.478	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.181	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2.603	95% Adjusted-CLT UCL (Chen-1995)	2.927
		95% Modified-t UCL (Johnson-1978)	2.661
Gamma GOF Test			
A-D Test Statistic	5.099	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.821	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.461	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.19	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.434	k star (bias corrected MLE)	0.408
Theta hat (MLE)	3.393	Theta star (bias corrected MLE)	3.614
nu hat (MLE)	20.85	nu star (bias corrected)	19.58
MLE Mean (bias corrected)	1.474	MLE Sd (bias corrected)	2.308
		Approximate Chi Square Value (0.05)	10.54
Adjusted Level of Significance	0.0392	Adjusted Chi Square Value	10.08
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	2.738	95% Adjusted Gamma UCL (use when n<50)	2.865
Lognormal GOF Test			

Shapiro Wilk Test Statistic	0.645	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.916	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.379	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.181	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-2.323	Mean of logged Data	-1.107
Maximum of Logged Data	2.485	SD of logged Data	1.446
Assuming Lognormal Distribution			
95% H-UCL	2.463	90% Chebyshev (MVUE) UCL	1.806
95% Chebyshev (MVUE) UCL	2.23	97.5% Chebyshev (MVUE) UCL	2.819
99% Chebyshev (MVUE) UCL	3.976		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	2.558	95% Jackknife UCL	2.603
95% Standard Bootstrap UCL	2.52	95% Bootstrap-t UCL	3.702
95% Hall's Bootstrap UCL	3.013	95% Percentile Bootstrap UCL	2.65
95% BCA Bootstrap UCL	2.895		
90% Chebyshev(Mean, Sd) UCL	3.45	95% Chebyshev(Mean, Sd) UCL	4.345
97.5% Chebyshev(Mean, Sd) UCL	5.588	99% Chebyshev(Mean, Sd) UCL	8.028
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	4.345		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Arsenic			
General Statistics			
Total Number of Observations	187	Number of Distinct Observations	21
		Number of Missing Observations	19
Minimum	2.415	Mean	6.962
Maximum	136	Median	5
SD	13.39	Std. Error of Mean	0.979
Coefficient of Variation	1.923	Skewness	8.166
Normal GOF Test			
Shapiro Wilk Test Statistic	0.161	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.441	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0648	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	8.581	95% Adjusted-CLT UCL (Chen-1995)	9.197
		95% Modified-t UCL (Johnson-1978)	8.678
Gamma GOF Test			
A-D Test Statistic	5.348E+28	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.765	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.476	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.0678	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.22	k star (bias corrected MLE)	2.188
Theta hat (MLE)	3.136	Theta star (bias corrected MLE)	3.182
nu hat (MLE)	830.3	nu star (bias corrected)	818.3
MLE Mean (bias corrected)	6.962	MLE Sd (bias corrected)	4.707
		Approximate Chi Square Value (0.05)	752.9
Adjusted Level of Significance	0.0487	Adjusted Chi Square Value	752.5
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	7.567	95% Adjusted Gamma UCL (use when n<50)	7.572
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.314	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.467	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.0648	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.882	Mean of logged Data	1.699
Maximum of Logged Data	4.913	SD of logged Data	0.42
Assuming Lognormal Distribution			
95% H-UCL	6.305	90% Chebyshev (MVUE) UCL	6.539
95% Chebyshev (MVUE) UCL	6.798	97.5% Chebyshev (MVUE) UCL	7.157
99% Chebyshev (MVUE) UCL	7.863		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	8.573	95% Jackknife UCL	8.581
95% Standard Bootstrap UCL	8.603	95% Bootstrap-t UCL	23.31
95% Hall's Bootstrap UCL	17.72	95% Percentile Bootstrap UCL	8.875
95% BCA Bootstrap UCL	9.216		
90% Chebyshev(Mean, Sd) UCL	9.899	95% Chebyshev(Mean, Sd) UCL	11.23
97.5% Chebyshev(Mean, Sd) UCL	13.08	99% Chebyshev(Mean, Sd) UCL	16.7

Suggested UCL to Use			
95% Student's-t UCL	8.581	or 95% Modified-t UCL	8.678
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Benzo(a)pyrene			
General Statistics			
Total Number of Observations	23	Number of Distinct Observations	21
		Number of Missing Observations	180
Minimum	0.0025	Mean	0.214
Maximum	3.5	Median	0.04
SD	0.722	Std. Error of Mean	0.151
Coefficient of Variation	3.38	Skewness	4.671
Normal GOF Test			
Shapiro Wilk Test Statistic	0.299	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.914	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.396	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.185	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.472	95% Adjusted-CLT UCL (Chen-1995)	0.618
		95% Modified-t UCL (Johnson-1978)	0.497
Gamma GOF Test			
A-D Test Statistic	2.31	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.837	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.276	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.195	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.356	k star (bias corrected MLE)	0.339
Theta hat (MLE)	0.6	Theta star (bias corrected MLE)	0.631
nu hat (MLE)	16.39	nu star (bias corrected)	15.58
MLE Mean (bias corrected)	0.214	MLE Sd (bias corrected)	0.367
		Approximate Chi Square Value (0.05)	7.669
Adjusted Level of Significance	0.0389	Adjusted Chi Square Value	7.268
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	0.434	95% Adjusted Gamma UCL (use when n<50)	0.458
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.949	**Shapiro Wilk Lognormal GOF Test**	

5% Shapiro Wilk Critical Value	0.914	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.111	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.185	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-5.991	Mean of logged Data	-3.425
Maximum of Logged Data	1.253	SD of logged Data	1.713
Assuming Lognormal Distribution			
95% H-UCL	0.522	90% Chebyshev (MVUE) UCL	0.288
95% Chebyshev (MVUE) UCL	0.362	97.5% Chebyshev (MVUE) UCL	0.466
99% Chebyshev (MVUE) UCL	0.669		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.461	95% Jackknife UCL	0.472
95% Standard Bootstrap UCL	0.457	95% Bootstrap-t UCL	2.018
95% Hall's Bootstrap UCL	1.611	95% Percentile Bootstrap UCL	0.499
95% BCA Bootstrap UCL	0.682		
90% Chebyshev(Mean, Sd) UCL	0.666	95% Chebyshev(Mean, Sd) UCL	0.87
97.5% Chebyshev(Mean, Sd) UCL	1.154	99% Chebyshev(Mean, Sd) UCL	1.712
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	0.87		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Cadmium			
General Statistics			
Total Number of Observations	24	Number of Distinct Observations	21
		Number of Missing Observations	179
Minimum	0.037	Mean	0.25
Maximum	1	Median	0.115
SD	0.303	Std. Error of Mean	0.0618
Coefficient of Variation	1.214	Skewness	1.915
Normal GOF Test			
Shapiro Wilk Test Statistic	0.633	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.916	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.357	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.181	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			

Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.356	95% Adjusted-CLT UCL (Chen-1995)	0.377
		95% Modified-t UCL (Johnson-1978)	0.36
Gamma GOF Test			
A-D Test Statistic	2.026	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.769	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.256	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.182	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.153	k star (bias corrected MLE)	1.037
Theta hat (MLE)	0.216	Theta star (bias corrected MLE)	0.241
nu hat (MLE)	55.35	nu star (bias corrected)	49.76
MLE Mean (bias corrected)	0.25	MLE Sd (bias corrected)	0.245
		Approximate Chi Square Value (0.05)	34.56
Adjusted Level of Significance	0.0392	Adjusted Chi Square Value	33.67
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	0.359	95% Adjusted Gamma UCL (use when n<50)	0.369
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.884	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.916	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.179	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.181	Data appear Lognormal at 5% Significance Level	
Data appear Approximate Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-3.297	Mean of logged Data	-1.881
Maximum of Logged Data	0	SD of logged Data	0.929
Assuming Lognormal Distribution			
95% H-UCL	0.377	90% Chebyshev (MVUE) UCL	0.375
95% Chebyshev (MVUE) UCL	0.441	97.5% Chebyshev (MVUE) UCL	0.532
99% Chebyshev (MVUE) UCL	0.712		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.351	95% Jackknife UCL	0.356
95% Standard Bootstrap UCL	0.35	95% Bootstrap-t UCL	0.419
95% Hall's Bootstrap UCL	0.341	95% Percentile Bootstrap UCL	0.36
95% BCA Bootstrap UCL	0.38		
90% Chebyshev(Mean, Sd) UCL	0.435	95% Chebyshev(Mean, Sd) UCL	0.519
97.5% Chebyshev(Mean, Sd) UCL	0.636	99% Chebyshev(Mean, Sd) UCL	0.865
Suggested UCL to Use			

95% Chebyshev (Mean, Sd) UCL	0.519		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Chromium			
General Statistics			
Total Number of Observations	187	Number of Distinct Observations	15
		Number of Missing Observations	19
Minimum	6	Mean	7.166
Maximum	37	Median	6
SD	3.602	Std. Error of Mean	0.263
Coefficient of Variation	0.503	Skewness	4.379
Normal GOF Test			
Shapiro Wilk Test Statistic	0.391	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.499	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0648	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	7.602	95% Adjusted-CLT UCL (Chen-1995)	7.69
		95% Modified-t UCL (Johnson-1978)	7.616
Gamma GOF Test			
A-D Test Statistic	53.75	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.753	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.513	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.067	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	7.814	k star (bias corrected MLE)	7.692
Theta hat (MLE)	0.917	Theta star (bias corrected MLE)	0.932
nu hat (MLE)	2922	nu star (bias corrected)	2877
MLE Mean (bias corrected)	7.166	MLE Sd (bias corrected)	2.584
		Approximate Chi Square Value (0.05)	2753
Adjusted Level of Significance	0.0487	Adjusted Chi Square Value	2752
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	7.488	95% Adjusted Gamma UCL (use when n<50)	7.491
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.415	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	

Lilliefors Test Statistic	0.512	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0648	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.792	Mean of logged Data	1.904
Maximum of Logged Data	3.611	SD of logged Data	0.312
Assuming Lognormal Distribution			
95% H-UCL	7.331	90% Chebyshev (MVUE) UCL	7.539
95% Chebyshev (MVUE) UCL	7.762	97.5% Chebyshev (MVUE) UCL	8.072
99% Chebyshev (MVUE) UCL	8.681		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	7.6	95% Jackknife UCL	7.602
95% Standard Bootstrap UCL	7.594	95% Bootstrap-t UCL	7.721
95% Hall's Bootstrap UCL	7.824	95% Percentile Bootstrap UCL	7.628
95% BCA Bootstrap UCL	7.703		
90% Chebyshev(Mean, Sd) UCL	7.957	95% Chebyshev(Mean, Sd) UCL	8.315
97.5% Chebyshev(Mean, Sd) UCL	8.811	99% Chebyshev(Mean, Sd) UCL	9.787
Suggested UCL to Use			
95% Student's-t UCL	7.602	or 95% Modified-t UCL	7.616
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Cobalt			
General Statistics			
Total Number of Observations	24	Number of Distinct Observations	20
		Number of Missing Observations	179
Minimum	3	Mean	6.966
Maximum	18	Median	6.4
SD	3.31	Std. Error of Mean	0.676
Coefficient of Variation	0.475	Skewness	2.019
Normal GOF Test			
Shapiro Wilk Test Statistic	0.808	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.916	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.21	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.181	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	8.124	95% Adjusted-CLT UCL (Chen-1995)	8.375
		95% Modified-t UCL (Johnson-1978)	8.171
Gamma GOF Test			
A-D Test Statistic	0.587	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.746	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.151	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.178	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	6.074	k star (bias corrected MLE)	5.342
Theta hat (MLE)	1.147	Theta star (bias corrected MLE)	1.304
nu hat (MLE)	291.5	nu star (bias corrected)	256.4
MLE Mean (bias corrected)	6.966	MLE Sd (bias corrected)	3.014
		Approximate Chi Square Value (0.05)	220.3
Adjusted Level of Significance	0.0392	Adjusted Chi Square Value	218
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	8.107	95% Adjusted Gamma UCL (use when n<50)	8.194
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.962	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.916	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.122	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.181	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.099	Mean of logged Data	1.857
Maximum of Logged Data	2.89	SD of logged Data	0.403
Assuming Lognormal Distribution			
95% H-UCL	8.144	90% Chebyshev (MVUE) UCL	8.67
95% Chebyshev (MVUE) UCL	9.464	97.5% Chebyshev (MVUE) UCL	10.57
99% Chebyshev (MVUE) UCL	12.73		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	8.078	95% Jackknife UCL	8.124
95% Standard Bootstrap UCL	8.05	95% Bootstrap-t UCL	8.661
95% Hall's Bootstrap UCL	10.47	95% Percentile Bootstrap UCL	8.112
95% BCA Bootstrap UCL	8.358		
90% Chebyshev(Mean, Sd) UCL	8.993	95% Chebyshev(Mean, Sd) UCL	9.911
97.5% Chebyshev(Mean, Sd) UCL	11.19	99% Chebyshev(Mean, Sd) UCL	13.69
Suggested UCL to Use			
95% Adjusted Gamma UCL	8.194		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Copper

General Statistics			
Total Number of Observations	187	Number of Distinct Observations	34
		Number of Missing Observations	19
Minimum	2	Mean	38.15
Maximum	57	Median	39
SD	9.723	Std. Error of Mean	0.711
Coefficient of Variation	0.255	Skewness	-1.991
Normal GOF Test			
Shapiro Wilk Test Statistic	0.803	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.175	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0648	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	39.32	95% Adjusted-CLT UCL (Chen-1995)	39.2
		95% Modified-t UCL (Johnson-1978)	39.3
Gamma GOF Test			
A-D Test Statistic	25.33	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.755	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.282	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0671	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	5.765	k star (bias corrected MLE)	5.676
Theta hat (MLE)	6.616	Theta star (bias corrected MLE)	6.72
nu hat (MLE)	2156	nu star (bias corrected)	2123
MLE Mean (bias corrected)	38.15	MLE Sd (bias corrected)	16.01
		Approximate Chi Square Value (0.05)	2017
Adjusted Level of Significance	0.0487	Adjusted Chi Square Value	2016
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	40.15	95% Adjusted Gamma UCL (use when n<50)	40.17
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.46	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.334	**Lilliefors Lognormal GOF Test**	

5% Lilliefors Critical Value	0.0648	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.693	Mean of logged Data	3.552
Maximum of Logged Data	4.043	SD of logged Data	0.581
Assuming Lognormal Distribution			
95% H-UCL	44.71	90% Chebyshev (MVUE) UCL	46.92
95% Chebyshev (MVUE) UCL	49.49	97.5% Chebyshev (MVUE) UCL	53.05
99% Chebyshev (MVUE) UCL	60.04		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	39.31	95% Jackknife UCL	39.32
95% Standard Bootstrap UCL	39.28	95% Bootstrap-t UCL	39.21
95% Hall's Bootstrap UCL	39.23	95% Percentile Bootstrap UCL	39.29
95% BCA Bootstrap UCL	39.23		
90% Chebyshev(Mean, Sd) UCL	40.28	95% Chebyshev(Mean, Sd) UCL	41.24
97.5% Chebyshev(Mean, Sd) UCL	42.59	99% Chebyshev(Mean, Sd) UCL	45.22
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	41.24		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			
Fluoranthene			
General Statistics			
Total Number of Observations	23	Number of Distinct Observations	10
		Number of Missing Observations	180
Minimum	0.18	Mean	0.279
Maximum	0.99	Median	0.21
SD	0.206	Std. Error of Mean	0.043
Coefficient of Variation	0.739	Skewness	2.929
Normal GOF Test			
Shapiro Wilk Test Statistic	0.463	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.914	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.435	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.185	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			

Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.353	95% Adjusted-CLT UCL (Chen-1995)	0.378
		95% Modified-t UCL (Johnson-1978)	0.357
Gamma GOF Test			
A-D Test Statistic	4.995	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.749	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.406	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.182	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	3.837	k star (bias corrected MLE)	3.365
Theta hat (MLE)	0.0727	Theta star (bias corrected MLE)	0.0829
nu hat (MLE)	176.5	nu star (bias corrected)	154.8
MLE Mean (bias corrected)	0.279	MLE Sd (bias corrected)	0.152
		Approximate Chi Square Value (0.05)	127
Adjusted Level of Significance	0.0389	Adjusted Chi Square Value	125.2
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	0.34	95% Adjusted Gamma UCL (use when n<50)	0.345
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.557	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.914	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.391	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.185	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-1.715	Mean of logged Data	-1.413
Maximum of Logged Data	-0.0101	SD of logged Data	0.45
Assuming Lognormal Distribution			
95% H-UCL	0.324	90% Chebyshev (MVUE) UCL	0.346
95% Chebyshev (MVUE) UCL	0.381	97.5% Chebyshev (MVUE) UCL	0.43
99% Chebyshev (MVUE) UCL	0.527		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.35	95% Jackknife UCL	0.353
95% Standard Bootstrap UCL	0.348	95% Bootstrap-t UCL	0.53
95% Hall's Bootstrap UCL	0.45	95% Percentile Bootstrap UCL	0.351
95% BCA Bootstrap UCL	0.393		
90% Chebyshev(Mean, Sd) UCL	0.408	95% Chebyshev(Mean, Sd) UCL	0.466
97.5% Chebyshev(Mean, Sd) UCL	0.547	99% Chebyshev(Mean, Sd) UCL	0.706

Suggested UCL to Use			
95% Student's-t UCL	0.353	or 95% Modified-t UCL	0.357
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Lead			
General Statistics			
Total Number of Observations	187	Number of Distinct Observations	24
		Number of Missing Observations	19
Minimum	1.5	Mean	8.466
Maximum	220	Median	1.5
SD	25.19	Std. Error of Mean	1.842
Coefficient of Variation	2.975	Skewness	5.223
Normal GOF Test			
Shapiro Wilk Test Statistic	0.333	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.438	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0648	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	11.51	95% Adjusted-CLT UCL (Chen-1995)	12.25
		95% Modified-t UCL (Johnson-1978)	11.63
Gamma GOF Test			
A-D Test Statistic	49.3	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.82	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.506	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.0708	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.507	k star (bias corrected MLE)	0.503
Theta hat (MLE)	16.68	Theta star (bias corrected MLE)	16.83
nu hat (MLE)	189.8	nu star (bias corrected)	188.1
MLE Mean (bias corrected)	8.466	MLE Sd (bias corrected)	11.94
		Approximate Chi Square Value (0.05)	157.4
Adjusted Level of Significance	0.0487	Adjusted Chi Square Value	157.1
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	10.12	95% Adjusted Gamma UCL (use when n<50)	10.13
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.48	Shapiro Wilk Lognormal GOF Test	

5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.493	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0648	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.405	Mean of logged Data	0.887
Maximum of Logged Data	5.394	SD of logged Data	1.136
Assuming Lognormal Distribution			
95% H-UCL	5.608	90% Chebyshev (MVUE) UCL	6.057
95% Chebyshev (MVUE) UCL	6.715	97.5% Chebyshev (MVUE) UCL	7.627
99% Chebyshev (MVUE) UCL	9.419		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	11.5	95% Jackknife UCL	11.51
95% Standard Bootstrap UCL	11.52	95% Bootstrap-t UCL	12.76
95% Hall's Bootstrap UCL	12.3	95% Percentile Bootstrap UCL	11.89
95% BCA Bootstrap UCL	12.45		
90% Chebyshev(Mean, Sd) UCL	13.99	95% Chebyshev(Mean, Sd) UCL	16.5
97.5% Chebyshev(Mean, Sd) UCL	19.97	99% Chebyshev(Mean, Sd) UCL	26.79
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	16.5		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Mercury			
General Statistics			
Total Number of Observations	187	Number of Distinct Observations	4
		Number of Missing Observations	19
Minimum	0.033	Mean	19.68
Maximum	20	Median	20
SD	2.512	Std. Error of Mean	0.184
Coefficient of Variation	0.128	Skewness	-7.766
Normal GOF Test			
Shapiro Wilk Test Statistic	0.12	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.535	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0648	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			

Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	19.98	95% Adjusted-CLT UCL (Chen-1995)	19.87
		95% Modified-t UCL (Johnson-1978)	19.97
Gamma GOF Test			
A-D Test Statistic	72.29	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.754	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.552	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0671	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	6.49	k star (bias corrected MLE)	6.389
Theta hat (MLE)	3.032	Theta star (bias corrected MLE)	3.08
nu hat (MLE)	2427	nu star (bias corrected)	2390
MLE Mean (bias corrected)	19.68	MLE Sd (bias corrected)	7.786
		Approximate Chi Square Value (0.05)	2277
Adjusted Level of Significance	0.0487	Adjusted Chi Square Value	2276
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	20.65	95% Adjusted Gamma UCL (use when n<50)	20.66
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.123	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.534	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0648	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-3.411	Mean of logged Data	2.901
Maximum of Logged Data	2.996	SD of logged Data	0.749
Assuming Lognormal Distribution			
95% H-UCL	26.84	90% Chebyshev (MVUE) UCL	28.48
95% Chebyshev (MVUE) UCL	30.49	97.5% Chebyshev (MVUE) UCL	33.29
99% Chebyshev (MVUE) UCL	38.77		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	19.98	95% Jackknife UCL	19.98
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	20.23	95% Chebyshev(Mean, Sd) UCL	20.48
97.5% Chebyshev(Mean, Sd) UCL	20.83	99% Chebyshev(Mean, Sd) UCL	21.51
Suggested UCL to Use			

95% Chebyshev (Mean, Sd) UCL	20.48		
Recommended UCL exceeds the maximum observation			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			
Molybdenum			
General Statistics			
Total Number of Observations	187	Number of Distinct Observations	11
		Number of Missing Observations	19
Minimum	1.5	Mean	3.609
Maximum	41	Median	1.5
SD	7.741	Std. Error of Mean	0.566
Coefficient of Variation	2.145	Skewness	3.518
Normal GOF Test			
Shapiro Wilk Test Statistic	0.296	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.522	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0648	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	4.545	95% Adjusted-CLT UCL (Chen-1995)	4.696
		95% Modified-t UCL (Johnson-1978)	4.569
Gamma GOF Test			
A-D Test Statistic	65.97	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.789	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.55	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0693	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.889	k star (bias corrected MLE)	0.878
Theta hat (MLE)	4.059	Theta star (bias corrected MLE)	4.109
nu hat (MLE)	332.5	nu star (bias corrected)	328.5
MLE Mean (bias corrected)	3.609	MLE Sd (bias corrected)	3.851
		Approximate Chi Square Value (0.05)	287.5
Adjusted Level of Significance	0.0487	Adjusted Chi Square Value	287.2
Assuming Gamma Distribution			

95% Approximate Gamma UCL (use when n>=50))	4.123	95% Adjusted Gamma UCL (use when n<50)	4.128
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.298	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.526	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0648	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.405	Mean of logged Data	0.625
Maximum of Logged Data	3.714	SD of logged Data	0.777
Assuming Lognormal Distribution			
95% H-UCL	2.828	90% Chebyshev (MVUE) UCL	3.006
95% Chebyshev (MVUE) UCL	3.227	97.5% Chebyshev (MVUE) UCL	3.532
99% Chebyshev (MVUE) UCL	4.133		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	4.54	95% Jackknife UCL	4.545
95% Standard Bootstrap UCL	4.531	95% Bootstrap-t UCL	4.794
95% Hall's Bootstrap UCL	4.644	95% Percentile Bootstrap UCL	4.632
95% BCA Bootstrap UCL	4.807		
90% Chebyshev(Mean, Sd) UCL	5.307	95% Chebyshev(Mean, Sd) UCL	6.076
97.5% Chebyshev(Mean, Sd) UCL	7.144	99% Chebyshev(Mean, Sd) UCL	9.241
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	6.076		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
PCB, Total			
General Statistics			
Total Number of Observations	206	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	0.0125	Mean	2.237
Maximum	2.5	Median	2.5
SD	0.761	Std. Error of Mean	0.053
Coefficient of Variation	0.34	Skewness	-2.565
Normal GOF Test			
Shapiro Wilk Test Statistic	0.352	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	

Lilliefors Test Statistic	0.528	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0617	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2.325	95% Adjusted-CLT UCL (Chen-1995)	2.315
		95% Modified-t UCL (Johnson-1978)	2.323
Gamma GOF Test			
A-D Test Statistic	69.12	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.771	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.552	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0641	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.553	k star (bias corrected MLE)	1.534
Theta hat (MLE)	1.44	Theta star (bias corrected MLE)	1.459
nu hat (MLE)	640	nu star (bias corrected)	632
MLE Mean (bias corrected)	2.237	MLE Sd (bias corrected)	1.806
		Approximate Chi Square Value (0.05)	574.7
Adjusted Level of Significance	0.0488	Adjusted Chi Square Value	574.3
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	2.461	95% Adjusted Gamma UCL (use when n<50)	2.462
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.366	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.526	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0617	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-4.382	Mean of logged Data	0.45
Maximum of Logged Data	0.916	SD of logged Data	1.375
Assuming Lognormal Distribution			
95% H-UCL	5.128	90% Chebyshev (MVUE) UCL	5.575
95% Chebyshev (MVUE) UCL	6.287	97.5% Chebyshev (MVUE) UCL	7.275
99% Chebyshev (MVUE) UCL	9.216		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	2.325	95% Jackknife UCL	2.325
95% Standard Bootstrap UCL	2.328	95% Bootstrap-t UCL	2.321
95% Hall's Bootstrap UCL	2.319	95% Percentile Bootstrap UCL	2.321
95% BCA Bootstrap UCL	2.309		

90% Chebyshev(Mean, Sd) UCL	2.397	95% Chebyshev(Mean, Sd) UCL	2.469
97.5% Chebyshev(Mean, Sd) UCL	2.569	99% Chebyshev(Mean, Sd) UCL	2.765
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	2.469		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			
Phenanthrene			
General Statistics			
Total Number of Observations	23	Number of Distinct Observations	11
		Number of Missing Observations	180
Minimum	0.11	Mean	0.213
Maximum	0.37	Median	0.21
SD	0.044	Std. Error of Mean	0.00918
Coefficient of Variation	0.206	Skewness	1.55
Normal GOF Test			
Shapiro Wilk Test Statistic	0.745	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.914	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.267	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.185	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.229	95% Adjusted-CLT UCL (Chen-1995)	0.232
		95% Modified-t UCL (Johnson-1978)	0.23
Gamma GOF Test			
A-D Test Statistic	2.156	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.742	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.268	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.181	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	25.84	k star (bias corrected MLE)	22.5
Theta hat (MLE)	0.00825	Theta star (bias corrected MLE)	0.00948
nu hat (MLE)	1188	nu star (bias corrected)	1035
MLE Mean (bias corrected)	0.213	MLE Sd (bias corrected)	0.045
		Approximate Chi Square Value (0.05)	961.1
Adjusted Level of Significance	0.0389	Adjusted Chi Square Value	956

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	0.23	95% Adjusted Gamma UCL (use when n<50)	0.231
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.774	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.914	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.283	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.185	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-2.207	Mean of logged Data	-1.565
Maximum of Logged Data	-0.994	SD of logged Data	0.204
Assuming Lognormal Distribution			
95% H-UCL	0.231	90% Chebyshev (MVUE) UCL	0.241
95% Chebyshev (MVUE) UCL	0.253	97.5% Chebyshev (MVUE) UCL	0.27
99% Chebyshev (MVUE) UCL	0.304		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.228	95% Jackknife UCL	0.229
95% Standard Bootstrap UCL	0.228	95% Bootstrap-t UCL	0.233
95% Hall's Bootstrap UCL	0.255	95% Percentile Bootstrap UCL	0.229
95% BCA Bootstrap UCL	0.232		
90% Chebyshev(Mean, Sd) UCL	0.241	95% Chebyshev(Mean, Sd) UCL	0.253
97.5% Chebyshev(Mean, Sd) UCL	0.271	99% Chebyshev(Mean, Sd) UCL	0.305
Suggested UCL to Use			
95% Student's-t UCL	0.229	or 95% Modified-t UCL	0.23
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Pyrene			
General Statistics			
Total Number of Observations	23	Number of Distinct Observations	11
		Number of Missing Observations	180
Minimum	0.14	Mean	0.284
Maximum	1.2	Median	0.21
SD	0.241	Std. Error of Mean	0.0502
Coefficient of Variation	0.847	Skewness	3.32
Normal GOF Test			

Shapiro Wilk Test Statistic	0.433	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.914	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.434	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.185	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.37	95% Adjusted-CLT UCL (Chen-1995)	0.404
		95% Modified-t UCL (Johnson-1978)	0.376
Gamma GOF Test			
A-D Test Statistic	4.954	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.75	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.4	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.183	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	3.306	k star (bias corrected MLE)	2.904
Theta hat (MLE)	0.086	Theta star (bias corrected MLE)	0.0979
nu hat (MLE)	152.1	nu star (bias corrected)	133.6
MLE Mean (bias corrected)	0.284	MLE Sd (bias corrected)	0.167
		Approximate Chi Square Value (0.05)	107.9
Adjusted Level of Significance	0.0389	Adjusted Chi Square Value	106.2
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	0.352	95% Adjusted Gamma UCL (use when n<50)	0.357
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.574	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.914	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.361	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.185	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-1.966	Mean of logged Data	-1.417
Maximum of Logged Data	0.182	SD of logged Data	0.474
Assuming Lognormal Distribution			
95% H-UCL	0.33	90% Chebyshev (MVUE) UCL	0.353
95% Chebyshev (MVUE) UCL	0.39	97.5% Chebyshev (MVUE) UCL	0.442
99% Chebyshev (MVUE) UCL	0.544		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.367	95% Jackknife UCL	0.37
95% Standard Bootstrap UCL	0.365	95% Bootstrap-t UCL	0.843

95% Hall's Bootstrap UCL	0.814	95% Percentile Bootstrap UCL	0.375
95% BCA Bootstrap UCL	0.422		
90% Chebyshev(Mean, Sd) UCL	0.435	95% Chebyshev(Mean, Sd) UCL	0.503
97.5% Chebyshev(Mean, Sd) UCL	0.597	99% Chebyshev(Mean, Sd) UCL	0.783
Suggested UCL to Use			
95% Student's-t UCL	0.37	or 95% Modified-t UCL	0.376
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Selenium			
General Statistics			
Total Number of Observations	187	Number of Distinct Observations	5
		Number of Missing Observations	19
Minimum	0.5	Mean	1.583
Maximum	9.7	Median	1.5
SD	0.847	Std. Error of Mean	0.0619
Coefficient of Variation	0.535	Skewness	9.472
Normal GOF Test			
Shapiro Wilk Test Statistic	0.113	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.523	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0648	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1.685	95% Adjusted-CLT UCL (Chen-1995)	1.73
		95% Modified-t UCL (Johnson-1978)	1.692
Gamma GOF Test			
A-D Test Statistic	5.348E+28	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.751	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.523	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0669	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	12.92	k star (bias corrected MLE)	12.71
Theta hat (MLE)	0.123	Theta star (bias corrected MLE)	0.124
nu hat (MLE)	4831	nu star (bias corrected)	4755
MLE Mean (bias corrected)	1.583	MLE Sd (bias corrected)	0.444
		Approximate Chi Square Value (0.05)	4595
Adjusted Level of Significance	0.0487	Adjusted Chi Square Value	4594

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1.637	95% Adjusted Gamma UCL (use when n<50)	1.638
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.156	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.511	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0648	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-0.693	Mean of logged Data	0.42
Maximum of Logged Data	2.272	SD of logged Data	0.209
Assuming Lognormal Distribution			
95% H-UCL	1.596	90% Chebyshev (MVUE) UCL	1.627
95% Chebyshev (MVUE) UCL	1.66	97.5% Chebyshev (MVUE) UCL	1.705
99% Chebyshev (MVUE) UCL	1.794		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1.684	95% Jackknife UCL	1.685
95% Standard Bootstrap UCL	1.683	95% Bootstrap-t UCL	2.601
95% Hall's Bootstrap UCL	3.358	95% Percentile Bootstrap UCL	1.703
95% BCA Bootstrap UCL	1.746		
90% Chebyshev(Mean, Sd) UCL	1.768	95% Chebyshev(Mean, Sd) UCL	1.853
97.5% Chebyshev(Mean, Sd) UCL	1.969	99% Chebyshev(Mean, Sd) UCL	2.199
Suggested UCL to Use			
95% Student's-t UCL	1.685	or 95% Modified-t UCL	1.692
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Silver			
General Statistics			
Total Number of Observations	187	Number of Distinct Observations	7
		Number of Missing Observations	19
Minimum	1.205	Mean	25.12
Maximum	59	Median	25
SD	4.949	Std. Error of Mean	0.362
Coefficient of Variation	0.197	Skewness	2.24
Normal GOF Test			
Shapiro Wilk Test Statistic	0.237	**Shapiro Wilk GOF Test**	

5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.494	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0648	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	25.72	95% Adjusted-CLT UCL (Chen-1995)	25.78
		95% Modified-t UCL (Johnson-1978)	25.73
Gamma GOF Test			
A-D Test Statistic	66.21	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.751	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.513	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0669	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	13.41	k star (bias corrected MLE)	13.2
Theta hat (MLE)	1.873	Theta star (bias corrected MLE)	1.903
nu hat (MLE)	5015	nu star (bias corrected)	4936
MLE Mean (bias corrected)	25.12	MLE Sd (bias corrected)	6.915
		Approximate Chi Square Value (0.05)	4773
Adjusted Level of Significance	0.0487	Adjusted Chi Square Value	4772
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	25.97	95% Adjusted Gamma UCL (use when n<50)	25.98
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.185	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.519	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0648	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.186	Mean of logged Data	3.186
Maximum of Logged Data	4.078	SD of logged Data	0.377
Assuming Lognormal Distribution			
95% H-UCL	27.26	90% Chebyshev (MVUE) UCL	28.18
95% Chebyshev (MVUE) UCL	29.19	97.5% Chebyshev (MVUE) UCL	30.58
99% Chebyshev (MVUE) UCL	33.33		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	25.72	95% Jackknife UCL	25.72
95% Standard Bootstrap UCL	25.71	95% Bootstrap-t UCL	25.88
95% Hall's Bootstrap UCL	26.28	95% Percentile Bootstrap UCL	25.71

95% BCA Bootstrap UCL	25.84		
90% Chebyshev(Mean, Sd) UCL	26.21	95% Chebyshev(Mean, Sd) UCL	26.7
97.5% Chebyshev(Mean, Sd) UCL	27.38	99% Chebyshev(Mean, Sd) UCL	28.72
Suggested UCL to Use			
95% Student's-t UCL	25.72	or 95% Modified-t UCL	25.73
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Thallium			
General Statistics			
Total Number of Observations	24	Number of Distinct Observations	15
		Number of Missing Observations	179
Minimum	0.086	Mean	1.346
Maximum	10	Median	0.14
SD	3.258	Std. Error of Mean	0.665
Coefficient of Variation	2.42	Skewness	2.423
Normal GOF Test			
Shapiro Wilk Test Statistic	0.403	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.916	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.511	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.181	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2.486	95% Adjusted-CLT UCL (Chen-1995)	2.791
		95% Modified-t UCL (Johnson-1978)	2.541
Gamma GOF Test			
A-D Test Statistic	6.506	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.833	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.496	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.191	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.38	k star (bias corrected MLE)	0.36
Theta hat (MLE)	3.546	Theta star (bias corrected MLE)	3.74
nu hat (MLE)	18.22	nu star (bias corrected)	17.28
MLE Mean (bias corrected)	1.346	MLE Sd (bias corrected)	2.244
		Approximate Chi Square Value (0.05)	8.869
Adjusted Level of Significance	0.0392	Adjusted Chi Square Value	8.446
Assuming Gamma Distribution			

95% Approximate Gamma UCL (use when n>=50))	2.622	95% Adjusted Gamma UCL (use when n<50)	2.753
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.531	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.916	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.405	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.181	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-2.453	Mean of logged Data	-1.451
Maximum of Logged Data	2.303	SD of logged Data	1.456
Assuming Lognormal Distribution			
95% H-UCL	1.79	90% Chebyshev (MVUE) UCL	1.301
95% Chebyshev (MVUE) UCL	1.608	97.5% Chebyshev (MVUE) UCL	2.034
99% Chebyshev (MVUE) UCL	2.872		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	2.44	95% Jackknife UCL	2.486
95% Standard Bootstrap UCL	2.417	95% Bootstrap-t UCL	2.708
95% Hall's Bootstrap UCL	2.051	95% Percentile Bootstrap UCL	2.549
95% BCA Bootstrap UCL	2.944		
90% Chebyshev(Mean, Sd) UCL	3.341	95% Chebyshev(Mean, Sd) UCL	4.245
97.5% Chebyshev(Mean, Sd) UCL	5.499	99% Chebyshev(Mean, Sd) UCL	7.963
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	4.245		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Trichloroethene			
General Statistics			
Total Number of Observations	2	Number of Distinct Observations	1
		Number of Missing Observations	20
Minimum	0.0025	Mean	0.0025
Maximum	0.0025	Median	0.0025
Warning: This data set only has 2 observations!			
Data set is too small to compute reliable and meaningful statistics and estimates!			
The data set for variable Trichloroethene was not processed!			
It is suggested to collect at least 8 to 10 observations before using these statistical methods!			

If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.			
Uranium			
General Statistics			
Total Number of Observations	187	Number of Distinct Observations	17
		Number of Missing Observations	20
Minimum	0.483	Mean	6.835
Maximum	134	Median	5
SD	13.42	Std. Error of Mean	0.981
Coefficient of Variation	1.963	Skewness	8.094
Normal GOF Test			
Shapiro Wilk Test Statistic	0.154	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.48	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0648	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	8.457	95% Adjusted-CLT UCL (Chen-1995)	9.07
		95% Modified-t UCL (Johnson-1978)	8.554
Gamma GOF Test			
A-D Test Statistic	62.4	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.766	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.503	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0678	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.115	k star (bias corrected MLE)	2.085
Theta hat (MLE)	3.231	Theta star (bias corrected MLE)	3.278
nu hat (MLE)	791.1	nu star (bias corrected)	779.7
MLE Mean (bias corrected)	6.835	MLE Sd (bias corrected)	4.734
		Approximate Chi Square Value (0.05)	715.9
Adjusted Level of Significance	0.0487	Adjusted Chi Square Value	715.4
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	7.444	95% Adjusted Gamma UCL (use when n<50)	7.449
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.296	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.476	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0648	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			

Lognormal Statistics			
Minimum of Logged Data	-0.728	Mean of logged Data	1.667
Maximum of Logged Data	4.898	SD of logged Data	0.453
Assuming Lognormal Distribution			
95% H-UCL	6.231	90% Chebyshev (MVUE) UCL	6.479
95% Chebyshev (MVUE) UCL	6.755	97.5% Chebyshev (MVUE) UCL	7.14
99% Chebyshev (MVUE) UCL	7.894		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	8.449	95% Jackknife UCL	8.457
95% Standard Bootstrap UCL	8.439	95% Bootstrap-t UCL	16.56
95% Hall's Bootstrap UCL	8.214	95% Percentile Bootstrap UCL	8.575
95% BCA Bootstrap UCL	9.216		
90% Chebyshev(Mean, Sd) UCL	9.779	95% Chebyshev(Mean, Sd) UCL	11.11
97.5% Chebyshev(Mean, Sd) UCL	12.96	99% Chebyshev(Mean, Sd) UCL	16.6
Suggested UCL to Use			
95% Student's-t UCL	8.457	or 95% Modified-t UCL	8.554
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Vanadium			
General Statistics			
Total Number of Observations	187	Number of Distinct Observations	68
		Number of Missing Observations	19
Minimum	2.5	Mean	105.1
Maximum	151	Median	109
SD	24.92	Std. Error of Mean	1.823
Coefficient of Variation	0.237	Skewness	-1.99
Normal GOF Test			
Shapiro Wilk Test Statistic	0.828	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.146	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0648	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	108.1	95% Adjusted-CLT UCL (Chen-1995)	107.8
		95% Modified-t UCL (Johnson-1978)	108.1

Gamma GOF Test			
A-D Test Statistic	23.81	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.755	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.279	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.0671	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	6.13	k star (bias corrected MLE)	6.036
Theta hat (MLE)	17.15	Theta star (bias corrected MLE)	17.42
nu hat (MLE)	2293	nu star (bias corrected)	2257
MLE Mean (bias corrected)	105.1	MLE Sd (bias corrected)	42.79
		Approximate Chi Square Value (0.05)	2148
Adjusted Level of Significance	0.0487	Adjusted Chi Square Value	2147
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	110.5	95% Adjusted Gamma UCL (use when n<50)	110.5
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.418	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.331	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.0648	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.916	Mean of logged Data	4.571
Maximum of Logged Data	5.017	SD of logged Data	0.597
Assuming Lognormal Distribution			
95% H-UCL	125.4	90% Chebyshev (MVUE) UCL	131.8
95% Chebyshev (MVUE) UCL	139.2	97.5% Chebyshev (MVUE) UCL	149.5
99% Chebyshev (MVUE) UCL	169.7		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	108.1	95% Jackknife UCL	108.1
95% Standard Bootstrap UCL	108.2	95% Bootstrap-t UCL	107.7
95% Hall's Bootstrap UCL	107.9	95% Percentile Bootstrap UCL	108
95% BCA Bootstrap UCL	107.9		
90% Chebyshev(Mean, Sd) UCL	110.6	95% Chebyshev(Mean, Sd) UCL	113.1
97.5% Chebyshev(Mean, Sd) UCL	116.5	99% Chebyshev(Mean, Sd) UCL	123.2
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	113.1		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			

For additional insight the user may want to consult a statistician.
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

UCL Statistics for Uncensored Full Data Sets			
User Selected Options			
Date/Time of Computation	3/11/2015 12:07:48 PM		
From File	Eco2_AOC204.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
Aluminum			
General Statistics			
Total Number of Observations	24	Number of Distinct Observations	21
		Number of Missing Observations	160
Minimum	4600	Mean	8242
Maximum	13700	Median	8100
SD	2084	Std. Error of Mean	425.5
Coefficient of Variation	0.253	Skewness	0.603
Normal GOF Test			
Shapiro Wilk Test Statistic	0.97	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.916	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.0985	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.181	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	8971	95% Adjusted-CLT UCL (Chen-1995)	8998
		95% Modified-t UCL (Johnson-1978)	8980
Gamma GOF Test			
A-D Test Statistic	0.188	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.743	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0928	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.178	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	16.45	k star (bias corrected MLE)	14.42
Theta hat (MLE)	501.1	Theta star (bias corrected MLE)	571.6
nu hat (MLE)	789.5	nu star (bias corrected)	692.1
MLE Mean (bias corrected)	8242	MLE Sd (bias corrected)	2171
		Approximate Chi Square Value (0.05)	632.1
Adjusted Level of Significance	0.0392	Adjusted Chi Square Value	628.1
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	9025	95% Adjusted Gamma UCL (use when n<50)	9083
Lognormal GOF Test			

Shapiro Wilk Test Statistic	0.982	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.916	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.11	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.181	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	8.434	Mean of logged Data	8.986
Maximum of Logged Data	9.525	SD of logged Data	0.255
Assuming Lognormal Distribution			
95% H-UCL	9087	90% Chebyshev (MVUE) UCL	9550
95% Chebyshev (MVUE) UCL	10140	97.5% Chebyshev (MVUE) UCL	10960
99% Chebyshev (MVUE) UCL	12570		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	8942	95% Jackknife UCL	8971
95% Standard Bootstrap UCL	8943	95% Bootstrap-t UCL	9026
95% Hall's Bootstrap UCL	9112	95% Percentile Bootstrap UCL	8939
95% BCA Bootstrap UCL	9067		
90% Chebyshev(Mean, Sd) UCL	9518	95% Chebyshev(Mean, Sd) UCL	10097
97.5% Chebyshev(Mean, Sd) UCL	10899	99% Chebyshev(Mean, Sd) UCL	12475
Suggested UCL to Use			
95% Student's-t UCL	8971		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Manganese			
General Statistics			
Total Number of Observations	187	Number of Distinct Observations	163
		Number of Missing Observations	0
Minimum	181	Mean	518.3
Maximum	1939	Median	473
SD	233.9	Std. Error of Mean	17.11
Coefficient of Variation	0.451	Skewness	2.268
Normal GOF Test			
Shapiro Wilk Test Statistic	0.844	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.126	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0648	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			

Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	546.6	95% Adjusted-CLT UCL (Chen-1995)	549.4
		95% Modified-t UCL (Johnson-1978)	547
Gamma GOF Test			
A-D Test Statistic	1.475	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.755	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0739	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0671	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	6.316	k star (bias corrected MLE)	6.218
Theta hat (MLE)	82.06	Theta star (bias corrected MLE)	83.35
nu hat (MLE)	2362	nu star (bias corrected)	2326
MLE Mean (bias corrected)	518.3	MLE Sd (bias corrected)	207.8
		Approximate Chi Square Value (0.05)	2215
Adjusted Level of Significance	0.0487	Adjusted Chi Square Value	2214
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	544.3	95% Adjusted Gamma UCL (use when n<50)	544.5
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.981	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0.414	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0588	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0648	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	5.198	Mean of logged Data	6.169
Maximum of Logged Data	7.57	SD of logged Data	0.394
Assuming Lognormal Distribution			
95% H-UCL	543.5	90% Chebyshev (MVUE) UCL	562.5
95% Chebyshev (MVUE) UCL	583.5	97.5% Chebyshev (MVUE) UCL	612.6
99% Chebyshev (MVUE) UCL	669.8		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	546.4	95% Jackknife UCL	546.6
95% Standard Bootstrap UCL	546.5	95% Bootstrap-t UCL	549.9
95% Hall's Bootstrap UCL	551.7	95% Percentile Bootstrap UCL	548.4
95% BCA Bootstrap UCL	550.2		
90% Chebyshev(Mean, Sd) UCL	569.6	95% Chebyshev(Mean, Sd) UCL	592.8
97.5% Chebyshev(Mean, Sd) UCL	625.1	99% Chebyshev(Mean, Sd) UCL	688.5

Suggested UCL to Use			
95% Student's-t UCL	546.6	or 95% Modified-t UCL	547
or 95% H-UCL	543.5		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
ProUCL computes and outputs H-statistic based UCLs for historical reasons only.			
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.			
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.			
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.			
Uranium-238			
General Statistics			
Total Number of Observations	25	Number of Distinct Observations	25
		Number of Missing Observations	164
Minimum	0.168	Mean	2.365
Maximum	5.37	Median	2.31
SD	1.196	Std. Error of Mean	0.239
Coefficient of Variation	0.506	Skewness	0.422
Normal GOF Test			
Shapiro Wilk Test Statistic	0.982	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.918	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.095	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.177	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2.774	95% Adjusted-CLT UCL (Chen-1995)	2.78
		95% Modified-t UCL (Johnson-1978)	2.777
Gamma GOF Test			
A-D Test Statistic	0.607	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.752	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.155	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.176	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.81	k star (bias corrected MLE)	2.499
Theta hat (MLE)	0.842	Theta star (bias corrected MLE)	0.946
nu hat (MLE)	140.5	nu star (bias corrected)	125
MLE Mean (bias corrected)	2.365	MLE Sd (bias corrected)	1.496
		Approximate Chi Square Value (0.05)	100.1
Adjusted Level of Significance	0.0395	Adjusted Chi Square Value	98.63

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	2.951	95% Adjusted Gamma UCL (use when n<50)	2.996
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.831	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.918	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.203	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.177	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-1.784	Mean of logged Data	0.672
Maximum of Logged Data	1.681	SD of logged Data	0.751
Assuming Lognormal Distribution			
95% H-UCL	3.638	90% Chebyshev (MVUE) UCL	3.813
95% Chebyshev (MVUE) UCL	4.381	97.5% Chebyshev (MVUE) UCL	5.168
99% Chebyshev (MVUE) UCL	6.715		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	2.758	95% Jackknife UCL	2.774
95% Standard Bootstrap UCL	2.754	95% Bootstrap-t UCL	2.778
95% Hall's Bootstrap UCL	2.832	95% Percentile Bootstrap UCL	2.744
95% BCA Bootstrap UCL	2.798		
90% Chebyshev(Mean, Sd) UCL	3.083	95% Chebyshev(Mean, Sd) UCL	3.408
97.5% Chebyshev(Mean, Sd) UCL	3.859	99% Chebyshev(Mean, Sd) UCL	4.745
Suggested UCL to Use			
95% Student's-t UCL	2.774		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Zinc			
General Statistics			
Total Number of Observations	187	Number of Distinct Observations	73
		Number of Missing Observations	0
Minimum	27.8	Mean	75.99
Maximum	869	Median	64
SD	65.4	Std. Error of Mean	4.782
Coefficient of Variation	0.861	Skewness	9.897
Normal GOF Test			

Shapiro Wilk Test Statistic	0.374	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.282	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0648	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	83.9	95% Adjusted-CLT UCL (Chen-1995)	87.56
		95% Modified-t UCL (Johnson-1978)	84.47
Gamma GOF Test			
A-D Test Statistic	5.348E+28	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.756	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.173	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0672	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	4.89	k star (bias corrected MLE)	4.815
Theta hat (MLE)	15.54	Theta star (bias corrected MLE)	15.78
nu hat (MLE)	1829	nu star (bias corrected)	1801
MLE Mean (bias corrected)	75.99	MLE Sd (bias corrected)	34.63
		Approximate Chi Square Value (0.05)	1703
Adjusted Level of Significance	0.0487	Adjusted Chi Square Value	1703
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	80.35	95% Adjusted Gamma UCL (use when n<50)	80.38
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.883	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.127	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0648	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	3.325	Mean of logged Data	4.225
Maximum of Logged Data	6.767	SD of logged Data	0.381
Assuming Lognormal Distribution			
95% H-UCL	77.2	90% Chebyshev (MVUE) UCL	79.82
95% Chebyshev (MVUE) UCL	82.7	97.5% Chebyshev (MVUE) UCL	86.69
99% Chebyshev (MVUE) UCL	94.53		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	83.86	95% Jackknife UCL	83.9
95% Standard Bootstrap UCL	84.08	95% Bootstrap-t UCL	92.33

95% Hall's Bootstrap UCL	116.1	95% Percentile Bootstrap UCL	85.01
95% BCA Bootstrap UCL	89.75		
90% Chebyshev(Mean, Sd) UCL	90.34	95% Chebyshev(Mean, Sd) UCL	96.84
97.5% Chebyshev(Mean, Sd) UCL	105.9	99% Chebyshev(Mean, Sd) UCL	123.6
Suggested UCL to Use			
95% Student's-t UCL	83.9	or 95% Modified-t UCL	84.47
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			

UCL Statistics for Uncensored Full Data Sets			
User Selected Options			
Date/Time of Computation	3/4/2015 4:30:00 PM		
From File	211_UCL95.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
Antimony			
General Statistics			
Total Number of Observations	6	Number of Distinct Observations	2
		Number of Missing Observations	13
Minimum	15	Mean	23.37
Maximum	65.23	Median	15
SD	20.51	Std. Error of Mean	8.372
Coefficient of Variation	0.877	Skewness	2.449
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.496	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.492	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.362	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	40.24	95% Adjusted-CLT UCL (Chen-1995)	46.09
		95% Modified-t UCL (Johnson-1978)	41.64
Gamma GOF Test			
A-D Test Statistic	1.732	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.702	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.512	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.335	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.674	k star (bias corrected MLE)	1.448
Theta hat (MLE)	8.741	Theta star (bias corrected MLE)	16.14
nu hat (MLE)	32.09	nu star (bias corrected)	17.38
MLE Mean (bias corrected)	23.37	MLE Sd (bias corrected)	19.42
		Approximate Chi Square Value (0.05)	8.942
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	6.87

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	45.42	95% Adjusted Gamma UCL (use when n<50)	59.11
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.496	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.492	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.362	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	2.708	Mean of logged Data	2.953
Maximum of Logged Data	4.178	SD of logged Data	0.6
Assuming Lognormal Distribution			
95% H-UCL	49.86	90% Chebyshev (MVUE) UCL	38.47
95% Chebyshev (MVUE) UCL	45.84	97.5% Chebyshev (MVUE) UCL	56.07
99% Chebyshev (MVUE) UCL	76.16		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	37.14	95% Jackknife UCL	N/A
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	48.49	95% Chebyshev(Mean, Sd) UCL	59.86
97.5% Chebyshev(Mean, Sd) UCL	75.65	99% Chebyshev(Mean, Sd) UCL	106.7
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	59.86		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Barium			
General Statistics			
Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	13
Minimum	50	Mean	171.5
Maximum	454.8	Median	104.1
SD	158.6	Std. Error of Mean	64.75
Coefficient of Variation	0.925	Skewness	1.463
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			

guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.81	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.317	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.362	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	301.9	95% Adjusted-CLT UCL (Chen-1995)	319.3
		95% Modified-t UCL (Johnson-1978)	308.4
Gamma GOF Test			
A-D Test Statistic	0.405	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.707	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.27	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.337	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.664	k star (bias corrected MLE)	0.943
Theta hat (MLE)	103.1	Theta star (bias corrected MLE)	181.8
nu hat (MLE)	19.97	nu star (bias corrected)	11.32
MLE Mean (bias corrected)	171.5	MLE Sd (bias corrected)	176.6
		Approximate Chi Square Value (0.05)	4.78
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	3.37
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	405.9	95% Adjusted Gamma UCL (use when n<50)	575.7
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.918	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.218	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.362	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	3.912	Mean of logged Data	4.815
Maximum of Logged Data	6.12	SD of logged Data	0.872
Assuming Lognormal Distribution			
95% H-UCL	759.9	90% Chebyshev (MVUE) UCL	343.6
95% Chebyshev (MVUE) UCL	423.6	97.5% Chebyshev (MVUE) UCL	534.6
99% Chebyshev (MVUE) UCL	752.6		
Nonparametric Distribution Free UCL Statistics			

Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	278	95% Jackknife UCL	301.9
95% Standard Bootstrap UCL	267.8	95% Bootstrap-t UCL	706.5
95% Hall's Bootstrap UCL	990.7	95% Percentile Bootstrap UCL	271.3
95% BCA Bootstrap UCL	297.6		
90% Chebyshev(Mean, Sd) UCL	365.7	95% Chebyshev(Mean, Sd) UCL	453.7
97.5% Chebyshev(Mean, Sd) UCL	575.8	99% Chebyshev(Mean, Sd) UCL	815.7
Suggested UCL to Use			
95% Student's-t UCL	301.9		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Benzo(a)pyrene			
General Statistics			
Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	8
Minimum	0.07	Mean	0.162
Maximum	0.21	Median	0.205
SD	0.0794	Std. Error of Mean	0.0459
Coefficient of Variation	0.491	Skewness	-1.724
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.777	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.374	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.296	95% Adjusted-CLT UCL (Chen-1995)	0.188
		95% Modified-t UCL (Johnson-1978)	0.288
Gamma GOF Test			
Not Enough Data to Perform GOF Test			
Gamma Statistics			
k hat (MLE)	4.598	k star (bias corrected MLE)	N/A

Theta hat (MLE)	0.0352	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	27.59	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.766	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.378	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level	
Data appear Approximate Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-2.659	Mean of logged Data	-1.935
Maximum of Logged Data	-1.561	SD of logged Data	0.627
Assuming Lognormal Distribution			
95% H-UCL	6.59	90% Chebyshev (MVUE) UCL	0.334
95% Chebyshev (MVUE) UCL	0.411	97.5% Chebyshev (MVUE) UCL	0.518
99% Chebyshev (MVUE) UCL	0.728		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.237	95% Jackknife UCL	0.296
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	0.299	95% Chebyshev(Mean, Sd) UCL	0.362
97.5% Chebyshev(Mean, Sd) UCL	0.448	99% Chebyshev(Mean, Sd) UCL	0.618
Suggested UCL to Use			
95% Student's-t UCL	0.296		
Recommended UCL exceeds the maximum observation			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			
Cadmium			

General Statistics			
Total Number of Observations	6	Number of Distinct Observations	1
		Number of Missing Observations	13
Minimum	6	Mean	6
Maximum	6	Median	6

Warning: There is only one distinct observation value in this data set - resulting in '0' variance!

ProUCL (or any other software) should not be used on such a data set!

The data set for variable Cadmium was not processed!

It is suggested to collect at least 8 to 10 observations using these statistical methods!

If possible, compute and collect Data Quality Objectives (DQOs) based sample size and analytical results.

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

Chromium

General Statistics			
Total Number of Observations	9	Number of Distinct Observations	6
		Number of Missing Observations	10
Minimum	6	Mean	27.89
Maximum	44.75	Median	32.67
SD	16.95	Std. Error of Mean	5.65
Coefficient of Variation	0.608	Skewness	-0.631

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use

guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.783	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.829	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.27	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.295	Data appear Normal at 5% Significance Level	
Data appear Approximate Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	38.39	95% Adjusted-CLT UCL (Chen-1995)	35.91
		95% Modified-t UCL (Johnson-1978)	38.2
Gamma GOF Test			
A-D Test Statistic	1.253	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.731	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.341	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.283	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics			
k hat (MLE)	1.833	k star (bias corrected MLE)	1.296
Theta hat (MLE)	15.21	Theta star (bias corrected MLE)	21.51
nu hat (MLE)	33	nu star (bias corrected)	23.33
MLE Mean (bias corrected)	27.89	MLE Sd (bias corrected)	24.49
		Approximate Chi Square Value (0.05)	13.34
Adjusted Level of Significance	0.0231	Adjusted Chi Square Value	11.78
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	48.77	95% Adjusted Gamma UCL (use when n<50)	55.24
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.703	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.349	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.295	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.792	Mean of logged Data	3.031
Maximum of Logged Data	3.801	SD of logged Data	0.936
Assuming Lognormal Distribution			
95% H-UCL	89.62	90% Chebyshev (MVUE) UCL	59.39
95% Chebyshev (MVUE) UCL	72.62	97.5% Chebyshev (MVUE) UCL	90.98
99% Chebyshev (MVUE) UCL	127.1		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	37.18	95% Jackknife UCL	38.39
95% Standard Bootstrap UCL	36.7	95% Bootstrap-t UCL	37.42
95% Hall's Bootstrap UCL	35.06	95% Percentile Bootstrap UCL	36.51
95% BCA Bootstrap UCL	35.09		
90% Chebyshev(Mean, Sd) UCL	44.84	95% Chebyshev(Mean, Sd) UCL	52.51
97.5% Chebyshev(Mean, Sd) UCL	63.17	99% Chebyshev(Mean, Sd) UCL	84.1
Suggested UCL to Use			
95% Student's-t UCL	38.39		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			
Copper			

General Statistics			
Total Number of Observations	9	Number of Distinct Observations	4
		Number of Missing Observations	10
Minimum	2	Mean	20.44
Maximum	39	Median	17.5
SD	11.43	Std. Error of Mean	3.809
Coefficient of Variation	0.559	Skewness	0.578
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.774	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.829	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.379	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.295	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	27.53	95% Adjusted-CLT UCL (Chen-1995)	27.49
		95% Modified-t UCL (Johnson-1978)	27.65
Gamma GOF Test			
A-D Test Statistic	1.236	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.729	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.382	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.282	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.413	k star (bias corrected MLE)	1.683
Theta hat (MLE)	8.474	Theta star (bias corrected MLE)	12.15
nu hat (MLE)	43.43	nu star (bias corrected)	30.29
MLE Mean (bias corrected)	20.44	MLE Sd (bias corrected)	15.76
		Approximate Chi Square Value (0.05)	18.72
Adjusted Level of Significance	0.0231	Adjusted Chi Square Value	16.83
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	33.08	95% Adjusted Gamma UCL (use when n<50)	36.8
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.677	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.829	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.419	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.295	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			

Lognormal Statistics			
Minimum of Logged Data	0.693	Mean of logged Data	2.796
Maximum of Logged Data	3.664	SD of logged Data	0.859
Assuming Lognormal Distribution			
95% H-UCL	57.83	90% Chebyshev (MVUE) UCL	42.49
95% Chebyshev (MVUE) UCL	51.53	97.5% Chebyshev (MVUE) UCL	64.08
99% Chebyshev (MVUE) UCL	88.74		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	26.71	95% Jackknife UCL	27.53
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	31.87	95% Chebyshev(Mean, Sd) UCL	37.05
97.5% Chebyshev(Mean, Sd) UCL	44.23	99% Chebyshev(Mean, Sd) UCL	58.35
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	37.05		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Fluoranthene			
General Statistics			
Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	8
Minimum	0.11	Mean	0.175
Maximum	0.21	Median	0.205
SD	0.0563	Std. Error of Mean	0.0325
Coefficient of Variation	0.322	Skewness	-1.717
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.787	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.369	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			

Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.27	95% Adjusted-CLT UCL (Chen-1995)	0.194
		95% Modified-t UCL (Johnson-1978)	0.265
Gamma GOF Test			
Not Enough Data to Perform GOF Test			
Gamma Statistics			
k hat (MLE)	12.28	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0142	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	73.71	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.778	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.374	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-2.207	Mean of logged Data	-1.784
Maximum of Logged Data	-1.561	SD of logged Data	0.367
Assuming Lognormal Distribution			
95% H-UCL	0.626	90% Chebyshev (MVUE) UCL	0.285
95% Chebyshev (MVUE) UCL	0.335	97.5% Chebyshev (MVUE) UCL	0.404
99% Chebyshev (MVUE) UCL	0.539		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.229	95% Jackknife UCL	0.27
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	0.273	95% Chebyshev(Mean, Sd) UCL	0.317
97.5% Chebyshev(Mean, Sd) UCL	0.378	99% Chebyshev(Mean, Sd) UCL	0.499
Suggested UCL to Use			
95% Student's-t UCL	0.27		
Recommended UCL exceeds the maximum observation			

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Lead

General Statistics

Total Number of Observations	9	Number of Distinct Observations	7
		Number of Missing Observations	10
Minimum	1.5	Mean	12.35
Maximum	24.06	Median	15.72
SD	8.94	Std. Error of Mean	2.98
Coefficient of Variation	0.724	Skewness	-0.295

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.859	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.221	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.295	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	17.9	95% Adjusted-CLT UCL (Chen-1995)	16.94
		95% Modified-t UCL (Johnson-1978)	17.85

Gamma GOF Test

A-D Test Statistic	0.999	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.74	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.274	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.286	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.175	k star (bias corrected MLE)	0.857
Theta hat (MLE)	10.52	Theta star (bias corrected MLE)	14.41
nu hat (MLE)	21.15	nu star (bias corrected)	15.43
MLE Mean (bias corrected)	12.35	MLE Sd (bias corrected)	13.34
		Approximate Chi Square Value (0.05)	7.562
Adjusted Level of Significance	0.0231	Adjusted Chi Square Value	6.435

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	25.21	95% Adjusted Gamma UCL (use when n<50)	29.62
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.743	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.275	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.295	Data appear Lognormal at 5% Significance Level	
Data appear Approximate Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.405	Mean of logged Data	2.031
Maximum of Logged Data	3.181	SD of logged Data	1.242
Assuming Lognormal Distribution			
95% H-UCL	87.48	90% Chebyshev (MVUE) UCL	33.26
95% Chebyshev (MVUE) UCL	41.75	97.5% Chebyshev (MVUE) UCL	53.53
99% Chebyshev (MVUE) UCL	76.67		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	17.26	95% Jackknife UCL	17.9
95% Standard Bootstrap UCL	17.09	95% Bootstrap-t UCL	17.42
95% Hall's Bootstrap UCL	16.32	95% Percentile Bootstrap UCL	17
95% BCA Bootstrap UCL	16.72		
90% Chebyshev(Mean, Sd) UCL	21.29	95% Chebyshev(Mean, Sd) UCL	25.34
97.5% Chebyshev(Mean, Sd) UCL	30.97	99% Chebyshev(Mean, Sd) UCL	42.01
Suggested UCL to Use			
95% Student's-t UCL	17.9		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			
Mercury			
General Statistics			
Total Number of Observations	9	Number of Distinct Observations	2
		Number of Missing Observations	10
Minimum	5	Mean	10
Maximum	20	Median	5
SD	7.5	Std. Error of Mean	2.5
Coefficient of Variation	0.75	Skewness	0.857

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.617	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.829	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.414	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.295	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	14.65	95% Adjusted-CLT UCL (Chen-1995)	14.88
		95% Modified-t UCL (Johnson-1978)	14.77
Gamma GOF Test			
A-D Test Statistic	1.858	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.729	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.429	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.282	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.317	k star (bias corrected MLE)	1.619
Theta hat (MLE)	4.316	Theta star (bias corrected MLE)	6.178
nu hat (MLE)	41.71	nu star (bias corrected)	29.14
MLE Mean (bias corrected)	10	MLE Sd (bias corrected)	7.86
		Approximate Chi Square Value (0.05)	17.82
Adjusted Level of Significance	0.0231	Adjusted Chi Square Value	15.98
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	16.35	95% Adjusted Gamma UCL (use when n<50)	18.24
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.617	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.829	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.414	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.295	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.609	Mean of logged Data	2.072
Maximum of Logged Data	2.996	SD of logged Data	0.693
Assuming Lognormal Distribution			
95% H-UCL	19.12	90% Chebyshev (MVUE) UCL	16.73
95% Chebyshev (MVUE) UCL	19.87	97.5% Chebyshev (MVUE) UCL	24.24
99% Chebyshev (MVUE) UCL	32.81		

Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	14.11	95% Jackknife UCL	N/A
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	17.5	95% Chebyshev(Mean, Sd) UCL	20.9
97.5% Chebyshev(Mean, Sd) UCL	25.61	99% Chebyshev(Mean, Sd) UCL	34.87
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	20.9		
Recommended UCL exceeds the maximum observation			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Molybdenum			
General Statistics			
Total Number of Observations	9	Number of Distinct Observations	2
		Number of Missing Observations	10
Minimum	1.5	Mean	5.5
Maximum	7.5	Median	7.5
SD	3	Std. Error of Mean	1
Coefficient of Variation	0.545	Skewness	-0.857
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.617	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.414	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.295	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	7.36	95% Adjusted-CLT UCL (Chen-1995)	6.84
		95% Modified-t UCL (Johnson-1978)	7.312
Gamma GOF Test			

A-D Test Statistic	1.869	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.729	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.43	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.282	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.362	k star (bias corrected MLE)	1.649
Theta hat (MLE)	2.328	Theta star (bias corrected MLE)	3.335
nu hat (MLE)	42.52	nu star (bias corrected)	29.68
MLE Mean (bias corrected)	5.5	MLE Sd (bias corrected)	4.283
		Approximate Chi Square Value (0.05)	18.24
Adjusted Level of Significance	0.0231	Adjusted Chi Square Value	16.38
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	8.949	95% Adjusted Gamma UCL (use when n<50)	9.967
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.617	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.414	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.295	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.405	Mean of logged Data	1.478
Maximum of Logged Data	2.015	SD of logged Data	0.805
Assuming Lognormal Distribution			
95% H-UCL	13.53	90% Chebyshev (MVUE) UCL	10.61
95% Chebyshev (MVUE) UCL	12.79	97.5% Chebyshev (MVUE) UCL	15.81
99% Chebyshev (MVUE) UCL	21.74		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	7.145	95% Jackknife UCL	N/A
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	8.5	95% Chebyshev(Mean, Sd) UCL	9.859
97.5% Chebyshev(Mean, Sd) UCL	11.74	99% Chebyshev(Mean, Sd) UCL	15.45
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	9.859		
Recommended UCL exceeds the maximum observation			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			

and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			
PCB, Total			
General Statistics			
Total Number of Observations	19	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	0.013	Mean	1.2
Maximum	2.5	Median	0.05
SD	1.268	Std. Error of Mean	0.291
Coefficient of Variation	1.057	Skewness	0.115
Normal GOF Test			
Shapiro Wilk Test Statistic	0.645	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.901	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.344	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.203	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1.704	95% Adjusted-CLT UCL (Chen-1995)	1.686
		95% Modified-t UCL (Johnson-1978)	1.705
Gamma GOF Test			
A-D Test Statistic	2.883	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.823	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.322	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.213	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.399	k star (bias corrected MLE)	0.371
Theta hat (MLE)	3.005	Theta star (bias corrected MLE)	3.232
nu hat (MLE)	15.17	nu star (bias corrected)	14.11
MLE Mean (bias corrected)	1.2	MLE Sd (bias corrected)	1.969
		Approximate Chi Square Value (0.05)	6.643
Adjusted Level of Significance	0.0369	Adjusted Chi Square Value	6.199
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	2.547	95% Adjusted Gamma UCL (use when n<50)	2.729
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.713	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.901	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.319	**Lilliefors Lognormal GOF Test**	

5% Lilliefors Critical Value	0.203	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-4.343	Mean of logged Data	-1.467
Maximum of Logged Data	0.916	SD of logged Data	2.341
Assuming Lognormal Distribution			
95% H-UCL	52.28	90% Chebyshev (MVUE) UCL	7.047
95% Chebyshev (MVUE) UCL	9.16	97.5% Chebyshev (MVUE) UCL	12.09
99% Chebyshev (MVUE) UCL	17.85		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1.678	95% Jackknife UCL	1.704
95% Standard Bootstrap UCL	1.679	95% Bootstrap-t UCL	1.621
95% Hall's Bootstrap UCL	1.578	95% Percentile Bootstrap UCL	1.593
95% BCA Bootstrap UCL	1.593		
90% Chebyshev(Mean, Sd) UCL	2.072	95% Chebyshev(Mean, Sd) UCL	2.467
97.5% Chebyshev(Mean, Sd) UCL	3.016	99% Chebyshev(Mean, Sd) UCL	4.093
Suggested UCL to Use			
99% Chebyshev (Mean, Sd) UCL	4.093		
Recommended UCL exceeds the maximum observation			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Phenanthrene			
General Statistics			
Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	8
Minimum	0.076	Mean	0.164
Maximum	0.21	Median	0.205
SD	0.076	Std. Error of Mean	0.0439
Coefficient of Variation	0.464	Skewness	-1.724
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.778	**Shapiro Wilk GOF Test**	

5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.373	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.292	95% Adjusted-CLT UCL (Chen-1995)	0.189
		95% Modified-t UCL (Johnson-1978)	0.284
Gamma GOF Test			
Not Enough Data to Perform GOF Test			
Gamma Statistics			
k hat (MLE)	5.287	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.031	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	31.72	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.768	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.378	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-2.577	Mean of logged Data	-1.907
Maximum of Logged Data	-1.561	SD of logged Data	0.58
Assuming Lognormal Distribution			
95% H-UCL	3.871	90% Chebyshev (MVUE) UCL	0.325
95% Chebyshev (MVUE) UCL	0.398	97.5% Chebyshev (MVUE) UCL	0.498
99% Chebyshev (MVUE) UCL	0.695		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.236	95% Jackknife UCL	0.292
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	0.295	95% Chebyshev(Mean, Sd) UCL	0.355
97.5% Chebyshev(Mean, Sd) UCL	0.438	99% Chebyshev(Mean, Sd) UCL	0.6

Suggested UCL to Use			
95% Student's-t UCL	0.292		
Recommended UCL exceeds the maximum observation			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			
Pyrene			
General Statistics			
Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	8
Minimum	0.13	Mean	0.182
Maximum	0.21	Median	0.205
SD	0.0448	Std. Error of Mean	0.0259
Coefficient of Variation	0.247	Skewness	-1.708
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.797	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.365	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.257	95% Adjusted-CLT UCL (Chen-1995)	0.197
		95% Modified-t UCL (Johnson-1978)	0.253
Gamma GOF Test			
Not Enough Data to Perform GOF Test			
Gamma Statistics			
k hat (MLE)	21.95	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.00828	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	131.7	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.788	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.369	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-2.04	Mean of logged Data	-1.729
Maximum of Logged Data	-1.561	SD of logged Data	0.27
Assuming Lognormal Distribution			
95% H-UCL	0.383	90% Chebyshev (MVUE) UCL	0.266
95% Chebyshev (MVUE) UCL	0.304	97.5% Chebyshev (MVUE) UCL	0.357
99% Chebyshev (MVUE) UCL	0.462		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.224	95% Jackknife UCL	0.257
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	0.259	95% Chebyshev(Mean, Sd) UCL	0.294
97.5% Chebyshev(Mean, Sd) UCL	0.343	99% Chebyshev(Mean, Sd) UCL	0.439
Suggested UCL to Use			
95% Student's-t UCL	0.257		
Recommended UCL exceeds the maximum observation			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			
Selenium			
General Statistics			
Total Number of Observations	9	Number of Distinct Observations	2
		Number of Missing Observations	10
Minimum	1.5	Mean	7.167

Maximum	10	Median	10
SD	4.25	Std. Error of Mean	1.417
Coefficient of Variation	0.593	Skewness	-0.857
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.617	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.829	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.414	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.295	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	9.801	95% Adjusted-CLT UCL (Chen-1995)	9.064
		95% Modified-t UCL (Johnson-1978)	9.734
Gamma GOF Test			
A-D Test Statistic	1.874	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.731	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.43	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.283	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.82	k star (bias corrected MLE)	1.287
Theta hat (MLE)	3.938	Theta star (bias corrected MLE)	5.567
nu hat (MLE)	32.76	nu star (bias corrected)	23.17
MLE Mean (bias corrected)	7.167	MLE Sd (bias corrected)	6.316
		Approximate Chi Square Value (0.05)	13.22
Adjusted Level of Significance	0.0231	Adjusted Chi Square Value	11.67
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	12.56	95% Adjusted Gamma UCL (use when n<50)	14.24
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.617	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.829	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.414	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.295	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.405	Mean of logged Data	1.67
Maximum of Logged Data	2.303	SD of logged Data	0.949
Assuming Lognormal Distribution			

95% H-UCL	23.77	90% Chebyshev (MVUE) UCL	15.47
95% Chebyshev (MVUE) UCL	18.94	97.5% Chebyshev (MVUE) UCL	23.76
99% Chebyshev (MVUE) UCL	33.23		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	9.497	95% Jackknife UCL	N/A
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	11.42	95% Chebyshev(Mean, Sd) UCL	13.34
97.5% Chebyshev(Mean, Sd) UCL	16.01	99% Chebyshev(Mean, Sd) UCL	21.26

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	13.34

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Silver

General Statistics

Total Number of Observations	9	Number of Distinct Observations	3
		Number of Missing Observations	10
Minimum	5	Mean	12.67
Maximum	34	Median	5
SD	11.79	Std. Error of Mean	3.93
Coefficient of Variation	0.931	Skewness	1.055

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.681	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.409	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.295	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	19.97	95% Adjusted-CLT UCL (Chen-1995)	20.61
		95% Modified-t UCL (Johnson-1978)	20.2
Gamma GOF Test			
A-D Test Statistic	1.655	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.734	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.429	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.284	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.539	k star (bias corrected MLE)	1.1
Theta hat (MLE)	8.232	Theta star (bias corrected MLE)	11.52
nu hat (MLE)	27.7	nu star (bias corrected)	19.8
MLE Mean (bias corrected)	12.67	MLE Sd (bias corrected)	12.08
		Approximate Chi Square Value (0.05)	10.7
Adjusted Level of Significance	0.0231	Adjusted Chi Square Value	9.324
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	23.43	95% Adjusted Gamma UCL (use when n<50)	26.9
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.654	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.829	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.413	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.295	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.609	Mean of logged Data	2.18
Maximum of Logged Data	3.526	SD of logged Data	0.861
Assuming Lognormal Distribution			
95% H-UCL	31.31	90% Chebyshev (MVUE) UCL	22.97
95% Chebyshev (MVUE) UCL	27.87	97.5% Chebyshev (MVUE) UCL	34.66
99% Chebyshev (MVUE) UCL	48		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	19.13	95% Jackknife UCL	19.97
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	24.46	95% Chebyshev(Mean, Sd) UCL	29.8
97.5% Chebyshev(Mean, Sd) UCL	37.21	99% Chebyshev(Mean, Sd) UCL	51.77
Suggested UCL to Use			

95% Chebyshev (Mean, Sd) UCL	29.8		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Uranium			
General Statistics			
Total Number of Observations	9	Number of Distinct Observations	4
		Number of Missing Observations	10
Minimum	5	Mean	9.323
Maximum	21.86	Median	10
SD	5.247	Std. Error of Mean	1.749
Coefficient of Variation	0.563	Skewness	1.911
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.746	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.338	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.295	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	12.58	95% Adjusted-CLT UCL (Chen-1995)	13.39
		95% Modified-t UCL (Johnson-1978)	12.76
Gamma GOF Test			
A-D Test Statistic	0.704	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.724	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.268	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.28	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	4.588	k star (bias corrected MLE)	3.133
Theta hat (MLE)	2.032	Theta star (bias corrected MLE)	2.976
nu hat (MLE)	82.58	nu star (bias corrected)	56.39
MLE Mean (bias corrected)	9.323	MLE Sd (bias corrected)	5.268
		Approximate Chi Square Value (0.05)	40.13
Adjusted Level of Significance	0.0231	Adjusted Chi Square Value	37.25
Assuming Gamma Distribution			

95% Approximate Gamma UCL (use when n>=50)	13.1	95% Adjusted Gamma UCL (use when n<50)	14.11
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.852	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.242	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.295	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.609	Mean of logged Data	2.12
Maximum of Logged Data	3.085	SD of logged Data	0.484
Assuming Lognormal Distribution			
95% H-UCL	13.67	90% Chebyshev (MVUE) UCL	13.76
95% Chebyshev (MVUE) UCL	15.81	97.5% Chebyshev (MVUE) UCL	18.66
99% Chebyshev (MVUE) UCL	24.25		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	12.2	95% Jackknife UCL	12.58
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	14.57	95% Chebyshev(Mean, Sd) UCL	16.95
97.5% Chebyshev(Mean, Sd) UCL	20.25	99% Chebyshev(Mean, Sd) UCL	26.73
Suggested UCL to Use			
95% Adjusted Gamma UCL	14.11		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Vanadium			
General Statistics			
Total Number of Observations	9	Number of Distinct Observations	3
		Number of Missing Observations	10
Minimum	35	Mean	54.67
Maximum	101	Median	35
SD	30.12	Std. Error of Mean	10.04
Coefficient of Variation	0.551	Skewness	0.998
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.659	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.41	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.295	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	73.33	95% Adjusted-CLT UCL (Chen-1995)	74.75
		95% Modified-t UCL (Johnson-1978)	73.89
Gamma GOF Test			
A-D Test Statistic	1.655	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.724	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.426	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.28	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	4.377	k star (bias corrected MLE)	2.992
Theta hat (MLE)	12.49	Theta star (bias corrected MLE)	18.27
nu hat (MLE)	78.79	nu star (bias corrected)	53.86
MLE Mean (bias corrected)	54.67	MLE Sd (bias corrected)	31.6
		Approximate Chi Square Value (0.05)	38
Adjusted Level of Significance	0.0231	Adjusted Chi Square Value	35.21
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	77.48	95% Adjusted Gamma UCL (use when n<50)	83.63
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.651	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.412	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.295	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	3.555	Mean of logged Data	3.883
Maximum of Logged Data	4.615	SD of logged Data	0.496
Assuming Lognormal Distribution			
95% H-UCL	81.06	90% Chebyshev (MVUE) UCL	81.28
95% Chebyshev (MVUE) UCL	93.6	97.5% Chebyshev (MVUE) UCL	110.7
99% Chebyshev (MVUE) UCL	144.3		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			

Nonparametric Distribution Free UCLs			
95% CLT UCL	71.18	95% Jackknife UCL	73.33
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	84.78	95% Chebyshev(Mean, Sd) UCL	98.42
97.5% Chebyshev(Mean, Sd) UCL	117.4	99% Chebyshev(Mean, Sd) UCL	154.6
Suggested UCL to Use			
95% Student's-t UCL	73.33	or 95% Modified-t UCL	73.89

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)

and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.

For additional insight the user may want to consult a statistician.

UCL Statistics for Uncensored Full Data Sets			
User Selected Options			
Date/Time of Computation	11/20/2015 1:38:37 PM		
From File	EcoEPC_Iron.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

SWMU13_Iron

General Statistics			
Total Number of Observations	166	Number of Distinct Observations	166
		Number of Missing Observations	0
Minimum	6540	Mean	21729
Maximum	47830	Median	20916
SD	5941	Std. Error of Mean	461.1
Coefficient of Variation	0.273	Skewness	1.399

Normal GOF Test			
Shapiro Wilk Test Statistic	0.884	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.158	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0688	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	22491	95% Adjusted-CLT UCL (Chen-1995)	22541
		95% Modified-t UCL (Johnson-1978)	22500

Gamma GOF Test			
A-D Test Statistic	4.413	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.751	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.123	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.0723	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics			
k hat (MLE)	14.41	k star (bias corrected MLE)	14.15
Theta hat (MLE)	1508	Theta star (bias corrected MLE)	1536
nu hat (MLE)	4783	nu star (bias corrected)	4698
MLE Mean (bias corrected)	21729	MLE Sd (bias corrected)	5776
		Approximate Chi Square Value (0.05)	4539
Adjusted Level of Significance	0.0486	Adjusted Chi Square Value	4538

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	22486	95% Adjusted Gamma UCL (use when n<50)	22493

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.924	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	4.004E-11	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.117	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0688	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	8.786	Mean of logged Data	9.951
Maximum of Logged Data	10.78	SD of logged Data	0.269
Assuming Lognormal Distribution			
95% H-UCL	22542	90% Chebyshev (MVUE) UCL	23129
95% Chebyshev (MVUE) UCL	23756	97.5% Chebyshev (MVUE) UCL	24626
99% Chebyshev (MVUE) UCL	26335		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	22487	95% Jackknife UCL	22491
95% Standard Bootstrap UCL	22497	95% Bootstrap-t UCL	22557
95% Hall's Bootstrap UCL	22556	95% Percentile Bootstrap UCL	22501
95% BCA Bootstrap UCL	22471		
90% Chebyshev(Mean, Sd) UCL	23112	95% Chebyshev(Mean, Sd) UCL	23739
97.5% Chebyshev(Mean, Sd) UCL	24608	99% Chebyshev(Mean, Sd) UCL	26317
Suggested UCL to Use			
95% Student's-t UCL	22491	or 95% Modified-t UCL	22500
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
SWMU15_Iron			
General Statistics			
Total Number of Observations	119	Number of Distinct Observations	119
		Number of Missing Observations	0
Minimum	9631	Mean	28527
Maximum	171000	Median	22541
SD	22241	Std. Error of Mean	2039
Coefficient of Variation	0.78	Skewness	3.941
Normal GOF Test			
Shapiro Wilk Test Statistic	0.622	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.212	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0812	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	31908	95% Adjusted-CLT UCL (Chen-1995)	32668
		95% Modified-t UCL (Johnson-1978)	32030
Gamma GOF Test			
A-D Test Statistic	3.925	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.758	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.125	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.0851	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	3.287	k star (bias corrected MLE)	3.209
Theta hat (MLE)	8680	Theta star (bias corrected MLE)	8889
nu hat (MLE)	782.2	nu star (bias corrected)	763.8
MLE Mean (bias corrected)	28527	MLE Sd (bias corrected)	15924
		Approximate Chi Square Value (0.05)	700.7
Adjusted Level of Significance	0.048	Adjusted Chi Square Value	700
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	31098	95% Adjusted Gamma UCL (use when n<50)	31130
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.936	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value	1.0519E-5	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0895	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.0812	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	9.173	Mean of logged Data	10.1
Maximum of Logged Data	12.05	SD of logged Data	0.511
Assuming Lognormal Distribution			
95% H-UCL	30224	90% Chebyshev (MVUE) UCL	31798
95% Chebyshev (MVUE) UCL	33664	97.5% Chebyshev (MVUE) UCL	36255
99% Chebyshev (MVUE) UCL	41344		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	31881	95% Jackknife UCL	31908
95% Standard Bootstrap UCL	31851	95% Bootstrap-t UCL	33117
95% Hall's Bootstrap UCL	33517	95% Percentile Bootstrap UCL	32237
95% BCA Bootstrap UCL	32603		
90% Chebyshev(Mean, Sd) UCL	34644	95% Chebyshev(Mean, Sd) UCL	37414
97.5% Chebyshev(Mean, Sd) UCL	41260	99% Chebyshev(Mean, Sd) UCL	48813

Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	37414		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
SWMU204_Iron			
General Statistics			
Total Number of Observations	187	Number of Distinct Observations	185
		Number of Missing Observations	0
Minimum	8980	Mean	23637
Maximum	33542	Median	23766
SD	3638	Std. Error of Mean	266
Coefficient of Variation	0.154	Skewness	-0.546
Normal GOF Test			
Shapiro Wilk Test Statistic	0.971	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0.0312	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.0691	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0648	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	24076	95% Adjusted-CLT UCL (Chen-1995)	24063
		95% Modified-t UCL (Johnson-1978)	24075
Gamma GOF Test			
A-D Test Statistic	2.549	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.751	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0936	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0668	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	37.35	k star (bias corrected MLE)	36.75
Theta hat (MLE)	632.9	Theta star (bias corrected MLE)	643.2
nu hat (MLE)	13967	nu star (bias corrected)	13745
MLE Mean (bias corrected)	23637	MLE Sd (bias corrected)	3899
		Approximate Chi Square Value (0.05)	13473
Adjusted Level of Significance	0.0487	Adjusted Chi Square Value	13471
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	24113	95% Adjusted Gamma UCL (use when n<50)	24117
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.9	**Shapiro Wilk Lognormal GOF Test**	

5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.108	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0648	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	9.103	Mean of logged Data	10.06
Maximum of Logged Data	10.42	SD of logged Data	0.172
Assuming Lognormal Distribution			
95% H-UCL	24174	90% Chebyshev (MVUE) UCL	24564
95% Chebyshev (MVUE) UCL	24971	97.5% Chebyshev (MVUE) UCL	25535
99% Chebyshev (MVUE) UCL	26644		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	24074	95% Jackknife UCL	24076
95% Standard Bootstrap UCL	24070	95% Bootstrap-t UCL	24049
95% Hall's Bootstrap UCL	24075	95% Percentile Bootstrap UCL	24076
95% BCA Bootstrap UCL	24091		
90% Chebyshev(Mean, Sd) UCL	24435	95% Chebyshev(Mean, Sd) UCL	24796
97.5% Chebyshev(Mean, Sd) UCL	25298	99% Chebyshev(Mean, Sd) UCL	26284
Suggested UCL to Use			
95% Student's-t UCL	24076	or 95% Modified-t UCL	24075
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			
SWMU26_Iron			
General Statistics			
Total Number of Observations	47	Number of Distinct Observations	47
		Number of Missing Observations	0
Minimum	6836	Mean	27274
Maximum	85100	Median	25529
SD	11217	Std. Error of Mean	1636
Coefficient of Variation	0.411	Skewness	3.025
Normal GOF Test			
Shapiro Wilk Test Statistic	0.758	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.946	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.214	**Lilliefors GOF Test**	

5% Lilliefors Critical Value	0.129	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	30020	95% Adjusted-CLT UCL (Chen-1995)	30736
		95% Modified-t UCL (Johnson-1978)	30141
Gamma GOF Test			
A-D Test Statistic	1.654	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.751	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.161	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.129	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	7.822	k star (bias corrected MLE)	7.337
Theta hat (MLE)	3487	Theta star (bias corrected MLE)	3717
nu hat (MLE)	735.3	nu star (bias corrected)	689.7
MLE Mean (bias corrected)	27274	MLE Sd (bias corrected)	10069
		Approximate Chi Square Value (0.05)	629.7
Adjusted Level of Significance	0.0449	Adjusted Chi Square Value	627.9
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	29869	95% Adjusted Gamma UCL (use when n<50)	29955
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.912	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.946	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.16	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.129	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	8.83	Mean of logged Data	10.15
Maximum of Logged Data	11.35	SD of logged Data	0.365
Assuming Lognormal Distribution			
95% H-UCL	30079	90% Chebyshev (MVUE) UCL	31732
95% Chebyshev (MVUE) UCL	33755	97.5% Chebyshev (MVUE) UCL	36564
99% Chebyshev (MVUE) UCL	42080		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	29965	95% Jackknife UCL	30020
95% Standard Bootstrap UCL	29871	95% Bootstrap-t UCL	31209
95% Hall's Bootstrap UCL	43716	95% Percentile Bootstrap UCL	30240
95% BCA Bootstrap UCL	30908		
90% Chebyshev(Mean, Sd) UCL	32182	95% Chebyshev(Mean, Sd) UCL	34406

97.5% Chebyshev(Mean, Sd) UCL	37492	99% Chebyshev(Mean, Sd) UCL	43553
Suggested UCL to Use			
95% Student's-t UCL	30020	or 95% Modified-t UCL	30141

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

SWMU80_Iron

General Statistics			
Total Number of Observations	22	Number of Distinct Observations	22
		Number of Missing Observations	0
Minimum	14800	Mean	26399
Maximum	41269	Median	26941
SD	6368	Std. Error of Mean	1358
Coefficient of Variation	0.241	Skewness	0.187
Normal GOF Test			
Shapiro Wilk Test Statistic	0.94	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.193	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.189	Data Not Normal at 5% Significance Level	
Data appear Approximate Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	28735	95% Adjusted-CLT UCL (Chen-1995)	28690
		95% Modified-t UCL (Johnson-1978)	28744
Gamma GOF Test			
A-D Test Statistic	0.74	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.741	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.166	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.185	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	17.04	k star (bias corrected MLE)	14.75
Theta hat (MLE)	1549	Theta star (bias corrected MLE)	1790
nu hat (MLE)	749.9	nu star (bias corrected)	649
MLE Mean (bias corrected)	26399	MLE Sd (bias corrected)	6874
		Approximate Chi Square Value (0.05)	590.9
Adjusted Level of Significance	0.0386	Adjusted Chi Square Value	586.8
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	28995	95% Adjusted Gamma UCL (use when n<50)	29199

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.918	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.164	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.189	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	9.602	Mean of logged Data	10.15
Maximum of Logged Data	10.63	SD of logged Data	0.255
Assuming Lognormal Distribution			
95% H-UCL	29282	90% Chebyshev (MVUE) UCL	30798
95% Chebyshev (MVUE) UCL	32773	97.5% Chebyshev (MVUE) UCL	35515
99% Chebyshev (MVUE) UCL	40901		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	28632	95% Jackknife UCL	28735
95% Standard Bootstrap UCL	28566	95% Bootstrap-t UCL	28664
95% Hall's Bootstrap UCL	28781	95% Percentile Bootstrap UCL	28582
95% BCA Bootstrap UCL	28603		
90% Chebyshev(Mean, Sd) UCL	30472	95% Chebyshev(Mean, Sd) UCL	32317
97.5% Chebyshev(Mean, Sd) UCL	34877	99% Chebyshev(Mean, Sd) UCL	39907
Suggested UCL to Use			
95% Student's-t UCL	28735		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			

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ATTACHMENT E4

SWMU/AOC ECOLOGICAL SCREENING

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Table E4.1. Ecological Screening

SWMU	Analysis	Unit	Bkgd[a]	Soil NFA	Max Screening Value	HQ (Max)	Below Bkgd?	EPC	HQ (EPC)
13	Aluminum	mg/kg	13000	50	14000	280.00	No	7078	141.60
13	Antimony	mg/kg	0.21	0.27	10	37.04	No	7.666	28.39
13	Arsenic	mg/kg	12	18	5	0.28	Yes		
13	Barium	mg/kg	200	330	180	0.55	Yes		
13	Benzo(ghi)perylene	mg/kg		119	0.25	0.00	No		
13	Beryllium	mg/kg	0.67	2.5	0.62	0.25	Yes		
13	Bis(2-ethylhexyl)phthalate	mg/kg		0.926	0.25	0.27	No		
13	Cadmium	mg/kg	0.21	0.36	1	2.78	No	0.901	2.50
13	Calcium	mg/kg	200000		140000		Yes		
13	Chromium	mg/kg	16	26	22	0.85	No		
13	Cobalt	mg/kg	14	13	12	0.92	Yes		
13	Copper	mg/kg	19	28	186	6.64	No	45.95	1.64
13	High molecular weight PAHs	mg/kg		1.1	4.171	3.79	No	1.49	1.35
13	Iron	mg/kg	28000	200	47830	239.15	No	22491	112.46
13	Lead	mg/kg	36	11	657	59.73	No	50.29	4.57
13	Lithium	mg/kg		2	8.59	4.30	No	6.62	3.31
13	Low molecular weight PAHs	mg/kg		29	0.5	0.02	No		
13	Magnesium	mg/kg	7700	440000	8400	0.02	No		
13	Manganese	mg/kg	1500	220	3114	14.15	No	699.2	3.18
13	Mercury	mg/kg	0.2	0.1	20	200.00	No	20.49	204.90
13	Molybdenum	mg/kg		2	43	21.50	No	6.976	3.49
13	Nickel	mg/kg	21	38	140	3.68	No	21.84	0.57
13	PCB, Total	mg/kg		0.02	2.5	125.00	No	2.557	127.85
13	Selenium	mg/kg	0.8	0.52	5	9.62	No	1.517	2.92
13	Silver	mg/kg	2.3	4.2	146	34.76	No	31.07	7.40
13	Sodium	mg/kg	320		85		Yes		
13	Thallium	mg/kg	0.21	1	10	10.00	No	9.537	9.54
13	Uranium	mg/kg	4.9	5	130	26.00	No	12.74	2.55
13	Vanadium	mg/kg	38	7.8	158	20.26	No	98.61	12.64
13	Zinc	mg/kg	65	46	1043	22.67	No	140.6	3.06
13	Americium-241	pCi/g		2160	0.02205	0.00	No		
13	Cesium-137	pCi/g	0.49	20.8	0.393	0.02	Yes		
13	Neptunium-237	pCi/g	0.1	814	1.08	0.00	No		
13	Plutonium-238	pCi/g	0.073	1750	0.0331	0.00	Yes		
13	Plutonium-239/240	pCi/g	0.025	1270	0.173	0.00	No		
13	Technetium-99	pCi/g	2.5	2190	150	0.07	No		
13	Thorium-228	pCi/g	1.6	530	1.2	0.00	Yes		
13	Thorium-230	pCi/g	1.5	9980	1.51	0.00	No		
13	Thorium-232	pCi/g	1.5	1520	1.2	0.00	Yes		
13	Uranium-234	pCi/g	1.2	5140	35.7	0.01	No		
13	Uranium-235	pCi/g	0.06	2750	4.12	0.00	No		
13	Uranium-238	pCi/g	1.2	1570	64.1	0.04	No		
13	**Total**					**1124.4**			**673.9**
15	2-Methylnaphthalene	mg/kg		0.0202	0.2	9.90	No	0.191	9.5
15	Aluminum	mg/kg	13000	50	9250	185.00	Yes	8455	169.1
15	Antimony	mg/kg	0.21	0.27	283.01	1048.19	No	87.04	322.37
15	Arsenic	mg/kg	12	18	62.55	3.48	No	14.98	0.83
15	Barium	mg/kg	200	330	629.9	1.91	No	322.7	0.98
15	Benzo(ghi)perylene	mg/kg		119	0.89	0.01	No		
15	Benzoic acid	mg/kg		650	1	0.00	No		
15	Beryllium	mg/kg	0.67	2.5	0.76	0.30	No		
15	Bis(2-ethylhexyl)phthalate	mg/kg		0.926	0.2	0.22	No		

Table E4.1. Ecological Screening (Continued)

SWMU	Analysis	Unit	Bkgd[a]	Soil NFA	Max Screening Value	HQ (Max)	Below Bkgd?	EPC	HQ (EPC)
15	Butyl benzyl phthalate	mg/kg		0.239	0.2	0.84	No		
15	Cadmium	mg/kg	0.21	0.36	24.15	67.08	No	8.604	23.90
15	Calcium	mg/kg	200000		156000		Yes		
15	Chromium	mg/kg	16	26	150.66	5.79	No	51.92	2.00
15	Cobalt	mg/kg	14	13	34.1	2.62	No	15.99	1.23
15	Copper	mg/kg	19	28	6122.47	218.66	No	571.9	20.43
15	Dibenzofuran	mg/kg		1.52	0.2	0.13	No		
15	Di-n-butyl phthalate	mg/kg		200	0.2	0.00	No		
15	Fluorene	mg/kg		30	0.2	0.01	No		
15	High molecular weight PAHs	mg/kg		1.1	15.99	14.54	No	12.35	11.23
15	Iron	mg/kg	28000	200	171000	855.00	No	37414	187.07
15	Lead	mg/kg	36	11	1040.18	94.56	No	134.7	12.25
15	Low molecular weight PAHs	mg/kg		29	4.73	0.16	No		
15	Magnesium	mg/kg	7700	440000	6730	0.02	Yes		
15	Manganese	mg/kg	1500	220	2903.39	13.20	No	761.7	3.46
15	Mercury	mg/kg	0.2	0.1	20	200.00	No	6.116	61.16
15	Molybdenum	mg/kg		2	23.6	11.80	No	8.001	4.00
15	Nickel	mg/kg	21	38	3787.15	99.66	No	411.8	10.84
15	PCB, Total	mg/kg		0.02	55	2750.00	No	8.604	430.20
15	Selenium	mg/kg	0.8	0.52	26.71	51.37	No	10.2	19.62
15	Silver	mg/kg	2.3	4.2	25	5.95	No	7.078	1.69
15	Sodium	mg/kg	320		266		Yes		
15	Thallium	mg/kg	0.21	1	0.3	0.30	No		
15	Uranium	mg/kg	4.9	5	459	91.80	No	91.33	18.27
15	Vanadium	mg/kg	38	7.8	122	15.64	No	40.15	5.15
15	Zinc	mg/kg	65	46	3168.62	68.88	No	474.4	10.31
15	Americium-241	pCi/g		2160	0.437	0.00	No		
15	Cesium-137	pCi/g	0.49	20.8	0.2	0.01	Yes		
15	Neptunium-237	pCi/g	0.1	814	4.1	0.01	No		
15	Plutonium-238	pCi/g	0.073	1750	0.12	0.00	No		
15	Plutonium-239/240	pCi/g	0.025	1270	2.78	0.00	No		
15	Technetium-99	pCi/g	2.5	2190	367	0.17	No		
15	Thorium-228	pCi/g	1.6	530	0.94	0.00	Yes		
15	Thorium-230	pCi/g	1.5	9980	7.23	0.00	No		
15	Thorium-232	pCi/g	1.5	1520	0.86	0.00	Yes		
15	Uranium-234	pCi/g	1.2	5140	185	0.04	No		
15	Uranium-235	pCi/g	0.06	2750	21.7	0.01	No		
15	Uranium-238	pCi/g	1.2	1570	1100	0.70	No		
15	**Total**					**5817.9**			**1325.5**
26	(1,1-Dimethylethyl)benzene	mg/kg			0.00335		No		
26	(1-Methylpropyl)benzene	mg/kg			0.00335		No		
26	1,1,1-Trichloroethane	mg/kg		0.1	0.305	3.1	No		
26	1,2,4-Trichlorobenzene	mg/kg		0.01	0.365	36.5	No		
26	1,2,4-Trimethylbenzene	mg/kg		0.1	0.00335	0.0	No		
26	1,2-Dichlorobenzene	mg/kg		0.1	0.365	3.65	No	0.268	2.70
26	1,2-Dimethylbenzene	mg/kg		0.05	0.00335	0.1	No		
26	1,3,5-Trimethylbenzene	mg/kg		0.1	0.00335	0.0	No		
26	1,3-Dichlorobenzene	mg/kg		0.1	0.365	3.65	No	0.268	2.68
26	1,4-Dichlorobenzene	mg/kg		0.1	0.365	3.65	No	0.268	2.70
26	1-Methyl-4-(1-methylethyl)benzene	mg/kg			0.00335		No		
26	2-Methylnaphthalene	mg/kg		0.0202	1.1	54.5	No		

Table E4.1. Ecological Screening (Continued)

SWMU	Analysis	Unit	Bkgd[a]	Soil NFA	Max Screening Value	HQ (Max)	Below Bkgd?	EPC	HQ (EPC)
26	Acetone	mg/kg		0.0099	6	606.1	No		
26	Aluminum	mg/kg	13000	50	34600	692.0	No	17359	347.2
26	Antimony	mg/kg	0.21	0.27	8.95	33.15	No	6.596	24.43
26	Arsenic	mg/kg	12	18	160	8.89	No	31.13	1.73
26	Barium	mg/kg	200	330	815.02	2.47	No	307.4	0.93
26	Benzene	mg/kg		0.01	0.305	30.50	No	0.305	6.10
26	Benzo(ghi)perylene	mg/kg		119	0.365	0.0	No		
26	Beryllium	mg/kg	0.67	2.5	15.7	6.28	No	8.793	3.52
26	Butylbenzene	mg/kg			0.00335		No		
26	Cadmium	mg/kg	0.21	0.36	4.45	12.36	No	2.527	7.02
26	Calcium	mg/kg	200000		95000		Yes		
26	Carbon disulfide	mg/kg		0.0239	0.00335	0.1	No		
26	Chromium	mg/kg	16	26	231	8.88	No	34.82	1.34
26	*cis* -1,2-Dichloroethene	mg/kg		0.1	0.00445	0.0	No		
26	Cobalt	mg/kg	14	13	90.5	6.96	No	57.17	4.40
26	Copper	mg/kg	19	28	220	7.86	No	91.59	3.27
26	Dibenzofuran	mg/kg		1.52	0.365	0.24	No		
26	Ethylbenzene	mg/kg		0.03	0.305	10.17	No	0.305	6.10
26	Fluorene	mg/kg		30	0.365	0.01	No		
26	High molecular weight PAHs	mg/kg		1.1	29.4	26.73	No	15.07	13.70
26	Iron	mg/kg	28000	200	85100	425.50	No	30020	150.10
26	Lead	mg/kg	36	11	297	27.00	No	87.73	7.98
26	Low molecular weight PAHs	mg/kg		29	2.25	0.08	No		
26	m,p-Xylene	mg/kg		0.1	0.00335	0.0	No		
26	Magnesium	mg/kg	7700	440000	5700	0.01	Yes		
26	Manganese	mg/kg	1500	220	1223	5.56	Yes	532.6	2.42
26	Mercury	mg/kg	0.2	0.1	20	200.00	No	21.16	211.60
26	Methylene chloride	mg/kg		2	0.305	0.2	No		
26	Molybdenum	mg/kg		2	78	39.00	No	18.09	9.05
26	Nickel	mg/kg	21	38	203	5.34	No	66.38	1.75
26	PCB, Total	mg/kg		0.02	2.5	125.00	No	2.115	105.75
26	Potassium	mg/kg	1300		4460		No		
26	Propylbenzene	mg/kg			0.00335		No		
26	Selenium	mg/kg	0.8	0.52	10	19.23	No	4.509	8.67
26	Silicon	mg/kg			2420		No		
26	Silver	mg/kg	2.3	4.2	25	5.95	No	26.38	6.28
26	Sodium	mg/kg	320		354		No		
26	Styrene	mg/kg		0.3	0.00335	0.01	No		
26	Thallium	mg/kg	0.21	1	9.6	9.60	No	8.655	8.66
26	Trichloroethene	mg/kg		0.001	0.305	305.00	No	0.00394	3.94
26	Uranium	mg/kg	4.9	5	3100	620.00	No	792.6	158.52
26	Vanadium	mg/kg	38	7.8	195	25.00	No	141.6	18.15
26	Zinc	mg/kg	65	46	800	17.39	No	215.3	4.68
26	Actinium-228	pCi/g			1.69		No		
26	Americium-241	pCi/g		2160	2.93	0.00	No		
26	Bismuth-211	pCi/g			2.575		No		
26	Bismuth-212	pCi/g			0.9996		No		
26	Bismuth-214	pCi/g			0.9513		No		
26	Cesium-137	pCi/g	0.49	20.8	11.2	0.54	No		
26	Lead-211	pCi/g			2.575		No		
26	Lead-212	pCi/g			1.88		No		
26	Lead-214	pCi/g			2.6		No		

Table E4.1. Ecological Screening (Continued)

SWMU	Analysis	Unit	Bkgd[a]	Soil NFA	Max Screening Value	HQ (Max)	Below Bkgd?	EPC	HQ (EPC)
26	Neptunium-237	pCi/g	0.1	814	4.1	0.01	No		
26	Plutonium-238	pCi/g	0.073	1750	0.39	0.00	No		
26	Plutonium-239/240	pCi/g	0.025	1270	15.9	0.01	No		
26	Potassium-40	pCi/g	16	119	13.7	0.12	Yes		
26	Protactinium-233	pCi/g			1.064		No		
26	Protactinium-234m	pCi/g			182		No		
26	Radium-223	pCi/g			0.6287		No		
26	Radium-226	pCi/g	1.5	28.8	0.8975	0.03	Yes		
26	Radium-228	pCi/g		24.5	1.69	0.07	No		
26	Radon-219	pCi/g			0.7544		No		
26	Strontium-90	pCi/g	4.7	22.5	7	0.31	No		
26	Technetium-99	pCi/g	2.5	2190	1870	0.85	No		
26	Thallium-208	pCi/g			0.82		No		
26	Thorium-227	pCi/g			0.4506		No		
26	Thorium-228	pCi/g	1.6	530	1.81	0.00	No		
26	Thorium-230	pCi/g	1.5	9980	111	0.01	No		
26	Thorium-232	pCi/g	1.5	1520	2.03	0.00	No		
26	Thorium-234	pCi/g			314		No		
26	Uranium-234	pCi/g	1.2	5140	437	0.09	No		
26	Uranium-235	pCi/g	0.06	2750	31.9	0.01	No		
26	Uranium-238	pCi/g	1.2	1570	1040	0.66	No		
26	**Total**					**3390.4**			**1125.3**
77	Antimony	mg/kg	0.21	0.27	0.38	1.41	No	0.38	1.41
77	Arsenic	mg/kg	12	18	5	0.28	Yes		
77	Barium	mg/kg	200	330	100	0.30	Yes		
77	Beryllium	mg/kg	0.67	2.5	0.18	0.07	Yes		
77	Cadmium	mg/kg	0.21	0.36	0.53	1.47	No	0.53	1.47
77	Calcium	mg/kg	200000		220000		No		
77	Chromium	mg/kg	16	26	83	3.19	No	83	3.19
77	Cobalt	mg/kg	14	13	2.5	0.19	Yes		
77	Copper	mg/kg	19	28	170	6.07	No	170	6.07
77	High molecular weight PAHs	mg/kg		1.1	0.5007	0.46	No		
77	Iron	mg/kg	28000	200	50329	251.65	No	50329	251.60
77	Lead	mg/kg	36	11	50	4.55	No	50	4.55
77	Magnesium	mg/kg	7700	440000	7600	0.02	Yes		
77	Manganese	mg/kg	1500	220	650	2.95	Yes	650	2.95
77	Mercury	mg/kg	0.2	0.1	20	200.00	No	20	200.00
77	Molybdenum	mg/kg		2	1.5	0.75	No		
77	Nickel	mg/kg	21	38	40	1.05	No	40	1.05
77	PCB, Total	mg/kg		0.02	2.5	125.00	No	2.5	125.00
77	Selenium	mg/kg	0.8	0.52	1.5	2.88	No	1.5	2.88
77	Silver	mg/kg	2.3	4.2	25	5.95	No	25	5.95
77	Sodium	mg/kg	320		160		Yes		
77	Thallium	mg/kg	0.21	1	0.06	0.06	Yes		
77	Uranium	mg/kg	4.9	5	666	133.20	No	666	133.20
77	Vanadium	mg/kg	38	7.8	168	21.54	No	168	21.54
77	Zinc	mg/kg	65	46	178	3.87	No	178	3.87
77	Americium-241	pCi/g		2160	0.25	0.00	No		
77	Cesium-137	pCi/g	0.49	20.8	0.25	0.01	Yes		
77	Neptunium-237	pCi/g	0.1	814	0.25	0.00	No		
77	Plutonium-239/240	pCi/g	0.025	1270	0.283	0.00	No		
77	Technetium-99	pCi/g	2.5	2190	8.5	0.00	No		

Table E4.1. Ecological Screening (Continued)

SWMU	Analysis	Unit	Bkgd[a]	Soil NFA	Max Screening Value	HQ (Max)	Below Bkgd?	EPC	HQ (EPC)
77	Thorium-228	pCi/g	1.6	530	0.403	0.00	Yes		
77	Thorium-230	pCi/g	1.5	9980	10.3	0.00	No		
77	Thorium-232	pCi/g	1.5	1520	0.471	0.00	Yes		
77	Uranium-234	pCi/g	1.2	5140	4.18	0.00	No		
77	Uranium-235	pCi/g	0.06	2750	0.314	0.00	No		
77	Uranium-238	pCi/g	1.2	1570	15.3	0.01	No		
77	**Total**					**766.9**			**764.7**
80	1,2,3,4,6,7,8-Heptachlorodibenzofuran	mg/kg			0.00008		No		
80	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	mg/kg			0.00017		No		
80	1,2,3,4,7,8,9-Heptachlorodibenzofuran	mg/kg			0.00003		No		
80	1,2,3,4,7,8-Hexachlorodibenzofuran	mg/kg			0.00008		No		
80	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	mg/kg			0.00000982		No		
80	1,2,3,6,7,8-Hexachlorodibenzofuran	mg/kg			0.00001		No		
80	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	mg/kg			0.00003		No		
80	1,2,3,7,8,9-Hexachlorodibenzofuran	mg/kg			0.00001		No		
80	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	mg/kg		0.1	0.00001	0.0	No		
80	1,2,3,7,8-Pentachlorodibenzofuran	mg/kg			0.00000965		No		
80	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	mg/kg			0.00000619		No		
80	2,3,4,6,7,8-Hexachlorodibenzofuran	mg/kg			0.00000552		No		
80	2,3,4,7,8-Pentachlorodibenzofuran	mg/kg			0.00003		No		
80	2,3,7,8-Tetrachlorodibenzofuran	mg/kg			0.00002		No		
80	Aluminum	mg/kg	13000	50	9320	186.4	Yes	9320	186.4
80	Antimony	mg/kg	0.21	0.27	58.17	215.44	No	40.4	149.62963
80	Arsenic	mg/kg	12	18	11.95	0.66	Yes		
80	Barium	mg/kg	200	330	313.73	1.0	No		
80	Benzo(ghi)perylene	mg/kg		119	0.195	0.00	No		
80	Beryllium	mg/kg	0.67	2.5	0.78	0.31	No		
80	Cadmium	mg/kg	0.21	0.36	6	16.7	No	6.719	18.7
80	Calcium	mg/kg	200000		63000		Yes		
80	Chromium	mg/kg	16	26	165	6.35	No	22.84	0.88
80	Cobalt	mg/kg	14	13	19	1.46	No	19	1.46
80	Copper	mg/kg	19	28	45	1.61	No	44.16	1.5771429
80	Dibenzofuran	mg/kg		1.52	0.195	0.1	No		
80	Dioxins/Furans, Total	mg/kg		0.0000025	8.82151E-05	35.29	No		
80	Fluorene	mg/kg		30	0.195	0.01	No		
80	High molecular weight PAHs	mg/kg		1.1	5.43	4.94	No	5.43	4.94
80	Iron	mg/kg	28000	200	41269	206.35	No	28735	143.675
80	Lead	mg/kg	36	11	113	10.27	No	33.51	3.0463636
80	Low molecular weight PAHs	mg/kg		29	1.56	0.05	No		
80	Magnesium	mg/kg	7700	440000	7800	0.02	No		
80	Manganese	mg/kg	1500	220	2066	9.39	No	744.1	3.38
80	Mercury	mg/kg	0.2	0.1	20	200.00	No	19.89	198.9

Table E4.1. Ecological Screening (Continued)

SWMU	Analysis	Unit	Bkgd[a]	Soil NFA	Max Screening Value	HQ (Max)	Below Bkgd?	EPC	HQ (EPC)
80	Molybdenum	mg/kg		2	46	23.0	No	16.42	8.2
80	Nickel	mg/kg	21	38	32.5	0.9	No		
80	Octachloro-dibenzo[b,e][1,4]dioxin	mg/kg			0.0118		No		
80	Octachlorodibenzofuran	mg/kg			0.00025		No		
80	PCB, Total	mg/kg		0.02	475	23750.00	No	41.83	2091.50
80	Selenium	mg/kg	0.8	0.52	10	19.2	No	5.619	10.8
80	Silver	mg/kg	2.3	4.2	25	5.95	No	28.8	6.8571429
80	Sodium	mg/kg	320		68		Yes		
80	Thallium	mg/kg	0.21	1	0.17	0.17	Yes		
80	Uranium	mg/kg	4.9	5	5724	1144.80	No	77.38	15.48
80	Vanadium	mg/kg	38	7.8	138	17.7	No	113.2	14.5
80	Zinc	mg/kg	65	46	638	13.87	No	153.5	3.3369565
80	Actinium-228	pCi/g			0.2984		No		
80	Americium-241	pCi/g		2160	6.4	0.0	No		
80	Bismuth-211	pCi/g			1.074		No		
80	Bismuth-214	pCi/g			0.633		No		
80	Cesium-137	pCi/g	0.49	20.8	0.84	0.0	No		
80	Lead-211	pCi/g			1.074		No		
80	Lead-212	pCi/g			0.1997		No		
80	Lead-214	pCi/g			0.4105		No		
80	Neptunium-237	pCi/g	0.1	814	0.505	0.00	No		
80	Plutonium-239/240	pCi/g	0.025	1270	0.438	0.0	No		
80	Potassium-40	pCi/g	16	119	3.98	0.0	Yes		
80	Protactinium-233	pCi/g			0.2998		No		
80	Protactinium-234m	pCi/g			1330		No		
80	Radium-226	pCi/g	1.5	28.8	0.319	0.01	Yes		
80	Radium-228	pCi/g		24.5	0.3381	0.01	No		
80	Strontium-90	pCi/g	4.7	22.5	6.7	0.3	No		
80	Technetium-99	pCi/g	2.5	2190	29.5	0.01	No		
80	Thallium-208	pCi/g			0.1662		No		
80	Thorium-228	pCi/g	1.6	530	1.04	0.00	Yes		
80	Thorium-230	pCi/g	1.5	9980	4.4	0.0	No		
80	Thorium-232	pCi/g	1.5	1520	0.95	0.00	Yes		
80	Thorium-234	pCi/g			1330		No		
80	Uranium-234	pCi/g	1.2	5140	229	0.04	No		
80	Uranium-235	pCi/g	0.06	2750	30	0.01	No		
80	Uranium-238	pCi/g	1.2	1570	1921	1.22	No	1921	1.22
80	**Total**					**25873.6**			**2864.5**
204	Aluminum	mg/kg	13000	50	13700	274.00	No	8971	179.4
204	Antimony	mg/kg	0.21	0.27	10	37.04	No	4.345	16.092593
204	Arsenic	mg/kg	12	18	136	7.56	No	8.581	0.4767222
204	Barium	mg/kg	200	330	200	0.61	No		
204	Benzo(ghi)perylene	mg/kg		119	0.57	0.00	No		
204	Beryllium	mg/kg	0.67	2.5	1.33	0.53	No		
204	bis(2-ethylhexyl)phthalate	mg/kg		0.926	0.23	0.2	No		
204	Cadmium	mg/kg	0.21	0.36	1	2.78	No	0.519	1.44
204	Calcium	mg/kg	200000		230000		No		
204	Chromium	mg/kg	16	26	175	6.73	No	7.602	0.29
204	Cobalt	mg/kg	14	13	18	1.38	No	8.194	0.63
204	Copper	mg/kg	19	28	57	2.04	No	41.24	1.47
204	High molecular weight PAHs	mg/kg		1.1	17.41	15.83	No	5.018	4.56

Table E4.1. Ecological Screening (Continued)

SWMU	Analysis	Unit	Bkgd[a]	Soil NFA	Max Screening Value	HQ (Max)	Below Bkgd?	EPC	HQ (EPC)
204	Iron	mg/kg	28000	200	33542	167.71	No	24076	120.38
204	Lead	mg/kg	36	11	220	20.00	No	16.5	1.5
204	Low molecular weight PAHs	mg/kg		29	0.245	0.01	No		
204	Magnesium	mg/kg	7700	440000	7900	0.02	No		
204	Manganese	mg/kg	1500	220	1939	8.81	No	546.6	2.48
204	Mercury	mg/kg	0.2	0.1	20	200.00	No	20.48	204.8
204	Molybdenum	mg/kg		2	41	20.50	No	6.076	3.04
204	Nickel	mg/kg	21	38	29	0.8	No		
204	PCB, Total	mg/kg		0.02	79	3950.00	No	2.469	123.45
204	Potassium	mg/kg	1300		1190		Yes		
204	Selenium	mg/kg	0.8	0.52	9.7	18.65	No	1.685	3.24
204	Silicon	mg/kg			498		No		
204	Silver	mg/kg	2.3	4.2	59	14.05	No	25.72	6.12
204	Sodium	mg/kg	320		150		Yes		
204	Thallium	mg/kg	0.21	1	10	10.00	No	4.245	4.25
204	Trichloroethene	mg/kg		0.001	0.5	500.00	No	0.5	500.00
204	Uranium	mg/kg	4.9	5	13070	2614.00	No	8.457	1.69
204	Vanadium	mg/kg	38	7.8	151	19.4	No	113.1	14.5
204	Zinc	mg/kg	65	46	869	18.89	No	83.9	1.823913
204	Actinium-228	pCi/g			1.09		No		
204	Americium-241	pCi/g		2160	3.709	0.0	No		
204	Bismuth-211	pCi/g			2.219		No		
204	Bismuth-212	pCi/g			0.8128		No		
204	Bismuth-214	pCi/g			1.038		No		
204	Cesium-137	pCi/g	0.49	20.8	1.172	0.1	No		
204	Lead-211	pCi/g			2.219		No		
204	Lead-212	pCi/g			0.735		No		
204	Lead-214	pCi/g			0.9276		No		
204	Neptunium-237	pCi/g	0.1	814	0.061	0.00	Yes		
204	Plutonium-238	pCi/g	0.073	1750	0.0379	0.00	Yes		
204	Plutonium-239/240	pCi/g	0.025	1270	0.098	0.00	No		
204	Potassium-40	pCi/g	16	119	11.25	0.1	Yes		
204	Protactinium-231	pCi/g		117	36.47	0.3	No		
204	Protactinium-234m	pCi/g			4383		No		
204	Radium-223	pCi/g			0.2017		No		
204	Radium-226	pCi/g	1.5	28.8	0.7736	0.0	Yes		
204	Radium-228	pCi/g		24.5	0.9619	0.04	No		
204	Radon-219	pCi/g			1.137		No		
204	Strontium-90	pCi/g	4.7	22.5	4.7	0.2	No		
204	Technetium-99	pCi/g	2.5	2190	7.64	0.00	No		
204	Thallium-208	pCi/g			0.2451		No		
204	Thorium-228	pCi/g	1.6	530	1.17	0.00	Yes		
204	Thorium-230	pCi/g	1.5	9980	1.3	0.0	Yes		
204	Thorium-232	pCi/g	1.5	1520	1.12	0.00	Yes		
204	Thorium-234	pCi/g			3263		No		
204	Uranium-234	pCi/g	1.2	5140	445	0.09	No		
204	Uranium-235	pCi/g	0.06	2750	57	0.02	No		
204	Uranium-238	pCi/g	1.2	1570	4386	2.79	No	2.774	0.00
204	**Total**					**7915.2**			**1191.7**
211	Aluminum	mg/kg	13000	50	8800	176.00	Yes	8800	176.00
211	Antimony	mg/kg	0.21	0.27	65.23	241.59	No	59.86	221.70
211	Arsenic	mg/kg	12	18	5.5	0.3	Yes		

Table E4.1. Ecological Screening (Continued)

SWMU	Analysis	Unit	Bkgd[a]	Soil NFA	Max Screening Value	HQ (Max)	Below Bkgd?	EPC	HQ (EPC)
211	Barium	mg/kg	200	330	454.82	1.38	No	301.9	0.9148485
211	Benzo(ghi)perylene	mg/kg		119	0.21	0.00	No		
211	Beryllium	mg/kg	0.67	2.5	0.48	0.2	Yes		
211	Cadmium	mg/kg	0.21	0.36	6	16.67	No	6	16.67
211	Calcium	mg/kg	200000		30000		Yes		
211	Chromium	mg/kg	16	26	42.5	1.63	No	38.39	1.48
211	Cobalt	mg/kg	14	13	7.7	0.59	Yes		
211	Copper	mg/kg	19	28	39	1.39	No	37.05	1.32
211	High molecular weight PAHs	mg/kg		1.1	1.89	1.72	No	1.89	1.72
211	Iron	mg/kg	28000	200	30465	152.33	No	30465	152.3
211	Lead	mg/kg	36	11	24.06	2.19	Yes	17.9	1.6272727
211	Low molecular weight PAHs	mg/kg		29	0.21	0.01	No		
211	Magnesium	mg/kg	7700	440000	3320	0.01	Yes		
211	Manganese	mg/kg	1500	220	701	3.19	Yes	701	3.19
211	Mercury	mg/kg	0.2	0.1	20	200.00	No	20.9	209
211	Molybdenum	mg/kg		2	7.5	3.75	No	9.859	4.93
211	Nickel	mg/kg	21	38	32.5	0.86	No		
211	PCB, Total	mg/kg		0.02	2.5	125.00	No	4.093	204.65
211	Selenium	mg/kg	0.8	0.52	10	19.2	No	13.34	25.7
211	Silver	mg/kg	2.3	4.2	25	5.95	No	29.8	7.0952381
211	Sodium	mg/kg	320		51.7		Yes		
211	Thallium	mg/kg	0.21	1	0.33	0.33	No		
211	Uranium	mg/kg	4.9	5	21.86	4.37	No	14.11	2.82
211	Vanadium	mg/kg	38	7.8	101	12.95	No	73.33	9.4012821
211	Zinc	mg/kg	65	46	52.47	1.14	Yes	52.47	1.1406522
211	Americium-241	pCi/g		2160	0.121	0.00	No		
211	Cesium-137	pCi/g	0.49	20.8	1.67	0.08	No		
211	Neptunium-237	pCi/g	0.1	814	5.93	0.01	No		
211	Plutonium-238	pCi/g	0.073	1750	0.0239	0.00	Yes		
211	Plutonium-239/240	pCi/g	0.025	1270	0.815	0.00	No		
211	Technetium-99	pCi/g	2.5	2190	106	0.05	No		
211	Thorium-228	pCi/g	1.6	530	0.84	0.00	Yes		
211	Thorium-230	pCi/g	1.5	9980	4.56	0.00	No		
211	Thorium-232	pCi/g	1.5	1520	0.88	0.00	Yes		
211	Uranium-234	pCi/g	1.2	5140	66.9	0.01	No		
211	Uranium-235	pCi/g	0.06	2750	3.86	0.00	No		
211	Uranium-238	pCi/g	1.2	1570	119	0.08	No		
211	**Total**					**973.0**			**1041.6**
224	Aluminum	mg/kg	13000	50	4910	98.20	Yes	4910	98.20
224	Antimony	mg/kg	0.21	0.27	108.07	400.26	No	108.07	400.26
224	Arsenic	mg/kg	12	18	5.5	0.3	Yes		
224	Barium	mg/kg	200	330	458.79	1.4	No	458.79	1.4
224	Benzo(ghi)perylene	mg/kg		119	0.28	0.00	No		
224	Benzoic acid	mg/kg		650	0.45	0.00	No		
224	Beryllium	mg/kg	0.67	2.5	0.33	0.1	Yes		
224	Cadmium	mg/kg	0.21	0.36	6	16.67	No	6	16.67
224	Calcium	mg/kg	200000		125000		Yes		
224	Chromium	mg/kg	16	26	42.5	1.63	No	42.5	1.6346154
224	Cobalt	mg/kg	14	13	7.1	0.55	Yes		
224	Copper	mg/kg	19	28	17.5	0.63	Yes		
224	Fluorene	mg/kg		30	0.051	0.00	No		
224	High molecular weight PAHs	mg/kg		1.1	4.139	3.76	No	4.139	3.76

Table E4.1. Ecological Screening (Continued)

SWMU	Analysis	Unit	Bkgd[a]	Soil NFA	Max Screening Value	HQ (Max)	Below Bkgd?	EPC	HQ (EPC)
224	Iron	mg/kg	28000	200	14444.19	72.22	Yes	14444.19	72.2
224	Lead	mg/kg	36	11	16.96	1.54	Yes	16.96	1.5418182
224	Low molecular weight PAHs	mg/kg		29	0.773	0.03	No		
224	Magnesium	mg/kg	7700	440000	2300	0.01	Yes		
224	Manganese	mg/kg	1500	220	429	1.95	Yes	429	1.95
224	Mercury	mg/kg	0.2	0.1	5	50.00	No	5	50
224	Molybdenum	mg/kg		2	7.5	3.75	No	7.5	3.75
224	Nickel	mg/kg	21	38	32.5	0.86	No		
224	PCB, Total	mg/kg		0.02	0.025	1.25	No	0.025	1.25
224	Selenium	mg/kg	0.8	0.52	10	19.2	No	10	19.2
224	Silver	mg/kg	2.3	4.2	5	1.19	No	5	1.1904762
224	Sodium	mg/kg	320		111		Yes		
224	Thallium	mg/kg	0.21	1	0.12	0.12	Yes		
224	Uranium	mg/kg	4.9	5	41.5	8.30	No	41.5	8.30
224	Vanadium	mg/kg	38	7.8	35	4.49	Yes	35	4.4871795
224	Zinc	mg/kg	65	46	108.71	2.36	No	108.71	2.3632609
224	Cesium-137	pCi/g	0.49	20.8	0.37	0.02	Yes		
224	Plutonium-238	pCi/g	0.073	1750	0.026	0.00	Yes		
224	Plutonium-239/240	pCi/g	0.025	1270	0.034	0.00	No		
224	Technetium-99	pCi/g	2.5	2190	0.48	0.00	Yes		
224	Thorium-228	pCi/g	1.6	530	0.93	0.00	Yes		
224	Thorium-230	pCi/g	1.5	9980	1.15	0.00	Yes		
224	Thorium-232	pCi/g	1.5	1520	0.97	0.00	Yes		
224	Uranium-234	pCi/g	1.2	5140	2.35	0.00	No		
224	Uranium-235	pCi/g	0.06	2750	0.25	0.00	No		
224	Uranium-238	pCi/g	1.2	1570	13.9	0.01	No		
224	**Total**					**690.8**			**688.2**
225	Aluminum	mg/kg	13000	50	8480	169.60	Yes	8480	169.60
225	Antimony	mg/kg	0.21	0.27	54.12	200.44	No	54.12	200.44
225	Arsenic	mg/kg	12	18	5	0.28	Yes		
225	Barium	mg/kg	200	330	347.67	1.05	No	347.67	1.05
225	Beryllium	mg/kg	0.67	2.5	0.48	0.2	Yes		
225	Cadmium	mg/kg	0.21	0.36	6	16.67	No	6	16.67
225	Calcium	mg/kg	200000		20000		Yes		
225	Chromium	mg/kg	16	26	42.5	1.63	No	42.5	1.6346154
225	Cobalt	mg/kg	14	13	7.3	0.56	Yes		
225	Copper	mg/kg	19	28	17.5	0.63	Yes		
225	High molecular weight PAHs	mg/kg		1.1	1.105	1.00	No	1.105	1.00
225	Iron	mg/kg	28000	200	27274	136.37	Yes	27274	136.37
225	Lead	mg/kg	36	11	65	5.91	No	65	5.9090909
225	Low molecular weight PAHs	mg/kg		29	0.175	0.01	No		
225	Magnesium	mg/kg	7700	440000	2100	0.00	Yes		
225	Manganese	mg/kg	1500	220	562	2.55	Yes	562	2.55
225	Mercury	mg/kg	0.2	0.1	20	200.00	No	20	200
225	Molybdenum	mg/kg		2	36	18.00	No	36	18.00
225	Nickel	mg/kg	21	38	32.5	0.86	No		
225	Selenium	mg/kg	0.8	0.52	10	19.2	No	10	19.2
225	Silver	mg/kg	2.3	4.2	25	5.95	No	25	5.952381
225	Sodium	mg/kg	320		36.5		Yes		
225	Thallium	mg/kg	0.21	1	0.28	0.28	No		
225	Uranium	mg/kg	4.9	5	10	2.00	No	10	2.00
225	Vanadium	mg/kg	38	7.8	109	13.97	No	109	13.974359

Table E4.1. Ecological Screening (Continued)

SWMU	Analysis	Unit	Bkgd[a]	Soil NFA	Max Screening Value	HQ (Max)	Below Bkgd?	EPC	HQ (EPC)
225	Zinc	mg/kg	65	46	75	1.63	No	75	1.6304348
225	Cesium-137	pCi/g	0.49	20.8	0.417	0.02	Yes		
225	Plutonium-238	pCi/g	0.073	1750	0.026	0.00	Yes		
225	Plutonium-239/240	pCi/g	0.025	1270	0.024	0.00	Yes		
225	Thorium-228	pCi/g	1.6	530	0.9	0.00	Yes		
225	Thorium-230	pCi/g	1.5	9980	1.03	0.00	Yes		
225	Thorium-232	pCi/g	1.5	1520	0.92	0.00	Yes		
225	Uranium-234	pCi/g	1.2	5140	1.13	0.00	Yes		
225	Uranium-235	pCi/g	0.06	2750	0.055	0.00	Yes		
225	Uranium-238	pCi/g	1.2	1570	2.04	0.0	No		
225	**Total**					**798.9**			**796.0**
565	Uranium	mg/kg	4.9	5	3.31	0.7	Yes		
565	Cesium-137	pCi/g	0.49	20.8	0.4	0.0	Yes		
565	Plutonium-238	pCi/g	0.073	1750	0.0098	0.00	Yes		
565	Plutonium-239/240	pCi/g	0.025	1270	0.0145	0.00	Yes		
565	Thorium-228	pCi/g	1.6	530	1.04	0.00	Yes		
565	Thorium-230	pCi/g	1.5	9980	1.21	0.00	Yes		
565	Thorium-232	pCi/g	1.5	1520	1.02	0.00	Yes		
565	Uranium-234	pCi/g	1.2	5140	0.93	0.00	Yes		
565	Uranium-235	pCi/g	0.06	2750	0.047	0.00	Yes		
565	Uranium-238	pCi/g	1.2	1570	1.11	0.00	Yes		
565	**Total**					**0.7**			

[a] Background (Bkgd) values are taken from Table A.12 of DOE 2015 *Methods for Conducting Risk Assessment and Risk Evaluation at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky, Volume 1. Human Health, DOE/LX/07-0107&D2/R5/V1, June.*

APPENDIX F

ANALYTICAL DATA (CD)

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APPENDIX F

ANALYTICAL DATA (CD)

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